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Artificial Intelligence and the Modernization of Public Spending:

Towards an Augmented Contingency Model for Fiscal Governance in Morocco

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Abstract

Fiscal rigidity poses a structural difficulty for oil-importing MENA economies, whose budgetary frameworks are not equipped to withstand external shocks, as evidenced by the 2025–2026 Strait of Hormuz crisis. This study formulates an Augmented Contingency Model that positions artificial intelligence as a mediating factor between budget rigidity and fiscal agility in public financial governance. The theoretical framework is based on three interrelated traditions: dynamic capacities theory, contingency theory, and real options theory. Seven research hypotheses are formulated from this model, establishing a framework for future empirical validation. The Moroccan instance is the principal analytical focus, augmented by comparative MENA data on budget rigidity and governmental AI preparedness from the IMF Fiscal Monitor 2025, the World Bank MENA Economic Update 2025, and the Oxford Insights Government AI Readiness Index 2025. The integration of AI encompassing predictive analytics, real-time expenditure monitoring, and simulation-based decision support can transform public finance management from a reactive crisis response to proactive fiscal resilience. Conceptual, contextual, and data limitations are recognized, and three methodological approaches for empirical validation are suggested.

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Introduction

Governing public finances is extremely important because it is a very powerful tool for economic stability and growth. Nevertheless, in the modern world, which faces an unstable energy market, increasing geopolitical uncertainties, and rising financial pressure from all sides, the government of many countries in the MENA region finds itself facing difficulties managing budgets. For energy importing countries, managing budgets becomes even more challenging because their finances are dependent on the price of oil on the international market.

The figures present a worrying scenario. According to the World Bank's 2025 April 2025 report on MENA Economic Update, the MENA economy managed only to grow at a rate of 1.9 percent in 2024. Among the causes of such poor growth is constant conflict, climatic challenges, and an increasingly changing international environment. It seems quite hopeless for the oil-importing countries in the Middle East-North Africa region. As shown by the IMF's Regional Economic Outlook May 2025 report, which provides figures for the year 2024, their growth rates averaged only 1.1 percent.

Morocco, for instance, has relies on imports for more than 90% of its hydrocarbon requirements. In June 2025, the clash of the midle east caused Brent crude to jump from $65 to the low $80s per barrel. Goldman Sachs analysts warned that a sustained closure of the strait could add $10 to $15 per barrel, depending on pipeline capacity and reserves. The February-March 2026 crisis further highlighted these vulnerabilities.

Morocco as a north african country for instance, depends on foreign sources for more than 90 percent of its fuel requirements, thus exposing the country to any disruption that might arise from issues such as those currently faced in the Hormuz Strait. Seen that the Brent's price rose from $65 to the low $80s during an incident involving the United States, Israel, and Iran in June 2025. According to Goldman Sachs, any prolonged closure would increase the cost by $10 to $15 per barrel.

This study thus investigates the role of artificial intelligence in managing public expenditure. Currently, the budget is determined, and any adjustments cannot easily be made. With the advent of AI technology, one can come up with flexible models that respond to economic fluctuations and energy shifts. Therefore, you can allocate resources for critical programs, yet you remain flexible.

This paper aims to develop a theoretical model for transformational change. We rely in our literature review in the use of academic sources about governance in public finance, flexible budgets, and artificial intelligence technology. The three theories which are applied in our thesis are dynamic capability, contingency theory, and real options. It is worth noting that our thesis analysis is comparative, placing Morocco within the wider Middle East and North Africa. Despite being theoretical, our thesis has empirical proof in the region.

I. Literature Review

1.1. What We Mean by Budget Rigidity

The concept of budget rigidity is not only a purely technical aspect but also an organizational issue that limits the ability of governments to perform their operations in the framework of their public budgeting. As indicated by Schwengler (2012), budget rigidity represents a limiting factor of discretion, thus defining a clear boundary for financial decision-making. In turn, Muñoz and Olaberría (2019), researchers from the World Bank, highlight the organizational, legal, and contractual limitations that make it impossible for the government to vary its spending during a predetermined timeframe. Such spending is described as "endogenous spending." Agénor (2018) suggests that rigidity is the primary structural constraint that can affect fiscal flexibility. He provides evidence that recurrent expenditures in form of salaries, pensions, and transfer payments cannot be reduced. If reductions are needed, they occur at the expense of investments, and Agénor speaks

of "anti-investment bias" in these circumstances. Countercyclical fiscal policy thus becomes impossible when almost all expenses cannot be adjusted.

More recently, however, the October 2025 International Monetary Fund Fiscal Monitor, entitled "Spending Smarter," provided empirical data from around the globe. This report uses measures of fiscal rigidity in different nations and finds average fiscal rigidity measures ranging between 0.18 for those nations whose rigidity levels are the lowest to 0.38 for those with high rigidity. Causes of such rigidity include factors related to the workings of budget procedures, characteristics of specific economies, as well as politics. One of the main results of the analysis in the report is that efficiency gaps in spending in particular sectors can be productive for economic output.

Table 1: *Indicators of Fiscal Rigidity in Selected MENA Oil-Importing Countries (2024)*

Country	**Rigid Expenditure Share (% of total)**	**Real GDP Growth 2024 (%)**	**Fiscal Balance (% GDP, 2024)**	**Public Debt (% GDP, 2024)**	**Primary Rigidity Driver**
Morocco	~65–70%	1.0%	-4.4%	69.5%	Civil service wages, energy subsidies
Tunisia	~68–72%	0.9%	-7.1%	79.2%	Subsidies, pension transfers
Jordan	~60–65%	2.4%	-3.8%	93.0%	Debt service, wage bill
Egypt	~70–75%	2.4%	-7.5%	95.0%	Interest payments, subsidies
MENA Avg (oil importers)	~65–72%	1.1%	-5.4%	~84.2%	Structural recurrent spending

Sources. IMF (2025); World Bank (2025); Muñoz & Olaberría (2019).

Table 1 indicates fiscal rigidity levels between 0.18 and 0.38, with Morocco and Egypt demonstrating the most significant structural expenditure constraints in the area.

1.2. AI: What It Is and How Its Value Chain Works

Artificial intelligence may seem straightforward to define; according to Jiang et al., it is the capability for machines to undertake activities which normally would have required human intelligence. However, the European Investment Bank (2023) offers a more nuanced definition through its focus on how much data and of what quality is necessary for machine learning processes, which require a human to assist in selecting useful data elements, and deep learning processes, which are a step forward in sophistication as they can be taught to recognize patterns without human involvement. The AI Policy Observatory by the OECD mentions the positive impact and risks that this entails.

There is always an AI value chain behind every AI implementation that consists of multiple layers that interconnect with one another. The first step includes Big Data, which refers to collecting and compiling large amounts of diverse data (Green et al., 2020). Next comes Machine Learning, which enables computers to gain experience without having to be programmed manually (Jordan & Mitchell, 2015; Kreuzberger et al., 2023). High-Performance Computing offers computing power, which is necessary for handling sophisticated processes (Pannier, 2021). Models that predict future outcomes based on past data are the next layer, followed by Decision Support Systems that include all of these aspects (Ravat, 2009).

Table 2 : *The AI Value Chain: Layers and Applications to Public Finance*

Layer	Definition	Key Technologies / Methods	Application to Fiscal Governance
1. Big Data	Collection and structuring of large, diverse datasets from multiple sources	Data warehouses, ETL pipelines, open government data portals	Integration of budget execution data, macroeconomic indicators, satellite-based activity proxies
2. Machine Learning	Algorithms that improve performance through experience without explicit programming	Supervised/unsupervised learning, neural networks, ensemble methods	Anomaly detection in public expenditure, expenditure classification, revenue forecasting
3. High-Performance Computing	Computational infrastructure enabling processing of complex, large-scale models	Cloud computing, GPU clusters, distributed systems	Real-time fiscal stress testing, large-scale multi-scenario budget simulations
4. Predictive Modelling	Statistical and AI models that generate future-oriented estimates from historical patterns	Time-series forecasting, Monte Carlo simulation, ARIMA, LSTM	Oil price impact modelling, tax revenue projections, social spending demand forecasting
5. Decision Support Systems	Integrated platforms combining data, models, and interfaces to assist decision-makers	Dashboards, scenario planners, recommendation engines	Dynamic budget allocation tools, fiscal risk dashboards, reallocation optimization modules

Sources. Green et al. (2020); Jordan & Mitchell (2015); Kreuzberger et al. (2023); Pannier (2021); Ravat (2009).

Table 2 highlights five interrelated AI layers, highlighting how Big Data, Machine Learning, and Decision Support Systems enhance the operational capabilities of fiscal governance.

1.3. What AI Can Do in the Public Sector

According to the OECD, in its 2025 report "Governing with Artificial Intelligence", AI will become an essential part of governmental digital transformation. In particular, governmental organizations may obtain analytical and operational skills that will help to improve their administration and increase the effectiveness of decision-making.

On practice, the benefits mentioned may manifest themselves in various spheres. First of all, with the help of AI governmental organizations will be able to automate such administrative operations as file processing, database management, documentation organizing; thus, more time and efforts will remain for making policies. Moreover, with the help of AI governmental organizations will be able to detect complicated correlations between various data, to make simulations for different scenarios, and to make predictions which were impossible before. The use of chatbots and assistants will increase the efficiency of interaction between citizens and governmental organizations.

None of this is achieved without difficulties. The OECD does not overlook the fact that applying AI to public governance creates serious dilemmas related to transparency, fairness of algorithms, data security, and accountability. Who should be held accountable when an algorithm advises trimming down a certain line from the budget, only for the advice to later prove mistaken?

2.4. Budget Agility and the Promise of Performance-Based Budgeting

If rigidity is seen as a problem, then budget agility is thought of as its solution. According to Lulaj (2024), this concept can be defined as "the ability to use funds efficiently when uncertainty exists," and it comprises three aspects, namely adaptation, communication, and foresight. In turn, Barroca et al. (2019), analyzing the situation at a local government, state that agility implies "being continually balanced on the edge between doing things differently and doing things normally."

One way to achieve agility is through performance-based budgeting. According to Robinson & Brumby (2005), this is the set of procedures which attempts to enhance the relationship between the resources devoted to public sector organizations and what these organizations accomplish. The OECD defines performance based budgeting as a managerial tool where government focuses not on input, which refers to how much funds have been committed, but output, and outcome, which indicates what the funds have delivered. There is no single model, but success is determined by clearly defined goals, practical application, credible accountability measures, and, most importantly, information systems delivering valuable performance information without noise.

II. Theoretical Framework

2.1. Dynamic Capabilities

Dynamic capabilities theory first appeared in the late 1990s as a reaction to one of the most popular criticisms of the resource-based theory of the firm (RBV): its static character. This means that RBV overemphasized the importance of the resources available in an organization and ignored how a company adjusted to changes. Teece (1997)'s basic definition of dynamic capabilities is as follows: the dynamic capabilities of a firm represent its capacity to integrate, build, and reconfigure internal and external competencies in order to adapt to rapid environmental changes.

The origins of dynamic capabilities lie in two major traditions. One is represented by the evolutionary tradition based on the works of Nelson and Winter (1982) and Penrose (1995). The other is the entrepreneurial tradition (Adner & Helfat, 2003; Teece, 2007). Both schools emphasize the need for an intentional building of capabilities because adaptation does not occur automatically. What does this mean for public finance? Well, it means that the government also must change. In an environment in which the price of oil is capable of increasing by $15 in one single week, the ability of the government to modify its tools of analysis, reallocate its assets quickly, and gain from experience in the face of previous economic shocks becomes an absolute necessity, rather than merely a luxury. The role of AI, in this sense, can thus be viewed as a method for creating dynamic capabilities within the government.

2.2. Contingency Theory

The foundation of contingency theory is based on a seemingly straightforward assumption; there is not one particular way of organizing that works best. It is rather the fit between organizational characteristics and environment which determines success. According to Kim (2024), there are three main levels of contingency theory evolution, which are structural contingency, strategic decision making, and configuration when holism is dominant.

In the sphere of public budgeting, the theory works perfectly well. As Elhamma (2010, 2023) puts it, control systems have to be built depending on such parameters as size of organization, technology or environment. In case of non-profits, one may use the experience of Wadongo & Abdel-Kader (2014), who analyze organizational culture, strategy, and stakeholders in relation to performance management. Oliveira and Callado (2018), as well as Coskun et al. (2022), extend the argument by focusing on less predictable environments.

The strict budgeting systems that exist in most MENA nations could be seen, from the perspective of contingency theory, as an indication of an underlying misfit, where the institutions, which are meant to operate in stable conditions, must now work in a volatile environment. AI could address this misfit by providing what we might refer to as "augmented contingency," where the budgeting systems would be able to detect, model, and adapt to environmental changes almost immediately.

2.3. Real Options Theory

This view on decision making stems from an unlikely place: the discussion regarding US national parks. Whereas Friedman believed the deficit-making parks should be closed down, Weisbrod (1964) responded by suggesting that there could be a chance that people would be willing to pay for the opportunity to use the park in the future. The principle of irreversibility formulated by Henry (1974) stated that once a certain action has been taken, the set of potential actions shrinks. This concept was introduced to strategy management by Bowman and Hurry (1993), who considered investment decisions to be similar to options that preserve their freedom. Their work followed the contributions made by Kester (1984) and Myers (1984). Durand et al. (2006) created a classification for the developing theory of real options that included: Pure Usage, Evolution, Sequential Decisions, Metaphorical Application.

In terms of public finance, the importance is obvious. Within the framework of ongoing shocks, a rigid budget planning technique is not only impractical but highly dangerous. From the perspective of real options theory, one needs to view budget planning not as an allocation technique but rather as a portfolio of potential strategic decisions. The point here is that some expenses may be postponed. Moreover, other expenditures can be redirected and there are even those which should not be touched at all. However, working with various budgeting alternatives requires certain skills which are beyond reach by means of traditional approaches to analysis. This is precisely where artificial intelligence shows its power.

Table 3 : *Synthesis of Theoretical Frameworks Underpinning the Augmented Contingency Model*

Theory	**Core Premise**	**Key Contributions**	**Application to AI-Driven Fiscal Governance**
Dynamic Capabilities	Organizations must continuously integrate, build, and reconfigure competencies to adapt to environmental change	Teece (1997); Nelson & Winter (1982); Penrose (1995); Adner & Helfat (2003)	AI enables governments to develop sensing (detecting fiscal shocks), seizing (reallocating resources), and reconfiguring (restructuring budget programmes) capabilities
Contingency Theory	There is no universal optimal organizational structure; fit between structure and environment determines performance	Kim (2024); Elhamma (2010, 2023); Wadongo & Abdel-Kader (2014); Coskun et al. (2022)	MENA budgetary rigidity represents a structural misfit in volatile environments; AI-enabled "augmented contingency" restores alignment between budget design and environmental volatility
Real Options Theory	Decisions should preserve future flexibility; irreversibility of choices demands option-based thinking about investment portfolios	Weisbrod (1964); Henry (1974); Kester (1984); Myers (1984); Bowman & Hurry (1993); Durand et al. (2006)	Public budgets should be conceived as portfolios of deferrable, redirectable, or irreversible expenditure options; AI enables real-time option valuation and reallocation under uncertainty

Sources. Authors' elaboration based on Teece (1997), Elhamma (2023), Durand et al. (2006), Bowman & Hurry (1993), and Kim (2024).

Table 3 integrates three complementary theoretical frameworks, elucidating how adaptive capabilities, contingency alignment, and reversible budgetary decisions all underpin AI-driven governance models.

III. Conceptual Model

3.1. The Transformation Logic

Conventional public budgets are generally quite « *rigid—limited* » by institutional factors, political considerations, and the massive load of recurring responsibilities. Incidents such as the coronavirus outbreak and the rising cost of energy have proven that traditional approaches cannot adjust to exceptional circumstances. There is surely an alternative approach.

The concept of flexibility in the budget offers the answer. This does not mean fiscal profligacy; rather, it entails finding ways to re-allocate resources depending on the scenario, while also pursuing long-term goals. Performance-oriented budgeting contributes towards achieving this goal by focusing on the results of government spending, rather than the expenditure itself.

3.2. The Proposed Framework

Our model rests on four pillars. The first is that of structural constraints—costs that are non-compressible, such as public salaries and social transfers, laws that must be adhered to, and political promises that set the starting point. External shocks to the economy, energy markets, and geopolitics magnify these constraints.

Secondly, there is public data, which is seen as a resourceful asset. Budgetary data of the past, macroeconomic data, current data flow, and many other elements contribute to the tools of analysis that enable smart governance. In absence of quality data, the use of the AI tool would be futile.

Thirdly, there is AI, which is placed as an analysis tool that links constraints to effects. The process of machine learning, forecasting, simulations, and decision-making tools all work in unison to create novel capabilities such as anticipation, optimization, and budgetary adjustments.

Finally, the desired effect will be resource flexibility, better crisis management, and enhanced financial performance. The reasoning here is straightforward. Constraints lead to the need for transformation. Information is the basic ingredient. Artificial intelligence is the analysis process. If everything aligns properly, the result will be an organization's truly flexible budget. In other words, artificial intelligence is a mediating factor that turns inflexible inputs into flexible outputs.

Figure 1: *The Augmented Contingency Model: AI as Mediator between Budget Rigidity and Fiscal Agility*

Pillar	Components	AI Mechanisms	Expected Outcomes
I. Structural Constraints (Input)	Non-compressible recurrent expenditures (wages, pensions, transfers); legal obligations; political commitments	Constraint mapping; rigidity index computation; expenditure classification models	Identification of the degrees of freedom available for reallocation
II. External Shocks (Amplifiers)	Oil price volatility; geopolitical disruptions (e.g., Strait of Hormuz); climate events; global financial tightening	Real-time commodity price monitoring; geopolitical risk scoring; scenario stress testing	Early warning signals; probabilistic shock impact quantification
III. Public Data (Enabling Resource)	Historical budget execution data; macroeconomic	Data quality assessment; multi-source integration;	High-quality analytical base for reliable modelling

Pillar	Components	AI Mechanisms	Expected Outcomes
	indicators; administrative microdata; satellite-based proxies	missing data imputation	
IV. AI Layer (Mediator)	Machine learning algorithms; forecasting engines; simulation platforms; decision support systems	Predictive modelling; multi-scenario simulation; optimisation algorithms; natural language interfaces	Dynamic expenditure reconfiguration; evidence-based budget adjustments
V. Augmented Fiscal Agility (Output)	Flexible budget execution; real-time reallocation capacity; performance-based accountability	Continuous forecast updating; automated reallocation proposals; inter-ministry coordination alerts	Transition from crisis-driven to anticipatory fiscal governance; improved allocative efficiency

Source. Authors' elaboration based on Teece (1997), Lulaj (2024), Elhamma (2023), and OECD (2025).

Figure 1 presents five interrelated pillars that connect structural restrictions, external shocks, public data, and AI methods to quantifiable fiscal agility outcomes at the regional level.

3.3. How AI Enables Dynamic Expenditure Reconfiguration

And how would the application of such AI tools to budgetary processes be concretized in practice? To give an illustration, consider the following scenario. Given the situation of uncertainty regarding energy prices, the tool would assess the impact of a 30 percent increase in oil prices lasting half a year on the budget. It will determine the spending items that would be affected the most, calculate the size of the budgetary deficit that would arise, and suggest possible responses, including both rationalizing expenditures and reallocating financial resources. Such a tool could go further than just doing one-off assessments, in the manner of the stress tests that banks perform for their balance sheets. It seeks to better detect and respond to risks, rather than to completely eliminate them.

The paradigm shift consists of the change from managing budgets through a static approach where an already established plan is implemented to a continuous dynamic approach whereby forecasts and adjustments are constantly made.

3.4. Research Hypotheses

This article is mainly theoretical, although the integration of the previously described frameworks produces a set of testable assertions. These assumptions are offered not as conclusive results, but as a foundational framework for empirical investigation: they specify the precise boundary conditions necessary for this model to preserve its validity in a practical context.

H1: The integration of predictive analytics technology into public budget management enhances the precision of fiscal revenue estimates in oil-importing MENA nations.

H2: AI-driven decision support technologies diminish the duration necessary for budget reallocation in reaction to external energy price fluctuations.

H3: Fiscal agility of MENA oil-importing economies correlates positively with government AI readiness scores, as indicated by the Oxford Insights Government AI Readiness Index.

H4: Increased budget rigidity is inversely connected to the capacity of a country to mitigate the fiscal effects of hydrocarbon price fluctuations without diminishing public investment spending.

H5: AI-driven real-time expenditure monitoring diminishes allocative inefficiencies in public sector resource allocation relative to conventional auditing techniques.

H6: The implementation of performance-based budgeting frameworks is positively influenced by the presence of AI-enhanced analytical infrastructure in public financial management systems.

H7: Governments that adopt integrated AI governance frameworks have enhanced fiscal resilience to geopolitical supply-side shocks compared to those that depend solely on traditional budget planning techniques.

These assumptions originate from the rationale of the Augmented Contingency Model and embody the convergence of dynamic capabilities theory, contingency theory, and real options theory. The empirical testing of these hypotheses, whether via panel data analysis across MENA countries, institutional case studies at entities such as the Budget Department of the Moroccan Ministry of Economy and Finance, or structured surveys of senior budget officials, constitutes the logical subsequent phase of this research program.

IV. Budget Rigidity and AI Readiness across the MENA Region

4.1. A Region of Fiscal Contrasts

The economies in MENA are not the same. While countries that export oil have abundant revenue from hydrocarbons, others import their oil and hence face the problem of high debt. The comparative economic situation in the two groups should be compared by taking a closer look at the different parts of MENA.

The figures provided by the World Bank in April 2025 suggest a dismal performance: 1.9 percent economic growth was witnessed in 2024 in MENA, while according to the predictions made by the Bank, the figure in 2025 will be only 2.6 percent"shrouded in uncertainty," however, warns the Bank. As per IMF data provided in May 2025 in the Regional Economic Outlook report, the average growth rate among the group of oil importing countries amounted to 1.1 percent in 2024, suffering from conflicts and structural issues. This problem has already been outlined in the previous April 2024 report, "Conflict and Debt," where MENA oil importing states have shown difficulties in growing out of debt since growth has been related to higher debt accumulation.

On an international scale, fiscal positions have weakened. According to the International Monetary Fund's April 2025 Fiscal Monitor, the world average deficit is at 5.1 percent of GDP, while public debt exceeds $100 trillion at end-2024. These global challenges only serve to amplify the intrinsic weaknesses of MENA.

Budgetary flexibility varies across nations according to their attributes. In the GCC states, budgetary rigidity is due to high wage bills and large subsidy programs, although the nations have invested considerable effort into diversification and development strategies such as Vision 2030 in Saudi Arabia. The median fiscal breakeven oil price in the GCC is expected to fall from $70 per barrel in 2025 to $62 per barrel in 2030, suggesting that the process of fiscal consolidation is gradually being implemented. On the other hand, the rigidity in the oil-importing states of Morocco, Tunisia, Jordan, and Egypt arises from non-contractible spending, energy subsidies, and low tax revenue. If there is any reduction required, it usually targets public investment projects.

Table 4:*Comparative Macroeconomic and Fiscal Indicators: Selected MENA Economies (2024)*

Country / Group	GDP Growth 2024 (%)	GDP Growth Forecast 2025 (%)	Fiscal Balance 2024 (% GDP)	Public Debt 2024 (% GDP)	Fiscal Break-even Oil Price 2025 (USD/bbl)	Key Structural Vulnerability
Morocco	1.0	3.2	-4.4	69.5	N/A (importer)	90%+ hydrocarbon

Country / Group	GDP Growth 2024 (%)	GDP Growth Forecast 2025 (%)	Fiscal Balance 2024 (% GDP)	Public Debt 2024 (% GDP)	Fiscal Break-even Oil Price 2025 (USD/bbl)	Key Structural Vulnerability
						import dependency
Tunisia	0.9	1.8	-7.1	79.2	N/A (importer)	High fiscal deficit, limited FX reserves
Jordan	2.4	2.5	-3.8	93.0	N/A (importer)	High debt service burden, remittance dependency
Egypt	2.4	3.8	-7.5	95.0	N/A (importer)	Currency pressure, interest payment burden
Saudi Arabia	1.3	3.1	-3.0	26.2	~70 (2025)	Oil revenue dependence; Vision 2030 transition
UAE	3.4	4.5	3.3	30.0	~50 (diversified)	Low; advanced diversification strategy
MENA Region	1.9	2.6	-4.2 (avg.)	~65 (avg.)	~62 (GCC avg., 2030)	Structural heterogeneity; oil price sensitivity

Sources. IMF (2025); World Bank (2025); IMF World Economic Outlook Database (April 2025).

Table 4 examines specific MENA economies from 2023 to 2026, emphasizing the differing fiscal vulnerabilities between GCC exporters and oil-importing nations amid volatile conditions.

4.2. The Hydrocarbon Price Crisis and Its Fiscal Fallout

Seen their position, we could think that energy crises don't affect MENA economies. Instead, they are harsh realities that directly impact the economy's finances. The year 2025-2026 exemplified this. To start with, think about the geographical positioning of the issues at hand. The Strait of Hormuz lies between Iran and Oman and plays a crucial role in energy transportation. Based on EIA's estimations, in 2024, there were 20 million barrels of oil going through the strait on a daily basis, which accounts for approximately 20% of all oil being consumed globally. Furthermore, more than 84% of the total amount was shipped to Asia. Unfortunately, there is currently no way to compensate for this, as the capacity of the bypass pipelines equals 4 million barrels per day (less than 17% of total).

What needs to be highlighted, though, is the fact that the clash that took place in June of 2025 eventually led to the commencement of a military campaign. During this time, the cost of Brent crude rose to the range of $80 from around $65, but then started falling because people understood that it would not result in cutting off any energy supplies. Still, Iran announced its closure in February-March 2026.

Scenario analyses done by the Dallas Federal Reserve in 2025 have proven to be prophetic. Under their worst-case scenario, the blockade of Hormuz would cause WTI to reach $100 per barrel and lead to significant inflationary pressures in energy-reliant countries. Price increases of between $1

and $15 were projected by Goldman Sachs, contingent upon the degree and longevity of the disruption. For a country that imports oil, such as Morocco, each increase in the cost per barrel causes more pressure on its subsidies, fiscal deficits, and capital investments.

As the IMF stated in its October 2025 Regional Economic Outlook, even if falling oil prices offered some reprieve to MENA importers in 2025, this sector did not enjoy equal benefits. Despite the rise in Morocco, Egypt, and Tunisia due to their thriving tourist and agricultural industries, the main problem remained unresolved because fiscal policies were not flexible enough to handle external factors without decreasing their investments.

4.3. How Ready Are MENA Governments for AI?

Nevertheless, in order to achieve its full potential in budget governance, governments need to be ready to adopt AI. The Government AI Readiness Index offered by Oxford Insights represents the most comprehensive international index that measures the level of government readiness towards AI. The index has been calculated for 188 countries in 2024, whereas, in 2025, the number of countries evaluated increased to 195. There are three pillars under which governments are evaluated: Government (strategy, regulation, digital capability), Technology Sector (innovation ecosystem, human capital), and Data & Infrastructure (connectivity, data availability).

As for the MENA region, the differences become evident. It ranks third in terms of heterogeneity within the geographical region regarding the score distribution. Some of the highest-ranked include the United Arab Emirates and Saudi Arabia, where the latter ranks first among the countries of this region in 2025. Qatar ranks 54th in the world and demonstrates high policy capacity. Their strengths include heavy investment in infrastructure, strategy, and computing power.

North African countries are falling behind, albeit slowly closing the gap. As for instance, Morocco has advanced 14 spots since the 2025 index, having reached the 86th spot at present. This happened thanks to a project known as "AI Made in Morocco," whose goal is to make sure that artificial intelligence will help boost its economy by $10 billion, create 50,000 AI jobs, and train 200,000 graduates until 2030. The strategy concentrates on three pillars: sovereignty and trust; innovation and competitiveness; and impact and influence, respectively. It is executed via the Al Jazari Institutes of Excellence spread across all twelve regions of Morocco.

However, there are certain problems. The UNESCO Readiness Assessment Methodology of Morocco claims that the technological infrastructure problem can be seen as the main problem of the country. Despite the growth of investments in the development of artificial intelligence technologies since 2020, they remain quite low compared to those made by other countries from the region. The score of the Moroccan e-Government Development Index in 2022 was 0.5915, which means that the country occupies the 101st place globally. The Open Data Index ranks it 35th.

This is the larger lesson offered by the "Oxford Insights 2025" report regarding this particular topic: "The highest-ranking countries generally have a specific national AI strategy as well as accountability measures in place, as well as an ethical framework for AI use in government organizations." In relation to the use of AI in the field of fiscal governance in the MENA region, the matter goes beyond simply technology to institutional considerations as well. Alongside computational capabilities and machine learning skills, what is important here are data governance capabilities and integrative capacity.

Figure 2 : *Positioning of Selected MENA Countries on the Budget Rigidity – AI Readiness Matrix*

Country	**Rigid Expenditure Share (%)**	**AI Readiness Score (/100)**	**Matrix Quadrant**	**Strategic Implication**
UAE	Low (~35–40%)	81.6	**Q1 — Frontier**	Low rigidity + high AI readiness: optimal conditions

Country	Rigid Expenditure Share (%)	AI Readiness Score (/100)	Matrix Quadrant	Strategic Implication
				for AI-enabled fiscal governance
Saudi Arabia	Medium (~50–55%)	~68	**Q1–Q2 Transition**	Strong AI capacity partially offset by structural wage and subsidy rigidities
Jordan	High (~60–65%)	~40	**Q3 — Constrained**	High rigidity + low AI readiness: most exposed to fiscal shocks; AI adoption a priority
Egypt	Very High (~70–75%)	~38	**Q3 — Constrained**	Highest rigidity exposure combined with moderate AI readiness gap; reform urgency high
Morocco (focus country)	**High (~65–70%)**	**~42 (+14 ranks)**	**Q3→Q2 Transition**	**High rigidity + rising AI readiness: critical transition window; AI investment can shift trajectory toward Q2**
Tunisia	Very High (~68–72%)	~35	**Q3 — Constrained**	Structurally fragile: fiscal constraints limit both AI investment and budget flexibility simultaneously

Sources. AI Readiness Scores: Oxford Insights (2025), Government AI Readiness Index 2025, https://oxfordinsights.com/ai-readiness/government-ai-readiness-index-2025/ [verified]. Rigid Expenditure Shares (oil importers): IMF (2025c); World Bank (2025) [verified, see Table 1]. Rigid Expenditure Shares (GCC): IMF Article IV Consultation Reports (UAE, Saudi Arabia) and IMF GCC Regional Economic Outlook 2025, https://www.imf.org/en/publications/reo/meca [approximate — to be confirmed]. Authors' elaboration.

Figure 2 situates six MENA countries inside four analytical quadrants, highlighting Morocco's +14 rank enhancement in the regional Government AI Readiness Index performance.

Table 5 :*Government AI Readiness Index 2025: Selected MENA Countries*

Country	Overall Rank (2025)	Overall Score (/100)	Government Pillar Score	Technology Sector Score	Data & Infrastructure Score	Key Strengths and Weaknesses
UAE	3	81.6	High	High	High	Leading national AI strategy; strong regulatory framework;

Country	Overall Rank (2025)	Overall Score (/100)	Government Pillar Score	Technology Sector Score	Data & Infrastructure Score	Key Strengths and Weaknesses
						advanced digital infrastructure
Saudi Arabia	~18–22	~67–70	High	Medium-High	High	SDAIA national AI authority; Vision 2030 investment; strong government commitment
Qatar	54	~55–58	Medium-High	Medium	Medium-High	High policy capacity; significant infrastructure investments; QNV 2030 alignment
Morocco	86 (+14)	~41–44	Medium	Medium-Low	Medium-Low	'AI Made in Morocco' strategy; Al Jazari institutes; e-Gov index 0.5915 (rank 101); limited AI investment vs. regional peers
Tunisia	~100–110	~34–37	Medium-Low	Low	Low	Nascent national AI strategy; limited infrastructure; fiscal constraints on digital investment
Egypt	~90–100	~37–40	Medium-Low	Low	Low	National AI strategy adopted (2019); large talent pool; implementation gaps; connectivity challenges
Jordan	~80–90	~38–42	Medium	Low	Low	ICT sector strength; limited domestic AI ecosystem; dependency on international technical assistance

Sources. Oxford Insights (2024, 2025); UNESCO (2024); e-Government Development Index (UN, 2022); Open Data Index.

Table 5 presents the Government AI Readiness Index 2025 scores across three institutional pillars, highlighting considerable variations between GCC and non-GCC countries in the region.

V. The Moroccan Case

5.1. How Morocco's Public Spending Is Structured

An analysis of Morocco's expenditure structure shows that expenditures in areas that cannot easily be adjusted in the short run constitute the backbone of the budget. Salaries and operational costs form a substantial part of total government spending and are entrenched in institutional obligations. They are not sensitive to changes in the economic cycle.

The only element left that can be used to adjust the budget is therefore public investments. It is unfortunate that the area of expenditures that is crucial for the long-run growth of the economy is the one that bears the greatest brunt when the budget experiences financial difficulties.

5.2. Facing Up to Energy Shocks

The dependency of Morocco on imported hydrocarbons, which constitute over 90 percent of its total requirement, has ensured that it is directly exposed to the global markets through its own budget. Higher prices for oil translate into higher subsidy expenditures, wider fiscal deficits, and reduced maneuvering space for the government.

The impact of the events in the Strait of Hormuz came into play quite literally here. While the first instance occurred in June 2025, the second, which was even more serious, took place between February and March 2026. For Morocco, it has three major implications, namely increased expenditure on mechanisms of compensation, fiscal balance difficulties, and lower revenues due to declining economic activity.

As the IMF's Regional Economic Outlook for October 2025 notes, Morocco is one of those oil-importing countries from the MENA region whose government is seeking to introduce tax reforms in an attempt to create fiscal resilience. However, such reforms will not be realized overnight. The underlying problem can be seen in a budgeting system based on reduced investment as a shock absorber.

5.3. AI-Driven Budget Governance: The Emerging Moroccan Model

ccording to the Moroccan Ministry of Digital Transition and Administrative Reform , the recent launch of the "AI Made in Morocco" plan by Morocco goes beyond being merely a technological project. This is a clear indication of a commitment to leverage AI as a tool to transform the public sector, including, possibly, the management of the country's finances.

The foundation of this plan lies in the infrastructure of the Al Jazari Institutes, which form a decentralized system based on AI specialization aligned with economic requirements. The first institute, the JAZARI Root Institute, was launched in Rabat in January 2026 and will be followed by thematic institutes in other regions, such as the one in Dakhla focusing on AI and energy transition. A collaboration with Mistral AI is part of the international component of the plan.

How would the implementation of AI-assisted fiscal governance play out in the case of Morocco? Fundamentally, this implies a shift away from the traditional approach of annually fixed budgets towards more dynamic processes. AI applications could assess the budget implications of various oil price scenarios, identify inefficient budget spending on an ongoing basis, and explore the effects of different budget allocation options through simulation modeling.

This can be attributed to the high level of efficiency and flexibility inherent in such approaches. Classical techniques involve the use of a finite number of variables and rather inflexible models. Machine learning algorithms can take into account a significantly larger number of input variables, including commodity prices, trade volumes, economic activity indicators based on satellite imagery, and administrative data. It does not negate the role of a person; instead, it complements his expertise by providing more accurate predictions faster.

There is a growing trend, and despite several challenges, Morocco is still moving in the right direction.

VI . Discussion

6.1. What AI Could Contribute

According to the arguments presented in this study, AI's potential impact on spending management strategy would extend beyond simple technical enhancement. The application of technology in managing public expenditures will transition from reactive mechanisms that address difficulties post-occurrence to proactive mechanisms that foresee and mitigate problems beforehand. Concerning allocative efficiency, AI-driven simulation models utilizing multidimensional fiscal data

might identify inefficiencies in public resource allocation that are overlooked by simpler auditing methods. They identify not only locations of waste but also regions where reallocation might yield optimal profits. This surpasses any form of incremental enhancement; it is optimization grounded in empirical knowledge.
Concerning decision time, the most significant potential contribution of AI may lie in the transition from reactive decision-making to anticipatory decision-making. Rather than inquiring if the government will respond to an unforeseen surge in oil prices, we should consider whether its response will be preemptive or reactive.
Concerning policy coherence: budgets are typically administered in isolation: one for education, another for defense, and a separate allocation for health, each from distinct ministries. By leveraging information across sectors, AI-driven systems could enhance policymakers' awareness of their interdependencies, which would otherwise be difficult to discern through siloed perspectives.

6.2. The Uncertainty Factor

This article is written at a moment that is anything but ordinary. The IMF's April 2025 Fiscal Monitor reports a simultaneous deterioration across four specific aspects of uncertainty: fiscal policy uncertainty, geopolitical risk, trade policy uncertainty, and overall global uncertainty , all heightened and mutually reinforcing. This convergence is not a transient variation. It signifies a structural transformation of the global economic landscape, which makes traditional budget planning frameworks progressively insufficient.

The Strait of Hormuz crisis in 2025-2026 closely parallels the natural experiment with the established theory. Classical budgeting systems in MENA oil-importing countries were taken aback not owing to the event's novelty, but rather because of the system's inflexibility to respond promptly. The scenario analysis conducted by the Dallas Federal Reserve Bank indicates that minor shocks rapidly propagate in energy-dependent economies. In early 2026, the closure of the Strait of Hormuz resulted in a 20 percent reduction of global oil supplies, significantly surpassing the effects of prior oil crises, including the 1973 embargo and the 1979 Iranian revolution, which impacted only 4-6 percent of supply. This is not a practice. The requirement for AI-assisted fiscal governance has emerged as a realistic imperative.

6.3. Study Limitations

This study does not purport to be anything beyond a theoretical contribution. Honesty necessitates recognizing its limitations. Four sorts of limitations merit detailed identification.
Conceptual limits: The Augmented Contingency Model is a theoretical model rather than an empirically substantiated framework. The causal linkages it proposes between AI adoption, budget flexibility, and financial resilience are conceptually sound yet unverified. The approach distills a complex institutional reality by conceptualizing AI as a cohesive mediating mechanism; nevertheless, in fact, AI implementations exhibit significant variability in quality, scope, and governance structure. In the absence of empirical testing, the model need to be regarded as a working hypothesis rather than an established conclusion.
Contextual limits: The article is fundamentally based in the Moroccan and MENA setting. Institutional structures, fiscal practices, and AI preparedness vary significantly among regions. The model's generalizability to other developing or middle-income regions such as Sub-Saharan Africa, South Asia, and Latin America cannot be presumed without modification. The diversity between GCC oil exporters and North African oil importers within MENA constrains the applicability of any standardized recommendation.
Theoretical limits: The article is fundamentally based in the Moroccan and MENA setting. Institutional structures, fiscal practices, and AI preparedness vary significantly among regions. The model's generalizability to other developing or middle-income regions such as Sub-Saharan Africa, South Asia, and Latin America cannot be presumed without modification. The diversity between

GCC oil exporters and North African oil importers within MENA constrains the applicability of any standardized recommendation.

Data limits: The secondary data utilized in this paper sourced from the IMF, World Bank, Oxford Insights, and OECD are dependable however aggregated. They fail to reflect the detailed realities of budgetary decision-making inside Moroccan ministries, as well as the degree to which current digital tools are effectively utilized in practice. Administrative microdata regarding budget execution, procurement trends, and real-time fiscal modifications are essential for a more accurate empirical analysis.

6.4. Proposed Methodology for Future Validation

Theoretical models gain credibility by withstanding empirical analysis. A approach is proposed for the empirical testing of the Augmented Contingency Model in forthcoming research. Three complementary methodologies are proposed, each targeting a distinct aspect of the model.

Approach 1 - Institutional Case Study:

A qualitative case study at the Directorate of the Budget (DGB) or the Tax Authority (DGI) will focus on the integration of digital and analytical tools in budget implementation and tax forecasting procedures. This study might evaluate the practical presence of the five pillars of the conceptual model using semi-structured interviews with senior officials, document analysis of budget circulars, and observation of planning procedures. This methodology emphasizes depth rather than breadth and is adept at producing process-level insights that quantitative techniques overlook.

Approach 2 - Survey of Budget Officials :

A structured survey intended to target budget officers, financial controllers, and planning directorate personnel across various Moroccan ministries will provide statistical testing of the established hypotheses. The questionnaire will assess perceptions of AI tool efficacy, existing budgetary flexibility, institutional obstacles to digital adoption, and readiness to implement automated reallocation suggestions. A sample size of 80 to 120 respondents from 6 to 8 ministries would facilitate structural equation modeling (SEM) to examine mediation effects, in accordance with the model's theoretical framework. The poll may be duplicated in Tunisia or Jordan to facilitate cross-country comparability.

Approach 3 – Panel Data Analysis across MENA Countries :

A statistical approach employing secondary panel data (IMF Fiscal Monitor, World Bank BOOST, Oxford Insights, and UN e-Government Development Index) over a 10 to 15-year timeframe (2010–2025) will facilitate econometric validation of hypotheses H1, H3, and H4 at the national level. The primary independent variable will be a composite AI readiness score, while the dependent variables will encompass budget balance volatility, public investment protection during shocks, and indices of expenditure rigidity. Fixed-effects panel regression and difference-in-differences methodologies may be employed when policy reforms yield quasi-experimental variance. This methodology emphasizes comprehensiveness and statistical generalizability.

These three approaches are not mutually incompatible. A future research program should ideally sequence as follows: commence with a case study to delineate the institutional landscape and enhance the measurement tools , advance to a survey for meso-level hypothesis testing; and culminate with panel analysis for macro-level validation. This mixed-methods methodology would yield the most comprehensive understanding of how AI influences, or does not influence, fiscal governance in practice.

Conclusion

In conclusion, the budgetary systems that remain prevalent in most of the MENA region today are inadequate for dealing with economic shocks and energy crises in the modern world. This fact was

exemplified by the 2025-2026 Strait of Hormuz incident, which demonstrated firsthand the financial repercussions of rigid budgeting systems.

We believe that artificial intelligence can be an effective tool for making budgeting systems more flexible and adaptive to changes, but only when used correctly and within adequate governance frameworks. AI technologies can assist in making forecasts, conducting simulations, and reallocating resources.

From our comparative analysis of the MENA region, we learned that countries face the same difficulties in their economies, but there are major differences in their readiness for implementing AI solutions. The countries of the GCC bloc are the most advanced ones in this respect; however, even among them, the UAE and Saudi Arabia are leading the way. On the other hand, Morocco has made substantial progress despite being at a lower initial level; the fact that it climbed 14 places in the Government AI Readiness Index is proof of this.

Several directions of research merit further consideration. Studies that could empirically assess the actual effect of the utilization of AI solutions on the performance of fiscal operations in developing countries would be useful here; while the logic is strong, there is little concrete empirical data available. The relationship between AI-based analysis and politics in the process of budget formulation is another avenue that requires further consideration; budgeting is hardly ever an apolitical issue, and learning about how AI-based analysis integrates into political processes is key. Finally, the governance of algorithms in public finance requires dedicated study. In conclusion, the matter of acceptability of such technologies from a socio-institutional perspective needs to be better understood. While even the best-designed algorithms may produce useful insights, without being socially and institutionally accepted, they will remain largely unused.

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