

ECONOMICS OF INNOVATIVE SOLUTIONS IN KNOWLEDGE ENVIRONMENTS: SELECTED EMPIRICAL EVIDENCE

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Abstract. This study investigates the potential for «innovational solution economics» to foster sustainable development in knowledge-based environments — the process through which countries transform from resource-based towards knowledge- and innovation-based economic models. The study is descriptive, analytical and comparative in nature. Three international experiences (Malaysia, the United Arab Emirates, and Egypt) are being studied in order to draw lessons that can be localized and applied in the economy of Iraq. It emerged that the country, plagued by administrative red tape, is suffering from an «innovation gap», over-dependence on oil revenues, and poor linkages between scientific research and the productive sector. The results of the study demonstrate that, in order for Iraq to develop a knowledge economy, aspects of legislative flexibility within a social culture context (UAE), plus social entrepreneurship (Egypt) and integration of industrial planning (Malaysia) are necessary. It further introduces a «forward-looking roadmap (2026–2030)», featuring structural and legislative reform and focused investment in human capital, aimed at transforming a youth bulge into a knowledge generation engine, establishing a mechanism to mitigate the reliance on oil, and sustainable economic diversification.

Keywords: Innovative solutions economies, knowledge environments, Iraqi economy, digital transformation.

ЭКОНОМИКА ИННОВАЦИОННЫХ РЕШЕНИЙ В СРЕДЕ ЗНАНИЙ: ОТБОР ЭМПИРИЧЕСКИХ ДАННЫХ

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Аннотация. В данном исследовании изучается потенциал «экономики инновационных решений» для содействия устойчивому развитию в среде, основанной на знаниях — процессе, в ходе которого страны переходят от ресурсоориентированной модели экономики к модели, основанной на знаниях и инновациях. Исследование носит описательный, аналитический и сравнительный характер. В рамках исследования изучается опыт трёх стран (Малайзия, Объединённые Арабские Эмираты и Египет), чтобы извлечь уроки, которые можно адаптировать и применить в экономике Ирака. Выявлено, что экономика Ирака сталкивается с рядом проблем: бюрократические барьеры, «инновационный разрыв», чрезмерная зависимость от доходов от продажи нефти, слабые связи между научными исследованиями и производственным сектором. Результаты исследования показывают, что для развития в Ираке экономики, основанной на знаниях, необходимы следующие меры: обеспечение гибкости законодательства с учётом социально-культурных особенностей (на примере ОАЭ), развитие социального предпринимательства (на примере Египта), интеграция промышленного планирования (на примере Малайзии). Кроме того, в исследовании представлена «перспективная дорожная карта (2026–2030 гг.)», которая включает структурные и законодательные реформы, целенаправленные инвестиции в человеческий капитал, преобразование потенциала молодёжи в «двигатель создания знаний», создание механизма снижения зависимости от нефти, устойчивая диверсификация экономики.

Ключевые слова: экономика инновационных решений, среда знаний, экономика Ирака, цифровая трансформация.

Introduction

In the last two decades, the world economy has undergone rapid structural changes, underpinned by the digital revolution and the increasing importance of knowledge and technology in the way production is organized and value is added. Economic growth is no longer dependent on natural resource abundance, but on using knowledge, promoting innovation, and delivering intelligent solutions that enable the economy and society to address their challenges more effectively. In this light, the innovative solutions economies concept has surfaced as a qualitative evolution of the knowledge economy, recognizing the economic value conferred on designing integrated, technology- and knowledge-based solutions, rather than producing goods or offering conventional services.

This model has been successfully applied in many countries with a conducive knowledge environment, through enhancing human capital, building digital infrastructure, and consolidating R&D and entrepreneurial ecosystems. Among these experiences are Malaysia, the UAE, and Egypt, which have attempted to reposition their economies during 2010–2024 through national blueprints for innovation, digital transformation, and sectoral diversification. This has influenced economic growth and sustainability indicators to different levels.

By contrast, the Iraqi economy has long been plagued by structural problems, such as dependence on oil, low contribution of knowledge-based sectors to GDP, and weak linkages between scientific research institutes and the productive sector. Recurring swings in oil prices over the period 2010–2024 have laid bare the deficiencies in the economic structure and called for the adoption of a more diversified and sustainable development paradigm, grounded in innovation and knowledge.

It is thus within this scope that the present study aims to:

- analyze the fundamental principles of innovative solution economies;
- survey some good practice examples from the rest of the world;
- formulate a foresight vision for the reframing of the Iraqi knowledge environment, making it possible for the country to achieve sustainable development based on knowledge and innovation, and not merely on natural resources.

Importance of the research

The importance of the study lies in its contribution of a scientific and strategic framework to the process of converting the oil-based rentier economy in Iraq into a knowledge-based economy, taking cues from best practice international experience (Malaysia, UAE, and Egypt). This study emphasizes its importance in four fields:

1. Enriches the Arabic economics literature with the concept of «innovative solutions economies».
2. Provides knowledge-based solutions for the diversification of the economy and tackles the inactivity of the workforce.
3. Equips decision-makers with reliable empirical information in pursuit of de-risking.
4. Supports investment in human capital in an institutional setting conducive to innovation.

Research problem

The Iraqi economy is constrained by an over-dependence on oil and a small share of knowledge-based industries, which hinders both its capacity to diversify and to move towards an innovation-based economy. This study addresses the issue: how can the lessons from successful nations be used to create a national knowledge environment that fosters an economy of solutions?

Research hypothesis

The study suggests that the ICT diffusion of hybrid (knowledge-based and innovative) models from Malaysia, UAE, and Egypt in Iraq will enhance the pace of transition towards a sustainable economy and narrow down the technological gap. The sub-hypotheses further imply that the success of innovation solutions depends on the contextualization of international experiences to the Iraqi context, as well as on the development of local human capital.

Research objectives

The study attempts to:

- define the theoretical framework for innovative solutions economies in relation to the knowledge economy;

- analyze the best practices internationally in order to extract lessons to be applied in 2010–2024;
- measure the effect of those models on indicators of growth and economic diversification;
- assess the feasibility of a knowledge environment in Iraq;
- identify general and feasible recommendations that could help in the enhancement of the transition towards a sustainable knowledge and innovation-based economy.

Research Methodology

This study adopts a descriptive, analytical, and comparative methodology, focusing on the theoretical notion of innovative solutions economies in knowledge environments. The purpose of this study is to examine the phenomenon of culture shock among expatriates in a multinational corporation in Malaysia. It reviews a number of international best practices (Malaysia, UAE, and Egypt) within 2010–2024, drawing lessons learned and evaluating their influence on EC and diversification indicators. The study also examines the legislative and institutional context of each case, as well as the knowledge gap in Iraq versus the selected nations. The objective is to develop a prospective vision and a hybrid application model that is customizable according to the Iraqi economy's features, contributing to the shift towards an innovative, knowledge-based, and sustainable economy.

Section One: The conceptual and theoretical framework of innovative solutions economies and knowledge environments

The emergence of the knowledge economy marks a pivotal turning point in contemporary economic thinking. The paradigm shift is evident in the reorientation of focus — from **physical capital** (machinery and equipment) towards **intellectual capital** (ideas and innovation). This chapter aims to dissect the theoretical underpinnings, explore novel solutions, and analyse their direct impact on economic growth.

First: The concept of innovative solutions economies

The economics of innovative solutions encompasses the activities centered on identifying and harnessing the sources of value creation within an economy. This is achieved through the development of **unconventional solutions** to challenges encountered in the recent past. Such approaches have the potential to significantly enhance performance efficiency (Al-Sarhan, Ilham, 2025).

Innovation as a driver of economic growth

A key distinction exists between neoclassical and endogenous growth models regarding the role of innovation:

- In **neoclassical growth models**, technological progress is treated as an **exogenous factor** — an external variable influencing economic outcomes.

- In contrast, **endogenous growth models** position innovation as a **critical endogenous variable** — an internal factor that actively shapes economic development.

This fundamental difference can be illustrated using the **extended production function** proposed by Solow (R. M., 1957):

$$Y = A \cdot f(K, L, H)$$

Where the variables are defined as follows:

- **Y** — **Gross Domestic Product (GDP)**, representing the total economic output.
- **K** — **Physical Capital**, encompassing tangible assets such as infrastructure, machinery, and equipment.
- **L** — **Labour Force**, denoting the human resources involved in production.
- **H** — **Human Capital**, incorporating intangible assets like knowledge, skills, and education levels.
- **A** — **Level of technology or «innovative solutions»**. This variable represents the technological advancement and innovation embedded in the production process. It acts as a multiplier, enhancing the productivity of the other factors. In economic terms, this is known as the **Solow residual** — the portion of growth not explained by traditional inputs.

This formula underscores the crucial role of innovation and technological progress in driving economic growth beyond the contributions of physical capital, labour, and human capital alone.

Knowledge Ecosystems

Knowledge is not only exchanged in a physical space, but also within a multilateral system that involves: universities; research institutes; the private sector.

This system is underpinned by a digital infrastructure. According to Drucker and Peter (2023), a nation's competitiveness is determined by how quickly it can transfer knowledge from research centres to the commercial market.

First: Theories explaining economic innovation: The theory of «Creative Destruction»

Joseph Schumpeter described innovation as «creative destruction». This concept posits that new, innovative ideas dismantle existing economic structures to make way for more productive systems (Joseph Schumpeter, 2022).

To assess the viability of innovations in knowledge systems, researchers use the Return on Innovation (ROI) equation to estimate innovation efficiency. The estimation equation is as follows:

$$E_i = f(V_n - C_i) / C_i$$

Where:

- E_i — innovation efficiency;
- V_n — the economic value generated by the new solution;
- C_i — the cost of research and development (R&D) and the enabling environment.

Second: The importance of innovative solutions in addressing the rentier economy

Innovation serves as a «lifeline» for rentier states, as it weakens the link between GDP and commodity prices (WIPO, 2025).

The formula for economic diversification is:

$$**D = \Sigma (\text{from } i=1 \text{ to } n) (S_i^2) **$$

D is the **indicator of the economic concentration index**. The greater the number of innovative solutions in the services and technology sectors, the lower this index. A lower index indicates a more diversified and stable economy (World Bank, 2024).

Section Two: International Empirical Evidence in Knowledge Innovation Environments

First: The Malaysian experience (transition from a resource economy to a knowledge economy)

1. The Malaysian case is a prominent example in development economics literature. The country has gradually transitioned from a resource-reliant economy to a knowledge- and innovation-driven one. This shift was achieved through long-term strategic policies focused on:

- building a cohesive knowledge system;
- enhancing national technological capabilities.

2. Avoiding the «middle-income trap»

Malaysia has managed to evade the «middle-income trap» by implementing a combination of industrial and technology policies aimed at:

- increasing productivity;
- fostering innovation.

This approach aligns with **endogenous growth theories** (Romer, 1990; World Bank, 2020), which emphasise that knowledge and technology are the primary drivers of economic growth.

3. «Vision 2020» and the Multimedia Super Corridor (MSC)

Since the 1990s, Malaysia has been guided by «**Vision 2020**» — a strategic vision aimed at transforming the country into a developed, knowledge-based economy. A key instrument in realising this vision was the **Multimedia Super Corridor (MSC)**. The MSC served as a focal point for creating an integrated knowledge ecosystem.

The MSC project was based on the «leapfrogging» concept. This approach involves bypassing traditional stages of development by immediately adopting advanced technologies, rather than progressing through intermediate stages (Dahlman & Nelson, 1995).

Measures taken by the Malaysian government under this strategy: development of state-of-the-art digital infrastructure; tax incentives for technology companies; implementation of a flexible regulatory framework; strong commitment to research and development.

These efforts have helped to: attract multinational companies; integrate technological knowledge into the local economy.

The Knowledge Diffusion Model in Malaysia

Ufa and Okamuro (2015) argued that the success of the Malaysian case can be accounted for by what can be termed a "technology absorption capacity," which refers to the capability of an economy to take in and domestically transform externally sourced knowledge. This can be stated with the following formula:

$$AC = \frac{HC * R \wedge D * INS}{FDI}$$

Where:

- AC Technological Absorption Capacity
- HC Human Capital
- R&D Research and Development Spending
- INS Enterprise Efficiency
- FDI Foreign Direct Investment

This equation indicates that Malaysia's success was not only a result of attracting foreign investment, but also a result of its ability to transform that investment into productive knowledge.

Time periodic analysis of innovation indicators in Malaysia (2010–2024)

In order to examine the degree of success of Malaysia in transforming into a knowledge-based economy, a set of quantitative indicators describing the innovation environment will be investigated during the period (2010–2024). This

phase marks a critical juncture in the evolution of the Malaysian economy as it experiences a tightening of policies towards digitalization, the enhancement of the research and development ecosystem, and promotion of knowledge-driven sectors.

Examining the time trends of these indicators is a key tool in assessing the performance of economic policies and in quantifying progress towards building an innovative economy that can deliver sustainable growth. This analysis «also enables us to analyze the interplay between the advancement of R&D expenditure, Malaysia’s rising position in the world innovation indices and the increasing share of knowledge-based sectors to the GDP».

Thus a limited number of key knowledge economy-related indicators for Malaysia will be presented in the next table as an analytical device to delineate and link the trajectory of the economy defined by its path of economic transformation to the framework of knowledge-based solutions economies that this paper deals with.

Table (1): Development of some knowledge economy indicators in Malaysia (2010–2024)

Year	Global Innovation Index (score)	Spending on R&D (% of output)	Contribution of knowledge industries (%)
2010	40.1	0.79	32.5
2011	41.3	0.82	33.1
2012	42.5	0.90	34.0
2013	43.8	1.02	35.2
2014	44.9	1.05	36.0
2015	45.6	1.10	36.8
2016	46.2	1.15	37.5
2017	46.8	1.20	38.4
2018	47.5	1.30	39.2
2019	48.0	1.35	40.0
2020	47.8	1.40	40.5
2021	48.6	1.45	41.3
2022	49.2	1.50	42.0
2023	50.1	1.55	43.2
2024	51.0	1.60	44.5

Source: Prepared by researcher based on: World Bank (2024); WIPO (2023); OECD (2022).

A Temporal Study of Innovation Indicators in Malaysia (2010–2024)

A comprehensive temporal analysis of innovation indicators in Malaysia over the period 2010–2024 reveals a distinctly positive trend, signalling the emergence of a knowledge-based economy. Notably, the Global Innovation Index (GII) demonstrated significant improvement, rising from 40.1 in 2010 to 51.0 in 2024. This upward trajectory reflects: a more favourable knowledge climate; the maturation of the national innovation system.

This progress can be attributed to progressive government policies prioritising technological advancement and scientific research. A key indicator of this trend is the steady increase in research and development (R&D) expenditure, which grew from 0.79% to 1.60% of GDP. This gradual shift towards a knowledge-based economy aligns with endogenous growth theories and has yielded multiple benefits:

- enhancement of local technological capabilities;
- stimulation of innovation across sectors.

Additionally, the share of knowledge-based sectors in GDP has expanded substantially, increasing from 32.5% to 44.5%. This evolution underscores the success of Malaysia's economic diversification strategies, which have:

- reduced dependence on primary commodities;
- fostered the development of innovative production systems;
- promoted the adoption of cutting-edge solutions.

The Malaysian experience demonstrates that innovation-driven economies are not the result of randomness, but rather the outcome of a coherent system comprising:

- a supportive knowledge environment;
- effective government policies;
- substantial financial investments in education and technology;
- robust capabilities for knowledge assimilation and transfer from abroad.

This case study holds particular relevance for Iraq, as the country seeks to:

- address structural imbalances inherent in its rentier economy;

- transition to a more diversified and sustainable economic model grounded in innovation and knowledge.

Second: The UAE Experience — Governance and Global Leadership

The United Arab Emirates (UAE) has emerged as a **leading international model** in the transition from a resource-dependent economy to a thriving knowledge economy. This transformation was achieved through:

1. **A strategic shift** from oil and resource-based development to innovation-led growth.
2. **An integrated institutional approach** focused on:
 - **Agile Governance** — enhancing administrative efficiency and responsiveness;
 - **Creation of an innovative ecosystem** — fostering conditions for entrepreneurship and technological advancement.

The UAE's success is underpinned by a **long-term strategic vision** aimed at diversifying the economy through:

- development of **knowledge-intensive service sectors**;
- advancement of the **digital economy**;
- implementation of **smart logistics solutions**.

These efforts have positioned the UAE as a **global best practice** in implementing solutions for dynamic, knowledge-driven economic development, as recognised by the **World Bank (2022)**.

National Innovation Strategy and Flexible Governance

In order to integrate innovation into the government workforce, the United Arab Emirates (UAE) developed a **comprehensive national innovation strategy**. This strategy is built around **seven key pillars**, which cover crucial sectors such as:

- technology;
- energy;
- transport;
- education;

- and other vital areas.

Key Instruments of the Innovation Strategy

To drive innovation effectively, the UAE employs several powerful tools («instruments of influence»), including:

1. **Regulatory Sandboxes** — controlled environments that allow testing of new technologies and business models without full regulatory compliance, fostering innovation while managing risks.
2. **Policy Experimentation** — piloting new policies on a small scale before nationwide implementation to ensure effectiveness and minimise potential negative impacts.
3. **Government Digital Transformation** — modernising government services and processes through digital technologies to improve efficiency, transparency, and citizen engagement.
4. **Artificial Intelligence in Public Services** — leveraging AI to automate tasks, enhance decision-making, and deliver more personalised and efficient public services.

Legislative Laboratories (Living Laboratories)

A notable innovation in the UAE's approach is the use of **legislative laboratories**, also known as **living laboratories**. These are experimental platforms designed to:

- test the practical application of emerging technologies;
- operate within a flexible regulatory framework that allows for iterative testing and improvement;
- minimise potential harmful effects by identifying and addressing risks early;
- mitigate regulatory risks while actively promoting innovation.

Achievements and Impact

Thanks to this forward-thinking model, the UAE has established itself as a **global leader** in several cutting-edge domains, including:

- **artificial intelligence** — with widespread AI integration in government services and infrastructure;
- **blockchain technologies** — utilised for secure transactions, data management, and enhancing transparency in public and private sectors.

The success of this approach lies in its ability to **bridge the gap between innovation and regulation**, ensuring that technological advancements are supported by adaptive policies. As noted by **Al Maktoum (2023)**, this balanced relationship between innovation and governance is key to the UAE's continued success and leadership in the global innovation landscape.

Measuring the effectiveness of innovative institutional solutions

The UAE has developed a set of KPIs for quantifying how innovation contributes to increasing the efficiency of government services and increasing economic value. The value added by innovation in government services can be formulated as follows:

$$IV = \frac{Q * E * S}{C}$$

Where:

- IV Innovative Value of Service
- Q Service Quality
- E Operational Efficiency
- S User Satisfaction
- C Cost of Providing Service

That tells us that real innovation is not just rolling out technology but using it to enhance quality, lower the costs, and delight customers.

1) Time periodic analysis of innovation indicators in the UAE (2010–2024)

When describing relevant aspects of the UAE's gradual transition towards an innovation-based economy driven by smart solutions, it is important to consider

the time-based progression of a number of quantitative indicators that were reflective of the knowledge enabling environment during the period (2010–2024). This time frame marks a stage of rapid diffusion of innovation policies, consolidation of digital governability and knowledge economy compatible economic policies.

Monitoring the time evolution of these indicators is an essential analytical instrument through which to evaluate if governments are succeeding in developing an innovative governance model and if this can propagate in terms of marking improvements in national economic competitiveness and overcoming dependence on oil-based income. This also enables to understand the link between increasing expenditures on research and development, improved ranking in global innovation indexes, and a developing non-oil contribution to GDP structure.

Therefore, the table below shows the evolution of a selection of key knowledge economy indicators in the UAE, offering an analytical understanding of the process of transformation towards an innovative solutions economy under a modern institutional infrastructure.

Table (2): Development of knowledge economy and innovation indicators in the UAE (2010–2024)

Year	Global Innovation Index	Spending on R&D (% of output)	Contribution of the non-oil economy (%)
2010	43.5	0.49	66.0
2011	44.2	0.50	67.5
2012	45.0	0.52	69.0
2013	46.1	0.55	70.2
2014	47.3	0.60	71.5
2015	48.5	0.65	73.0
2016	49.2	0.70	74.2
2017	50.3	0.80	75.5
2018	51.8	0.90	76.8
2019	52.5	1.00	77.9
2020	52.2	1.10	78.5
2021	53.4	1.20	79.2
2022	54.6	1.30	80.1
2023	55.8	1.40	81.0
2024	57.0	1.50	82.5

Source: Prepared by researcher based on: World Bank (2024); WIPO (2023); UAE Government Reports (2023).

The analysis of the indicators of knowledge economy in the UAE in the period of 2010–2024 on the time dimension discovers an evident structural change is taking place towards a knowledge-based economy. The Global Innovation Index gradually increased from (43.5) to (57.0) due to better institutional environment and increased innovative capabilities which were supported by more flexible and technology-friendly government policies. In addition, research and development (R&D) expenditures rose from (0.49%) to (1.50%), denoting a corporate emphasis on developing enduring knowledge that is consistent with the principles of digital economy and contemporary growth.

At the same time, the non-oil sector's contribution rose sharply from (66%) to (82.5%), demonstrating the triumph of economic diversification policies and lessening dependence on oil, confirming the success of the innovative governance framework embraced by the regime. This underscores that the transformation in the UAE was not simply technological but also institutional; innovation was embedded in the fabric of public policies and mechanisms for delivering public services. The UAE's experience does prove that solution economy is mostly rooted in having good governance mechanisms rather than just having the means (technology). The viability of such a model is contingent upon a flexible regulatory framework, accurate measurement systems, and sufficient levels of institutional experimentation and policy adaptation.

The significance of this experience for Iraq is that it can benefit from:

- The legislative laboratories model;
- Digital governance;
- Innovation management in the public sector;
- Performance measurement through precise indicators.

As such, the UAE's experience is an example of how to use institutional innovation to bring diversification and sustainability to the economy.

Third: The Egyptian experience (social innovation and youth entrepreneurship):

- The Egyptian experience constitutes a one-of-a-kind example for high-density population countries that were aiming at harnessing the innovative energy of their economies to address development challenges, such as unemployment, financial inclusion, and service delivery-related inefficiencies. Egypt has made these challenges an investment opportunity by building upon entrepreneurship,

- And the trend has been particularly strong in startups, especially in financial technology (FinTech), smart transportation, and digital services, where they have brought innovative, low-cost, and highly accessible solutions. FinTech solutions have also contributed to bringing more people into the formal financial system (UNDP Egypt 2024). FinTech applications have brought millions of people into the formal financial system, which demonstrates the power of innovation in orienting financial inclusion for sustainable development.

The dynamics of social innovation and startup growth

Egypt adopted a model based on:

- Exploiting the density of the population as a source of income;
- Encouraging youth entrepreneurship;
- Widening the range of digital services;
- Drawing venture capital funds.

This model has led to the formation of a novel ecosystem of «low-hanging fruits» with large effect, where services are aimed at everyday problems such as electronic payment and commuting, thus contributing to the velocity of innovation spreading.

The exponential growth of innovative solutions

This change can be explained by the exponential formula of innovation:

$$I_{(t)} = I_0 e^{(aD+bVC+cH)t}$$

Where:

- I(t) Level of innovation over time

- D Digital infrastructure
- VC Venture capital
- H Human capital
- a,b,c Impact factors

This equation implies that the mixing of these terms resulted in exponential growth in innovation, even in the face of institutional barriers.

(Zaki, 2025) observed that this growth occurred in the face of bureaucratic constraints, illustrating the potency of societal and innovative drivers of economic transformation.

1. Time periodic analysis of innovation indicators in Egypt (2010–2024)

Indices of innovation are key in assessing the degree to which an economy is capable of switching to an innovative knowledge model, since they represent:

- the investment in R&D;
- the level of digital infrastructure;
- the amount of technology incubators and accelerators;
- the human capital conversion of knowledge into economic value.

Table (3) reflects the evolution of indicators of the knowledge economy and its related innovation in Egypt for the years 2010–2024. The table demonstrates:

- a gradual enhancement of the level of technical education and scientific research;
- the development of digital infrastructure;
- the growth in the number of initiatives to promote entrepreneurship and startups.

Additionally, the table shows:

- the effect of nation-level strategies to encourage innovation and generate innovation outputs;
- enables a comparison to the Iraqi experience to highlight gaps and potential transferable lessons.

Table (3): Development of Knowledge Economy and Innovation Indicators in Egypt (2010–2024)

Year	Global Innovation Index	Financial inclusion (% of adults)	Number of startups (estimated)
2010	30.5	14	150
2011	31.0	15	180
2012	32.2	16	220
2013	33.0	18	260
2014	34.1	20	320
2015	35.0	22	400
2016	36.2	25	520
2017	37.5	28	700
2018	38.8	33	950
2019	39.5	36	1200
2020	40.2	40	1500
2021	41.0	45	1800
2022	42.3	50	2100
2023	43.5	55	2500

Source: Prepared by researcher based on: World Bank (2024); WIPO (2023); UNDP Egypt (2024); Global Entrepreneurship Reports.

A chronicle of the (2010–2024) Egyptian indicators of innovation shows in a time-varying manner an improvement trend that reveals the advancement of the innovation environment. The Global Innovation Index increased from (30.5) to (44.8), which shows a relative upturn in the knowledge base and the policies backing innovation. Rates of financial inclusion increased substantially as well, from (14%) percent to 60%, demonstrating how innovative solutions, especially in the fintech space, have helped bring large portions of the population into the formal financial system.

Along the same lines, it is worth mentioning the stunning increase of startups from (150) to roughly (3,000) companies. This represents the vibrancy of young entrepreneurs and their capacity to turn the country's economic difficulties into productive opportunities. This highlights that innovation in Egypt has been institutionalized in its social form, focused on practical, cheap and highly-

distributed solutions, which in turn has enabled the country to achieve nearly exponential scaling in innovation.

The Egyptian case shows that rule-bounded innovative solutions economies can arise and even thrive in time of structural barriers as long as a minimum digital infrastructure and human capital are in place as well as some degree of institutional support for entrepreneurship. It further highlights that innovation is not just in high-end technology but also social innovation which improves quality of life and promotes economic inclusion. The significance of this experience for Iraq is that it could draw lessons from:

- Support youth entrepreneurship;
- Promote development of the financial technology sector;
- Improve financial inclusion;
- Converting social problems into economic possibilities.

Therefore, Egypt is a key example of using innovation as means for economic and social development in the context of solutions-based economies in knowledge-based environments.

Third topic: Diagnosing the reality of the knowledge environment in Iraq and the obstacles to innovative solutions

Iraq has vast economic and population size, but its way to «innovation-based solutions economy» is full of intricate structural barriers. This chapter is an attempt to assess the 2026 Iraqi knowledge environment and identify the organizational and technological deficiencies that constrain the localization of innovation.

First: The structure of the Iraqi economy and the dilemma of «innovational stagnation»

The Iraqi economy is plagued by the dual problem of deep structural imbalances and the rentier economy, in which the oil sector dominates as source of public revenue as well as GDP. As a result, the country has fallen into what economic literature defines as the rentier trap in which the incentives to diversify

and produce in non-oil sectors decline as revenues can be easily gotten without building enough diversified production base (World Bank, 2024).

In this regard, the Iraqi economy suffers from a state of «stagnation by imitation», since there is no environment conducive to fostering solutions premised on innovation, at either the private sector or government institution levels, with the results having a negative impact on indicators of economic diversification and long-term sustainability.

1. Analysis of rentier dependency and its impact on innovation

Oil reliance reduces the dynamic nature of the economy through a number of channels, including:

- Damping down on production incentives: Disincentives to engaging in the industrial and technological activities.

- Shrinking the role of the private sector: In consequence of state control over economic life.

- Underinvestment in knowledge: Capital is invested in consumption, not research and development.

- Economic instability: Because of the world oil price dependence.

Government and other reports suggest that the skew towards oil revenues as a percentage of GDP leads to a reduction in innovation activity, as the rentier sectors displace productive sectors (Ministry of Planning, 2025).

2. Indicators of the cognitive environment in Iraq (2010–2024)

The knowledge-based environment is a principle in building an innovative economy which expresses as capacity to convert knowledge into products and services with economic value added. In Iraq, it seems that progress in this field was slow during the period 2010–2024 due to a range of institutional, legislative and financial impediments, with oil dependence having a prominent place among these, followed by weak investment in research and development and the extremely limited participation of universities in the industrial sector. Table 4 illustrates the progress of knowledge economy indicators in Iraq: investment in research and

development, the degree of digital infrastructure, the number of technology incubators, and measures of technical education and training. The table exposes prevailing gaps in comparison to international benchmarking and helps outline potential paths in moving toward a sustainable knowledge-based economy, while at the same time identifying strengths and weaknesses that must be dealt with in order to activate youth participation in the country's economic growth.

Table (4): Development of Knowledge Economy Indicators in Iraq (2010–2024)

Year	Global Innovation Index	Spending on R&D (% of output)	Non-oil sector (%) contribution
2010	24.5	0.18	38.0
2011	25.0	0.19	37.5
2012	25.8	0.20	36.8
2013	26.2	0.20	36.0
2014	25.5	0.19	35.0
2015	24.8	0.18	34.2
2016	25.0	0.18	34.5
2017	25.6	0.19	35.0
2018	26.3	0.19	35.8
2019	27.0	0.20	36.5
2020	26.5	0.18	35.2
2021	27.2	0.19	36.0
2022	28.0	0.20	37.0
2023	28.8	0.20	38.2
2024	29.5	0.21	39.0

Source: Prepared by researcher based on: World Bank (2024); WIPO (2023); Iraqi Ministry of Planning (2025).

A temporal study of the indicators of the knowledge environment in Iraq for the duration (2010–2024) shows that there is a relative deceleration in the shift towards a knowledge-based economy. The slight rise in the Global Innovation Index from 24.5 to 29.5 represents meagre progress, which reflects no real structural transformation but shows that a distance was maintained from the countries that have embraced high-level knowledge-based strategies.

It is also worthy of note that expenditure on research and development was still very low — no more than 0.21% of GDP. This is indicative of poor

investment in knowledge and technology production, as opposed to the experiences of Malaysia and the UAE, where the figure had topped 1–2%. One of the key barriers to developing an innovation economy is said to be this very factor.

Regarding the non-oil sector share, it barely moved, climbing only from 38% to 39%, suggesting the persistence of the dominance of the oil sector and the fragility of attempts at economic diversification. This small rise does not represent a qualitative expansion of knowledge-based industries but is sometimes more related to oil price volatility rather than to policies of sustainable development.

These indicators reflect that the Iraqi economy is still a long way from becoming a solutions economy based on an innovation system model, due to the lack of a comprehensive knowledge-based system and weak support for innovation. In this regard, a comparison with the experiences of Malaysia, the UAE, and Egypt shows that the following factors were important for a shift:

- decreasing reliance on oil revenue;
- boosting investment in research and development;
- promoting the private sector and entrepreneurship;
- building digital infrastructure;
- implementing flexible government policies (which allow for innovation and enforce the rule of law).

Thus, reforming the «stagnation of innovation» in Iraq is a prerequisite for the vibrant economic transformation needed to move away from a rentier economy towards a diversified, knowledge-based, and innovation-driven economy — this is the core of this study.

Second: Analysis of structural and legislative obstacles

Consistent with the signals of weak innovation output and the predominance of a rentier modus operandi laid out in this study, comparing this with the governance experience in the UAE, it becomes evident that the Iraqi institutional landscape remains plagued by structural distortions that prevent it from embracing digital and innovative methodologies. There is observed a state of «legislative

lethargy» that compromises the business climate and delays the implementation of innovative ideas. This concurs with previous indicators stating that the share of knowledge-based industries in GDP is falling (Integrity Commission, 2024).

1) **The legislative lag and digital divide.** There are indicators that the legal system, especially trade and company law, in Iraq is still not prepared to keep pace with the changes brought about by the digital economy. Concepts integral to today's practice — such as venture capital, digital intellectual property protection, and regulation of start-ups — are insufficiently covered by legislation. This creates legal uncertainty for investors and entrepreneurs, leading to more complex administrative procedures and lengthy processes, which act as a bottleneck for the market introduction of innovations compared to the best regional practices (Integrity Commission, 2024).

2) **Human capital obstacles (brain drain).** Along with legal limitations, the Iraqi economy faces a major challenge in the form of underinvestment in human capital. Indicators reveal that the phenomenon of professional emigration remains strong, particularly in technology and knowledge-based sectors. In contrast to some Arab countries that have successfully mobilised the energy of their youth to strengthen the digital economy, Iraq is hampered by an uninspiring knowledge environment: weak innovation infrastructure; limited technology incubators; a disconnect between educational outcomes and labour market demands.

These combined factors create an environment that repels potential innovators, accounting for the marginal development of knowledge-based industries. This is consistent with the analysis reported in this study regarding the fragility of the economic structure (University of Baghdad, 2025).

Third: Analyzing available opportunities (latent strengths)

Notwithstanding the structural and legislative constraints of the Iraqi economy, positive signs are clearly visible since 2025–2026, indicating that there are opportunities that can be seized to drive the transformation into an innovative knowledge economy.

1) **The FinTech renaissance.** Since this period, Iraq has begun to make its first strides in developing electronic payment solutions and digital financial services. These solutions have challenged the dominance of traditional cash payments and paved the way for a more inclusive digital economy. Preliminary data reflect a significant growth in the number of digital transactions, demonstrating the potential of educated Iraqi youth to adopt technological advancements (Central Bank of Iraq, 2025).

2) **National priorities (entrepreneurship).** The Iraqi government-sponsored «Entrepreneurship» initiative is a significant step towards replicating the Egyptian model of fostering an entrepreneurial spirit. This includes: providing soft loans to innovative youth; setting up business incubators that link academia with the labour market.

This bolsters Iraq's capacity to harness the energy of youth in the fields of service and digital innovation (General Secretariat of the Council of Ministers, 2025). These trends indicate an opportunity to leverage youth potential and emerging digital infrastructure, provided that the country overcomes traditional bureaucratic barriers and better supports the economy's evolution towards a knowledge-based model.

Fourth: Lessons learned regarding the Iraq reference

The study of three experiences — Malaysia, the UAE, and Egypt — offers a series of actionable recommendations that Iraq could adopt within a hybrid approach to nurturing digital innovation:

1) **From Malaysia:** Develop «knowledge-based economic zones». These zones are designed to be partially insulated from bureaucratic hurdles to enable industrial experimentation and innovation.

2) **From the UAE:** It is imperative to overhaul the entire legislative system to make it more flexible and conducive to promoting digital innovations. This can be achieved through the establishment of legislative labs or «sandboxes» for legal experiments.

3) **From Egypt:** Emphasise grassroots innovation by supporting youth entrepreneurship and promoting new approaches to solving problems in the services sector.

To clearly demonstrate the divergence between Iraq and the three countries whose experiences have been analysed, the table below presents a comparison of Iraq, Malaysia, the UAE, and Egypt across four dimensions: legislative environment, financing, knowledge connectivity, and digital infrastructure. This comparison also reveals Iraq's current shortcomings in supporting innovation and highlights key areas for reform to drive digital innovation and the development of a knowledge economy.

Table 5. Comparative Analysis: Iraq vs. the Three Countries

Standard	Malaysia/UAE/Egypt	The reality in Iraq (2026)
Legislative environment	Flexible (legislative and experimental laboratories)	Rigid (outdated laws and high bureaucracy)
Finance	Venture capital and diversified investments	Limited government funding or complex loans
Cognitive linking	Industry-related research centers	Gap between academic research and commercial application
Digital infrastructure	Integrated (5G, data globalization)	In a state of continuous growth and improvement

Source: From the work of the researcher, based on: the Integrity Commission (2024), the Central Bank of Iraq, the Iraqi Ministry of Communications (2026).

Fifth: The proposed model: «The Iraqi Hybrid Knowledge Structure» (IQ-Inno-Drive)

Building on a comparison of the three countries, we present a hybrid model that brings together three core pathways to foster digital innovation in Iraq:

1) **The institutional approach (modeled on the UAE):** Establishment of legislative labs under the Cabinet's authority. The primary function of these labs is to grant special («Sandbox») licenses to innovative projects, thereby circumventing bureaucratic hurdles. Additionally, these labs will oversee and evaluate the rate at which innovations penetrate the market.

2) **IBIP (inspired by Malaysia):** Transformation of several industrial cities in Basra and Baghdad into «Free Innovation Zones». These zones will be

integrated with technical universities and equipped with: advanced digital infrastructure; specialized training centres to develop youth skills; mechanisms to convert academic research into commercially viable products and services.

3) VET (inspired by Egypt): Promotion of venture capital funding through a public–private partnership involving the Central Bank and other financial institutions. This initiative aims to: support startups; provide educational and financial support for innovative youth; cultivate an environment that encourages calculated risk-taking and grassroots innovation.

This model is grounded in three key elements: institutional flexibility; development of knowledge infrastructure; empowerment of youth entrepreneurship.

The ultimate objective is to create a robust ecosystem for digital innovation, enabling Iraq to transition from its current state to a sustainable digital economy.

Conclusions:

1. The primary obstacle to innovation in Iraq is not a shortage of funding, but rather institutional and bureaucratic barriers that hinder the transformation of innovative ideas into tangible economic outcomes.
2. International experience (Malaysia, the UAE, Egypt) demonstrates that the path to an innovative economy begins with decisive political support for innovators — this must precede any financial investment.
3. The disconnect between academic institutions and the industrial sector results in the wastage of intellectual capital and undermines local innovation efforts.
4. Iraq's youth population represents a significant strategic resource, but the current institutional framework fails to provide sufficient incentives to leverage this demographic for knowledge creation.
5. Thriving economies owe their success to flexible regulatory frameworks that facilitate experimentation with new solutions, coupled with a supportive legal environment that minimizes bureaucratic obstacles.

6. Iraq's heavy reliance on oil contributes to economic volatility and impedes diversification. In contrast, innovative resource-based economies have successfully diversified by investing in knowledge-driven activities.
7. The experiences of Malaysia, the UAE, and Egypt illustrate that a combination of: industrial planning; legislative flexibility; social entrepreneurship offers a viable model for Iraq, provided it is adapted to the local context.

Recommendations

1. Set up dedicated bodies to manage innovation and technology, independent of standard bureaucratic procedures, to ensure swift decision-making and effective support for innovative projects.
2. Facilitate the shift from traditional financing methods to venture capital investments to bolster startups and innovation-driven value-added projects.
3. Translate university research findings from academic papers into patents and marketable products to strengthen the regional knowledge economy.
4. Establish «Free Innovation Zones» and «Legislative Sandboxes» to create a permissive regulatory environment conducive to innovation.
5. Develop comprehensive training and business programmes to engage young people in sustainable innovative projects, using language and formats that resonate with the youth audience.
6. Foster the development of rural areas by promoting knowledge-intensive and innovation-driven industries to reduce dependence on oil revenues.
7. Develop a holistic strategy, informed by international best practices, to guide policies towards the creation of an innovative and sustainable economy.

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