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Oil rents and non-oil economic growth in CIS oil exporters. The role of financial development

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ABSTRACT

The role of financial development is vital in long-run economic growth. Due to the windfall revenues it might have extra relevance in natural resource-rich developing economies. This study explores whether financial development, measured in the percentage share of the bank loans to the private sector in GDP, can facilitate the impact of oil rents on the development of the non-oil sector in Commonwealth of Independent States oil exporters: Azerbaijan, Kazakhstan, and Russia in the long run. It develops a combined framework where financial development acts as both a threshold variable and an interaction term for the impact of oil rents on non-oil GDP. We find a threshold effect of oil rents for the non-oil sector in Azerbaijan and Kazakhstan. It shows that the same magnitude of oil rents can create more non-oil growth if financial development exceeds 9.6% and 15.5% in Azerbaijan and Kazakhstan, respectively. For Russia, neither threshold nor interaction effects were found – oil rents have a linearly positive impact on non-oil economic development. Moreover, we find that institutional quality fosters non-oil development in Azerbaijan. It also positively affects non-oil development in Kazakhstan and Russia, albeit statistically insignificant. In the design of policies, authorities may wish to implement measures that would lead to the further development of the financial sector and institutional quality to make oil rents more beneficial for the development of the non-oil sector.

1. Introduction

The abundance of natural resources like oil, minerals, and natural gas are critical components influencing the economic development of a country (Auty, 2001; Su et al., 2020). The resource-rich economies exhibit different characteristics in that a large portion of economic activity is suppressed by resource extraction. Many theoretical and empirical studies have concluded that natural resources, including oil, harm the long-run economic development of resource-rich economies. In this respect, oil is a curse for these economies (Auty, 1993; Sachs and Warner, 1997). However, another stream of studies shows that the oil sector and its revenues support the long-run economic growth in these economies, where oil is considered a blessing (Aragon and Rud, 2013; Esfahani et al., 2013, 2014; Allcott and Keniston, 2018).

We have two motivating factors in conducting this research. First, recent studies have shown that the impact of oil revenues/rents on long-term economic growth is conditioned on other factors of development, such as institutions, human capital, foreign direct investment, and innovation (e.g., see Hussain et al., 2021; Dou et al., 2022; Belaid et al., 2021). Although ample literature shows the vital role of financial intermediary development (FD) in economic development, a limited number of studies have focused on how FD moderates the effect of oil rents (OR) on the long-term growth in oil-exporting economies. We are unaware of any such research for the Commonwealth of Independent States (CIS) oil exporters. Second, to capture the non-linear effect of OR on economic growth through FD, the existing studies have used either the interaction method (e.g., Jarrett et al., 2019; Law and Moradbeigi, 2017; Mohammed et al., 2020; Nili and Rastad, 2007) or the threshold

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method (Erdoğan et al., 2020; Sun and Cai, 2020 inter alia). However, we are unaware of any OR-economic growth study that combines these two non-linear effects. The combined approach has econometric and policy-related merits, as we discussed below. Given the backdrop above, this paper aims to investigate whether FD can facilitate the impact of OR on the long-run development of the non-oil sector in Azerbaijan, Kazakhstan, and Russia, considering FD as both a threshold variable (regime swither) and an interactive term (moderator) variable.

We conducted a long-run analysis using a combined approach and considered the stochastic properties of our data, such as integration-cointegration in the extended framework of the production function. For Azerbaijan and Kazakhstan, we find a threshold effect of OR for the non-oil GDP, where FD acts as a threshold variable (regime switcher). It indicates that the same magnitude of OR can lead to more non-oil economic development if FD, measured in the percentage GDP share of the bank loans to the private sector, exceeds 9.6% and 15.5% in Azerbaijan and Kazakhstan, respectively. For Russia, OR has a linear positive impact on non-oil economic development - neither threshold nor interaction effects are supported by the data. Moreover, we estimated that the quality of institutions promotes the long-run growth of the non-oil sector in Azerbaijan. It does so in Kazakhstan and Russia, too, albeit statistically insignificant.

The contribution of the paper to the literature is threefold. *First*, we are unaware of any study that considers FD as both a threshold variable (regime swither) and an interactive term (moderator) variable for the impact of OR on non-oil sector development. As mentioned above, the existing studies consider either the interaction or threshold effect. These two effects are non-linear. However, they are conceptually different in nature: the interaction effect indicates that the impact of OR on growth varies (increases or decreases) over time with the values of FD, while the threshold method shows that this impact makes a quantitative/qualitative shift as it is regime dependent, but stays constant in each regime. The motivation behind using a combined approach is that the non-linear effect of OR on economic growth might not be fully captured by either interaction or threshold terms when used separately. If only say the interaction term is considered, it will also contain the threshold effect and thus lead to biased estimates if there is also a threshold effect and we ignore it. Therefore, since we never know the data-generating process for the economic growth effects of OR, we need to consider both terms together to rule out distorted estimation results, incorrect conclusions, and, thus, misleading policy recommendations. This combined framework has been employed in the studies listed in Section 6, and many of them are devoted to economic growth. In addition to growth studies, such a combined framework is also used by studies in other domains: Liu and Gu (2020) in environmental economics, Wu and Hsu (2012) in income inequality, Zhang et al. (2020) in microeconomics, Berry et al. (2012) in political sciences, Schwartz et al. (1995) in medicine, Martin et al. (2015) in physics. To this end, we consider a combined framework in our analysis. The combined framework can also be useful to the policy decision-making process by avoiding misleading policy recommendations that can come from distortionary estimation results. Given that such a framework provides comprehensive information content than what can be extracted from the threshold model or interaction term model if they are considered separately. *Second*, to our knowledge, no study investigates the proposed issue either in the OR-economic growth literature or for the CIS oil exporters of Azerbaijan, Kazakhstan, and Russia in particular. These countries influence the global oil market as OPEC+ (Organization of the Petroleum Exporting Countries) members. In addition, the significance of these countries has increased due to the recent conflict between Ukraine and Russia, sanctions directed against Russia, and the growing energy demand following the COVID-19 pandemic. Moreover, these three countries are important to the Silk Road, which would boost trade and other socio-economic relations between the East and West. Furthermore, given the shared Soviet Union legacy of these countries, which were under a centrally planned economy, they are juvenile in terms of a free-market system. They are also in the early stage of development as they declared independence at the beginning of the 1990s. Accordingly, they possess distinctive characteristics from other oil-abundant countries. We believe that specific political and economic systems formed in these countries and relatively new financial systems with unique problems will enable us to look at the nexus between natural resources, financial development, and economic growth from a different perspective. *Third*, the most recent study, that is, Mohammed et al. (2020), analyzing the role of FD in the impact of OR on economic growth for a panel of oil exporters, including Azerbaijan, Kazakhstan, and Russia, ended in 2015. We believe it is essential to incorporate data from recent years that contain volatile oil price environment and COVID-19 into the analysis of non-oil growth effects of OR.

The following section presents a literature review. Section 3 introduces the theoretical background, while Section 4 provides an overview of the focus countries. Section 5 describes the data. The econometric methodology and estimation strategy of the study are given in Section 6. Section 7 reports the results of the empirical analysis, and Section 8 discusses them. Section 9 concludes the study with some policy insights.

2. Literature review

Given the aim of this paper, we first review the studies examining the impact of FD on economic growth, the so-called finance-growth nexus. Then, we survey the studies investigating the (non-oil) growth effects of the (oil) natural resource sector. Finally, our review considers the studies dedicated to natural resources, FD, and economic growth nexus.

2.1. Finance-growth nexus

The investigation of the finance-growth nexus traces back to Schumpeter (1934), in which savings mobilization, project evaluation, risk management, and monitoring services provided by financial intermediaries are described as critical for economic development. Much later, MacKinnon (1973) and Shaw (1973) point to the significance of FD, suggesting that government control over the finance industry hampered economic growth; accordingly, both support the liberalization of interest rates to accelerate growth.

King and Levine (1993) signal the significance of the finance sector by considering its role in triggering technological innovation by allocating resources to projects with high success probabilities. The finance industry accumulates the savings of individuals and creates a better utilization of savings for more profitable industries, and enhances economic growth. The views of King and Levine explain the reasons for triggering economic growth: with the pooling of the funds, the cost of productivity-increasing projects declines. Another view suggests that the liquidity shocks inherent in financial markets direct the investors to long-term investments since these projects are less inclined to be affected by liquidity shocks. To diversify their investments from liquidity shocks, investors prefer investing in long-term projects that also enhance industries promoting economic growth (Obstfeld, 1994). Beck et al. (2000) empirically show the role of FD in economic growth and its sources, such as Total Factor Productivity (TFP) and physical capital accumulation, in their cross-country analysis.

Four hypotheses have been proposed regarding the direction of the relationship between finance and growth: supply-leading, demand-following, feedback, and no relationship. However, no consensus has been reached regarding the nature of this relationship.

Schumpeter (1934) is one of the earliest supporters of the supply-leading hypothesis that FD promotes economic growth as a determinant of growth. Financial intermediaries offer services that enhance technological innovation, serving as a growth engine. MacKinnon (1973) and Shaw (1973) point to the importance of financial system liberalization, which will lead to competition in the finance industry and boost economic growth. Many empirical papers empirically support the supply-leading hypothesis and recognize the capital accumulation role of FD that will steer more investment and economic growth. Lower FD is one of the biggest challenges for developing countries, as it may obstruct economic growth triggered by technology transfers (Menyah et al., 2014). The role of FD on economic growth is investigated in various contexts, and many papers note the long-run impact of finance on growth (Jedidia et al., 2014; Peia and Roszbach, 2015; Samargandi et al., 2014; Nguyen et al., 2019; Afonso and Blanco-Arana, 2022). For Sub-Saharan African countries, credit supply augments economic growth only in lower-income countries (An et al., 2021; Taiwo, 2021). The outcomes of the quantile regression of Tariq et al. (2020) reveal a U-shaped relationship between the FD index and economic growth, where FD refers to an index provided by the IMF that captures the access, depth, and efficiency of financial institutions and financial markets. Finance adversely impacts growth below a certain level of the FD index; however, this impact is reversed when the FD exceeds the threshold level. When the financial institutions' access, depth, and efficiency are low, this is reflected by decreasing economic growth.

Another view suggests that FD follows economic growth, denoted as the demand-following hypothesis (Robinson, 1952). As a country's economy grows, the needed financial services will increase, and the financial institutions and services in that context will progress. Thus, this view suggests that the level of economic development impacts FD. Ono (2017) investigates Russia's finance-growth nexus, contemplating oil prices and foreign exchange rates. The 1999–2008 results favor demand following hypothesis, whereas this relationship fades in the 2009–2014 period because of massive interventions in the foreign exchange market. Song et al. (2021) provide global evidence by examining 142 countries and supporting the demand-following hypothesis. They further stress the necessity of boosting economic growth to enhance FD in developing countries. Cojocaru et al. (2016) investigate the CEE and CIS countries and consider many financial development indicators. They suggest that market efficiency and competition in the finance industry in these countries are the primary triggers of economic growth.

The third view indicates that the impact of FD on economic growth is bidirectional; thus, a feedback relationship exists. Financial sector development is a consequence of economic growth, which feeds back to economic growth as a growth determinant (Patrick, 1966). Recent empirical evidence also suggests the validity of this hypothesis. Chow et al. (2019) investigated 14 developing countries. They note that supply-leading and demand-following hypotheses are valid, implying a feedback relationship, except for Pakistan, where no connection is detected. Asafo-Adjei et al. (2021) reports similar findings in the context of BRICS countries by adopting bivariate, partial, and wavelet multiple correlations techniques. Calderón and Liu (2003) validate the feedback hypothesis in 109 developing and industrialized countries. The results of bootstrap ARDL, coupled with the Granger causality test of Wu et al. (2020), confirm both the supply-leading and demand-following hypotheses (feedback relationship) for Japan and India but a positive causality running from FD to economic growth. Ehigiamusoe (2021) suggests a bidirectional relationship in the case of African economies.

The last view suggests no causal relationship between FD and economic growth. This view notably fails to show a significant role of finance in economic growth (Lucas, 1998; Stern, 1989). Chang's (2002) estimations in Mainland China reveal no relationship between FD and economic growth, rejecting supply-leading and demand-following hypotheses.

2.2. Natural resources and economic growth nexus

Classical growth theories overlooked the role of natural resources in economic growth. Energy resources were treated as they facilitated economic growth through their productivity enhancements in production and industrial development (Balassa, 1980). The impact of natural resources endowment was ignored. It was noted that the resources would enhance necessary change in underdeveloped countries by creating new markets and investment opportunities, especially for post-war periods (Rostow, 1960). However, many papers suggesting the availability of resources may not necessarily contribute to economic growth challenge this idea; instead, they can be detrimental to the economy.

The "resource-curse hypothesis" states that abundant natural resources, especially energy-related resources, hinder these countries' economic development (Auty, 1993). The availability of energy sources directs policies away from industrial progress, promotes rent-seeking activities, and obstructs growth. The abundance of natural resources leads countries to resource-dependent industries that bring about declines in economic development (Satti et al., 2014).

Several factors constitute the underlying reasons for negative economic growth, such as Dutch disease (Sachs and Warner, 1997), corruption (Sachs and Andrew, 1997; Roberts, 2015), misallocation of oil revenues (Watts, 2004), lack of adequate education services (Gylfason, 2001) and non-democratic governance structures (Collier and Hoeffler, 2000). The Dutch disease takes its name after the collapse of Dutch manufacturing following the natural gas discovery. Thus, this phenomenon is an immediate antecedent of the resource curse that links the abundance of natural resources to declines in productive industries (Sachs and Warner, 2001). Several mechanisms ground the decrease in growth following a natural resource discovery. Dutch disease represents the pressure on growth through the exchange rate mechanism. The real exchange rate keeps up through commodity exports, which causes non-resource exports to become uncompetitive, leading to a shrinkage in productive industries (Beck, 2011). Resource-rich countries majorly witness forming a power group that inhibits the establishment of democracy, where the residents can speak up for equal income distribution (Jensen and Wantchekon, 2004). The wealth accumulated from natural resources creates conflict and corruption, followed by pressures on institutional quality (Eregha and Mesagan, 2016). The availability of natural resources can impede institutional quality through civil wars and institutional conflicts that can further destabilize the state (Zallé, 2019).

There is a vast amount of literature addressing the resource curse hypothesis. Mehrara (2009) examines oil-exporting countries considering the possible existence of threshold effects, and the results reveal that 18–19 percent growth of oil revenues significantly diminishes growth. The paper further points to the necessity to consider threshold effects while investigating this relationship.

Kim and Lin (2017) investigate 40 developing countries and document that countries with abundant natural resources grow slower than those lacking. They further explore the various factors like differences in the degree of government intervention, legal structures, degree of globalization, and corruption that potentially explains the existing heterogeneity in the impact of resource abundance on development. This study also suggests the significance of considering the resources-growth relationship at different thresholds. Apergis and Payne (2014) scrutinize some MENA countries' oil abundance and economic growth. The results support the resource curse hypothesis for 1990–2003, which contradicts 2003–2013. This changing pattern is attributed to the improvements in institutional quality and economic reforms. Finally, Badeeb et al. (2017b) favor the resource-curse hypothesis considering a thorough literature survey focusing on the significant determinants of growth in developing countries. They conclude that the papers contradicting the resource-curse hypothesis discuss the necessity of adopting better econometric approaches given the possible heterogeneity in the data. They highlight the need to adopt advanced methodologies and techniques to investigate this complicated relationship.

James (2015) opposes the resource-curse hypothesis by presenting the significance of considering industry compositions and notes that sector-specific growth rates are not strongly correlated with resource dependence and claims this relationship to be a statistical mirage.

The literature also notes a positive effect of resources on economic growth called the "resource-blessing hypothesis" (Aragon and Rud, 2013; Allcott and Keniston, 2018). Van der Ploeg (2011) explains that exchange rate appreciation, loss of learning by doing, inferior quality of institutions, authoritative government structures, corruption, genuine negative savings, promotion of rent-seeking, and poorly structured policies are the mechanisms through which the abundance of resources impacts the economic growth negatively. Van der Ploeg further explains the ability of the country to overcome these mechanisms that convert resources into a curse that can be altered into blessings. Esfahani et al. (2014) develop a growth theory for the oil-exporting economies in which the oil sector positively impacts economic development. They then empirically validate their theory in the case of six OPEC countries. Erum and Hussain (2019) report evidence of positive growth effects of the natural resources in 43 member countries of the Organization of Islamic Corporation. Arin and Braunfels (2018) contradict the resource curse hypothesis and note the positive effects of OR on medium and long-term economic growth in 91 countries. They further add that the positive impact of OR depends on the quality of institutions. Moshiri and Hayati (2017) verify the resource-blessing hypothesis using various measures of natural resources in 149 countries and conclude there are threshold levels for the quality of institutions above which the resource curse turns into a blessing. Aimer (2018) estimated positive oil rent elasticity of GDP growth in nine oil-exporting economies, including Russia. Smith (2015) assesses that significant resource discoveries caused positive short- and long-run effects on GDP and its per capita in 16 oil-exporting countries. At the same time, Esfahani et al. (2014) estimate a positive impact of oil income on the output of six major oil-exporting economies, namely Iran, Kuwait, Libya, Nigeria, Saudi Arabia, and Venezuela, which are pretty similar to Russia in their economic nature. Also, particularly for Russia, Yang et al. (2021) conclude that OR is a blessing as it positively impacts GDP. Alexeev and Chernyavskiy (2014) find a positive impact of resource taxes on GDP in Russia, although the magnitudes of the effects are quite small. Libman (2013) also estimated a positive impact of resource revenues on regional economic growth in Russia. Similarly, Korkmaz (2022) estimates that OR positively affects GDP.

2.3. Natural resources, FD, and economic growth nexus

Some early literature presents the mechanisms through which natural resources impact FD in resource-rich countries. As Beck (2011) explains, on the demand side, the windfall gains from natural resources and the resultant growth in the non-traded goods industry may increase the demand for financial services. However, the need for financial services might be suppressed more from the natural resource industry than the non-traded goods industry, causing a Dutch disease case. Moreover, if resource-rich countries are associated with lower savings rates, it will cause lower demand for financial services and lower FD. On the supply side of this channel, the investments directed to the natural resource sector will withdraw the sources from the financial institutions. The revenues from resources can be used to smooth consumption, which hinders the reasons to provide an efficient financial sector that will smooth expenditures over the business cycles (Gylfason, 2006).

Some recent papers extend the resources-growth nexus by considering the impact of other factors such as institutionalization, corruption, and FD. Several articles view the natural resource-economic growth relationship with the development of the finance industry. Also, some investigate the impact of FD on the economic growth of countries with natural resource abundance.

Papers focusing on the impact of the finance industry in the resource-abundance-growth relationship report different outcomes. Ali et al. (2022) evaluate the natural resource rents on FD by proxying the banking development index, stock market development index, and FD index for Malaysia and report the triggering impact of natural resource revenues on economic growth through increased institutional quality channeled by the revenues from banks and stock markets. Shahbaz et al. (2018) assess the impact of natural resource abundance in FD in the USA, reflecting education, economic growth, and market capitalization as factors impacting FD. The outcomes of causality analysis provide evidence of a feedback relationship between natural resources and FD. Kurronen (2015) studies 128 countries, and the banking industry is found to be smaller in resource-dependent countries. Moreover, a finance sector designed to serve the needs of the resource sector hampers economic diversification and strengthens the resource curse. Yıldırım et al. (2020) note the positive effects of oil revenues on FD in the long term.

Several other recent papers note a bidirectional relationship between various measures of FD, natural resource revenues, and growth in multiple contexts, such as in a global sample (Canh and Thong, 2020), for a group of developed countries (Dogan et al., 2020), for Turkey (Faisal et al., 2019), in OECD countries (Zaidi et al., 2019) in Russia (Rustamov and Adaoglu, 2018).

Khan et al. (2020a) assess FD and natural resource rents focusing on the moderating effect of institutional quality in Pakistan using symmetric, asymmetric, and threshold effects. The results suggest that natural resource rents positively contribute to FD over a certain institutional quality level. The institutional quality level then becomes a determinant of the finance-growth relationship. Khan et al. (2020b) further investigate natural resource rent and FD nexus in 87 emerging and developing economies and suggest a negative impact of resource rents on the finance industry. However, after contemplating the threshold impacts of institutional quality, the resource curse becomes a blessing for FD. Similarly, Jiang et al. (2021) examine this nexus in China, suggesting that accumulated resource revenues facilitate economic growth by developing the financial sector.

Quixina and Almeida (2014) investigate the oil-growth relationship considering FD as a growth determinant in their model. Their results suggest that FD has a limited but positive contribution to the natural resource-growth nexus in Angola to stimulate economic growth. Badeeb and Lean (2017) investigate the impact of natural resource dependence and FD on the sectoral value added in Yemen and report that FD does not promote real sector growth when the natural resource dependence level is controlled. Satti et al. (2014) examine Venezuela by adding FD in an augmented production function and note a long-run cointegrating relationship between variables. They further point out that FD reverses the negative impacts of natural resources on economic growth. Nawaz et al. (2019) contemplate the role of natural resources in the finance-growth nexus by adopting bootstrap ARDL and validated natural blessings in Pakistan and a long-run cointegration between FD, and natural resources, capital, labor, and economic growth.

Rustamov and Adaoglu (2018) apply the Toda and Yamamoto Granger causality test to scrutinize the effects of fossil energy sources, the production cost of oil, and FD on economic growth in Russia. Oil prices and production costs adversely affect economic growth, whereas natural gas prices and FD have a favorable and significant impact on development. OR in Malaysia have direct and positive effects on the level of investment, and investment quality diminishes the negative impacts of OR on economic growth (Badeeb et al., 2016). Rongwei and Xiaoying (2020) note that FD eases the resource curse by impacting economic fluctuations, human capital accumulation, technological innovation, and investment efficiency.

Some studies consider varying degrees of FD in this finance-growth-resource relationship. Law and Moradbeigi (2017) focused on a sample of 63 oil-producing countries by applying a common correlated effect mean group estimator approach. Their results display that oil abundance impacts economic growth depending on the degree of FD. Mohammed et al. (2020) examine how financial markets influence the government and the private sector's effects of oil revenue management on economic growth in 83 oil-producing countries from 1990 to 2015. They observe that the positive impact of total government investment on growth increases as banking sector development improves. In contrast, the magnitude of the negative effect of private sector investment on growth increases as the level of banking sector development improves.

Investigating the literature on this nexus makes it possible to see some papers adopting the threshold methodology. Erdoğan et al. (2020) explain that natural resources impact economic growth when the financial deepening is less than 45%. In contrast, this relationship is positive and significant over this level in Next-11 countries. Sun and Cai (2020) explore the existence of the "resource curse" and "financial threshold effect" in China. They apply linear regression and non-dynamic panel threshold models using data from 30 provinces and find that the resource curse appears at the lower levels of FD. While in the regions with higher levels of FD, the resource endowment contributes to economic growth. Kose et al. (2011) explore the relationship between growth and financial integration and threshold variables (domestic financial market development and institutional quality) using: (i) high/low, (ii) linear, and (iii) quadratic interactions.

Overall, the papers investigating this nexus report inconclusive results regarding the relationship's significance and impact. Moreover, it can be concluded that examining this multifaceted nexus should involve both threshold and interactive terms to capture the multi-dimensional effects and, thus, provide robust results.

3. Theoretical framework

In this section, we discuss the theoretical framework that makes a basis for our empirical analysis. In the Solow growth model, a simple Cobb-Douglas type production function is used to explain the long-run economic development. The model provides a modest and straightforward explanation for the long-term growth of output. Thus, the standard Cobb-Douglas production function is our basic specification (Mankiw et al., 1992):

$$Y\ (t) = A(t)K\ (t)^{\alpha}\ L(t)^{\beta} \tag{I}$$

where capital stock (K), labor (L), and technological progress or TFP (A) are the main determinants of domestic production (Y), while α and β represent capital and labor shares, respectively.

The standard output framework, such as (I), would not be sufficient to represent long-run economic growth in resource (say oil) rich economies. Therefore, modifications of this framework have been suggested in the literature, which includes resource (oil) sector-related indicators. For example, Esfahani et al. (2013, 2014) developed a theoretical framework for oil-exporting economies where oil revenues are included in the long-run output equation. They empirically test their developed theoretical framework and confirm that oil sector-related indicators are essential to consider in the long-run development of output in oil-exporting economies, especially in developing economies. Other studies also highlight the importance of resource sector-related indicators (say oil revenues) in the economic growth of resource-rich economies (see papers discussed in sub-section 2.2 above in addition to Apergis and Payne, 2014; Hamdi and Sbia, 2013; Mehrara, 2008). Thus, natural resources are considered among the major determinants of economic growth, in addition to capital, labor, and technological progress. Therefore, equation (I) for the oil-rich economies can be extended by including oil sector-related factors.

Another conventional determinant of long-term economic growth is FD, as we extensively discussed in section 2.1. There are possibilities for how equation (I) can be augmented to account for the proposed additional factors: FD and OR. For instance, Hansson and Henrekson (1994) assume that a catching-up factor and the relevant government spending measure determine the relative growth rate in TFP (A). Nawaz et al. (2019) use a similar approach to account for the effects of natural resources and FD. Krinichansky and Sergi (2019) also use a similar technique to confirm that FD influences economic growth through productivity in Russia. Esfahani et al. (2014) assume that oil income affects long-term output through capital accumulation and plays a role in technological catch-up with the rest of the world.

Thus, we can augment (I) with FD and OR. Following the above-mentioned studies, we assume that OR and FD influence the output through (A):

$$A(t) = \Omega\ OR(t)^{\gamma} FD(t)^{\delta} \tag{II}$$

Where Ω is a time-invariant part of A, that is, constant. If we substitute (II) in (I), we get the augmented form of the Cobb-Douglas production function:

$$Y\ (t) = \Omega\ OR(t)^{\gamma} FD(t)^{\delta} K\ (t)^{\alpha}\ L(t)^{\beta} \tag{III}$$

We can apply a natural logarithmic transformation (ln) and add an error term $[\varepsilon(t)]$ to (III) to get an econometrically estimable specification as follows:

$$ln[Y(t)] = \varphi + \gamma\ ln\ [OR\ (t)] + \delta\ ln\ [FD\ (t)] + \alpha\ ln\ [K\ (t)] + \beta\ ln\ [L\ (t)] + \varepsilon(t) \tag{IV}$$

Where $\varphi = \ln(\Omega)$.

Section 6 discusses our estimation strategy based on equation (IV) and adopts various econometrically testable specifications.

4. Oil-rich CIS countries: Azerbaijan, Kazakhstan, and Russia

This study focuses on the three natural resource-rich CIS economies: Azerbaijan, Kazakhstan, and Russia – countries that face complex challenges in transitioning to a market economy. These countries produce and export large quantities of oil (and other natural resources), which shapes their economic and political systems. They also share the same 70 years of Soviet history followed by the three decades of struggle to replace the inherited centrally planned system with a more efficient market economy. We believe that specific and unique political and economic systems formed in these countries and relatively new financial systems with unique problems will enable us to look at the nexus between natural resources, financial development, and economic growth from a different perspective.

Despite many initiated reforms and declared strategic targets, these countries still face many challenges in building an efficient, market-oriented financial system. High oil revenues promote a strong government, hide fault lines in the financial system and hinder the development of the non-oil sector. This, in turn, results in an underdeveloped financial system and weak financial institutions. Therefore, the financial system struggles to serve its primary purpose: establishing a credible and smooth link between the savers and borrowers and ultimately bringing investment to the non-oil sector, where it is most needed.

There are also many differences between these three countries. The first is heterogeneity in area, population size, and geopolitical location (Fig. 1). Russia is huge and has access to major sea routes, while Azerbaijan and Kazakhstan are landlocked. These countries also differ in terms of the scale of their economies and dependence on oil revenue (Fig. 2). The smallest among the others, Azerbaijan, is the most dependent one. OR made up 22% of GDP in 2020, and about 90% of total exports are oil and oil-related products (nearly half of the total output is produced in the oil sector). Russia and Kazakhstan are less dependent, though oil and other natural resources still play a vital role in the functioning of their economies.

The existence of oil and other natural resources increases the economic potential of these countries. However, natural resource endowment may also bring challenges associated with the volatility of global oil prices, uncertainty with natural resource reserves; the resource curse discussed earlier, political risks, inequality, etc. As we can see from Fig. 3, GDP per capita in all these three countries was stagnant after the collapse of the Soviet Union till 2000 and surged sharply, mainly driven by natural resource exports till 2010, and positive trends were not maintained. We observe drops in the levels afterward.

Graph A of Fig. 4 illustrates that total outputs in Russia, Kazakhstan, and Azerbaijan follow similar trends over different scales. Not

Fig. 1. Azerbaijan, Kazakhstan, and Russia.

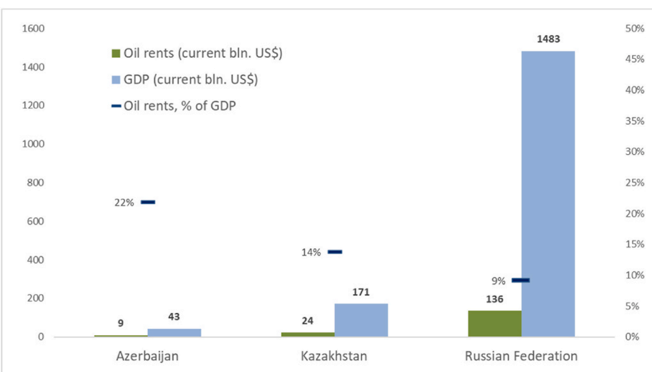

Fig. 2. GDP and OR, 2020
Source: World bank, world development indicators database.

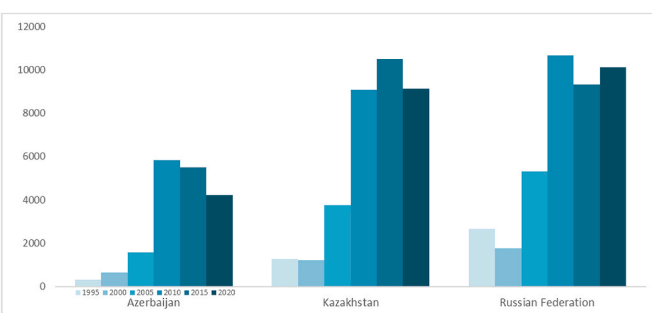

Fig. 3. GDP per capita, current US$
Source: World Bank, World Development Indicators Database.

surprisingly, the total natural resource rents as a percentage of GDP also follow similar paths as Graph B of Fig. 4 shows. This is because output mainly consists of natural resources with a significant share of oil.[1] A closer look reveals that output and total natural resource rents (and OR) move closely with global oil prices. The message is clear: all these three countries are exposed to external oil price shocks, and therefore international oil price and demand are the pivotal factors in these economies.

Given all the sources of uncertainty and risks these countries face, wise management of the economy is necessary. To transform windfall revenues into a sustainable and well-functioning non-oil sector, one needs to understand the existing working mechanism of the economy and how everything else relates to the natural resources these countries possess. In this study, we are trying to shed light on one of the levers of economic growth: FD. Specifically, we study the interactive role of FD and OR in economic development. FD, which is conventionally measured as the private credit to GDP ratio, has been quite volatile in these countries. At first glance, there is no clear visual relationship to oil revenues. Therefore, to uncover potential connections further, an in-deep investigation is required.

5. Data

This section introduces the data used in the empirical analysis. This research uses annual time series data. The start date of the data is 1992 for Azerbaijan and 1993 for Kazakhstan and Russia. Both start dates are dictated by the availability of domestic credit to the private sector by banks (% of GDP) variable from WDI (2021).[2] The end period of the data is 2020. We use the following variables in the empirical analysis.

Output (Y). This is the real non-oil sector output. Since the values of this variable for the entire period are not available, at least to us, for the countries considered, we calculated them.

For Azerbaijan, the real values for 2000–2020 were calculated using the real growth rates of non-oil GDP for the same period and its nominal million manat value in 2005. We considered 2005 a base year in which the nominal value is equal to the real value to be consistent with the base year of GDP. Then, for 2006–2020, we calculated each year's real value as the real growth rate of a given year multiplied by the calculated real value of non-oil GDP in the previous year. From 2004 to 1999, we calculated each year's real value as the calculated real value of non-oil GDP in the next year divided by the real growth rate of the following year. The real growth rates and nominal million manat value of non-oil GDP for 2000–2005 and 2005 were collected from the Central Bank statistical bulletins (https://www.cbar.az/page-40/statistical-bulletin). The real values of non-oil GDP for 1992–1999 were calculated as follows. The share of real non-oil GDP in real GDP was 52% in 1999. We assumed that this share was two percentage points higher each year from 1999 to 1993 based on our knowledge of Azerbaijan's economic structure and developments of the oil and non-oil sectors. Then we

[1] The share of OR in total natural resource rents was 86%, 79%, and 70% in Azerbaijan, Kazakhstan, and Russia respectively in 2019 (World Bank, World Development Indicators Database).

[2] One would not consider the years before 1992 because of a deep recession in the former Soviet countries including the ones we consider here caused by the collapse of the Soviet regime.

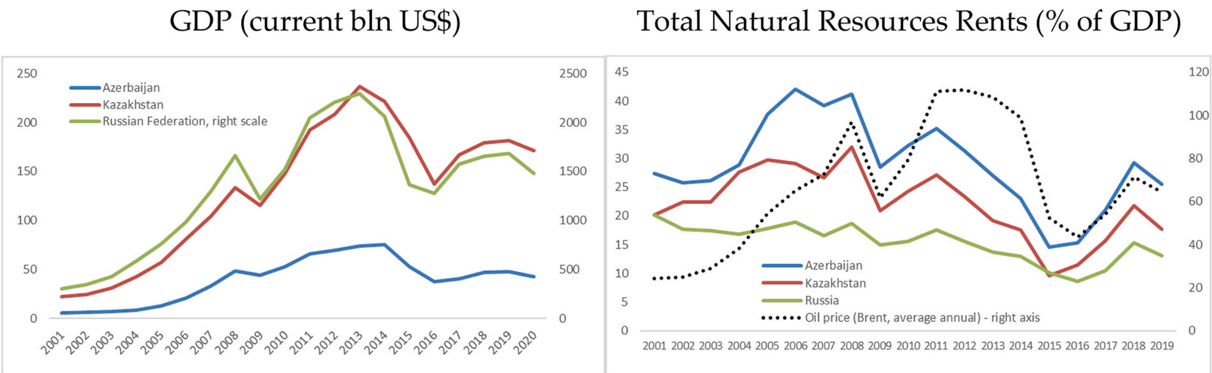

Fig. 4. Graph A. GDP (current bln US$). **Graph B.** Total Natural Resources Rents (% of GDP)
Source: World Bank, World Development Indicators Database.

multiplied real GDP values in millions of manat by these shares to obtain real values for non-oil GDP. Real GDP in 2005 manat was collected from WDI (2021).

For Kazakhstan, we could not retrieve either nominal or real non-oil GDP for 1993–2020 from domestic (e.g., the National Statistics Office or the Central Bank) or international (e.g., International Monetary Fund-IMF, World Bank-WB, United Nations-UN) databases.[3] Therefore, we calculated the Kazakh real non-oil sector output as follows. First, the OR percentage of GDP (OR) was multiplied by the nominal GDP in Tenge to get nominal values of it. Then obtained, nominal values were deflated by the GDP deflator with the base year of 2005 to get the real values of OR. Finally, these real values were subtracted from the values of the real GDP in 2005 Tenge to obtain real non-oil GDP in 2005 Tenge. The resulting real values were upscaled to a million.

For Russia, real non-oil GDP in billions of 2016 Ruble for 1993–2020 was taken from the Oxford Economics Global Economic Model database in the March 2021 release. The values were downscaled to millions to be consistent with other countries' non-oil GDP measures.

Labor (L). This is the labor force measured in millions of persons. For Azerbaijan, employment data in millions of persons are taken from the Penn World Tables (PWT, 2021),[4] while labor force data are collected from WDI (2021) for Kazakhstan and Russia and upscaled to million persons.

Capital (K). This is the real gross fixed capital formation (GFCF). For Azerbaijan, WDI does not report real values of the GFCF for the entire period of 1992–2020, but it does so for nominal values in manat (WDI, 2021). We took the nominal values and deflated them by the GDP deflator index, 2005 = 100, to get the real values. For Kazakhstan and Russia, WDI (2021) reports real values of GFCF with the base years of 2005 and 2016, respectively. For the former country, the data ended in 2019, and we calculated the value for 2020 by multiplying the real value of GFCF in 2019 by the GDP growth rate in 2020, i.e., −2.6%. For all three countries, the real data upscaled to million to be consistent with the scales of output and labor.

Oil rents (OR). This is the share of the oil rents in GDP in percentage. According to WDI, the oil rents are the value of crude oil production at regional prices minus the total costs of its production. For all three countries, we retrieved the data from WDI (2021) till 2019, and the value for 2020 was calculated using the growth rate of 2019.

Financial intermediary development (FD). This is the percentage share of the domestic credit to the private sector by banks in GDP. For Azerbaijan and Kazakhstan, the values of the variable are available from WDI (2021) from 1992 to 1993, respectively, and it ends in 2020. The values are available for Russia since 2001 from WDI (2021). The data for 1993–2000 are the values of the share of the domestic credit provided by the banking sector in GDP in percentage obtained from Oxford Economics Global Economic Model database, March 2021 release. Figs. 5–7 below illustrate evolvements in the above-discussed variables over time.

6. Econometric method and estimation strategy

Economic, energy, and environmental variables are mostly non-stationary over time. This necessitates performing unit root tests to check their stochastic properties. For this purpose, we use the Augmented Dickey-Fuller (ADF, Dickey and Fuller, 1979) unit root test augmented with the Fourier components by Enders and Lee (2012a, 2012b) to capture multiple smooth and, to some extent large structural breaks. Furuoka (2017) further enriched this framework with dummy variables to account for large/sharp structural breaks. We call it FADF-SB (Structural Break Fourier ADF with Structural Break) test. Appendix A describes the FADF-SB test and discusses its advantages over other unit root tests. Suppose variables under consideration appear non-stationary (mainly unit root processes) from the tests. In that case, we need to test whether they are cointegrated; that is, they establish a long-run relationship. If they are not cointegrated, the coefficients of the estimated level regressions can be spurious (see Granger and Newbold, 1974; Phillips, 1986 inter alia). To estimate the level relationship and test for cointegration, we use the Canonical Cointegrating Regression method and added variable test, both developed by Park (1992).[5]

6.1. Econometric method

Finding the most appropriate approach to answer the underlying

[3] FED has non-oil real GDP growth rates in constant prices for Kazakhstan sourced from IMF (https://fred.stlouisfed.org/series/KAZNGDPXORPCHPT), but it starts only in 1999. The other disadvantages of this data are that the values for 2015 and 2016 were not observed values and calculated by the IMF staff and it is not reported which year is the base year.

[4] Number of employed person data from the State Statistical Committee of Azerbaijan are almost the same as employment data from PWT (2021).

[5] *n* non-stationary variables can establish a maximum of *n-1* long-run relationships. This can be checked using a system-based cointegration test, such as the Johansen reduced rank method (see, Johansen, 1988; Juselius, 2006). We rely on the growth theory and assume that the variables under consideration here can establish only one long-run relationship. To this end, we do not use system-based cointegration tests because they consume many degrees of freedom, but we do not have a sufficiently large number of observations against the number of variables (for the inefficiency of the Johansen method in small samples, see e.g., Cheung and Lai, 1993; Pesaran and Shin, 1999). Second, if the variables under consideration establish more than one long-run relationship, but a researcher assumes only one, this can lead to inefficient and even biased estimates for the short-run relationship (Ericsson and MacKinnon, 2002; Badinger, 2004; Johansen, 1988; Johansen and Juselius, 1990), but our interest in this research is the long-run relationship.

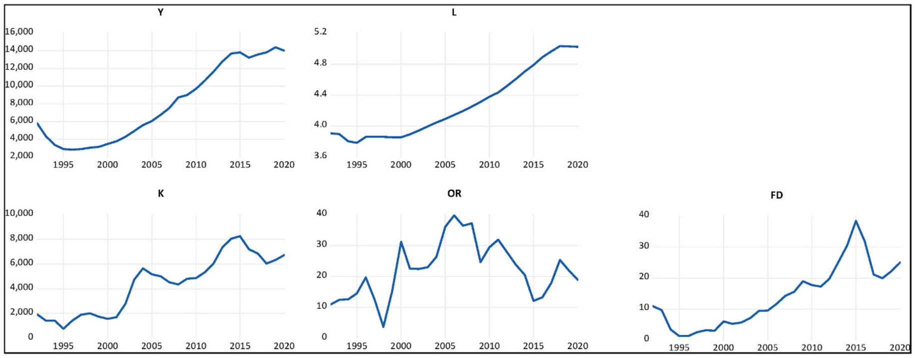

Fig. 5. Time trajectories of the Azerbaijani variables, 1992–2020.

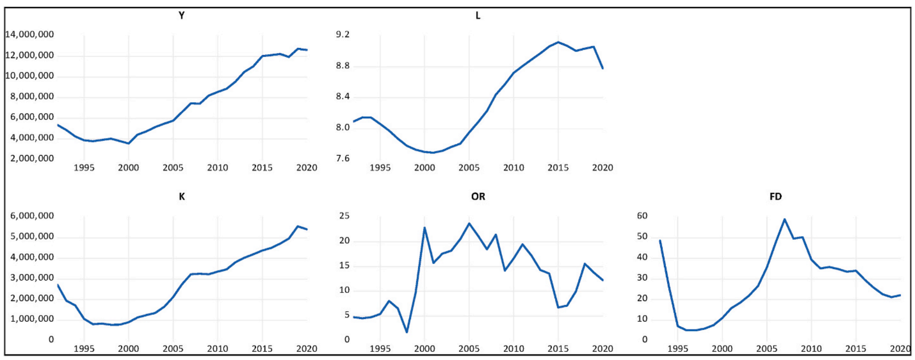

Fig. 6. Time trajectories of the Kazakhstani variables, 1993–2020.

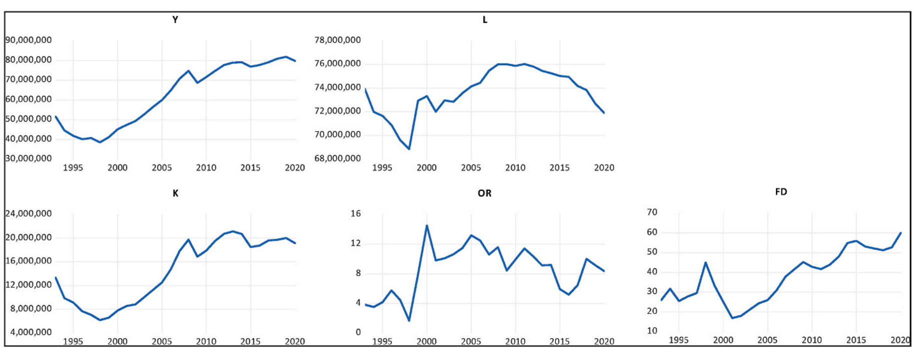

Fig. 7. Time trajectories of the Russian variables, 1993–2020.

research questions is challenging. This subsection explores the various relevant methods employed in the literature to answer the related questions considered. These methods range from simple interactions models to more complex combined frameworks of threshold-interaction effects.

The interaction method is the simplest and most popular tool that enables exploring the effect of one variable on an outcome that also depends on the evolvement of another variable (e.g., see Andersson et al., 2020 inter alia). Put differently, the impact of the regressor of interest on the dependent variable happens indirectly by means of the moderator role of another regressor (Baron and Kenny, 1986; Hayes, 2022). This method has been widely used to explore finance-growth and natural resources-growth nexuses discussed above. Financial markets can collect a portion of OR through savings from the government and individuals. Then the markets transform them into financial assets, such as stocks, bonds, mutual funds, and bank deposits, and allocate them to investment projects, through which OR indirectly impacts economic growth. In other words, this is the growth effect of OR moderated by financial indicators. For example, see the empirical analysis in Jarrett et al. (2019), Law and Moradbeigi (2017), Mohammed et al. (2020), and Nili and Rastad (2007).

The threshold methodology, i.e., splitting the sample into multiple parts to explore various relationships, is a widely used approach in the economic growth literature (e.g., see Aidt et al., 2008; Bose et al., 2008; Haque and Kneller, 2009; Kremer et al., 2013; Mohtadi and Ruediger, 2014). While the method is not relatively new, it recently became prevalent in various areas of science. Durlauf and Johnson (1995) used the regression tree method to divide countries into groups according to initial output and literacy rate. The threshold method was developed by Hansen (1996, 1999, 2000), Caner and Hansen (2001, 2004) after the pioneering work of Tong (1978, 1983). It was further developed by Gonzalo and Pitarakis (2006), Chen (2015), and Chudik et al. (2017), among others. Generally, OR are spent by the government to stimulate economic growth. This impact might not be the same if financial institutions are less or more developed. This brings up the consideration of the threshold or regime-dependent approach, in which the impact of OR on growth makes a quantitative/qualitative shift beyond a certain level of FD (see Erdoğan et al., 2020; Sun and Cai, 2020, among others).

A combined framework of interaction and threshold effects. The interaction effect and threshold effect are both non-linear. However, it is important to note that they are conceptually different in nature: the interaction method indicates that the impact of OR on growth varies (increases or decreases) over time with the values of FD. While the threshold method shows that this impact makes a quantitative/qualitative shift as it is regime dependent, but remains constant in each regime. The motivation behind using a combined approach is that the non-linear effect of OR on growth might not be fully captured with interaction or threshold methods when used separately. It can be seen from the context that the threshold effect is the individual, regime-dependent impact of OR on growth. In contrast, the interaction term effect is not the individual effect of OR. It is the indirect effect of OR on growth moderated by FD. Therefore, it is quite natural for these two effects to occur together.[6] If only one effect, say the interaction term, is considered, it will also contain the threshold effect and thus lead to biased estimates if there is also a threshold effect and we ignore/omit it. Since we never know the data-generating process for the growth effects of OR, we need to consider both effects together to rule out any biased estimation results and, thus, misleading policy recommendations. It is worth noting that a combined framework has been used by the studies listed below, many of which are devoted to economic growth. Liu and Gu (2020), Barnes and Duquette (2006), Alfada (2019), Borensztein et al. (1998), Wu and Hsu (2008, 2012), Jiang et al. (2011), Zhang et al. (2020), Suardi (2008), Yang and Chang (2008), Zhang et al. (2006), Girma (2005). In addition to the growth studies above, such a combined approach is also employed by studies in other fields: In addition to growth studies, such a combined framework is also used by studies in different domains: Liu and Gu (2020) in environmental economics, Wu and Hsu (2012) in income inequality, Zhang et al. (2020) in microeconomics, Berry et al. (2012) in political sciences, Schwartz et al. (1995) in medicine, Martin et al. (2015) in physics. To this end, we consider a combined framework in this present study.

6.2. Estimation strategy

This study examines whether FD plays a role (either as a threshold or interaction term or both) in the non-oil development effects of the oil sector. To this end, our primary interest variables are OR and FD. We also consider other conventional determinants of output in our analysis. Specifically, we include labor and capital in the empirical analysis as they are the fundamental determinants of output according to the production function theory (e.g., see Cobb and Douglas [1928]; Douglas [1976]; Arezki and Reda [2010]). We begin with a simple specification and proceed with more sophisticated models in the empirical analysis. That is, in the first step, we estimate just a Cobb-Douglas type production function for non-oil output as follows:

$$y_t = \alpha_0 + \alpha_1 \bullet l_t + \alpha_2 \bullet k_t + \varepsilon_t \quad (1)$$

Here, *y* is the natural logarithmic transformation of real non-oil output; *l* is the natural logarithmic transformation of labor; *k* is the natural logarithmic transformation of real gross fixed capital; ε is the error term; sub-script *t* indicates time. α_1 and α_2 are the elasticities of non-oil output with respect to labor and capital, respectively. Theoretically, both are expected to be positive.

(1) is the basic output equation and the most parsimonious one, as it includes only the key theoretically articulated determinants of output. It provides information about whether standard growth theory works for the non-oil sector of the countries under consideration.

In the second step, we extend (1) with the OR variable (transformed into the natural logarithm, *or*) to see whether it provides any additional explanatory power in explaining the behavior of non-oil output. This is because theoretical and empirical studies have found that the former plays an essential role in the latter's development (e.g., see Esfahani et al., 2014). Hence, we estimate the following specification:

$$y_t = \alpha_0 + \alpha_1 \bullet l_t + \alpha_2 \bullet k_t + \alpha_3 \bullet or_t + u_t \quad (2)$$

Where, *u* is the error term. **(2) is an oil-rich country-specific output equation**. One should expect α_3 to be positive under the standard macroeconomic framework, as an increase in the oil sector will spill over to the non-oil sector positively through channels such as fiscal spending and technological progress (e.g., see Esfahani et al., 2013, 2014). α_3 can also be negative according to the resource curse theory (e.g., see Sachs and Warner, 1995). In short, this theory articulates that the development of the natural resource sector can result in the contraction of the non-resource sector through mainly three channels: rent-seeking, real exchange rate appreciation, and transmission of the resource price volatility into the macroeconomic environment. We do not discuss resource blessing or resource curse theories here, but interested readers can refer to Sachs and Warner (1995), Ross (1999), Brunnschweiler and Bulte (2008), Esfahani et al. (2013, 2014), Badeeb et al. (2017b) inter alia.

In the third step, we extend equation (2) with both the threshold and interaction term effects of FD for *or*. Thus, (2) becomes:

$$y_t = \alpha_0 + \alpha_1 \bullet l_t + \alpha_2 \bullet k_t + \alpha_3 \bullet (FD_t < \tau) \bullet or_t + \alpha_4 \bullet (FD_t \geq \tau) \bullet or_t + \alpha_5 \bullet fd_t + \alpha_6 \bullet or_t \bullet fd_t + v_t \quad (3)$$

Where τ is the threshold level of *FD*. *fd* is the natural logarithmic transformation of FD. *v* is the error term. $\alpha_3 \bullet (FD_t < \tau) \bullet or_t + \alpha_4 \bullet (FD_t \geq \tau) \bullet or_t$ part represents the threshold relation while $\alpha_5 \bullet fd_t + \alpha_6 \bullet or_t \bullet fd_t$ part captures the interaction effect. It is a sophisticated specification that includes threshold and interaction term effects of FD for OR alongside FD, labor, and capital. **We call (3) an oil-rich country-specific output equation augmented with threshold and interaction term effects**. The studies using such a combined framework are listed in the previous subsection. With regard to including an interaction term and a threshold effect in one regression equation, like (3) above, various options have been considered in the literature. The following options are apparent:

(i) only selected, not all, regressors are allowed to shift their coefficients across regimes determined by threshold (see Liu and Gu, 2020; Barnes and Duquette, 2006).
(ii) all regressors are allowed to shift their coefficients across regimes determined by threshold (see Alfada, 2019; Borensztein et al., 1998; Wu and Hsu, 2012; Wu and Hsu, 2008; Zhang et al., 2020).
(iii) threshold variable is used in the interaction term too (see Liu and Gu, 2020; Alfada, 2019; Barnes and Duquette, 2006; Borensztein et al., 1998; Wu and Hsu, 2012; Wu and Hsu, 2008; Zhang et al., 2020).
(iv) threshold variable and the interaction term variable are included in the specification as individual regressors (see Liu and Gu, 2020; Alfada, 2019; Barnes and Duquette, 2006; Borensztein

[6] Borensztein et al. (1998) discuss that a statistically significant interaction term of Foreign Direct Investment (FDI) with secondary schooling may be a representation of non-linear effects that are important in explaining economic growth. Barnes and Duquette (2006) expresses that the theoretical literature argues about the existence of both (i) threshold effect in the relationship among inflation, financial market development and economic growth, and (ii) interaction effect between inflation and financial market development in their impact on economic growth. Osei and Kim (2020), among many other studies, highlight that the interaction term models take a priori assumption that the growth effect of FDI monotonically decreases/increases with FD, which is their limitation as FDI can also exert asymmetric effect such as regime dependent.

et al., 1998; Wu and Hsu, 2012; Wu and Hsu, 2008; Zhang et al., 2020).

(v) threshold variable and the interaction term variable are not included in the specification as individual regressors (see Wu and Hsu, 2012).

The framework we used in this research is the combination of options (i), (iii), and (iv). There are two reasons for us to consider such a combination. The main reason is that we are interested in whether only OR (not all regressors) switches its impact across regimes. Caner and Hansen (2001) state: "*Our model (1) specifies that all the slope coefficients switch between the regimes, but in some applications, it may be desirable for only a subset of the coefficients to depend on the regime. There is nothing essential in this choice, and other parameterizations may be used in other contexts*". In addition, Barnes and Duquette (2006) discuss that according to Hansen (1999), having the coefficients of some regressors not change across regimes does not change the distribution theory of the threshold models. Moreover, Chudik et al. (2017) note that various combinations of threshold effects with interaction terms can be entertained. Also, the literature discusses that the regressors that establish an interaction term should be individually included in the regression equation to ensure that the interaction term does not proxy the impacts of those regressors (e.g., see Alfaro et al., 2004). The other reason for allowing only OR to switch its coefficients across the regimes is that we do not have a sufficiently long sample span, unlike the studies we mentioned above, which used either panel or daily time series data. The point is that allowing all regressors to switch their impacts across the regimes means that the number of coefficients to be estimated will be doubled in the case of a single threshold.[7]

If the estimation of (3) does not provide theoretically and/or statistically reasonable results in the empirical analysis, then (3) can be reduced into (4) and (5) to estimate the threshold effect and the interaction term effect separately.[8]

$$y_t = \alpha_0 + \alpha_1 \bullet l_t + \alpha_2 \bullet k_t + \alpha_3 \bullet (FD_t < \tau) \bullet or_t + \alpha_4 \bullet (FD_t \geq \tau) \bullet or_t + w_t \tag{4}$$

$$y_t = \alpha_0 + \alpha_1 \bullet l_t + \alpha_2 \bullet k_t + \alpha_3 \bullet or_t + \alpha_4 \bullet fd_t + \alpha_5 \bullet or_t \bullet fd_t + \xi_t \tag{5}$$

Where w and ξ are the error terms, respectively. **(4) is an oil-rich country-specific output equation augmented with a threshold effect.** While **(5) is an oil-rich country-specific output equation augmented with interaction term effect.** One of the critical considerations in the threshold analysis is that it is not sufficient only look at the t-ratio values of the threshold-related coefficients, such as α_3 and α_4 in equations (3) and (4) to make inferences about statistical significance, that is, the validity of the threshold level considered and thus threshold effect obtained. In addition to these coefficients' individual statistical significance, the null hypothesis of their equality has to be tested (e.g., Enders and Siklos, 2001; Shin et al., 2014). Unfortunately, this point is largely ignored in many empirical studies.

7. Empirical results

First, we tested our variables for a unit root while accounting for possible multiple smooth structural breaks and a large/sharp structural break. We follow the Fourier Augmented Dickey-Fuller with Structural Break (FADF-SB) test procedures given in Appendix A. Table 1 documents the test results.

The key takeaway from Table 1 is that the log levels of the variables are non-stationary, and their growth rates are stationary. To be precise, for the log level of the variables, the null hypothesis of the unit root process (with or without structural breaks) cannot be rejected as the test sample values are smaller than the corresponding critical values in absolute terms (see Panel A).[9] Whereas, for their growth rates, the test sample values are greater than the corresponding critical values in absolute terms, mainly at the 1% and 5% significance levels leading to the rejection of the null in favor of the alternative hypothesis of stationarity with or without structural breaks (See Panel B).

Thus, the stochastic properties of the variables, especially those of the dependent variables, y_t s, make them convenient for the long-run (cointegration) analysis. Following our estimation strategy in the previous section, we estimated all five specifications, i.e., equations (1)–(5) in the empirical analysis. Estimating these five models provided a broader understanding of non-oil output evolvements in CIS's three oil-rich countries, considering linearity and non-linearities in the relationships. Also, it would enable us to assess the robustness of our estimations. The results of the econometric analysis for the countries are reported below.

7.1. Azerbaijan

Table 2 documents the estimation results for the Azerbaijani non-oil GDP through equations (1)–(5).

The comparison of the estimation results of equation (1) with equation (2) shows that the latter provides more information in a statistically significant way (see columns 2 and 3 in the table). Precisely speaking, in Azerbaijan, OR demonstrates a positive impact on non-oil GDP at the 10% significance level alongside statistically significant impacts of labor and capital. We further examined OR in equation (3) to see whether it can have both threshold effect and interaction with FD in its impact on non-oil GDP. The results reported in column 4 indicate that the combination of these two effects does not provide additional explanatory power in explaining non-oil GDP, as (i) the threshold-related coefficients are not statistically significantly different from zero, although 15.5% threshold level of FD yields the smallest sum of squared residuals among 20 potential threshold levels[10]; (ii) FD and its interaction with OR, both are not statistically significant. In addition, the capital elasticity of non-oil GDP is reduced by about three times in equation (3) compared to that of equations (1) and (2). Moreover, and more importantly, the cointegration test results show that this specification does not yield a cointegrating relationship among the variables as the estimated Chi-squared value of 12.5 from the Park's added variables test is greater than the critical value even at the 1% significance level.

[7] We have also allowed interaction term to change across the regimes, but this did not change the main results we found earlier (the estimation results can be obtained from the authors).

[8] What we mean by 'theoretically reasonable results' is that the impacts of labor and capital on output should be both positive and statistically significant from the estimations as articulated by the production function theory. Since the impact of oil rent and financial development (and their interaction) is theoretically inconclusive, that is, can be either positive or negative, we additionally introduce 'statistically reasonable results' term, which means that the mentioned variables should be statistically significant.

[9] Only for the log of labor, l_t in Kazakhstan, the null hypothesis of unit root can be strongly rejected in favor of the alternative hypothesis of trend stationary. The FADF-SB test result also suggests a trend stationarity of the Azerbaijani labor, but the statistical evidence is not as strong as that in Kazakhstan. To this end, we considered the first one as a trend-stationary process (and hence did not test the growth rate of it) while the second one was considered as a difference stationary variable (see Enders, 2015 inter alia for treating trend-stationary and difference-stationary variables). Having trend-stationary regressor included in our analysis is fine as the Canonical Cointegrating Regressions (CCR) method we use for the long-run analysis can accommodate integrated and trend-stationary and even stationary variables (see Park, 1992; Chang et al., 2014).

[10] In the search for the threshold level, Chan (1993) method was used, where the trimming level is set at 15%. This means that 15% of the beginning and 15% of the end observations of FD were ignored, which yields 19.6 (=28*0.7) observations, that is, potential threshold levels to consider.

Table 1
FADF-SB unit root test results.

Panel A: Level of the variables						Panel B: First Difference of the variables					
	t-value	k	f	DC	DSB		t-value	k	f	DC	DSB
Azerbaijan											
y_t	−3.046	1	SI	t	SI	$d(y_t)$	-3.193^{C}	1	SI	c	SI
or_t	−2.719	0	SI	c	SI	$d(or_t)$	-6.088^{A}	1	SI	c	SI
fd_t	−1.973	0	SI	c	1997	$d(fd_t)$	-5.728^{A}	1	SI	t	1997
l_t	-3.737^{B}	1	SI	t	1996	$d(l_t)$	-4.776^{B}	0	1	n	1996
k_t	−1.781	1	SI	t	1996	$d(k_t)$	-4.148^{B}	0	SI	c	1996
$or_t \bullet fd_t$	−2.197	0	SI	c	1997	$d(or_t \bullet fd_t)$	-6.371^{A}	1	SI	t	1997
Kazakhstan											
y_t	−2.478	0	SI	t	2001	$d(y_t)$	-4.450^{A}	0	SI	c	2001
or_t	−2.631	0	SI	c	SI	$d(or_t)$	-5.876^{A}	1	SI	c	SI
fd_t	−1.801	0	SI	t	1997	$d(fd_t)$	-4.231^{A}	1	SI	t	1997
l_t	-6.692^{A}	0	2	t	2000	$d(l_t)$	–	–	–	–	–
k_t	−3.439	0	SI	t	2000	$d(k_t)$	-4.235^{C}	0	1	t	SI
$or_t \bullet fd_t$	−2.967	0	SI	t	1999	$d(or_t \bullet fd_t)$	-4.380^{B}	1	SI	t	1999
Russia											
y_t	−3.946	0	1	t	SI	$d(y_t)$	-4.675^{B}	0	1	t	SI
or_t	−2.693	0	SI	c	SI	$d(or_t)$	-6.298^{A}	1	SI	c	SI
fd_t	−2.676	1	SI	t	SI	$d(fd_t)$	-4.061^{B}	0	SI	t	SI
l_t	−3.361	0	1	t	1999	$d(l_t)$	-8.064^{A}	1	SI	t	1999
k_t	−2.147	0	SI	t	1999	$d(k_t)$	-4.523^{B}	0	1	t	SI
$or_t \bullet fd_t$	−2.835	1	SI	c	1999	$d(or_t \bullet fd_t)$	-6.402^{A}	1	SI	c	1999

Note: *d* is the first difference operator; ***DC*** means deterministic term; ***t-value*** is the sample value of the t statistic from the test equation; ***k*** and ***f*** indicate the optimal lag order and the optimal particular frequency, respectively; c, t, n mean constant, or constant and time trend, or no constant and no trend are included in the test equation depending on the statistical significance of constant and time trend, respectively; ***DSB*** column presents dummy variables used in the test equations to capture structural breaks; SI shows that a used dummy variables or particular frequency to capture structural breaks were statistically insignificant in the final test equation. **Years** in the columns show the dates when breaks occur; Break dates (and thus dummies) are exogenously identified based on the information on the historical developments of the countries and the graphical illustration of the variables in Figs. 5–7. The maximum lag order is set at one, and the maximum particular frequency is set at two. Subscript A, B, and C denote rejection of the null hypothesis of the unit root at the 1%, 5%, and 10% significance levels, respectively; The critical tau values are from Table 3 of Furuoka (2017) in the case of T = 50, and corresponding ***k*** and λ. The test sample is 1993–2020 for Azerbaijan, and 1994–2020 for Kazakhstan and Russia.

Table 2
Estimation results for Azerbaijan.

	(1) Basic	(2) With OR	(3) Interaction & threshold	(4) Threshold	(5) Interaction
l_t	3.289*** (0.00)	3.657*** (0.00)	2.490*** (0.00)	2.857*** (0.00)	3.166*** (0.00)
k_t	0.408*** (0.00)	0.306*** (0.00)	0.115** (0.03)	0.302*** (0.00)	0.056 (0.30)
or_t	–	0.130* (0.09)	–	–	−0.134 (0.21)
$(FD_t < \tau) \bullet or_t$	–	–	0.006 (0.95)	0.081** (0.02)	–
$(FD_t \geq \tau) \bullet or_t$	–	–	0.064 (0.57)	0.172*** (0.00)	–
$or_t \bullet fd_t$	–	–	0.046 (0.35)	–	0.127*** (0.01)
fd_t	–	–	0.078 (0.53)	–	−0.107 (0.39)
α_0	0.680 (0.27)	0.602 (0.21)	3.65*** (0.00)	1.774*** (0.00)	3.506*** (0.00)
τ	–	–	15.53%	9.60%	–
χ^2_τ	–	–	10.62*** (0.00)	45.68*** (0.00)	–
χ^2	0.089 (0.77)	3.176* (0.07)	12.542*** (0.00)	0.133 (0.72)	5.419** (0.02)

Note: Dependent variable is y_t; χ^2 is the Chi-squared value from Park's *added variables test* for the null hypothesis of variables are cointegrated; χ^2_τ is the Chi-squared value from testing the null hypothesis of symmetric relationship, that is, no threshold effect, i.e., H_0: $\alpha_3 = \alpha_4$ in equations (3) and (4); *, **, *** denote statistical significance at the 10%, 5%, and 1% levels, respectively; Numbers in parentheses are the probability values. Estimation period: 1993–2020.

Thus, equation (3) estimation did not provide reasonable results. Conceptually, this might imply that the data generating process (DGP) for the relationship of the Azerbaijani non-oil GDP does not include both non-linear effects together. But it may include one of the effects. To check this, we examined the threshold and interaction effects separately by estimating equations (4) and (5), respectively. The estimation of equation (5) in the last column of Table 2 has the following issues: the capital elasticity of non-oil GDP became statistically insignificant and very small; the impact of OR switched to negative and was statistically insignificant; FD also has a negative and statistically insignificant effect on non-oil GDP. Lastly, we consider the estimation of equation (4), i.e., threshold model, in Table 2, and it has the following merits: all the estimated coefficients are statistically significant with their theoretically expected signs (for example, labor and capital elasticities of non-oil GDP are positive). Threshold-related coefficients are also statistically significant, which supports testing the null hypothesis of a symmetric relationship: no threshold effect. Doing so yields the sample Chi-squared statistic value of 45.7, which is hugely greater than the corresponding critical values. This means that the null hypothesis of the symmetric effect can be rejected firmly in favor of the alternative hypothesis of the asymmetric relationship: the threshold effect. The selected threshold level of FD was 9.6%, given that it provides the smallest sum of squared residuals among 20 potential threshold levels and is statistically significant from the threshold or breakpoint test.[11] Finally, the sample Chi-squared value of 0.1 with the probability of 72% shows that the null hypothesis of cointegration among the variables in equation (4) cannot be rejected. Thus, equation (4), i.e., the threshold model, seems to be preferred for Azerbaijan.

7.2. Kazakhstan

Table 3 presents the estimates of equations (1)–(5).

We inspected the results of each of the five estimated equations for Kazakhstan in terms of their statistical coherence and theoretical consistency, as we did for Azerbaijan. The results are similar to those obtained for Azerbaijan. In brief, statistically, one cannot extend the basic growth model of equation (1) to either equation (2) or (3), or (5) as all these specifications include statistically insignificant regressors. Equation (1) can be extended only to equation (4), i.e., the threshold model, as it contains statistically significant regressors with theoretically coherent signs of the coefficients. Also, the variables in (4) are cointegrated, as Park's added variables test suggests that the null hypothesis of cointegration cannot be rejected. In addition, the sample Chi-squared value of 1179.7 is enormously larger than the critical Chi-squared value. Hence, the null hypothesis of the symmetric effect can be profoundly rejected in favor of the alternative hypothesis of the asymmetric effect. This indicates a threshold effect of OR on non-oil GDP. Resultantly, equation (4), i.e., the threshold model, becomes a preferred specification for the impact of OR on non-oil GDP in Kazakhstan.

7.3. Russia

Finally, we estimated equations (1)–(5) for Russia, another country in our sample. The results are recorded in Table 4.

We carried out the same inspection (e.g., statistical significance and theoretical coherence) for the estimated five specifications for Russia as we did for Azerbaijan and Kazakhstan. Briefly, in equations (3) and (5), labor, a theoretically articulated important variable of economic growth, has statistically insignificant and negative elasticity. While threshold-related coefficients are statistically insignificant in equation (4) and the equation does not establish a cointegrated relationship. Thus, it seems reasonable to only augment the basic growth model of equation (1) with OR, which becomes equation (2). In addition to the theoretical and statistical merits of its estimated coefficients, equation (2) establishes a long-run relationship among the variables, as the null hypothesis of cointegration from Park's *added variables test* cannot be rejected at the 1% significant level (see e.g., Esfahani et al., 2013 for a hypothesis testing using the same significance level). Moreover, Hansen's parameter instability test cannot reject the null hypothesis of cointegration, as the probability of the sample value of the test is 0.18. To this end, we selected model (2) as a relevant specification for Russia.

7.4. The role of institutional quality[12]

Obviously, the quality of institutions plays a vital role in the development of nations. This has also been an important line of research in the case of oil-exporting economies. Resource rent is believed to be either a curse or a blessing, determined by institutional development to a greater extent (Bulte et al., 2005; Mehlum et al., 2006; Robinson et al., 2006; Brunnschweiler and Bulte, 2008; Brunnschweiler, 2008; Boyce and Emery, 2011; Apergis and Payne, 2014; Sarmidi et al., 2014; Lawer et al., 2017; Tiba, 2019; Abdulahi et al., 2019). To this end, this subsection examines whether our preferred models and findings for Azerbaijan, Kazakhstan, and Russia change regarding sign switch and statistical insignificance of regressors if we extend these models with the measure of institutional quality.

As a measure of institutional quality, we considered the Index of Economic Freedom (IEF) as this indicator has several merits. Economic freedom is the fundamental right of each individual to control labor and property s/he owns. An economically free society allows individuals to work, produce, consume, and invest in any way convenient. At the same time, governments provide free movement of labor, capital, and goods and cease the constraint of liberty beyond the extent necessary to protect and maintain freedom. The index is calculated based on 12 quantitative and qualitative factors, classified into four broad categories of Rule of Law (property rights, government integrity, judicial effectiveness), Government Size (government spending, tax burden, fiscal health), Regulatory Efficiency (business freedom, labor freedom, monetary freedom), and Open Markets (trade freedom, investment freedom, financial freedom). Details of the calculation and methodology can be found on the official webpage of Economic Freedom (https://www.heritage.org/index/about). IEF uses a scale of 100, with a higher score meaning more economic freedom. We collected the index's values from the said webpage. The values are available from 1996, 1998, and 1995 for Azerbaijan, Kazakhstan, and Russia, respectively. Fig. 8 below illustrates the time trajectories of the index for the countries under consideration.

Our two main observations from the graphs are: (i) the institutional quality improved over time in Azerbaijan and Kazakhstan, while that of Russia stagnated till 2016 with ups and downs and rapidly improved since then. The levels of quality are almost the same in the first two countries while it was mostly lower in Russia despite the rapid improvement recently.

We considered the preferred growth models for the countries, that is, threshold effect models for Azerbaijan and Kazakhstan, and the growth model with OR for Russia (that is, equation (4) in Tables 2 and 3, and equation (2) in Table 4). They were extended by including the natural logarithmic transformation of the index of economic freedom (*ief*) and then re-estimated.[13] Table 5 reports the results of the re-estimations.

Let's look at the estimation results with the purpose of this exercise in mind: whether the regressors in the preferred models change their sign and/or become statistically insignificant at the conventional levels due to the inclusion of IEF. The regressors in the selected model of Azerbaijan do not switch their sign and do not become statistically insignificant from the comparison of the results in Table 5 and the estimated equation (4) in Table 2 *ief* is statistically significant at the 1% level. In addition, Park's *added variables test* with the null hypothesis of

[11] We used Bai and Perron (2003) multiple breakpoints test in selecting the threshold level and testing the statistical significance of the selected one because of the following reasons. (i) Searching, testing and estimation for a threshold is fundamentally equivalent to doing so for breakpoints (e.g., see Bai and Perron, 2003; EViews 13, User's Guide II, Chapter 35); (ii) The bootstrap tests such as developed in Hansen (1996, 1999, 2000) are valid only if regressors in the regression equation are strictly exogenous, which is highly doubted in the empirical applications; (iii) Validity of bootstrap inference for threshold regression is questionable as it has been criticized in the literature (see Gonzalo and Wolf, 2005; Seo and Linton, 2007; Yu, 2014 inter alia). In addition, we used the CCR method for the final estimations to rule out the simultaneity bias in the estimated coefficients caused by endogeneity. This allows us to provide policy insights that are derived from the econometrically sound estimations. All econometric analysis is performed in EViews 13 software package.

[12] We thank very much to an anonymous referee for suggesting this to us.

[13] For *ief* in Azerbaijan and Kazakhstan, the FADF-SB unit root test indicates trend stationarity, while Kwiatkowski et al. (1992) and Ng and Perron (2001) tests suggest I(1) process. The SBFADF test shows that *ief* in Russia is a unit root process, and its first difference is a stationary process, both with the structural break in 2017. Thus, we can use *ief* variables in the long-run analysis (Details of the tests can be obtained from the authors).

Table 3
Estimation results for Kazakhstan.

	(1) Basic	(2) With OR	(3) Interaction & threshold	(4) Threshold	(5) Interaction
l_t	1.688*** (0.00)	1.441*** (0.00)	1.479*** (0.00)	2.528*** (0.00)	1.401*** (0.01)
k_t	0.163*** (0.00)	0.180*** (0.00)	−0.017 (0.77)	0.081*** (0.00)	0.148* (0.07)
or_t	–	−0.016 (0.19)	–	–	−0.050 (0.25)
$(FD_t < \tau) \bullet or_t$	–	–	0.046 (0.46)	−0.113*** (0.00)	–
$(FD_t \geq \tau) \bullet or_t$	–	–	−0.025 (0.62)	−0.030*** (0.00)	–
$or_t \bullet fd_t$	–	–	−0.021 (0.22)	–	−0.004 (0.80)
fd_t	–	–	0.208*** (0.00)	–	0.065 (0.16)
α_0	9.272 (0.00)	9.572*** (0.00)	11.693*** (0.00)	8.872*** (0.00)	10.012*** (0.00)
t	0.030*** (0.00)	0.031*** (0.00)	0.043*** (0.00)	0.025*** (0.00)	0.032*** (0.00)
τ	–	–	7.61%	15.53%	–
χ^2_τ	–	–	13.32*** (0.00)	1179.71*** (0.00)	–
χ^2	2.255 (0.13)	12.048***(0.00)	0.713 (0.40)	0.676 (0.41)	3.671* (0.06)

Note: Dependent variable is y_t; χ^2 is the Chi-squared value from Park's *added variables test* for the null hypothesis of variables are cointegrated; χ^2_τ is the Chi-squared value from testing the null hypothesis of symmetric relationship, that is, no threshold effect, i.e., H_0: $\alpha_3 = \alpha_4$ in equation (3) and or (4); *, **, *** denote statistical significance at the 10%, 5%, and 1% levels, respectively; Numbers in parentheses are the probability values. Estimation period: 1994–2020.

Table 4
Estimation results for Russia.

	(1) Basic	(2) With OR	(3) Interaction & threshold	(4) Threshold	(5) Interaction
l_t	0.823*** (0.01)	0.633** (0.03)	−0.036 (0.92)	0.795*** (0.00)	1.150 (0.68)
k_t	0.367*** (0.00)	0.372*** (0.00)	0.473*** (0.00)	0.379*** (0.00)	0.452*** (0.00)
or_t	–	0.031*** (0.00)	–	–	0.449*** (0.01)
$(FD_t < \tau) \bullet or_t$	–	–	0.554*** (0.01)	0.010 (0.24)	–
$(FD_t \geq \tau) \bullet or_t$	–	–	0.564*** (0.00)	−0.007 (0.54)	–
$or_t \bullet fd_t$	–	–	−0.149*** (0.01)	–	−0.118** (0.01)
fd_t	–	–	0.281** (0.02)	–	0.243** (0.02)
α_0	−3.248** (0.52)	0.052 (0.99)	9.564 (0.11)	−2.972 (0.50)	−0.238 (0.97)
t	0.013*** (0.00)	0.013*** (0.00)	0.010*** (0.00)	0.014*** (0.00)	0.001*** (0.00)
τ	–	–	29.49%	41.70%	–
χ^2_τ	–	–	1.84 (0.17)	17.02*** (0.00)	–
χ^2	20.970*** (0.00)	5.151** (0.02)	2.044 (0.15)	24.098*** (0.00)	0.875 (0.35)

Note: Dependent variable is y_t; χ^2 is the Chi-squared value from Park's *added variables test* for the null hypothesis of variables are cointegrated; χ^2_τ is the Chi-squared value from testing the null hypothesis of symmetric relationship, that is, no threshold effect, i.e., H_0: $\alpha_3 = \alpha_4$ in equation (3) and or (4); *, **, *** denote statistical significance at the 10%, 5%, and 1% levels, respectively; Numbers in parentheses are the probability values. Estimation period: 1994–2020.

Fig. 8. Time trajectory of IEF.

cointegration cannot be rejected for equation (4) when *ief* was additionally included in it, indicating that the results should not be spurious but rather the reflection of the long-run relationship. Also, for Kazakhstan, the regressors of the preferred model do not switch their sign and statistical significance at the conventional levels, and *ief* is not statistically significant at the conventional levels of 1%, 5% and 10%.[14]

[14] Although Castle et al. (2021) discuss that regressors with a significance level of 16% can be considered for analysis and forecasting, we would not consider it for two reasons. First, IEF is not our main variable of interest in this study. Second, the inclusion of IEF in equation (4) leads to no or weak evidence of cointegration.

Park's test rejects the null hypothesis of cointegration as the sample value of Chi-squared is hugely greater than its critical value for equation (4) augmented with *ief*. In addition, Hansen's instability test rejects the null hypothesis of cointegration at the 5% significance level. Thus, the statistical support for cointegration among the variables is zero. In the case of Russia, the regressors in the preferred equation of (2) do not change their signs, and they are statistically significant at the conventional levels. However, *ief* is highly statistically insignificant. In addition, both Park's *added variables test*, and Hansen's instability test profoundly reject the null hypothesis of cointegration for equation (2) extended with *ief*.

To conclude the subsection, overall, accounting for the institutional quality does not worsen the preferred growth models for Azerbaijan,

Table 5
Estimation results with institutional quality.

	Azerbaijan	Kazakhstan	Russia
ief_t	0.400***(0.00)	0.256 (0.15)	0.052 (0.61)
l_t	2.586*** (0.00)	1.721*** (0.00)	0.618* (0.08)
k_t	0.277*** (0.00)	0.397*** (0.00)	0.383*** (0.00)
or_t	–	–	0.017* (0.07)
$(FD_t < \tau) \bullet or_t$	0.042* (0.10)	−0.190*** (0.00)	–
$(FD_t \geq \tau) \bullet or_t$	0.128*** (0.00)	−0.160*** (0.00)	–
α_0	0.911*** (0.00)	5.711*** (0.00)	0.003 (0.99)
t	–	–	0.012*** (0.00)
χ^2	0.351 (0.55)	78.011*** (0.00)	44.232*** (0.00)

Note: Dependent variable is y_t; The regressors are defined as above; τ is the threshold level of 9.60% and 15.53% for Azerbaijan and Kazakhstan, respectively; χ^2 is the Chi-squared value from Park's *added variables test* for the null hypothesis of cointegration; *, **, *** denote statistical significance at the 10%, 5%, and 1% levels, respectively; Numbers in parentheses are the probability values. Estimation periods are 1997–2020, 1999–2020, and 1996–2020 for Azerbaijan, Kazakhstan, and Russia, respectively, dictated by the data availability.

Kazakhstan, and Russia. Moreover, institutional quality appears to be an important factor in Azerbaijan's non-oil economic development. It also exerts a positive impact on the non-oil GDP in Kazakhstan and Russia, but the impact is not statistically significant at the conventional levels. Therefore, in the next section of the discussion of the econometric results, we considered the threshold model of equation (4) extended with IEF for Azerbaijan, while we used estimated equations (4) and (2) in Tables 3 and 4, respectively, for Kazakhstan and Russia.

8. Discussion of the results

8.1. Azerbaijan

It is worth briefly discussing the estimation results of equation (4) in Table 5. Firstly, one can conclude that equation (4) best represents the non-oil GDP considering OR, its relationship with FD, and institutional quality. This means that the Azerbaijani data do not support the idea that OR's threshold and interaction effects are jointly important for the non-oil sector's development. The data also do not support the existence of the interaction relationship between OR and FD for non-oil GDP. However, the data provide evidence that non-oil GDP depends on labor, capital as well as OR, and the quality of institutions in the long run. The data further provide evidence that the positive impact of OR on non-oil GDP is asymmetric depending on the level of FD.

Numerically, if the level of FD is below 9.6% in the Azerbaijani economy, then a 1% increase in OR causes a 0.04% increase in non-oil GDP. If the FD level is above 9.6%, then a 1% rise in OR expands non-oil GDP by 0.13%. It is impressive that rising FD above 9.6% increases the impact of OR on non-oil GDP more than three times. This highlights the vital role of FD in efficiently using oil revenues and oil sector-related activities in fostering non-oil economic activities. Indeed, suppose financial markets, instruments, and intermediaries are not well developed. In that case, spillover from the oil sector to the non-oil sector will remain mainly through fiscal spending in oil-rich developing economies (e.g., see Dehning et al., 2016; Hasanov and Alirzayev, 2016; Hasanov et al., 2018; Mukhtarov et al., 2018 for Azerbaijan; Hasanov et al., 2022 for Saudi Arabia-another oil-rich economy). This might hugely diminish the potential positive spillover effect of the oil sector. If the financial markets are developed, oil sector activities and oil revenues can have more channels to spill over to the non-oil sector. Privatizing the oil sector activities also plays an essential role in this framework. For example, if the banking system functions well, the non-oil sector can easily borrow oil money from banks. In this regard, earlier studies found positive non-oil growth effects of bank loans in Azerbaijan (e.g., see Hasanov and Huseynov, 2013). Also, developed stock and bond markets make it easy the companies in the non-oil sector to buy government treasury bonds or attract oil money by selling their shares to oil activity-related companies.

The estimation results also show that a 1% increase in labor, capital, and institutional quality expands non-oil GDP by 2.6%, 0.3%, and 0.4% in the long run. These findings signify the importance of labor, capital, and the quality of institutions in the long-term development of the non-oil sector in Azerbaijan. Since these findings align well with the economic growth theories and empirical literature, we do not discuss them here.

8.2. Kazakhstan

The findings are somewhat similar to what we found for Azerbaijan above. Unlike in the case of Azerbaijan, OR demonstrates an adverse threshold effect on the non-oil sector in Kazakhstan, but its magnitudes are quite small. Numerically, the estimation results of equation (4) estimation results in Table 3 show that in the long run and holding other factors constant, a 1% increase in OR leads to a 0.1% fall in the non-oil GDP if FD is lower than 15.5%. Once FD is equal to or higher than 15.5%, this effect of OR diminishes considerably and becomes effectively zero, precisely −0.03.

Although it is quite small in magnitude, the finding of the adverse growth effect of OR can be explained by resource curse theories (Sachs and Warner, 1995; Buiter and Purvis, 1980 inter alia). According to the resource curse theories, the booming sector (the oil sector in the Kazakhstani case) can harm the non-resource tradable sector (non-oil economic activities in Kazakhstan) through the channels such as rent-seeking, corruption, political regimes, weak institutional and economic infrastructure, appreciation of real exchange rate – high price level in the non-tradable sector, labor and capital movement from non-recourse tradable sector to booming sector and non-tradable sector, the transmission of the volatility in the international resource price (oil price in this case) into main macroeconomic indicators. Empirically, our findings align with various studies focusing on Kazakhstan as they found pieces of evidence in this regard. For example, Czech (2018) discussed that there is a high correlation between the volatility in the international price of crude oil and that in the macroeconomic indicators in Kazakhstan. Oskenbayev and Karimov (2013) investigated 14 provinces of Kazakhstan. They concluded that there are symptoms of Dutch Disease as the labor force migrates from manufacturing to the non-traded sector due to the wage increase and the cost of manufacturing increases due to the increases in the prices of non-tradable goods and services. Additionally, Pelzman et al. (2018) found that this is mainly commodity price volatility causing the resource curse. Furstenberg (2018) argued that the political regime drives Kazakhstan's resource curse. Apparently, the negative effect of OR vanished effectively over time as financial markets further developed beyond 15.5%. Our explanation is that the developed financial sector is accompanied by factors such as efficiency gains, technological progress, and innovations (recall the dicsussion in Section 3). Moreover, Pelzman et al. (2018) concluded that institutional quality is not a determinant of the resource curse in Kazakhstan, although this finding contradicts the findings of the earlier studies for this country. In this regard, we also found a positive albeit statistically insignificant effect of institutional quality on non-oil growth. This lends support to the finding of Pelzman et al. (2018).

Our finding above, first of all, signifies the importance of the FD in Kazakhstan – such a development can alleviate the adverse effect of OR by about four times and make it effectively neutral. Moreover, compared to Azerbaijan, a higher level of FD is needed in Kazakhstan. This finding is not surprising as the thresholds are estimated endogenously using the observed values of FD over time. Cross-country empirical analysis demonstrates that countries abundant in natural resources have systematically lower levels of financial sector development (Beck, 2011). Among the two countries, Azerbaijan is more dependent on oil, and the non-oil sectors are limited compared to Kazakhstan. Thus, higher levels of FD might be required to transit to a growth phase. Moreover, considering the size of these two economies, it is evident that more FD is needed in Kazakhstan than in Azerbaijan to develop the non-oil sector.

The literature generally discusses that, particularly in transition countries, the financial sector development is of great importance for capital accumulation, the transformation of savings into investments, risk-sharing, and diversification, all leading to economic growth (e.g., see Kulhánek et al., 2004). Cojocaru et al. (2016) estimated that bank credit to the private sector has a statistically significant positive impact on GDP per capita using panel data of 21 transition economies, including Kazakhstan and Russia. Also, Oskonbaeva (2018) assessed that the ratio of broad money to GDP, another measure of FD, establishes a long-run relationship with GDP per capita, and the former Granger causes the latter in the panel of nine transition economies, including Kazakhstan and Azerbaijan. Particularly for Kazakhstan, Ilyukhin (2015) estimated that bank credits to the private sector have a positive impact on economic growth in the long run, while Katenova and Nurmakhanova (2017) found that FD, measured by the KASE index of the stock market, positively affects economic growth, measured by industrial production index.

Table 3 reports that a 1% increase in labor and capital results in a 2.5% and 0.1% increase in non-oil GDP, respectively. Finding positive impacts of labor and capital are in line with the production function theory and do not need further explanation. These estimated elasticities are quite similar to those estimated in equation (4) of Table 5 for Azerbaijan. Linear time trend is usually considered a proxy for the effects of technological progress (or technical changes) in empirical studies (e.g., Beckmann and Sato, 1969; Lieberman, 1977; Nelson and Kang, 1984). In this regard, we estimate that due to technological progress, Kazakhstan's non-oil GDP increases by 2.5% per year.

8.3. Russia

According to the estimates of equation (2) in Table 4, a 1% rise in OR leads to a 0.03% increase in non-oil GDP. As we discussed above, regarding the impact of the resource sector's rents or revenues on the non-resource sector, there are two competing theories: the resource curse concept and the resource blessing concept. It appears that Azerbaijan and Russia follow the latter, while Kazakhstan follows the former. Note also that it is not unusual to find that the oil sector's rent or revenues positively affect economic development in developing oil economies. For example, Aimer (2018) estimated positive OR elasticity of GDP growth in nine oil-exporting economies, including Russia. Smith (2015) found that major resource discoveries caused positive short and long-run effects on GDP and per capita income in 16 oil-exporting countries, while Esfahani et al. (2014) estimated a positive impact of oil income on the output of six major oil-exporting economies, namely Iran, Kuwait, Libya, Nigeria, Saudi Arabia, and Venezuela, which are quite similar to Russia in their economic nature. Also, particularly for Russia, Yang et al. (2021) concluded that OR is a blessing as it positively impacts GDP. Alexeev and Chernyavskiy (2014) found positive impacts of resource taxes on GDP, although the magnitudes of the effects are quite small. Libman (2013) also estimated a positive impact of resource revenues on regional economic growth. Korkmaz (2022) concluded that OR has a positive effect on GDP.

Our finding of a small elasticity suggests that OR's positive growth effects are rather limited in Russia. This might imply that channels, including FD, that establish a positive impact from the oil sector to the non-oil sector need to be sufficiently developed, and hence there is a lot of room for improvement. This might be the underlying reason for not achieving a statistically significant positive impact of the interaction term of FD with OR in the non-oil GDP equation. Instead, a statistically significant negative impact of the interaction term is found in the estimated equation (5).

Another possible explanation for the small magnitude of OR elasticity is that other channels fostering economic growth effects of the oil sector, such as institutions, the efficiency of government budget spending, legislation, and the business environment, need to be sufficiently developed in Russia. Our finding in Table 5 supports this reasoning that institutional quality does not exert a statistically significant impact on the non-oil GDP in Russia.

The estimation results of equation (2) also suggest that a 1% increase in labor and capital causes a 0.6% and 0.4% increase in non-oil GDP in the long run. The results also indicate that technological progress increased Russian non-oil GDP by 1.3% annually from 1994 to 2020.

In the estimated equation (5), OR has a statistically significant positive impact on non-oil GDP. However, this impact switches to a statistically significant negative once the variable interacts with the FD. This negative interaction term might be interpreted as a sign of a resource curse, possibly through corruption or capital flights. That is, higher OR and more loans to the private sector harm long-term growth due to inducing rent-seeking behavior, perhaps leading to more non-performing loans extended during the oil windfalls and high bank liquidity. However, the two points below make the above interpretation less probable. Statistically, the coefficient of labor, a theoretically articulated important economic growth factor, is not statistically significant in the estimated equation (5). Since the mentioned coefficient is also highly statistically insignificant in the estimated equation (3), we conclude that this issue is caused by including the interaction term in the equations. This conclusion is further supported by the estimation results that the coefficient of labor is statistically significant in other equations where the interaction term is not included. Empirically, the literature does not support the idea of the resource curse through a credit channel in Russia. In contrast, the studies document a positive effect of FD on economic growth in Russia (e.g., Burakov, 2017; Krinichansky and Sergi, 2019; Ono, 2017; Rustamov and Adaoglu, 2018). Also, studies such as Aimer (2018), Korkmaz (2022), Mo et al. (2019), and Yang et al. (2021) found that oil positively contributes to economic growth in Russia.

Fig. 9 depicts how the FD evolved in all three countries compared to the threshold values (obviously no reference point for Russia) and middle- and high-income countries.

The first observation is that the FD has been above the threshold levels in Azerbaijan and Kazakhstan over the last decades. At the same time, FD's decline and near-threshold values were observed when these economies were hit by the recessions after 2015. This fact exhibits the financial system's fragility and underlines its importance in long-term economic growth. Additionally, the authorities should consider that the bank credit to the private sector in Azerbaijan and Kazakhstan is significantly below the average values in the middle- and high-income countries. Russia is in a better position than Azerbaijan and Kazakhstan but still far below the global averages. This implies that there is ample room to develop the financial sector in these countries.

We find that institutional quality has a statistically significant positive effect on non-oil economic growth in Azerbaijan. Institutional quality also demonstrates a positive role in the development of the non-oil sector in Kazakhstan and Russia, although its impact is not statistically significant at the conventional levels. Our interpretations of these results are as follows. Fig. 8 shows that Azerbaijan's level of institutional quality is almost equal to that of Kazakhstan and higher than that of Russia. Given the country's size, population, and economy, Azerbaijan is enormously smaller than the other two countries (see Section 4 and Fig. 1). Therefore, the established levels of institutional quality were sufficient in Azerbaijan to create a statistically significant growth-promoting effect. In contrast, the levels achieved in Kazakhstan and Russia needed to be increased to create such effects. This reasoning is supported by the literature, namely the empirical evidence that oil wealth increases economic growth only when institutional quality

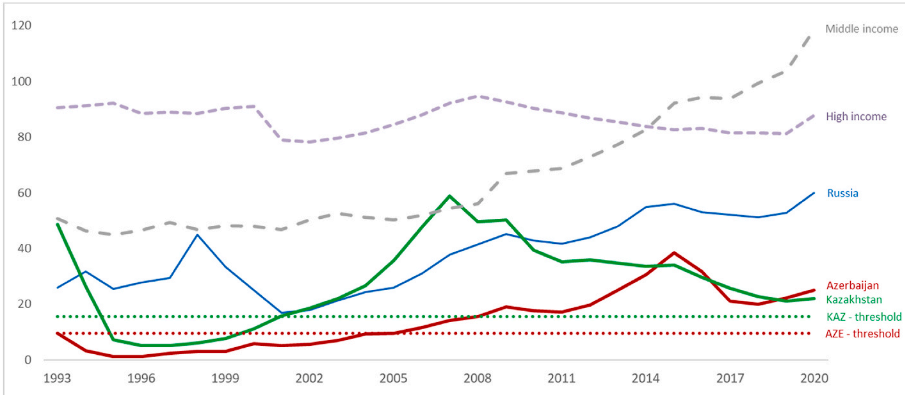

Fig. 9. Domestic credit to the private sector by banks (% of GDP)
Source: WDI (2021) data and authors' estimations.

exceeds certain threshold levels (for example, Abdulahi et al., 2019; Hassan et al., 2019; Keikha et al., 2012). In this regard, our findings for the non-oil economic development effects of institutional quality open an exciting research avenue to investigate whether there is a threshold effect of the latter on the former in Azerbaijan, Kazakhstan, and Russia.

9. Concluding remarks and policy insights

FD is considered one of the factors that can avoid the negative impact of resource rents and boost the development of the non-resource sector in natural resource-rich economies. To this end, we investigated whether FD could play any role – either as a regime switcher or a moderator in the impact of OR on the non-oil GDP in CIS oil exporters, namely Azerbaijan, Kazakhstan, and Russia, in the long-run. The following concluding remarks can be made based on the results of the econometric analysis: (i) for Azerbaijan and Russia, data suggested that OR has a positive effect on the non-oil sector development. In Kazakhstan, although this relationship was found to be adverse, it is very small in magnitude; (ii) for Azerbaijan and Kazakhstan, data supported the idea that OR's effect on the non-oil sector was switched and enhanced if the financial sector was further developed, while this was not the case for Russia; (iii) for none of these economies, FD plays a statistically significant moderator role for the non-oil economic growth effects of OR; (iv) institutional quality has a positive effect on non-oil economic growth in Azerbaijan. It does so also in Kazakhstan and Russia, albeit statistically insignificant.

Some policy insights can be derived from the findings as follows. Policymakers should be aware that the same magnitude of OR can lead to more non-oil economic growth if FD exceeds certain levels in Azerbaijan and Russia. This shows that FD can boost the progressive non-oil development effects of OR in Azerbaijan and Kazakhstan. The numerical measure for the policy design to consider is that the GDP share of bank credit to the private sector should be achieved to be equal to or higher than 9.6% and 15.5%, respectively, in Azerbaijan and Kazakhstan. It is critical that the authorities should keep these shares in mind in formulating macroeconomic and financial policies. Policies targeting the financial system's development help take the most benefit of the windfall revenue. Thus, the authorities should implement measures leading to the further development of the financial sector in these economies. One of the measures to increase bank credits to the private sector is lowering lending rates. This is particularly worth considering as a policy measure given that the rates are quite high in both countries compared to the world average. Another policy implementation would be soft loans to the private sector, where the government can act as warrantor. Moreover, legislative measures that can reduce bank monopoly and increase competitiveness and facilitate financial intermediation should also be considered in the policy designs. Given the importance of institutions, and our related findings, it is essential to improve their quality, especially in Russia and Kazakhstan.

Regarding direct effect of OR in boosting non-oil economic growth, which is most relevant for Russia, some policy measures can be considered. For example, expanding government investments in non-oil activities using oil revenues through the government budget, oil fund, or sovereign wealth fund. Also, oil revenues can be used to finance various socio-economic projects in the non-oil sector. One of the indirect measures would be that the government can buy shares of non-oil companies and hence, provide them with financial resources, which can be used for investment and intermediate purposes in producing goods and services. Moreover, localization or import substitution policies can be applied to the oil realted activities where possible. The experience of other oil-rich countries, including Saudi Arabia, can be considered in successfully implementing the above-mentioned measures.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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Appendix A. The SBFADF test

The literature on the unit root discusses that if there is a structural break in the time series to be tested, then conventional UR tests, such as the ADF or Phillips-Perron can yield misleading and thus non-common-sense results.[15] The situation gets worse if a given series contains more than one structural break. Although some tests have been developed to account for two or more structural breaks, Kejriwal and Perron (2010) among others discuss that these tests may suffer from the non-monotonic power issue if number of breaks in data is more than what a given test explicitly accounts for. This shortcoming coupled with another limitation (that multiple breaks need dummy variables to be included in the test equations, which consume degree of freedom) directed recent literature towards developing tests with non-linear components. A bright example is the Fourier approximation extended tests for unit root and cointegration (e.g., see Enders and Lee, 2012a, 2012b; Tsong et al., 2016; Banerjee et al., 2017; Furuoka, 2017). As Tsong et al. (2016), Enders and Lee (2012a, 2012b), Becker et al. (2006), Gallant (1981), Gallant and Souza (1991) discuss, the Fourier component can effectively approximate the behavior of unknown function even if it is not periodic, which makes it an excellent method in capturing multiple structural breaks, with unknown forms and unknown date of occurrence, in data.

To check for a unit root while accounting for multiple structural breaks, this study uses the test developed by Furuoka (2017) as this test (FADF-SB) encompasses conventional ADF of Dickey and Fuller (1979), the ADF with structural break (ADF-SB) developed by Perron and Vogelsang (1992), Zivot and Andrews (2002), and the ADF augmented with the Fourier approximation (FADF) developed by Enders and Lee (2012a, 2012b). For variable y_t, the test equation can be expressed as below:

$$\Delta y_t = \alpha_0 y_{t-1} + \alpha_1 + \alpha_2 t + \sum_{i=1}^{q} \beta_i \Delta y_{t-i} + \sum_{f=1}^{n} \gamma_f \, sin\left(\frac{2\pi ft}{T}\right) + \sum_{f}^{n} \delta_f \, cos\left(\frac{2\pi ft}{T}\right) + \alpha_3 DSH_t + \alpha_4 DP(BD)_t + e_t \tag{A1}$$

Where, $\alpha_i, i = 0, \ldots, 4$; β_i; γ_f, δ_f are the parameters to be econometrically estimated; t is the linear time trend; i is a particular lag order; q is the maximum lag order; *sin* and *cos* are the sin and cos trigonometric functions; f is a particular frequency; n is the number of cumulative frequencies; T is the number of observations in the estimation; $\pi = 31416$; DSH is the step dummy variable taking unity for $BD \geq t$ and zero otherwise; BD is the date when a structural break occurs; DP is the one time break dummy, taking unity in BD and zero otherwise; e is the stationary error term with σ_e^2 variance.

Becker et al. (2006), Enders and Less (2012a, 2012b), Tsong et al. (2016), and Furuoka (2017) discuss that using a particular frequency, f, instead of a sum of frequencies, n, is recommended if the number of observations is small as doing so avoids consuming additional degrees of freedom, overparameterization and resultantly loss in the power of the tests. With a particular frequency of f, (A1) becomes:

$$\Delta y_t = \alpha_0 y_{t-1} + \alpha_1 + \alpha_2 t + \sum_{i=1}^{q} \beta_i \Delta y_{t-i} + \gamma \sin\left(\frac{2\pi ft}{T}\right) + \delta \cos\left(\frac{2\pi ft}{T}\right) + \alpha_3 DSH_t + \alpha_4 DP(BD)_t + e_t \tag{A2}$$

There are limited papers explaining step-by-step application of these tests to data in the empirical analyses given that the UR test by Enders and Lee (2012a, 2012b) and its extension by Furuoka (2017) are recently developed. Therefore, we believe that providing such an explanation might be beneficial for researchers in their empirical work.

(1). A proper estimation of (A2) involves the following two points to be considered.
- (1.1). Note that (A2) accommodates only one frequency for the trigonometric functions and one shift dummy variable (and its first difference, i. e., pulse dummy variable) for a large structural break at a time. Regarding the frequency, Enders and Lee (2012a, 2012b) recommend employing up to five particular frequencies, while Tsong et al. (2016) and Furuoka (2017) use only up to three and two, respectively. The mentioned studies discuss that multiple breaks in data can be approximated/captured with low frequencies in many cases. As for the shift dummy variable, Furuoka (2017) discusses considering each observation of the sample as a potential large structural break, which yields T number of shift dummy variables (and T number of their first differences). For example, if the recommendation of Enders and Lee (2012a, 2012b) to consider up to five particular frequencies is followed, and if T = 30, then (A2) should be estimated 150 (=30*5) times. Obviously, it is a lot of work and hence, in the empirical analysis, a researcher may want to select number of shift dummy variables, i.e., large structural breaks by graphically illustrating trajectory of a given times series instead of considering each observation of T as a potential large structural break.
- (1.2). (A2) is the general unrestricted form of the Furuoka (2017)'s test equation, which estimates many coefficients. However, in an empirical work, the following considerations can be taken to avoid overparameterization particularly when the sample size is small. (1.2.1) The linear time trend should be excluded from (A2) if it is statistically insignificant because Enders and Lee (2012b) discuss that such exclusion would increase the power of the test. (1.2.2.) Intercept can be also excluded from the test equation if it is statistically insignificant to save degree of freedom. For example, in many cases the first difference of a given variable does not demonstrate trending behavior and it has a zero mean. Thus, both the deterministic components of linear trend and intercept can be dropped if they are statistically insignificant. (1.2.3.) Lagged values of the dependent variable, Δy_{t-i} can be excluded if the residuals, e_t of the test equation is free of serial correlation/autocorrelation.

(2). It is noteworthy that Enders and Lee (2012a, 2012b) and Furuoka (2017) use different criterion to select the final form of (A2). Precisely, the former one selects the optimal frequency by minimizing sum squared residuals of the estimated (A2), while the latter selects the optimal frequency and optimal structural break point jointly by minimizing the t-value of the coefficient of the autoregressive term, i.e., α_0. In this research we follow Furuoka (2017).

(3). Once (A2) with the optimal frequency and optimal structural break is selected among alternatives, the selected equation should be tested to examine whether it (FADF-SB) can be reduced to FADF or ADF-SB or ADF (DF) if there is no lagged values of the dependent variable). This stage

[15] The common-sense results mean the results that are commonly found in empirical studies. It is commonly accepted/found that socio-economic, energy, and environmental variables usually are unit root (or trend-stationary) processes at their levels or log levels, but their first differences are stationary. Examples of non-common-sense results are: a stationary series with a break in its level can be falsely concluded as a non-stationary process. Or an integrated order of one series with a break in its level or trend can be mis-concluded as an integrated order of two processes (see discussions in Perron, 1989; Hansen, 2001, inter alia).

involves testing joint significance using the standard F-statistic. Note, however, that the sample value of the F-statistic has to be compared to the critical values of the F-statistic from Table 4 of Furuoka (2017) considering options of T, significance level, frequency if any, and the λ parameter (which is the percentage ratio of the optimal break point to the total sample size, i.e., $\lambda = \frac{BD}{T} * 100$) if any. A researcher should test the following restrictions in (A2):

(3.1). Whether FADF-SB can be reduced to ADF, where $\alpha_3 = \alpha_4 = \gamma = \delta = 0$.
(3.2). Whether FADF-SB can be reduced to FADF, where $\alpha_3 = \alpha_4 = 0$.
(3.3). Whether FADF-SB can be reduced to ADF-SB, where $\gamma = \delta = 0$.
(3.4). If (3.2) holds, it can be further tested whether FADF can be reduced to ADF, where $\gamma = \delta = 0$.
(3.5). If (3.3) holds, it can be further tested if ADF-SB can be reduced to ADF, where $\alpha_3 = \alpha_4 = 0$.

(4). Once any of the reduced form is concluded from the previous stage, finally the null hypothesis of unit root can be tested. That is, $\alpha_0 = 0$. If the sample value of t-statistic of α_0 is greater than the critical tau values from Table 3 of Furuoka (2017) in absolute term considering options of T, significance level, frequency if any, and the λ parameter if any, then the null hypothesis of unit root can be rejected in favor of alternative hypothesis. Furuoka (2017) lists four alternative hypotheses in (2a), (2b), (2c), and (2d) equations in his paper, which correspond to four equations of ADF, FADF, ADF-SB, and FADF-SB with unit root.

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