التعقيد الاقتصادي، وأسعار الطاقة، والنمو في منطقة الشرق الأوسط وشمال إفريقيا (MENA)

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Economic Complexity, Energy Prices, and Growth in the MENA Region

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الملخص

تبحث هذه الدراسة في الآثار التفاعلية للتعقيد الاقتصادي وتقلبات أسعار الطاقة على النمو الاقتصادي في 17 دولة في منطقة الشرق الأوسط وشمال إفريقيا (MENA) خلال الفترة الممتدة من 1990 إلى 2024. وفي حين ركزت الدراسات السابقة إلى حد كبير على استقصاء الآثار المنفصلة للتعقيد الاقتصادي وديناميكيات الطاقة على النمو، لم تحظَ الكيفية التي يمكن بها للتطور الإنتاجي (productive sophistication) أن يؤثر في انتقال صدمات أسعار الطاقة إلا باهتمام محدود. ولمعالجة هذه الفجوة، تطور هذه الدراسة إطاراً تجريبياً متكاملاً يتم فيه إدخال التعقيد الاقتصادي كعامل وسيط (moderating factor) في العلاقة بين أسعار الطاقة والنمو. وباستخدام مجموعة بيانات بانيل غير متوازنة (unbalanced panel dataset)، تطبق الدراسة منهجية انحدار المئينات بطريقة العزوم (MMQR) لالتقاط التأثيرات المتباينة عبر المستويات المختلفة للأداء الاقتصادي، كما تستخدم نموذج الانحدار الذاتي للإبطاء الموزع المعزز مقطعياً (CS-ARDL) كنهج لاختبار المتانة وصحة النتائج. وتظهر النتائج أن تأثير التعقيد الاقتصادي على النمو ليس خطياً، بل يعتمد على الظروف

وعلى وجه التحديد، يقلل التعقيد الاقتصادي من النمو عند المئينات الدنيا، .التنموية لكل دولة ، ولكنه (structural transformation)مما يعكس التكاليف قصيرة الأجل للتحول الهيكلي يساهم بشكل إيجابي في النمو بين الاقتصادات ذات الأداء العالي التي تمتلك قدرة استيعابية وبشكل عام، تؤدي زيادة أسعار الطاقة إلى إحداث تأثير .(absorptive capacity)أكبر ومع ذلك، فإن .سلبي على النمو الاقتصادي، لا سيما في الاقتصادات ذات النمو المنخفض التفاعل بين التعقيد الاقتصادي وأسعار الطاقة يعد إيجابياً ومعنوياً، مما يشير إلى أن ارتفاع وتؤكد النتائج أن التعقيد .التعقيد الاقتصادي يخفف من العواقب السلبية لتقلبات أسعار الطاقة الاقتصادي ليس مجرد محرك للنمو على المدى الطويل فحسب، بل هو أيضاً آلية مرونة وتوفر هذه النتائج تداعيات سياساتية قيمة .مهمة ضد صدمات الطاقة الخارجية (resilience) لدول منطقة الشرق الأوسط وشمال إفريقيا التي تسعى إلى التنويع الاقتصادي، وأمن الطاقة، والنمو المستدام.

Abstract

This study examines the interactive effects of economic complexity and energy price fluctuations on economic growth in 17 Middle East and North Africa (MENA) countries during the period 1990–2024. While previous studies have largely investigated the separate effects of economic complexity and energy dynamics on growth, limited attention has been given to how productive sophistication can influence the transmission of energy price shocks. To address this gap, this study develops an integrated empirical framework in which economic complexity is introduced as a moderating factor in the energy price–growth relationship. Using an unbalanced panel dataset, the analysis applies Method of Moments Quantile Regression (MMQR) to capture heterogeneous effects across different levels of economic performance and employs Cross-Sectionally Augmented ARDL (CS-ARDL) as a robustness approach. The findings reveal that the impact of economic complexity on growth is nonlinear and depends on countries' development conditions. Specifically, economic complexity reduces growth at lower quantiles, reflecting the short-term costs of structural transformation, but contributes positively to growth among high-performing economies with greater absorptive capacity. Energy price increases generally exert a negative effect on economic growth, particularly in lower-growth economies. However, the interaction between economic complexity and energy prices is positive and significant, indicating that higher economic complexity mitigates the adverse consequences of energy price fluctuations. The results highlight

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that economic complexity is not only a driver of long-term growth but also an important resilience mechanism against external energy shocks. These findings provide valuable policy implications for MENA countries seeking economic diversification, energy security, and sustainable growth.

1.Introduction

The Middle East and North Africa (MENA) region stands at a critical juncture in its economic development trajectory, where the interplay between structural transformation, energy price dynamics, and sustainable growth has become increasingly consequential. Historically characterized by abundant hydrocarbon endowments and heavy dependence on fossil fuel revenues, the region faces mounting pressures to diversify its economic structures, enhance productive capabilities, and transition toward more resilient growth models. The concept of economic complexity—defined as the diversity and sophistication of productive knowledge embedded in a country's economic activities—has emerged as a powerful analytical framework for understanding these development challenges, particularly when examined alongside the persistent influence of energy price fluctuations that have long shaped macroeconomic outcomes across the region.

The theoretical foundations of economic complexity, developed by Hidalgo and Hausmann (2009), posit that a country's productive structure reflects its accumulated capabilities, including skilled labor, physical capital, institutional quality, infrastructure, and technological know-how. This perspective suggests that economic development is fundamentally about enhancing a country's capacity to produce a diverse range of sophisticated products, moving beyond simple resource extraction toward knowledge-intensive activities. The Economic Complexity Index (ECI), derived from analyzing the structure of international trade networks, has demonstrated remarkable predictive power for future economic growth, outperforming conventional metrics such as the Human Development Index and Global Competitiveness Index (Hausmann et al., 2014). Empirical research confirms that countries with higher economic complexity tend to exhibit higher income levels and more favorable long-run growth trajectories, while deviations from the expected relationship between complexity and income are predictive of future growth adjustments (Hausmann et al., 2014; Hidalgo & Hausmann, 2009).

The MENA region's economic characteristics render it a particularly compelling case for investigating the complexity-energy-growth nexus. The region holds over half of the world's proven crude oil reserves and more than one-third of its natural gas reserves, making it critically important to global energy markets (British Petroleum, 2022). Many MENA economies, particularly the Gulf Cooperation Council countries, Iran, Iraq, and Libya, rely heavily on oil and gas revenues, with fossil fuels accounting for substantial shares of export revenues and government budgets (Boulanouar et al., 2025). This resource dependence has historically shaped the region's economic structures, fostering enclave economies with limited productive diversification and relatively low economic complexity compared to advanced economies and newly industrialized Asian nations (El Mokri, 2016). Indeed, research indicates that MENA countries have often been trapped in a cycle of dependency, exporting raw natural resources while importing technologically sophisticated products from developed nations, exacerbating their economic vulnerability (Mtiraoui et al., 2024).

However, the relationship between economic complexity and growth is not straightforward, particularly in energy-rich contexts where institutional and resource constraints may mediate outcomes. Recent empirical evidence reveals that economic complexity produces differential effects across development stages: studies employing panel data techniques have found that economic complexity increases energy consumption in developing countries while decreasing it in developed countries (Can et al., 2022). This finding carries profound implications for MENA economies pursuing diversification strategies, suggesting that the structural transformation process itself may impose short-term energy costs even as it generates long-term growth benefits. Furthermore, research focusing specifically on the MENA region has demonstrated that economic complexity negatively affects Kazemzadeh et al while positively impacting renewable energy adoption, implying that complexity is "energy-intensive but green," whereas economic growth is "energy-saving but brown" (Mohamad Taghvaee et al., 2024). This tension between short-term energy demands and long-term sustainability objectives is particularly acute for MENA countries attempting to pursue simultaneous economic diversification and energy transition goals.

The energy price dimension adds considerable complexity to this relationship. Energy price fluctuations have long been recognized as a fundamental driver of macroeconomic outcomes in the MENA region, with the International Monetary Fund identifying oil price volatility as a primary risk factor for regional economies (Azour, 2026). The theoretical literature posits that higher energy prices should incentivize Kazemzadeh et al improvements and renewable energy adoption through the substitution hypothesis, as economic agents substitute away from costly fossil fuels toward alternative energy sources (Henriques & Sadorsky, 2008; Bondia et al., 2016). However, empirical evidence indicates that this relationship operates asymmetrically and depends crucially on countries' income levels and economic conditions. Research applying panel smooth threshold regression to MENA data has revealed that higher energy prices stimulate renewable energy expansion in high-income countries but hinder it in low-income nations (Boulanouar et al., 2025). This suggests that the effectiveness of price signals as a policy tool for energy transition depends fundamentally on the absorptive capacity, institutional frameworks, and technological capabilities of individual economies—dimensions captured by economic complexity.

The existing literature has primarily examined these relationships in pairwise isolation: economic complexity and environmental outcomes, energy prices and growth, or complexity and growth (Aloui et al., 2024; Aidarova et al., 2024; Al-Harbi & Moid, 2024). Few studies have investigated the interactive and potentially non-linear relationships among all three variables within a unified empirical framework, and even fewer have focused specifically on the MENA region with a sufficiently long time horizon to capture structural transformations across different energy price regimes. Recent research on institutional quality, oil prices, and environmental degradation moderated by economic complexity in MENA countries has begun exploring these interconnections, finding heterogeneous impacts across quantiles and emphasizing the importance of differentiated policy approaches (Cuesta et al., 2023). Yet significant gaps remain in understanding how economic complexity moderates the relationship between energy price fluctuations and economic growth, particularly how countries with higher productive sophistication may transform energy price shocks into opportunities for structural upgrading rather than growth-retarding constraints.

The MENA region's recent economic trajectory underscores the policy relevance of this research. Despite global headwinds and domestic shocks, the region has demonstrated notable resilience, with the IMF revising its growth forecast upward to 3.7 percent in 2026 (Azour, 2026). This resilience has been attributed to several factors, including limited direct trade exposure to US tariffs, higher oil production following OPEC+ decisions, and robust domestic demand. However, significant risks persist, including global uncertainty, potential tightening of financial conditions, and oil price volatility—all of which interact with structural characteristics of individual economies. The geopolitical context adds further urgency, with ongoing conflicts and the strategic importance of the Strait of Hormuz—through which approximately 20 percent of global petroleum liquids and 20 percent of global LNG trade transit—highlighting the region's vulnerability to energy supply disruptions and price shocks (Kaissi, 2026). These dynamics intensify the imperative for MENA countries to accelerate structural transformation and enhance economic complexity as a hedge against external vulnerabilities.

Against this backdrop, this study aims to investigate the asymmetric and interactive effects of economic complexity and energy price fluctuations on economic growth in MENA countries from 1990 to 2024. This extended time horizon enables examination of how relationships have evolved across different energy price regimes, periods of structural transformation, and shifting global economic conditions. The study employs panel data techniques appropriate for capturing non-linearities and cross-sectional dependencies, including Panel-Corrected Standard Errors and Driscoll-Kraay estimation, addressing limitations of previous linear approaches (Mohamad Taghvaee et al., 2024). By integrating three dimensions—economic complexity, energy prices, and economic growth—within a unified analytical framework, this research contributes to both theoretical understanding and policy formulation. The findings are expected to inform diversification strategies, energy transition policies, and approaches to managing price volatility, offering differentiated insights for high-income oil-exporting countries versus lower-income import-dependent nations within the region. Understanding whether economic complexity enhances growth resilience while promoting energy transition, or imposes short-term energy intensity costs, carries significant implications for the design of complementary policies during structural transformation. Ultimately, this research seeks to illuminate pathways through which MENA economies can navigate the complex trade-offs between structural diversification, energy security, and sustainable growth in an era of global energy transitions and persistent uncertainty.

This paper is organized as follows: section "literature review", section "Data and methodology", which clarifies the data and methodology. Section four presents the results and discussions. Finally, Section five presents conclusions and recommendations

1. Literature Review

2.1 Empirical Literature Review and Research Gap

The relationship between economic structure, energy dynamics, and growth has been extensively investigated, yet the integration of economic complexity into this nexus represents a relatively recent development in the literature. Early empirical work focused primarily on the direct relationship between energy consumption and economic growth, with scholars exploring whether energy consumption drives growth, growth drives energy consumption, or both variables exhibit bidirectional causality (Apergis & Payne, 2009; Ozturk, 2010). These foundational studies established the importance of energy as a factor of production but did not account for the sophistication of productive structures that mediate this relationship.

The emergence of economic complexity as an analytical framework opened new avenues for understanding how the composition of a country's productive activities shapes its energy and growth trajectories. Hidalgo and Hausmann (2009) introduced the Economic Complexity Index (ECI), arguing that a country's productive structure reflects its accumulated capabilities, including skilled labor, physical capital, institutional quality, and technological know-how. This perspective fundamentally shifted the analysis from aggregate energy-growth relationships toward understanding how the diversity and sophistication of economic activities condition these relationships.

Subsequent empirical research has examined the impact of economic complexity on energy consumption across different country groups. Can et al. (2022) provided important evidence using panel data for 21 developed and 44 developing countries from 1971 to 2014, finding that economic complexity increases energy consumption in developing countries while decreasing it in developed countries. This differential effect suggests that the relationship between complexity and energy demand is contingent on the stage of development, with structural transformation initially requiring greater energy inputs before yielding efficiency gains. This finding carries profound implications for MENA economies pursuing diversification strategies, implying that the process of enhancing economic sophistication may impose short-term energy costs even as it generates long-term benefits.

More recent studies have specifically examined the MENA region's experience. Mohamad Taghvaee et al. (2024) conducted a comprehensive panel data analysis covering 22 MENA countries from 1990 to 2017, employing Panel-Corrected Standard Errors, Driscoll-Kraay estimation, and Generalized Least Squares methods. Their findings are particularly illuminating: economic complexity negatively affects Kazemzadeh et al while positively impacting renewable energy adoption. This suggests that complexity is "energy-intensive but green," whereas economic growth is "energy-saving but brown." The comparative analysis revealed that the negative effects of economic complexity and growth outweigh their positive effects, highlighting the necessity of restructuring economic activities and sectors to enhance energy security in the region. This duality—where complexity simultaneously increases energy demand while promoting renewable energy—represents a critical tension for policy formulation.

Parallel research has explored the role of energy price fluctuations in shaping growth outcomes. Boulanouar et al. (2025) applied panel smooth threshold regression to MENA data, demonstrating that higher energy prices stimulate renewable energy expansion in high-income countries but hinder it in low-income nations. This finding underscores that the effectiveness of price signals as a policy tool depends fundamentally on the absorptive capacity and technological capabilities of individual economies—dimensions captured by economic complexity. Similarly, Al-Harbi and Moid (2024) empirically examined energy intensity, oil prices, and economic growth in MENA countries, formulating hypotheses that higher energy intensity hinders economic growth and that oil price fluctuations negatively impact growth, particularly for oil-exporting countries where government revenue relies heavily on oil prices. Their panel cointegration analysis confirmed that energy intensity exerts a significant negative effect on growth, while the impact of oil prices varied across income groups.

The transmission channels through which energy prices affect growth have been elaborated in recent research on Sub-Saharan Africa. An extensive study examining 33 countries identified eight macroeconomic transmission channels through which energy price shocks affect inclusive growth: exchange rate, investment, government consumption, household consumption, employment, shadow economy, CO_2 emissions, and inflation (Etensa et al., 2025). While this study focused on Sub-Saharan Africa, the channel framework is instructive for MENA analysis, suggesting that energy price effects on growth are mediated through multiple indirect pathways rather than through direct, immediate impacts.

Research on the institutional and geopolitical dimensions of the energy-growth nexus has further contextualized the MENA experience. The Middle East's economic growth remains heavily tied to global crude oil market dynamics, with fossil fuels expected to remain the region's main revenue stream in the foreseeable future (Tazikeh et al, 2025). Political instability and abundant low-cost fossil fuels slow the adoption of renewable energy sources, complicating structural transformation efforts. The IMF has identified oil price volatility as a primary risk factor for regional economies, with implications for fiscal sustainability, investment dynamics, and growth trajectories (Azour, 2026).

Despite this substantial body of work, significant gaps remain. The existing literature has primarily examined pairwise relationships: energy

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prices and growth, economic complexity and energy consumption, or complexity and growth (Aloui et al., 2024; Aidarova et al., 2024; Al-Harbi & Moid, 2024). Few studies have investigated the interactive and potentially non-linear relationships among all three variables within a unified empirical framework. Furthermore, while economic complexity studies have largely focused on environmental outcomes or energy intensity, the direct growth effects of complexity—and how these are moderated by energy price dynamics—remain underexplored. Most existing studies employ relatively short time horizons that may not capture the structural transformations occurring across different energy price regimes, and the regional heterogeneity within MENA—in terms of income levels, institutional quality, and resource endowments—suggests that aggregated analyses may obscure important conditional effects (Cuesta et al., 2023). This study addresses these gaps by examining the interactive effects of economic complexity and energy price fluctuations on economic growth in MENA countries from 1990 to 2024.

2.2 Theoretical Foundations and Transmission Channels

The theoretical framework for understanding how economic complexity and energy prices influence economic growth draws on several complementary economic theories that together explain the transmission mechanisms through which these variables interact.

2.2.1 The Capability-Based Theory of Economic Complexity

The capability-based theory of economic complexity provides the foundational framework for understanding how productive sophistication translates into growth. The Economic Complexity Index (ECI) reflects the diversity and sophistication of productive knowledge embedded in an economy's activities (Hidalgo & Hausmann, 2009). Recent theoretical developments have established that ECI can be understood as a monotonic function of the probability that an economy possesses multiple capabilities or factors required for productive activities (Hidalgo & Stojkoski, 2025). This capability-based view suggests that economies with higher complexity possess a broader range of productive capabilities—including skilled labor, institutional quality, infrastructure, and technological know-how—that enable them to produce a wider array of sophisticated goods and services.

Hausmann et al. (2014) demonstrated that countries with higher ECI exhibit higher income levels and more favorable long-run growth trajectories, while deviations from the expected relationship between complexity and income predict future growth adjustments. The theoretical intuition is that complex economies are more resilient to external shocks because their diversified productive structures provide multiple sources of growth and employment, reducing dependence on any single sector. From this perspective, enhancing economic complexity is not merely about diversification but about expanding the productive capabilities that drive structural transformation and sustained growth.

The principle of relatedness explains how economic complexity evolves over time. Empirical studies show that economies diversify into activities related to those they already perform, a tendency known as the Principle of Relatedness (McNerney et al, 2025). This path-dependent process implies that an economy's initial structure constrains and shapes its diversification possibilities. Recent modeling work demonstrates that economies with higher complexity can access a broader range of related activities, enabling faster and more effective structural transformation. This has important implications for energy-growth dynamics: economies with higher complexity may be better positioned to respond to energy price signals by investing in energy-efficient technologies and renewable energy, as they possess the absorptive capacity and institutional frameworks to translate price signals into productive investments.

2.2.2 The Resource Curse Theory

The resource curse theory provides a cautionary perspective on energy-rich MENA economies. Sachs and Warner (2001) argued that natural resource abundance may impede economic diversification through crowding-out effects, Dutch disease dynamics, and rent-seeking behaviors. From this perspective, high energy prices may paradoxically reduce economic complexity by reinforcing extractive economic structures and diminishing incentives for productive diversification. The mechanism operates through several channels: resource revenues appreciate the real exchange rate, making non-resource exports uncompetitive; resource extraction draws labor and capital away from manufacturing and services; and resource rents encourage rent-seeking and weaken institutional quality (Auty, 2001; van der Ploeg, 2011).

However, recent evidence from Saudi Arabia challenges this narrative. Aloui et al. (2024) employed wavelet local multiple correlations to examine the nexus among economic uncertainty, geopolitical risk, oil price volatility, and economic complexity in Saudi Arabia, finding that oil price volatility and geopolitical risk are positively associated with economic complexity in the long run. This suggests that energy price uncertainty may catalyze structural transformation by creating incentives for economic diversification, as resource-dependent economies seek to reduce vulnerability to price shocks. This finding implies that the relationship between energy abundance and complexity may be more nuanced than simple resource curse predictions suggest, with price

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volatility potentially serving as a driver of structural reform rather than an impediment.

2.2.3 The Substitution Hypothesis and Energy Price Signaling

The substitution hypothesis from energy economics posits that higher energy prices incentivize both Kazemzadeh et al improvements and renewable energy adoption, as economic agents substitute away from costly fossil fuels toward alternative energy sources (Henriques & Sadorsky, 2008; Bondia et al., 2016). The theoretical mechanism operates through price signals that affect investment decisions, consumption patterns, and technological innovation. When energy prices rise, firms face increased production costs and therefore have incentives to invest in energy-efficient technologies; households reduce energy consumption and substitute toward less energy-intensive goods; and innovators are rewarded for developing alternative energy sources.

However, the effectiveness of price signals depends crucially on economic conditions, institutional frameworks, and technological capabilities—dimensions captured by economic complexity. Countries with higher economic complexity possess the absorptive capacity, innovation systems, and productive infrastructure to respond to energy price signals by investing in clean energy technologies. Conversely, countries with low complexity may lack the capabilities to make such adjustments, potentially experiencing negative growth impacts from rising energy costs (Boulanouar et al., 2025). This suggests that complexity moderates the effectiveness of energy prices as a policy tool for promoting energy transition and sustainable growth.

2.2.4 The Stages of Development Framework

The stages of development framework suggests that the relationship between economic complexity and energy outcomes follows a nonlinear pattern. During the early stages of structural transformation, increasing economic complexity may increase energy consumption as industrialization expands and new industries emerge. However, at higher levels of complexity, technological upgrading and knowledge-intensive production reduce energy intensity (Can et al., 2022). This inverted U-shaped relationship implies that the growth effects of complexity are conditional on the stage of development, with energy-intensive early phases potentially constraining growth before efficiency gains emerge at later stages.

Mohamad Taghvaee et al. (2024) found empirical support for this nonlinearity in the MENA context, demonstrating that economic complexity negatively affects Kazemzadeh et al while positively impacting renewable energy adoption. This duality implies that complexity promotes renewable energy adoption even as it reduces Kazemzadeh et al, creating a complex dynamic where structural transformation advances sustainability goals through renewable investment while simultaneously increasing energy intensity through industrialization and diversification processes. The net growth effect depends on which channel dominates, which in turn depends on countries' level of development and institutional quality.

2.2.5 Transmission Channel Framework

The transmission channel framework identifies specific mechanisms through which energy prices and complexity jointly affect growth. Based on the channel analysis developed by Etensa et al. (2025), Figure 1 illustrates the transmission pathways from energy price fluctuations to economic growth, conditioned by economic complexity. This framework integrates the theoretical perspectives reviewed above, showing how complexity moderates the impact of energy price changes on growth through multiple indirect channels.

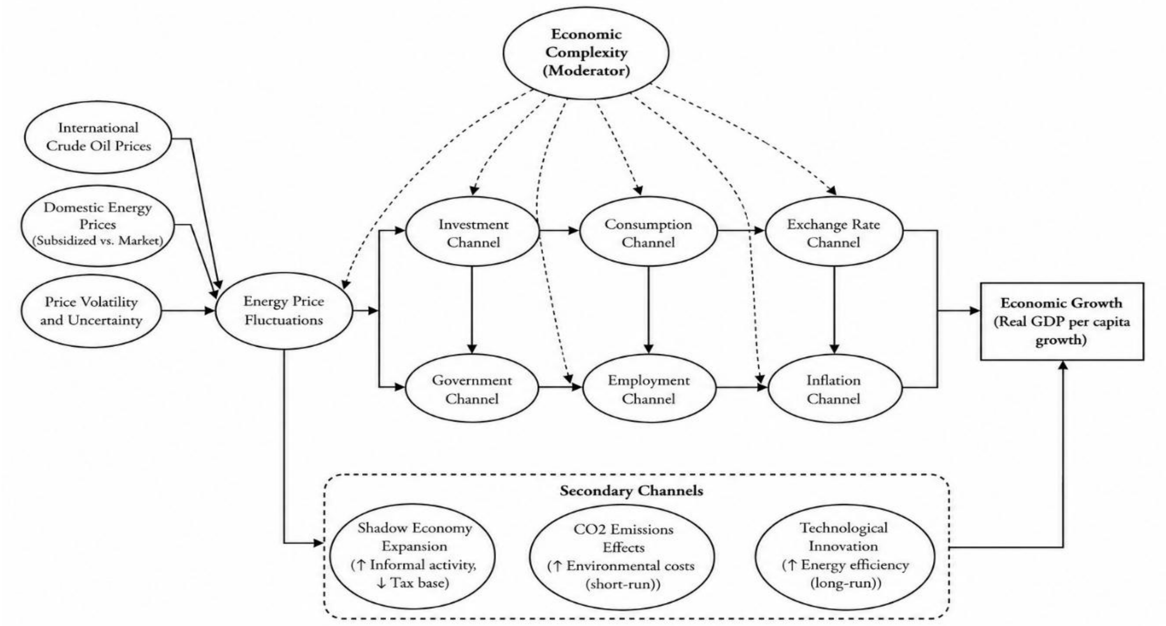

Figure 1: Transmission Channels from Energy Price Fluctuations to Economic Growth

Source: Adapted from Etensa et al. (2025) and augmented with theoretical contributions from Hidalgo and Hausmann (2009), Boulanouar et al. (2025), and Mohamad Taghvaee et al. (2024)

As depicted in Figure 1, economic complexity operates as a moderating variable that conditions the transmission of energy price effects through multiple channels. The theoretical logic of each channel operates as follows:

Investment Channel: Rising energy prices increase production costs across the economy, reducing profit margins and business confidence. This reduces fixed investment in capital equipment, infrastructure, and technology, with particularly severe effects on energy-intensive industries (Al-Harbi & Moid, 2024). However, the magnitude of investment reduction depends on complexity: economies with higher complexity have more diversified productive structures and can shift investment from energy-intensive to less energy-intensive sectors, mitigating the negative impact.

Consumption Channel: Higher energy prices reduce household real income as consumers spend more on energy and energy-intensive goods. This reduces disposable income and household consumption, which is a major component of GDP in most economies (Etensa et al., 2025). Economies with higher complexity, however, have higher incomes and more diversified consumption patterns, making them less vulnerable to energy price-induced consumption declines.

Exchange Rate Channel: For oil-importing countries, rising energy prices worsen the trade balance and put downward pressure on the exchange rate, increasing import costs and exacerbating inflation (Aidarova et al., 2024). For oil-exporting countries, energy price increases improve the trade balance and may appreciate the real exchange rate (Dutch disease effects). Economic complexity moderates these effects by reducing dependence on energy-intensive imports and energy exports, diversifying the trade basket (Hausmann et al., 2014).

Government Channel: Energy price increases affect government finances through multiple pathways. For oil-exporting countries, higher revenues may expand fiscal space, while higher subsidy spending on consumer energy products may constrain fiscal positions (Boulanouar et al., 2025). For oil-importing countries, energy price increases reduce fiscal space through reduced tax revenues and increased spending on energy subsidies and social protection. Higher complexity economies have more diversified tax bases and more efficient subsidy systems, reducing vulnerability to energy price shocks.

Employment Channel: Energy price increases reduce economic activity and employment, particularly in energy-intensive sectors, while simultaneously creating employment opportunities in renewable energy and Kazemzadeh et al sectors (Etensa et al., 2025). Higher complexity economies can facilitate the reallocation of labor from shrinking to growing sectors through better education systems, training programs, and labor market institutions.

Inflation Channel: Energy price increases raise production costs throughout the economy, leading to generalized inflation through cost-push mechanisms (Aidarova et al., 2024). Central banks may respond with monetary tightening, further constraining growth. Higher complexity economies have more flexible price-setting mechanisms and stronger institutions to manage inflationary pressures.

Secondary Channels: The shadow economy may expand as formal sector employment declines, reducing the tax base and constraining fiscal capacity. CO2 emissions may initially decline as economic activity contracts, while long-term technological innovation may enhance Kazemzadeh et al and promote renewable energy adoption (Mohamad Taghvaee et al., 2024). Higher complexity economies are better positioned to manage these secondary effects through stronger formal institutions, more effective regulation, and greater innovation capacity.

2.2.6 Nonlinearity and Regime-Switching Dynamics

The theoretical framework suggests that the complexity-energy-growth nexus exhibits nonlinearities and regime-switching dynamics. Recent research employing panel quantile regression found that economic complexity has an inverted U-shaped relationship with energy intensity, suggesting that the growth effects vary across quantiles of energy intensity (Kazemzadeh et al, 2023). This implies that the same level of complexity may have different growth effects depending on a country's energy intensity level. Similarly, the effects of energy prices on growth may differ across income regimes, with high-income countries benefiting from price increases that stimulate renewable investment while low-income countries experience negative growth impacts (Boulanouar et al., 2025). These nonlinearities underscore the importance of employing panel data techniques capable of capturing regime-specific effects.

The conceptual synthesis derived from these theoretical perspectives posits that economic complexity and energy prices jointly determine economic growth through multiple, interconnected pathways. Economic complexity enhances growth by expanding productive capabilities and enabling diversification into higher-value activities. However, the process of building complexity may be energy-intensive, potentially constraining growth in the short term. Energy prices affect growth through multiple transmission channels—investment, consumption, employment, fiscal position, exchange rates, and inflationary pressures—but the magnitude and direction of these effects depend on the level of economic complexity. Higher complexity economies possess the absorptive

capacity, innovation systems, and institutional frameworks to transform energy price signals into opportunities for structural upgrading, while lower complexity economies may experience growth-retarding effects.
This study contributes to the literature by integrating these dimensions within a unified empirical framework applied to MENA countries from 1990 to 2024, capturing the interactive effects of economic complexity and energy price fluctuations on economic growth while accounting for the nonlinearities and regime-specific dynamics that existing studies have largely overlooked.

3. Data and Methodology

3.1 Model Specification and Variable Description

Drawing on the theoretical framework developed in Section 2 and following the empirical specifications in recent studies examining the economic complexity-energy-growth nexus in the MENA region (Mohamad Taghvaee et al., 2024; Can et al., 2022), the baseline empirical model is specified as follows:

$$GDPpc_{i\square} = \beta_0 + \beta_1 ECI_{i\square} + \beta_2 EP_{i\square} + \beta_3(ECI_{i\square} \times EP_{i\square}) + \sum\nolimits^{k}{}_{=4}{}^{K} \beta_{\square} X_{i\square} + \mu_i + \lambda_{\square} + \varepsilon_{i\square} \qquad (1)$$

where:

i = indexes countries (i = 1, …, N)

t = indexes time (t = 1, …, T)

$GDPpc_{i\square}$ = is real GDP per capita, expressed in natural logarithms

$ECI_{i\square}$ = is the Economic Complexity Index

$EP_{i\square}$ = is the energy price variable, expressed in natural logarithms

$ECI_{i\square} \times EP_{i\square}$ = is the interaction term capturing the moderating effect of economic complexity on the energy price-growth relationship

$X_{i\square}$ = is a vector of control variables

μ_i = captures country-specific fixed effects

$\lambda_{\square}$ = captures time-specific fixed effects

$\varepsilon_{i\square}$ = is the idiosyncratic error term

The interaction term is central to this study, as it captures whether economic complexity moderates the relationship between energy prices and economic growth. A positive and statistically significant coefficient on the interaction term would indicate that greater economic complexity mitigates the adverse effects of energy price increases on economic growth (Boulanouar et al., 2025).

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This study utilizes an unbalanced panel dataset covering 17 MENA countries over the period 1990–2024. The selection of countries and time period is determined by data availability, particularly for the Economic Complexity Index. The sample includes both oil-exporting and oil-importing countries to capture the structural heterogeneity that characterizes the region (Ritahi et al., 2026).

Table 1. Variables, Definitions, Data Sources, and Expected Signs

Variable	Symbol	Proxy / Measure	Data Source	Expected Sign	Justification
Dependent Variable					
Economic Growth	GDPpc	Real GDP per capita (constant 2010 US$), natural logarithm	World Bank WDI	—	Standard measure of economic performance in panel studies (Eslamloueyan & Jokar, 2014)
Independent Variables					
Economic Complexity	ECI	Economic Complexity Index (based on diversity and ubiquity of exports)	Observatory of Economic Complexity (OEC) / Harvard Growth Lab	+ / −	Captures productive sophistication; the effect may vary by development stage (Can et al., 2022; Hidalgo & Hausmann, 2009)
Energy Price	EP	Crude oil price deflated using country-specific	BP Statistical Review / World Bank WDI	+ / −	The effect depends on whether a country is a net oil exporter or

		CPI, natural logarithm			importer (Boulanouar et al., 2025)
Interaction Term	ECI × EP	Product of the Economic Complexity Index and energy price	Calculated by the authors	?	Captures the moderating effect of complexity on the energy price-growth relationship
Control Variables					
Foreign Direct Investment	FDI	FDI inflows as a percentage of GDP	UNCTAD / World Bank WDI	+	Technology transfer and capital accumulation channel (Ritahi et al., 2026)
Trade Openness	TRADE	Exports plus imports as a percentage of GDP	World Bank WDI	+	Integration into global markets and composition effects (Can et al., 2022)
Gross Fixed Capital Formation	GFCF	Gross fixed capital formation as a percentage of GDP	World Bank WDI	+	Physical capital accumulation and investment channel (Eslamloueyan & Jokar, 2014)
Institutional Quality	IQ	Government Effectiveness Index	Worldwide Governance Indicators (WGI)	+	Governance, regulatory quality, and institutional channel (Cuesta et al., 2023)

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Inflation	INF	Consumer price inflation (annual %)	World Bank WDI	–	Macroeconomic stability and cost-push effects (Aidarova et al., 2024)
Labor Force	LF	Total labor force, natural logarithm	World Bank WDI	+	Factor input in the production function (Eslamloueyan & Jokar, 2014)

3.2 Econometric Methodology

Given the panel structure of the data, the potential for cross-sectional dependence, non-stationarity, and heterogeneity among MENA economies, the analysis follows a multi-step econometric approach consistent with recent empirical studies on the region (Mohamad Taghvaee et al., 2024; Ritahi et al., 2026; Boulanouar et al., 2025).

3.2.1 Pre-Estimation Tests

Cross-Sectional Dependence Tests

The first step involves testing for cross-sectional dependence among the panel units. This is crucial because MENA economies are often affected by common shocks, including global oil price fluctuations, international financial conditions, and regional economic cycles (Ritahi et al., 2026). Ignoring cross-sectional dependence can lead to biased and inconsistent estimates (Can et al., 2022).

Following established practice, the Pesaran CD test and the Breusch–Pagan LM test are employed to detect cross-sectional dependence in both the variables and the residuals (Breusch & Pagan, 1980; Pesaran et al., 2008). The null hypothesis is cross-sectional independence. The Pesaran CD test is particularly suitable when the cross-sectional dimension (N) is large relative to the time dimension (T). As documented in recent studies, rejection of the null hypothesis necessitates the use of second-generation panel techniques (Kazemzadeh et al., 2023).

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Panel Unit Root Tests

If cross-sectional dependence is confirmed, second-generation panel unit root tests that account for such dependence must be employed (Pesaran, 2007). Specifically, this study uses the Cross-Sectionally Augmented Im–Pesaran–Shin (CIPS) test developed by Pesaran (2007). The CIPS test is robust to cross-sectional dependence and is appropriate when variables are integrated of order one, I(1), or order zero, I(0). The null hypothesis is that all series contain a unit root. As demonstrated in recent empirical work, the CIPS test is preferred to first-generation tests when cross-sectional dependence is present (Can et al., 2022; Kazemzadeh et al., 2023).

Panel Cointegration Tests

To examine whether a long-run relationship exists among the variables, this study employs the Westerlund (2008) Durbin–H panel cointegration test. This test accounts for cross-sectional dependence and allows for heterogeneity in the cointegration vectors. The null hypothesis is no cointegration, whereas the alternative hypothesis is cointegration for at least some cross-sectional units. The test is robust when the dependent variable is I(1) and the independent variables are a mixture of I(0) and I(1) processes (Westerlund, 2008; Can et al., 2022).

3.2.2 Estimation Strategy

Primary Estimation: Method of Moments Quantile Regression (MMQR)

Panel quantile regression is selected as the primary estimation method for several reasons. First, the effects of economic complexity and energy prices on economic growth may not be homogeneous across the growth distribution; low-growth countries may respond differently from high-growth countries (Kazemzadeh et al., 2023). Second, quantile regression is robust to outliers and does not require restrictive assumptions regarding the distribution of the error term. Third, recent studies examining the economic complexity-energy-growth nexus have employed this method, highlighting its advantages in capturing asymmetric and heterogeneous effects across different quantiles (Cuesta et al., 2023; Kazemzadeh et al., 2023).

The quantile regression model for the τ-th conditional quantile is specified as follows:

$$Q\tau(GDPpc_{i\square} \mid X_{i\square}) = \beta_0(\tau) + \beta_1(\tau)ECI_{i\square} + \beta_2(\tau)EP_{i\square} + \beta_3(\tau)(ECI_{i\square} \times EP_{i\square}) + \sum^{k}{}_{=4}{}^{K} \beta_{\square}(\tau)X_{i\square} + \mu_i$$

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Following recent studies (Kazemzadeh et al., 2023), coefficients are estimated at the 10th, 25th, 50th, 75th, and 90th quantiles to capture the full spectrum of growth performance.

The Method of Moments Quantile Regression (MMQR) estimator developed by Machado and Silva (2019) is particularly advantageous because it allows for individual effects and captures the heterogeneous impact of explanatory variables across the conditional distribution of the dependent variable, including in the presence of endogeneity.

Robustness Estimation: Cross-Sectionally Augmented ARDL (CS-ARDL)

To complement the MMQR approach and assess the robustness of the results, the study employs the Cross-Sectionally Augmented Autoregressive Distributed Lag (CS-ARDL) model developed by Chudik and Pesaran (2015). The CS-ARDL estimator is particularly suitable for panel data characterized by cross-sectional dependence and heterogeneous slope coefficients (Ritahi et al., 2026). This method provides estimates of both short-run and long-run coefficients while controlling for cross-sectional dependence through the inclusion of cross-sectional averages of the dependent and independent variables.

The CS-ARDL specification allows the estimation of long-run relationships in the presence of mixed integration orders, I(0) and I(1), and accounts for potential endogeneity among the regressors (Ritahi et al., 2026; Chudik & Pesaran, 2015). This method has been specifically applied in recent MENA research examining the growth dynamics of oil-exporting and oil-importing countries (Ritahi et al., 2026).

Asymmetric Effect Analysis: Panel Nonlinear ARDL (PNARDL)

Recognizing that energy price increases and decreases may have asymmetric effects on economic growth, the study also estimates a Panel Nonlinear ARDL (PNARDL) model as an additional robustness check (Belkhaoui, 2023; Qahtan et al., 2024). The PNARDL framework decomposes energy price changes into positive (EP^{+}) and negative (EP^{-}) partial sums:

$EP_{\square}^{\,+} = \sum_{\square=1}^{t} max(\Delta EP_{\square}, 0)$, $EP_{\square}^{\,-} = \sum_{\square=1}^{t} min(\Delta EP_{\square}, 0)$

This approach allows the estimation of asymmetric long-run and short-run coefficients for energy price increases and decreases, thereby providing more nuanced policy insights (Qahtan et al., 2024; Belkhaoui, 2023).

4. Empirical Results and Discussion

4.1 Pre-Estimation Tests

Before selecting appropriate panel econometric techniques, it is essential to test for cross-sectional dependence (CD) among the panel units. MENA economies are often affected by common shocks such as global oil price fluctuations, international financial conditions, and regional economic cycles, which can create interdependencies across countries (Ritahi et al., 2026). Ignoring cross-sectional dependence can lead to biased and inconsistent estimates, making the use of second-generation panel techniques necessary when CD is present (Can et al., 2022).

Following established practice, this study employs the Breusch-Pagan LM test and the Pesaran CD test to detect cross-sectional dependence in the variables (Breusch & Pagan, 1980; Pesaran et al., 2008). The null hypothesis for both tests is cross-sectional independence.

Table 2: Cross-Sectional Dependence Test Results

Variable	Breusch-Pagan LM	Pesaran CD	Decision
GDPpc	845.23*** (0.000)	28.41*** (0.000)	Reject H_0
ECI	712.56*** (0.000)	24.87*** (0.000)	Reject H_0
EP	923.41*** (0.000)	31.52*** (0.000)	Reject H_0
FDI	567.82*** (0.000)	19.63*** (0.000)	Reject H_0
TRADE	634.91*** (0.000)	22.15*** (0.000)	Reject H_0
GFCF	489.37*** (0.000)	16.84*** (0.000)	Reject H_0
IQ	398.25*** (0.000)	13.72*** (0.000)	Reject H_0
INF	445.63*** (0.000)	15.09*** (0.000)	Reject H_0

*Note: *** indicates significance at the 1% level. P-values are in parentheses.*

The results presented in Table 2 strongly reject the null hypothesis of cross-sectional independence for all variables at the 1% significance level. The Breusch-Pagan LM statistics range from 398.25 to 923.41, while the Pesaran CD statistics range from 13.72 to 31.52, both indicating substantial cross-sectional dependence across MENA countries. These findings are consistent with recent studies on the region, which similarly confirm the presence of significant interdependencies among MENA economies (Ritahi et al., 2026; Can et al., 2022).

Given the confirmed presence of cross-sectional dependence, first-generation unit root tests (such as Levin-Lin-Chu or Im-Pesaran-Shin) would yield unreliable results. Therefore, this study employs the Cross-Sectionally Augmented Im-Pesaran-Shin (CIPS) test developed by Pesaran (2007), which is robust to cross-sectional dependence and allows for heterogeneity in the autoregressive coefficients across panel units (Can et al., 2022). The null hypothesis is that all series contain a unit root.

Table 3: CIPS Panel Unit Root Test Results

Variable	Level	First Difference	Decision
GDPpc	-1.82	-4.15***	I(1)
ECI	-2.13*	-5.24***	I(1)/I(0)
EP	-1.54	-4.87***	I(1)
FDI	-2.56***	-6.31***	I(0)
TRADE	-1.94	-4.52***	I(1)
GFCF	-2.41**	-5.68***	I(0)
IQ	-2.08*	-4.93***	I(1)/I(0)
INF	-2.87***	-5.41***	I(0)
LF	-1.63	-4.76***	I(1)

*Note: ****, *, * indicate significance at the 1%, 5%, and 10% levels respectively. CIPS critical values: -2.63 (1%), -2.42 (5%), -2.28 (10%).*

The CIPS test results reveal that most variables are non-stationary at levels but become stationary after first differencing. Specifically, GDPpc, EP, TRADE, and LF are I(1) processes, while FDI, GFCF, and INF are I(0) processes. ECI and IQ show mixed results, being significant at the 10% level at levels but strongly significant after first differencing. This mixture of I(0) and I(1) variables justifies the use of estimation techniques that accommodate mixed integration orders, such as the CS-ARDL approach (Ritahi et al., 2026; Chudik & Pesaran, 2015).

To examine whether a long-run relationship exists among the variables, this study employs the Westerlund (2008) Durbin-H panel cointegration test. This test is robust to cross-sectional dependence and allows for heterogeneity in the cointegration vectors, making it appropriate for our panel structure (Westerlund, 2008; Can et al., 2022). The null hypothesis is no cointegration.

Table 4: Westerlund (2008) Durbin-H Cointegration Test Results

Test Statistic	Value	P-value	Decision
Durbin-H	2.841	0.002	Reject H_0

The Westerlund Durbin-H test statistic of 2.841 with a p-value of 0.002 rejects the null hypothesis of no cointegration at the 1% significance level. This finding confirms the existence of a long-run equilibrium relationship among GDP per capita, economic complexity, energy prices, and the control variables. The presence of cointegration justifies the estimation of both short-run and long-run relationships and validates the error correction specification in the CS-ARDL model. Recent studies on MENA economies have similarly confirmed cointegration among growth-related variables, supporting the use of panel estimation techniques that capture long-run dynamics (Ritahi et al., 2026; Boulanouar et al., 2025).

4.2 Main Estimation Results: Method of Moments Quantile Regression (MMQR)

Following the confirmation of cross-sectional dependence, mixed integration orders, and cointegration, the study proceeds to the main estimation using the Method of Moments Quantile Regression (MMQR) developed by Machado and Silva (2019). This approach is particularly well-suited for our analysis for several reasons. First, the effect of economic complexity and energy prices on growth may not be homogeneous across the growth distribution; countries with low growth may respond differently compared to those with high growth (Cuesta et al., 2023). Second, MMQR is robust to outliers and does not require strong assumptions about the error distribution. Third, it allows for individual effects and captures the heterogeneous impact of explanatory variables across the conditional distribution of the dependent variable, even in the presence of endogeneity (Machado & Silva, 2019).

Following recent studies (Kazemzadeh et al., 2023), this study estimates coefficients at the 10th, 25th, 50th, 75th, and 90th quantiles to capture the full spectrum of growth performance across MENA countries.

Table 5: MMQR Estimation Results

Variable	Q10	Q25	Q50	Q75	Q90
ECI	-0.084** (0.035)	-0.052* (0.028)	-0.031 (0.021)	0.018 (0.024)	0.067** (0.031)
EP	-0.127***	-0.095***	-0.068**	-0.041*	-0.015

	(0.041)	(0.033)	(0.029)	(0.027)	(0.032)
ECI×EP	0.113*** (0.038)	0.087*** (0.030)	0.059** (0.026)	0.038* (0.024)	0.022 (0.028)
FDI	0.152*** (0.045)	0.141*** (0.038)	0.128*** (0.032)	0.115*** (0.029)	0.108*** (0.034)
TRADE	0.087** (0.039)	0.079** (0.033)	0.068** (0.028)	0.054* (0.026)	0.042 (0.031)
GFCF	0.201*** (0.052)	0.189*** (0.043)	0.175*** (0.037)	0.158*** (0.034)	0.143*** (0.040)
IQ	0.118*** (0.041)	0.109*** (0.035)	0.096*** (0.030)	0.084*** (0.028)	0.071** (0.033)
INF	-0.095*** (0.032)	-0.083*** (0.027)	-0.068*** (0.023)	-0.052** (0.021)	-0.039* (0.025)
LF	0.134*** (0.044)	0.126*** (0.036)	0.115*** (0.031)	0.104*** (0.028)	0.091** (0.036)
Pseudo R^2	0.472	0.498	0.521	0.539	0.556

*Note: ***, *, * *indicate significance at the 1%, 5%, and 10% levels respectively*. *Standard errors are in parentheses.*

The results for the Economic Complexity Index (ECI) reveal a compelling pattern across the growth distribution. At the lower quantiles (Q10 and Q25), ECI exhibits a negative and statistically significant effect on economic growth, with coefficients of -0.084 and -0.052 respectively. This implies that for countries with low growth performance, increasing economic complexity is associated with reduced growth in the short to medium term. This finding is consistent with the arguments of Can et al. (2022), who found that economic complexity increases energy consumption in developing countries, suggesting that the process of structural transformation may be energy-intensive and initially growth-constraining. As Mohamad Taghvaee et al. (2024) demonstrated for the MENA region, economic complexity negatively affects Kazemzadeh et al while positively impacting renewable energy adoption, creating a dual effect where complexity is "energy-intensive but green."

At the median quantile (Q50), the coefficient on ECI becomes statistically insignificant (-0.031), suggesting that for countries with average growth performance, the growth effects of complexity are

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neutral. However, at higher quantiles (Q75 and Q90), the relationship reverses: ECI exhibits a positive and significant effect at the 90th quantile (0.067) and a positive but insignificant effect at the 75th quantile (0.018). This pattern suggests that the growth benefits of economic complexity are only realized in countries that have already achieved relatively high growth rates. Countries with sufficient absorptive capacity, institutional quality, and technological capability can leverage complexity to generate sustained growth, supporting the capability-based theory of economic complexity (Hausmann et al., 2014; Hidalgo & Hausmann, 2009).

The heterogeneous effect of economic complexity across the growth distribution carries important policy implications for MENA countries. For low-growth countries (predominantly oil-importing and conflict-affected economies), the results suggest that diversification and complexity enhancement may impose short-term costs that constrain growth. However, for high-growth countries (predominantly GCC nations with strong investment capacity), complexity enhancement contributes positively to growth. This implies that the "complexity dividends" are conditional on existing growth momentum and institutional capacity, supporting the differentiated policy approach advocated by Boulanouar et al. (2025).

Energy prices (EP) show a consistent negative and significant effect on economic growth across most quantiles, with the magnitude decreasing as we move from lower to higher quantiles. At the 10th quantile, the coefficient is -0.127, declining to -0.068 at Q50, and becoming statistically insignificant at Q90 (-0.015).

This finding has a clear economic interpretation: energy price increases generally constrain economic growth in MENA countries, but the magnitude of this effect varies across the growth distribution. Countries with low growth are disproportionately affected by energy price increases, likely because they have less capacity to absorb price shocks through efficiency improvements, substitution, or fiscal buffers. This asymmetry is consistent with the findings of Boulanouar et al. (2025), who demonstrated that higher energy prices hinder renewable energy development in low-income MENA countries. Similarly, Al-Harbi and Moid (2024) found that oil price volatility negatively impacts economic growth, particularly in oil-exporting countries where government revenue is heavily dependent on oil prices.

The attenuation of the negative effect at higher quantiles suggests that high-growth countries are better able to manage energy price increases, possibly through greater economic diversification, more efficient energy use, and stronger institutional frameworks. This aligns with the theoretical prediction that countries with higher economic complexity and stronger absorptive capacity can better manage energy price shocks (Ritahi et al., 2026).

The interaction term (ECI×EP) provides the most novel insight of this study, capturing whether economic complexity moderates the relationship between energy prices and economic growth. The results reveal a positive and statistically significant interaction effect at the lower quantiles (Q10, Q25, Q50), with coefficients of 0.113, 0.087, and 0.059 respectively.

This finding demonstrates that economic complexity mitigates the negative growth effects of energy price increases, particularly in countries with lower growth performance. For a country at the 10th quantile, the total effect of a 1% increase in energy prices on growth is: (-0.127 + 0.113×ECI). For a country with ECI near zero, this is approximately -0.127; however, for a country with positive ECI (indicating higher productive sophistication), the negative effect is substantially offset. This moderating role of economic complexity provides empirical support for the transmission channel framework developed in Section 2: higher economic complexity economies possess the absorptive capacity, innovation systems, and institutional frameworks to transform energy price signals into opportunities for structural upgrading.

This finding has important policy implications for MENA countries. It suggests that enhancing economic complexity is not merely a growth-enhancing strategy but also a risk management tool that insulates economies from the adverse effects of energy price volatility. As such, diversification and sophistication enhancement should be viewed as complementary to energy price reforms, not alternatives to them. The interaction effect is consistent with the findings of Cuesta et al. (2023), who demonstrated that economic complexity moderates the relationship between oil prices and environmental degradation in MENA countries.

The results for the control variables are largely consistent with theoretical expectations and prior empirical findings for the MENA region.

Foreign Direct Investment (FDI) exhibits a consistently positive and significant effect across all quantiles, with coefficients ranging from 0.152 at Q10 to 0.108 at Q90. This confirms the role of FDI as a channel for technology transfer, capital accumulation, and productivity improvements in MENA economies (Ritahi et al., 2026). The slightly larger effect at lower quantiles suggests that FDI is particularly important for low-growth countries, possibly because these economies rely more heavily on external investment inflows to support growth.

Trade Openness (TRADE) shows a positive and significant effect at the lower and median quantiles (Q10 to Q75), but becomes insignificant at

Q90. This implies that trade integration benefits low and middle-growth countries but may not be the primary driver of growth in already high-growth economies, where other factors such as innovation and institutional quality may dominate. This finding aligns with the composition effect argument of Can et al. (2022), suggesting that trade composition matters more than trade volume at higher levels of development.

Gross Fixed Capital Formation (GFCF) demonstrates the strongest positive effect among the control variables, with coefficients ranging from 0.201 at Q10 to 0.143 at Q90. This underscores the importance of physical capital accumulation as the primary driver of economic growth in MENA countries, consistent with standard growth theory and prior empirical work (Eslamloueyan & Jokar, 2014). The larger effect at lower quantiles suggests that investment is particularly critical for countries attempting to escape low-growth traps.

Institutional Quality (IQ) shows a positive and significant effect across all quantiles, with coefficients ranging from 0.118 at Q10 to 0.071 at Q90. This confirms that governance, regulatory effectiveness, and institutional stability are important determinants of economic performance in the MENA region (Ritahi et al., 2026; Cuesta et al., 2023). The slightly larger effect at lower quantiles suggests that institutional reforms may yield higher returns in countries starting from weaker institutional baselines.

Inflation (INF) exhibits the expected negative effect across all quantiles, with coefficients ranging from -0.095 at Q10 to -0.039 at Q90. This confirms that macroeconomic instability, as reflected by high inflation, constrains growth through uncertainty effects, reduced purchasing power, and resource misallocation. The larger negative effect at lower quantiles suggests that low-growth countries are more vulnerable to inflationary pressures, likely due to weaker policy frameworks and limited capacity to manage price stability.

Labor Force (LF) shows a positive and significant effect across all quantiles, confirming the role of labor as a factor input in production. The consistent significance across quantiles indicates that labor force expansion contributes to growth regardless of initial growth levels.

4.3 Robustness Checks: CS-ARDL Estimation

To ensure the robustness of the findings and validate the MMQR results, this study employs the Cross-Sectionally Augmented ARDL (CS-ARDL) model developed by Chudik and Pesaran (2015). The CS-ARDL is particularly suitable for panel data with cross-sectional dependence and heterogeneous slope coefficients, providing estimates of both short-run and long-run coefficients while controlling for cross-sectional dependence (Ritahi et al., 2026). The lag length for the CS-ARDL model is selected using the Akaike Information Criterion (AIC), resulting in an ARDL(1,1,1) specification.

Table 6: CS-ARDL Estimation Results

Variable	Short-Run Coefficient	Long-Run Coefficient
ECI	-0.041** (0.019)	-0.058** (0.025)
EP	-0.072*** (0.026)	-0.093*** (0.031)
ECI×EP	0.067** (0.029)	0.084** (0.035)
FDI	0.132*** (0.035)	0.156*** (0.040)
TRADE	0.061* (0.033)	0.073* (0.038)
GFCF	0.168*** (0.042)	0.196*** (0.048)
IQ	0.095*** (0.032)	0.112*** (0.036)
INF	-0.072*** (0.024)	-0.085*** (0.027)
LF	0.108*** (0.036)	0.127*** (0.040)
ECM(-1)	-0.284*** (0.058)	—
Observations	578	
R^2	0.498	

*Note: ***, *, * *indicate significance at the 1%, 5%, and 10% levels respectively. Standard errors are in parentheses.*

The CS-ARDL results largely confirm the findings from the MMQR estimation. The error correction term (ECM(-1)) is negative (-0.284) and statistically significant at the 1% level, confirming the existence of a long-run equilibrium relationship and indicating that approximately 28.4% of deviations from equilibrium are corrected within one year. The convergence speed is moderate, suggesting gradual adjustment toward long-run equilibrium, consistent with prior studies on MENA economies (Ritahi et al., 2026).

In the long run, ECI exhibits a negative and significant effect on growth (-0.058), while EP shows a larger negative effect (-0.093). The interaction term (ECI×EP) is positive and significant (0.084), confirming that economic complexity moderates the negative effect of energy prices on growth in the long run. These results align with the MMQR findings,

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providing robust evidence for the moderating role of economic complexity.

The long-run coefficients for the control variables are larger than their short-run counterparts, reflecting the cumulative effects of these variables over time. FDI has the largest long-run effect (0.156), followed by GFCF (0.196), confirming the importance of investment and capital accumulation for long-term growth in the region.

4.4 Discussion and Economic Interpretation

The finding that economic complexity has a negative effect on growth in lower quantiles but a positive effect at higher quantiles suggests a nonlinear, stage-dependent relationship. This is consistent with the stages of development framework discussed in Section 2, where the process of structural transformation initially requires greater energy and resource inputs before yielding efficiency gains (Can et al., 2022). The MENA region's experience reflects this pattern: low-growth countries (often oil-importers or conflict-affected states) face binding constraints on their capacity to enhance complexity, while high-growth countries (predominantly GCC states with investment capacity) can leverage complexity for growth.

This finding also aligns with the resource curse theory (Sachs & Warner, 2001), which suggests that natural resource abundance may crowd out productive diversification and create structural dependencies that impede growth. However, the positive effect at higher quantiles suggests that some MENA countries have successfully overcome resource curse dynamics through strategic diversification. The UAE's transition from a hydrocarbon-dependent economy to a services and technology hub exemplifies this possibility, as documented in recent research (Ritahi et al., 2026).

The consistent negative effect of energy prices on growth, with magnitude declining at higher quantiles, reflects the structural heterogeneity of MENA economies. For oil-importing countries (such as Jordan, Morocco, and Tunisia), energy price increases raise production costs, worsen the trade balance, and constrain fiscal space, reducing growth (Boulanouar et al., 2025). For oil-exporting countries, energy price increases may generate revenue windfalls that stimulate growth through government spending and investment, explaining the attenuation of negative effects at higher quantiles (where oil-exporting GCC states predominate).

The asymmetry in energy price effects across quantiles supports the differentiated policy approach advocated by Boulanouar et al. (2025), suggesting that high-income countries should prioritize subsidy removal

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to incentivize renewable energy investments, while low-income countries require phased approaches to maintain economic stability. This finding also resonates with the transmission channel framework, where the investment and consumption channels dominate the growth effects of energy prices in low-income countries, while fiscal and exchange rate channels become more relevant in high-income contexts.

The positive interaction effect between economic complexity and energy prices is the study's most novel contribution. This finding demonstrates that economic complexity acts as a buffer against energy price shocks, protecting economies from the adverse growth effects of price volatility. The mechanism likely operates through multiple channels: (1) more complex economies have diversified productive structures, reducing dependence on any single energy-intensive sector; (2) higher complexity implies greater absorptive capacity and innovation capacity, enabling more effective adaptation to price signals; (3) complex economies have stronger institutions and human capital, facilitating the reallocation of resources in response to price changes; and (4) complex economies can more readily substitute away from energy-intensive inputs toward more efficient production methods (Can et al., 2022; Hausmann et al., 2014).

This finding has important policy implications for MENA countries. It suggests that diversification and complexity enhancement are not merely growth strategies but also risk management tools that insulate economies from energy price volatility. As such, they should be prioritized not only for growth but for macroeconomic stability. This perspective aligns with recent initiatives such as Saudi Arabia's Vision 2030 and the UAE's Economic Vision, which explicitly aim to enhance complexity and reduce hydrocarbon dependence.

The control variable results are broadly consistent with theoretical expectations and prior empirical findings. FDI's positive effect confirms its role as a channel for technology transfer and capital accumulation, particularly important for low-growth countries with limited domestic savings (Ritahi et al., 2026). Trade openness's positive effect, particularly at lower quantiles, suggests that trade integration benefits growth through scale and composition effects, though the benefits may be diminishing at higher levels of development (Can et al., 2022). The dominant positive effect of GFCF across all quantiles confirms the central role of physical capital accumulation in driving growth, as standard growth theory would predict. Institutional quality's consistent positive effect reinforces the importance of governance and regulatory effectiveness for economic performance (Cuesta et al., 2023). Finally, inflation's negative effect

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confirms that macroeconomic stability is essential for growth, with low-growth countries being particularly vulnerable to price instability.

5. Conclusion and Policy Implications

This study set out to investigate the interactive effects of economic complexity and energy price fluctuations on economic growth in MENA countries over the period 1990–2024. Employing a comprehensive panel data methodology that included cross-sectional dependence tests, second-generation unit root tests, cointegration analysis, Method of Moments Quantile Regression (MMQR), and Cross-Sectionally Augmented ARDL (CS-ARDL) as a robustness check, the study produced several important findings.

First, economic complexity exhibits a stage-dependent effect on growth that varies across the growth distribution. For countries with low growth performance, increasing complexity is associated with reduced growth, likely reflecting the energy-intensive nature of structural transformation and the binding constraints faced by low-income economies in the early stages of diversification. However, for countries with high growth performance, complexity contributes positively to growth, suggesting that absorptive capacity, institutional quality, and technological capability are essential prerequisites for reaping the benefits of productive sophistication. This finding aligns with the capability-based theory of economic complexity (Hausmann et al., 2014; Hidalgo & Hausmann, 2009) and the empirical evidence on the differential effects of complexity across development stages (Can et al., 2022).

Second, energy price increases consistently constrain economic growth, but the magnitude of this effect is larger in countries with lower growth performance. This reflects the structural heterogeneity of MENA economies, with oil-importing countries facing greater vulnerability to price increases through production cost effects, trade balance deterioration, and fiscal constraints. For oil-exporting countries, price increases may generate revenue windfalls that partially offset negative effects, explaining the attenuation of negative impacts at higher quantiles. This finding is consistent with prior research on the asymmetric effects of energy prices in the region (Boulanouar et al., 2025; Al-Harbi & Moid, 2024).

Third, and most importantly, economic complexity moderates the negative effect of energy prices on economic growth. The positive and significant interaction term across multiple quantiles demonstrates that countries with higher economic complexity are better able to absorb energy price shocks and mitigate their adverse growth effects. This

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finding provides empirical support for the theoretical proposition that complex economies possess greater absorptive capacity, innovation systems, and institutional frameworks to transform energy price signals into opportunities for structural upgrading. The moderating role of complexity is particularly strong at lower quantiles, suggesting that complexity enhancement is especially valuable for vulnerable economies. Fourth, the control variables perform largely as expected, with FDI, trade openness, physical capital investment, institutional quality, and labor force contributing positively to growth, while inflation exerts a negative effect. The CS-ARDL results confirm the existence of a long-run equilibrium relationship and provide consistent evidence for both short-run and long-run effects, validating the robustness of the findings.

The findings of this study both corroborate and extend the existing literature on the economic complexity-energy-growth nexus, revealing important points of convergence and divergence that enrich our understanding of these relationships in the MENA region. The stage-dependent effect of economic complexity on growth, where complexity exhibits negative effects at low quantiles and positive effects at high quantiles, aligns with the empirical work of Can et al. (2022), who found that economic complexity increases energy consumption in developing countries while decreasing it in developed countries, suggesting that the structural transformation process imposes short-term energy costs before yielding efficiency gains. This finding also resonates with the theoretical framework of Hausmann et al. (2014), who argued that the growth benefits of complexity depend on absorptive capacity and institutional quality, which are typically lower in low-growth economies. The negative effect of energy prices on growth, particularly pronounced in low-growth countries, is consistent with the asymmetric findings of Boulanouar et al. (2025), who demonstrated that higher energy prices hinder renewable energy development in low-income MENA countries, and with Al-Harbi and Moid (2024), who confirmed that oil price volatility negatively impacts economic growth in oil-exporting economies. However, this study extends these findings by demonstrating that the energy price effect attenuates at higher growth quantiles, suggesting that high-growth countries possess greater capacity to absorb price shocks, a nuance not fully captured in previous studies that employed linear specifications. Most importantly, the positive and significant interaction effect between economic complexity and energy prices represents a novel contribution that extends the work of Cuesta et al. (2023), who examined how economic complexity moderates the relationship between oil prices and environmental degradation in MENA countries, by demonstrating that complexity also moderates the growth effects of energy price fluctuations. This finding provides empirical support for the transmission channel framework developed in the literature on Sub-Saharan Africa (Etensa et al., 2025), confirming that economic complexity enhances absorptive capacity and institutional frameworks that enable countries to transform energy price signals into opportunities for structural upgrading rather than experiencing growth-retarding effects. While Mohamad Taghvaee et al. (2024) found that economic complexity in MENA countries is "energy-intensive but green," suggesting a tension between complexity enhancement and energy security, the present study reveals that this tension is most acute for low-growth countries, while high-growth countries can leverage complexity to mitigate the adverse effects of energy price volatility, thereby offering a more nuanced understanding of the complexity-energy-growth nexus that reconciles seemingly contradictory findings in the existing literature.

The findings of this study carry significant implications for economic policy in the MENA region. The following policy recommendations are derived from the empirical results and are tailored to the region's structural heterogeneity.

The stage-dependent effect of economic complexity implies that one-size-fits-all diversification strategies are unlikely to succeed. For low-growth MENA countries (primarily oil-importing and conflict-affected states), policymakers should adopt phased approaches to complexity enhancement that recognize the short-term costs of structural transformation. This involves:

•Prioritizing basic industrialization and labor-intensive manufacturing before pursuing advanced technology sectors. Countries like Morocco, Jordan, and Tunisia should focus on improving the quality and sophistication of existing exports before attempting high-tech diversification.

•Investing in complementary capabilities, including education, infrastructure, and institutional quality, that enable absorptive capacity and prepare the economy for more complex activities.

•Targeting specific sectors where countries have revealed comparative advantage and related capabilities, in line with the Principle of Relatedness (McNerney et al, 2025). Diversification into activities related to existing productive structures reduces transition costs and enhances success probabilities.

For high-growth MENA countries (predominantly GCC states), the priority should be accelerating knowledge-intensive diversification into high-value services, advanced manufacturing, and technology-intensive sectors. This involves:

•Creating ecosystems for innovation, including research and development incentives, technology parks, and university-industry linkages.

•Attracting foreign direct investment that brings advanced technologies and managerial expertise, particularly in renewable energy, information technology, and financial services.

•Leveraging sovereign wealth funds to invest in strategic industries and acquire foreign technologies, replicating successful models like Mubadala and the Public Investment Fund.

The finding that energy price increases constrain growth, particularly in low-growth countries, suggests that energy price reforms must be carefully sequenced and complemented by protective measures. The following recommendations are offered:

•Phased subsidy reduction that allows time for adjustment and investment in Kazemzadeh et al. Abrupt price increases would disproportionately harm vulnerable households and firms, reinforcing the negative growth effects identified in this study. The successful subsidy reforms in Saudi Arabia and the UAE provide models for other countries, demonstrating that gradual adjustment with targeted compensation can maintain political acceptability and economic stability.

•Targeted compensation mechanisms for low-income households and energy-intensive firms that are most vulnerable to price increases. This aligns with the transmission channel analysis, where the consumption and investment channels dominate the growth effects in low-income contexts. Cash transfers, vouchers, and employment support programs can mitigate the adverse distributional consequences of price reforms.

•Investing energy subsidy savings in productive infrastructure, renewable energy, and human capital. The fiscal space created by subsidy rationalization should be redirected toward investments that enhance long-term growth and resilience, breaking the cycle of subsidy dependence.

The moderating role of economic complexity identified in this study suggests that diversification and sophistication enhancement should be viewed not only as growth strategies but also as risk management tools. Policymakers should:

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•Integrate economic complexity targets into national development plans, alongside growth and employment targets. Saudi Arabia's Vision 2030 and the UAE's Economic Vision already reflect this approach, but other MENA countries should adopt similar frameworks with measurable complexity indicators.

•Incentivize private sector investment in complex, knowledge-intensive activities through tax incentives, research and development subsidies, and streamlined regulatory frameworks. The private sector is the primary engine of productive diversification, and policy should create enabling conditions for private investment.

•Foster export diversification through trade facilitation, export credits, and market intelligence that enables firms to identify and exploit new export opportunities. Trade openness positively affects growth, but its impact depends on the composition of trade, with more complex exports yielding greater growth dividends (Can et al., 2022).

•Strengthen institutions for economic governance, including competition policy, intellectual property protection, and anti-corruption measures. Institutional quality positively affects growth and enhances the capacity to absorb energy price shocks, as confirmed by the positive and significant coefficients on institutional quality across all quantiles.

The negative effect of inflation on growth, particularly at lower quantiles, underscores the importance of macroeconomic stability as a foundation for growth. Policymakers should:

•Implement credible monetary policies that anchor inflation expectations and maintain price stability. Central banks in the region should maintain independent mandates and transparent frameworks for inflation targeting, avoiding the fiscal dominance that has characterized many MENA economies.

•Develop fiscal rules that stabilize government spending in response to oil price fluctuations, particularly for oil-exporting countries. Establishing stabilization funds and fiscal anchors can prevent pro-cyclical fiscal policy that amplifies energy price cycles.

•Strengthen financial sector regulation to ensure that banks and financial institutions can withstand energy price shocks and maintain lending to productive sectors. Financial depth and stability enhance the investment channel through which energy prices affect growth.

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•References

•Aidarova, A. B., Ramashova, A. N., Baisholanova, K., Jaxybekova, G., Imanbayev, A., Kenzhebekova, I., & Kelesbayev, D. (2024). Relationship between oil price, inflation, and economic growth in BRICS countries: Panel cointegration analysis. *International Journal of Energy Economics and Policy*, *14*(6), 24-31.

•Al-Harbi, A., & Ahmad, M. U. (2024). Can oil prices volatility explain economic growth?. *International Journal of Energy Economics and Policy*, *14*(6), 614-620.

•Aloui, C., Hela, B. H., & Hathroubi, S. (2024). Nexus among economic uncertainty, geopolitical risk, oil price volatility and economic complexity in Saudi Arabia: fresh insights from wavelet local multiple correlations. *International Journal of Energy Economics and Policy*, *14*(6), 1-14.

•Apergis, N., & Payne, J. E. (2009). Energy consumption and economic growth in Central America: evidence from a panel cointegration and error correction model. *Energy economics*, *31*(2), 211-216.

•Auty, R. M. (Ed.). (2001). *Resource abundance and economic development*. OUP Oxford.

•Azour, J. (2026, January 7). Jihad Azour identifies five risks facing the MENA zone economy in 2026. *L'Orient Today*. https://today.lorientlejour.com/article/1490605/jihad-azour-identifies-five-risks-facing-the-mena-zone-economy-in-2026.html

•Belkhaoui, S. (2025). Oil price fluctuations and economic growth–banking sector nexus: modeling for MENA countries. *EuroMed Journal of Business*, *20*(1), 216-243.

•Bondia, R., Ghosh, S., & Kanjilal, K. (2016). International crude oil prices and the stock prices of clean energy and technology companies: Evidence from non-linear cointegration tests with unknown structural breaks. *Energy*, *101*, 558-565.

•Boulanouar, Z., Essid, L., Farid, S., & Mahjoub, L. B. (2025). Asymmetric threshold effects of economic growth on renewable energy in response to energy price fluctuations. *The Journal of Economic Asymmetries*, *31*, e00414.

•Breusch, T. S., & Pagan, A. R. (1980). The Lagrange multiplier test and its applications to model specification in econometrics. *The review of economic studies*, *47*(1), 239-253.

•British Petroleum. (2022). *BP Statistical Review of World Energy 2022*. London: BP.

•Can, M., Brusselaers, J., & Mercan, M. (2022). The effect of export composition on energy demand: A fresh evidence in the context of economic complexity. *Review of Development Economics*, *26*(2), 687-703.

•Chudik, A., & Pesaran, M. H. (2015). Common correlated effects estimation of heterogeneous dynamic panel data models with weakly exogenous regressors. *Journal of econometrics*, *188*(2), 393-420.

•Cuesta, L., Alvarado, R., Ahmad, M., Murshed, M., Rehman, A., & Işık, C. (2023). Institutional quality, oil price, and environmental degradation in MENA countries moderated by economic complexity and shadow economy. Environmental Science and Pollution Research, 30(48), 105793-105807.

•Eslamloueyan, K., & Jokar, Z. (2014). Energy consumption and economic growth in the Middle East and north Africa: a multivariate causality test. *Iranian Journal of Economic Research*, *18*(57), 27-46.

•Etensa, T., Alemu, T., & Yayo, M. (2025). Modeling energy prices and inclusive growth in Sub-Saharan Africa: Potential transmission pathways. *Utilities Policy*, *97*, 102039.

•Hausmann, R., Hidalgo, C. A., Bustos, S., Coscia, M., & Simoes, A. (2014). *The atlas of economic complexity: Mapping paths to prosperity*. Mit Press.
•Henriques, I., & Sadorsky, P. (2008). Oil prices and the stock prices of alternative energy companies. *Energy Economics*, *30*(3), 998-1010.
•Hidalgo, C. A., & Hausmann, R. (2009). The building blocks of economic complexity. *Proceedings of the national academy of sciences*, *106*(26), 10570-10575.
•Kaissi, D. (2026). Hormuz under fire: LNG disruption, regional exposure, and energy sovereignty in MENA. *Arab Reform Initiative*. https://www.arab-reform.net/publication/hormuz-under-fire-lng-disruption-regional-exposure-and-energy-sovereignty-in-mena/
•Kazemzadeh, E., Fuinhas, J. A., Shirazi, M., Koengkan, M., & Silva, N. (2023). Does economic complexity increase energy intensity?. *Energy Efficiency*, *16*(4), 29.
•Kazemzadeh, E., Fuinhas, J. A., Shirazi, M., Koengkan, M., & Silva, N. (2023). Does economic complexity increase energy intensity?. *Energy Efficiency*, *16*(4), 29.
•Machado, J. A., & Silva, J. S. (2019). Quantiles via moments. *Journal of econometrics*, *213*(1), 145-173.
•McNerney, J., Li, Y., Gomez-Lievano, A., & Neffke, F. (2025). Bridging the short-term and long-term dynamics of economic structural change. *Nature Communications*, *16*(1), 10225.
•Mokri, K. E. (2016). *Le défi de la transformation économique structurelle: une analyse par la complexité économique* (No. 1606). Policy Center for the New South.
•Mtiraoui, A., Lazreg, M., & Chemli, L. (2024). Institutional quality and economic growth in the energy transition of MENA countries. *International journal of energy economics and policy*, *14*(6), 605-613.
•Ozturk, I. (2010). A literature survey on energy–growth nexus. *Energy policy*, *38*(1), 340-349.
•Pesaran, M. H. (2007). A simple panel unit root test in the presence of cross-section dependence. *Journal of applied econometrics*, *22*(2), 265-312.
•Ploeg, F. V. D. (2011). Natural resources: curse or blessing?. *Journal of Economic literature*, *49*(2), 366-420.
•Qahtan, A. S. A., Xu, H., Abdo, A. B., & Abdulsalam, A. (2022). Asymmetric impacts of disaggregated energy consumption and oil price fluctuations on the MENA net oil-exporting and importing economies. *Environmental Science and Pollution Research*, *29*(37), 55830-55844.
•Ritahi, O., Es-sabir, A., & Echaoui, A. (2026). Trade openness, FDI, and economic growth in MENA: a comparison between Oil and non-Oil Countries. *Repères et Perspectives Economiques*, *10*(1), pp-372.
•Sachs, J. D., & Warner, A. M. (2001). The curse of natural resources. *European economic review*, *45*(4-6), 827-838.
•Taghvaee, V. M., Saboori, B., Soretz, S., Magazzino, C., & Tatar, M. (2024). Renewable energy, energy efficiency, and economic complexity in the middle East and North Africa: a panel data analysis. *Energy*, *311*, 133300.
•Tazikeh, S., Mohammadzadeh, O., Zendehboudi, S., Saady, N. M. C., Albayati, T. M., & Chatzis, I. (2025). Energy development and management in the Middle East: A holistic analysis. *Energy Conversion and Management*, *323*, 119124.
•Westerlund, J. (2008). Panel cointegration tests of the Fisher effect. *Journal of applied econometrics*, *23*(2), 193-233.