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Abstract

This study investigates the nexus between natural resource volatility (NRV) and inclusive growth (IG) while examining the moderating impact of financial development (FD) and institutional quality (IQ) across 18 Middle East and North African (MENA) countries from 2002 to 2021. The empirical results —which are based on the two-step System Generalized Methods of Moments (SYS-GMM) estimation—reveal that NRV positively affects IG after controlling for moderation effects, implying that natural resources are a blessing in MENA. The results also indicate that the proposed moderators play a pivotal role in shaping the impact of volatility on IG. Institutions and volatility exhibit a synergistic relationship in promoting inclusivity in the MENA region. Nonetheless, volatility and FD are substitutive in promoting IG since FD (NRV) weakens the positive impact of volatility (FD). Overall, IQ and FD have a net positive impact on IG. However, the positive effect of FD is entirely negated at a volatility threshold of 34 percent, whereas IQ has a net positive effect beyond a volatility threshold of 17 percent. Additionally, the net positive impact of volatility on IG is nullified at an FD threshold of 80 percent. Policymakers in MENA are advised to be prudent with these thresholds while pursuing shared prosperity from their abundant natural resources.

Keywords: Inclusive growth, Natural resource volatility, Financial development, Governance, Institutional quality, MENA.

JEL Classifications: P48, E02, I24.

ملخص

تبحث هذه الدراسة في العلاقة بين تقلب الموارد الطبيعية (NRV) والنمو الشامل (IG) مع فحص التأثير المعتدل للتنمية المالية (FD) والجودة المؤسسية (IQ) في 18 دولة في الشرق الأوسط وشمال إفريقيا (MENA) من 2002 إلى 2021. تكشف النتائج التجريبية - التي تستند إلى تقدير طرق اللحظات المعممة للنظام المكون من خطوتين (-SYS GMM) - أن NRV يؤثر بشكل إيجابي على IG بعد التحكم في تأثيرات الاعتدال، مما يعني أن الموارد الطبيعية هي نعمة في الشرق الأوسط وشمال إفريقيا. تشير النتائج أيضًا إلى أن الوسطاء المقترحين يلعبون دورًا محوريًا في تشكيل تأثير التقلبات على IG. وتظهر المؤسسات والتقلبات علاقة تآزر في تعزيز الشمولية في منطقة الشرق الأوسط وشمال أفريقيا. ومع ذلك، فإن التقلب و FD بديلان في تعزيز IG لأن (NRV) FD يضعف التأثير الإيجابي للتقلب (FD). بشكل عام، يكون لمعدل الذكاء و FD تأثير إيجابي صاف على IG. ومع ذلك، فإن التأثير الإيجابي لـ FD ينفي تمامًا عند عتبة تقلب تبلغ 34 بالمائة، في حين أن معدل الذكاء له تأثير إيجابي صاف يتجاوز عتبة التقلب البالغة 17 بالمائة. بالإضافة إلى ذلك، تم إلغاء التأثير الإيجابي الصافي للتقلب على IG عند عتبة FD البالغة 80 بالمائة. يُنصح صانعو السياسات في الشرق الأوسط وشمال إفريقيا بالحذر مع هذه العتبات مع السعي لتحقيق الازدهار المشترك من مواردهم الطبيعية الوفيرة.

1. Introduction

Natural resources are the world's major traded commodities (Cao and Xiang, 2023; Ma et al., 2023). In 2021, oil, coal, and natural gas accounted for 82 percent of primary energy consumption (BP, 2022). Approximately 33 percent of the world's energy consumption is derived from crude oil, and its raw materials are used in practically every sector of the economy (Eyden et al., 2019; Wachtmeister et al., 2018). However, natural resource prices, particularly oil, are exceedingly volatile and bounce higher than other mineral resources (Zhang et al., 2024). Such volatility has always been a source of apprehension for governments in oil-producing and oil-consuming countries (Yating et al., 2022). The escalating geopolitical fragmentation and climate change imperatives have compounded these concerns (IMF, 2023a; Li, 2023). For instance, the oil price surge following the Ukrainian-Russian conflict and the relaxation of COVID-19 restrictions culminated in a record high of USD 120 per barrel in June 2022 after a substantial drop to USD 16.70 per barrel in April 2020 (World Bank, 2023; Zhang et al., 2024). However, the price plunged significantly again, eventually settling at USD 81.08 per barrel in November 2023 (OPEC, 2023). This is primarily due to concerns over reduced demand in the global economy, further deteriorating as a result of the current tensions in the Middle East, with additional downturns expected in the future (IMF, 2023a).

Accordingly, natural resource volatility (NRV) and its impact on economic performance have piqued scholars' and policymakers' interest (Bakhsh and Zhang, 2023), particularly with a continuing stream of research empirically verifying the volatility-triggering and long-lasting impact of the current crises (Zhang et al., 2024; Cao and Xiang, 2023; Thi et al., 2023; Sha, 2022; Su et al., 2021; Guan et al., 2021). This is coupled with the deleterious impact of geopolitical risks on natural resources' returns and volatility (Zheng et al., 2023; Dogan et al., 2021). Therefore, the literature has extensively evolved to explore NRV's multifaceted effects—especially the impact of oil prices on economic growth—and it has provided contradictory results (Guo et al., 2022; Wang et al., 2022; Liu et al., 2022; Yu et al., 2022).

Not only can NRV affect growth prospects, it can also impact the likelihood of its inclusiveness, discerning a shift from focusing on the income level or growth rate to how this income is shared (i.e., inclusive growth (IG)). In addition to its effects on growth, the amplification of NRV inevitably contributes to higher inflation, which could push millions into food insecurity and poverty—especially in developing countries (IMF, 2023b). A staggering 345 million people worldwide are expected to suffer from severe food insecurity this year, almost twice the number recorded in 2020 (WFP, 2023). In addition, between 75 and 95 million more people lived in extreme poverty in 2022 than in the pre-pandemic era (IMF, 2023c). The current brewing conflict in the Middle East further exacerbates these concerns due to its impact on oil prices. Since the beginning of the conflict, oil prices have risen by roughly six percent. A sustained rise in oil prices would further push inflation (World Bank, 2023b), which can aggravate living standards and poverty. However, as will be discussed, some scholars argue in favor of the beneficial impact of NRV on economic growth and, hence, its inclusivity, causing ambiguity as to how exactly volatility affects IG.

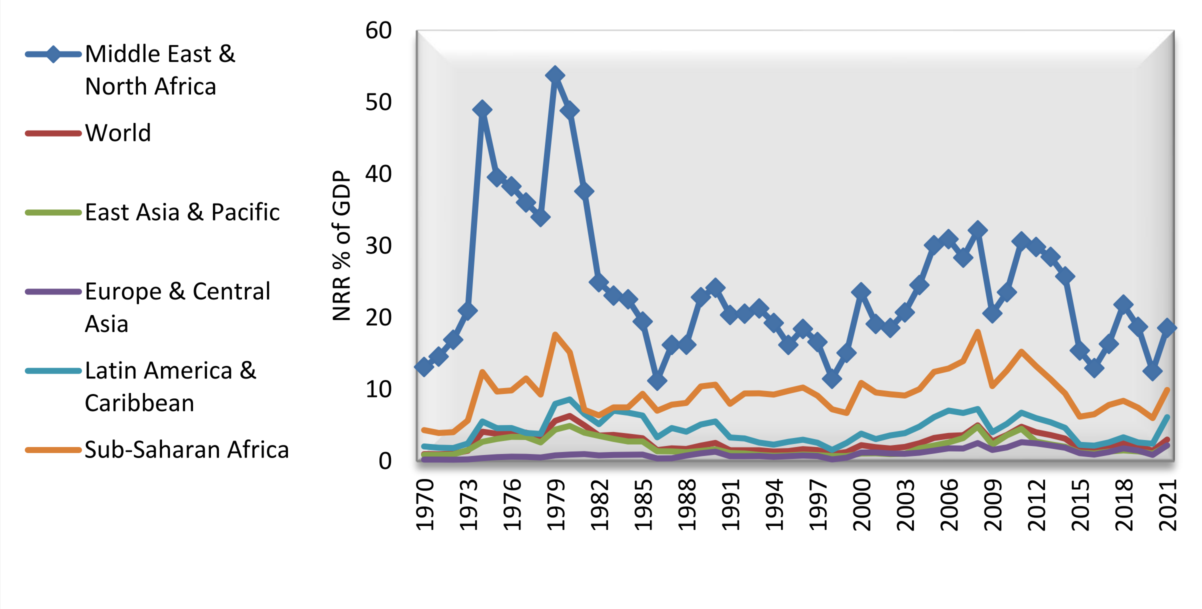
Additionally, natural resource management is considered indispensable for long-term shared prosperity, as the potential positive attributes of natural resources are heavily dependent on how they are used and managed (Cheng et al., 2023). Recent propositions indicate that poorly functioning institutions and financially underdeveloped economies are more prone to volatility and external shock risk. On the one hand, according to Ploeg and Poelhekke (2009), NRV has a disruptive indirect effect on economic growth, suggesting that a well-functioning financial sector lessens the volatility curse. On the other hand, weak institutional fabrics are a significant impediment to the government's ability to decouple its spending priorities from fluctuations in resource revenue, thereby hindering IG (Raheem et al., 2018). Therefore, this paper argues that financial development (FD) and institutional quality (IQ) could moderate the relationship between NRV and IG.

This paper draws the attention of scholars and practitioners to an emerging issue, accentuating the quality of growth rather than the quantity (Raheem et al., 2018). Specifically, we scrutinize whether and how NRV affects IG while considering the moderating role of FD and IQ in the Middle East and North Africa (MENA), which is exceptionally pertinent for various reasons.

The MENA region is one of the world's leading energy-producing regions, boasting approximately 60 percent of global oil reserves and 45 percent of global gas reserves (Suad et al., 2023). The region's economic performance is linked to its natural wealth, as shown in Figure 1. Moreover, oil exports account for more than 85 percent of the region's overall exports (Liu et al., 2022), rendering it dramatically prone to NRV (Chengyonghui et al., 2023). Natural resource-driven revenues allow the region's countries to achieve high growth rates, yet countries grapple with ensuring that development perks are shared equally. Poverty and inequality in the region are remarkably high, ranking it the most unequal region globally (OXFAM, 2023). Poverty rates in MENA have almost doubled since 2010 compared to other regions, with around 192 million people living in extreme poverty in 2021[3] (World Bank, 2022). In total, a mere 11 percent of the total income reaches the bottom half, whereas half goes to the top 10 percent (OXFAM, 2023). This fuels economic exclusiveness, which is a crucial driver of the region's social instability (Lui et al., 2022). Cascading and multidimensional crises also hinder MENA's prospects for IG. These include atypical soaring food and energy prices, climate-related risks, the ongoing Russian-Ukrainian conflict, IMF-imposed austerity measures in certain countries, public debt surges, currency depreciation, interest rate increases (OXFAM, 2023; World Bank Group, 2023), and, most importantly, natural resource price oscillations (Liu et al., 2022). Hence, NVR, IG, and their relationship are highly relevant for the region.

[3] Less than USD 5.50 per day.

Figure 1. Trends in natural resources rent shares in MENA vs other regions



Source: WDI (2022).

As mentioned, no study has investigated the effect of NRV on IG. Thus, our investigation provides a unique contribution to the existing field of knowledge with new empirical findings:

1. To the best of our knowledge, this is one of the first studies that empirically investigate the impact of NRV on IG, which refines the existing literature on the NRV-economic performance nexus. Arezki and Nabil (2012) highlight the potential impact of NRV on IG, albeit without empirical validation.
2. The dataset spans from 2002 to 2021, covering the COVID-19 pandemic, a significant source of global uncertainty—especially in natural resources.
3. This study examines the dynamics among the selected variables, emphasizing the MENA region, where NRV and IG are relatively crucial, particularly in current crises.
4. This study investigates how internal FD and IQ (governance) can moderate the impact of exogenous NRV on IG, which is a novel perspective in policy-based analyses.

Using a two-step System Generalized Methods of Moments (SYS-GMM), this paper finds a positive relationship between NRV and IG after controlling for the two proposed modulating variables. Unconditionally, FD positively affects IG, whereas institutions have a negative effect. Regarding interactive terms, the findings demonstrate that the NRV-IG link is moderated by IQ and FD. On the one hand, IQ and NRV are particularly complementary in promoting IG in MENA. In contrast, FD and NRV are substitutes for improving IG. Overall, both modulators generate positive net effects in the MENA region. However, the positive effect of FD is completely negated at a volatility threshold of 34 percent, whereas IQ starts to have a net positive effect after a volatility threshold of 17 percent. In addition, the net positive impact of volatility on IG is nullified at an FD threshold of 80 percent.

The rest of the paper is organized as follows. Section 2 surveys the existing literature. Next, section 3 introduces the model specification and the estimation strategy. The empirical results are then reported and discussed in section 4. Finally, section 5 concludes and provides policy implications.

2. Literature survey and hypotheses development

2.1 NRV and IG

Plentiful natural resources were considered a “boon” for economic growth and development for millennia. However, since the 1980s, economists have voiced doubts in this regard, arguing that natural resource abundance can adversely affect growth and development (Lotfalipour et al., 2022). Eventually, Corden and Neary (1982) and Bruno and Sachs (1982) coined the term “Dutch disease,” which was later empirically supported by Sachs and Warner (1995), who stated that resource-rich economies tend to grow more slowly than resource-poor economies (Lotfalipour et al., 2022). The findings of Sachs and Warner (1995) sparked a surge of academic investigations into the so-called “resource curse,” yielding two seemingly divergent findings: some assert that natural resources are a curse (Rahim et al., 2021) and others advocate that they are a blessing (Hayat and Taher, 2021). Nonetheless, a parallel strand maintains that natural resources do not inhibit development on their own but rather induce aberrations that act as transmission channels to stymie development (Yang et al., 2021; Aljarallah and Angus, 2020; Haouas and Soto, 2012), ranging from human capital, environmental quality, institutional settings, and others (Dialga and Ouoba, 2022; Destek et al., 2023; Elmassah and Hassanein, 2022). However, these studies substantially overlooked the volatility channel of effect (Su et al., 2021).

A strand of research has highlighted the volatility channel as the primary channel of the resource curse, positing that the adverse indirect effects of NRV may trump the positive impact of natural resource abundance on economic performance (Joya, 2015; Eyden et al., 2019), and the current severe fluctuations prove to support this claim (Sun et al., 2022). This notion was initially supported by Ramey and Ramey (1995), who demonstrate that NRV negatively affects economic growth. Specifically, countries with higher levels of NRV tend to have lower average growth rates even after controlling for other factors influencing growth. Ploeg and Poelhekke (2009) also observe that the disruptive indirect impact of natural resources on economic growth through volatility obscures any favorable direct impact. In a similar vein, Cavalcanti et al. (2015) deduce that volatility's harmful effects on growth dwarf the positive impact of commodity booms, implying that volatility rather than abundance causes the 'resource curse' paradox. Benramdane (2017) finds that oil price volatility, rather than abundance, dictates Algeria's "resource curse" dichotomy. In addition, Hayat and Tahir (2021) analyze NRV and economic growth in resource-rich economies and conclude that while natural resources can promote economic growth, their volatility harms it. Guan et al. (2021) and Jaya (2015) also provide similar results using a sample of top oil-producing nations and a global sample of 187 countries.

The link between NRV and economic growth has recently emerged as a prominent theme in resource research, particularly following the COVID-19 outbreak, triggering a growing body of research with heterogeneous findings in various contexts. Most studies, however, concur that NRV impairs economic growth. For example, Zhang et al. (2023) utilize the Bootstrap Autoregressive Distributed Lagged (BARDL) estimation method to examine economic performance and uncertainties in natural resource prices from 1996 to 2021. The long- and short-run results indicate that NRV impedes China's growth. In a similar vein, Deng (2022), Hsu et al. (2023), Wen et al. (2022), and Etokakpan et al. (2020) empirically analyze the previous relationship in China, 11 emerging countries, BRICS, and the G7 economies, respectively, and provide similar findings. In addition, Aloui et al. (2018) find that the volatile oil market hindered Saudi Arabia's economic growth from 1969 to 2014. Over 144 data points, Eyden et al. (2019) blend several panel data estimations in OECD countries and report that oil price volatility significantly affected their economic growth. Adeosun et al. (2022), Sha (2022), Guan et al. (2018), Zhou et al. (2022), and Ma et al. (2022) also report similar results across different time series and panel data. However, Rosnawintang et al. (2021) and Charfeddine and Barkat (2020) observe that inverse swings in oil prices harm GDP growth only in the short run. In contrast, Guan et al. (2021) reveal that NRV severely impacts economic growth in the long run.

Scholars have challenged this seemingly obvious consensus by noting that volatility may benefit growth. For example, Nusair (2015) analyzes the influence of oil price fluctuations on the real GDP of the GCC region and the results show a positive correlation, with positive fluctuations having a significantly greater impact on real GDP. Similarly, Nasir et al. (2019) show that oil price shocks have a statistically favorable, though variant, effect on GCC countries' growth, a finding refuted by Erdogan et al. (2020) in the same context. In an analysis of Brazil, Russia, India, China, and South Africa between 1990 and 2020, Wu et al. (2023) find that natural gas and coal volatility positively correlate with economic performance, whereas oil volatility is insignificant. According to the results of Arif et al. (2022), NRV is crucial in bolstering China's economic performance. Li (2023) also reports a positive link between coal commodity prices, crude oil commodity prices, and economic expansion.

Although an empirical examination of the effect of NRV on IG is understudied, the few attempts to study this link are typically devoted to a single aspect of IG (i.e., inequality). Moreover, they are severely limited in number and scope and result in inconsistent outcomes. Some evidence demonstrates that natural resource supply chains, from discovery to sale, are considered a source of elitism and exclusivity (Shah et al., 2023; Raheem et al., 2018). For instance, Kim et al. (2020) find that oil abundance mitigates income inequality while its volatility inhibits it through institutional channels. They claim that resource abundance may lead to institutional decay, political corruption, and rent-seeking, distorting public expenditures from productive activities and thereby exacerbating income disparities. According to Aizenman and Pinto (2005), high NRV adversely affects social welfare, poverty, and income inequality. In addition, Baba (2017) shows that household welfare, economic growth, and poverty in Nigeria have declined substantially due to oil price volatility from 1997 to 2017. High NRV can be a crucial avenue for inducing inequality in resource-rich nations, according to Chekouri (2023). Conversely, using household-level data, Howie and Atakhanova (2014) examine how a resource boom affects income inequality in Kazakhstan's regions and find that booms reduce income inequality.

As noted, the many results on the effect of NRV on economic growth and the few ones on IG show that they are related but with inconclusive directions. Thus, based on the preceding discussion, the first hypothesis of this study posits that NRV affects IG. However, the specific direction of this influence cannot be priory ascertained as the available literature presents conflicting evidence. The first hypothesis is as follows:

H1: NRV has an effect on IG in MENA.

2.2. Institutions, financial development, volatility, and inclusivity

2.2.1. Empirical literature on institutions and volatility

Since Ross' (2001)[4] groundbreaking study, research on the resource curse has repeatedly demonstrated that natural resource-dependent countries tend to have poor institutional structures and weak revenue management, potentially turning natural resources into a curse by triggering rent-seeking behavior (Ding, 2023; Pata et al., 2021; Aljarallah and Angus, 2020). This has led to numerous studies suggesting that well-functioning institutions are crucial to natural resource management. Contrarily, studies on the significance of institutions in the context of volatility are sparse (Hsu et al., 2023).

Among the few attempts, Leong and Mohaddes (2011) examine a panel of 112 economies from 1970 to 2005 and reveal that NRV has a hazardous impact on output. Nevertheless, they reckon that a well-established institutional structure can negate these adverse effects. El-Anshasy et al. (2015) also verify these findings by examining 17 major oil producers over the period 1961-2013, showing that volatility in oil revenues coupled with weak government responses drives the resource curse paradox. Even so, robust institutions can mitigate some of the negative impacts of oil revenue volatility. Arezki and Gylfason (2011) reiterate this point, stating that volatility spurs non-resource GDP growth in democracies but not autocracies. Thus, they suggest that curbing natural resource infringement and propagating good governance may moderate the negative impact of volatility on the economic performance of resource-based countries. Moreover, Henri (2019) examines Africa's institutional and economic indicators most adversely affected by natural resource rents from 1992 to 2016. The results indicate that countries with poor governance exhibit higher volatility.

[4] A study of 113 countries confirms that oil exports and other kinds of mineral exports are strongly associated with authoritarian rule.

2.2.2. Empirical literature on financial development and volatility

Since Poelhekke and Van der Ploeg (2007) propose a robust financial sector to mitigate the volatility curse on growth, FD has been noted as a potent instrument for transforming the resource curse into a blessing in subsequent academic studies. However, only a handful of empirical studies have discussed the impact of FD on NRV, reporting contradictory results. On the one hand, Liu et al. (2023) use second-generation methods to examine the long-run impacts of several macroeconomic variables on NRV in MENA. They empirically prove that globalization and governance increase NRV, whereas FD reduces it by promoting responsible and sustainable business practices. Easterly et al. (2001) also reveal that a robust financial system can reduce macroeconomic volatility. Regarding its moderating effect, Gazdar et al. (2019) find that the development of the Islamic financial system reinforces the growth-promoting effect of oil volatility in the GCC context. Additionally, in a sample of 63 oil-producing countries, Moradbeigi and Law (2016) demonstrate that FD dampens the negative effect of oil volatility on growth. Erdogan et al. (2020) find that an increase in oil exports has no statistically significant effect on economic growth when the FD rate is less than 45 percent. However, when the rate is greater than 45 percent, one unit of oil exports increases economic growth by seven percent. These results indicate that FD can enhance (mitigate) volatility's positive (adverse) effects on growth. However, few scholars have mentioned crowding out between natural resources and FD (Yuxiang and Chen, 2011; Moradbeigi and Law, 2016). It is argued that high reliance on natural resources negatively affects the development of the financial sector and, consequently, growth (Gylfason, 2004). This is because heavy reliance on natural resources diverts financial resources away from other uses and directs them to exploit natural resources (Yuxiang and Chen, 2011). Thus, an increasing FD might weaken (enhance) the positive (negative) effect of natural resources on growth and vice versa. These arguments indicate that both natural resource dependence and FD may crowd out each other 's effects on growth.

2.2.3. Institutions, financial development, and inclusivity

A similar pattern emerges in the literature, demonstrating that institutions and FD have discernible effects on IG. Regarding institutions, Lotfalipour et al. (2022) conduct a panel quantile regression analysis using 14 data points to determine how natural resource dependence and IQ affect social welfare in developing fuel-exporting countries. The findings show that natural resource dependence harms social welfare in the sampled countries, thereby validating the welfare curse, while IQ benefits it. A competent strategy for utilizing resource rents, combined with solid governance, can promote shared growth in countries endowed with natural resources, according to the results of Chen et al. (2023). Ofori and Asongu (2022) apply the GMM estimator to examine how Sub-Saharan African (SSA) institutional fabrics moderate the influence of foreign direct investment (FDI) on IG in SSA from 1990 to 2020. They observe that the region's fragile governance settings negate the weak FDI-induced IG effects. In their study, Amponsaha et al. (2021) highlight that a solid governance structure promotes inclusiveness: a one percent increment in governance results in a 0.3-0.5 percent increase in IG. Solid institutions that ensure accountability and fair redistribution are indispensable to achieving IG (Ofori et al., 2022).

However, the research findings regarding FD's impact on IG are inconclusive. For instance, Oyinlola and Adedeji (2019) investigate the role of FD in the human capital-IG link and generally report a direct positive impact of FD on IG. Nevertheless, in certain specifications, the authors indicate that FD had either no significant impact or a negative impact on IG due to the crowding out of domestic investment or, broadly, the ineffectiveness of the financial system. Iddrisu et al. (2023) examine how FD shapes the relationship between foreign bank presence and IG using a two-stage GMM in 28 African countries and find that FD magnifies the beneficial impact of foreign bank presence on IG. Gyamfi et al. (2010) research the relationship between FD and IG while examining how institutions moderate this relationship. They find that the IG and FD variables are non-linearly related, indicating that weak institutions inhibit the favorable impact of FD on IG. Ofori et al. (2022) also show that FD has a positive impact on IG and enhances the positive effect of information and communication technologies (ICT) on IG. In contrast, Rumbogo et al. (2021) examine the relationship between financial sector development, financial inclusion, and economic growth in 33 Indonesian provinces. They demonstrate that FD might disproportionately satisfy the wealthy and exclude the poor in the absence of financial inclusion, triggering income inequality and poverty, a finding previously reached by Demirgu et al. (2016) and Levine (2005). Relatedly, Ofori et al. (2023) find that Africa's weakened financial sector impedes the beneficial effect of remittances on IG; a minimum FD threshold of 14.5 percent is required for FD to boost IG.

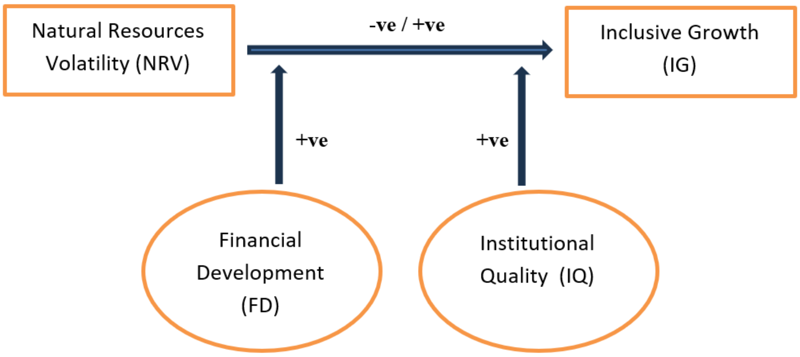
According to the previous literature, both IQ and FD are proven to impact volatility. In addition, both variables can moderate the effect of volatility on economic growth as well as the effect of other macroeconomic variables on IG. Thus, it may moderate the volatility effect on IG, acting as a damper on the curse or an enhancer for the blessing. However, no previous study investigated whether these variables could moderate the relationship between NVR and IG. In this context, and based on the majority of findings, this paper proposes that IQ and FD in the MENA region can moderate the relationship between NRV and IG in the sense that countries with higher IQ/FD have a less (more) detrimental (positive) effect of NRV on IG.

Thus, the second hypothesis of this paper is as follows:

H2: FD and IQ act as moderators, enhancing (mitigating) the positive (negative) relationship between NVR and IG in MENA.

Figure 2 recapitulates the two hypotheses of the paper.

Figure 2. Study design



3. Data and methodology

3.1. Sample and variables

This study examines the impact of NRV on IG in 18 MENA countries between 2002 and 2021. Data availability guides the sample selection and time frame, and we follow the World Bank's classification of MENA countries. This analysis considers two policy variables that can moderate the effect of natural resources on IG in MENA: FD and IQ. The primary research question is how FD and IQ can moderate the relationship between inclusiveness and NRV.

IG is the dependent variable and it is calculated using a principal component analysis (PCA) as explained below in detail, since there is no direct measurement of IG. The primary explanatory variable is NRV, measured as the conditional standard deviation of the total natural resources rent (TNR) (% of GDP) as explained below. Regarding the moderators, IQ is also constructed as a PCA composite index using the six worldwide governance indicators as illustrated below. Domestic credit to the private sector is used as a proxy for FD since it is the most commonly used indicator in the literature for FD (Cao et al., 2022). Finally, control variables are added following the literature, including Internet access, trade openness, and vulnerable employment (e.g., Bello et al., 2023; Kouladoum, 2023).

Internet access is an indicator of ICT; ICT (or digital infrastructure) is argued to enhance IG by creating more jobs, enhancing learning and education, and supporting connection and networking through social media. Nevertheless, ICT can also be detrimental to IG by decreasing job availability due to automation and increasing the information gap between the rich and the poor (Ejemeyovwi and Osabuohien, 2018; Adeleye et al., 2023). Vulnerable employment is included to capture the informality in our sample. On the one hand, the informal sector may increase economic growth and reduce poverty, which could enhance IG; however, rising vulnerability may also harm IG as vulnerability's effect is more pronounced on the income of poor individuals than rich ones (Ofori et al., 2023a; Ofori et al., 2023b).

Likewise, trade openness may favorably impact IG through job creation and decreasing inequality. Nevertheless, some argue that trade could harm income distribution and IG as it threatens domestic employment (Agyei and Idan, 2022).

Most data on these variables are derived from World Bank data. Table A1 in the Appendix provides additional information regarding the data sources and measurements.

3.2. Natural resource volatility estimation

To measure the volatility in natural resource rents, conditional variance is considered since the simple unconditional variance gives one value for the whole sample without considering volatility clustering and the over-the-year change in the natural resource rents. Hence, the estimation technique of Ni et al. (2022) using the exponential GARCH (EGARCH) is followed. The GARCH models are argued to be more efficient in showing the volatility clustering than the ARCH models. Yet, while the GARCH models have the advantage of taking past values into account, they are symmetric, meaning that only the absolute value of the shock matters with no consideration of the sign of the shock. However, the effect of a negative shock on NRV may be greater than the effect of a positive shock of the same magnitude. The threshold GARCH (TGARCH) takes this asymmetry into consideration and can differentiate between the effects of negative and positive shocks. Nevertheless, TGARCH models have the potential to obtain a negative variance. Thus, the exponential GARCH (EGARCH) model that ensures nonnegative variance and tackles all the previous limitation is the appropriate model to estimate volatility in natural resources rents (Ni et al., 2022).

Variance and standard deviation using ARCH, GARCH, TGARCH, and EGARCH specifications are estimated. Figures A4.1 to A4.8 (in Appendix: A4) show the volatility in natural resource rents using the variance and standard deviation from the four specifications for the countries in the sample over the considered years.

3.3. PCA

3.3.1. IG Index

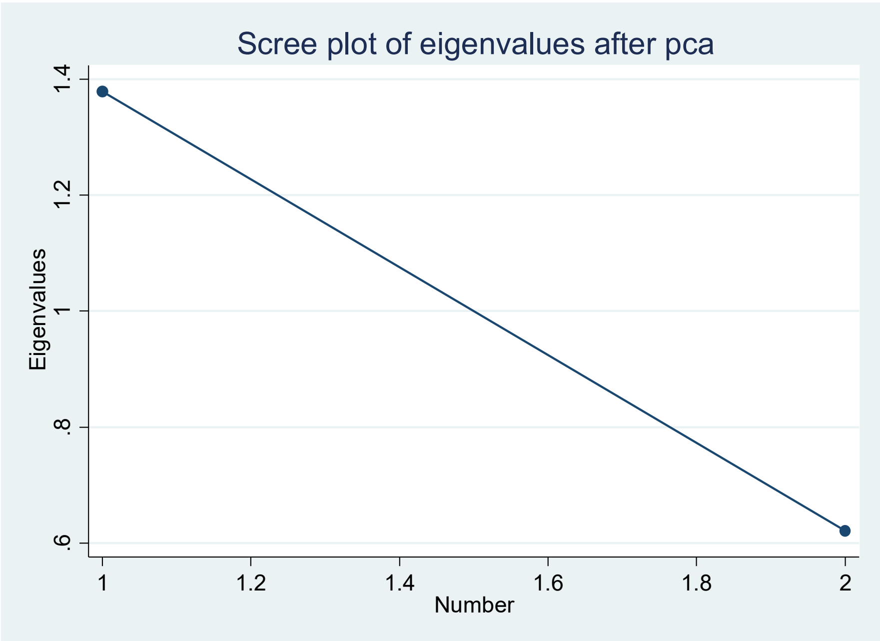
The IG index is constructed following Anand et al. (2013), which quantifies IG depending on income growth and distribution. Following Ofori and Asongu (2021) and Kouladoum (2023), GDP per capita is used as a proxy for income growth, and the Gini index is used for income distribution. IG is then calculated as a component score using the PCA. Before conducting the PCA, an adequate sample from the two indicators covariates, the correlations' strength between these covariates, and the partial and overall intercorrelations' strength between these indicators are tested (Bello et al., 2023). The correlation matrix and the Bartlett test with a p-value of 0.0000 (found in Appendix A2) show significant correlations supporting these indicators' selection. The Kaiser-Meyer-Olkin (KMO) statistics (found in Appendix: A2) is 0.5, which supports that the sample is adequate for computing a composite index for IG. In order to compose the index, the two indicators are standardized to have a mean of 0 and a standard deviation of 1. Table 1 provides components' differences, proportion, cumulative, and eigenvalues. Consistent with Kaiser's eigenvalue rule (Tchamyou, 2020), the index is constructed using only the first component as the eigenvalue of only the first component is larger than one. Figure 3 depicts the scree plot of the components of the IG index, which provides results consistent with Table 1. The first component explains 69 percent of the variation in the data.

Table 1. Principal components and Eigenvalues (IG)

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	1.379	0.758	0.690	0.690
Comp2	0.621		0.311	1.000

Variable	Comp1	Comp2	Unexplained
GINI	0.707	0.707	0
GDP	0.707	-0.707	0

Figure 3. Scree plot of principal components of IG index



Source: Generated by the authors using STATA.

3.3.2. Institutional Quality Index

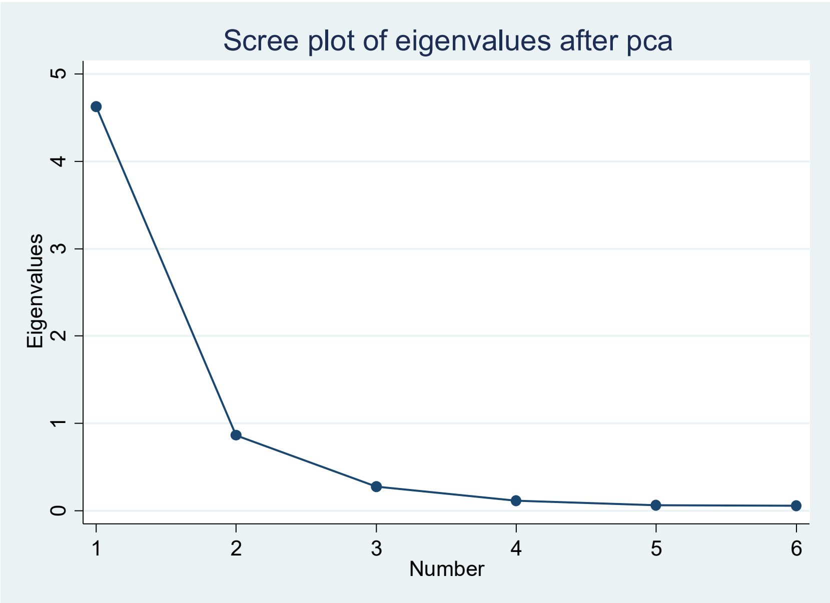
Following Bekana (2023), the IQ index is constructed using a PCA based on the six Worldwide Governance Indicators: Control of Corruption, Government Effectiveness, Political Stability and Absence of Violence, Regulatory Quality, Rule of Law, and Voice and Accountability. The correlation matrix and the Bartlett test with a p-value of 0.0000 (found in Appendix: A2) support the selection of these indicators, while the Kaiser-Meyer-Olkin (KMO) statistics (found in Appendix: A2) of 0.8907 support that the sample is adequate for computing a composite index for IG. As shown in Table 2, only the first component is larger than one, so the index is constructed using this component. Figure 4 provides the scree plot for the eigenvalues of the different components. The first component explains about 77 percent of the variation in the data.

Table 2. Principal components and Eigenvalues (IQ)

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	4.629	3.766	0.771	0.771
Comp2	0.863	0.589	0.144	0.915
Comp3	0.274	0.160	0.046	0.961
Comp4	0.114	0.053	0.019	0.980
Comp5	0.061	0.002	0.010	0.990
Comp6	0.059		0.010	1.000

Variable	Comp1	Comp2	Comp3	Comp4	Comp5	Comp6	Unexplained
CC	0.449	-0.114	-0.006	-0.384	0.154	-0.783	0
GE	0.445	-0.045	-0.267	-0.585	0.199	0.589	0
PS	0.402	-0.265	0.814	0.206	0.162	0.194	0
RQ	0.437	0.018	-0.457	0.670	0.389	-0.001	0
RL	0.452	-0.065	-0.113	0.136	-0.872	0.031	0
VA	0.209	0.954	0.213	-0.020	0.006	-0.010	0

Figure 4. Scree plot of principal components of IQ index



Source: Generated by the authors using STATA.

3.3 Model specification and estimation strategy

Our model takes the following specification:

$$IG_{it} = \alpha_0 + \alpha_1 NRV_{it} + \alpha_2 FD_{it} + \alpha_3 IQ_{it} + \alpha_4 INT_{it} + \alpha_5 TO_{it} + \alpha_6 VE + \varepsilon_{it} \qquad \text{(Eq.1)}$$

Where IG is inclusive growth, NRV is natural resources volatility, IQ is institutional Quality, FD is financial development, INT is Internet access, TO is trade openness, and VE is vulnerable employment.

To probe the moderating effects, we incorporate interaction terms between NRV, FD, and IQ (Eq. 2).

$$IG_{it} = \alpha_0 + \alpha_1 NRV_{it} + \alpha_2 FD_{it} + \alpha_3 IQ_{it} + \alpha_4 INT_{it} + \alpha_5 TO_{it} + \alpha_6 VE_{it} + \alpha_7 NVR * IQ + \alpha_8 NRV * FD + \varepsilon_{it} \quad \text{(Eq.2)}$$

In order to mitigate the common econometric issues related to the typical panel data estimation methods (Pooled OLS, Fixed Effects, and Random Effects), such as omitted variable bias, endogeneity, and heterogeneity, we utilize the GMM method. However, the typical difference GMM may suffer from a lack of precision and weak instruments in finite samples (Teixeira and Queirós, 2016). To mitigate this problem, we employ the standard two-step system GMM procedure. Weindmeijers' (2005) correction is also applied to resolve the downward bias in standard errors. We use the lag of IG as an endogenous variable. To test the validity of the instruments, the AR (2) test for serial correlation and the Hansen test for overidentification restriction are implemented (Teixeira and Queirós, 2016; Kouki, 2021). Hence, equations 1 and 2 take the following forms in level:

$$IG_{it} = \gamma_0 + \gamma_1 IG_{i(t-\tau)} + \gamma_2 NRV_{it} + \sum_{h=1}^{k} \lambda_h \boldsymbol{X}_{h,i(t-\tau)} + \varepsilon_{it} \quad \text{(Eq.3)}$$

$$IG_{it} = \gamma_0 + \gamma_1 IG_{i(t-\tau)} + \gamma_2 NRV_{it} + \gamma_3 FD + \gamma_4 IQ + \gamma_5 NVR * FD + \gamma_6 NRV * IQ + \sum_{h=1}^{k} \lambda_h \boldsymbol{X}_{h,i(t-\tau)} + \varepsilon_{it} \quad \text{(Eq.4)}$$

4. Empirical results and discussion

Table 3 displays descriptive statistics for all the variables, while Table A3 in the Appendix shows the correlation among the critical variables employed in the empirical investigation. As noted, the range of economic dependence on natural resources rents in our sample varies between 0.001 percent and 66.06 percent. Likewise, GDP per capita is primarily dispersed with a minimum value of USD 726.7 and a maximum value of USD 73,493.2. In addition, IQ is low in the region, given the negative mean values for all governance indicators. The correlation matrix shows that there is a significant positive correlation between TNR, NRV, IQ, FD, Internet usage, and trade openness on the one hand and IG on the other hand, while vulnerable employment shows a significant negative correlation with IG.

Table 3. Descriptive statistics

Variable	Observations	Mean	Std. Dev.	Min	Max
IG	348	0	1.174	-2.236	3.064
TNR	355	20.733	17.865	.001	66.06
NRV	360	3.29	4.27	0	56.4
FD	321	44.36	26.849	1.266	138.42
IQ	360	0	2.151	-4.709	3.942
INT	348	40.212	31.438	.487	100
TO	329	90.895	44.973	29.857	347.997
VE	360	22.105	17.685	.05	58.106
GINI	360	.617	.05	.488	.694
GDP per capita	348	14369.384	17075.163	726.739	73493.27
CC	360	-.347	.75	-1.798	1.559
GE	360	-.315	.759	-2.362	1.501
PS	360	-.654	1.074	-3.18	1.224
RQ	360	-.382	.805	-2.302	1.097
RL	360	-.352	.773	-2.096	.978
VA	360	-1.078	.466	-2.05	.304

In order to test our hypotheses, Table 4 uses the two-step system GMM to estimate Model 1 without interaction terms and Model 2 with interaction terms. As the table indicates, the test of second-order serial correlation AR(2) for both models is not rejected, which means there is no second-order serial correlation problem. In addition, the Hansen test for over-identification for both models does not reject the hypothesis of exogenous instruments. These results validate our models.

In Model 1, NRV is found to have a significant negative correlation with IG. This gives initial evidence that innovation in natural resource rents might be detrimental to IG in the region. FD is also found to have a significant negative impact on IG. This result is consistent with the strand of literature arguing that FD might decrease IG since people experiencing poverty cannot access these new financial opportunities, negatively affecting income distribution (Rumbogo et al., 2021; Demirgu et al., 2016; Levine, 2005). Similarly, vulnerable employment is found to decrease IG, which is consistent with the earlier argument that vulnerability is detrimental to the poor's income and thus widens the inequality gap. In addition, IQ is found to have a negative yet insignificant effect on IG, while trade openness and Internet access show no significant impact on IG.

However, when interaction terms are added in Model 2, NRV is found to have a significant positive correlation with IG, which validates our first hypothesis (H1) that there is a correlation between NRV and IG in the MENA region. Regarding the direction of this relationship, this result is consistent with the discussed strand in the literature that views natural resources as a blessing to the economy with a positive effect on economic growth (e.g., Nusair, 2015; Nasir et al., 2019; Arif et al., 2022). More specifically, our results are consistent with the recent results of Bakhsh and Zhang (2023), who find NRV to positively affect economic growth. The effect of FD on IG is also reversed to be positive. However, IQ still has a significant negative effect on IG.

Table 4. Impact of NRV on IG and the moderating effect of IQ and FD

Variables	**(1)** **IG**	**(2)** **IG**
$IG_{(t-1)}$	1.030***	1.063***
	(0.014)	(0.035)
NRV	-0.034**	0.039***
	(0.014)	(0.015)
FD	-0.001***	0.002*
	(0.000)	(0.001)
IQ	-0.013	-0.032*
	(0.009)	(0.019)
FD_NRV		-0.001***
		(0.000)
IQ_NRV		0.010**
		(0.005)
INT	-0.000	-0.000
	(0.000)	(0.000)
TO	-0.000	-0.000
	(0.000)	(0.000)
VE	-0.002**	0.001
	(0.001)	(0.001)
Constant	0.218***	-0.078
	(0.065)	(0.053)
Observations	273	273
Number of Countries	18	18
AR(2) p-value	0.208	0.477
Hansen p-value	0.542	0.826

*Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1*

Regarding the interaction terms, both are found to be significant, meaning that the positive effect of NRV on IG depends on the level of FD and IQ. The significantly positive interaction effect between NRV and IQ indicates that IQ intensifies the positive impact of NRV on IG. The higher the quality of institutions in the region, the more the variance in natural resources rents acts as a blessing for inclusiveness in the MENA region. This positive interaction term between NRV and IQ and the negative effect of IQ imply that as NRV increases, the detrimental effect of IQ on IG decreases. Since IQ has a negative effect and its interaction with NRV has a positive effect, the net effect of IQ on IG can be calculated as follows:

Net effect (IQ)= $\gamma_4 + (\gamma_6 * \overline{NRV})$

Where γ_4 is the unconditional (direct) impact of IQ, γ_6 is the conditional (indirect) impact of IQ, and $\overline{NRV}$ is the mean value of NRV. The net effect of IQ on IG is calculated to be [-0.032 + (0.010*3.29)]= 0.0009. This positive net effect of IQ implies that economies with robust institutions experience more IG after a specific critical value of innovation in natural resource rents. The threshold at which higher IQ stops having a negative impact and starts positively influencing innovation in natural resource rents is found by taking the absolute value of the ratio between the unconditional and conditional effects of IQ, as follows:

Threshold (NRV)= $\left|\frac{\gamma_4}{\gamma_6}\right|$

This threshold is calculated to be 3.2, which is well within the sample range. Below this threshold, the direct negative effect of IQ outweighs the positive indirect effect, therefore the net effect of IQ is negative, which means that IQ is detrimental to IG below this threshold. At this threshold of 3.2, this negative effect is nullified. However, beyond this volatility threshold, the positive indirect effect outweighs the negative direct effect, and so the net harmful impact of IQ is reversed and IQ has a net positive effect on IG.

Additionally, the interaction term between NRV and FD is negative. With a positive effect of NRV, this negative interaction term indicates that the higher the FD, the less the positive effect of NRV on IG. Likewise, with a positive direct effect of FD and a negative interaction term between NRV and FD, NRV is detrimental to the positive relationship between FD and IG. The higher the NRV, the lower the positive effect of FD on IG. These results support the minor literature on crowding out between the effects of NRV and FD. This could be explained (as mentioned earlier) by the argument that the higher the natural resource abundance, dependence, and volatility, the less the pace of FD. This is due to production factors being diverted away from manufacturing and private sectors that represent the largest demanders of financial services (Yuxiang and Chen, 2011). Thus, at high levels of (positive) natural resource rent volatility, the dependence on FD to increase growth and reduce poverty is low since production factors are devoted more to exploiting natural resources. However, as (positive) natural resource rent volatility decreases, there becomes a rising dependence on FD to increase growth and equality and enhance IG. Similarly, as the level of FD increases, the reliance on natural resources decreases since individuals have access to other financial services that can increase their well-being. In other words, at low levels of FD, the dependence on positive innovations in natural resource rents to increase growth and reduce poverty is high. However, as FD increases, this dependence on the positive shocks in natural resource rents decreases as more resources are devoted to the private sector and more financial opportunities are provided to the poor, which enhances IG. These results indicate that volatility in natural resource rents and FD can be considered substitutes with regard to enhancing IG in the MENA region. The higher the level of one of them, the lower the positive effect of the other on IG. Since NRV and FD have positive coefficients and their interaction term is negative, the net effect of FD could be calculated as follows:

Net effect (FD)= $\gamma_3 + (\gamma_5 \, * \, \overline{NRV})$

The net effect of FD on IG is found to be negative and equals to [0.002+ (-0.001*3.29)]=-0.00129. The threshold of volatility in natural resource rents beyond which increasing FD has a negative net impact on IG is calculated by taking the absolute value of the ratio of the unconditional and conditional effects of FD as follows:

Threshold (NRV)= $\left|\frac{\gamma_3}{\gamma_5}\right|$

This threshold is calculated to be 2, which is well within the sample range. Below this threshold, the positive direct effect of FD outweighs the negative indirect effect. At this critical mass, this positive effect is neutralized. After this threshold, the negative indirect effect outweighs the positive direct effect, and the net effect of FD on IG becomes negative.

This implies that for FD to be an IG enhancer with a net positive effect, innovation in natural resource rent should be below 2 Standard deviation (SD).

In addition, the net effect of natural resource rent volatility could be calculated as follows:

Net effect (NRV)= $\gamma_2 + (\gamma_5 * \overline{FD})$

The net effect of NRV on IG is found to be positive as well and equals [0.039+ (-0.001*44.36)]=-0.00536. These results indicate that FD has a threshold effect on the nexus between NRV and IG. The threshold of FD beyond which increasing NRV has a negative impact on IG is calculated by taking the absolute value of the ratio of the unconditional and conditional effects of natural resource rents share as follows:

Threshold (FD)= $\left|\frac{\gamma_2}{\gamma_5}\right|$

This threshold is calculated to be 39 percent, which is well within the sample range. Below this critical value, the positive direct effect of natural resource rent volatility on IG outweighs the negative indirect effect. Reaching the critical value of 39 percent nullifies this positive effect. However, when the FD level goes beyond this threshold, the negative indirect effect outweighs the positive direct effect of NRV and the net effect on IG becomes negative. This threshold indicates that FD should be below 39 percent for natural resource rent volatility to have a positive net effect and enhance IG.

These results on the net effects and thresholds of FD and NRV mean that when NRV and FD are simultaneously below their thresholds of 2 SD and 39 percent, respectively, there will be a positive net effect for both FD and NRV on IG. However, when NRV and FD are simultaneously above their thresholds, there will be a negative net effect for both FD and NRV on IG. Yet, when FD is below (above) 39 percent and NRV is above (below) 2, there will be opposing net effects for FD and NRV on IG. This indicates that when FD and NRV are simultaneously either below or above their calculated critical values, they enhance each other's effects (whether positive or negative), which means that they are complements in their net effects on IG in these cases. When one of them surpasses its critical value and the other is below its own threshold, this is the only time their net effects conflict and they become substitutes in their net effects on IG.

Based on the calculations and discussion above, it can be concluded that when natural resource rent volatility is below 2, IQ has a negative net effect and is detrimental to IG while increasing FD (until FD reaches the threshold of 39 percent) has a net positive effect and enhances IG. For natural resource rent volatility between 2 and 3.2, increasing both IQ and FD has a negative net effect and decreases IG. However, when natural resource rent volatility exceeds 3.2, FD has a net negative effect and decreases IG, whereas IQ has a net positive effect and increases IG.

Since some studies (e.g., Wen et al., 2022; Khan, 2022) employ the share of natural resource rents as a measure of volatility, the previous models are estimated using total natural resource rents as a robustness check. Models 3 and 4 in Table 5 show the estimates that are (to a great extent) consistent with the estimates of Models 1 and 2. In addition, as GDP per capita is employed in literature as the absolute indicator of IG (Ofori et al., 2023b), Model 5 in Table 5 provides the results when GDP per capita is used and the results are highly consistent with the previously discussed results of Model 2.

Table 5. Impact of TNR on IG and the moderating effect of IQ and FD

VARIABLES	(3) IG	(4) IG	(5) Ln GDP per capita
$IG_{(t-1)}$	1.062***	0.726***	
	(0.029)	(0.101)	
TNR	-0.010***	0.080***	0.014***
	(0.004)	(0.024)	(0.004)
FD	-0.003***	0.034***	0.004***
	(0.001)	(0.009)	(0.001)
IQ	-0.045**	-0.272**	0.003
	(0.022)	(0.116)	(0.018)
FD_TNR		-0.001***	-0.000***
		(0.000)	(0.000)
IQ_TNR		0.016***	0.002**
		(0.005)	(0.001)
Int	-0.001	0.006**	0.001***
	(0.001)	(0.003)	(0.001)
TO	-0.000	0.002**	0.000*
	(0.000)	(0.001)	(0.000)
VE	-0.007**	0.016	0.001
	(0.003)	(0.010)	(0.002)
Ln GDP per $capita_{(t-1)}$			0.853***
			(0.030)
Constant	0.576***	-3.047***	0.885***
	(0.206)	(0.878)	(0.198)
Observations	273	273	273
Number of Countries	18	18	18
AR(2) p-value	0.851	0.608	0.562
Hansen p-value	0.735	0.697	0.363

*Standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1.*

5. Concluding Remarks and Policy Propositions

This study investigates the link between NRV and IG while exploring the potential moderating effects of FD and IQ in the MENA region. Two hypotheses are proposed: the first posits that NRV influences IG; however, due to inconclusive results regarding the volatility-economic growth relationship, the specific direction of this influence cannot be determined priorly. The second hypothesis proposes that FD and IQ moderate the relationship between NRV and IG by enhancing (mitigating) the positive (negative) impact of volatility on growth.

Using a sample of 18 countries from the MENA region between 2002 and 2021 and employing a two-step system GMM approach, our findings validate the first hypothesis that NRV has a positive impact on IG, lending support to the argument that any shock in natural resources is a blessing for the region. Furthermore, the results reveal a direct positive effect of FD and a negative effect of IQ on IG. Concerning the interaction between variables, a positive interaction between volatility and IQ is observed, suggesting that improving IQ can amplify the positive influence of NRV on IG. Conversely, a negative interaction between volatility and FD is found, indicating that FD (NRV) weakens the positive effect of volatility (FD) on IG.

When overall effects are calculated, IQ is found to have net positive effect on IG while FD is found to have a net negative effect on IG in the MENA region. Based on the calculated net effects and thresholds, the following findings are reported. When natural resource rent volatility is below 2, IQ has a negative net effect and is detrimental to IG while increasing FD (till a threshold of 39 percent) has a net positive effect and enhances IG. For natural resource rent volatility between 2 and 3.2, increasing both IQ and FD has a negative net effect on IG. However, when natural resource rent volatility exceeds 3.2, FD has a net negative effect and decreases IG, whereas IQ has a net positive effect and increases IG. These thresholds are policy-relevant since they are within the range of our sample disclosed in summary statistics. Countries experiencing NRV lower than 2 are suggested to increase their FD up to 39 percent to enjoy the net positive effect of FD on IG, while countries with natural resource rent volatility exceeding 3.2 are advised to focus more on improving their IQ to attain the net positive effect of IQ on IG.

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Appendix
A1. Variables and Data Sources

Table A1. Variables and data sources

Variable	Abbreviation	Definition	Source	Position
Inclusive Growth	IG	Integrating income growth and distribution in a unified manner using the absolute definition (i.e., GDP per capita) and relative definition (Gini index) of inclusive growth.	Computed by the authors using PCA	Dependent
Gini Index		A measure of inequality ranging from one (perfect equality) to 100 (one person controls all the resources in the economy).	WID	Indicator in PCA of IG
GDP per Capita		GDP per capita is gross domestic product divided by population.	WDI	Indicator in PCA of IG
Total Natural Resource Rents	TNR	The sum of oil, natural gas, coal (hard and soft), mineral rents, and forest rents equals total natural resource rents and measured as a percentage of GDP.	WDI	Used to estimate NRV
Natural Resource Volatility	NRV	Conditional standard deviation of TNR.	Computed by the authors using EGARCH	Independent
Institutional Quality	IQ	PCA of six World Governance Indicators.	WGI	Moderator
Rule of Law	RL	A measure of public perceptions of the quality of contract enforcement, property rights, police, and courts, as well as the likelihood of crime and violence in society.	WGI	Indicator in PCA of IQ
Control of Corruption	CC	A measure of public perceptions about whether public authority is exercised for private gain as well as "captured" by elites and private interests of the state.	WGI	Indicator in PCA of IQ
Government Effectiveness	GE	A measure of perceptions about the effectiveness of government growth policies.	WGI	Indicator in PCA of IQ
Regulatory Quality	RG	A measure of public perceptions of the government's ability to develop and implement sound policies and regulations.	WGI	Indicator in PCA of IQ
Political Stability	PS	A measure of perceptions of political instability, violence, including terrorism.	WGI	Indicator in PCA of IQ
Voice and Accountability	VA	A measure of citizen perceptions in government selection, expression, association, and free media.	WGI	Indicator in PCA of IQ
Financial Development	FD	Domestic credit to private sector (% of GDP).	WDI	Moderator
Trade Openness	TO	Exports plus imports (% of GDP).	WDI	Control
Vulnerable Employment	VE	Contributing family workers and own-account workers as a percentage of total employment.	WDI	Control
Internet Access	INT	Internet users (% of population).	WDI	Control

**Note: WDI is World Development Indicators, WGI is World Governance Indicators, and WID is World Inequality Database.*

A2. Principal Component Analysis (PCA)

A2.1. Correlation Matrix for IG Index Indicators and Bartlett Test

Variables	(1)	(2)	Bartlett Test
(1) Equality index	1.000		
(2) GDP per capita	0.379***	1.000	
Chi (X^2) statistic			53.567***
Chi (X^2) p-value			0.0000

*** *p<0.01, *** *p<0.05, * *p<0.1.*

A2.2. Kaiser-Meyer-Olkin Measure of Sampling Adequacy for IG Indicators

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Kaiser-Meyer-Olkin measure of sampling adequacy
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Variable	kmo
gini	0.5000
GDP	0.5000
Overall	0.5000

A2.3. Correlation Matrix for IQ Index Indicators and Bartlett Test

Variables	(1)	(2)	(3)	(4)	(5)	(6)	Bartlett Test
(1) cc	1.000						
(2) ge	0.931***	1.000					
(3) ps	0.845***	0.775***	1.000				
(4) rq	0.881***	0.892***	0.727***	1.000			
(5) rl	0.930***	0.923***	0.826***	0.915***	1.000		
(6) VA	0.341***	0.378***	0.218***	0.408***	0.376***	1.000	
Chi (X^2) Statistic							2745.410
Chi (X^2) p-Value							0.000

*** *p<0.01, *** *p<0.05, * *p<0.1.*

A2.4. Kaiser-Meyer-Olkin Measure of Sampling Adequacy for IQ Indicators

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Kaiser-Meyer-Olkin measure of sampling adequacy
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Variable	kmo
cc	0.8750
ge	0.8987
ps	0.8885
rq	0.9050
rl	0.8805
va	0.9317
Overall	0.8907

A3. Correlation Matrix

Table A3. Correlation Matrix

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) IG	1.000							
(2) TNR	0.292	1.000						
	(0.000)							
(3) NRV	0.181	0.376	1.000					
	(0.001)	(0.000)						
(4) FD	0.308	-0.342	-0.193	1.000				
	(0.000)	(0.000)	(0.001)					
(5) IQ	0.533	-0.016	-0.094	0.633	1.000			
	(0.000)	(0.768)	(0.074)	(0.000)				
(6) INT	0.352	-0.124	-0.077	0.653	0.448	1.000		
	(0.000)	(0.021)	(0.154)	(0.000)	(0.000)			
(7) TO	0.235	-0.035	-0.004	0.168	0.360	0.202	1.000	
	(0.000)	(0.521)	(0.942)	(0.004)	(0.000)	(0.000)		
(8) VE	-0.568	-0.388	-0.116	-0.424	-0.689	-0.470	-0.238	1.000
	(0.000)	(0.000)	(0.028)	(0.000)	(0.000)	(0.000)	(0.000)	

A4. NRV

Figure A4.1. Trends in NRV using ARCH Variances

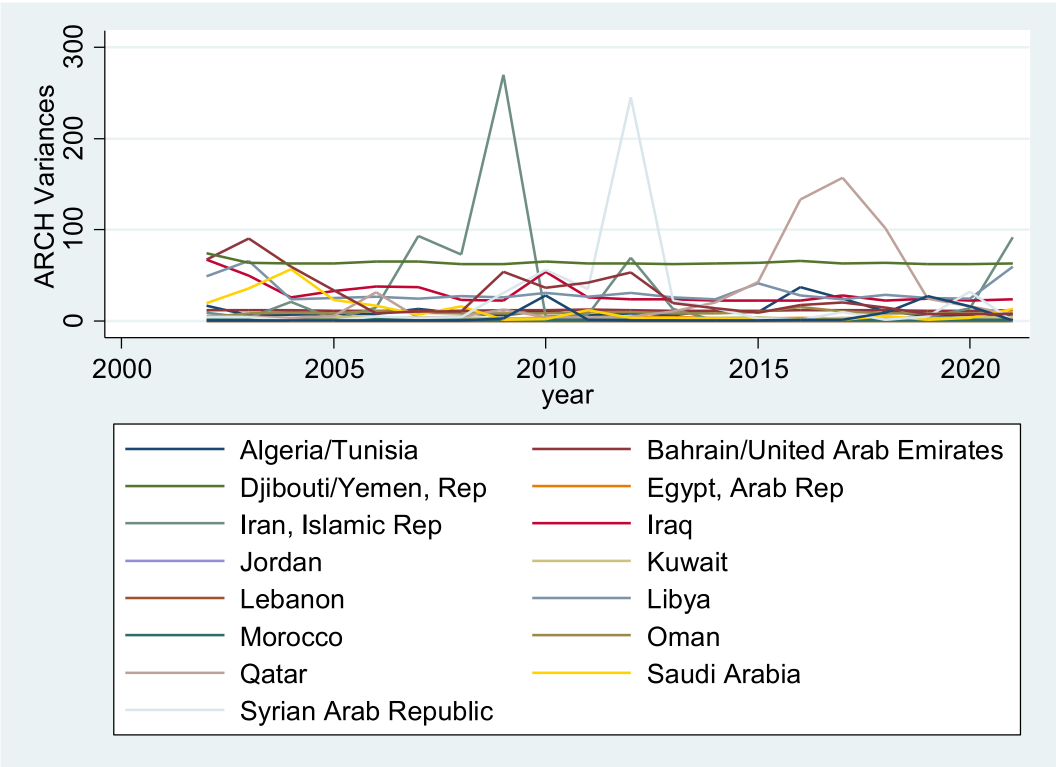

Figure A4.2. Trends in NRV using ARCH Standard Deviation

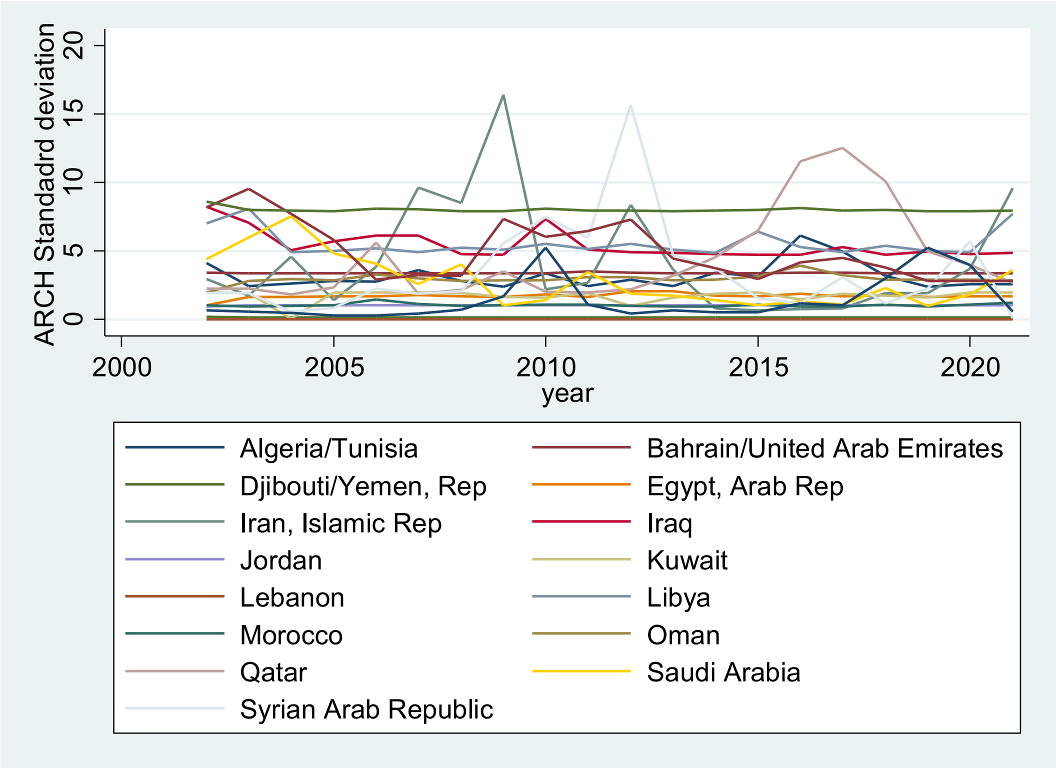

Figure A4.3. Trends in NRV using GARCH Variances

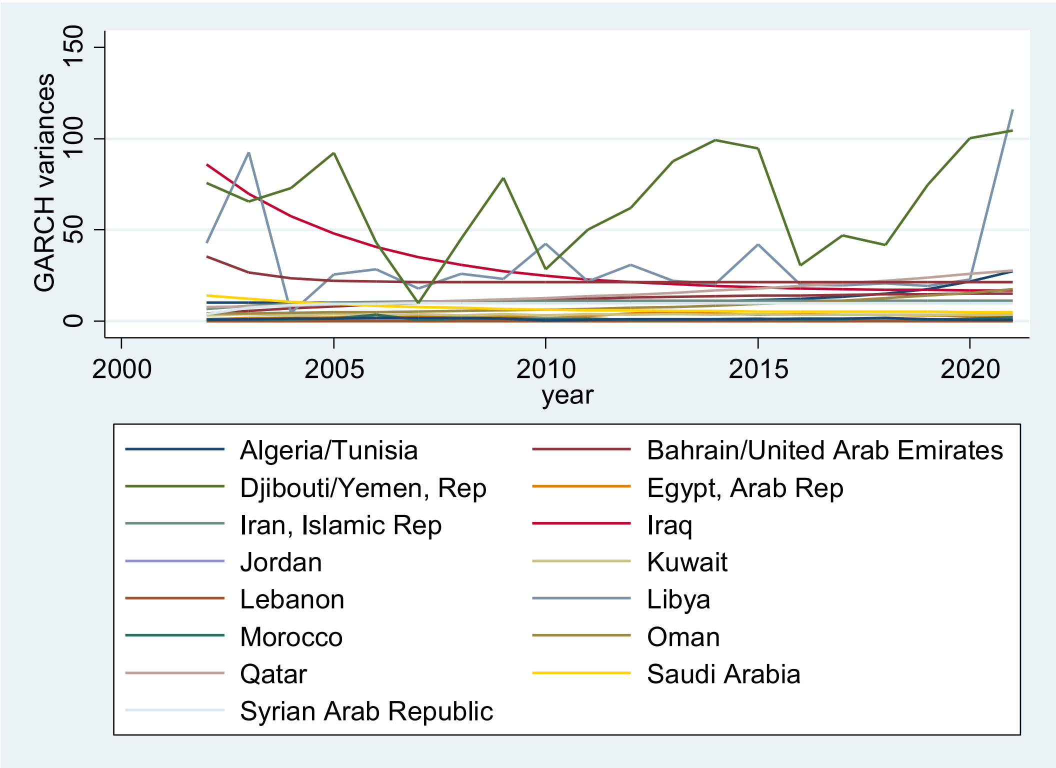

Figure A4.4. Trends in NRV using GARCH Standard Deviation

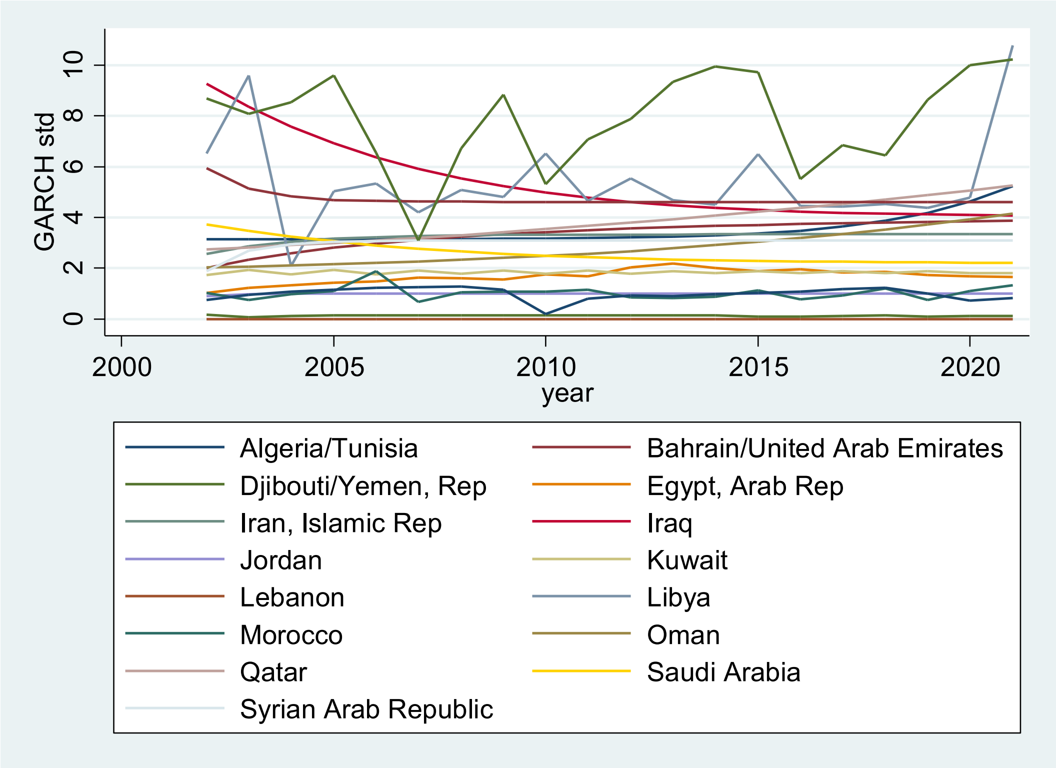

Figure A4.5. Trends in NRV using TGARCH Variances

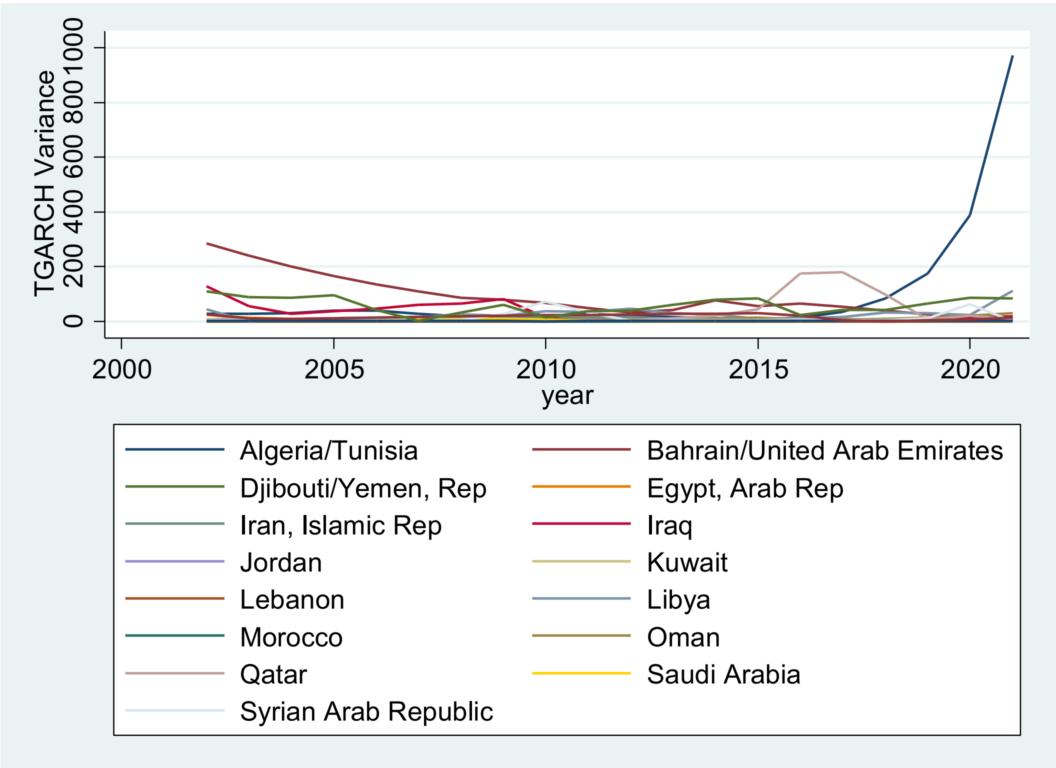

Figure A4.6. Trends in NRV using TGARCH Standard Deviation

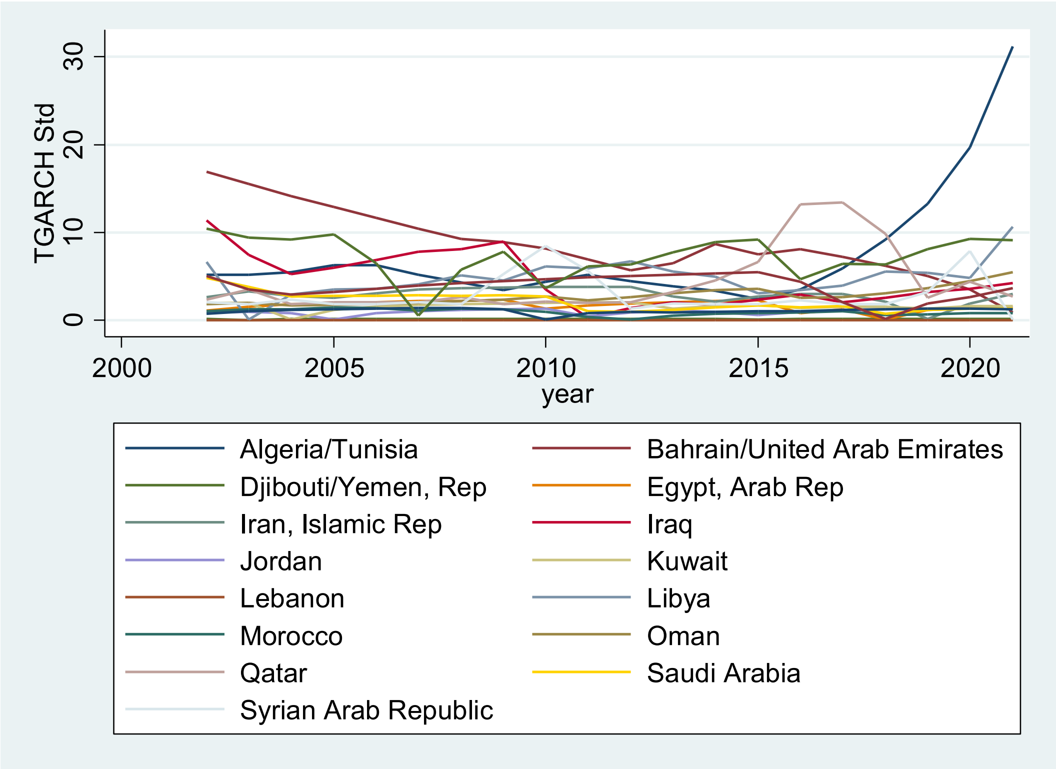

Figure A4.7. Trends in NRV using EGARCH Variances

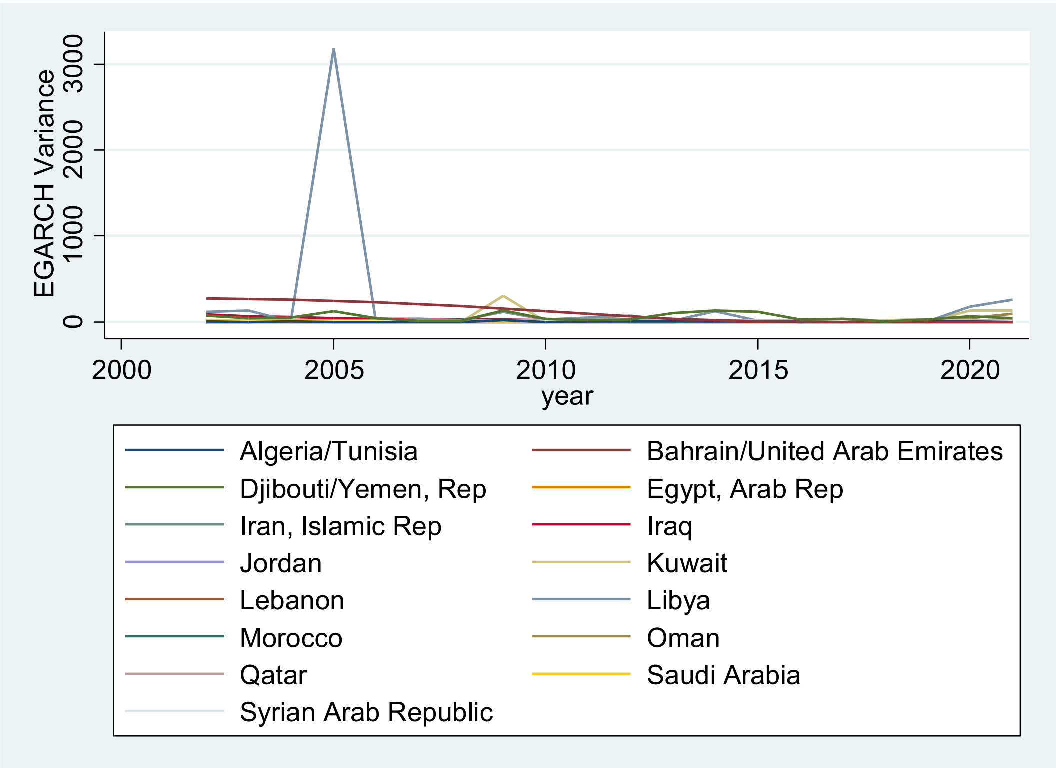

Figure A4.8. Trends in NRV using EGARCH Standard Deviation