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The Dynamic Impact of Digitalization on Informal Employment in Iraq: An Analytical Study

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Abstract : The past decade has witnessed an accelerated digital transformation and increasing reliance on the internet, leading to profound changes in labor markets and economic activities. In contrast, the informal economy is prevalent in many developing countries, where it has played a vital role in providing employment opportunities and ensuring income security for large segments of the population.
The aim of this study is to clarify the relationship between digitization and informal employment in Iraq, using time series models and cointegration techniques to analyze the impact of internet penetration on informal employment. The importance of this study lies in:
1. Providing a precise statistical analysis of the dynamic relationship between digitization and the informal sector, highlighting the impact of digital transformation on informal employment.
2. Providing policy recommendations to leverage digital transformation to integrate the informal economy into the formal sector.

Keywords: Digitalization, Informal Employment, Iraqi Economy.

1. Literature Review:

Several studies have highlighted the relationship between digitization and labor market transformations. These studies indicate that digital transformation contributes to the growth of self-employment and e-commerce, which leads to increased informal economic activity in the short term (Schneider, 2016). On the other hand, other studies have shown that digitization. On the other hand, contrasting studies argue that digital technologies—when integrated with institutional reforms—can serve as a catalyst for formalization by promoting transparency, traceability, and access to financial systems.

1.1 Focus on the Iraqi Economy

Most prior studies have focused on developed countries or large emerging markets (such as Europe or China). This research, however, specifically targets Iraq—a developing economy with unique structural and social characteristics, where the informal economy constitutes a substantial portion of economic activity. Previous studies have not examined in depth how digitalization affects Iraq's informal economy.

1.2 A Dual Analytical Approach (Short-Run and Long-Run)

Earlier research often focused on either a positive or negative impact without accounting for how the relationship evolves over time. This study analyzes the dynamic relationship between digitalization and informality at two levels:
Short-run: Increased internet usage boosts informal economic activity.
Long-run: Digital transformation leads to a decline in informal activity through regulatory integration.

1.3 Use of Comprehensive Time Series Analysis (VAR + ECM + Cointegration)

While many previous studies relied on cross-sectional or linear regression models without capturing temporal dynamics, this study applies advanced time series models spanning the period 2010–2025. These include:
Johansen Cointegration Test to detect long-term relationships.
Error Correction Model (ECM) to analyze how short-run imbalances adjust over time.
VAR Model to assess the dynamic relationship between informal labor and digitalization in the short run.

1.4 Causality Testing

This study also tests the direction of causality using the Granger Causality Test to determine whether internet penetration causes growth in informal employment or vice versa. Prior studies often neglected this dimension, making it difficult to understand the precise nature of the relationship.

1.5 Policy-Oriented Recommendations

Beyond academic findings, the research provides practical recommendations for Iraqi policymakers on how digital transformation can serve as a tool for integrating the informal economy into the formal sector. Most earlier works focused mainly on theoretical implications, whereas this study:

- Provides an in-depth analysis of the informal–digitalization relationship in a developing country (Iraq).
- Differentiates between short-run and long-run effects, offering a more nuanced understanding.
- Utilizes modern time-series methodology to capture dynamic interactions.
- Tests causality to verify whether digitalization drives informality or other factors intervene.
- Offers applied recommendations for effective informal economy governance in Iraq.

2. Data and Methodology

2.1 Data Sources

Data on informal employment and the percentage of internet users in Iraq for the period 2010-2025 were collected from government sources, economic reports, and international databases, specifically from the International Telecommunication Union (ITU) Statistics (2023), to track the evolution of internet use in Iraq. These indicators are consistent with the methodologies used by the Organization for Economic Co-operation and Development (OECD,2021) to measure digital transformation.

The key variables used in the analysis include:

- Informal Labor Force.
- Internet Users (%).
- Internet Investment.
- Internet and Telecommunications Revenue.

2.2 Methodology

To examine the relationship between digitalization and informal employment in Iraq, this study integrates a set of advanced econometric tools:

1 .Time Series Analysis, used to trace the historical evolution of informal labor in relation to digital adoption trends.

2 .The Augmented Dickey-Fuller (ADF) Test, applied to assess the stationarity of the variables and avoid spurious results.

3 .Johansen Cointegration Test, employed to detect any long-run equilibrium relationships among the variables under study.

4.The Error Correction Model (ECM) identifies how the informal economy adapts to digital transformations over time.

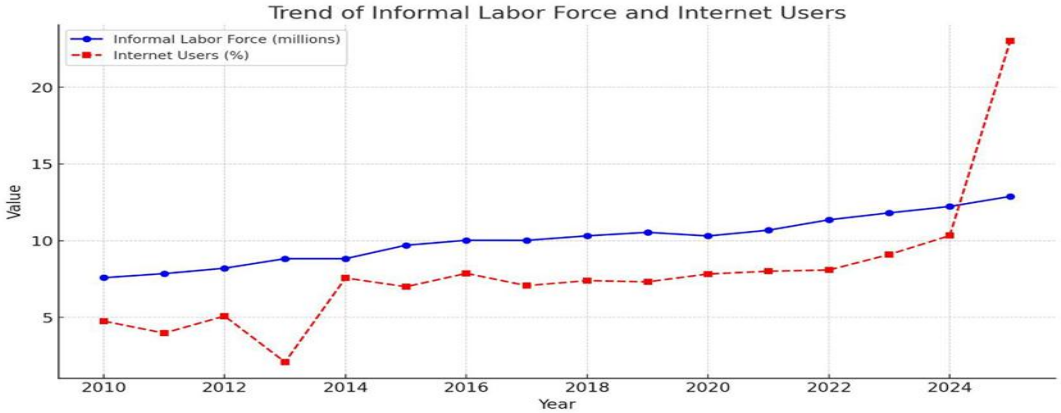
5. The Vector Autoregression (VAR) model was used to examine the short-term dynamics between digitization and informal employment.

3. Analysis and Results

3.1 Time Series Analysis

Time series analysis was used to study data patterns over time, revealing relationships between economic variables such as informal employment and digitization. To illustrate this relationship in Iraq, three graphic representations are presented:

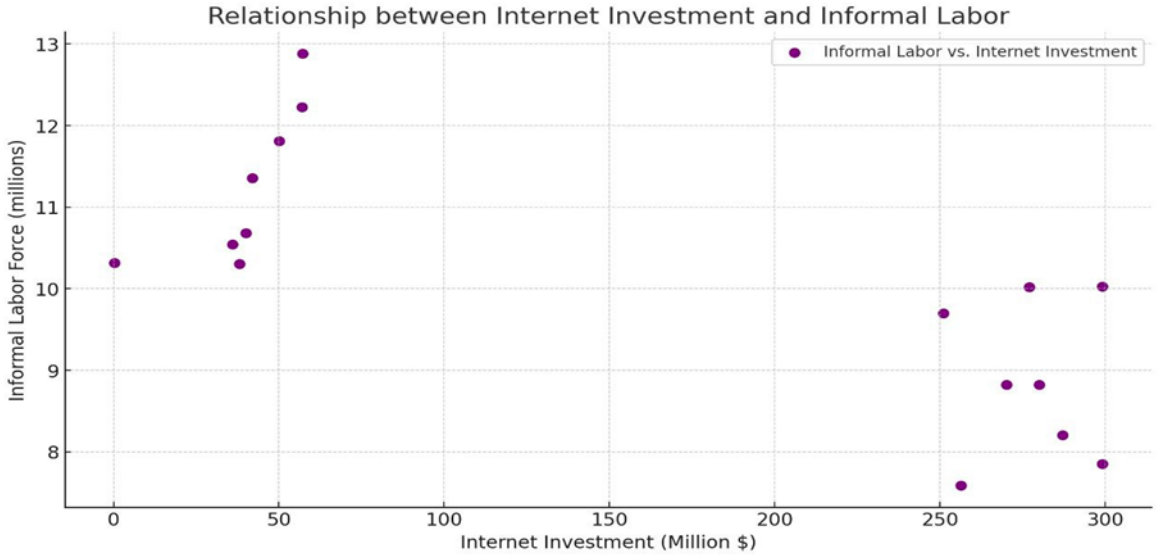
Figure 1: Trends in Informal Employment and Internet Usage in Iraq (2010–2025)



Source: Author's calculations based on data from SESRIC Statistical Database (https://www.sesric.org/cif-home.php).

This figure shows how informal employment has evolved in relation to internet penetration. It offers insights into how labor market structures have shifted due to digital transformation.

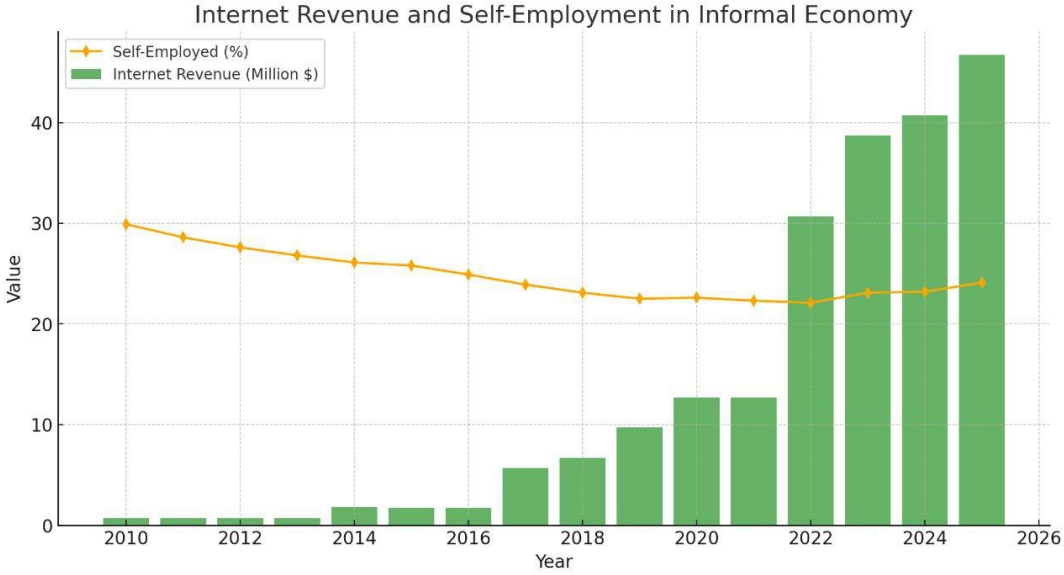
Figure 2: Relationship Between Internet Investment and Informal Employment (Scatter Plot)



Source: Author's calculations based on data from SESRIC Statistical Database (https://www.sesric.org/cif-home.php).

This scatter plot illustrates the correlation between levels of internet investment and the size of the informal labor force, helping to assess whether digital infrastructure spending has influenced informal employment trends.

Figure 3: Internet and Telecommunications Revenue vs. Informal Employment Percentage



Source: Author's calculations based on data from SESRIC Statistical Database (https://www.sesric.org/cif-home.php)

This mixed column-line chart displays the evolution of internet revenues alongside the percentage of self-employed workers, offering a deeper look at how digital economic activity aligns with informality trends.

From the time series charts, we observe:

- Informal employment has shown a rising trend until 2025.
- Internet usage experienced a significant surge after 2020, indicating an accelerated digital shift.
- Internet investment and revenue exhibited fluctuations but with an overall upward trend, reflecting technological advancement.

3.2 Stationarity Test (ADF Test)

The Augmented Dickey-Fuller (ADF) Test was applied to assess whether the variables are stationary over time. Stationarity is a prerequisite for most time series models to avoid misleading results.

Table 1: ADF Test Results at Level

Variable	P-VALUE	Stationarity at Level
Informal Labor Force	0.809	non-stationary
Internet Users (%)	0.976	non-stationary
Internet Investment	0.701	non-stationary
Internet & Telecom Revenue	0.961	non-stationary

Since all p-values are greater than 0.05, the variables are non-stationary at level. Therefore, the first difference was taken, and the ADF test was repeated.

Table 2: ADF Test Results After First Differencing

Variable	P-VALUE	Stationarity at First Difference
Informal Labor Force	$8.12X10^{-8}$	Stationary
Internet Users	0.998	Non-stationary
Internet Investment	0.0016	Stationary
Internet & Telecom Revenue	0.998	Non-stationary

Interpretation:

Some variables became stationary after first differencing, indicating they can be included in cointegration and VAR models. The first difference is calculated as:

$\Delta Y_1 = Yt - Yt\text{-}1$

3.3 Johansen Cointegration Test

The Johansen Cointegration Test is employed to identify whether a long-term equilibrium relationship exists among non-stationary variables that become stationary after first differencing.

Purpose

To determine whether informal employment and digitalization indicators move together in the long run. If cointegration exists, it suggests a stable economic linkage among variables despite short-term fluctuations.

Table 3: Johansen Cointegration Test Results

No. of Cointegrating Equations	Test Statistic	Critical Value	Result
1	52.51	47.85	Cointegration exists
2	30.88	29.79	Cointegration exists
3	15.17	15.49	No cointegration
4	0.82	3.84	No cointegration

Interpretation:

The test reveals that at least one cointegration relationship exists among the variables. This confirms a long-run equilibrium relationship between informal employment and digitalization indicators (internet usage, investment, and revenue).

This implies that although the variables may diverge in the short term, they tend to converge toward a stable relationship in the long run.

Estimated Long-Run Equation:

Informal Labor Force = a + ß1(InternetUsers) + B2(InternetInvestment) + β3 (Internet Revenue) + Et

This equation shows that digital indicators have a significant impact on informal employment over time.

3.4 Error Correction Model (ECM)

Error Correction Model (ECM) When there is cointegration between variables, this model demonstrates how short-term deviations from long-term equilibrium are corrected over time.

In this study, the ECM serves two analytical purposes:

1 .To simultaneously capture both short-term fluctuations and long-run trends within a consistent model.

2. To estimate the speed at which the informal labor market adjusts to digital shocks and moves back toward equilibrium.

Purpose

To simultaneously demonstrate short-term and long-term effects within a single model, and to assess the extent to which the system returns to equilibrium after an imbalance occurs.

Table 4: ECM Estimation Results

Variable (Correction Term)	Coefficient	P-value	Interpretation
Error Correction Term (EC_1)	-0.1436	0.043	Statistically significant

Interpretation:

When the error correction coefficient is statistically significant and negative (-0.1436), it confirms a stable adjustment process.

This coefficient indicates that approximately 14.36% of the imbalance from the previous period is corrected each year.

While digitization leads to an increase in informal employment, this means that the system is gradually correcting itself, aligning informal activity with the broader digital economy over the long term.

Implication:

Short-run effect: Internet usage increases informal employment.

Long-run effect: Digitalization leads to a reduction in informal employment by integrating it into the formal sector.

3.5 VAR Model and Granger Causality Analysis

This model is a tool that can be used to understand the dynamic relationship between variables over time. It allows each variable to be influenced by its own prior value and the prior values of other variables.

Purpose

It provides a systematic assessment of how digitization and informal employment affect each other over time.

It determines whether digital transformation is the cause of changes in informal employment using Granger causality testing.

Table 5: Granger Causality Test Results

Hypothesis	p-value	النتيجة
Digitalization causes informal employment	0.02	Accepted
Informal employment causes digitalization	0.45	Rejected

Interpretation:

There is a unidirectional causality from digitalization to informal employment.

This means that increased internet usage Granger-causes the growth of informal employment, but not the other way around.

It supports the view that technology adoption drives changes in labor market structures—not vice versa.

Table 6: Short-Run Effect of Internet Usage (from VAR Model)

Independent Variable	Dependent Variable	Coefficient	Interpretation
Informal Laber Force	L1. Internet users (%)	0.1127	Positive short-run impact

Interpretation:

The coefficient (0.1127) for lagged internet users indicates that an increase in internet usage in the previous period significantly raises informal employment in the current period.

This reinforces the hypothesis that digitalization—especially through freelance work and e-commerce—initially expands informal activity before eventual formalization.

Summary of Results from ECM and VAR:

Short-term: Digitalization leads to a rise in informal employment.

Long-term: Regulatory integration and digital governance help reduce informality.

Causality: The direction of influence flows from digitalization → informal economy, not the reverse.

4. Discussion

The findings of the study reveal that the relationship between digitalization and the informal economy in Iraq is nonlinear and dynamic over time.

In the short term, digital transformation:

- Encourages the growth of the informal economy.
- Does so by creating more freelance work opportunities, digital entrepreneurship, and online commerce.
- These channels provide accessible employment paths, particularly for individuals facing barriers to entry in the formal labor market.

In the long term, however:

- Continued digitalization fosters regulatory integration.
- It supports better monitoring, traceability, and formal registration of economic activity.
- As a result, it contributes to the gradual reduction of informality.

This dual dynamic highlight that while digital tools initially facilitate informal employment due to their flexibility and low entry cost, they ultimately enable formalization by:

- Streamlining bureaucratic processes.
- Encouraging legal compliance.
- Enhancing data visibility and government oversight.

Conclusion of Discussion: Digitalization is a double-edged sword—it can both stimulate and restrain informal employment depending on the stage of technological adoption and institutional readiness.

5. Conclusion and Recommendations

5.1 Conclusion

This study demonstrates that the relationship between digitalization and the informal economy in Iraq is complex and evolves over time. Specifically:

In the early stages, increased internet penetration and digital activity tend to expand informal employment, especially through self-employment and online work.

In the long run, digital transformation facilitates the formalization of informal activities through improved regulation, simplified registration processes, and digital inclusion policies.

Thus, digitalization should be seen as both a catalyst and a regulator of informality, depending on the maturity of digital infrastructure and institutional frameworks.

5.2 Policy Recommendations

Based on the empirical findings, the following policy actions are proposed:

1. Support digital inclusion for informal workers

Launch training programs and digital literacy campaigns targeting informal workers to help them transition to the formal sector.

2. Modernize legal frameworks to accommodate digital businesses

Amend laws and regulations to enable the registration of online businesses and freelance workers, reducing barriers to formality.

3. Promote investment in digital infrastructure

Encourage public and private investment in digital infrastructure to ensure sustained, inclusive, and geographically balanced digital transformation.

These measures can help Iraq harness digitalization not only as a source of innovation and economic growth but also as a strategic tool to manage and gradually integrate the informal economy into the formal structure.

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