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The Role of Financial Inclusion in Reducing Youth Unemployment and Mortality in the MENA Region:

An Application of FMOLS Approach with Panel Data

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Abstract:

This study investigates the effects of financial inclusion on youth unemployment and mortality rates, using panel data from 17 countries in the MENA region over the period 2004-2022. Controlling for variables such as the ICT development index, economic growth, and inflation rates, the results reveal a causal relationship between financial inclusion and both youth unemployment and mortality rates. Moreover, the FMOLS model results support the hypothesis that an inclusive financial system contributes to reducing both youth unemployment and mortality rates in the long term. Additionally, the GMM estimates further corroborate the role of financial inclusion in achieving SDGs 3 and 8. In contrast, the control variables show that an increase in the ICT development index raises unemployment but reduces the likelihood of youth mortality. Meanwhile, economic growth and inflation rate have a relatively weak impact on both youth unemployment and mortality risk in the MENA region.

Keywords: Financial inclusion, unemployment, mortality, youth, MENA

JEL : G29, D14, C01

Introduction

Although progress has been made under the Sustainable Development Goals (SDGs) framework in the MENA region, substantial inequalities remain evident among various countries. Certain segments of the population, particularly young people, do not benefit from these advancements at the same pace. Health inequalities and limited access to the labour market remain pressing concerns, exacerbated by factors such as rapid demographic transitions, economic disparities, and prolonged conflicts in certain countries (Fehling et al., 2015). These challenges hinder sustainable development and limit opportunities for young people, who constitute over half (55%) of the region's population (OECD, 2022).

Young people embody transformative potential but face complex challenges. From the perspective of labour market participation, statistics reveal that young people in the MENA region continue to suffer from a high unemployment rate, reaching 24.4% in 2023 (ILO, 2024). Regarding health-related risks, the average mortality rate among youth aged 15-24 years per 1,000 individuals remained at approximately 10% between 2004 and 2022, which is slightly below the global average of 11%, with the highest rates recorded in the Sub-Saharan region at 25% (UN IGME, 2024). Concerning the causes of death, the UNICEF (2023) report identified several factors for the cohort of young people aged 10-24 years, indicating that these are primarily linked to injuries (resulting in 45,000 deaths annually), where transport accidents are the leading cause of death, particularly among boys, except in Iraq, Sudan, and Yemen, where unintentional injuries or conflicts are more prevalent. Other causes include non-communicable diseases, mental health disorders, harmful behaviours (including smoking, physical inactivity, and obesity). In this context, it is crucial to strengthen national systems and mechanisms that address the growing challenges hindering young people from realising their full potential.

In recent years, increasing attention has been given to the concept of financial inclusion as a strategic approach to achieving various dimensions of the SDGs, particularly in reducing inequalities (Amaghouss & Elmasmari, 2024), unemployment (Alshyab and al.,2021), poverty (Tran and Le, 2021; Zhuang et al., 2009) and health risks (Gyasi et al., 2019). Access to formal financial services enhances health outcomes by helping individuals manage crises, cover medical expenses without depleting their savings (Klapper et al., 2016), and improve mental health (Ajefu et al., 2020). Moreover, it fosters resilience to external shocks and facilitates resource allocation towards productive investments such as education and healthcare (Zhuang et al., 2009; Demirgüç-Kunt et al., 2018).

Among young people, financial inclusion plays a critical role in enabling them to pursue education, launch businesses, and save for the future (Lyons & Contreras, 2017). However, their continued exclusion from financial systems restricts their economic autonomy and ability to contribute to the social and economic development of their communities (Wealth et al., 2023). Greater financial inclusion could not only support their transition to employment but also improve their living conditions and reduce their vulnerability to unforeseen crises (Sykes et al., 2016).

In this regard, this article examines how financial inclusion can act as a lever for reducing unemployment and health risks among youth in the MENA region. It contributes to the literature by exploring, on the one hand, the role of financial inclusion in reducing youth unemployment and, on the other, its impact on reducing mortality rates within this demographic.

The remainder of this article is structured as follows. Section 2 reviews the literature on the relationships between financial inclusion, youth employment, and health. Section 3 describes the data, variables, and empirical methodology employed in the analysis. Section 4 presents the empirical results, followed by the conclusion in Section 5.

2. Literature Review

Financial Inclusion and Youth Employment

Enhancing employment levels requires a balanced dynamic between labour supply (available workers) and demand (positions offered by employers). In this context, financial inclusion, by influencing factors such as access to credit, entrepreneurial behaviour, and investment, plays a pivotal role in stimulating employment. From a theoretical standpoint, this relationship can be explained through Amartya Sen's capabilities approach, which posits that the objective of public policy is to expand individuals' capabilities by removing freedoms deprivations such as poverty, financial exclusion, and limited access to health and education services. Additionally, we draw on the theory of vulnerable groups, which suggests that financial inclusion efforts should focus on the most vulnerable members of society, including young people (Ozili, 2020).

Empirically, this relationship has been studied from both macroeconomic and microeconomic perspectives. From a macroeconomic view, financial inclusion fosters business investment, promoting development and the creation of new employment opportunities (Boustanifar, 2014; Song and Wu, 2024; Elouaourti and Ibourk, 2024). This helps reduce various forms of unemployment, whether related to adults, youth, or gender disparities, particularly in developing countries (Raifu et al., 2024; Sun and Scola, 2023; Mehry et al., 2021). Similarly, other findings suggest that financial sector development serves as a key driver in transforming and integrating economic sectors most capable of generating productive and attractive employment (Osikena & Ugur, 2016), thereby enhancing labour market performance (Bruhn and Love, 2014). However, some studies have nuanced these conclusions, indicating that financial inclusion does not always have a significant impact on employment or unemployment rates (Amakor & Eneh, 2021; Sari et al., 2023).

Conversely, other studies have explored the impacts of financial inclusion on youth employment from a microeconomic perspective, suggesting that formal financial services are a crucial tool for creating employment opportunities for young people by fostering entrepreneurship and improving living conditions (Koomson et al., 2023). These findings are supported by additional research demonstrating

that financial inclusion and fintech enhance youth participation in the labour market (Elmasmari & Amaghouss, 2024) and encourage youth entrepreneurship, including in sectors like agriculture (Koloma, 2021; Ketema et al., 2020). Similarly, Senou and Manda (2022) found that access to finance increases the likelihood of entrepreneurship by 15.2% on average.

Nonetheless, the literature also provides evidence of a bidirectional and inverse causal relationship between employment and financial inclusion. Being active in the labour market is a determining factor for financial inclusion (Elouaourti and Ibourk, 2024). This relationship has been examined by Lyons and Contreras (2017), who analysed the bidirectional link between financial inclusion and entrepreneurship. Their findings indicate that the dominant effect flows from financial inclusion to entrepreneurship.

Based on the literature, the first hypothesis is formulated as follows:

H1: Financial inclusion significantly reduces youth unemployment rates.

Financial Inclusion and Health

Several studies have highlighted the role of formal financial systems in improving living conditions and health indicators, particularly in reducing mortality rates. Research demonstrates that countries with more developed credit markets experience significantly lower infant and maternal mortality rates (Sharma and Changkakati, 2022; Blau et al., 2024). Theoretically, this effect can be understood through Grossman's (1972) health demand model, which conceptualises health as a stock of capital that deteriorates over time due to factors such as ageing and disease but can be enhanced through investments in healthcare, nutrition, and related measures. However, these investments are often constrained by individuals' financial resources. In this context, financial inclusion can play a pivotal role by granting individuals access to financial resources, increasing their income, and thereby enabling the investments required to maintain or enhance their health capital. As Claessens and Feijen (2006) argued, financial development provides populations with services such as credit, savings, and insurance, which facilitate access to quality healthcare, improve living and working conditions, and offer financial protection against unforeseen health crises.

Empirical evidence further supports this hypothesis. Banerjee et al. (2023) found that financial inclusion has a significant positive impact on health outcomes. Other studies have demonstrated that inclusive financial systems contribute to increased life expectancy and significantly lower mortality rates (Chireshe, 2021; Xiao and Tao, 2022). Similarly, Angrisani and Blanco (2016) emphasised the benefits of financial inclusion for minorities and the elderly, reducing health inequalities and infant mortality rates. These findings align with Wirajing et al. (2024), who reported that financially included individuals are more likely to spend on health improvements compared to their excluded counterparts. Consequently, financial inclusion addresses key financial barriers to healthcare, such as the high cost of medical services, which are often a major obstacle to accessing medical care (Tucker-Seeley et al.,

2015). Nevertheless, some studies contradict these findings. For instance, Nica et al. (2023) revealed that formal financial systems have an insignificant impact on population health.

Based on this body of literature, the second hypothesis is as follows:

H2: Financial inclusion significantly reduces the risk of mortality among young people.

3. Data and Methodology:

This study aims to examine the extent to which financial inclusion contributes to reducing youth unemployment and mortality rates in selected MENA countries[2], namely: Algeria, Djibouti, Egypt, Iran, Iraq, Israel, Jordan, Kuwait, Libanon, Libia, Morocco, Oman, Qatar, Saudi Arabia, Tunisia, United Arab Emirates, and West Bank and Gaza, over the period 2004 to 2022.

3.1 Methodology

This study examines the role of financial inclusion in reducing youth unemployment and mortality rates in MENA countries during the period 2004–2022. Previous research underscores the existence of a bidirectional causal relationship between financial inclusion and the dependent variables (youth unemployment and mortality rates). To investigate this relationship, the Dumitrescu-Hurlin (2012) panel causality test was applied, accounting for cross-country heterogeneity. For model estimation, pooled panel OLS model was initially employed to obtain a preliminary understanding of the relationships between the variables. Thereafter, we implemented the FMOLS to examine the long-run relationship between our variables. The Fully Modified Ordinary Least Squares (FMOLS) approach is a widely used econometric method for estimating long-run relationships in panel data analysis, particularly when the data exhibits cointegration. Developed by Phillips and Moon (1999), FMOLS is designed to address challenges such as endogeneity and serial correlation that arise in standard Ordinary Least Squares (OLS) estimation of cointegrated panels. Its primary justification lies in its ability to provide consistent and efficient estimators even in the presence of non-stationarity and heterogeneity across cross-sections.

The FMOLS technique modifies the traditional OLS estimator by incorporating adjustments for serial correlation and endogeneity. It achieves this by augmenting the regression equation with leads and lags of first-differenced variables to account for correlation between the regressors and the error term. This adjustment ensures that the estimates are robust and unbiased in the presence of cointegration.

In the context of panel data, FMOLS accommodates heterogeneity across cross-sections by allowing for individual-specific fixed effects and varying dynamics among panel units. This makes it particularly suitable for analyzing relationships in diverse datasets, such as those involving multiple countries or

[2] The other countries in the MENA region have been excluded due to a lack of data

regions. Furthermore, FMOLS assumes that all variables are integrated of the same order (usually I(1)) and that the regressors are not co-integrated, ensuring the validity of the method in practical applications.

However, to address potential endogeneity bias and omitted variables, a two-step system GMM estimation approach (Blundell and Bond, 1998) was adopted to provide robust hypothesis testing. In this context, two diagnostic tests are conducted. First, the Arellano and Bond (1995) autocorrelation test evaluates the presence of second-order autocorrelation in the residuals of the first-differenced equations, with the null hypothesis being the absence of such autocorrelation. Second, the Hansen test for overidentifying restrictions is applied to assess the validity of the instruments.

Thus, the study's objectives and hypotheses were addressed through the specification of the following models:

Hypothesis 1: Financial inclusion significantly reduces youth unemployment.

$$Unempl_{it} = \beta_0 + \beta_1 IFI_{it} + \beta_2 ICT_{it} + \beta_3 GDP_{it} + \beta_4 Inflation_{it} + \mu_{it} \quad (1)$$

For GMM model, we include $unempl_{it-1}$ the first lag of the unemployment rate, as a dynamic term in the panel model. Consequently, equation (2) becomes:

$$Unempl_{it} = \beta_0 + \beta_1 unempl_{it-1} + \beta_2 IFI_{it} + \beta_3 ICT_{it} + \beta_4 GDP_{it} + \beta_5 Inflation_{it} + \mu_{it} \quad (2)$$

Hypothesis 2: Financial inclusion significantly reduces the probability of mortality among young people.

To test the validity of this second hypothesis, the same steps previously outlined were followed. Thus, the model specification becomes:

$$Mortality_{it} = \beta_0 + \beta_1 IFI_{it} + \beta_2 ICT_{it} + \beta_3 GDP_{it} + \beta_4 Unempl_{it} + \beta_5 Inflation_{it} + \mu_{it} \quad (3)$$

For GMM model,

$$Mortality_{it} = \beta_0 + \beta_1 Mortality_{it-1} + \beta_2 IFI_{it} + \beta_3 ICT_{it} + \beta_4 GDP_{it} + \beta_5 Unempl_{it} + \beta_6 Inflation_{it} + \mu_{it} \quad (4)$$

With :

$Unempl_{it}$: Youth unemployment rate

$Mortality_{it}$: Youth mortality rate

IFI: Index of Financial Inclusion

ICT : Information and Communications Technologies

GDP: Gross Domestic Product per capita

$Inflation$: Inflation Rate

And "i" denotes country and "t" denotes time

3.2 Data sources:

Endogenous variables:

The endogenous variables of our study are defined as follows:

- Youth unemployment rate: This is measured as the proportion of young people aged 15-24 years who are unemployed but available and actively seeking work. The data are sourced from the ILOEST database.
- Youth mortality rate: This is expressed as the probability of a person aged 15 dying before reaching their 25th birthday, per 1,000 individuals aged 15. The data are derived from the UN Inter-agency Group for Child Mortality Estimation.

Exogenous variables:

- **Index of Financial Inclusion (IFI):**

To calculate the financial inclusion index, we adopt the approach developed by Sarma (2008), using three dimensions of financial inclusion. The Access dimension is measured by the number of commercial bank branches per 100,000 adults. The Usage dimension is evaluated based on outstanding deposits with commercial banks (as a percentage of GDP) and outstanding loans from commercial banks (as a percentage of GDP). Additionally, we measure the Availability dimension using the number of commercial banks and ATMs per 100,000 adults. The data are derived from the Financial Access Survey of the International Monetary Fund (FAS-IMF).

We applied Min-Max normalization to these dimensions to standardize their values, bringing them within a range of 0 to 1. The overall financial inclusion index was then calculated using Sarma's formula:

$$IFI = 1 - \frac{\sqrt{(1-d_1)^2 + (1-d_2)^2 + (1-d_3)^2}}{\sqrt{3}}$$

We also use three control variables:

• **ICT (Information and Communications Technologies) Development Index:** this variable was incorporated into our model due to its contemporary relevance, particularly in light of the global technological revolution. In terms of its relationship with unemployment, this dynamic can be characterised as a competition between technological advancement and the workforce. Theoretical perspectives, such as those of Karl Marx and David Ricardo, have long expressed concerns about the

potential for technological progress to lead to "technological unemployment", especially if not accompanied by parallel developments. This concern is echoed by Schlogl and Summer (2020), who suggest that the impact of ICT development may be more adverse in developing countries compared to high-income nations. Moreover, other studies provide evidence of the negative influence of ICT adoption on unemployment rates (Hesda, 2023; Ogbonna and al., 2023). Regarding its broader societal role, ICT plays a pivotal role in enhancing health systems by offering innovative solutions such as digital platforms for health education, telemedicine, and disease surveillance. Remote monitoring tools, for instance, enable better management of health conditions, improve access to care in remote areas, and enhance responsiveness to pandemics. Such advancements contribute significantly to reducing adult mortality rates and improving overall public health outcomes (Megbowon and al., 2023).

We construct an ICT index based on a principal component analysis of three dimensions: Access (measured by mobile cellular subscriptions (per 100 people) and fixed telephone subscriptions (per 100 people), extracted from the WDI database), Usage (Measured by the percentage of individuals using the internet (% of the population), extracted from the WDI database) and Skills (measured by the average years of schooling, extracted from the UNDP database).

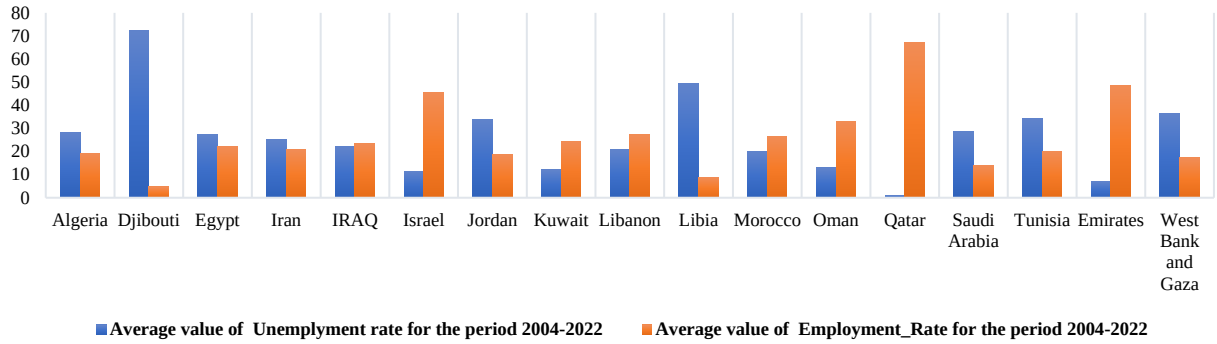
- **Gross Domestic Product per capita (GDP)** and **Inflation Rate** (Inflation): Data sourced from the UNCTADstat database.

4. Results and discussion

4.1 An Overview of Youth Employment, Mortality Rates, Financial Inclusion and ICT in the MENA Region

Examining the average trends from 2004 to 2022 in youth unemployment rates (ages 15–24) across the studied MENA countries (Figure 1) reveals striking disparities. Djibouti and Libya report alarmingly high unemployment rates, exceeding 72% and 49% respectively, underscoring significant challenges in their labour markets. These economies struggle to absorb and respond to the available workforce, resulting in persistently low employment rates. Conversely, Qatar and United Arab Emirates display low unemployment rates and high employment levels, reflecting robust and dynamic labour markets fostered by policies promoting active labour market participation.

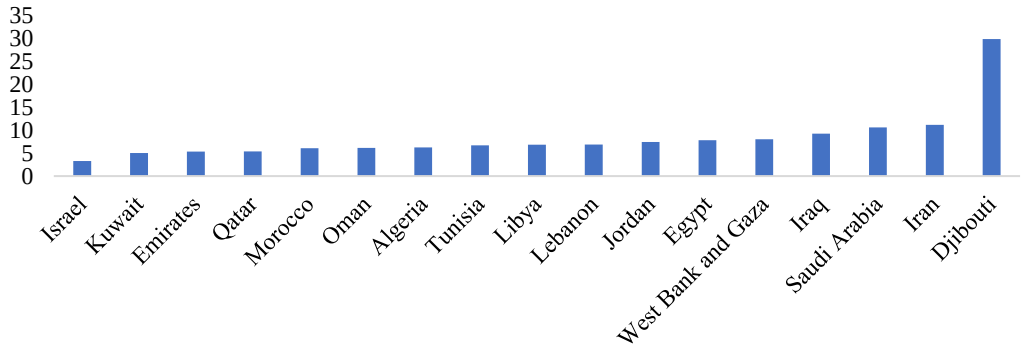
Figure 1. Employment and Unemployment Among Youth



Source: Authors' elaboration, based on ILOEST database

Regarding youth mortality rates (Figure 2), Djibouti registers the highest figures, indicative of enduring public health and developmental inequalities. UNICEF (2018) highlights significant disparities in access to maternal healthcare, particularly between urban and rural areas, which perpetuate poor child health outcomes. Additionally, vaccination coverage remains inadequate; as of 2021, only 48% of children had received two doses of the measles vaccine, and just 59% had completed three doses of the DTP vaccine. In contrast, Israel, United Arab Emirates and Kuwait stand out for their low youth mortality rates.

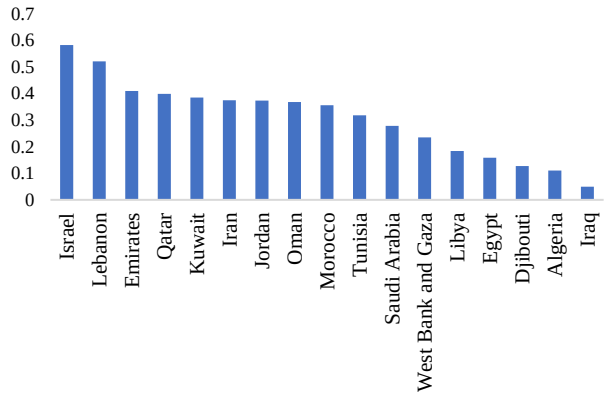
Figure 2. Average value of Youth mortality rate for the period 2004-2022



Source: Authors' elaboration, based on UN Inter agency Group for Child Mortality Estimation

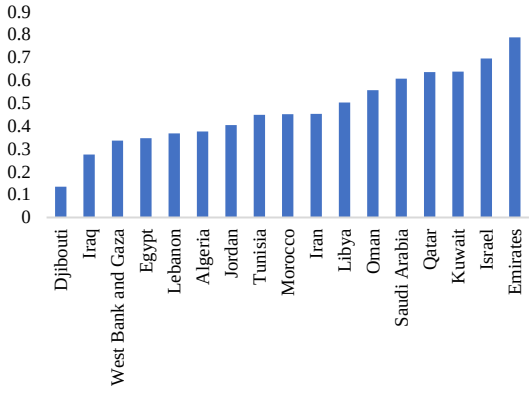
In terms of financial inclusion index (Figure 3), countries such as Israel (0.58) and Lebanon (0.52) lead, benefiting from well-established financial systems and policies that promote accessibility. However, countries such as Djibouti (0.12) and Iraq (0.05) face severe financial exclusion, indicating limited access to formal financial services for a large part of their population.

Figure 3. Average value of Financial inclusion Index for the period 2004-2022



Source: Authors' calculation, based on FAS-IMF database

Figure 4. Average value of ITC Index for the period 2004-2022



Source: Authors' calculation, based on WDI and UNDP database

As for the Information and Communication Technology (ICT) index (Figure 4), the Gulf countries, particularly the United Arab Emirates (0.79) and Kuwait (0.63), along with Israel (0.69), exhibit the highest levels of ICT access and usage. This is attributed to their economic wealth, modern infrastructure, and prioritisation of ICT development. North African countries, including Morocco (0.45), Tunisia (0.44), Algeria (0.37), and Egypt (0.34), have shown steady progress but continue to lag behind the Gulf nations. Conversely, nations such as Djibouti (0.13) and Iraq (0.27) record the lowest scores.

4.2 Stationarity Analysis

Table 1. Unit root tests

	Levin, Lin & Chu t*		Im-pesaran-shin	
	Level	First Difference	Level	First Difference
Unempl	0.9842	-13.8375***	-0.744	-9.189***
Mortality	4.308	-6.660***	1.667	-6.262***
IFI	-3.510***	-8.626***	-1.257	-8.343***
ICT	-2.231**	-3.503***	1.382	-4.34461***
GDP	-2.780***	-4.663***	-0.774	-3.289***
Inflation	-0.986	-6.783***	-1.235	-5.819***

Note: *Significance at 10% level; **Significance at 5% level; ***Significance at 1% level

The LLC and IPS unit root tests in Table 1 produce conflicting results for certain variables. However, given the heterogeneity accounted for in the IPS test, this study places greater emphasis on its findings. Based on the IPS test, the panel data for our study suggest that all variables are I (1). This indicates the presence of long-term properties in each variable, thereby supporting the use of cointegration tests.

4.3 Causal analysis

Table 2. Granger causality tests using Dumitrescu-Hurlin tests

Null Hypothesis: Absence of causal relationships	W-Stat.	Prob.
IFI → Unempl	5.62605	0.000***
Unempl → IFI	3.02239	0.382
ICT → Unempl	4.06370	0.019**
Unempl → ICT	3.19754	0.263
GDP → Unempl	2.57236	0.809
Unempl → GDP	3.21740	0.251
Inflation → Unempl	3.86622	0.039**
Unempl → Inflation	1.66007	0.299
IFI → Mortality	17.5185	0.000***
Mortality → IFI	4.00659	0.024**
ICT → Mortality	16.7828	0.000***
Mortality → ICT	3.02463	0.381
GDP → Mortality	6.24138	0.000***
Mortality → GDP	2.59240	0.787
Unempl → Mortality	14.7961	0.000***
Mortality → Unempl	5.50514	0.000***
Inflation → Mortality	2.80688	0.568
Mortality → Inflation	3.35220	0.182

Source: Authors' calculation.

The table provides an analysis of Granger causality between our variables, with the test indicating the presence of unidirectional and bidirectional causal relationships. Unidirectional causality is evident in the influence of financial inclusion, ICT, inflation and GDP on unemployment and mortality. Bidirectional causality is observed between financial inclusion and mortality, and between unemployment and mortality.

4.4. Impact of Financial inclusion on of Youth unemployment rate

4.4.1 Cointegration Analysis

Table 3. Johansen Fisher Panel Cointegration Test Results

Hypothesized	Fisher Stat.*		Fisher Stat.*	
No. of CE(s)	(from trace test)	Prob.	(from max-eigen test)	Prob.
None	507.0	0.0000	321.0	0.0000
At most 1	252.3	0.0000	156.3	0.0000
At most 2	141.4	0.0000	108.8	0.0000
At most 3	70.11	0.0003	60.41	0.0035
At most 4	45.19	0.0949	45.19	0.0949

Source: Authors' calculation.

Table 4. Multicollinearity test

Variable	VIF	1/VIF
ICE	2.20	0.454025
GDP	2.09	0.477756
IFI	1.60	0.624303
Inflation	1.03	0.975596
Mean VIF	1.73	

Source: Authors' calculation.

According to the table 3, it can be said that the hypotheses of there is no cointegration is rejected. Thus, the Trace Test confirms the existence of multiple cointegrating relationships among the variables. To evaluate the role of financial inclusion in reducing youth unemployment in the MENA region, we first examined the correlation among the variables and assessed multicollinearity. Using the Variance Inflation Factor (VIF) approach (Table 4), we confirmed that all variables had VIF values below 10, indicating no severe multicollinearity and validating the suitability for regression analysis.

Table 5. Impact of financial inclusion on youth unemployment using Pooled OLS and FMOLS Models

	IFI	ICT	GDP	Inflation
Pooled OLS	-0.6759** (0.309)	0.788 *** (0.243)	-0.666 *** (0.045)	-0.001 (0.002)
FMOLS	-0.121*** (0.02)	0.1992*** (0.014)	-0.073*** (0.015)	-0.0121 (0.025)

Note: ***, ** and * denote significance level at 1%, 5% and 10% respectively. OLS: Ordinary least square, FMLOS: Fully modified ordinary least squares.

The estimation results using the Pooled OLS method indicate a negative effect of financial inclusion and economic growth on the unemployment rate. However, the ICT index shows a positive effect. These effects are also observed in the long term, where the unemployment rate can be reduced by higher levels of financial inclusion and economic growth. Conversely, ICT has a negative effect. In terms of inflation, the impact is insignificant (Table 5).

Table 6. System GMM Regression Analysis

	Coefficient	Std. err.
Unempl_{it-1}	0.682***	0.118
IFI	-1.041**	0.4221
ICT	0.504***	0.1507
GDP	-0.000***	0.000
Inflation	-0.002***	.0007
_cons	1.353***	0.447
Arellano-Bond test for AR(2)	0.424	
Hansen (p-value)	0.681	
Number of obs	306	

Note: ***, ** and * denote significance level at 1%, 5% and 10% respectively.

Source: Authors' estimations

The specification tests, including those of Hansen and Arellano-Bond, show p-values greater than 5%, indicating that the model is correctly specified (Table 6). The estimation results confirm the first research hypothesis: financial inclusion contributes to reducing youth unemployment rates. This aligns with the results of the causality tests (Table 2) and is consistent with prior research, such as Mehry et al. (2021), who demonstrated that increased financial inclusion in developing countries reduces unemployment levels. Similarly, Molefhi (2019) highlighted that the availability of bank branches and account ownership positively influences job creation in both the short and long term.

On the other hand, ICT diffusion within the model exacerbates youth unemployment. This may be attributed to an increased demand for skilled labour at the expense of unskilled workers, thereby

intensifying inequalities in the labour market. Supporting this, Kuhn and Skuterud (2004) found that individuals seeking jobs online do not secure employment faster than those using offline methods. Other study suggest also that internet usage has had a negative, though statistically insignificant, effect on youth unemployment, but that mobile subscriptions have significantly reduced youth unemployment in Sub-Saharan Africa (Ebaidalla, 2024).

As for economic growth, the results reveal a weak inverse relationship with youth unemployment. These findings align with evidence questioning the applicability of Okun's Law in certain contexts. The limited effect of economic growth may be due to non-inclusive growth, a large informal economy, insufficient structural reforms, or reliance on natural resource exports, which restrict economic diversification and labour-intensive sector expansion. Furthermore, inflation also demonstrates a decreasing relationship with youth unemployment, consistent with the findings of Evanezza et al. (2020). However, as with economic growth, its effect remains marginal. The negative relationship between inflation and unemployment can be explained in the short term by the Phillips curve, so that unexpected inflation temporarily reduces real wages, thus increasing employment (Cashell, 2004).

4.5. Impact of financial inclusion on Youth mortality rate

4.5.1 Cointegration Analysis

Table 7. Johansen Fisher Panel Cointegration Test Results

Hypothesized	Fisher Stat.*		Fisher Stat.*	
No. of CE(s)	(from trace test)	Prob.	(from max-eigen test)	Prob.
None	353.9	0.0000	125.7	0.0000
At most 1	770.2	0.0000	587.4	0.0000
At most 2	787.5	0.0000	436.9	0.0000
At most 3	625.6	0.0000	275.5	0.0000
At most 4	210.4	0.0000	145.7	0.0000
At most 5	116.0	0.0000	116.0	0.0000

Source: Authors' calculation

Table 8. Multicollinearity test

Variable	VIF	1/VIF
GDP	3.53	0.283297
ICT	2.28	0.439539
Unempl	2.23	0.448691
IFI	1.63	0.615105
Inflation	1.03	0.975048
Mean VIF	2.14	

Source: Authors' calculation.

The analysis confirms multiple cointegrating relationships among variables using the Trace Test (Table 7). Additionally, VIF values (Table 8) indicate no significant multicollinearity (all below 10), ensuring data reliability for regression analysis of financial inclusion's impact on youth mortality.

Table 9. Impact of financial inclusion on youth mortality by Pooled OLS and FMOLS Models

	IFI	GDP	ICT	Unempl	Inflation
Pooled OLS	-0.766 *** (0.156)	0.019 (0.029)	-0.711*** (0.124)	0.155 *** (0.028)	0.0011 (0.001)
FMOLS	-0.753*** (0.281)	0.2016*** (0.018)	-1.084*** (0.216)	0.3016*** (0.02)	0.003 (0.002)

Note: ***, ** and * denote significance level at 1%, 5% and 10% respectively. OLS: Ordinary least square, FMLOS: Fully modified ordinary least squares.

Source: Authors' estimations

The Pooled OLS results indicates that financial inclusion and ICT significantly reduce youth mortality, while unemployment increases it. Economic growth and inflation are insignificant. In the long term, FMOLS confirms stronger negative effects of financial inclusion and ICT on youth mortality, while economic growth and unemployment positively influences it (Table 9).

Table 10 presents the results using two-step System GMM models. Diagnostic tests confirm the validity of the System GMM model. The Arellano-Bond test for AR (2) shows p-values above 5%, indicating no second-order autocorrelation. Similarly, the Hansen test validates the instruments used, with p-values greater than 5%.

Table 10. System GMM Regression Analysis

Mortaliy	**Coefficient**	**Std. err.**
$\text{Mortality}_{\text{it}-1}$	0.779***	.0434968
IFI	-0.191***	.052705
GDP	0.0205***	.0067221
ICT	-0.116***	.0233475
Unempl	0.0546***	.0124314
Inflation	.0001*	.0000964
_cons	0.1991	.1458047
Arellano-Bond test for AR(2)	0.193	
Hansen (p-value)	0.653	
Number of obs	306	

Note: ***, ** and * denote significance level at 1%, 5% and 10% respectively.

Source: Authors' estimations

The estimation results indicated that financial inclusion exhibits a statistically significant and negative effect on youth mortality rates, suggesting that higher levels of financial inclusion reduce youth mortality. Thus, a one-unit increase in financial inclusion reduces youth mortality rates by approximately 0.19%, ceteris paribus. Consequently, we confirm our second hypothesis. Therefore, more financially inclusive economies thus achieve better health outcomes (Banerjee et al., 2023). These findings align with those of Watkins et al. (2023), who demonstrated that countries with greater access to and use of formal financial services before the COVID-19 pandemic exhibited significantly lower population mortality risks. This is explained by the essential role of financial services (savings, insurance, credit, and payment systems) in supporting daily expenses such as food, housing, and medical care, while also providing protection against health emergencies.

The estimated models also confirm that ICT diffusion contributes to reducing youth mortality rates. These results align with previous studies showing that ICT positively influences public health and has a negative association with mortality (Wu et al., 2012; Raghupathi et al., 2013). Broader access to ICT infrastructure improves healthcare systems, particularly in terms of transparency and information sharing, leading to lower youth mortality rates.

Additionally, youth unemployment rates significantly increase mortality rates. This finding is consistent with Davila et al. (2010), who highlighted employment as a key factor in preventing premature mortality among young adults. Similarly, Morris et al. (1994) observed that unemployed or retired British men faced higher mortality risks than those in employment. Also, Nordt and al., (2015) have demonstrated that unemployment increases suicide risk. A high employment rate acts as a catalyst for improving youth well-being by ensuring stable income, adequate nutrition, safe housing, and access to quality healthcare. However, the impact of employment depends on job quality (contracts, wages, and security), as highlighted by Balogh et al. (2021), who found higher mortality risks among precariously employed workers.

Regarding economic growth, the literature generally associates it with reduced mortality by improving education and living conditions (Brenner, 2005). Nevertheless, its impact varies over time. During economic recessions, a decline in GDP per capita significantly increases mortality rates (Nishiyama, 2011). However, our results indicate a positive effect on mortality risk. This can be explained through mechanisms such as inequality, environmental degradation, lifestyle changes, or social tensions (Renton and al., 2012).

Furthermore, inflation was included in the model because it directly affects purchasing power and the cost of living, particularly healthcare expenses (Bourne, 2009), thereby increasing infant and youth mortality rates, especially in low-income countries (Lee et al., 2016). Our findings support these suggestions, indicating that inflation has a significant but weak positive effect on youth mortality rates.

Conclusion

This study investigates the impact of financial inclusion on youth unemployment and mortality rates, using data from 17 MENA countries between 2004 and 2022. The causality tests reveal two significant relationships, the first is a unidirectional relationship from financial inclusion to youth unemployment, and the second is a bidirectional relationship between financial inclusion and youth mortality.

Addressing the central question of whether financial inclusion can reduce youth unemployment and mortality rates, the findings from both the pooled OLS, FMOLS, and system GMM models demonstrate a negative effect of financial inclusion on these two indicators. Thus, an inclusive financial system that caters to marginalised groups, particularly youth, enables them to pursue education, enhance their skills,

and gain empowerment, equipping them to make informed decisions about their lives, including reproductive health.

Regarding the control variables, the results indicate that ICT diffusion exacerbates youth unemployment, likely due to skill disparities. The adoption of ICT demands specific technical and digital competencies, potentially excluding untrained workers from employment opportunities. However, ICT has a positive impact on reducing mortality rates by enhancing healthcare systems and overall well-being. Economic growth and inflation demonstrate a weak negative correlation with youth unemployment, whereas their impact on youth mortality is positive but minimal. However, unemployment emerges as a significant determinant of health outcomes, as elevated unemployment rates directly contribute to higher youth mortality in the region. The results of this study are important from a political point of view. Policy interventions should prioritise integrated strategies that expand access to financial services while also promoting inclusive ICT development. Such approaches would foster equitable employment opportunities and significantly reduce youth mortality rates in the MENA region.

However, our study has certain limitations. Firstly, due to data constraints, the analysis was restricted to only 17 countries in the MENA region. Secondly, we did not account for potential interaction effects between variables, which could influence the direction and magnitude of the estimated relationships. Despite these limitations, our research provides a scientific contribution by enhancing understanding of the role of financial inclusion in achieving the SDGs, particularly its association with mortality outcomes.

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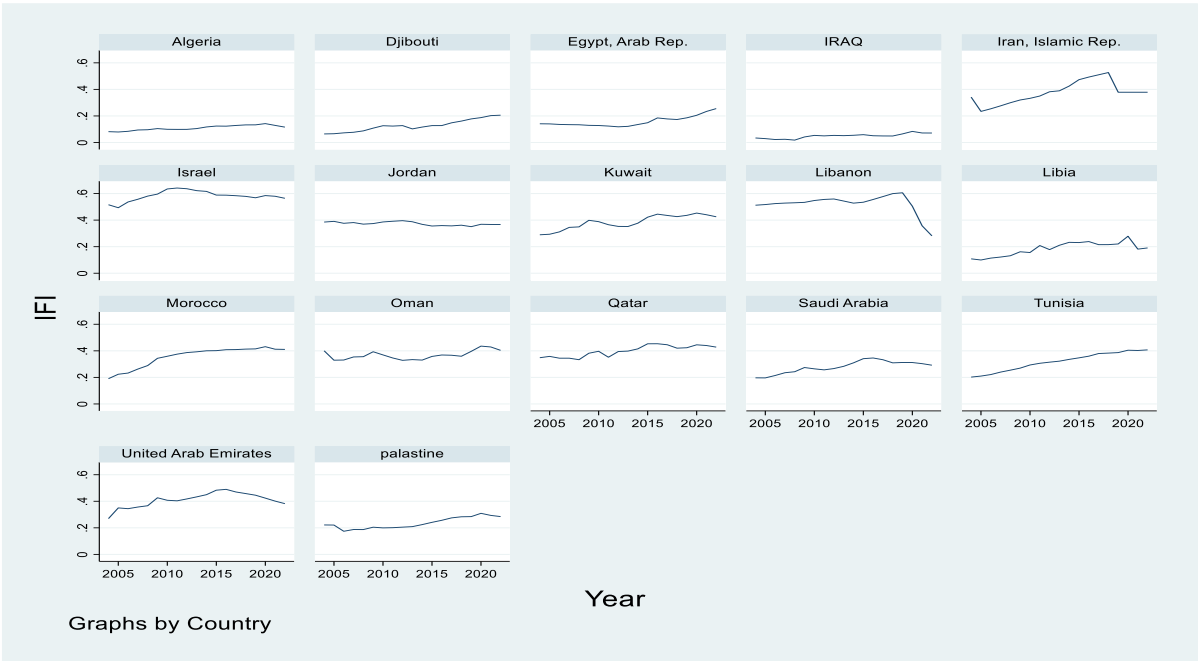
Appendix

➢ Rankings

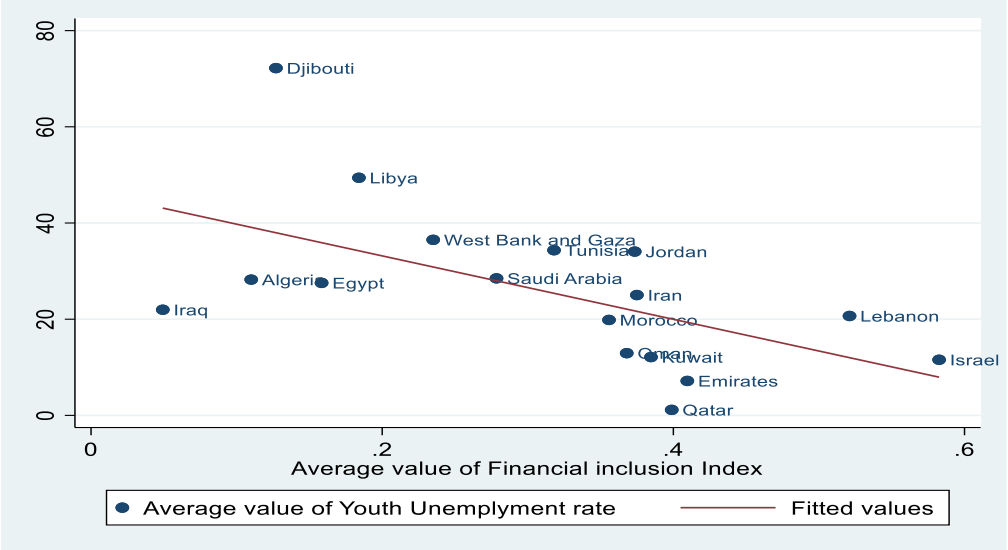
Country	Average value of financial inclusion Index for the period 2004-2022	Rank
Israel	0,58254039	1
Lebanon	0,52101109	2
Emirates	0,40956701	3
Qatar	0,39887093	4
Kuwait	0,38462696	5
Iran	0,37494993	6
Jordan	0,37345514	7
Oman	0,36796162	8
Morocco	0,35578887	9
Tunisia	0,31804153	10
Saudi Arabia	0,27850159	11
West Bank and Gaza	0,23503755	12
Libya	0,18402373	13
Egypt	0,15838881	14
Djibouti	0,12701636	15
Algeria	0,11003633	16
Iraq	0,04929356	17

Country	Average value of ITC Index for the period 2004-2022	Rank
Emirates	0,78750786	1
Israel	0,69540466	2
Kuwait	0,63766114	3
Qatar	0,63556612	4
Saudi Arabia	0,60705748	5
Oman	0,55643091	6
Libya	0,50254723	7
Iran	0,45327813	8
Morocco	0,45134586	9
Tunisia	0,4491883	10
Jordan	0,40397329	11
Algeria	0,37640083	12
Lebanon	0,36753832	13
Egypt	0,34639388	14
West Bank and Gaza	0,33587755	15
Iraq	0,27530857	16
Djibouti	0,13453055	17

➢ Evolution of the financial inclusion index by country



➢ **Relationship between financial inclusion and Youth Unemployment**



➢ **Relationship between financial inclusion and Youth mortality rate**