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# The role of natural resources in financial expansion: evidence from Central Asia

Aliya Zhakanova Isiksal<sup>1\*</sup>

\*Correspondence:  
aisiksal@wpucyprus.com

<sup>1</sup> World Peace University, Nicosia,  
Via Mersin 10, Türkiye

## Abstract

Central Asian States (CAS) have diverse natural resources. This research aims to shed light on the finance–natural resource’s association in the context of CAS namely Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan in 1996–2020 using the cross-sectionally augmented autoregressive distributed lag technique. It seeks to examine the research question, “What is the effect of natural resource wealth on the financial expansion (FE) of Central Asia?” The results demonstrated an inverted U-shaped association between financial growth and natural resource rents. It implies that natural resources are initially a “resource blessing” that later becomes a “resource curse.” Additionally, the effect of institutional quality (INQ) and human development (HD) on financial growth is examined. The results reveal that INQ and HD positively affect FE. Moreover, a bidirectional causal relationship exists between FE and INQ. Finally, all variables contribute to a long term FE. Based on these outcomes, the major policy recommendations are that the CAS authorities diversify their financial services and products and direct the proceeds from natural resource rents to effective investments particularly in HD. In addition, the social and political infrastructures in CAS must be restructured to achieve a high-quality institutional environment, which is necessary to increase the role of the private sector.

**Keywords:** Financial expansion, Natural resources, Resource curse, Central Asia

## Introduction

One of the most frequently asked questions is whether natural resources are a curse or a blessing for a country’s economic expansion (Marques and Pires 2019; Ali et al. 2022; Tang et al. 2022). Natural capital abundance and sluggish economic expansion are referred to the “resource curse” and the “Dutch Disease.” The “resource curse” is an economic phenomenon characterized by the fact that states with abandoned natural resources have significantly less developed economies than states with few or no resources (Asif et al. 2020; Okada and Shinkuma 2022). The “resource curse” effect can be mitigated by making better use of the natural capital and having a strong financial system. Financial expansion (FE) can mitigate the “resource curse” effect and boost economic growth. Although FE is a sign of economic progress, other factors, such as the rule of law, democratic accountability, level of corruption, institutional quality (INQ), and human development (HD), should also be considered. This

study fills a gap in the literature by analyzing the relationship between FE and natural resource (NR) rents in resource rich developing countries.

Deriving from these preliminary remarks, the main research question of this article could be formulated as “What is the effect of NR wealth on FE of Central Asian States (CAS) that have a huge and well diversified NR base?” Kazakhstan, Kyrgyzstan, Turkmenistan, Uzbekistan, and Tajikistan are important CAS countries due to their strategic geographical location and abundance of natural resources (World Bank 2021). The majority of coal and oil resources are concentrated in Kazakhstan, the highest potential for hydro energy is concentrated in Kyrgyzstan and Tajikistan, and gas reserves are shared by Turkmenistan, Uzbekistan, and Kazakhstan (Mehta et al. 2021; Zakeri et al. 2022; UNECE). The Kazakh financial sector is an important case study for understanding the natural “resource curse” in finance. Kazakhstan is a major oil producer, accounting for 1.8% of the world’s oil reserves, with the oil sector accounting for more than 60% of total exports (BP 2017). Kyrgyzstan has a high potential for a variety of minerals. On its territory, “geologists have discovered several thousand different basins of various types of minerals. Among main minerals are gold, mercury, antimony, tin, coal, non-metallic raw materials, and groundwater” (MFA; Rogalsky 2019). Uzbekistan, another Central Asian country, is also rich in mineral resources. It has all types of fossil fuels, including oil, natural gas, uranium, and brown coal (Kholikov 2019). It also has the most mineral reserves, including copper, gold, uranium, natural gas, and phosphorites. Uzbekistan is one of the top ten gold producing countries (Forbes). Turkmenistan also contains valuable minerals like oil, natural gas, sulfur, lead, and iodine; it ranks second in the Commonwealth of Independent States (CIS) in terms of explored gas reserves, trailing only Russia (Neftegaz.ru). Tajikistan is also rich in silver, lead, and boron, and it ranks first in the CIS (Mfa.tj; UNECE).

On the basis of the above research question and discussion, this research concentrates on the relationship between NR rents and FE in CAS. The following hypotheses are proposed:

$H_0$ : A U-shaped relationship exists between FE and NR rents.

$H_1$ : An inverted U-shaped relationship exists between FE and NR rents.

As previously stated, the literature primarily focused on the relationship between finance and natural resources in developed and developing countries. However, despite their importance, the natural resources in CAS have received little attention. The potential contributions of this research are as follows:

1. Most of the recent studies have employed one or more proxies for FE. However, financial institutions and markets monitor the performance of investments and corporations. To avoid using proxies for FE (Sandow et al. 2022), this research employs a FE index that comprises financial institutions and markets (IMF 2021).
2. In this study, the emphasis was placed on natural resources and the square of natural resources’ effect on FE to examine whether a U-shaped or inverted U-shaped relationship exists between these variables.

3. The “resource curse” concept reflects public officials’ rent seeking attitude toward the economy. The channel of productive resource rent revenues is mostly corrupted rather than going to economic development. The worst-case scenario occurs when officials transfer funds to their offshore banks. Therefore, strong and stable institutions are critical for FE (Khan et al. 2020). Thus, the stability of institutions may be the most important determinant of the natural resources’ capital effect on FE.
4. Previous studies on “resource curse” or “resource blessing” were conducted for developing countries, but research on CAS was largely ignored.
5. This study employed the sophisticated econometric cross-sectionally augmented autoregressive distributed lag (CS-ARDL) technique (Chudik et al. 2016) that is robust to “serial correlation, presence of misspecification bias, cross-sectional dependency, non-stationarity, and the endogeneity bias problem.”

Following the preceding discussions, the study’s structure is as follows: The second section focuses on the theoretical framework and the review of the empirical literature. The third section focuses on data and methodology, the fourth on outcomes and findings, and the fifth on the conclusion. Thus, the following section provides detailed information on the “resource curse” and empirical literature review.

## **Theoretical and empirical literature review**

### **Theoretical framework**

In the theoretical framework section, we focus on the financial variation “resource curse” and four ways in which commodity price volatility may prevent countries from expanding their financial sectors. First, in a period of abundant access to capital from outside sources caused by an increase in NR prices, due to the export of resources at high prices, the national currency strengthens, thereby reducing the profitability and competitiveness of other industries (Borge et al. 2015). Furthermore, with high commodity prices, manufacturing investments become unprofitable in comparison to mining sector investments (Okada and Shinkuma 2022). Since investment has shifted away from manufacturing, it has weakened that sector, reducing demand for financial services and weakening the financial sector. As a result of inefficient resource allocation, pursuing foreign capital abundance is the channel through which commodity price booms can prevent FE, bringing the financial “resource curse” (Mlachila and Ouedraogo 2020; Umar et al. 2021). Thus, one of the solutions to the financial “resource curse” could be strengthening the institutions (Khan et al. 2020). The second set of reasons is related to government administration. Rent seeking activity is associated with corruption and high government spending, and it increases the likelihood of political repression and military conflicts (Dell’Anno and Maddah 2022). It is widely acknowledged that in countries with low levels of institutional development, resource abundance breeds authoritarian institutions in which property rights are not guaranteed (Eregha and Mesagan 2016). Big rent is too tempting for rulers, and the desire to control it can lead to violent power struggles and armed conflicts. Thus, in rent seeking economies, a small number of citizens participate in financial reforms, and the elite group has few incentives to improve the financial system (Asiamah et al. 2022). The researchers pointed out that oil-rich states are rentier countries, and with huge revenues from oil, these countries protect the

interests of special groups (Collier and Hoeffler 2004). However, controlling corruption can transform the negative effects of natural resources into positive ones (Sharma and Mishra 2022; Mlambo 2022). Because businesses cannot obtain capital at a reasonable cost, demand will fall and FE will be hampered. Therefore, rent seeking also leads to a “resource curse” in finance (Kim and Lin 2018). Third, human capital can influence FE in resource rich countries. Previous research has found that human capital promotes FE (Rahim et al. 2021; Zaidi et al. 2019; Ibrahim and Sare 2018; Zallé 2019; Ahmed et al. 2020). Therefore, the low investment in HD during the NR boom may have a negative impact on FE. Thus, adequate human capital investment can help to mitigate the natural “resource curse” (Wen and Jia 2022). Finally, in a poorly regulated environment, commodity price shocks can have a negative impact on financial operations, potentially triggering a financial crisis (Masson 2014). However, a well regulated environment can reduce the adverse effect of natural resources on FE (Tang et al. 2022). Therefore, these factors are critical in obtaining “resource blessing”. These facts are discussed in the following section, which is divided into sections based on the findings.

### **Empirical literature review**

The resource-growth association was widely investigated in the empirical literature (Shahbaz et al. 2019). Even though financial institutions and markets are regarded as indicators of prosperity and economic expansion (Zeqiraj et al. 2020), the finance “resource curse” only recently fascinated researchers (Ebrahimi Salari et al. 2022), (Ali et al. 2022). The studies on the “resource curse” in the background of FE are still in their inception. Gokmenoglu and Rustamov (2022) examined the association between FE (“domestic credits to the private sector as a percentage of GDP”), and the natural capital market in the Kingdom of Saudi Arabia during 1970–2017 by using the autoregressive distributed lag bounds testing technique. The findings indicated an inverse relationship between FE and natural capital, which can be decreased by the human capital effect. Interesting outcomes were presented by Yıldırım et al. (2022), who examined ten states with the highest natural capital rents during the 1993 to 2017 period and found that these states also had finance “resource curse.” In addition, Li et al. (2022) found the “resource curse” in China using the quantile autoregressive distribution lag technique. They claimed that sustainable technologies could turn China’s “resource curse” into “resource blessing”. Another study (Adetutu et al. 2020) examined the influence of oil booms on bank productivity in Kazakhstan, using monthly data from 2008 to 2017. There was a significant decrease in total factor productivity of banks during the commodity shocks, with this negative effect being more pronounced in banks with higher exposure to foreign currency. This negative correlation demonstrated the natural “resource curse” in finance. In addition, Rongwei and Xiaoying (2020) discovered that the “resource curse” is significant in China from 2005 to 2018, but FE mitigates the “crowding effect” by advancing HD and making efficient investments in socially beneficial projects and enhancing investment. The authors used the ratio of current liabilities to GDP, the ratio of private credit to GDP, and the ratio of deposits and loans to GDP as proxies for FE. Naseer et al. (2020) examined natural capital, investment freedom, and FE in South Asia between 1990 and 2017. They found that the “resource curse” hypothesis is valid for South Asia. Furthermore, they found that investment freedom is negatively related to FE, whereas trade raises

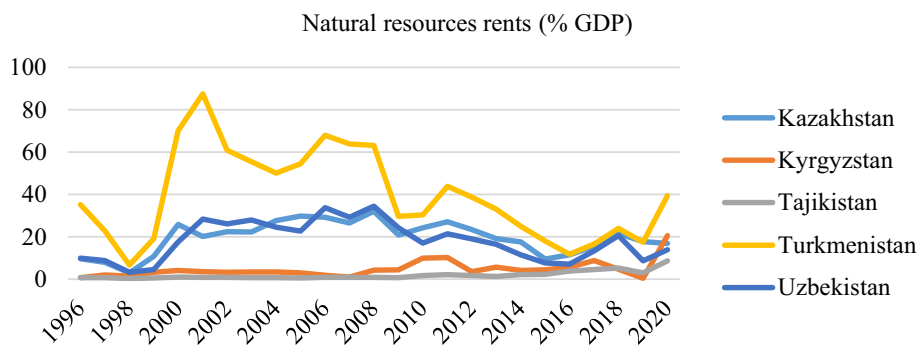
FE. Kassouri et al. (2020) tested the association among democratic accountability, price of oil, and FE (“domestic credit to private sector percentage of GDP, private credit by deposit money banks and other financial institutions as a percentage of GDP”) for 21 oil-exporting states from 1984 to 2016. They provided insights into the financial sector curse hypothesis, stating that having adequate democratic institutions can mitigate the financial sector curse. Khan et al. (2020) tested the nexus of natural capital rent and FE by incorporating the effect of INQ for 87 developing and emerging countries from 1984 to 2018. The “resource curse” in the finance sector was found to be valid for these states. However, INQ plays a positive role in the promotion of the financial sector. They also stated that the “resource curse” can be transformed into a “resource blessing” with a specific threshold level of INQ. Ebrahimi Salari et al. (2022) examined the association among revenues from oil and FE (“the ratio of liquidity to GDP”) during 1990–2018. The outcomes of the study supported the “resource curse”, demonstrating that oil revenues in Iran had a negative and significant effect on FE, whereas a high level of HD mitigated the negative effect of oil revenues.

Another group of researchers proposed that natural capital and human resources can boost FE, such as Yıldırım et al. (2020), who studied the impact of natural capital revenues on FE in 16 emerging economies from 1994 to 2017 by employing pooled mean group and dynamic fixed effect techniques. They found that as oil revenues rise, so does FE in the long run; however, the short term effects of these variables are insignificant. Uzar (2021) assessed the validity of the finance curse in the Emerging 7 economies between 2001 and 2017 by using the panel autoregressive distributed lags technique. FE (“domestic credit to the private sector”) positively affects the growth of the economy and stable financial regulations are crucial for these states. Wei et al. (2020) studied the G-7 states from 1990 to 2017 and found a positive relationship between natural capital rent and the index of FE. Dogan et al. (2020) used quantile regression to focus on the developed countries from 2001 to 2017 and found that natural capital drove FE; they also highlighted that the forest capital effect was greater than any other natural capital effect. Zaidi et al. (2019) investigated the impact of natural capital, HD, and economic expansion on FE (measured by “domestic credit provided by the financial sector as a percentage of GDP, domestic credit to the private sector as a percentage of GDP, and domestic credit to the private sector by banks as a percentage of GDP”) for the Organisation for Economic Co-operation and Development (OECD) member countries from 1990 to 2016. Natural capital, HD, and economic expansion were found to have a positive impact on FE. They advocated for greater financial institution expansion and more efficient use of natural capital. Meanwhile, Shahbaz et al. (2018) discovered a positive relationship between the abundance of natural capital and FE, stating that education has a positive impact on FE. Law and Moradbeigi (2017) investigated 63 states from 1980 to 2010 using the second generation technique and found that abundant oil states with more advanced financial markets can turn the “resource curse” into a “resource blessing”. Another study by Gokmenoglu and Rustamov (2019) examined the effect of World Bank loans and natural capital abundance on FE in Azerbaijan, Russia, Turkmenistan, and Kazakhstan from 1992 to 2017. By employing the dynamic ordinary least square technique, they found that World Bank loans and natural capital abundance have a long term positive

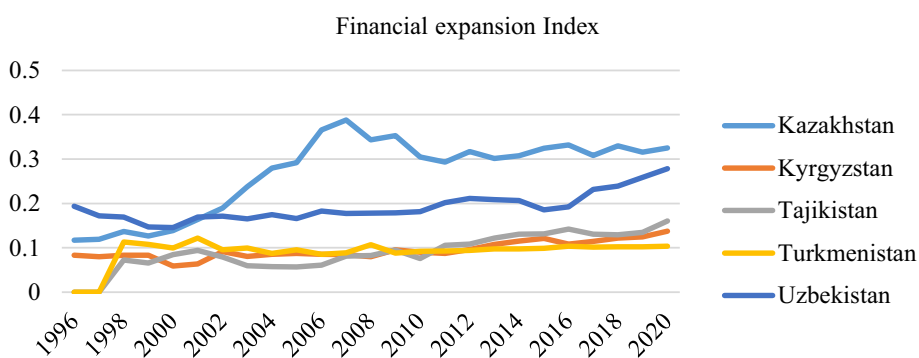
effect on FE. However, the World Bank's high borrowing rate and loan mismanagement adversely affect FE. It was discovered that the INQ positively affects FE. Recent research has also supported the "resource blessing" theory for Ghana (Adabor et al. 2022), and Gulf Cooperation Council Countries (Altaee et al. 2022).

Some researchers found mixed or insignificant results, claiming that the effect of FE on natural capital is dependent on the indicator used to measure FE. Thus, Dwumfour and Ntow-Gyamfi (2018) investigated 38 African states from 2000 to 2012 using the generalized method of moments (GMM) technique and found that the "resource curse" in finance is significant when only Z-score is used as an indicator of FE. The INQ decreases the negative effect of natural capital on FE. Faisal et al. (2019) presented a positive but insignificant association between natural capital and FE indicators in Turkey using the nonlinear autoregressive distributed lag technique. Sandow et al. (2022) used the GMM estimator to examine 25 Sub-Saharan African states between 1996 and 2017. They found that the "resource curse" can be transformed into a "resource blessing" by improving INQ channels. Moreover, they emphasized that the effect of natural capital rents on FE ("private credit, liquid liabilities, and commercial central bank assets") is dependent on the FE variable's measurement. Another study (Ali et al. 2022) examined the finance "resource curse" by using bootstrapped autoregressive distributed lag and data from 2002 to 2018. They found that the "resource curse" is valid in the context of bank expansion, whereas the "resource blessing" is valid in the context of stock market application. Another study (Adebayo et al. 2022) used data from 1970 to 2019 to revisit Mexico, Indonesia, Nigeria, and Turkey countries. They found that Nigeria and Mexico are resource blessed, whereas Indonesia and Turkey experience a "resource curse". Another study by Mohammed et al. (2020) concentrated on public and private oil revenue investment significance for oil producing states for the 1990–2015 period by using the GMM technique. They claimed that public and private investments had a significant effect on economic growth through banking expansion. Credit to the private sector by banks and other financial institutions, bank credit and money supply as a percentage of GDP were used as proxies for bank expansion. Moreover, Muhamad et al. (2020) examined private sector expansion to overcome the "resource curse" for NR producers between 1990 and 2017. Natural capital has been found to stimulate private sector expansion. In addition, Kou et al. (2022) stated that fossil fuel in transport vehicles contributes to carbon emissions. The authors recommended that solar panels receive sunlight vertically at different times and flexible structured solar panels should be used to obtain electrical energy and reduce carbon emissions.

Based on the above literature, various studies were conducted to investigate the relationship between natural capital and FE using different sets of states and different econometric techniques. The findings are inconclusive, particularly when it comes to emerging resource rich countries and the proxies used to measure FE. Furthermore, a review of the empirical literature reveals a huge gap in the research for resource rich Central Asia (Vakulchuk et al. 2022), (Isiksal et al. 2022). Therefore, this study aims to fill the gap in the literature by investigating the validity of "resource curse" or "resource blessing" in these states using advanced econometric techniques. This study provides important findings about the association between FE, NR rents, INQ,



**Fig. 1** Natural resource rents in Central Asia



**Fig. 2** Financial expansion index in Central Asia

and human capital in Central Asia. It also offers policy implications and recommendations for future research in Central Asia. The next section discusses the data and econometric tests used to achieve this goal.

**Data and methodology**

This research aims to examine the relationship between NR rents and FE. Figure 1 shows that NR rents in all CAS were increasing in 2020. Furthermore, Fig. 2 presents that the rise in FE was observed for the entire CAS, with Kazakhstan and Kyrgyzstan having a higher trend in FE than the other CAS. In this article, FE index is the dependent variable, and the explanatory variables are NR rents as a percentage of GDP, the square of NR rents as a percentage of GDP, GDP per capita (Y), HD index, and INQ index. The study examines the resource–finance nexus in CAS (Kazakhstan, Kyrgyzstan, Turkmenistan, Tajikistan, and Uzbekistan) using panel time series data from 1996 to 2020. The data for NR rents as a percentage of GDP and GDP per capita were obtained from the World Development Indicators published by World Bank (2021). The INQ variables are extracted from the World Bank’s World Governance Indicators, which cover six different governance dimensions (WGI 2022). The following indicators are included to represent INQ: voice and accountability, political stability and absence of violence, government effectiveness, regulatory quality, rule of law, and corruption control (Table 1). Because the above indicators have a positive correlation, a composite index was created using principle component analysis (PCA) to deal with multicollinearity (Table 2). To run

**Table 1** Variables of principal component analysis

Variable	Definition	Sources
<i>Definition of quality of institutions variables</i>		
CORP	Control of corruption	WGI
RULE	Rule of law	WGI
REQ	Regulatory quality	WGI
VOICE	Voice and accountability	WGI
PSTAB	Political stability	WGI
GOVEF	Government effectiveness	WGI

WGI refers to World Governance Indicators

**Table 2** The composite index of quality of institutions

**Eigen value: [S = 6, a = 1]**

No	Eigen-value	Diff	Prop	C.Value
P <sub>1</sub>	3.715	2.697	0.619	0.619
P <sub>2</sub>	1.018	0.444	0.169	0.789
P <sub>3</sub>	0.574	0.103	0.095	0.884
P <sub>4</sub>	0.471	0.324	0.078	0.963
P <sub>5</sub>	0.146	0.074	0.024	0.987
P <sub>6</sub>	0.072		0.012	1.000

Eve	P <sub>1</sub>	P <sub>2</sub>	P <sub>3</sub>	P <sub>4</sub>	P <sub>5</sub>	P <sub>6</sub>
CORP	0.4063	0.1137	-0.4892	0.6809	0.3438	-0.0294
RULE	0.4798	0.0824	-0.2461	-0.0541	-0.8259	0.1319
REQ	0.4849	-0.1482	0.2989	-0.1135	0.0577	-0.7984
VOICE	0.4109	-0.2913	0.6429	0.245	0.0844	0.5156
PSTAB	0.1122	0.9346	0.3298	-0.018	0.0654	0.0254
GOVEF	0.4338	0.0023	-0.2979	-0.6784	0.4301	0.279

All variables are defined in Table 1

P<sub>1</sub>, first principal component; P<sub>2</sub>, second principal component; P<sub>3</sub>, third principal component; P<sub>4</sub>, fourth principal component; P<sub>5</sub>, fifth principal component; P<sub>6</sub>, six principal component

**Table 3** KMO test and Bartlett's Test for INQ index

**KMO test and Bartlett's Test for INQ index**

Bartlett test	
Chi-square	547.498
Degrees of freedom	15
p value	0
KMO	0.743
Parameter	6

PCA, we must verify the suitability of INQ through the data factorability. Thus, the Bartlett's Test (Bartlett 1950) and Kaiser–Meyer–Olkin (KMO) (Kaiser 1970) tests are used to estimate sampling adequacy, which measures the suitability of sample size to create PCA. Table 3 shows the results of KMO and Bartlett's estimates. The KMO is between 0 and 1. The suitable PCA range of the KMO value is when it is over 0.60 (Kaiser 1970).



**Table 4** Variables’ description

Symbol	Variable	Definition	Sources
FE	Financial expansion index	The index of the financial expansion includes “financial institutions, financial markets, financial institution depth, financial institution access, financial institution efficiency, financial market depth, financial market access, and financial market efficiency”	IMF
NR	Natural resource rents	"Natural resource rents % of GDP"	WDI
NR2	Square of natural resources	"Square of natural resources rents % of GDP"	WDI
INQ	Institutional Quality	The quality of institutions is comprised of six indicators: "voice and accountability, political stability and absence of violence, government effectiveness, regulatory quality, rule of law, and control of corruption"	WGI
HD	Human development index	This index includes a "long and healthy life, knowledge, a decent standard of living"	UNDP
Y	Gross domestic product	"Real GDP per capita" [constant 2015 US\$]	WDI

"WDI refers to World Development Indicators, WGI stands for World Governance Indicators, IMF stands for International Monetary Fund, and UNDP stands for United Nations Development Programme"

**Table 5** Correlation matrix for the panel data

	FE	Y	NR	HD	INQ
FE	1				
Y	0.7369	1			
NR	0.1389	0.3032	1		
HD	0.4516	0.4237	−0.256	1	
INQ	0.6011	0.4297	−0.3124	0.4885	1

Furthermore, the p-value of the Bartlett test should be less than 0.05 to accept the suitability of principal components. In Table 3, the result of KMO is 0.743, indicating that correlation among variables is quite strong and proposes the appropriateness of the PCA since the KMO value is above 0.6. Bartlett’s test results are statistically significant at 1%, and they support the KMO findings. Therefore, INQ variables are appropriate to use in PCA composition. The INQ index outcomes are presented in Tables 2 and 3.

The World Bank indicators are quite objective since they employ a broad sample for the survey. The research will focus on the post-1991 era, when CAS gained its independence. Having said that, the statistics available after 1991 for all CAS are incomplete. Therefore, to provide a valid and consistent analysis with complete data and statistics, this study will span the years 1996–2020. The FE index data were extracted from IMF (2021). FE index comprises of “financial institutions, financial markets, financial institution depth, financial institution access, financial institution efficiency, financial market depth, financial market access, and financial market efficiency (IMF 2021).” In addition, the HD index was obtained from (UNDP 2021). The purpose of the HD index is to demonstrate that people’s capabilities and people themselves should be decisive criteria for assessing the state’s development and economic expansion. The HD index is an average of major human evolution achievements: “a long and healthy life, to have knowledge and an honorable standard of living (UNDP 2021).” Table 4 contains a detailed description of the variables. Table 5 shows the correlation

between the panel data variables used in this study. The FE index has the highest correlation with the economic expansion variable and the lowest correlation with the NR indicator. Based on the descriptive statistics (Table 6), Y and NR are expressed as natural logarithms.

Thus, as proposed by previous research (Dwumfour and Ntow-Gyamfi 2018; Zaidi et al. 2019), natural capital rents may have a significant impact on FE. Therefore, we employ the following estimating model to investigate the effect of NR rents and other independent variables on FE:

$$FE_{it} = \delta_i d_t + \beta_{1i} LNR_t + \beta_{2i} LNR^2_t + \beta_{3i} YL_t + \beta_{4i} INQ + \beta_{5i} HD_t + \epsilon_{it} \tag{1}$$

Natural resources may have a significant effect on FE (Dwumfour and Ntow-Gyamfi 2018; Gokmenoglu and Rustamov 2019) where an increase in NR rents raises demand for financial services and may increase FE. Furthermore, according to previous literature (Rongwei and Xiaoying 2020), an increase in natural wealth rent may lead to a decrease in FE. We also included Y, an HD index, and INQ index as independent variables for FE (Nguyen et al. 2018). The expansion of the economy may have a positive effect on FE (De Gregorio and Guidotti 1995). The association between the INQ index and FE can be either positive or negative. Thus, we cannot assign a positive or negative symbol to INQ. The HD index includes three indices, namely, a healthy life, knowledge, and an honorable standard of living, all of which should boost FE. Therefore, it may lead to increased financialization (Zaidi et al. 2019).

Following the model specification, the next section focuses on the methodology employed for this research.

### Methodology

When using panel data techniques, we must confirm the presence of cross-sectional dependence (CSD) early on. If it is not tested, the outcomes might state “over rejection of the null hypothesis of the unit root.” Furthermore, when it is not evaluated, the results can be deceptive. To avoid misleading results, we begin with the CSD tests. Breusch and Pagan (1980) derived the following model:

$$CSD_{BP} = T \sum_{i=1}^{N-1} \sum_{j=i+1}^N \hat{p}_{ij}^2 \tag{2}$$

The statistics for Lagrange Multiplier were derived by Pesaran (2004):

**Table 6** Descriptive statistics

	FE	NR	Y	HDI	INQ
Mean	0.147	16.779	3137.958	0.620	0.001
SD	0.086	17.308	3066.263	0.164	1.000
Skewness	1.009	1.587	1.314	-2.158	0.306
Kurtosis	3.275	5.702	3.542	7.637	2.356
Obs	125	125	125	125	125

$$CSDLM = \sqrt{\frac{1}{N(N-1)} \sum_{i=1}^{N-1} \sum_{j=i+1}^N (T\hat{p}_{ij}^2 - 1)} \tag{3}$$

“ $H_0 = Cov(u_{it}, u_{ij}) = 0$ , no CSD”

“ $H_1 = Cov(u_{it}, u_{ij}) \neq 0$ , CSD”

The null hypothesis is not accepted when the  $p$  value is lower than the significance value. Otherwise, we will accept the null hypothesis. Another test for CSD is by Pesaran (2004), which was used in this study because CAS has similar characteristics. It is shown in Eq. 4:

$$CSDp = \left( \frac{TC[C-1]}{2} \right)^{1/2} \bar{P} \tag{4}$$

where  $\bar{P} = \left( \frac{2}{C[C-1]} \right) \sum_{i=1}^{C-1} \sum_{j=i+1}^C \check{p}_{ij}$ , and  $\check{p}_{ij}$  refers to “pairwise correlation coefficients of cross-sectional residuals extracted from Augmented Dickey–Fuller (ADF) regression.”  $C$  and  $T$  stand for cross-sectional periods and dimensions, respectively. Following CSD testing, we proceed with the unit root test that takes CSD into account, such as the cross-sectional ADF (CADF) test of the unit root (Baltagi et al. 2012; Pesaran 2007), and the results provided by this test are robust because the technique considers the effects of cross-sections.

Meanwhile, the “Westerlund (2007) error correction model technique for panel cointegration” examines the existence of cointegration among panels and individual states.

The Westerlund (2007) approach is outlined as follows:

$$y_{it} = \delta_i d_t + \alpha_i y_{it-1} + \pi_i x_{it-1} + \alpha_i \gamma \Delta_{it-1} + \sum_{j=1}^P \alpha_i X \Delta_{it-1} + \varepsilon_{it} \tag{5}$$

where  $\alpha$  in Eq. 5 stands for the error correction parameter and,  $d_t = (1, t)$  incorporates the “deterministic components.” The variables used in this research are likely to be dependent cross-sectionally since CAS are assimilated by trade associations, technological development, and globalization. Based on these facts, the CS-ARDL technique developed by Chudik et al. (2016) was applied. This technique uses the lag of dependent series derived within the error correction framework to seize the dynamic performance. The CS-ARDL technique is very effective in the existence of unobserved common factors. This technique has the advantage of referring to CSD in both the long and short terms. We employed three versions of the CS-ARDL technique (Chudik et al. 2016) that refer to CSD: “the long run, both the short and long term, and the short run.”

These methods are illustrated in Eq. 6:

$$\begin{aligned} \Delta FE_{it} = & \mu_i + \phi_t (FE_{it-1} - \beta_i X_{it-1} - \phi_{1i} \overline{FE}_{t-1} - \phi_{2i} \overline{X}_{t-1}) + \sum_{j=1}^{p-1} \lambda_{ij} \Delta FE_{it-j} \\ & + \sum_{j=0}^{q-1} \zeta_{ij} \Delta X_{it-j} + \eta_{1i} \Delta \overline{FE}_t + \eta_{2i} \Delta \overline{X}_t + \varepsilon_{it} \end{aligned} \tag{6}$$

where  $\Delta FE$  stands for the dependent variable,  $X_{it}$  incorporates all independent series;  $\overline{FE}_{t-1}$  is the dependent variable’s long run mean;  $\Delta FE_{it-j}$  stands for the dependent variable in the short term;  $\Delta X_{it-j}$  stands for independent variables in the short term ;  $\overline{\Delta FE}_t$  refers to the short term dependent variable mean;  $\overline{\Delta X}_t$  stands for short run independent series mean, and  $\varepsilon_{it}$  is the “error term”;  $t$  represents time and  $t = 1 \dots T$ . We used the dynamic common correlated effects mean group (DCCEMG) approach introduced by Pesaran (2006) for the robustness measure, which was later adjusted by Chudik and Pesaran (2015). This method considers CSD, endogenous regressors, and heterogeneity.

Accordingly, a long run relationship between the variables implies at least one causality relationship between the variables. Therefore, the Engle–Granger test under “vector error correction mechanism” (VECM) is used to determine both short run and long run causalities. For this estimation test, the “error correction term (ECT)” was included in the “vector autoregression” (VAR) as an auxiliary variable. The ECT indicates the presence of a long run association. The F-statistics of the Wald test are used to define the significance of the related coefficient in the short run. The significant lagged ECT, as defined by a t-test, is used to report long term causality. Based on the econometric techniques being specified for this research, the next section analyzes the empirical outcomes.

**Empirical outcomes**

As a first step, we must test for the existence of CSD for two reasons: it will provide guidance for selecting the appropriate unit root test technique and appropriate data analysis techniques. Table 7 shows the estimated results of the CSD technique. These findings confirm the presence of CSD and support the use of Pesaran’s (2007) CADF techniques for unit root tests, as this technique accounts for CSD. In the CADF test, the constant term is also taken into account during estimation. The results indicate that the FE index, NR, square of NR, GDP per capita, HD index, and INQ index are non-stationary at this level. During the estimation process, however, every variable becomes stationary at its first difference. As a result, both the CSD and unit root results suggest that the CS-ARDL method should be used in the future. The CS-ARDL technique has the advantage of considering CSD in three stages: short, long, and both short and long stages, which all contribute to the robustness of the results. The Westerlund’s (2007) test of cointegration was applied to investigate cointegration, and the results are presented in Table 8. According to the table’s findings, there is a long term and significant relationship between FE, NR, economic expansion, INQ, and HD.

**Table 7** CSD and unit rot tests outcomes

Variable	CSDbp	CSDIm	CSDp	CADF (Level)	CADF (First difference)
FE	78.703***	15.363***	8.100***	− 1.417	− 3.005***
LNR	64.927***	12.282***	5.670***	− 0.730	− 3.401***
YL	233.320***	49.936***	15.270***	− 1.774	− 3.271***
HD	211.607***	45.081***	14.490***	− 1.357	− 3.136***
INQ	62.500***	11.739***	1.850*	− 2.038	− 4.298***

\*, \*\*, \*\*\* refers that there is significance at the 10%, 5%, 1% levels

**Table 8** Cointegration of Westerlund test outcomes

Statistic	Value	Z-value	p value
Gt	−3.525*	−1.239	0.068
Ga	−11.483**	1.887	0.018
Pt	−5.571	0.661	0.313
Pa	−12.863**	0.699	0.013

\*\* , \* refers that there is significance at the 5%, 10% levels

**Table 9** CS-ARDL technique outcomes

FE	CSD in short-term		CSD long term		CSD in short and long term	
	Long term	Short term	Long term	Short term	Long term	Short term
<i>Error correction</i>		−0.841***		−0.962***		−0.666***
$\Delta LNR$		0.012*		0.031**		0.007
$\Delta LNR2$		−0.001		−0.009*		−0.001
$\Delta YL$		0.125**		0.164**		0.026
$\Delta HD$		0.326		0.071		0.057
$\Delta INQ$		0.007**		0.004		0.01***
<i>LNR</i>	0.007**		0.016*		0.004***	
<i>LNR2</i>	−0.001		−0.005*		−0.001***	
<i>YL</i>	0.069**		0.09**		0.015***	
<i>HD</i>	0.142		0.045*		0.035***	
<i>INQ</i>	0.004**		0.003		0.006***	
<i>Constant</i>	−0.284**		−0.438**		0.078	

\* , \*\* , \*\*\* refers that there is significance at the 10%, 5% and 1% levels

Table 9 summarizes the findings and discusses cross-sectional dependencies in the short run, long run, and both short and long run. We focus on the results of the last column because the spillover effect occurs in both the short and long run between CAS (Zeqiraj et al. 2020). The error correction term is significant and negative based on the estimation results. As a result, there is a long term relationship between FE index and the independent variables. It states that after a shock, economies adjust 67% of the time to the long run equilibrium. The findings of previous studies differ on the relationship between NR and FE. Recent studies have discussed and re-evaluated this issue, but the results remain contentious. The square term of NR rents is included in the model to determine whether a nonmonotonic relationship exists between NR rents and FE index in CAS.

Table 9 displays the long run test results using FE index as the dependent series. Economic expansion has a positive and statistically significant effect on FE. These findings are consistent with the “demand following hypothesis,” which states that increased economic activity increases demand for financial services and products. Thus, it will stimulate financial growth. These findings are supported by Shahbaz et al. (2018). With the expansion of the economy, the private sector’s demand for new financial services may increase. Furthermore, it may increase demand for greater external finance access. Thus, the firms will seek debt financing through bank intermediation

or equity markets to raise external funds. Therefore, it will increase the number of different companies, which will increase employment, export, and financial services demand. Thus, economic expansion leads to an increase in FE. Moreover, due to increased prices and a high volume of export, Kazakhstan and Turkmenistan have high gas and oil revenues. Furthermore, Kyrgyzstan, Uzbekistan, and Tajikistan continue to receive significant remittances from Russia, which has a high demand for migrant workers. Additionally, real wages and public revenues are increasing rapidly in the region. The region's capital cities are experiencing a real estate boom (EBRD).

Furthermore, INQ has a positive and statistically significant effect on FE in the long run. It presents the significance of institutions in financial growth. This outcome states that the better INQ helps to provide a clearer view of corruption, contract imposition, and rent seeking, as well as increased democracy. Furthermore, higher-quality institutions promote economic growth by assisting with financial improvement. These findings are consistent with those obtained by Dwumfour and Ntow-Gyamfi (2018), Ali et al. (2022), Gokmenoglu and Rustamov (2019). The positive effect of INQ also refers to the fact that strong, stable, and independent civil and public services have a positive impact on FE. High political stability is required for the economy to function effectively. Furthermore, FE can develop and function effectively in states that are politically strong, stable, and less corrupt. As a result of these findings, it is suggested that INQ be improved in order to efficiently exploit natural resources and advance financial markets and institutions. It also implies that well functioning institutions would result in greater corruption control, better contract enforcement, less violence, and more democracy. These findings are comparable to those Khan et al. (2020), Dwumfour and Ntow-Gyamfi (2018).

The NR rents and FE association is positive and significant, whereas the association of the square of the NR rents and FE is negative. Thus, the NR rents and FE follow an inverted U-shaped relationship. The major research question of "What is the effect of NR wealth on FE of Central Asia that has a huge and well diversified natural resource basis?" is answered here by stating that NR rents help to improve FE in the early stages, but excessive use of natural resources hinders CAS's FE. Therefore, the null hypothesis claiming a U-shaped relationship between NR rents and FE is rejected. Thus, the alternative hypothesis that an inverted U-shaped relationship exists between NR rents and FE is accepted. Furthermore, the inverted U-shaped association implies that the positive influence of NR rents occurs only when NR rents are moderate. Hence, excessive misuse of NR revenues can turn the blessing of natural resources into a "resource curse." These findings support the outcomes of Mohammed et al. (2020), Muhamad et al. (2020) who claimed that resource rich states are inclined to be less financially developed. These findings are supported by Khan et al. (2020), Yildirim et al. (2022) who state that the abundance of natural resources increases only the NR extraction fields, resulting in a limited expansion of financial services and markets. Thus, based on the finding it can be stated that FE in resource rich Central Asia is not expanding and these states currently experiencing a "resource curse." However, these findings contradict those Gokmenoglu and Rustamov (2019) who examined the effect of NR rents on FE in Kazakhstan, Azerbaijan, Russia, and Turkmenistan states and found that natural resources are a source of income that can be used to boost FE. Thus, the financial "resource curse" for CAS

is confirmed by using updated data and robust and current techniques. It implies that natural resources are taking the lead in the economies of the CAS and these states can reduce NR consumption by focusing on investment in renewable energy resources (Kou et al. 2022). It also refers to the fact that the public sector dominates these states, and the private sector's weakness prevents FE. Thus, it suggests that the private sector should be more efficient in utilizing resources and stimulating economic activity (Mohammed et al. 2020), (Muhamad et al. 2020). Because CAS are NR exporters, the flow of the revenues from natural resources to the public sector should be monitored because it creates a "spillover effect" on FE (Mohammed et al. 2020).

The HD index has a positive effect on FE. This finding implies that households and individuals with no or limited education are more likely to struggle with basic financial management principles, and financial services and products. It also states that knowledge based expansion, long life, and honorable living standards are critical for FE. Furthermore, based on these results, it follows that, in addition to organizational success, which is heavily reliant on human capital, the state's FE is also reliant on human capital. The findings support previous research that found HD factors such as living standards and literacy rates to be driving factors in FE (Shahbaz et al. 2018). This result is similar to the findings of Ebrahimi Salari et al. (2022) research, which stated that business promotion is dependent on HD policy, and investment in human capital could be the most efficient and productive way to increase demand for financial services because it promotes FE. Similar findings were presented by Rahim et al. (2021), Khan et al. (2020), Gokmenoglu and Rustamov (2022) who found that a skilled and educated population is more efficient, innovative, and productive. As a result, it can be stated that HD increases FE in CAS. Additional human capital investment is required as part of CAS's increased FE. Adults in CAS are educated and talented individuals who wish to further their research abroad. CAS has a high mobility ratio among Ph.D. students and academic professors, which has exacerbated exchanges between CAS and many states around the world. Increased investment in HD will spur economic growth and help to turn the "resource curse" into a "resource blessing".

To the best of our knowledge, this is the first study to examine the finance "resource curse" or finance "resource blessing" in the finance–natural resource association by testing the nonlinear relationship between NR rents and FE index in the context of CAS. The major findings of the current literature are that CAS are an important chain of natural resources that are initially experiencing "resource blessing" that later turns into the "resource curse." These findings were supported by the DCCEMG test outcomes presented in Table 10, which was used for the robustness check. Table 10 outcomes state that NR rents and FE have an inverted U-shaped relationship, and INQ and HD promote FE.

The Westerlund (2007) approach confirms the existence of cointegration between FE index, NR rents, economic expansion, INQ, and HD. To provide an effective policy framework, policymakers must understand the causality directions. To address this issue, the VECM Granger causality test is used to define the variables' short and long run causalities. Engle and Granger (1987) argued that if the variables are cointegrated, there should be at least one causality. Table 11 displays the VECM Granger causality outcomes. It presents the results of the FE causality test, stating that there is a one way short

**Table 10** DCCEMG outcomes

Variables	DCCEMG
<i>FE</i> (− 1)	0.030*
<i>LNR</i>	0.067*
<i>LNR</i> 2	− 0.022 ***
<i>YL</i>	0.126
<i>HD</i>	1.869
<i>INQ</i>	0.013 *
Constant	0.907

\*, \*\*, \*\*\* refers that there is significance at 10%, 5% and 1% levels

**Table 11** VECM causality test outcomes

	$\Delta FE$	$\Delta LNR$	$\Delta LNR2$	$\Delta YL$	$\Delta HD$	$\Delta INQ$	$ECT_t - 1$
$\Delta FE$	−	1.450	1.858	4.172	3.593	7.040*	− 0.018**
$\Delta LNR$	1.166	−	10.506	2.361	1.881	2.915	0.055
$\Delta LNR2$	2.458	9.902	−	3.347	2.279	1.612	2.182
$\Delta YL$	0.364	1.859	1.670	−	1.474	0.949	− 0.032
$\Delta HD$	2.872	0.898	2.299	7.355*	−	2.731	0.032
$\Delta INQ$	7.777*	8.462**	9.117	3.365	0.870	−	− 0.327

\*\*, \*\*\* refers that there is significance at 5% and 1% levels

run causality running from GDP to human capital. It implies that economic growth promotes human capital. Furthermore, a short run, one way causality runs from NR rents to INQ, stating that proper management of natural resources will affect INQ, which can lead to a more democratic and less corrupted life for the current and future generations of CAS. There is also a short run bidirectional causality between INQ and FE. Therefore, it appears that INQ is the deterministic parameter to optimize FE, while FE is also detrimental to INQ. As a result, these variables are additive and affect each other’s performance. Furthermore, there is a long run causality extending from all variables to FE, demonstrating the significance of all variables for future FE.

The significant findings discussed above are required to conclude the paper and provide future policy implications, which are presented in the following section.

**Conclusion**

This study employs panel data from CAS, namely, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan from 1996 to 2020, and employs empirical tests known as the CS-ARDL and VECM Granger causality tests. The test results showed an inverted U-shaped relationship between FE index, NR rents, and quadratic terms of NR rents. The CAS experience “resource blessing” during the early stages of development; however, the excessive use of natural resources leads to the “resource curse” phenomenon. In addition, HD index and INQ index were employed to verify whether they could alleviate the “resource curse” observed in these states.

This study’s findings imply some important facts. FE and NR rents have an inverted U-shaped relationship, with NR rents initially raising FE in CAS and further growth decreasing it. An inverted nonlinear U-shaped relationship between finance and NR rents was observed. It implies that the inverted U-shaped association can only have a



positive influence on NR rents when NR rents are moderate. Thus, excessive NR revenues misuse can turn the blessing of natural resources into a “resource curse.” This inverted U-shaped relationship between FE and natural resources implies that CAS can reduce NR consumption by increasing support to the private sector, improving INQ, decreasing corruption, and enhancing human capital that could drive down NR exploitation, developing other industries other than resource rents oriented, and focusing on investment in renewable energy resources. Furthermore, the subsequent outcomes demonstrated a positive effect of economic development on FE. In addition, HD index and INQ have a positive effect on FE. Moreover, a bidirectional causality exists between INQ and FE, and the causality extends from all variables to FE in the long run. Therefore, based on these results, we can conclude that the increased FE will decrease poverty and increase people’s living standards, thereby stimulating HD. Since the economies of CAS are backed by the proceeds from NR rents, the initially positive but later negative effect on FE indicates that these proceeds are not well managed. Hence, proceeds from the NR rents may prevent FE and have a negative impact on growth due to the insufficient level of FE and misuse of these proceeds.

Based on these findings, the CAS authorities are suggested to implement the following policies:

- They must diversify financial services and products, and manage the proceeds from NR rents to make effective investments.
- Current financial institution and market services and products appear to be inefficient. Therefore, they must increase the quality and effectiveness of financial institutions and markets.
- To counteract the negative effect of NR rent, CAS should focus on increasing the quality of existing institutions and enhancing HD.
- Furthermore, these states should promote financial education for financial services and products, and train the public to use digital channels.
- Accountability and transparency must be strengthened to protect investors and increase competition in the financial system.
- Well governed institutions are required for CAS to transition from a rentier position based on NR revenues to an expansive economy with institutions that would eventually increase the role of the private sector by restructuring the states’ social and political infrastructures.
- With the structural transformations, diversification and sustainability through government investment, a gradual shift to greener incentives, and the potential involvement of international collaborations must be prioritized.

The research for CAS has some limitations. The main limitations of this analysis are the data availability and indicators available. Because statistics for Central Asian countries after 1991 are incomplete, this study attempted to cover the longest available (in terms of data availability) period. CAS are an essential case to study since these states are rich in natural resources. However, they are currently facing the “resource curse” as a result of mismanagement and misuse of NR revenues. Future research should focus on the finance resource nexus for these states by incorporating additional CAS-relevant

variables such as economic freedom, exchange rates, and interest rates. Furthermore, the finance resource nexus must be analyzed using disaggregated analysis for each CAS country, and the threshold levels that can turn the “resource curse” into a “resource blessing” for these overlooked resource rich CAS must be emphasized.

#### Abbreviations

CAS	Central Asian States
CS-ARDL	Cross-sectionally Augmented Autoregressive Distributed Lag
CIS	Commonwealth of Independent States
PMG	Pooled Mean Group
DFE	Dynamic Fixed Effect
DOLS	Dynamic Ordinary Least Square
GMM	Generalized Method of Moments
NARDL	Nonlinear Autoregressive Distributed Lag
BARDL	Bootstrapped Autoregressive Distributed Lag
PARDL	Panel Autoregressive Distributed Lags
MINT	Mexico, Indonesia, Nigeria, and Turkey
KMO	Kaiser–Meyer–Olkin
PCA	Principle Component Analysis
WGI	World Governance Indicators
CSD	Cross-sectional Dependence
DCCEMG	Dynamic Common Correlated Effects Mean Group
VECM	Vector Error Correction Mechanism
ECT	Error Correction Term
CADF	Cross-sectional Augmented Dickey–Fuller
ADF	Augmented Dickey–Fuller
EBRD	European Bank for Reconstruction and Development
VAR	Vector Autoregression
LM	Lagrange Multiplier
OECD	The Organization for Economic Cooperation and Development

#### Acknowledgements

I would like to express my gratitude and thank the Editor and the anonymous Reviewers for reviewing the article which helped me to improve it a lot.

#### Author contributions

The author conducted all the research. The author read and approved the final manuscript.

#### Funding

No funding has been used for the production of this research.

#### Availability of data and materials

The dataset supporting the conclusions of this article is available on reasonable request.

#### Declarations

##### Competing interests

The authors declare that they have no competing interests.

Received: 25 June 2022 Accepted: 15 March 2023

Published online: 17 April 2023

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