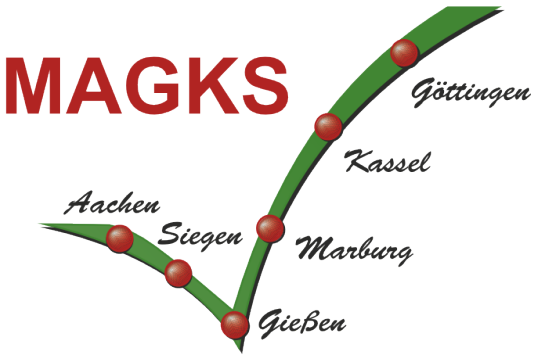


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# The effect of oil rents on economic growth: Does digital adoption matter?



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# The effect of oil rents on economic growth: Does digital adoption matter?

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## Abstract

This study investigates the relationship between oil rents and economic growth, identifying digital adoption as a critical moderating factor. Utilizing a cross-sectional sample of 101 countries, we analyze the impact of oil rents (2014–2016) on subsequent GDP per capita growth (2016–2023). Our regression analysis provides empirical evidence of a "digitalization-resource nexus": while a significant "oil curse" persists in countries with low digital adoption, this negative association attenuates as digital integration increases. Notably, our findings suggest a turning point (DAI ≈ 0.72) beyond which oil wealth may transition from a growth constraint to a catalyst. These results remain robust after controlling for institutional quality, human capital, and trade openness. The study concludes that investments in digital infrastructure and skills are not merely technological upgrades but essential structural reforms for resource-dependent economies seeking to bypass the resource curse.

**Keywords:** Economic growth, digitalization, digital adoption, oil rents, resource curse

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## 1. Introduction

The "oil curse", the paradoxical adverse effect of oil rent dependence on long-term economic growth, remains a focal point of development economics (Ross, 2012). Over decades, scholarship has identified various conditioning factors that determine whether resource wealth acts as a blessing or a burden. Existing research has centered on institutional quality (Mehlum et al., 2006), political and ethnic fragmentation (Bjorvatn et al., 2012; Hodler, 2006), and human capital development (Farzanegan and Thum, 2020; Gylfason, 2001). Furthermore, literature has explored the "curse" through the lenses of rent-seeking and corruption (Mahdavy, 1970; Torvik, 2002), civil conflict (Collier and Hoeffler, 2005), socioeconomic inequality (Farzanegan and Habibpour, 2017; Farzanegan and Krieger, 2019), entrepreneurship (Farzanegan, 2014; Pavlik and Ross, 2024) and the macroeconomic distortions of Dutch disease (van Wijnbergen, 1984).

Despite these extensive inquiries, this study introduces a novel and increasingly critical conditioning factor: digital adoption. We utilize the Digital Adoption Index (DAI) introduced by the World Bank (2016) to capture the extent of digital technology uptake across three vital domains: people, government, and business. The DAI, measured on a 0–1 scale, emphasizes the supply-side of digital adoption, aggregating sub-indexes that reflect the digital infrastructure and capabilities necessary for firm productivity, individual welfare, and public sector accountability. As digital infrastructure becomes the backbone of modern economies, investigating how it moderates the oil-growth nexus provides a timely and policy-relevant contribution to the resource curse literature.

The real-world divergence in economic outcomes among resource-rich nations highlights the potential role of digital capacity. Between 2016 and 2023, the United Arab Emirates (UAE) leveraged its oil wealth, which accounted for 11% of GDP in 2016, to achieve an average annual growth of 2.4% and a GDP per capita exceeding $42,000. In stark contrast, Equatorial Guinea, with a nearly identical oil share in 2016, experienced a 4% annual economic contraction, with its GDP per capita languishing at approximately $6,000 (WDI, 2025). This striking disparity underscores the ongoing debate in the literature, where 40% of studies identify oil rents as a "resource curse," 20% as a "blessing," and 40% detect no consistent effect (Havranek et al., 2016). A primary driver of this difference may lie in their digital adoption levels: in 2016, the UAE boasted a DAI of 0.82, while Equatorial Guinea ranked near the bottom at 0.18 (World Bank, 2016).

As the digital revolution gains momentum, projected to contribute $100 trillion to global GDP by 2025 (World Economic Forum, 2016), critical question arises: can digital adoption be associated with a weaker adverse relationship between oil rents and economic growth? While the oil-growth nexus has garnered significant attention (Ross, 2015), the moderating role of digital adoption remains largely overlooked. By enhancing productivity, transparency, and economic diversification (Manyika et al., 2016), digital technologies may fundamentally redefine the dynamics of resource-driven growth.

This study examines the relationship between oil rents and economic growth across 101 countries from 2014 to 2016, specifically focusing on the moderating role of digital adoption. We argue that higher levels of digital adoption can weaken the negative association between oil rents and growth, potentially transforming a "curse" into a source of sustained prosperity. In this context, we distinguish "digital adoption" from "digitalization": while digitalization refers to the broad structural transformation of traditional processes into digital ones, digital adoption concerns the actual utilization and uptake of these technologies by individuals, businesses, and governments.

The remainder of this study is structured as follows: Section 2 reviews the relevant literature and develops our conceptual framework; Section 3 describes the data and empirical methodology; Section 4 presents the results and discussion; and Section 5 concludes with policy implications.

## 2. Literature review

The literature relevant to this study can be categorized into two primary strands: one exploring the relationship between oil rents and economic growth, and the other examining the impact of digitalization on economic growth. This section reviews these strands systematically, highlighting key findings and debates, before identifying a critical gap at their intersection that this study seeks to address.

### 2.1. Oil rents and economic growth

The effect of oil rents on economic growth has been extensively debated, with studies broadly classifying their impact into three perspectives: a "resource blessing," a "resource curse," or a neutral effect. The "resource blessing" view posits that oil rents can drive significant economic growth and development (Kaznacheev, 2017). Sachs (2007) argues that oil revenues stimulate consumption, investment, and public budgets, while (Willebald, 2015) demonstrates their

contribution to growth across various countries. For instance, oil extraction creates jobs and infrastructure in disadvantaged regions (Adabor and Buabeng, 2021) and taxes from resource firms generate wealth that boosts economic activity (Mawejje, 2019). These benefits also enhance living standards by increasing income for workers and employers in the sector.

In contrast, the "resource curse", also termed the paradox of plenty, suggests that abundant natural resources, such as oil, often lead to poorer economic growth, weaker institutions, and worse development outcomes compared to resource-scarce nations (Christensen et al., 2024). Sachs and Warner (1995) analyzing 97 developing countries from 1971 to 1989, found a negative correlation between natural resource exports and growth, a phenomenon often exemplified by the Dutch disease. (Davis, 1995) explains that resource booms increase exchange rates and inflation, shifting capital and labor to the oil sector and undermining non-oil industries. Additionally, oil wealth can fuel conflict and violence, further stifling growth (Bjorvatn and Farzanegan, 2015; Farzanegan et al., 2018).

A third perspective contends that oil rents have no consistent impact on growth. Sachs and Warner (1995) challenge their own curse hypothesis by suggesting that neither resource abundance nor investment directly drives growth, pointing to other mediating factors. Similarly, Stijns (2005) finds no clear evidence of a direct oil-growth link, highlighting the relationship's complexity.

### 2.2. Digitalization and economic growth

Over the past two decades, digitalization, defined as the adoption of digital technologies across sectors, has emerged as a transformative force in global economies. By reducing transaction costs and increasing transparency, it drives growth through enhanced productivity, innovation, market expansion, and accountability (Dahlman et al., 2016). Myovella et al. (2020), using a generalized method of moments (GMM) analysis across 41 sub-Saharan African and 33 OECD countries over 11 years, confirm that digitalization boosts growth irrespective of development level, with benefits for developing nations via improved productivity and market access.

Brynjolfsson and McAfee (2015, 2014) argue that digital technologies outperform human labor in task automation, significantly raising productivity in manufacturing and services. Novikova et al. (2022) link higher digitalization levels to stronger economic development, while Eslami Andargoli et al. (2023) demonstrate that government support for digital adoption spurred firm-level innovation during the COVID-19 pandemic, underscoring its role in fostering entrepreneurship.

### 2.3. Our contribution

While extensive literature has examined the individual impacts of digitalization on economic growth, emphasizing dimensions such as innovation, entrepreneurship, productivity, and market expansion, a critical gap remains regarding the moderating role of digitalization in shaping the relationship between resource rents and economic growth.

The relationship between resource rents, such as oil and mineral wealth, and economic growth is well-documented, with extensive research exploring the contrasting "resource curse" and "resource blessing" phenomena. However, limited attention has been given to the potential interaction between digital adoption and oil rents. It is plausible that digital technologies could alter, enhance, or mitigate the traditional association between oil wealth and economic growth. These technologies may improve governance, foster innovation, and increase the efficiency of resource utilization. As economies become increasingly digitalized, they could develop new pathways to mitigate the negative effects typically associated with the resource curse, such as poor governance, corruption, and over-reliance on resource exports.

This study aims to fill this gap by examining the interaction between digitalization and resource rents in shaping economic growth, with a particular focus on developing, resource-dependent countries. By synthesizing insights from both the digitalization and resource curse literatures, this research enhances our understanding of how modern technological advancements can influence the growth trajectories of resource-rich economies.

Because digital adoption is a cross-cutting technology that influences the private sector, the public sector, and individual consumers simultaneously, it operates as a “multi-channel” moderator. This study concentrates on identifying this broad conditional relationship, thereby establishing a foundation for future research to examine more specific sector-level transmission mechanisms.

### 2.4. Hypothesis development

This section outlines the theoretical foundation for our hypothesis, linking economic growth, oil rents, and digitalization.

The core argument is that association between oil rents and growth varies with a country’s digitalization level. As noted, oil rents may act as a curse, blessing, or neutral factor, depending on

conditions like governance, diversification, and productivity (Mehlum et al., 2006; Dahlman et al., 2016).

Governance channel. Digitalization drives growth directly by enhancing transparency and reducing discretionary power, thereby curbing corruption and rent-seeking through increased accountability and information access (Adam, 2020).

Diversification channel. By reducing transaction costs, expanding market access, and enabling new business models, digital technologies foster entrepreneurship and the development of non-oil sectors (Diaconu, 2019).

Productivity channel. Digitalization enhances productivity by improving firm-level efficiency, coordination, and innovation, while also strengthening human capital through improved access to education and skills (Dahlman et al., 2016; Zhao et al., 2022).

Moreover, the moderating role of digital adoption can be interpreted within the Dutch Disease framework as another argument. In resource-dependent economies, oil windfalls typically lead to real exchange rate appreciation, which reduces the competitiveness of tradable sectors, particularly manufacturing, and shifts resources toward non-tradable activities. However, digital adoption modifies this transmission channel in several important ways.

First, digitalization supports the expansion of digitally deliverable service exports, such as ICT services, fintech, and knowledge-intensive business services. These sectors are generally less sensitive to exchange rate appreciation than traditional manufacturing, as they depend more on human capital and digital infrastructure than on cost-competitive physical inputs. This makes them relatively more resilient to currency overvaluation (Jiang and Jia, 2022).

Second, improved digital infrastructure lowers transaction costs and reduces barriers to entry for non-oil firms. This enhances sectoral flexibility and helps mitigate the crowding-out effects typically associated with resource booms (Diaconu, 2019).

Third, digital technologies can strengthen fiscal transparency and improve public-sector efficiency, increasing the probability that oil revenues are directed toward productivity-enhancing investments rather than rent-seeking activities or inefficient public employment (Sharmin and Chowdhury, 2025; Tariq, 2025).

Through these mechanisms, digital adoption attenuates the conventional Dutch Disease effect and moderates the negative growth association commonly observed in oil-dependent economies.

Thus, our key hypothesis is:

*The association between oil-rents dependence and economic growth varies with a country's digitalization level. Lower levels of digital adoption are expected to be associated with a more negative relationship between oil rents and growth, while higher levels may weaken these associations.*

## 3. Model and data

### 3.1. Model

The conceptual framework hypothesizes that depending on the level of digitalization, oil rents dependency impacts economic growth. To test the hypothesis, the following model is estimated:

$$\begin{aligned} \text{GDPPCgrowth}_i = \alpha_i + \beta_1 \text{LnOilrents}_i + \beta_2 \text{Digitalization}_i + \\ \beta_3(\text{LnOilrents}_i \times \text{Digitalization}_i) + \beta_4 \text{L.LnGDP}_i + \beta_5 Z_i + \epsilon_i \end{aligned} \quad (1)$$

In this case, $\text{GDPPCgrowth}_i$ represents GDP per capita growth rate in country i, $\alpha_i$ corresponds to intercept, $\text{LnOilrents}_i$ is the Log of oil rents (%) of GDP, $\text{L.LnGDP}_i$ represents the lag of Log of GDP per capita, and digitalization stands for Digital Adoption Index. In equation 1, $\beta_1$ captures the association between oil rents and GDP growth, and $\beta_3$ measures the association between oil rents and GDP growth conditional on the level of digitalization. It is predicted that the linear effect and the interaction effect will be negative and positive respectively ($\beta_1<0$, $\beta_3>0$). Thus, higher levels of digital adoption index, the weaker the negative association between oil rents and the economic growth. $Z_i$ stands for all control variables. Robust standard errors are used for all coefficients to account for potential heteroskedasticity.

Since the dependent variable is the GDP per capita growth rate (measured in percentage points) and several explanatory variables enter the regression in logarithmic form, such as the log of oil rents as a share of GDP, the estimated coefficient on the log of oil rents should be interpreted as a semi-elasticity. Specifically, a 1% proportional increase in the oil rents share of GDP corresponds to an approximate 0.01 change in the log of oil rents. This change is associated with a $0.01 \times \beta_1$ change in the GDP per capita growth rate, measured in percentage points, holding other variables constant.

It is important to stress that the empirical specification follows a reduced-form approach. The model does not directly estimate the intermediate transmission channels, such as firm-level adjustments to exchange rate appreciation, sectoral reallocation processes, or the operational efficiency of digital public procurement systems, through which digitalization may alleviate the resource curse. Rather, the interaction term captures the overall macroeconomic outcome of these underlying mechanisms. If digital adoption mitigates the negative growth effects of oil dependence through improvements in governance, attenuation of Dutch Disease dynamics, productivity enhancements, or human capital development, this should be reflected in a positive and statistically significant coefficient on the interaction between oil rents and digital adoption. The empirical findings are consistent with this reduced-form interpretation.

A central empirical challenge in cross-country growth regressions is the risk of endogeneity. Oil rents may be correlated with unobserved country-specific characteristics, such as institutional quality, political stability, or historical development trajectories, that also shape growth performance. Likewise, digital adoption is closely associated with income levels and broader measures of economic development, raising concerns that it may proxy for underlying structural advantages rather than exerting an independent effect. Although the explanatory variables are measured prior to the growth period in order to reduce concerns about reverse causality, this temporal ordering does not fully address the possibility of omitted variable bias. As a result, the estimated coefficients should be interpreted as conditional correlations rather than causal estimates. The empirical strategy therefore adopts a reduced-form perspective: it captures the net macroeconomic association between oil dependence, digital adoption, and subsequent growth outcomes, without claiming to identify a structural causal parameter or isolate the precise transmission mechanisms at work.

### 3.2. Data

This study employs a cross-sectional dataset in which explanatory variables are measured prior to the growth period in order to mitigate concerns related to reverse feedback. GDP per capita growth, the dependent variable, is computed as the average annual growth rate over the period 2016–2023. All core explanatory variables, oil rents, control variables, and lagged GDP per capita, are averaged over the pre-determined period 2014–2016. This timing structure ensures that the conditioning

variables precede the growth outcome, thereby reducing the likelihood that short-run growth fluctuations directly influence digital adoption, oil rents dependence, or other covariates.

Digital adoption is measured using the Digital Adoption Index (DAI). DAI is available only for the years 2014 and 2016. To construct a stable measure of pre-growth digital adoption, we use the average of the 2014 and 2016 values. This approach reduces measurement errors arising from year-specific fluctuations and ensures that digital adoption is measured prior to the subsequent growth period. DAI measures the adoption of digital technology across three dimensions of the economy: people, government, and business. The index covers 180 countries on a 0–1 scale. Three sub-indices make up the overall DAI. The sub-indices are based on technologies required for each agent to promote digital development. While the DAI provides a broad, internationally comparable measure of digital adoption, it does not capture all dimensions of digital development, such as digital skills, usage intensity, or the quality of digital services. As with most composite indices, the DAI may therefore be subject to measurement error. However, because such measurement error is unlikely to be systematically correlated with oil rents dependence, it would tend to attenuate estimated coefficients rather than generate spurious interaction associations.

To control for the convergence theory, the Lag of GDP, which is the average of 2014-2016, is added to the model. According to the convergence hypothesis the sign of the lag of GDP should be negative. Also, trade, which is the sum of exports and imports, controlling for trade openness, is included. The model also incorporates Foreign Direct Investment (FDI) to control for the effects of external investments on GDP. The Governance Index, the averages of six governing indicators (Control of Corruption, Rule of Law, Regulatory Quality, Voice and Accountability, Political Stability and Absence of Violence/Terrorism, Government Effectiveness), is added as well to capture the quality of the government. A logarithmic transformation is applied to oil rents, lag of GDP, trade, and foreign direct investment (FDI), to reduce skewness, limit the influence of outliers, and to interpret elasticities. Table 2 provides the summary statistics for the variables of interest. All data are taken from the (World Bank, 2024) except KOF which is taken from (Gygli et al., 2019). Other control variables, which are Population growth (to capture the demographic effects), KOF Globalization (to investigate the effects of globalization), Gross capital formation (to control the capital accumulation), and secondary school enrollment (to capture the effects of the educated people on the GDP). Regional dummy variables are incorporated into the model to account for unobserved regional heterogeneity. Countries are classified into the following regions: East Asia &

Pacific, Europe & Central Asia, Latin America & the Caribbean, Middle East & North Africa, North America, South Asia, and Sub-Saharan Africa.

The effective sample size varies across specifications due to differential data availability across variables. In particular, while oil rents, GDP growth, and the Digital Adoption Index are available for a relatively broad set of countries, several control variables, most notably secondary school enrollment, exhibit missing observations for a non-trivial number of countries. As a result, specifications that include the full set of controls are estimated on a reduced sample of approximately 101 countries.

**Table 2:** Summary statistics

| Variable | N | Mean | SD | Min | Max |
|---|---|---|---|---|---|
| GDPPC Growth (% annual) | 101 | 2.20 | 2.0 | -4.11 | 5.95 |
| Oil rents (% of GDP) (Log) | 101 | -1.41 | 2.64 | -9.31 | 3.70 |
| Digital adoption index (DAI) | 101 | 0.55 | 0.19 | 0.15 | 0.86 |
| Lag of GDPPC (Constant 2021 $) (Log) | 101 | 9.69 | 1.13 | 6.86 | 11.79 |
| Trade (% of GDP) (Log) | 101 | 4.36 | 0.53 | 3.23 | 5.84 |
| Foreign direct investment (FDI) (Log) | 101 | 1.12 | 1.04 | -1.34 | 4.91 |
| Governance index | 101 | 0.19 | 0.84 | -1.33 | 1.84 |
| Population growth (annual %) | 101 | 1.24 | 1.37 | -1.02 | 8.61 |
| KOF Globalization | 101 | 66.89 | 14.48 | 37.61 | 90.76 |
| Gross capital formation (% of GDP) | 101 | 23.99 | 7.48 | 6.94 | 55.38 |
| Secondary school enrollment (% of population) | 101 | 74.77 | 22.93 | 15.89 | 99.53 |

## 4. Results and discussions

### 4.1. Main results

Initially, an OLS analysis was carried out to examine the direct association between our independent variables (oil rents and digital adoption index) and our dependent variable GDP per capita growth, which is in table 3 column 1. With a negative association, the coefficient of oil rents is statistically significant at the 5% significance level. Despite negative correlation, digitalization is not

significant. To ensure comparability across model specifications and to avoid changes in sample composition influencing coefficient estimates, all regressions reported in Table 3 are estimated using the same sample of countries as the most general specification (column 4). Specifically, the estimation sample from the full model is retained, and earlier restricted models are re-estimated on this identical set of observations. This approach ensures that differences across columns reflect model specification rather than sample variation.

To investigate the marginal association between oil rents and GDP per capita growth across different levels of digitalization, an interaction term is introduced in the second specification, in the second column of Table 3. In this model, the coefficient on oil rents becomes statistically insignificant. Similar to the first specification, the digitalization variable also remains insignificant. Furthermore, the interaction term itself is not statistically significant in column 2, before adding the control variables. Table 3 column 3 adds additional control variables to the model except regional dummies.

The regression results in column 3, based on a sample of 101 countries, indicate that oil rents have a statistically significant negative association with GDP at the 1% significance level, whereas digitalization, when considered independently, is statistically insignificant. This analysis suggests that, ceteris paribus, oil rents have a relatively modest negative association with economic growth in resource-rich countries when accounting for digitalization. In column 3, the interaction term between oil rents and digitalization becomes statistically significant at the 5% significance level. In column 4, the inclusion of regional dummy variables in the model, designated as the main specification, results in negligible changes to the primary statistical findings, maintaining the robustness of the core results, compared to column 3. That shows a statistically significant interaction term between digitalization and oil rents at the 1% significance level. This means the interaction term indicates that higher levels of digital adoption are associated with a weaker negative relationship between oil rents and GDP per capita growth, or to put it another way, the estimated marginal association between oil rents and growth becomes less negative, and in some cases positive, at higher levels of digital adoption.

**Table 3:** Economic growth, oil rents, digital adoption index, and other control variables

| | Dependent variable: GDP per capita growth (%) | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Oil rents (% of GDP) (Log) | -0.207** | -0.501 | -0.575*** | -0.588*** |
| | (0.085) | (0.359) | (0.214) | (0.181) |
| Digital adoption index | -1.495 | -0.955 | -0.596 | -1.417 |
| | (1.105) | (1.388) | (2.592) | (2.878) |
| Oil rents × Digital adoption index | | 0.491 | 0.779** | 0.817*** |
| | | (0.531) | (0.332) | (0.299) |
| Lag of GDP (Log) | | | -0.507 | -0.459 |
| | | | (0.344) | (0.332) |
| Trade (Log) | | | -0.259 | -0.658* |
| | | | (0.333) | (0.314) |
| FDI (Log) | | | 0.480*** | 0.680*** |
| | | | (0.128) | (0.120) |
| Governance index | | | 0.039 | 0.234 |
| | | | (0.395) | (0.416) |
| Population growth (annual %) | | | -0.475*** | -0.564*** |
| | | | (0.084) | (0.135) |
| KOF Globalization | | | 0.026 | 0.017 |
| | | | (0.026) | (0.032) |
| Gross capital formation (% of GDP) | | | 0.031 | 0.020 |
| | | | (0.020) | (0.020) |
| Secondary school enrollment (% of population) | | | 0.013 | 0.006 |
| | | | (0.014) | (0.01) |
| Regional dummies | Not Included | Not Included | Not Included | Included |
| Number of countries | 101 | 101 | 101 | 101 |
| R-squared | 0.075 | 0.087 | 0.404 | 0.508 |

Note: The method of estimation is ordinary least squares with Huber-robust standard errors (reported in parentheses). Significantly different from zero at 90% *, 95% **, 99% *** confidence intervals.

In Figure 1 the estimated association between oil rents and GDP per capita growth based on Table 3, column 4 is plotted based on the different levels of digitalization, along with 95% confidence bands. The upward-sloping pattern supports the existence of a moderating mechanism: as digitalization increases, the negative association between oil rents and economic growth gradually weakens. Notably, the estimated association shifts from being significantly negative at low levels of digital adoption to statistically insignificant, and in certain intervals even positive, at higher levels of digitalization. The plot shows an upward trend including a turning point around 0.72. As digital adoption increases beyond moderate levels, the negative association between oil rents and economic growth weakens. However, before the level of 0.58 there is negative and statistically significant association. Thus, higher levels of digital adoption are associated with a shift from a statistically significant negative relationship between oil rents and growth to a statistically insignificant, and in some ranges positive, relationship. This consistent upward trajectory suggests that digital adoption functions as a structural constraint-relaxing factor. In the absence of such moderation, the marginal effect curve would appear flat, indicating no conditional relationship between oil rents and growth. The observed transition from negative to neutral effects therefore provides empirical evidence that digitalization modifies the transmission mechanism through which oil dependence influences economic performance.

Putting it differently, let us consider Angola, Iraq, and Chad as examples of countries which have relatively low levels of digitalization below 0.58. In these countries, oil is detrimental to economic growth due to poor telecommunications infrastructure, including limited internet access and unreliable electricity, limited digital literacy, and limited educational opportunities. Conversely, among countries with digitalization levels above 0.72, such as Norway, Bahrain, and the United Arab Emirates, strong institutional frameworks and regulatory environments promote digital innovation and safeguard users, thereby enhancing trust and engagement in digital platforms. These countries also invest in advanced telecommunications infrastructure. In such contexts, oil rents are more likely to function as a catalyst for economic growth rather than a constraint, as digital capacity enables more productive allocation and utilization of resource revenues.

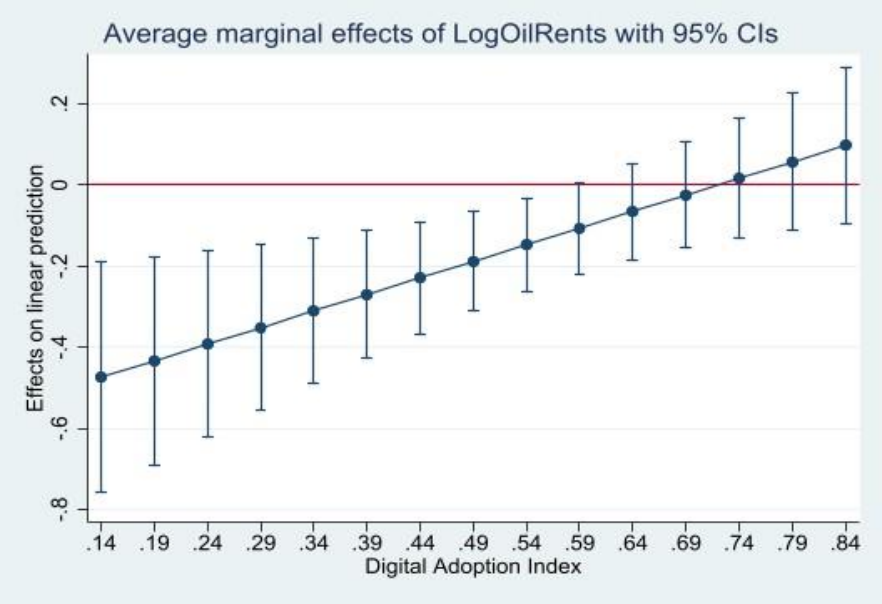


**Figure 1:** Marginal effects of oil rents on GDP per capita at different levels of digital adoption index. Note: The error band represents the 95% confidence intervals.

### 4.2. Competing moderating channels

It should be mentioned that the main results focus exclusively on the interaction between oil rents and digital adoption, which constitutes the core contribution of the study. However, to enhance the robustness of the results, Table 4 extends Table 3, column 4 by incorporating two additional interaction terms to evaluate their marginal association with GDP growth. Specifically, we investigate the interaction effects of the following variables with oil rents as competing moderating channels:

Secondary school enrollment (to control for human capital channel), and trade openness (to control for Dutch disease/trade channel). These interaction terms allow us to assess whether the association between oil rents and economic outcomes at different levels of digitalization varies conditionally across different economic contexts.

Table 4 column 1 presents the main specification of the model. As shown in column 2, the interaction term between digitalization and secondary school enrollment is added to the regression and the interaction term between digitalization and oil rents shows a positive and statistically significant association with GDP growth in columns, indicating that digitalization mitigates the

adverse association between oil rents and economic growth. However, in column 3, where the interaction between Trade openness and oil rents is included, the digitalization–oil rents interaction shows a statistically significant as well.

The robustness of the digital interaction term in Table 4 suggests that digitalization provides a growth-stabilizing effect that is distinct from traditional human capital or Dutch disease channels.

**Table 4:** Economics growth, oil rents, digital adoption index, and other interaction terms

| | Dependent variable: GDP per capita growth | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| Oil rents (% of GDP) (Log) | -0.588*** | -0.490** | -0.213 |
| | (0.181) | (0.220) | (0.430) |
| Digital Adoption Index | -1.417 | -0.051 | -1.251 |
| | (2.878) | (3.270) | (2.899) |
| Oil rents × Digital Adoption Index | 0.817*** | 1.542*** | 0.918*** |
| | (0.299) | (0.531) | (0.336) |
| Secondary school enrollment | | -0.002 | |
| | | (0.016) | |
| Oil rents × Secondary school enrollment | | -0.007 | |
| | | (0.005) | |
| Trade | | | -0.781** |
| | | | (0.372) |
| Oil rents × Trade | | | -0.097 |
| | | | (0.107) |
| All other control variables | Included | Included | Included |
| Regional dummies | Included | Included | Included |
| Number of countries | 101 | 101 | 101 |
| R-squared | 0.508 | 0.519 | 0.511 |

Note: The method of estimation is ordinary least squares with Huber-robust standard errors (reported in parentheses). Significantly different from zero at 90% *, 95% **, 99% *** confidence intervals.

## 5. Conclusion and policy implications

The purpose of this study was to examine the association between oil rents and the economic growth conditional on digitalization. To test the main hypothesis on the moderating role of the digitalization in the final association between oil rents and GDP growth, a cross-sectional dataset in which growth outcomes are measured over 2016–2023, while explanatory variables are averaged over the preceding period 2014–2016, is used.

The main hypothesis is supported by the data. The main results remain robust after controlling for control variables. It was demonstrated that in countries with relatively low levels of digital adoption, oil rents are associated with weaker economic growth, whereas this negative association attenuates and becomes statistically insignificant at higher levels of digital adoption.

Nevertheless, the results contribute to the debate on the ambiguity of digitalization's role in oil-dependent countries. The results indicate that higher levels of digital adoption are associated with a weaker negative relationship between oil rents and economic growth.

From a policy perspective, these results imply that investments in digital infrastructure, digital skills, and digital public services may complement broader development strategies in resource-dependent economies. Rather than viewing digitalization as a stand-alone solution to the resource curse, policymakers may consider it as part of a wider policy mix that includes institutional strengthening, economic diversification, and productivity-enhancing reforms. The analysis does not imply that digitalization alone can offset the adverse effects of oil dependence, but it highlights its potential role in shaping the conditions under which resource revenues are associated with more favorable growth outcomes.

An important limitation of this cross-country analysis is the “black box” nature of the moderating effect. While the empirical results provide consistent evidence that digital adoption weakens the negative association between oil rents and economic growth, the aggregate design of the study does not allow us to conclusively disentangle the precise transmission channel. Digitalization may operate through improved governance and transparency, mitigation of Dutch Disease dynamics in the non-oil tradable sector, enhanced human capital accumulation, or a combination of these mechanisms. Because the Digital Adoption Index captures broad, cross-cutting technological penetration, our estimates identify a macro-level conditional relationship rather than a specific micro-level pathway. Nevertheless, the robustness of the interaction effect across specifications

suggests that the moderating role of digitalization represents a structural feature of contemporary resource-dependent economies rather than a model-specific artifact.

## References


Adabor, O., Buabeng, E., 2021. Asymmetrical effect of oil and gas resource rent on economic growth: Empirical evidence from Ghana. Cogent Economics & Finance 9, 1971355. https://doi.org/10.1080/23322039.2021.1971355

Bjorvatn, K., Farzanegan, M.R., 2015. Resource rents, balance of power, and political stability. Journal of Peace Research 52, 758–773.

Bjorvatn, K., Farzanegan, M.R., Schneider, F., 2012. Resource curse and power balance: evidence from oil-rich countries. World Development 40, 1308–1316. https://doi.org/10.1016/j.worlddev.2012.03.003

Brynjolfsson, E., McAfee, A., 2015. Will humans go the way of horses. Foreign Aff. 94, 8.

Brynjolfsson, E., McAfee, A., 2014. The second machine age: Work, progress, and prosperity in a time of brilliant technologies. WW Norton & Company.

Christensen, H.B., Maffett, M., Rauter, T., 2024. Reversing the resource curse: Foreign corruption regulation and the local economic benefits of resource extraction. American Economic Journal: Applied Economics 16, 90–120.

Collier, P., Hoeffler, A., 2005. Resource rents, governance, and conflict. Journal of Conflict Resolution 49, 625–633. https://doi.org/10.1177/0022002705277551

Dahlman, C., Mealy, S., Wermelinger, M., 2016. Harnessing the digital economy for developing countries.

Davis, G.A., 1995. Learning to love the Dutch disease: Evidence from the mineral economies. World development 23, 1765–1779.

Eslami Andargoli, A., Gholipour, H.F., Farzanegan, M.R., 2023. Government's support for adoption of digital technologies and firms' innovation during the COVID-19 pandemic. Applied Economics 55, 5518–5527. https://doi.org/10.1080/00036846.2022.2140110

Farzanegan, M.R., 2014. Can oil-rich countries encourage entrepreneurship? Entrepreneurship & Regional Development 26, 706–725.

Farzanegan, M.R., Habibpour, M.M., 2017. Resource rents distribution, income inequality and poverty in Iran. Energy Economics 66, 35–42. https://doi.org/10.1016/j.eneco.2017.05.029

Farzanegan, M.R., Krieger, T., 2019. Oil booms and inequality in Iran. Review of Development Economics 23, 830–859. https://doi.org/10.1111/rode.12569

Farzanegan, M.R., Lessmann, C., Markwardt, G., 2018. Natural resource rents and internal conflicts: Can decentralization lift the curse? Economic Systems 42, 186–205. https://doi.org/10.1016/j.ecosys.2017.05.009

Farzanegan, M.R., Thum, M., 2020. Does oil rents dependency reduce the quality of education? Empirical Economics 58, 1863–1911.

Gygli, S., Haelg, F., Potrafke, N., Sturm, J.-E., 2019. The KOF Globalisation Index – revisited. The Review of International Organizations 14, 543–574. https://doi.org/10.1007/s11558-019-09344-2

Gylfason, T., 2001. Natural resources, education, and economic development. European Economic Review 45, 847–859. https://doi.org/10.1016/S0014-2921(01)00127-1

Havranek, T., Horvath, R., Zeynalov, A., 2016. Natural Resources and Economic Growth: A Meta-Analysis. World Development 88, 134–151. https://doi.org/10.1016/j.worlddev.2016.07.016

Hodler, R., 2006. The curse of natural resources in fractionalized countries. European Economic Review 50, 1367–1386. https://doi.org/10.1016/j.euroecorev.2005.05.004

Jiang, M., Jia, P., 2022. Does the level of digitalized service drive the global export of digital service trade? Evidence from global perspective. Telematics and Informatics 72, 101853. https://doi.org/10.1016/j.tele.2022.101853

Kaznacheev, P., 2017. Curse or Blessing? How Institutions Determine Success in Resource-Rich Economies. Cato Institute Policy Analysis 808, 1–48.

Mahdavy, H., 1970. Patterns and problems of economic development in rentier states : the case of Iran, in: Studies in the Economic History of the Middle East. Routledge, pp. 428–467.

Manyika, J., Lund, S., Bughin, J., Woetzel, L., Stamenov, K., Dhingra, D., 2016. Digital globalization: The new era of global flows. McKinsey Global Institute.

Mawejje, J., 2019. Natural resources governance and tax revenue mobilization in sub saharan Africa: The role of EITI. Resources Policy 62, 176–183.

Mehlum, H., Moene, K., Torvik, R., 2006. Institutions and the Resource Curse*. The Economic Journal 116, 1–20. https://doi.org/10.1111/j.1468-0297.2006.01045.x

Myovella, G., Karacuka, M., Haucap, J., 2020. Digitalization and economic growth: A comparative analysis of Sub-Saharan Africa and OECD economies. Telecommunications Policy 44, 101856. https://doi.org/10.1016/j.telpol.2019.101856

Novikova, O., Khandii, O., Shamileva, L., Olshanskyi, O., 2022. The impact of digitalization on ensuring economic growth. Management Theory and Studies for Rural Business and Infrastructure Development 44, 223–234. https://doi.org/10.15544/mts.2022.23

Pavlik, J.B., Ross, A., 2024. Resource shocks, firm obstacles, and local business in Africa. Southern Economic Journal. *92*(2), 218-271.

Ross, M.L., 2015. What Have We Learned about the Resource Curse? Annual Review of Political Science 18, 239–259. https://doi.org/10.1146/annurev-polisci-052213-040359

Ross, M.L., 2012. The Oil Curse: How Petroleum Wealth Shapes the Development of Nations. Princeton University Press.

Sachs, J. D. 2007. How to handle the macroeconomics of oil wealth. In M. Humphreys, J. D. Sachs, & J. E. Stiglitz (Eds.), Escaping the resource curse (pp. 173–193). Columbia University Press.

Sachs, J.D., Warner, A., 1995. Natural resource abundance and economic growth. NBER Working Papers 5398, National Bureau of Economic Research, Inc.

Sharmin, S., Chowdhury, R.H., 2025. Digital Transformation in Governance: The Impact of e-governance on Public Administration and Transparency. Journal of Computer Science and Technology Studies 7, 362–379. https://doi.org/10.32996/jcsts.2025.7.1.27

Stijns, J.-P.C., 2005. Natural resource abundance and economic growth revisited. Resources policy 30, 107–130.

Tariq, M.U., 2025. Digital Accountability: Revolutionizing Public Sector Transparency and Service Delivery, in: Enhancing Public Sector Accountability and Services Through Digital Innovation. IGI Global Scientific Publishing, pp. 129–154. https://doi.org/10.4018/979-8-3693-9251-5.ch004

Torvik, R., 2002. Natural resources, rent seeking and welfare. Journal of Development Economics 67, 455–470. https://doi.org/10.1016/S0304-3878(01)00195-X

van Wijnbergen, S., 1984. Inflation, Employment, and the Dutch Disease in Oil-Exporting Countries: A Short-Run Disequilibrium Analysis. The Quarterly Journal of Economics 99, 233–250. https://doi.org/10.2307/1885524

WDI, 2025. World Development Indicators.

Willebald, H., 2015. Natural Resources and Economic Growth: Learning from History.

World Bank, 2024. World Development Indicators.

World Bank, 2016. World Development Report 2016: Digital Dividends (https://www.worldbank.org/en/publication/wdr2016).

World Economic Forum, 2016. $100 Trillion by 2025: the Digital Dividend for Society and Business [WWW Document]. URL https://www.weforum.org/press/2016/01/100-trillion-by-2025-the-digital-dividend-for-society-and-business/ (accessed 5.17.25).

Zhao, X., Shang, Y., Ma, X., Xia, P., Shahzad, U., 2022. Does carbon trading lead to green technology innovation: recent evidence from Chinese companies in resource-based industries. IEEE Transactions on Engineering Management.