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MIDDLE EAST AND CENTRAL ASIA DEPARTMENT

Digital Transformation in the Gulf Cooperation Council Economies

Prepared by Ran Bi, Fozan Fareed, Jeong Dae Lee, Sidra Rehman, Yuan Gao Rollinson, and Tongfang Yuan

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Executive Summary

The Gulf Cooperation Council (GCC) economies have placed a strong emphasis on leveraging digitalization to drive innovation and spur economic growth. These nations have embedded ambitious digitalization strategies within their overarching economic transformation agendas, often with set targets. This paper reviews the GCC's progress in digitalization, especially since the pandemic, and benchmark achievements against performances in advanced and other emerging market economies. It also assesses the effect of enhanced digital adoption on macrofinancial outcomes. By examining the interplay between digitalization progress, policy measures implemented, and the macrofinancial effect, this paper sheds light on the policies needed to further advance digitalization and balance opportunities against risks.

In both the stocktaking and empirical analysis, this paper employs a three-pillared approach covering (1) the public sector, focusing on how enhanced public sector digitalization can improve public service efficiency and government effectiveness; (2) the financial sector, emphasizing the role of digital banking and fintech in improving financial inclusion and banking sector resilience during economic downturns; and (3) the corporate sector, highlighting how digital penetration in the production process can improve productivity and firms' resilience against shocks, thus contributing to overall economic growth and resilience.

The GCC has seen a significant acceleration in digitalization, especially since the pandemic. This is assessed by looking at digitalization progresses in individual sectors as well as the economy as a whole, with the latter measured by a novel composite index—the Enhanced Digital Access Index (EDAI)—encompassing infrastructure quality, digital knowledge, internet usage, affordability, and quality of information and communications technology services. The GCC's progress is notably visible in (1) the extensive development of digital infrastructure, improving digital access and connectivity; (2) government digitalization maturity, which is generally on par or exceeding advanced economy (AE) levels; and (3) fintech activities, driven by a dynamic ecosystem of start-ups and a sharp increase in investment. The analysis of the EDAI and its components suggests that the GCC, on average, has closed its gap with AEs on the overall EDAI, with strengths particularly in digital infrastructure and affordability. The progress thus far underscores the significant policy efforts made toward integrating digital technologies across economic and public spheres.

Yet digitalization progress is uneven across sectors and countries in the GCC, calling for more efforts, especially with the rise of artificial intelligence (AI). Although significant strides have been made in digital infrastructure and public sector digitalization in all GCC countries, some can benefit from further improving digital citizen engagement and robustness of core government systems. In comparison with AEs, the GCC shows larger gaps in fintech and digital penetration of the corporate sector. In particular, the uptake of digital financial services remains relatively low, overall digital skills of the GCC labor force are seen as insufficient and a main hindrance to further fintech and broader digitalization advancement, further development of fintech and digitalization regulations are necessary to close regulation gaps with AEs, and limited local digital innovation and technological diffusion constrain industry integration of digital inputs. In terms of AI preparedness, the GCC in general is in a better position than an average emerging market, but it still lags AEs, especially in digital innovation and regulations. The broad adoption of digital technologies also introduces challenges related to data protection and cybersecurity, as well as the potential of widening digital divide and job displacement, including because of AI.

Our empirical analysis highlights the positive correlation between progress in digitalization and more favorable macroeconomic and financial outcomes. Digital advancement is found to have a statistically significant association with financial inclusion. Moreover, digitally advanced banking sectors were more resilient during the global financial crisis and the pandemic, benefiting from operational efficiencies and expanded

customer engagement. Higher digital maturity in the public sector is associated with significant improvement in government effectiveness. In the corporate sector, firms in more digitally intensive industries tend to recover faster from economic downturns. To complement the sectoral analysis, we also examine the relationship of economic growth and resilience with economy-wide digitalization and find a positive association.

Comprehensive strategies are needed to further accelerate the GCC's impressive progress in digitalization by upgrading regulatory frameworks, enhancing digital skills, fostering a dynamic innovation ecosystem, and ensuring labor market inclusion. Priorities include to (1) further leverage digitalization to enable a more open, effective, and transparent public sector; (2) balance opportunities and risks associated with fintech and increase market scalability; (3) enhance digital skills and digital adoption, with adequate social safety nets in place to support displaced workers and appropriate training to facilitate their job transitions; and (4) create an enabling environment to further digital penetration. Continued efforts to strengthen cybersecurity and trust would support the ongoing digital transformation momentum. Decisive implementation of the GCC countries' comprehensive reform agendas—with a special focus on bridging the digital divide and ensuring labor market inclusiveness—will support their efforts to further digitalization.

1. Introduction

Digitalization is transforming the global economic and financial landscape, with the potential to boost productivity and promote diversification in the Gulf Cooperation Council (GCC). The COVID-19 pandemic has significantly accelerated the digitalization agenda globally, creating new opportunities for the digital economy as an increased number of activities have shifted online. The growing role of digitalization—including through e-government initiatives, data sharing and interoperability between the public and private sectors, fintech, e-commerce, artificial intelligence (AI), and the related technological diffusion in firms—has the potential to improve services, boost productivity, and spur innovation. The GCC's young and tech-savvy population, along with its relatively advanced digital infrastructure (see the following), positions it well to reap the economic benefits of further digitalization.

The GCC countries have embedded digital transformation initiatives in their overarching national visions. GCC national development strategies underscore a staunch commitment to leveraging digitalization as an engine for economic transformation. Key focal points include the upgrading of digital infrastructure and increasing the digital economy's contribution to GDP (Qatar, Saudi Arabia, United Arab Emirates); streamlining government operations and promoting open governance for enhanced efficiency and innovative public services (Bahrain, Qatar); implementing national information and communications technology (ICT) and broadband strategies, with an emphasis on accelerating nationwide broadband access and enhancing local ICT content (Oman, Saudi Arabia); and enhancing the quality of life and operational efficiency, focusing on digital initiatives to improve citizens' living standards (Bahrain, Kuwait). Several GCC countries have also established medium-term numerical targets on the contribution of the digital economy to GDP and have set targets for digital government services (Table 1). These concerted efforts reflect the region's strategy to harness technology for sustainable development and economic diversification.[1]

Consistent with the global trend, digitalization across the GCC region has accelerated since the pandemic. Since the onset of the pandemic, an increased number of activities have shifted to online platforms, including e-education (for example, Kuwait's rapid deployment of online learning tools through Kuwait Foundation for Advancement of Sciences, Oman's integration of digital platforms for education), telehealth initiatives (for example, Saudi Arabia's "Seha" virtual hospital services and the United Arab Emirates' "Doctor for Every Citizen" initiative), digital banks (for example, Bahrain's push toward digital banking and the United Arab Emirates' fintech innovations), virtual courts (for example, Kuwait's digital legal proceedings and Qatar's introduction of virtual court sessions), and e-businesses (for example, Oman's digital marketplace expansions and Saudi Arabia's e-commerce platforms). The private sector is undergoing a significant transformation because of digitalization, as evidenced by businesses increasingly integrating innovative technologies such as AI, the Internet of Things, and blockchain to boost operational efficiency and productivity. Furthermore, the COVID-19 pandemic accelerated a shift toward remote working—the possibility of flexible work arrangements could help promote a more inclusive labor market.

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[1] See, for example, the national strategies—Bahrain: Digital First Policy, Digital Government as a Right, Once Only Data Policy; Kuwait: Digital Transformation Strategy; Oman: Digital Oman Strategy, National ICT Strategy, National Broadband Strategy; Qatar: Digital Agenda 2030; Saudi Arabia: 2019 ICT Sector Strategy; and the United Arab Emirates: Digital Economy Strategy.

Table 1. Gulf Cooperation Council: Selected National Digitalization Targets

Country	Indicator	Baseline	Target
DE Contribution to GDP			
Oman	DE contribution to real GDP	2% (2021)	10% (2040)
Qatar	DE contribution to non-oil GDP	4.5% (2017)	7.8% (2030)
Saudi Arabia	DE contribution to real GDP	11.5% (2018)	16% (2025)
United Arab Emirates	DE contribution to non-oil GDP	9.7% (2022)	19.4% (2032)
Digital Government Services			
Bahrain	Digitalization of government services	n/a (2022)	Increase by 200 services (2026)
Kuwait	Digitalization of government services	n/a (2023)	90% (2027)
Oman	Ranking in the UN E-Government Development Index	50th (2020)	10th (2040)
Qatar	Digitalization of government services	n/a (2022)	90% (2030)
Saudi Arabia	Ranking in the UN E-Government Development Index	31st (2022)	5th (2030)
United Arab Emirates	Digitalization of government services	n/a	100% (2025)

Source: National authorities.
Note: DE = digital economy.

This paper aims to take stock of the GCC's progress in digitalization, assess the macroeconomic and financial effect of digitalization, and shed light on policy priorities. It provides a holistic assessment of each GCC economy's progress in digitalization of the public, financial, and nonfinancial corporate sectors, in comparison with advanced economy (AE) and emerging market (EM) peers. In addition to sector-specific assessment, we construct a novel composite index—the Enhanced Digital Access Index (EDAI), encompassing infrastructure quality, digital knowledge, internet usage, affordability, and quality of ICT services—to measure the overall digital access at the country level. This allows benchmarking progress over time and across country groups to map out both achievements and areas for further development. After the stocktaking exercise, the paper provides an empirical assessment of the effect of digitalization on (1) financial inclusion and banking sector resilience, (2) government effectiveness, (3) corporate sector performance, and (4) economic growth and its resilience to shocks. The paper concludes by providing policy recommendations to further enhance the region's digitalization ecosystem and balance opportunities and risks.

The rest of the paper is organized as follows: Section 2 describes the different pillars of digitalization under study and assesses the level of progress made by GCC economies in those areas. This section also discusses the construction of the EDAI and where the GCC economies stand relative to AEs and other EMs. Section 3 discusses the empirical strategy and results regarding the relationship between digitalization and economic outcomes, both across different sectors and for the entire economy. Section 4 concludes with policy recommendations.

2. Progress on Digitalization: Where Do GCC States Stand?

A. Key Pillars of Digitalization

Digitalization is a multidimensional concept, and its benefits can differ across sectors (Figure 1). Assessing the progress and effect of digitalization in an economy thus requires a holistic approach, covering the public sector, the financial sector, and the nonfinancial corporate sector:[2]

- *Public sector:* Digitalization can help strengthen how governments collect and analyze data, manage public finance operations, and deliver public services. Digital revenue solutions can improve revenue collection and compliance by enabling the use of digital payment systems and electronic tax filing. Automating budget payments can enhance budget management, and adopting an e-procurement platform can boost fiscal transparency. Digitalization is also associated with higher efficiency in expenditure, including better targeting in education, health, and social assistance spending. Although digitalization may not be the silver bullet to achieving better fiscal outcomes, it can certainly complement and reinforce underlying structural fiscal reforms (IMF 2020).

- *Financial sector:* Digitalization increases the efficiency of financial services by automating many traditional banking procedures (for example, loan approval and asset management) and by improving service speed. Digital payment facilitates instant and secure payments, which reduce processing times and transaction costs. These mechanisms are also expected to help mitigate adverse effects of recessions on bank profitability. In addition, digitalization can promote financial inclusion by providing enhanced access to financial services, which is particularly important for households residing in rural or remote regions.

- *Corporate sector and labor market:* In the nonfinancial corporate sector, digital adoption extends beyond websites and online commerce to optimize production processes and gain a deeper understanding of customers. The literature highlights several channels through which digital adoption can boost firm performance. For instance, sales could benefit from better access to customers, improved quality of products, and flexibility in price setting, whereas productivity could benefit from improved knowledge sharing and production process (Elding and Morris 2018). Some studies indicate that ICT specialists and other ICT task-intensive occupations have accounted for a significant portion of new employment created over the past decade, although the effect on overall employment is less certain. Although digitalization has the potential to generate new employment particularly in high-skilled fields (for example, information technology, data analysis, and cybersecurity), automation and AI technologies could lead to job displacement (for example, certain jobs in manufacturing, administrative support, and customer service). Digitalization has a profound effect also on other aspects of the labor market, including increasing the long-term productivity by automating routine tasks and enhancing labor force participation by improving workers' work–life balance and reducing gender gaps (Dabla-Norris and others 2023).

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[2] Digitalization also affects the household sector, including through digital infrastructure and usage, financial inclusion, and labor market effect. These aspects are studied under the financial and corporate sectors in the paper. Therefore, we do not include the household sector as a separate pillar to avoid repetition. The broader social effect of digitalization on households (for example, on education) is beyond the scope of the paper.

Figure 1. Pillars of Digitalization and Transmission Channels

Public sector	Financial sector	Corporate sector and labor market
GovTech maturity	Digital payments	Digital infrastructure
Digital citizen engagement	FinTech companies	Digital skills and AI
Digital public service delivery	Financial inclusion	Digital industry and innovation ecosystem

Increase revenue collection	Enhance credit access	Access to customers
Transparent fiscal spending	Reduce transaction costs	Flexibility in price setting
Efficient public finance management	Improve profitability	Higher productivity
	Mitigate adverse shocks	Job creation and displacement

Source: IMF staff illustration.
Note: AI = artificial intelligence.

B. GCC Digitalization Progress under Key Pillars

GCC states have made significant strides in enhancing digital government services—they are now among the top globally as measured by the GovTech Maturity Index (GTMI). The GTMI is one of the most comprehensive measures of digital transformation in the public sector focusing on four areas: supporting core government systems, enhancing service delivery, mainstreaming citizen engagement, and fostering GovTech enablers.[3] Most GCC countries have a higher GTMI than the AE average in 2022, with substantial progress made in every GCC country since the onset of the pandemic, when the United Arab Emirates was the only GCC country with a GTMI score comparable with an average AE (Figure 2).[4] Progress has been particularly notable in Bahrain, Kuwait, and Saudi Arabia. In Bahrain, increasing government transactions conducted through digital channels have led to a sharp reduction in the government's operational costs and significant time savings, and the digital platform for citizen engagement (Tawasul) has been enhanced to be more user friendly (Government of Bahrain 2023). Saudi Arabia's significant progress in service accessibility and government efficiency has been driven by concerted efforts under its Vision 2030 to enhance the digital economy and government services (WEF, MCIT, and TFC 2023).

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[3] The 2022 version of the GTMI constructed by the World Bank is a simple average of the normalized scores of four components: (1) CGSI: The Core Government Systems Index (17 indicators) captures the key aspects of a whole-of-government approach, including government cloud, interoperability framework, and other platforms; (2) PSDI: The Public Service Delivery Index (9 indicators) measures the maturity of online public service portals, with a focus on citizen-centric design and universal accessibility; (3) DCEI: The Digital Citizen Engagement Index (6 indicators) measures aspects of public participation platforms, citizen feedback mechanisms, open data, and open government portals; and (4) GTEI: The GovTech Enablers Index (16 indicators) captures strategy, institutions, laws, and regulations, as well as digital skills and innovation policies and programs, to foster GovTech. Constructed for 198 economies, the GTMI is one of the most comprehensive measures of digital transformation in the public sector. For details, see https://www.worldbank.org/en/programs/govtech/gtmi.

[4] The GCC countries' rapid progress on digital government is also reflected in the UN E-Government Development Index, whose latest vintage for 2024 shows that the GCC countries are on par with advanced economies. Saudi Arabia, the United Arab Emirates, and Bahrain (in that order) exceed the AE average, whereas the other three are below. The largest improvements since 2022 were seen in Bahrain, Saudi Arabia, and Qatar.

Figure 2. GovTech Maturity Index

(Index: 0–1, 1 = highest maturity of digital government)
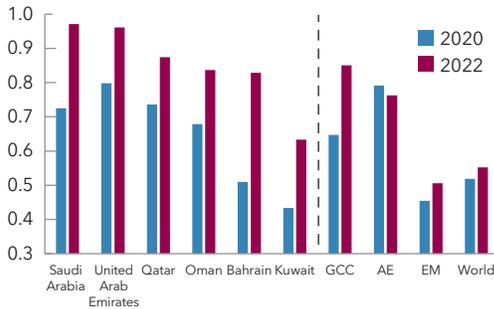
Sources: World Bank; and IMF staff calculations.

Note: AE = advanced economy; EM = emerging market; GCC = Gulf Cooperation Council.

However, progress in digital government maturity is uneven across GCC countries (Figure 3). Kuwait, for instance, trails behind its regional counterparts in critical areas, such as digital citizen engagement and the robustness of core government systems. Oman, likewise, does not meet regional benchmarks in digital citizen engagement, an area where it saw a decline in 2022 compared to 2020. On the other hand, recent initiatives such as the online public service portal and an open data portal, updated daily or weekly, are promising steps to narrow gaps in this area. Similarly, Bahrain has made commendable advances in public service delivery in 2022 but still falls short of regional standards. Moreover, the *United Nations E-Government Survey 2024* suggests that GCC countries can make further progress on digital participation and human capital, including e-government literacy (UN Department of Economic and Social Affairs 2024).

Figure 3. Gulf Cooperation Council: GovTech Maturity Index Subdimensions

1. Digital Citizen Engagement Index
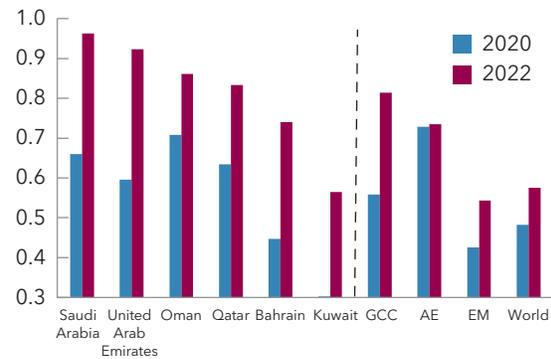
2. Public Service Delivery Index
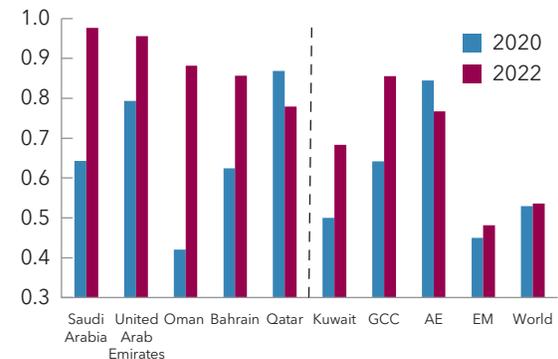
3. GovTech Enablers Index
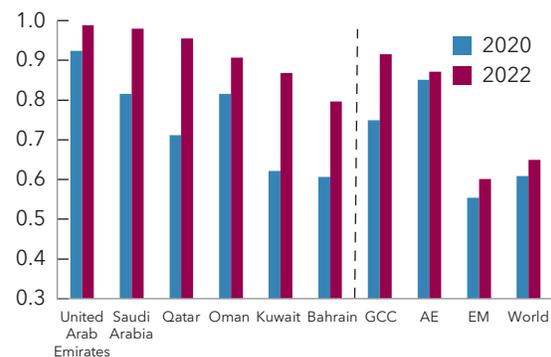
4. Core Government Systems Index
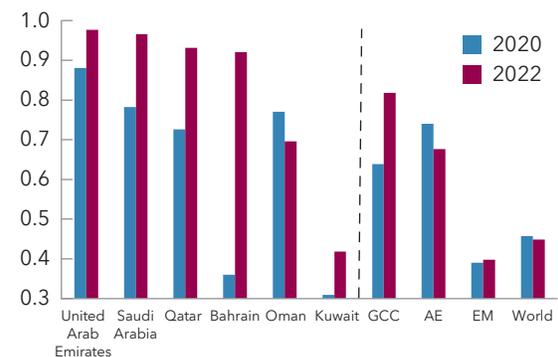
Sources: World Bank; and IMF staff calculations.

Note: AE = advanced economy; EM = emerging market; GCC = Gulf Cooperation Council.

Among GCC peers, Saudi Arabia and the United Arab Emirates are advancing the fastest in fintech, but even the GCC front runners still have considerable ground to catch up with AEs (Figures 4, 5, and 6). Great efforts have been made in promoting fintech investment, establishing regulatory sandbox, and facilitating financial inclusion. More efforts are needed to enhance financial regulation compliance, sustained funding, and talent, which are highlighted as key challenges for further fintech development in the Saudi Fintech Report 21/22 (Fintech Saudi 2023) that are also relevant to other GCC countries.

- *Fintech investment:* The GCC region has seen a surge in fintech investments, with venture capital

Figure 4. Saudi Arabia: Fintech Challenges
(Percentage of fintech companies reported, more than one response allowed)

Challenge	Value
Financial regulation compliance	60
Funding	51
Talent and recruitment	43
Access to customers	31
Technology regulation compliance	26
Product development	23

Source: Fintech Saudi (2023).

firms and corporate investors actively participating. Saudi Arabia and the United Arab Emirates have been the leading destinations for fintech investments and funding deals in the GCC and the Middle East and North Africa (MENA) region. In particular, the value of completed fintech funding deals in Saudi Arabia increased by nearly 80 times between 2019 and 2022 (from SAR 19 million to SAR 1,508 million). Following them, Bahrain also had sizable fintech funding deals disclosed in 2022.

Figure 5. Gulf Cooperation Council: Developments in Fintech

1. Global Ranking of Fintech Hubs City
(Top 10 of Middle East region in 2021, GCC countries in brown color)

Rank	City	2021
2. Dubai United Arab Emirates		55
3. Riyadh (Saudi Arabia)		126
4. Abu Dhabi United Arab Emirates		173
5. Jeddah (Saudi Arabia)		186
6. Manama (Bahrain)		196
7. Tehran (Iran)		222
8. Amman (Jordan)		231
9. Beirut (Lebanon)		235
10. Kuwait City (Kuwait)		238

(1. Tel Aviv Area (Israel))

2. Fintech Funding in the GCC
(Disclosed deal funding in millions of US dollars)

Legend: Bahrain, Saudi Arabia, United Arab Emirates

Years: 2017, 18, 19, 20, 21, 22

3. Fintech Regulatory Coverage in the GCC
(As of November 2024)

	Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	United Arab Emirates
Regulatory sandbox	Y	Y	Y	Y	Y	Y
Open banking	Y				Y	Y
Crypto assets	Y	Y				Y
Blockchain						Y
Robo-advisory	Y					Y
AI						
Payments	Y	Y		Y	Y	Y
e-KYC	Y			Y	Y	Y
Crowdfunding	Y			Y	Y	Y

4. Number of Active Fintech Companies in Saudi Arabia

Year	Value
2018	10
19	20
20	60
21	90
22	147
23	216

Sources: Findexable (2021); Fintech Saudi (2024); McKinsey; Saudi Central Bank (SAMA); and World Bank, Global Findex Database.
Note: AI = artificial intelligence; GCC = Gulf Cooperation Council; KYC = Know Your Customer.

Figure 6. Gulf Cooperation Council: Financial Inclusion and Digital Banking

1. Bank Accounts
(Adults with an account at a formal financial institution, percent)
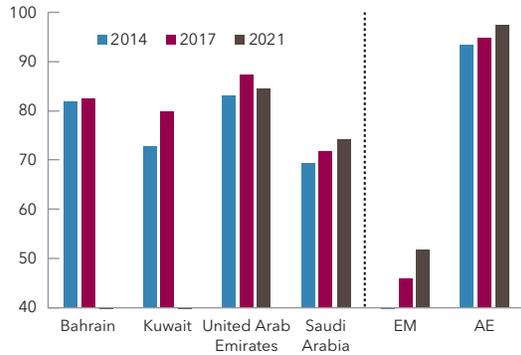
2. Borrowing
(Adults who borrowed from a financial institution, percent)
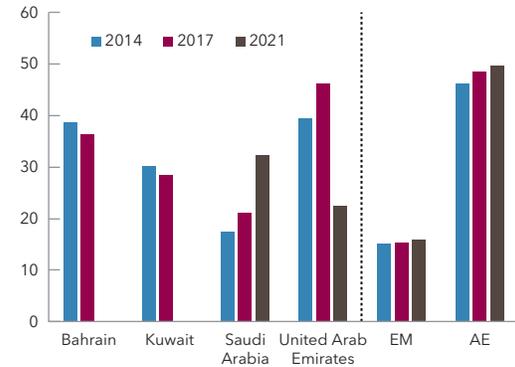
3. Debit or Credit Card Usage
(Adults, percent)
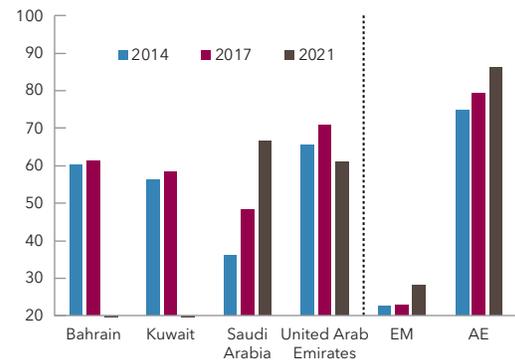
4. Savings
(Adults who saved at a financial institution, percent)
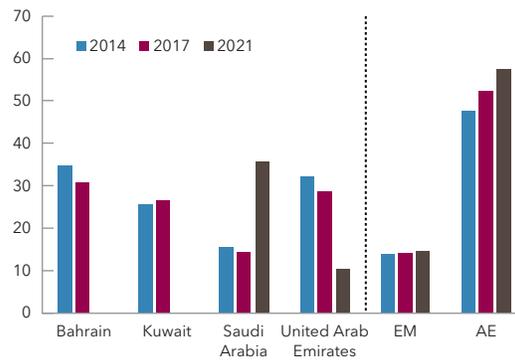
5. Digital Payments
(Adults who made or received a digital payment, percent)
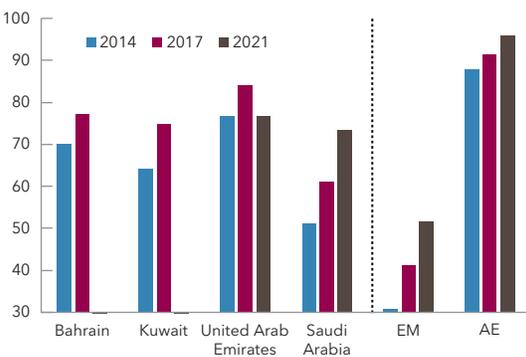
6. Used a Mobile Phone or the Internet to Check Account Balance
(Percent, age 15+)
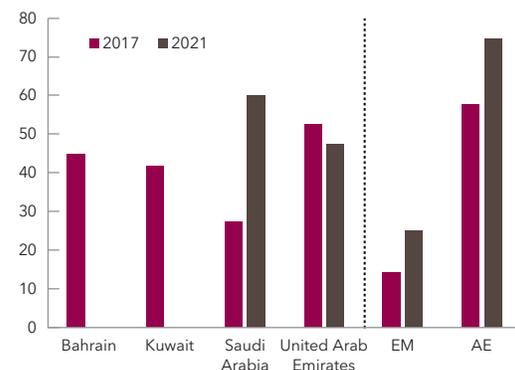
Sources: World Bank, Global Findex Database; and IMF staff calculations.

Note: Data for Oman and Qatar are not available from source. Saudi Central Bank's point-of-sales data show that the percentage of sales using mobile or card payments in Saudi Arabia reached 94 percent in 2024. Its financial access survey data show that the number of depositors with commercial banks grew by 30 percent between 2021 and 2023 (to 1,747 per 1,000 adults). AE = advanced economy; EM = emerging market.

- *Regulatory sandbox:* To encourage innovation in fintech, several GCC countries have introduced regulatory sandboxes. These allow fintech start-ups to test their products and services in a controlled environment under the regulators' guidance. Bahrain was the first GCC country to introduce a regulatory sandbox, followed by others such as Qatar, Saudi Arabia, and the United Arab Emirates.

- *Digital banking and financial inclusion:* Digital banking has been bridging the gap between traditional financial institutions and the underserved populations, thereby fostering financial inclusion. In general, financial inclusion has improved in the GCC since 2014—with access to bank accounts, loans, savings all picking up—but some still lag AEs (Figure 6). Similarly, in general, the GCC still has considerable scope to catch up with AEs in digital payments and online banking.[5]

- *Fintech regulations:* The GCC authorities have implemented regulations to mitigate cybersecurity and data privacy risks in general (Annex 1), but the fintech sector requires additional regulations to address cross-border compliance, financial stability, technology adoption, and competition issues. Regulators face the task of balancing flexibility to foster the fintech ecosystem and enforcing compliance to protect consumers and investors. Furthermore, fintech regulation challenges could arise both on compliance in a specific country and on regulatory harmonization across countries. Overall, Bahrain, Saudi Arabia, and the United Arab Emirates have more comprehensive fintech regulatory coverage, whereas fintech regulations in Kuwait, Oman, and Qatar only cover sandbox and payment activities.

- *Central bank digital currency (CBDC):* As part of the broader fintech advancement, the GCC countries have been testing the applicability of CBDCs. For instance, Saudi Arabia and the United Arab Emirates are leaders in this arena, launching significant pilot projects such as the joint "Aber" initiative, which aimed to assess the feasibility of a dual-issued digital currency for financial settlements. This project highlighted the potential for enhanced efficiency in cross-border payments. Furthermore, Saudi Arabia and the United Arab Emirates are involved in global collaborations such as the "mBridge" project, which intended to innovate cross-border payment systems.

- *Fintech talent:* Human capital is crucial to the development of fintech, emphasizing the need for a skilled workforce who are competent in both finance and technology. The fintech advancements in Saudi Arabia and the United Arab Emirates have benefited from their skilled ICT labor forces, but fintech companies still report talent acquisition as one of the main challenges of doing business. The challenge of not having sufficient fintech talent could be even more prominent in GCC countries with a lower level of skilled ICT labor forces. More broadly, enhancing "digital skills" in the labor force is a priority for the GCC, as discussed in the following section.

Digitalization also has a profound effect on households and the nonfinancial corporate sector. While the GCC region is among the best globally in digital connectivity, there is room to improve the ecosystem for digital skills, industry, and innovation (Figure 7).

- *Digital infrastructure:* GCC countries are among the best globally in providing digital connectivity (Figure 8). Mobile broadband subscriptions are among the highest in the world, though not in the case of fixed broadband. The share of population using the internet and covered by 5G mobile networks is also the highest globally. Among the Group of Twenty, Saudi Arabia ranks second on the International Telecommunication Union (ITU)'s ICT Development Index, only after the United States. The Global System for Mobile Association projects that by 2030, average 5G adoption in the GCC states could reach 95 percent, higher than developed Asia–Pacific and North America and well above the world average of 54 percent.

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[5] For cross-country comparability, we rely on the World Bank's Global Findex Database, which has data up to 2021. As a result, countries' progresses in digital banking and financial inclusion in more recent years are not reflected. For example, Saudi Arabia has made significant progress in these areas since 2021 (see footnote of Figure 6).

Figure 7. Total Patent Applications, 2019-21
(Per million people, three-year average)
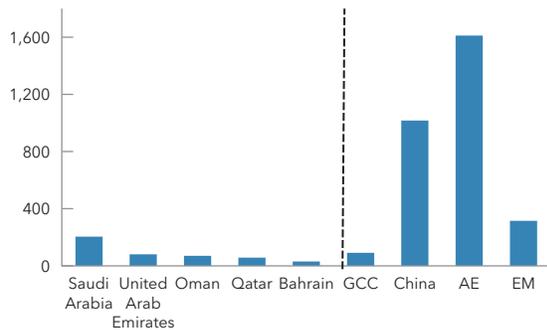
Sources: World Intellectual Property Organization; and IMF staff calculations.

Note: AE = advanced economy; EM = emerging market; GCC = Gulf Cooperation Council.

- *Digital skills:* The GCC lags AEs in having high levels of digital talent. Most GCC countries are behind AEs in terms of science, technology, engineering, and medicine graduates and Programs for International Student Assessment test scores. The average proportion of AI specialists in the GCC workforce is 1.7 percent, whereas the European Union has 5.4 percent and Singapore has 6.9 percent. The region has a prorated average of about two PhDs in AI per million people, compared with the Organisation for Economic Co-operation and Development (OECD) average of 25. Although GCC countries rank high on ICT skills in the ITU survey, user-generated data from LinkedIn suggest that there is room to increase digital skill intensity across several industries. According to the LinkedIn data, Saudi Arabia and the United Arab Emirates (the only GCC countries with such data available) fall below the global average on penetration of "tech skills"—defined as a range of abilities to use digital services, communication applications, and networks to access and manage information (Figure 9).

- *Digital industry and innovation ecosystem:* Estimates by PwC (2021) showed that Internet retail as a share of total retail trade in the GCC reached an average of 6 percent in 2021, compared with 15 percent in the OECD. The share of each industry's inputs that are sourced from digital industries is relatively low compared with countries at the frontier of digitalization, despite recent progress (Figure 9). This is partly because of the GCC countries' insufficient local production of digital goods and services—they often rely on imported technology and services. Most GCC countries need more research and development and financial resources to support innovation. There are recent signs that local output in the region's digital innovation is increasing rapidly albeit from a low base—with Qatar, Saudi Arabia, and the United Arab Emirates having faster growth in the number of apps published than other regional peers.

- *AI:* AI adoption is increasing in the GCC—62 percent of the respondents in a McKinsey survey reported using AI in at least one business function in their organization (Chandran and others 2023). However, adoption of AI is low in some functions where the value potential is significant, such as in manufacturing. The GCC governments have moved swiftly in adopting national AI strategies and investing in related infrastructure. Overall, the GCC is found to be better prepared for AI adoption than average EMs but has not yet reached AE levels, with gaps mainly in digital innovation and regulations (Box 1). Going forward, in line with the global trend, the AI market size is expected to grow rapidly in the GCC, led by machine learning but also autonomous and sensor technology and AI robotics. Harnessing the benefits of AI to boost productivity hinges not only on the quality of digital infrastructure and accessibility but also on the ability of workers to leverage this new technology, with proper regulations in place to balance AI growth against risks. The labor market effect from the adoption of AI would depend on the employment structure (prevalence of cognitive-task-oriented jobs), as well as on supportive regulatory frameworks, training, and social protection.

Figure 8. Gulf Cooperation Council: Digital Infrastructure and Usage

1. Fixed Mobile Broadband Subscriptions
(Per 100 inhabitants)

2. Active Mobile Broadband Subscriptions
(Per 100 inhabitants)

3. Individuals with Basic and Advanced ICT Skills

4. Individuals Using the Internet
(Percentage of population)

5. Population Covered by at Least a 5G Mobile Network
(Percentage of population)

6. E-Commerce Market Size
(Billions of US dollars)
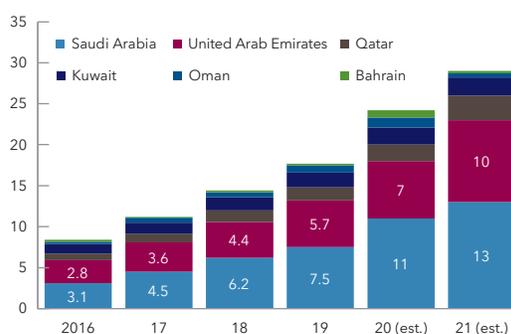
Sources: International Telecommunication Union; Kearney Consulting; and IMF staff calculations.

Note: Data of "E-Commerce Market Size" were estimated by Kearney Consulting, which include all B2C e-commerce spendings excluding airline travels and accommodations. Saudi Arabia's "E-Commerce Transactions Using Mada Cards," a slightly different definition published by the Saudi Central Bank, indicated a value of $19.8 billion in 2021, which increased to $41.8 billion in 2023. AE = advanced economy; EM = emerging market; ICT = information and communications technology.

Figure 9. Digitalization in Gulf Cooperation Council Industries and Job Markets

1. Inputs from Digital Industries
(Percentage of total output)

Legend:
- IT hardware
- Digital services

Categories: Saudi Arabia, United States

2. Tech Skills in LinkedIn Profiles
(Global average = 1)

Legend: Germany, United Kingdom, United States, Saudi Arabia, United Arab Emirates
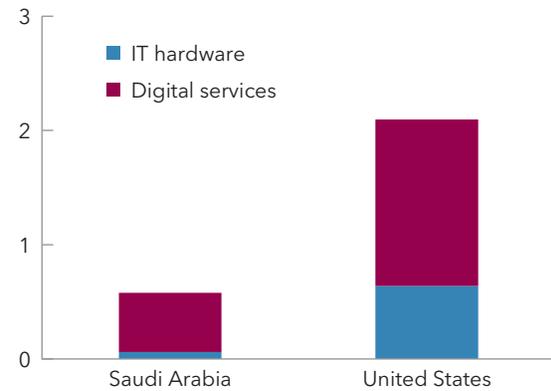
Sources: General Authority for Statistics of Saudi Arabia; OECD Input–Output Tables 2021; and IMF staff calculations.
Note: Data for Saudi Arabia for 2021; data for the United States for 2018. IT = information technology.
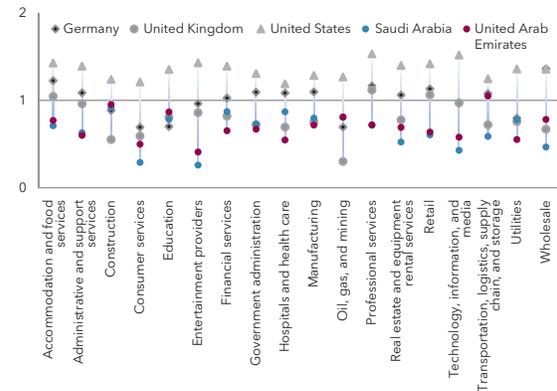
Source: LinkedIn data.
Note: 2017–22 average.

Box 1. The Gulf Cooperation Council's Artificial Intelligence Strategies and Preparedness

GCC AI Strategies and Initiatives

Governments in the Gulf Cooperation Council (GCC) region have moved quickly to introduce national strategies on artificial intelligence (AI) and advanced technologies and invest in related infrastructure such as supercomputers and data centers. Saudi Arabia's National Strategy for Data & AI and the United Arab Emirates' Strategy for AI 2031 outline comprehensive road maps for AI development and adoption, with the goal of becoming global leaders. Several GCC countries are encouraging AI research and innovation through initiatives with universities, research centers, and the private sector (Bahrain, Kuwait, Qatar, Saudi Arabia, United Arab Emirates). Highlighting the importance of AI regulation and ethics, some have also developed principles or guidelines for the ethical use of AI (Bahrain, United Arab Emirates). Such efforts are starting to bear fruit, as exemplified by increasing AI applications across various industries in the GCC as well as leadership in generative AI development (for example, open-source large language models Falcon and Jais developed by the United Arab Emirates).

Box Figure 1.1. Number of Data Centers
(GCC region, as of April 2024)

Categories: Saudi Arabia, United Arab Emirates, Oman, Bahrain, Qatar, Kuwait
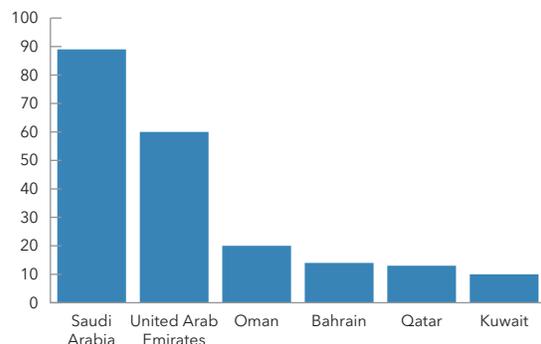
Source: DC Byte.
Note: Data labels in the figure use International Organization for Standardization (ISO) country codes.

Box Figure 1.2. AI Preparedness by Components
(Scaled score to [0, 0.25] each higher = better)

■ Digital infrastructure ■ Digital innovation
■ Human capital   ■ Regulation

United Arab Emirates
Saudi Arabia
Qatar
Oman
Bahrain
Kuwait
GCC
AE
EM

0.00   0.20   0.40   0.60   0.80
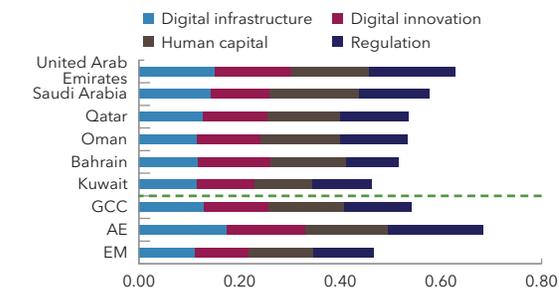
Source: Cazzaniga and others (2024).
Note: AE = advanced economy; EM = emerging market; GCC = Guld Cooperation Council.

The GCC is better prepared than an average emerging market in embracing AI, but gaps remain relative to advanced economies, especially in digital innovation and regulations. A composite index to measure AI preparedness (covering digital infrastructure, innovation, human capital, and regulation) suggests that the GCC is generally more prepared to embrace AI than an average EM (Cazzaniga and others 2024). In particular, the United Arab Emirates and Saudi Arabia, ranked at 36th and 45th globally, are the most AI-ready countries in the Middle East. Nonetheless, more efforts are needed in multiple dimensions for the GCC to catch up with advanced economy levels, especially on digital innovation and regulations.

AI adoption could have a profound effect on the labor market, requiring a careful strategy to balance productivity gains against job displacement risks. As estimated by Cazzaniga and others (2024), about 40 percent of the workforce worldwide is exposed to AI, with a higher share reported in AEs where there are more cognitive-task-oriented jobs. For some occupations, AI will likely complement human labor and increase their productivity (for example, judges), whereas for some others, AI could replace human labor (for example, telemarketers). Policy measures to develop local AI talent and facilitate the transition into jobs with high complementarity with AI are thus important. Social safety nets are needed to support displaced workers during this transition. The speed and success of AI adoption are also contingent on the data availability and regulatory frameworks that mitigate risks but without stifling innovation.

## C. Enhanced Digital Access Index: A Composite Index to Measure Progress

To capture the country-level progress in digitalization more broadly, we construct a composite index called the EDAI. The index serves as a crucial barometer for measuring a nation's digital advances and inclusivity. The composite index covers five key aspects: availability of infrastructure, affordability of access, digital knowledge of the population, quality of ICT services, and internet usage (including access to high-speed internet). All indicators were rescaled to a [0, 1] interval using the min–max transformation. Equal weights are applied to all indicators to construct subindices, which are then aggregated to a single composite index. A score closer to 1 indicates a higher level of digitalization. This index is constructed in the same spirit as the one used by Alper and Miktus (2019) and the ITU's Digital Access Index, with the advantage of covering broader aspects of digitalization and a larger number of countries. Annex 2 describes all the indicators used and the methodology to construct the EDAI.

Over the past two decades, the GCC, on average, has closed the gap with AEs on the overall EDAI, although further catch-up is needed on certain dimensions (Figure 10). The gap between the GCC average and AE average in the overall EDAI scores has narrowed from −0.2 in 2005 (that is, 20 percent of the entire EDAI scale) to nearly zero in 2022, with Saudi Arabia and the United Arab Emirates outperforming the AE average and Oman having the largest gap. On the subindices, the GCC average is now on par with AEs in infrastructure, affordability, and digital knowledge. However, gaps persist in internet usage (mainly on the fixed subscriptions to high-speed internet, not shown in Figure 8) and ICT service quality as of 2022. The average affordability score of the GCC was on par with the AEs until 2020, but a marginal gap opened in the past two years. This could be attributed to several factors: high digital expenditures linked to the rising cost of living across all GCC economies; limited competition of the telecommunication markets, where a few state-owned enterprises dominate the market (for example, Ooredoo in Qatar, Saudi Telecom Company in Saudi Arabia, and Etisalat and du in the United Arab Emirates); and relatively costly deployment and maintenance of infrastructure given the GCC's geographical location, resulting in higher prices.

The overall progress in the GCC, however, masks cross-country variations, especially on internet usage, digital knowledge, and ICT service quality. On digital infrastructure and affordability, all GCC countries have similarly high scores, either on par or exceeding the AE average. On ICT service quality, Bahrain, Qatar, and the United Arab Emirates perform similarly to, or even better than, the AE average, whereas other GCC countries have some scope to catch up. The internet usage and digital knowledge are the two areas where cross-GCC differences are the largest—Saudi Arabia and the United Arab Emirates are notably more advanced because of the rapid progress made in those areas since the pandemic. In particular, Saudi Arabia's significant advancement in digital knowledge from 2019 to 2022 is mainly driven by the efforts to enhance ICT proficiency of its labor force as part of the national digitalization initiatives. Oman also improved its digital knowledge score considerably during this period but from a relatively low base. In contrast, Bahrain, Kuwait, and Qatar demonstrate only marginal improvement in the past decade on digital knowledge. However, there was a decline in ICT service quality in Kuwait, Oman, and Saudi Arabia between 2019 and 2022, which may relate to network congestions.

In sum, the GCC economies have advanced significantly in their digitalization journey, especially since the pandemic, and more can be achieved by leveraging on their strengths. Tangible progress has been made in public sector digitalization, financial sector innovation, and digital infrastructure and connectivity. In particular, the GCC economies are largely on par with the AE average in GovTech maturity and digital infrastructure and connectivity, driven by their national digitalization initiatives (Table 1). Nonetheless, there are

areas for further improvement, notably in enhancing financial inclusion through digital solutions, bridging the digital skills gap to foster further digital penetration in economic activities, broadening the regulatory framework to ensure proper growth in fintech, and balancing the employment and productivity gains from digitalization with the risks of increasing job displacement and digital divide.

Figure 10. Gulf Cooperation Council: Progress in the Enhanced Digital Access Index
(Index: 0–1, 1 = highest level of digitalization)

1. GCC's EDAI Gap with AE
(GCC average–AE average)
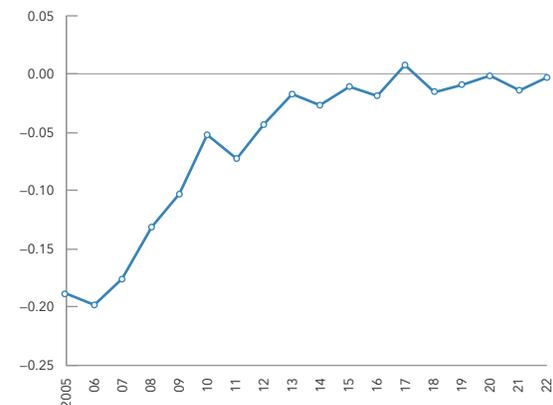
2. GCC's EDAI Gap with AE by Subindex
(GCC average–AE average)
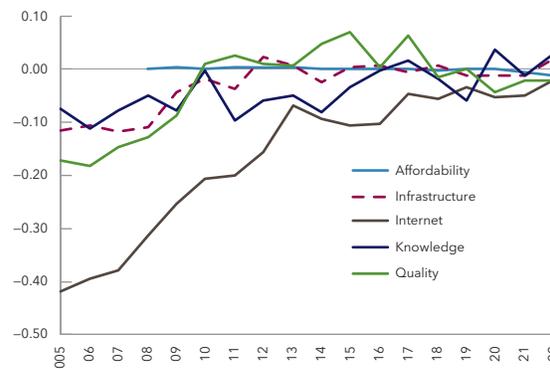
3. EDAI Improvement
(Increase from 2019 to 2021/22)
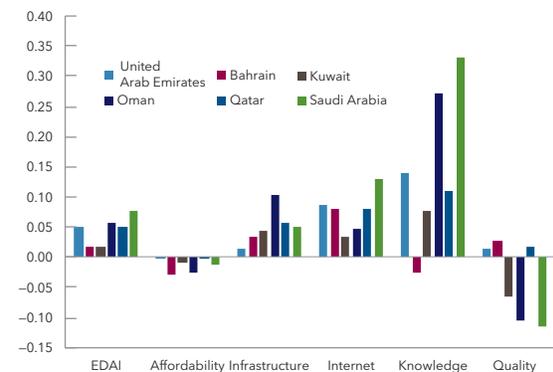
4. EDAI Performance by Subindex, 2021/22
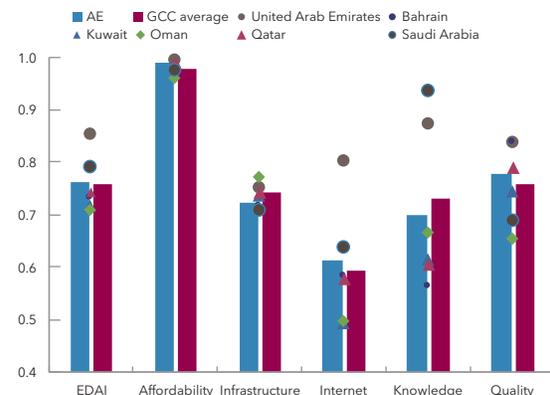
Sources: World Bank; and IMF staff calculations.
Note: Because of missing data of some indicators for the United Arab Emirates' 2022 knowledge score, 2021 data are used for the United Arab Emirates in panels 3 and 4. All other countries used the 2022 data. AE = advanced economy; EDAI = Enhanced Digital Access Index; GCC = Gulf Cooperation Council.

3. Effect of Digitalization and Implications for the GCC

In this section, we first assess the macroeconomic effect of enhanced digital adoption in the financial and public sectors, as well as the overall effect on economic growth (subsections A–D). The analysis uses a panel data set across 175 economies for 2000–22 (Annex 3), employing a similar empirical approach and a set of control variables to capture the macroeconomic conditions (Table 2). Because of data limitations in some GCC countries, we rely on the empirical results of the EM subsample to draw implications for the GCC region.

Table 2. Summary of the Empirical Methodology

Equations	Method	Sample
Financial inclusion $FI_{it} = \beta_0 + \beta_1 Digital_{it} + \beta_2 Z_{it} + \alpha_i + \alpha_t + \epsilon_{it}$	Fixed effects regression	Global panel with country-level data, 2000–22
Banking sector performance $BP_{it} = \beta_0 + \beta_1 Shocks_{it} + \beta_2 Digital_{it} + \beta_3 Digital_{it} \times Shocks_{it} + \beta_4 Z_{it} + \alpha_i + \alpha_t + \epsilon_{it}$	Fixed effects regression	
Government effectiveness $GoV_{it} = \beta_0 + \beta_1 Digital_{it} + \beta_2 Z_{it} + \alpha_{region} + \alpha_t + \epsilon_{it}$	OLS regression	
Economic growth $Growth_{it} = \beta_0 + \beta_1 Digital_{it} + \beta_2 Z_{it} + \alpha_i + \alpha_t + \epsilon_{it}$	Fixed effects regression	
Corporate sector assessment *See subsection E*	Local projection	GCC with firm-level data, 2001:Q1–22:Q4

- Dependent variables: FI_{it} denotes the level of financial inclusion in country *i* in year *t*, measured as the percentage of adult population with a bank account at a formal financial institution. BP_{it} denotes the banking sector performance measured by return on assets and return on equity. GoV_{it} denotes the Government Effectiveness Index. $Growth_{it}$ is measured by GDP per capita scaled (log-transformed then multiplied by 100).

- Independent variables: $Digital_{it}$ denotes the magnitude of digital adoption, measured by the EDAI rescaled to [0, 100] (for the analysis on financial inclusion, banking sector, and economic growth) or GovTech Maturity Index/ Public Service Delivery Index (for the analysis on government effectiveness). $Shocks_{it}$ refers to the global financial crisis (2008–09) and the COVID-19 pandemic (2020–21).

- Other: Z_{it} refers to a vector of control variables (different sets for each regression, as explained in subsections A–D); α_i and α_{region} denote unobserved country-specific and regional-specific effects, respectively, and α_t denotes time effects; ϵ_{it} represents the error term.

Source: IMF staff estimates.
Note: EDAI = Enhanced Digital Access Index; GCC = Global Cooperation Council; OLS = ordinary least squares.

Subsection V on the corporate sector adopts a micro approach to analyze the effect of digitalization on firm-level performances. The analysis focuses on firms' resilience during recessions and considers different measures of industry-level digital adoption because the EDAI is at the country level (Annex 4).

A. Digitalization and Financial Inclusion

We first explore the role of digitalization in improving financial inclusion. The financial inclusion index data (from the Global Findex database) are available for four different time periods (2011, 2014, 2017, and 2021)[6] with a sample of 155 economies. We consider a vector of control variables that are commonly used in the literature. Inflation is used as a proxy for macroeconomic stability and the sum of exports and imports to GDP as a proxy for trade openness. To control for institutional quality, we include indexes of government effectiveness and control of corruption from the International Country Risk Guide and the World Bank's World Governance Indicators.[7] Although the oil price is very important for GCC economies, it is not included because it is strongly correlated with GDP growth (both nominal and real) and the EDAI. In all our specifications, lagged values of certain variables (such as GDP growth) are used to avoid endogeneity.

The results suggest a positive and statistically significant relationship between digitalization and financial inclusion, which is even stronger for the EM subsample. The full sample results show that a one-unit increase in the EDAI, which is approximately GCC's average annual improvement during 2017–21, is positively associated with a 0.6 percentage point increase in average financial inclusion (Table 3, regression (1)). The effect is even stronger for the EM subsample, with a one-unit increase in the EDAI being positively associated with a 0.76 percentage point increase in average financial inclusion (Table 3, regression (2)). These highlight the significant potential of further digitalization in allowing better access to financial services.

Bahrain and Saudi Arabia are estimated to have larger potential gains from further digitalization in improving financial inclusion (Figure 11). To examine the effect for an individual GCC country, we replace the interaction term of *EDAI * GCC* in regression (3) of Table 3 by *EDAI * country_dummy*. The estimated coefficients of the interaction term for Bahrain (11.4) and Saudi Arabia (1.1) are positive and significant at the 1 and 5 percent level, respectively, indicating a larger-than-EM average effect of digitalization on financial inclusion in these countries. However, Kuwait exhibits a lower-than-EM average effect, whereas the United Arab Emirates shows a positive but insignificant coefficient. Because of limited financial inclusion data for Oman and Qatar (only available for 2011), their interaction terms were omitted. The base effect of EDAI is similar across regressions incorporating individual GCC country dummies, ranging from 0.75 to 0.81 at the 1 percent level of significance.

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[6] Details about the Findex data are available at: https://www.worldbank.org/en/publication/globalfindex. Please note that the panel data are not completely balanced because the survey was not conducted for all countries for all the time periods under study here.

[7] The existing literature provides evidence of a strong correlation between financial inclusion and the degree of urbanization, legal system, and income level. We have considered these variables but did not include all of them because of multicollinearity. The degree of multicollinearity was tested by variance inflation factor. Therefore, controls with high variance inflation factor values are dropped from the final regressions (for example, urban population, Women, Business, and the Law Index).

Table 3. Effect of Digitalization on Financial Inclusion

Dependent Variable	(1) Financial Inclusion (percent) Full Sample	(2) Financial Inclusion (percent) EMs	(3) Financial Inclusion (percent) EMs
EDAI	**0.60***	**0.76***	**0.77***
	(0.08)	(0.16)	(0.17)
Control of corruption	4.94	8.39*	8.36*
	(3.04)	(4.79)	(4.81)
CPI inflation (period average, percent)	0.01***	0.01**	0.01**
	(0.00)	(0.01)	(0.01)
GDP growth ($n-1$)	−0.49***	-0.63***	−0.62***
	(0.13)	(0.20)	(0.20)
Interaction: GCC#EDAI			−0.14
			(0.46)
Constant	22.88***	13.99	13.71
	(4.49)	(9.87)	(9.94)
Country fixed effects	Yes	Yes	Yes
Crisis dummies	No	No	No
Observations	533	239	239
Number of countries	155	69	69
Corrected R^2	0.94	0.86	0.85
Within-panel R^2	0.74	0.30	0.28

Source: IMF staff estimates.

Note: Robust standard errors in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Corrected R^2 estimated while accounting for panel effect in the overall fitness. A crisis dummy variable is not included because of its collinearity with lagged GDP growth and EDAI. CPI = consumer price index; EDAI = Enhanced Digital Access Index; EMs = emerging markets; GCC = Gulf Cooperation Council.

Figure 11. Gulf Cooperation Council: Country-Level Effect of Digitalization on Financial Inclusion
(Replacing GCC dummy in regression (3) by each country dummy)
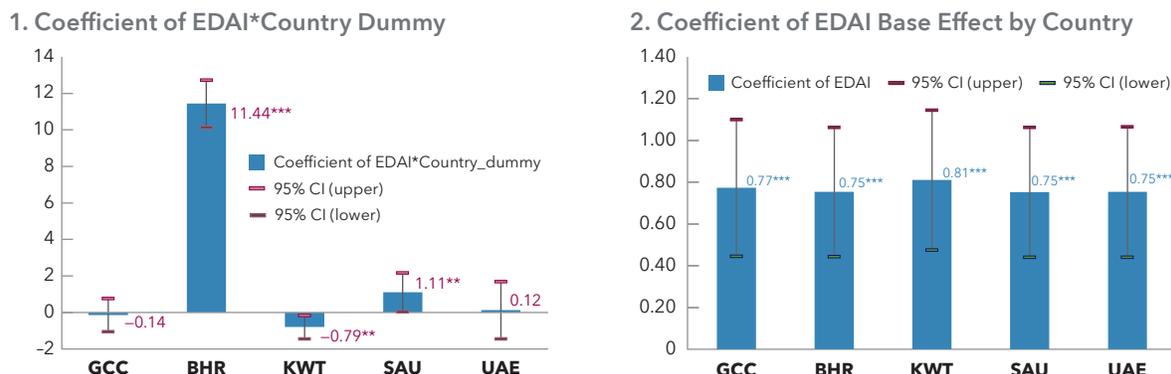
Source: IMF staff estimates.

Note: Asterisk signs represent the level of significance *** $p < 0.01$, ** $p < 0.05$. Interaction terms for Oman and Qatar were omitted because of limited data of financial inclusion (only 2011 data available). Data labels in the figure use International Organization for Standardization (ISO) country codes. CI = confidence interval; EDAI = Enhanced Digital Access Index; GCC = Gulf Cooperation Council.

B. Digitalization and Banking Sector Resilience

Second, we analyze the effect of digitalization on banking sector resilience during the global financial crisis and the COVID-19 pandemic.[8] An interaction term ($Digital_{it} \times Shocks_{it}$) is employed to ascertain the effect of digitalization on banking sector resilience (Table 4). Control variables are similar to those considered in the previous subsection.

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[8] We focus on banking sector resilience rather than profitability because the digitalization measure we have (EDAI) is at the country level, whereas banking sector profitability is more likely to be affected by bank-level characteristics, such as net interest rate margin, leverage, and bank-level digital adoption, with significant heterogeneity across banks that is not captured by the country-level EDAI.

Table 4. Effect of Digitalization on Banking Sector Resilience

Dependent Variable	(1) Return on Equity (Full Sample)	(2) Return on Equity (EMs)	(3) Return on Assets (Full Sample)	(4) Return on Assets (EMs)
Crisis shocks	−13.55***	−19.93**	−1.82***	−2.39***
	(3.16)	(8.07)	(0.55)	(0.84)
EDAI	0.04	0.04	−0.00	−0.01
	(0.05)	(0.09)	(0.01)	(0.01)
Crisis shocks * EDAI	**0.12****	**0.25***	**0.02****	**0.03****
	(0.05)	(0.13)	(0.01)	(0.01)
CPI inflation (period average, percent)	0.09	0.02	0.01	0.00
	(0.13)	(0.17)	(0.01)	(0.02)
Control of corruption	1.14	2.39	–0.04	0.03
	(1.67)	(2.15)	(0.23)	(0.26)
Government effectiveness	3.07**	1.25	0.26	–0.05
	(1.54)	(1.87)	(0.18)	(0.22)
Trade (percent of GDP)	0.07***	0.04	0.01**	0.00
	(0.02)	(0.04)	(0.00)	(0.00)
GDP growth ($t − 1$)	0.46***	0.39**	0.04***	0.03*
	(0.11)	(0.18)	(0.01)	(0.02)
Constant	5.66*	9.80**	1.47**	2.23***
	(3.33)	(4.44)	(0.59)	(0.54)
Year fixed effects	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes
Observations	1,729	859	1,715	855
Number of countries	129	65	129	65
Corrected R^2	0.38	0.35	0.46	0.46
Within-panel R^2	0.1	0.08	0.1	0.09

Source: IMF staff estimates.

Note: Robust standard errors in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Corrected R^2 estimated while accounting for panel effect in the overall fitness. CPI = consumer price index; EDAI = Enhanced Digital Access Index; EMs = emerging markets.

Results suggest that digitally advanced banking sectors tend to be more resilient during the global crisis. This finding is consistent with the recent literature, including on the MENA region (Abidi, El-Herradi, and Sakha 2022; Copestake, Estefania-Flores, and Furceri 2022), which emphasizes that embracing digitalization enables banks to enhance operational efficiency, reduce transaction costs, expand their customer base, and drive innovation. These mechanisms, in turn, help mitigate the adverse effects of recessions on bank

profitability. The association between digitalization and banking sector resilience is even stronger for the EM subsample than for the full sample, pointing to potentially larger gains in GCC banking sector resilience with a given amount of improvement in digitalization.

C. Digitalization and Government Effectiveness

In this section, we study the relationship between public sector digitalization and government effectiveness. Two alternative sectoral indexes, the GTMI and Public Service Delivery Index (PSDI), are used in this analysis to measure the public sector's digital transformation. There is a positive correlation between the EDAI, the GTMI, the PSDI, and the Government Effectiveness Index (Figure 12). We use the GTMI and PSDI, instead of the EDAI, in this analysis because the former two are more targeted to public sector digitalization than the latter. A cross-country pooled ordinary least squares regression is used because of the limited year coverage of the panel data (GTMI and PSDI data are only available for two years). The dependent variable—Government Effectiveness Index—measures the quality and credibility of public services, including the perception of public service quality, civil service quality and its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies (World Bank 2016). The regressions consider a similar vector of controls as in previous subsections, including inflation, control of corruption, trade openness, and financial access (Table 5). Inflation and trade openness were scaled by 1/100 to show the magnitude of the estimated coefficients.

Figure 12. Enhanced Digitalization Access Index, GovTech Maturity Index, Public Service Delivery Index, and Government Effectiveness

1. GTMI and EDAI
(Latest available)
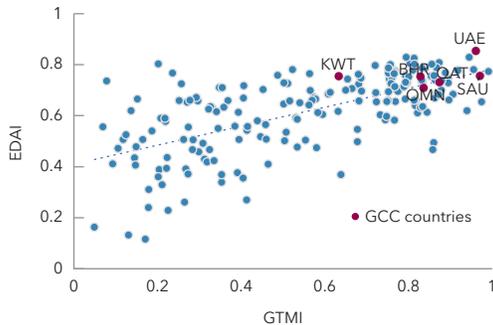
2. GTMI and Government Effectiveness
(Latest available)
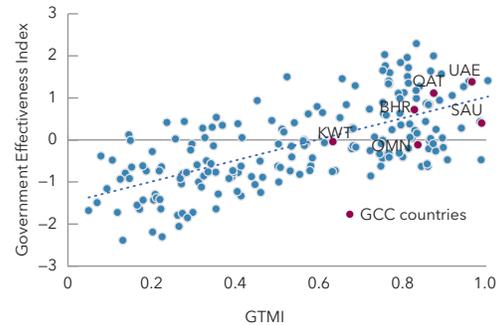
3. EDAI and Government Effectiveness
(Latest available)
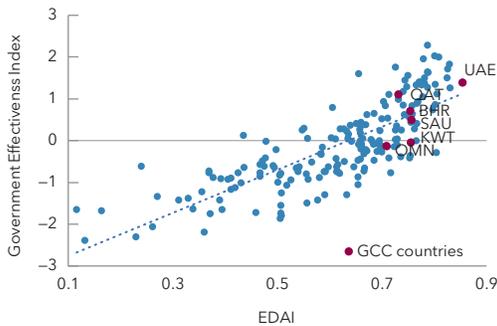
4. PSDI and Government Effectiveness
(Latest available)
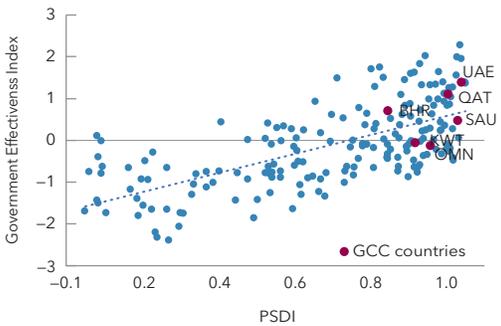
Sources: World Bank; and IMF staff estimates.

Note: Data labels in the figure use International Organization for Standardization (ISO) country codes. EDAI = Enhanced Digitalization Access Index; GCC = Gulf Cooperation Council; GTMI = GovTech Maturity Index; PSDI = Public Service Delivery Index.

We find that improvement in public sector digitalization has a significant and positive association with higher government effectiveness (Table 5). The result is robust to the public sector digitalization indicator used (GTMI or PSDI). Digital government transformation helps streamline administrative processes, automate paperwork, and reduce waiting times and errors. It also enhances citizen engagement and promotes transparency, accountability, and public trust. Finally, government digitalization strengthens data management, which helps inform policymaking, identify areas for improvement, and measure performance—all areas that will ultimately help improve overall government effectiveness.

Table 5. Effect of Digitalization on Government Effectiveness: OLS Regressions

Dependent Variable	(1) Government Effectiveness	(2) Government Effectiveness
GTMI	**1.03***	
	(0.11)	
PSDI		**0.95***
		(0.11)
CPI inflation (period average, percent), scaled by 1/100	−0.09*	−0.11***
	(0.04)	(0.06)
Trade (percent of GDP), scaled by 1/100	0.13***	0.13***
	(0.03)	(0.03)
Control of corruption	0.61***	0.58***
	(0.03)	(0.03)
Constant	−0.45***	−1.40***
	(0.10)	(0.11)
Regional effect	Yes	Yes
Year effect	Yes	Yes
Observations	320	320
R^2	0.91	0.91

Source: IMF staff estimates.
Note: Robust standard errors in parentheses *** p <0.01, * p < 0.1. CPI = consumer price index; GTMI = GovTech Maturity Index; OLS = ordinary least squares; PSDI = Public Service Delivery Index.

Although many GCC countries' GTMI already rank high globally (Figure 13), their marginal gains from further improvement in public sector digitalization could still be statistically and economically significant (Figure 14). In addition to the previous ordinary least squares regression, a pooled quantile regression is conducted to shed light on GCC-specific implications. As expected, countries with low levels of public sector digitalization are likely to benefit more from digital advancement. All the GCC countries, except for Kuwait, have their GTMI scores above the 80th percentile globally, with Saudi Arabia and the United Arab Emirates having above the 95th percentile (ranked the third and fourth, respectively). This implies that among the GCC peers, Kuwait is likely to gain the most from further government digitalization, whereas for the others, the expected gains would be smaller than the global average. Nonetheless, such gains are still expected to be economically mean-

Figure 13. GovTech Maturity Index Percentiles of the Gulf Cooperation Council
(2022 data in the quantile regression sample)
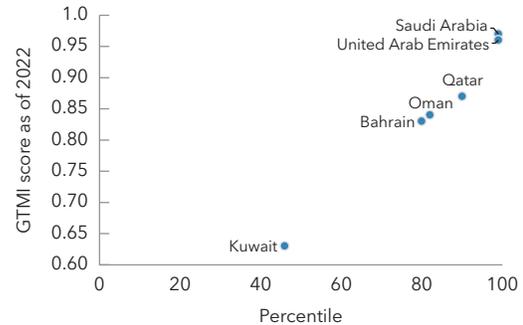
Source: IMF staff calculations.
Note: GTMI = GovTech Maturity Index.

ingful. For example, for Saudi Arabia and the United Arab Emirates, where their GTMI scores are already above the 95th percentile, the potential marginal gains from further public sector digitalization are around 0.53 (compared with a global average of 1.03).

Figure 14. Effect of Digitalization on Government Effectiveness: Pooled Quantile Regression

1. Coefficient of GovTech Maturity Index
(Percentiles)
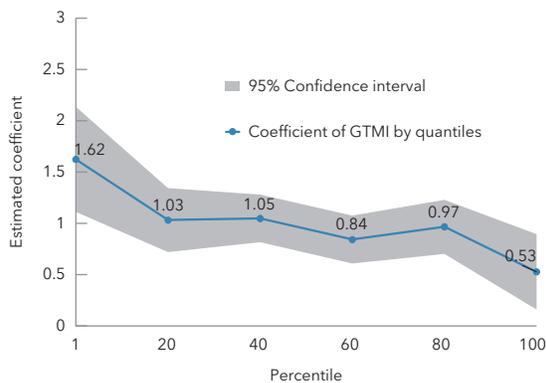
2. Coefficient of Public Service Delivery Index
(Percentiles)
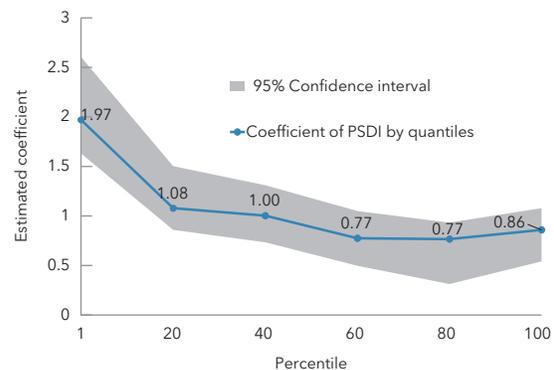
Source: IMF staff estimates.
Note: GTMI = GovTech Maturity Index; PSDI = Public Service Delivery Index.

D. Digitalization and Economic Growth

Next, we assess the effect of digitalization on the overall economic growth. Control variables include inflation, control of corruption, government effectiveness, trade openness, lagged real GDP growth, and crisis shocks. Digital adoption has the potential to increase efficiency in factor markets and boost economic growth. Cusolito and others (2022) estimate that fully digitalizing the economy could deliver a long-term economic gain of at least $1.6 trillion for the MENA region.

A positive and statistically significant correlation is found between digitalization and economic growth (Table 6). The estimated effects based on the full sample and the EM subsample are very similar, with a one-unit increase in the EDAI (approximately GCC's average annual improvement during 2017–21) associated with a 0.68 to 0.7 percentage point increase in GDP per capita growth. As expected, crisis has a negative effect on growth, with the EMs more vulnerable to shocks. A robustness check has included the interaction term of $Digital_{it} \times Shocks_{it}$, but it has an insignificant coefficient in both the global and EM samples, suggesting a limited crisis-mitigation effect from digitalization on average. Admittedly, compared with other factors (for example, strong macroeconomic fundamentals), the degree of digitalization may not be as important a factor for growth resilience during shocks, especially because some EMs and low-income countries in our sample, however, had limited investment in digitalization before the pandemic.[9] Nevertheless, with the swift move to online platforms and the significant acceleration in digitalization since the pandemic, the crisis-mitigation role of digitalization could become more prominent. To further examine this point, we conducted a case study on Saudi Arabia where significant investment in digital infrastructure was made before the global health crisis to shed light on the crisis-mitigation role of digitalization during the COVID-19 pandemic (Box 2).

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[9] Studies indicate that countries with higher levels of digitalization tend to find more significant crisis-mitigation effects of digitalization. A study conducted by the ITU on a global sample reveals that after controlling for country/time-fixed effect, investment, and human capital, countries with a better infrastructure for connectivity were more able to offset part of the negative economic effects of COVID-19 (ITU 2021). A recent IMF study found that based on a sample of 23 advanced economies, higher digitalization mitigated the economic disruptions caused by the pandemic by increasing aggregated productivity growth by a quarter and reducing the loss in hours worked by a third (Jaumotte and others 2023).

Table 6. Effect of Digitalization on Economic Growth

Dependent Variable	(1) GDP per Capita, Scaled (Full Sample)	(2) GDP per Capita, Scaled (EMs)
EDAI	**0.70*****	**0.68*****
	(0.04)	(0.07)
CPI inflation (period average, percent)	−0.06**	−0.13**
	(0.02)	(0.05)
Control of corruption	7.34***	6.79***
	(1.31)	(1.86)
Government effectiveness	14.60***	11.43***
	(1.37)	(1.87)
Trade (percent of GDP)	0.02	0.06*
	(0.02)	(0.03)
GDP growth ($t - 1$)	0.22***	0.17*
	(0.07)	(0.10)
Crisis shocks	−2.36**	−3.47**
	(1.01)	(1.63)
Constant	821.11***	839.67***
	(2.64)	(4.95)
Year fixed effects	Yes	Yes
Country fixed effects	Yes	Yes
Observations	3,281	1,616
Number of countries	175	86
Corrected R^2	0.99	0.98
Within-panel R^2	0.58	0.54

Source: IMF staff estimates.

Note: Robust standard errors in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Corrected R^2 estimated while accounting for panel effect in the overall fitness. CPI = consumer price index; EDAI = Enhanced Digital Access Index; EMs = emerging markets.

Box 2. Digital Deep Dive: Saudi Arabia

National Digital Strategies of Saudi Arabia

Saudi Arabia has embedded digital transformation initiatives in its Vision 2030 to diversify its economy. The 2030 national transformation agenda of Saudi Arabia has placed a strong emphasis on improving digital connectivity and developing the digital sector. Impressive progress has been made in this regard, as evident by the increase in the digital economy's contribution to the GDP from 11.5 percent in 2018 to 14 percent in 2022. Furthermore, the percentage of the population using the internet in Saudi Arabia has gone up significantly from 68.5 percent in 2015 to 99 percent in 2023. Saudi Arabia's digital transformation agenda includes strategies covering the ICT sector (governed by the Ministry of Communications and Information Technology) and across economic sectors.[1]

Impressive progress has been made under the information and communications technology (ICT) sector strategy, which was launched in 2019, with 11 of 15 indicators having already surpassed their 2023 targets in 2022 (for example, ICT workforce and Saudization, internet user penetration), indicating significant progress made by the authorities (Box Table 2.1).

Digitalization as a Driver of Economic Resilience in Saudi Arabia

We rely on the ITU study (ITU 2021) to better understand the effect of digitalization on economic resilience in Saudi Arabia during COVID-19. The ITU model is based on structured models composed of four equations (see Box Table 2.2) and highlights the association between the number of deaths because of COVID-19, national levels of fixed broadband (FBB) penetration, and the extent of the fall in GDP per capita (adjusted purchasing power parity). The starting premise is that an increase in COVID-19 deaths negatively affects a country's GDP per capita. The ITU study measured the extent to which similar increases in COVID-19 deaths had different levels of negative effects on the GDP of a country, depending on its FBB penetration level. The important implication of this relationship is that countries with higher FBB penetration saw a lower economic effect, in terms of GDP per capita (purchasing power parity), compared with those with lower FBB penetration. Because of the strength of the correlation, and based on the triangulation of these three factors, an estimate of the likely fall in GDP in a country is possible.[2]

According to the estimates by the authorities, digitalization was a significant driver of economic resilience during the COVID-19 pandemic in Saudi Arabia. By mapping Saudi Arabia's FBB penetration levels in 2017 and 2019 to the ITU study brackets, we extract the coefficients corresponding to the GDP per capita change per 1 percent increase in COVID-19 deaths for each FBB penetration level: −0.024 percent for 2017 and −0.021 percent for 2019. The actual GDP per capita (purchasing power parity) decline in 2020 was 6.32 percent. However, if Saudi Arabia would have FBB penetration at 2017 level based on the formula of the ITU study, the estimated fall of GDP per capita (purchasing power parity) would be −6.82 percent. Based on this analysis, it can be inferred that Saudi Arabia's investment in FBB helped mitigate the fall in GDP per capita (purchasing power parity) by 0.54 percentage point (Box Figure 2.1). This enhanced resilience was made possible by Saudi Arabia's efficient transition to a digital model, supported by the advanced telecommunications network. Moreover, during the COVID-19 pandemic, approximately 98 percent of students were able to join the online schooling platform—substantially higher than the global average of 50 percent estimated by the UN Educational, Scientific and Cultural Organization—and over 95 percent of businesses operated or switched to online trading. Not only has Saudi Arabia's digital readiness

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[1] 2023 data are obtained from Communications, Space & Technology Commission (2024).
[2] For details of the methodology, please see ITU (2021).

Box Table 2.1. Saudi Arabia: Status of ICT Sector Strategy 2019–23

Initiative/Indicator	Baseline	2022 Actual (or otherwise specified)	2023 Target
Macro Indicator			
DE contribution to real GDP (percent)	2018 = 11.5	14	2025 = 16
ICT contribution to real GDP (percent)	2018 = 3.3	3.50	4.6
ICT workforce	n/a	+340 K	+250 K (Surpassed target)
Internet user penetration (percent)	2015 = 68.5	2023 = 99[1]	2025 = 97 (Surpassed target)
Market Level: Telecommunication Market			
Telco services Mkt size (billions of riyals)	2017 = 61.3	73	62 (Surpassed target)
MBB coverage percent (4G)	2017 = 86	2023 = 98[1]	96 (Surpassed target)
5G coverage (percent population)	2019 = 0	53	n/a
Data center capacity (MW)	2020 = 68	127	150
FBB speed (Mbps)	2020 = 66	109.83	77 (Surpassed target)
MBB speed (Mbps)	2019 = 55.58	2023 = 214.6[1]	70 (Surpassed target)
Market Level: IT and Emerging Technologies Market			
IT market size (billions of riyals)	2019 = 58.7	81	61 (Surpassed target)
Investment on start-ups (billions of riyals)	2017 = 0.161	3.7	1.1 (Surpassed target)
Number of start-ups deals	2019 = 72	144	80 (Surpassed target)
Saudization level in ICT (percent workforce)	2016 = 37	63.83	50 (Surpassed target)
Female participation (percent workforce)	2016 = 7	33.01	18 (Surpassed target)

Source: Saudi Arabia Ministry of Communications and Information Technology.
Note: DE = digital economy; FBB = fixed broadband; ICT = information and communications technology; IT = information technology; MBB = mobile broadband.

mitigated the severity of the shock but has also resulted in a number of enhanced outcomes during the crisis. According to a survey conducted by the World Bank, more than 66 percent of teachers in Saudi Arabia believed that their students' academic performance improved when they were able to study at home.

**Box Table 2.2. Four Equations of Structural Model**

| Aggregate production function	$GDP\ per\ capita_{it} = a_1\ (Capital)_{it} + a_2\ (Education)_{it} + a_3\ (Broadband\_penetration)_{it} + e_{it}$
Demand function	$Broadband\_penetration_{it}$ $= b_1(Rural\_population)_{it} + b_2(Broadband\_price)_{it} + b_3(GDP\ per\ capita)_{it}$ $+ b_4(HHI)_{it} + e_{it}$
Supply function	$Broadband\_revenue_{it}$ $= c_1(Broadband\_price)_{it} + c_2(GDP\ per\ capita)_{it}$ $+ c_3(HHI\ fixed\ broadband)_{it} + e_{it}$
Output function	$\Delta Broadband\_penetration_{it} = d_1\ (Fixed\_broadband\_revenue)_{it} + \epsilon_{it}$

Source: ITU (2021).

Box Figure 2.1. Digitalization as a Driver of Economic Resilience in Saudi Arabia

1. Real GDP Distribution
(SAR 73 billion of digital economy GDP was created by leveraging digital infrastructure)
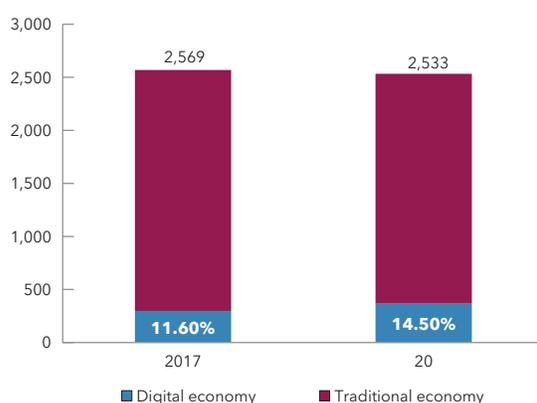
2. Simulation of 2020 GDP Decline with Different Levels of FBB Penetration
(FBB penetration helped mitigate the effect of COVID-19 on GDP per capita [PPP] by 0.54 percent)
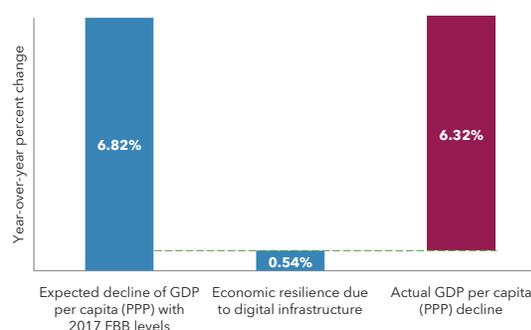
Sources: Country authorities' estimates; Fiber Connect Council Middle East and North Africa; International Telecommunication Union; Oliver Wyman Analysis; and Statista.

Note: Refer to coordination across Ministry of Communications and Information Technology, Communications, Space & Technology Commission, Digital Government Authority, General Authority for Competition, Saudi Central Bank, Water & Electricity Regulatory Authority, and SAMENA Telecommunications Council. For details of the methodology, please see ITU (2021). FBB = fixed broadband; PPP = purchasing power parity.

E. Digitalization and Corporate Sector Resilience: A Firm-Level Analysis

We analyze the effect of digitalization on firm-level performance, with a focus on resilience during recessions. Given the lack of adequate data on digitalization at the firm level, we consider digitalization at the industry level and compare firms across industries based on recent studies (Copestake, Estefania-Flores, and Furceri 2022). We use Jordà's (2005) local projection method to estimate the following equation:

$$y_{n,i,t+h} - y_{n,i,t-1} = \alpha_{is}^h + \gamma_{nq}^h + \beta_1^h Shocks_{i,t} + \beta_2^h Digital_{i,t} + \beta_3^h \left(Shocks_{i,t} * Digital_{i,t} \right) + \theta M_{it} + \varepsilon_{n,i,t+h},$$

where the dependent variable is the log difference in a performance indicator (revenue, earnings, return on assets, or return on equity) for firm *n* from country *i* at quarterly date *t* over *h* quarters, *Shocks* is a dummy variable equaling 1 at the start of a technical recession, and *Digital* is a measure of digitalization. How to measure digital intensity at the industry level is key to the empirical approach. We use three alternative indicators as proxies of digitalization: (1) intangible assets share, (2) share of each industry's inputs that come from digital industries, and (3) a composite index created by Calvino and others (2018). See Annex 4 for more information on model specification and how digital intensity is measured.

Our results show that firms in more digital-intensive industries tend to recover faster from recessions (Figure 15, Annex 4). The results are robust by using different measures of firm performance. For all GCC firms, the average revenue declines by 6 percent one quarter after a recession hits and fall further to about 9 percent (cumulatively) below the preshock level after six quarters. In contrast, for GCC firms in industries with larger shares of intangible capital, after a sharp decline, the average revenue bounces back to about 2 percent above preshock level after six quarters. Firms in industries with high intensity of digital inputs—as calculated from the Input-Output Tables—suffer smaller revenue losses, and so do firms in digital-intensive industries as calculated by Calvino and others (2018). Recovery in profitability—as measured by return on equity—also seems to be faster and more robust for those firms.

Figure 15. Firm Performance during Recessions, Conditional on Digital Intensity
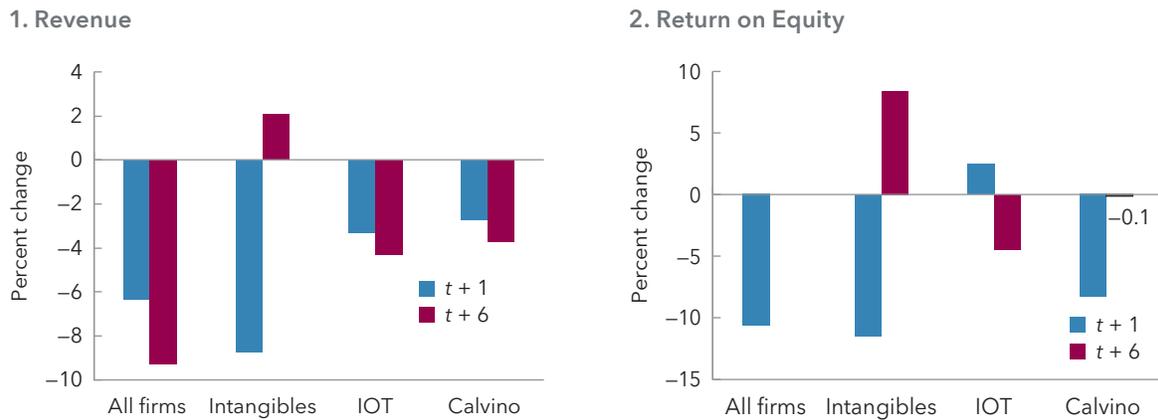
Sources: Calvino and others (2018); Capital IQ; Haver Analytics; Organisation for Economic Co-operation and Development, Input-Output Tables database; and IMF staff estimates.

Note: Cumulative effect of recessions after one quarter (*t* + 1) and six quarters (*t* + 6), where the horizontal line zero indicates the preshock level. Sample includes publicly listed firms in all six Gulf Cooperation Council countries over the period 2001:Q1–22:Q4. IOT = Input-Output Tables.

4. Conclusion and Policy Implications

The GCC has actively embraced digitalization, which we demonstrate to be positively associated with financial inclusion, government effectiveness, private sector resilience, and economic growth. GCC countries have initiated strategic blueprints for digitalization, which are broadly embedded within their overarching economic transformation agendas. Ambitious policies have been implemented to foster digitalization across the public, financial, and private sectors, with the pandemic serving as a catalyst for advancements. In particular, the GCC countries are among the best globally in terms of digital infrastructure and public sector digitalization, with significant growth in fintech. Measured by a novel composite index—the EDAI—that we construct to capture more broadly the progress in digitalization, the GCC, on average, is on par with AEs in its overall EDAI score, with strengths particularly in digital infrastructure and affordability. Based on a global sample covering up to 175 countries, our empirical analysis shows that enhanced digital adoption is positively associated with improvements in financial inclusion and government effectiveness, stronger economic growth, and macroeconomic and financial sector resilience to shocks. The relationship is often stronger when we focus on an EM subsample. The role of digitalization in enhancing economic resilience is further confirmed through a firm-level analysis focusing on the GCC economies, showing that more digitally advanced firms tend to weather economic downturns better.

Looking ahead, there are several policy priorities for further digital transformation (Figure 16). The GCC should focus on enhancing digital skills, fostering fintech and digital penetration in industries, putting in place proper regulations, and ensuring labor market inclusiveness (Figure 11). Cross-country comparisons of the EDAI scores suggest that most GCC countries have strong digital connectivity, but gaps remain on internet usage (including access to high-speed internet), digital knowledge, and ICT service quality despite accelerated progress in some since the pandemic. Heterogeneities also exist within the GCC, with the

Figure 16. Policy Priorities for Further Digital Transformation in the Gulf Cooperation Council

Public sector

- Further enhancements and within-GCC convergence on digital citizen engagement and core government system digitalization
- Data privacy laws and cybersecurity to foster trust and mitigate risks
- Regulations in line with the evolving digital industry

Financial sector

- Promotion of digital payments and e-commerce
- Industry-led fintech development that enhances competition
- Cross-border payment and cooperation to improve market scalability

Corporate sector and labor market

- Education and training to enhance digital skills
- SME finance to adopt new technologies
- Targeted investments in digital infrastructure, industry, and innovation ecosystem

Source: IMF staff.
Note: GCC = Gulf Cooperation Council; SME = small and medium enterprise.

United Arab Emirates, in general, exceeding AEs and Oman having the largest gap. On public sector digitalization, GCC countries have generally done well, but some would need to further improve digital citizen engagement and the robustness of core government systems. On financial and corporate sectors, digital payments, e-commerce, and digital (including fintech) skills are key areas to be improved. Use of inputs from digital industries could also be expanded because GCC economies continue to diversify and increase local production of digital products. Addressing these gaps calls for a comprehensive strategy that balances regulatory enhancements, education and skill development, and targeted investments in digital infrastructure, industry, and innovation ecosystem to sustain the momentum of digital transformation and ensure its benefits are widely shared. Specifically, we recommend the following:

- *Leverage digitalization to enable a more open, effective, and transparent public sector.* There is room for the GCC countries to use ICT more effectively to engage citizens in the design, delivery, and evaluation of public services. More fundamentally, public administrations need to center services and policies on the citizens' needs and preferences (OECD 2017). GCC governments could promote a data-driven culture that enables open data for transparency, better service delivery, and public participation. Efforts are also needed to address existing digital divides and avoid the emergence of new forms of digital exclusion, especially with the rise of automation and AI.

- *Balance opportunities and risks associated with fintech and increase market scalability.* The fintech innovation drive should be underpinned by careful assessments of benefits and risks, including those to monetary and financial stability. Allowing fintech companies to build without being overly regulated at the early stages will unleash more innovation, whereas a more industry-led approach could enhance competition (Ahmad 2023). The GCC regulators should continue to apply a mix of activity- and entity-based regulations proportional to the size, complexity, and risks of fintech firms. Building on their successful efforts to facilitate cross-border payment, the GCC regulators could cooperate to improve market scalability and develop a regional framework covering multiple markets. If the GCC countries plan to fully deploy CBDCs as a way to advance the digital economy and enhance their global competitiveness in the fintech landscape, robust regulatory frameworks should be put in place to ensure digital security and interoperability with existing financial technologies. Furthermore, the implications of introducing a CBDC on monetary policy transmission and financial sector stability should also be thoroughly studied (Bouza and others 2024).

- *Enhance digital skills and digital adoption, but be mindful of their labor market implications.* Education and training programs to upgrade digital literacy of the population and improve digital skills of the GCC labor force are critical. Welcome initiatives are already underway. Several GCC countries are updating curricula and providing teachers and other key stakeholders with the training and resources to integrate digital skills development into the education system. Specialized training programs and research centers have been established to focus on future skills, including AI, machine learning, blockchain, and cybersecurity. Further digital adoption in economic activities, while creating new job opportunities and increasing productivity and labor market flexibility, could also lead to job displacement and skill mismatches, particularly for workers in routine and manual jobs. The rise of AI would further affect cognitive-task-oriented jobs, complementing human labor and boosting productivity in some occupations, whereas substituting human jobs in some others. Moreover, digitalization benefits may not be evenly distributed across the society, with some groups, such as low-skilled workers and women, facing greater challenges in accessing and benefiting from digital technologies (Jaumotte and others 2023). Therefore, adequate and well-targeted social safety nets are crucial to support displaced workers and limit digital divide, and digital skill upgrade of the labor force could facilitate job transitions.

- *Create an enabling environment to further digital penetration.* Continued investment in digital infrastructure and advancement in research and development would help boost the digital sector's contribution to economic growth. ICT investments can have high multiplier effects on non-oil GDP and support diversification of the economy (IMF 2023). Further investments in e-commerce, local production, and expansion

of electronic payment systems, as well as significant government and private sector collaboration, would enhance digital transformation. Because successful digital diffusion also depends on firms' investment in ICT, policies could be adopted to alleviate the financing constraints faced by small and medium enterprises in accessing new technologies. Greater access to finance would also help innovators introduce new digital products more quickly. Streamlining regulations and enhancing the legal environment, including on data and intellectual property rights protection, could also help create a more enabling environment for digital penetration.

Reducing cybersecurity risks is a key priority in a rapidly growing digital ecosystem. Building on the GCC's progress in legal and regulatory reforms to ensure cybersecurity and protection of data privacy, efforts should continue to further strengthen trust in digital adoption, including using risk management as a framework for further policy development. International experience suggests that transparency on the uses of personal data collections and enhancing users' access and control over their data are particularly relevant. Effective ways are needed to support digital consumers who face challenges related to online information disclosure, misleading and unfair commercial practices, confirmation and payment, fraud and identity theft, product safety, and dispute resolution and redress (OECD 2019).

Annex 1. Cybersecurity and Data Protection Regulations in the GCC

To mitigate cybersecurity risks and prevent cybercrimes, the GCC has enacted laws and established national authorities to ensure cybersecurity and fight against cybercrimes. They have also invested in cybersecurity research and development and promoted cybersecurity awareness and education. Regarding the protection of data privacy, by the end of 2022, all GCC countries enacted data protection laws and established the authorities responsible for developing relevant regulations and providing guidance and support in data protection (see Annex Table 1.1).

Annex Table 1.1. Cybersecurity and Data Protection Regulations in the GCC

Country	Category	Year of Enactment	Details
Bahrain	Cybersecurity	2017	The authorities published a National Cybersecurity Strategy in 2017, which addressed threats, including cybercrime, that threaten the country's interests in cyberspace. The strategy also announced the creation of a National Cybersecurity Committee.
	Data protection	2018	Bahrain enacted Law No. 30 of 2018 with respect to PDPL on July 12, 2018. The PDPL is the main data protection regulation in Bahrain. This came into force on August 1, 2019, and supersedes any law with contradictory provisions. On March 17, 2022, the Personal Data Protection Authority has issued 10 ministerial resolutions supplementing the PDPL.
Kuwait	Cybersecurity	2014	The Communication and Information Technology Regulatory Authority was established in 2014 to supervise the telecommunication sector in Kuwait. The law was enacted in 2015. In 2017, the authorities launched a cybersecurity strategy covering the period 2017–20.
	Data protection	2021	The authorities issued the Data Privacy Protection Regulation.
Qatar	Cybersecurity	2014	The authorities published the Cybercrime Prevention Law that regulates and penalizes crimes pertaining to hacking of information systems, information programs, information networks, and websites.
	Data protection	2016	The authorities enacted the Personal Data Privacy Protection Law in 2016, as the first GCC member state to issue a generally applicable data protection law.
Oman	Cybersecurity	2011	The authorities issued the Cybercrime Law.
	Data protection	2022	The authorities issued the Personal Data Protection Law, which consolidated the Electronic Transactions Law enacted in 2008.
Saudi Arabia	Cybersecurity	2017	The authorities enacted the Cybercrime Law and established a national cybersecurity authority with defined strategies.
	Data protection	2020	The authorities enacted the Personal Data Protection Law and established the Saudi Data and AI Authority in 2020, which is responsible for developing regulations and providing guidance and support in data protection.

Country	Category	Year of Enactment	Details
United Arab Emirates	Cybersecurity	2012	The authorities published the Cybercrime Law in 2012. The authorities published the New Cybercrimes Law in 2021, which created additional categories of offenses addressing the increase in the incidence of cybercrime in the United Arab Emirates. It took effect on January 2, 2022.
	Data protection	2021	The authorities published the Personal Data Protection Law in 2021, which was the first federal law to be drafted in partnership with major technology companies in the private sector. It took effect on January 2, 2022.

Source: National authorities.
Note: GCC = Gulf Cooperation Council; PDPL = personal data protection.

Annex 2. Composition of the EDAI

Annex Table 2.1. Enhanced Digitalization Access Index (EDAI)

Subcategories of the EDAI	Source
Affordability	
Entry-level fixed-broadband basket. Combined time series data: from 2008 to 2017, the basket is composed of the cheapest plan providing at least 1 GB of monthly high-speed data (256 kbit/s or higher) from the operator with the largest market share in each economy. From 2018, the basket is composed of the cheapest plan providing at least 5 GB of monthly high-speed data (256 kbit/s or higher) from the operator with the largest market share in each economy.	ITU
Mobile data and voice high-consumption basket. Combined time series data: from 2018 to 2020, the basket is based on a monthly usage of a minimum of 140 voice minutes, 70 SMSs, and 1.5 GB of data using at least 3G technology. From 2021, the basket is based on a monthly usage of a minimum of 140 voice minutes, 70 SMSs, and 2 GB of data using at least 3G technology.	ITU
Mobile data and voice low-consumption basket. The basket is based on a monthly usage of a minimum of 70 voice minutes, 20 SMSs, and 500 MB of data using at least 3G technology.	ITU
Mobile cellular low usage basket. Combined time series data: from 2008 to 2017, the basket is composed of 30 calls and 100 SMSs. From 2018, it is composed of 70 voice minutes and 20 SMSs.	ITU
Infrastructure	
Percentage of inhabitants who are within range of at least a 4G/LTE mobile-cellular signal, irrespective of whether they are subscribers	ITU
Percentage of inhabitants within range of a mobile-cellular signal, irrespective of whether they are subscribers or users	ITU
Percentage of inhabitants who are within range of at least a 3G mobile-cellular signal, irrespective of whether they are subscribers	ITU
Mobile cellular subscriptions (per 100 people)	WDI
Sum of all active analogue fixed-telephone lines, voice-over-IP subscriptions, fixed wireless local loop subscriptions, Integrated Services Digital Network voice-channel equivalents, fixed public pay phones and satellite-based subscriptions provided to fixed locations that allow for a voice communication, per person	ITU
Internet Usage	
Active mobile-broadband subscriptions per 100 inhabitants.	ITU
Fixed subscriptions to high-speed access to the public internet (a Transmission Control Protocol/Internet Protocol connection), at downstream speeds equal to, or greater than, 256 kbit/s divided by population and multiplied by 100.	ITU
Refers to the proportion of individuals who used the internet from any location in the past three months. Access can be through a fixed or mobile network.	ITU
Knowledge	
Gross intake ratio to the last grade of lower secondary general education, both sexes (percent)	UNESCO
School enrollment, primary (percent gross)	WDI
Expected years of schooling	WDI

Subcategories of the EDAI	Source
Adult literacy rate, population 15+ years, both sexes (percent)	WDI
Individuals with basic information and communication technology skills	ITU
Quality	
International bandwidth; in Mbit/s, per person	ITU
Per person lit/equipped capacity of international links, namely fiber-optic cables, international radio links, and satellite uplinks to orbital satellites in the end of the reference year (expressed in Mbit/s)	ITU
Ratio of unsuccessful mobile-cellular calls to the total number of mobile-cellular call attempts in the given year	ITU

Source: ITU, UNESCO, and WDI.

Note: EDAI = Enhanced Digital Access Index; ITU = International Telecommunications Union; SMS = Short Message Service; UNESCO = UN Educational, Scientific and Cultural Organization; WDI = World Development Indicators.

Annex 3. Details of the Data Set

Annex Table 3.1. List of Variables

Variable	Source	Time Coverage
Financial inclusion (percent of adults with bank account at a formal financial institution)	Findex, World Bank	2011, 2014, 2017, 2021
Digital payments (percent of adults who made digital payments)	Findex, World Bank	2011, 2014, 2017, 2021
Return on assets	FSI, IMF	2000–21
Return on equity	FSI, IMF	2000–21
IMD Digital Competitiveness Ranking	IMD	2017–22
International bandwidth usage	ITU	2005–22
Population covered by a 4G network	ITU	2012–21
Individuals with basic ICT skills	ITU	2010–21
Individuals with advanced ICT skills	ITU	2010–21
EDAI	ITU and IMF staff	2000–21
Exports of ICT goods	UNCTAD	2000–21
Exports of ICT services	UNCTAD	2000–21
Exports of digitally deliverable services	UNCTAD	2000–21
Imports of ICT goods	UNCTAD	2000–21
Imports of ICT services	UNCTAD	2000–21
Imports of digitally deliverable services	UNCTAD	2000–21
EGDI	UNDESA	2003–22 (biannual)
Internet usage	WDI, World Bank	2000–21
Fixed broadband subscriptions	WDI, World Bank	2000–21
Mobile cellular subscriptions	WDI, World Bank	2000–21
Unemployment rate	WDI, World Bank	2000–21
Unemployment rate for women	WDI, World Bank	2000–21
Labor force participation	WDI, World Bank	2000–21
Labor force participation for women	WDI, World Bank	2000–21
Private sector credit as percent of GDP	WDI, World Bank	2000–21
Control of corruption	WDI, World Bank	2000–22
Government effectiveness	WDI, World Bank	2000–22
Women Business and Law Index	WDI, World Bank	2000–21
Strength of Legal Rights Index	WDI, World Bank	2000–21

Variable	Source	Time Coverage
Trade openness (sum of exports and imports to GDP)	WEO, IMF	2000–21
Fiscal balance as percent of GDP	WEO, IMF	2000–21
CA balance as percent of GDP	WEO, IMF	2000–21
Public spending as percent of GDP	WEO, IMF	2000–21
GDP growth	WEO, IMF	2000–22
Non-oil GDP growth	WEO, IMF	2000–22
Inflation	WEO, IMF	2000–22
GDP per capita	WEO, IMF	2000–22
GovTech Maturity Index	World Bank	2020, 2022
Public Service Delivery Index	World Bank	2020, 2022
Digital Citizen Engagement Index	World Bank	2020, 2022
Core Government Systems Index	World Bank	2020, 2022
GovTech Enablers Index	World Bank	2020, 2022
Brent oil prices	Bloomberg	2000–22

Source: IMF staff compilation.

Note: CA = current account; EDAI = Enhanced Digital Access Index; EGDI = E-Government Development Index; FSI = Financial Soundness Indicators database; ICT = information and communications technology; IMD = International Institute for Management Development; ITU = International Telecommunications Union; UNCTAD = UN Trade and Development; UNDESA = UN Department of Economic and Social Affairs; WDI = World Development Indicators; WEO = World Economic Outlook database.

Annex 4. Corporate Sector Analysis

A. Where GCC Countries Stand

We use several measures of digital adoption, based on various sources of information.

- First, we use the *OECD Input-Output Tables* to calculate the share of each industry's inputs that are sourced from digital industries—which cover both physical IT hardware and digital services. Based on this measure, Saudi Arabia (for which data are available) lags countries at the frontier of digitalization by a wide margin. In addition, domestic value added in foreign final demand remains low for digital industries in Saudi Arabia, despite slight improvement since 2000, based on the Trade in Value-Added database.

- Second, we use the share of intangibles in total assets, constructed from *corporate balance sheet data from S&P Capital IQ*. Intangible capital is shown to be positively correlated with other measures of digitalization and could help reap the benefits of digitalization. By this measure, Kuwait, Qatar, and the United Arab Emirates rank relatively higher than other GCC countries, and certain industries—communication services, information technology, energy, and consumer discretionary—rely more on intangibles.

- Third, based on user-generated data from LinkedIn, we look at the relative frequency of "tech skills" on *LinkedIn profiles* within each industry. Tech skills are defined as a range of abilities to use digital services, communication applications, and networks to access and manage information. By this measure, Saudi Arabia and United Arab Emirates (for which data are available) lag countries at the frontier of digitalization by a wide margin, especially in the services sectors.

B. Effect of Digital Adoption

Model specification: We use Jordà's Local Projection method. In the equation in Section 3.E, on the left-hand side are indicators of firm performance, including revenue, earnings, return on assets, and return on equity for the period 2001–22. These are all quarterly data. The shock is a dummy variable equaling 1 at the start of a technical recession, computed based on real GDP growth from Haver Analytics. Controls include lags of dependent variable and shock, and firm-quarter dummy to control for unobservable time-invariant firm characteristics and firm-specific seasonality, and country-sector fixed effects to account for cross-sector variations across countries (for example, country-specific comparative advantage in specific sectors). To control for endogeneity (for example, tough times may induce firms to become more digital), we use time-invariant measures of digitalization (for example, period averages and so on after checking that the relative digital intensity of industries does not change much over time).

Digital intensity: After estimating the unconditional effect of shocks, we introduce an interaction term to estimate the effect conditional on digital intensity. Digital intensity is measured by the three indicators highlighted earlier—inputs from digital industries, intangible capital, and a composite index created by Calvino and others (2018), which is a more comprehensive way of measuring digital adoption across industries (subindexes include share of online sales and ICT specialists) but is based on selected AEs, and therefore one needs to assume that other countries share similar dynamics. See Annex Table 4.1 that shows the digital-intensive industries based on these measures. (These are selected industries of 62 industries in the Capital IQ database, from which most left-hand side variables are derived.)

Annex Table 4.1. Digital-Intensive Industries by Measures

IQ Industry	Intangibles	Input-Output	Calvino and others (2018)
Aerospace and defense			1
Air freight and logistics	1		
Banks			1
Capital markets			1
Commercial services and supplies			1
Communications equipment		1	
Consumer finance			1
Containers and packaging			1
Distributors	1		
Diversified consumer services	1		
Diversified telecommunication services	1		1
Electronic equipment, instruments, and components		1	
Financial services			1
Health care equipment and supplies	1	1	
Household durables		1	
Industrial conglomerates			1
Interactive media and services		1	1
IT services		1	1
Machinery		1	
Professional services			1
Software	1		
Specialty retail	1		
Transportation infrastructure	1		
Wireless telecommunication services	1	1	1

Source: IMF staff.
Note: IQ = S&P Capital IQ; IT = information technology.

Results: The findings—highlighted in Section 3.E ("Digitalization and Corporate Sector Resilience: A Firm-Level Analysis)" and in Annex Figure 4.1—are broadly in line with the recent literature looking at a global sample (Copestake, Estefania-Flores, and Furceri 2022) and MENA excluding the GCC sample (Abidi, El-Herradi, and Sakha 2022). Recovery from economic recessions is faster for firms in digital-intensive industries based on various measures of firm performance.

Annex Figure 4.1. Impulse Responses Results of Recession Effect

1. All Industries
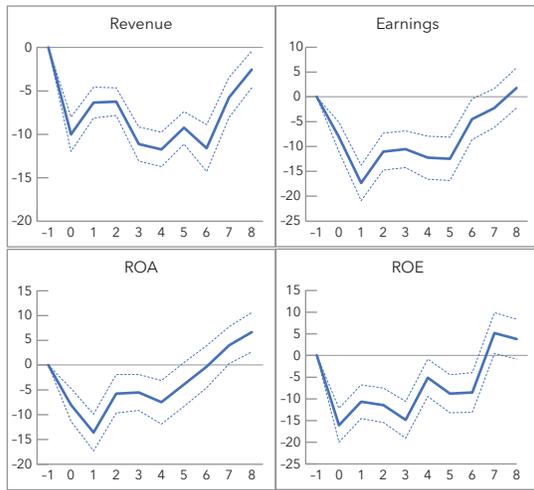
2. Industries with High Intensity of Intangible Capital
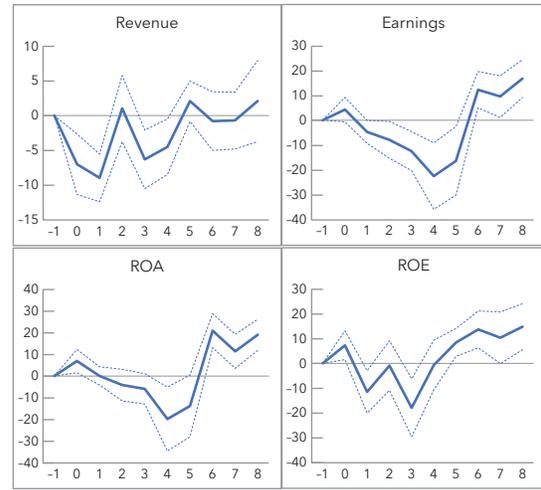
3. Industries with High Intensity of Digital Inputs
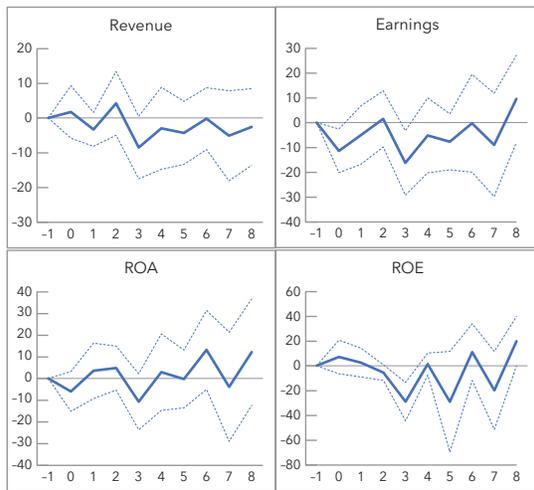
4. Industries with High Digital Intensity (Calvino and others 2018)
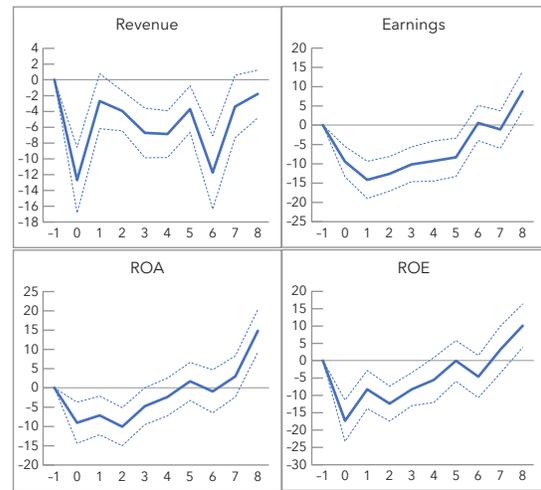
Sources: Calvino and others (2018); Capital IQ; Haver Analytics; Organisation for Economic Co-operation and Development, Input-Output Tables database; and IMF staff estimates.

Note: Sample includes publicly listed firms in all six Gulf Cooperation Council countries during the period 2001:Q1–22:Q4. Solid lines represent estimates for the average of all the Gulf Cooperation Council countries, whereas dashed lines represent 95 percent confidence intervals. ROA = return on assets; ROE = return on equity.

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