The Impact of Innovation on Employment in Arab Mediterranean Countries

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Abstract

The ability to innovate and exploit new technologies and processes is critical for economic diversification, sustainable development, and long-term success. As a result, this study aims to outline the Mediterranean countries' performance in the national innovation system and the major barriers and impediments to innovation. In addition, the paper studies how innovation affects employment rates using the FGLS model. The study concluded that innovation is friendly-labor in the Mediterranean region. Moreover, capital accumulation, economic growth, and labor force participation rates tend to have a positive impact on employment rates. The study also deduced that Mediterranean countries show moderate performance in the global innovation index (GII) with special drawbacks in the market sophistication, business sophistication, and institution pillars. In addition, they suffer from low employment rates. Thus, policymakers must address structural barriers to strengthening the business and regulatory environments and financial sector and modernize them to raise the private sector's potential for job creation.

الملخص
الابتكار أمر حتمي. ومع ذلك، يجب على الحكومات أن تكون قادرة على التعامل مع آثارها الاجتماعية. لذا، هدفنا في هذه الدراسة إلى دراسة أداء نظم الابتكار الخاصة بدول منطقة الشرق الأوسط وشمال أفريقيا وكيف يؤثر الابتكار على معدلات التوظيف. استخدمت الدراسة FGLS وأسلوب panel threshold methods لدراسة العلاقة بين الابتكار والتوظيف وخلصت إلى أن الابتكار صديق للعمالة في دول البحر المتوسط العربى ومنطقة الشرق الأوسط وشمال أفريقيا ككل رغم أنه سلبي في حالة دول مجلس التعاون الخليجي. علاوة على ذلك، يميل تراكم رأس المال والنمو

الاقتصادي ومعدلات المشاركة في القوى العاملة إلى التأثير بشكل إيجابي على معدلات التوظيف في دول البحر المتوسط العربى . كما خلصت الدراسة إلى أن دول مجلس التعاون الخليجي تظهر أداء جيدا في مؤشر الابتكار العالمي وإن كان يتجاوز مستوى دخلها، في حين تظهر دول البحر الأبيض المتوسط أداء معتدلا في مؤشر الابتكار مع وجود عيوب خاصة في السوق، وتطور الأعمال، وركائز المؤسسة.

1. Introduction

After the emergence of Covid-19, the Arab Mediterranean countries have significantly invested in innovation and experimentation where Covid-19 has intensified the need for research and development, and innovation reshuffling Arab Mediterranean countries' priorities towards innovation and digitalization, especially in a range of fields like medicine and education. Accordingly, innovation policy has become a central focus for policymakers in the region to enhance their competitiveness and journey to convert knowledge-based and move away from the oil and mineral sectors. However, the various shortages in the region's national innovation system (NIS) have prevailed. For instance, their NIS suffer from low education quality, bureaucratic and complex regulation system, lack of coordination between scientific organizations like research centers, governments, universities, and the private sector, low private sector participation in R&D, in addition to the shortage of skilled labor (Casadella & Bouacida, 2020).

Thus, policymakers, entrepreneurs, labor, and other stakeholders became more concerned about the disruption that innovations and technologies could carry to labor markets, where robots, information, and communication technology (ICT), and artificial intelligence (AI) not only substitute manual tasks but also can substitute cognitive tasks to a lesser extent (United Nations, 2017). For instance, the current edition of the *global employment trends for Youth* report debates how young people will face opportunities and challenges in the labor market due to innovations. According to Schumpeter, innovation can be induced through new products, new methods of production, new markets, and innovative marketing and organization techniques. Product innovation is mainly accompanied by job creation increasing the job growth rate. On the other hand, process innovation is likely to be labor substituting (Schumpeter, 1934; Feldmann, 2013; Ugur & Mitra, 2017). Furthermore, the impact of innovation on employment is affected by

several variables like the degree of rigidity in the labor and product market, the level of institutions, and the inability of firms to adopt new technologies. Such anxieties are understandable given that the North African region suffers from the highest unemployment rate in the world, ranging from 9.6 % in Morocco to 19 % in the case of Libya according to the international labor organization, 2021. In addition, the evolution of Covid-19 has caused an extra employment gap that is estimated at 3.2 million relatives to the non-pandemic scenario (Berg et al., 2021). Thus, governments in the region should exert great efforts to support the labor-augmenting nature of innovation and this can be accomplished by first modifying the institutional framework.

Therefore, this study tries to highlight what is Mediterranean countries' situation in the GII and what is the innovation system weakness in the Arab Mediterranean countries and how could innovation affect overall employment in the Mediterranean countries. The following section briefly discusses the literature review and theories that address innovation, and employment relationships, section 3 analyses the innovation system, and employment trends in the Arab Mediterranean countries, and section 4 shows an overview of the data used in the study, the econometric model, and results of the model and its implications. Finally, section 5 states the conclusion and recommendations.

2. Literature Review

Many papers studied the impact of innovation on employment in both developed and developing countries, both on the macro and the micro levels. Most researchers who are working on the macro level have proved humble or no relation in terms of the effect of innovation on employment. For instance, (Matuzeviciute, et al., 2017) using data from European countries from 2000 to 2012, found that innovation does not affect the employment growth rate in the short run. In addition, (Feldmann, 2013) using the ratio of triadic patent families to the population as a proxy for technological progress in 21 developed countries, concluded that on the macroeconomic level, technological unemployment arises in the short run – 3 years – but vanishes in the long run. (Krousie, 2018) indicated that commercially-supplied research and development expenditures have a humble labor-saving effect on the aggregate level in the US over the period 2002 - 2013.

On the micro level, there are asymmetries in downsizing and upsizing processes across research (i.e. negative and positive employment growth rates, respectively). Many researchers consented to the innovation augmenting effect on employment. For example, (Piva & Vivarelli, 2018) using data from European countries from 2002 to 2013, discussed that research and development (R&D) has a positive impact on employment with an elasticity of 2.6 for the whole economy. Moreover, he concluded that the strength of R&D on employment increases as the firm implies a higher rate of technology. (Zimmermann, 2009) indicated using a quantile regression approach that process as well as product innovation support labor augmenting effect in small and medium enterprises in Germany and is especially intensified in highly growing and exporting companies. (Gregory, et al., 2016) have undertaken a task-based framework in 27 European countries from 1999 to 2010 to estimate to what extent routine replacing technological change can influence labor. The results unexpectedly indicated that job creation and spillover exceed the job displacement effect thus inducing an increase in employment by 19.64 million jobs. Furthermore (Okumu, et al., 2019), using the world bank database in 27 African countries, concluded that both process and product innovation are upsizing employment growth rates and they tend to supplement each other in the production process providing higher employment but a weak business environment hinders this result. In addition, (Cirera, et al., 2016) studied how jobs created by innovative Spanish companies in the period from 2002 to 2009 surpass their counterbalance non-innovative firms in the matter of their degree of persistence and growth proving that the former can achieve higher and more sustainable employment growth than their non-innovating counterparts firms except in case of small highly innovative start-up projects which prefer to delay its recruitment decisions for some time in the short run. Moreover, innovative firms have higher flexibility and more persistence in overcoming positive shocks and have higher growth innovative: small and young firms are more likely to have higher sales. Moreover, the paper investigated the relationship between technology and inequality, supporting the increase of inequality between high-level incomes but not in the whole economy.

On the other hand, technology has been proven to have detrimental effects on innovation in some studies such as (Chiacchio, et al., 2018). The study

adopted the local labor market equilibrium approach to determine the substitution, demand, and spillover effects of robots on employment in 3 manufacturing sectors in 6 European countries and it came up with a conclusion that the substitution effect surpasses two other effects, leading to a decrease in employment rate by 0.16 -0.20 percentage points for each additional robot per thousand workers.

Some researchers have concentrated on the technology substitution effect such as (Graetz & Michaels, 2018). The paper constructed a simple model of firms' decisions to study the productivity effect of robots. The study's results are consistent with productivity theory where an increase in robot densification decreased employment in 17 countries in the period 1993 to 2007 by a percentage ranging from 0.58 to 1.48 due to a decrease in quality-adjusted prices of robots by 80% from 1990 to 2005. In addition, it increased labor productivity by 0.36 percentage points. Although innovation appears to highly boost total factor productivity (TFP) and average wages, these gains are marginally diminishing with the increase in the usage of robots, but it does not support significant aggregate implications.

On the frontage of developing countries, most research proved positive effects such as (Aboushady & Zaki, 2018), This paper sheds light on how exports and innovation highly affect skilled labor in nine MENA countries. The research has indicated that innovation is complementary to skilled labor increasing the demand for them and that exports increase innovation levels where becoming an exporter increases the probability of adopting new technologies, which, in turn, increases the demand for skilled labor. (Haile, et al., 2017) aim to study the effect of technology on employment in the manufacturing sector in Ethiopia from 1996 to 2004. Using the GMM-SYS model, Although Ethiopia is considered a developing country, the research set out to observe that technology has a positive effect on employment and is skill-biased and this business is exacerbated by FDI and by firm existence in the capital city. The research moreover evidences the applicability of the compensation channel in manufacturing firms in Ethiopia, where firms spend part of their profits on expanding their production capacity, therefore, increasing employment. (Ebaidalla, 2015) studies how ICT shapes employment in the MENA region using the GMM model from 1995 to 2012.

The study found that the internet and home telephone upsize employment growth and that ICT is gender discrimination where ICT goes in favor of men more than women. (Badran, 2019) studies technological unemployment using the Egyptian labor market panel survey (ELMPs) in 1998, 2006, and 2012 using OLS as well as the fixed effects model and the random effects model. He asserts that technology is skill-biased and promotes market polarization. Moreover, He agrees with (Ebaidalla, 2015) in proving that firms suffer from gender discrimination.

This paper surpasses previous papers in the following aspects. First, as far as I know, it is the first paper in the region that studies the relationship between innovation and employment using the GII. Second, it is the first study that works on the macro level in the Arab Mediterranean countries. Third, it is one of the few papers to analyze innovation conditions in the Arab Mediterranean countries.

3. Hypothesis

H1: innovation has a significant and positive impact on employment in the Arab Mediterranean countries.
H2: Gross capital formulation has a significant and positive impact on employment.
H3: Education is more likely to have a significant positive effect on employment.

4. The Research Questions

The study addressed the unemployment problem by investigating the following research question:

1. What is the relationship between innovation and employment in the Arab Mediterranean countries?
2. Does the job creation effect dominate over the displacement effect in the case of the effect of innovation on employment?
3. What are the strengths and weakness of the innovation system in the Arab Mediterranean countries?
4. What are the policies that should be undertaken by the government to decrease the harms of innovation on labor?

5. Theoretical Background

In this part, innovation is defined, measures of innovation are represented, and Mediterranean countries are categorized and ranked according to these indices. Moreover, employment in the region of interest is studied from both the demand and supply sides.

5.1 Definition of Innovation

Innovation is a very complex terminology; innovation isn't just R&D. It is much broader than R&D. The latter is only one of the innovation steps (OECD, 1981). Moreover, researchers have distinguished between innovation and inventions, innovation requires adding value to customers, but the invention is often considered as the capability to patent an idea, it needs no fulfillment of any useful customer need (O'Sullivan & Dooley, 2009). The most comprehensive definition was introduced by the Oslo Manual, which defines innovation as "the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations" (OECD, 2005, p. 46). Thus, we can deduce that innovation is the introduction of the new in whole or in part that develop the economic and social benefit to the economy based on the reading of its needs.

5.2 Methods of Innovation Measurement

Finding measures that represent innovation as it occurs in the world today is a major issue. Direct official measures of innovation outputs are still exceedingly rare. There are no governmental data, for example, on the quantity of innovative activity, defined as the number of new goods, processes, or other innovations (GII, 2020). There are various methods to measure innovation as stated by (Vanessa et al., 2020).

The first option is to use science and technology indicators. These indicators include Gross Expenditure on research and development (GERD), patents, triadic patents, and the number of publications. These indicators aren't a good proxy for innovation for several reasons. GERD and several research institutions are just part of innovation input, but they don't reflect whether these expenditures on R&D is reflected in new product or process and economic effect. As for patents and the number of publications, they just show inventions, not innovations. According to Peter Drucker, 1985, science and technology are only two components of innovation. Innovation entails identifying and addressing the demand of customers.

The second option is to rely on innovation surveys but unfortunately, there is a scarcity of innovation surveys in Arab Mediterranean countries. Moreover, innovation surveys are more concerned with the micro level and what is the change in firms' sales and employment as a result of innovation but do not show the big picture on the macro level.

The third option is the composite indicators such as the global competitiveness index (GCI) and the GII that offer a full picture of the quality of countries' global innovation trends and the innovation performance in innovation inputs and outputs. However, they do not evaluate countries' innovation visions. Therefore, we are going to depend in this study on a composite indicator known as the GII. GII is one of the most comprehensive leading references regarding innovation that illustrates the innovation landscape in different countries all over the world. As of 2021, the report is published by WIPO, in collaboration with the Portulans Institute, several business and academic network partners, and the GII Advisory Board (WIPO, 2021).

GII was first published in 2007 after the financial crisis that urged the need for innovation in economic growth and in dealing with crises. The GII encompasses 2 main indices: the innovation inputs index and the innovation output index. The innovation input index consists of 5 pillars: Institutions,

Human capital and research, infrastructure, market sophistication, and business sophistication. The innovation output pillar consists of 2 pillars: knowledge and technology outputs and creative output. Moreover, the report ranks the countries according to their scores, The country with the highest score takes the first rank, while the country with the lowest score ranks 131 – since there are 132 countries in GII 2021 report (WIPO, 2021).

5.3 The Mediterranean Arab Countries Rankings in GII

Table (1) provides a list of the Mediterranean countries for which GII are available according to the GII report in 2021, together with their GII values, and their rank compared to other countries included in the report.

Table 1: The Arab Mediterranean Countries' Scores in GII

Country	GII score (out of 100)	World rank (out of 132)	Income group	Rank among income group
Tunisia	30.7	71	Lower middle income	7
Morocco	29.3	77	Lower middle income	8
Jordan	28.3	81	Upper middle income	25
Lebanon	25.1	92	Upper middle income	30
Egypt	25.1	94	Lower middle income	13
Algeria	19.9	120	Lower middle income	29

Notes: - World Bank Income Group Classification (June 2020)
- The upper-middle-income countries included in the GII report 2021 are 34 while lower-middle-income countries are 34 countries.
- Rank 1 is the highest possible rank for the country, the total number of countries is 132.
source(s): WIPO, 2021

This table indicates that the Arab Mediterranean countries achieved a mediocre position in GII in 2021. None of them ranks within the highest 50 countries in innovation performance. Even more, none of them scored above the median score- of 31.7- for the entire group of countries included in the GII 2021 report. As for Morocco and Tunisia, Although, they still rank below the world median, they managed to attain innovation scores close to the world median and rank near the top of their lower middle-income group. Algeria ranks among the last twenty countries in the index. Dramatic policy changes are required in Algeria in order to improve its rank in practically all sub-indices and improve its innovation system. Unfortunately, there are no scores for Syria and Libya in the current issue of the GII 2021 because of their internal conflicts.

Challenges and Opportunities according to GII

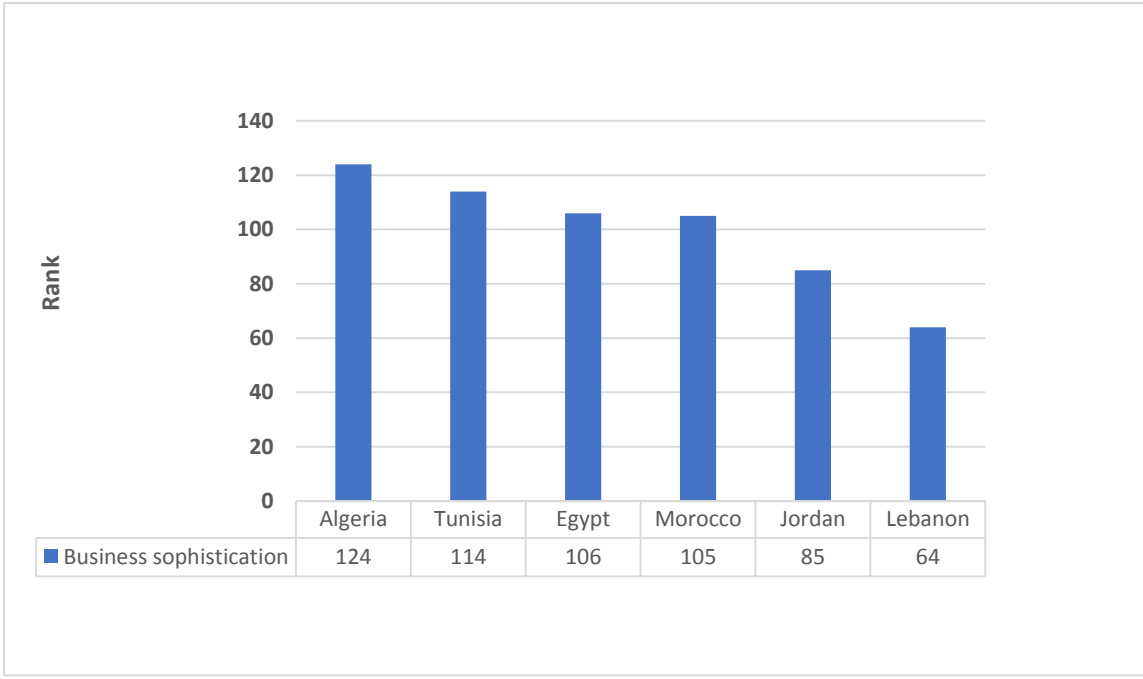
We can find that The Mediterranean countries' rankings are particularly low regarding the business sophistication and market sophistication pillars in addition to the institutions pillar.

First: Business sophistication

We can find that all the Arab Mediterranean countries' scores are far below the global average in the business sophistication pillar. Moreover, most of them rank in the last quintile, making this pillar one of their main weaknesses, as seen in **Figure (1).** This can be contributed to several reasons: (Radwan, 2018).

- Highly centralized and complicated NIS except for Lebanon and the absence of an overarching research strategy enlarges the gap between policy and implementation.
- Curtailed collaboration between the research institutions like universities and the productive sphere except in Lebanon and Algeria.
- Shortage in skilled labor due to the brain drain phenomenon where most of the skilled labor tends to immigrate to the GCC or Europe union.
- The limited capacity of the private sector to absorb innovation due to the presence of a large informal sector and the low number of innovative firms.
- Low private sector participation in R&D except in Tunisia and Morocco.
- Ineffective enforcement of intellectual property rights law.

Figure 1: The Mediterranean Countries' Rank in Business Sophistication Pillar in 2021



Source: Global Innovation Report, 2021.

Second: Market sophistication

Another pillar that drives the Arab Mediterranean countries' rank down is the market sophistication pillar. This pillar illustrates the soundness of the financial sector in the country and the volume of trade within the country and outside. Financing innovation is a worldwide challenge, particularly in a society still reeling from the effects of the epidemic. Indeed, the headline of the GII report in 2020 is Who Will Finance Innovation?

Access to funds (equity, loans, and investment) was one of the region's central concerns for businesses (Majdouline et al., 2020) where all Arab Mediterranean countries except Jordan rank poorly in the credit sub-pillar with a rank between 88 in Jordan and 129 in Algeria. Banks in the region prefer to lend to large, well-known, or politically connected firms rather than smaller or newer ones – even though small companies are more innovative or productive than large ones - which affects competitiveness levels and new business formation rates negatively (WEF, 2018). This condition persists despite central banks' efforts to reverse the trend. This could be due to the issue of firms' asymmetric information, poor rates of financial inclusion, and

capacity constraints where firms especially SMEs do not offer accurate data regarding their financial situation which forces the banking sector to raise collateral requirements and increase interest rates. Moreover, it leads to a limited choice for financial institutions (Betz, Kappeler & Bennani, 2020).

Third: Institutions

A third pillar in which the analyzed countries score unsatisfactorily is the institutions. The pillar encompasses 3 sub-indices: political environment, regulatory environment, and business environment. This pillar shows huge disparities between the countries of interest in the present study as can be seen in **Table (2)**. On the one hand, Jordan, Tunisia, and Morocco show moderate performance with ranks 63, 74, and 75 respectively, on the other hand, Algeria, Lebanon, and Egypt show weakness in the pillar with ranks 104, 112, and 114 respectively out of 132 countries evaluated.

Table 2: The Arab Mediterranean countries rank in institutions pillar in 2021

GII 2021	Jordan	Morocco	Tunisia	Algeria	Lebanon	Egypt
Political environment	69	80	84	106	129 (weak)	99
Regulatory environment	39 (strength)	86	90	108	72	124 (weak)
Business environment	97	59	54	92	121 (weak)	84
Institutions	63	74	75	104	112	114

Source: GII 2021

The Mediterranean countries suffer from poor governance as can be noticed in their rank in the **regulatory environment** sub-index in table (2). One of the main reasons behind countries poor governance is its past heavy reliance on oil and mineral rents leading to an oversized public sector, where 20% of Algeria's GDP comes from the oil and gas sector. Although the dependence of Egypt and Tunisia on these sectors decreases, they still suffer from Dutch disease consequences.

Another reason is the heavily centralized system in these countries, high corruption rates, red tape and clientelism, and complicated legal and

regulatory system that causes poor NIS and hinders the development of innovation, for instance, firms have to resort to lawyers to help them in finishing the registration procedures. Thus, NACs countries should work on facilitating their procedures and try to get rid of bureaucracy and clientelism.

As for the business environment, NACs show great discrepancies in this sub-pillar. For example, both Tunisia and Morocco registered significant development over the period 2011- 2021 with ranks 54 and 59 respectively, while Lebanon ranks in the lower quartile. Moreover, Jordan, Algeria, and Egypt rank 97, 92, and 84 respectively despite initiatives they tried to develop startups. The NACs suffer from a large share of the informal sector and many state-owned and well-connected large private sector firms that get privileges more than SMEs. Furthermore, there are few tax incentives to stimulate investment in start-ups and innovation in general.

Finally, regarding the political environment, as can be seen in Table (2), we can find that Lebanon, Algeria, and Egypt are lagging in this sub-pillar. In 2020, the Lebanese harbor was hardly attacked, in the case of Egypt, the war in Palestine and Libya next to its border provoked its political stability, and finally, Algeria suffered from internal protests against the political system in 2019, known as Herak.

5.4 Employment in the Mediterranean Countries

In this part, an overview of the employment rates in the Mediterranean countries is presented, then the reasons for low employment rates in the region are displayed and discussed from the demand and supply point of view.

5.2.1 Overview of Employment Rates

It is no secret that Arab Mediterranean countries suffer from disappointing employment rates[1] hovering around 38% in 2021, much below the world average (Berg et al., 2021) as can be seen in **Figure (2)**. Although some countries like Egypt have been achieving reasonable economic growth rates (5%) (WB, 2020), they suffer from jobless growth. These low rates have been accentuated by Covid-19 revealing the region's serious long-standing

[1] According to ILO, employment rates measure the percentage of working-age population 16 to 64 who are employed.

challenges regarding high unemployment, low employment rates, and high percentage of low-quality jobs (ILO, 2021).

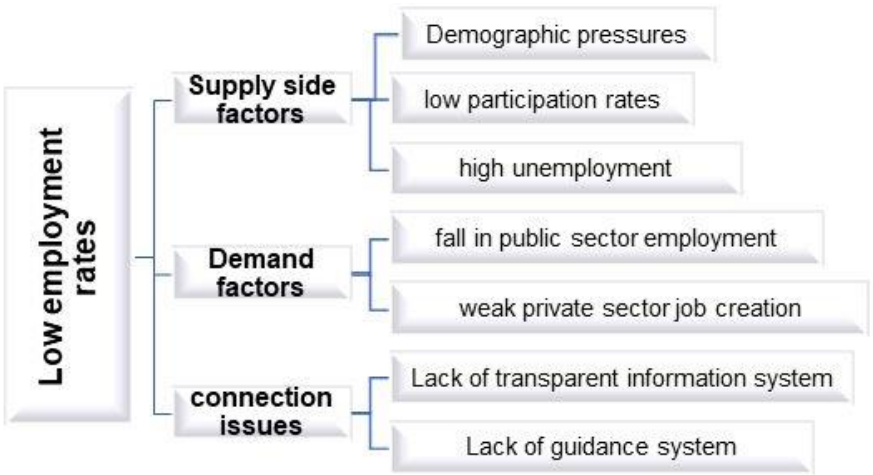
Figure 2: Employment to Population in Different Regions Worldwide in 2021

Source: Done by the researcher using ILO data (modeled estimates, 2022).

5.2.2 Reasons for Low Employment Rates in Mediterranean Countries

Besides the economic situation in these counties and the fluctuations in oil prices, other variables can explain these low employment rates and can be divided into demand-side issues, supply-side issues, and connection issues that limit the opportunity for job seekers to have a better-paid job as illustrated in **Figure (3)**

Figure 3: The reasons behind low employment rates in the Arab Mediterranean countries



Source: Done by researcher

5.2.2.1 Supply Side Factors

First: Demographic Pressures

Demographic pressures are one of the main causes of the high youth unemployment rate starting from the 1970s, North African countries have witnessed progress in the healthcare sector leading to a decrease in infant mortality rates and high fertility rates. This resulted in a large number of young job seekers which Mediterranean economies aren't able to deal with (ILO, ESCWA, 2021). However, this trend has changed with the fall in fertility rates leading to slowing population growth except in Jordan, which registered more than 19% on average over time. The Mediterranean population is still mainly youthful for instance, almost 17% of Lebanon's and Egypt's populations are youth between 15 to 24 years in 2021, 16% of the Moroccan population are youth, and about 26 % young under 15 years old, and finally, more than 13% are youth in both Tunisia and Algeria at the same year.

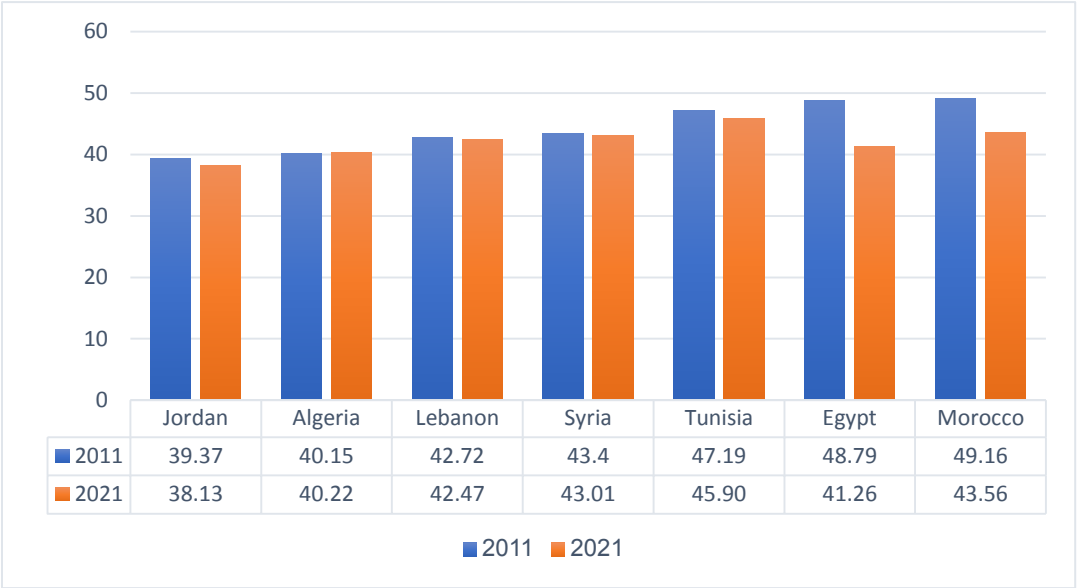
Second: Low Labor Force participation rates (LFPR)

All Mediterranean countries suffer from low LFPR[1], hovering around 45% in 6 countries under study which is far below the world average of 58.9% in 2021 and 52.8% and 64.3% on average in the case of lower and upper-middle-income countries respectively, as can be seen in the **figure (4)** with a growth rate below population growth. This problem was exacerbated in 2020 because of Covid-19 but they started to recover in 2021 and 2023 to return to their pre-crisis condition. Even before the crisis, most countries' LFPs have been decreasing or stagnating (ILO, 2021).

Figure 4: The Arab Mediterranean countries' labor force participation rate[2]

[1] According to ILO, LFPR shows the percentage of the country's working-age population – population from 15 years to 65 years - actively engages in the labor market.

[2] Labor force participation rate is the proportion of the population ages 15 and older that is economically active: all people who supply labor for the production of goods and services during a specified period.



	Jordan	Algeria	Lebanon	Syria	Tunisia	Egypt	Morocco
2011	39.37	40.15	42.72	43.4	47.19	48.79	49.16
2021	38.13	40.22	42.47	43.01	45.90	41.26	43.56

source: World bank database 2021

The fall in labor force participation can be explained by low female participation, stagnating or falling male participation rates, a fall in youth participation in the labor force due to an increase in educational attainment in the region especially for women, and the inability of the private sector to compensate for the contraction in public sector jobs for women.

Third: High unemployment

Looking at unemployment rates, we can find that unemployment rates have either stabilized or fallen in NACs due to the slowdown in the youth population and rising NEET rates, especially in Tunisia. Moreover, the region suffers from high rates of long-term unemployment in the youth population and rising NEET rates. Furthermore, the region suffers from extremely high rates of long-term youth unemployment, with Tunisia having 36%, Morocco having 60%, and Egypt having 80% (ILO, 2020)[1]. If young people are unemployed for an extended period of time, they may eventually cease seeking work, drop out of the labor force, and disappear from unemployment statistics (ILO & ESCWA, 2021).

A closer inspection of the high unemployment rate in North African countries shows that it is mainly due to the labor market insertion problems for youth.

Education in Arab Mediterranean countries isn't a guarantee for employment where unemployment is higher for graduates than low educated what is known as MENA Paradox (ILO & ESCWA, 2021), this could be explained by various reasons as follows.

1) Misalignment between graduate skills and the skills needed by North African economics. NACs have failed to prepare youth for the world of work though they have achieved significant improvement in enrolment rates.

2) The educated youth are expecting particular types of jobs with social security and good work conditions (Kabbani, 2019). Moreover, they may be supported by their families which makes them not obliged to accept any jobs offered to them in reversal to their desire.

3) The private sectors in NACs can't create high-quality jobs where most opportunities are created in the informal sector, which generally offers fewer benefits or protections due to the fragility of the main employment sectors where most jobs are created in the services sector and even jobs created in the industrial sector mainly in construction, oil, and capital-intensive manufacturing.

4) The youth are seeking to obtain jobs in the public sector, At the same time when governments are decreasing recruitment in the public sector due to fiscal consolidation.

5.2.1 Demand Side Factors

First: Private Sector Employme*nt*

Labor demand is the main determinant of low employment rates. Unfortunately, the private sector in the Mediterranean countries is not able to create enough decent jobs, despite the Mediterranean's efforts to encourage private sector investment and improve the business climate. This low private sector job creation could be attributable to many reasons as follows.

1) Political instability is one of the main constraints to private sector investment, especially in conflict countries like Libya and Iraq and countries that are near conflict countries such as Lebanon and Jordan where according to the enterprise survey in 2019, 36.9% of surveyed firms consider political instability as their biggest obstacle and 14.3% in case of Jordanian companies and 17.4% in the case of Egyptian firms (WB, 2020).

2) Poor regulatory system: Regulatory system in Arab Mediterranean countries is very complex, opaque, inefficient, and biased toward few

existing companies (cronyism) which limits formal firm creation and increases the informal sector and resulting in a high informal sector as we referred to before (ILO & ESCWA, 2021; Slimane &Tahar, 2018).

3) Poor access to finance: A well-functioning financial sector is the main determinant of private sector development entrepreneurship and firms' decision to innovate. Access to credit was one of the region's main issues even before Covid-19. Morocco, Lebanon, and Algeria are particularly weak in terms of credit availability; on the other hand, Morocco, Lebanon, and Jordan do well in terms of domestic lending to the private sector as a proportion of GDP (Slimane & Tahar, 2018).

4) Rigid labor market regulation and high financial cost of labor: The regulations should achieve an equilibrium between worker compensation, job security, and flexibility (Slimane & Tahar, 2018).

Second: Lower Public Sector Employment

Several countries in the region including the GCC, Egypt, Iraq, and Tunisia nowadays are pursuing fiscal consolidation through decreasing wage bills. Public employment in some countries (Egypt, Jordan, and Algeria) is high. For instance, public employment in Algeria is among the largest in the world about a third of total employment. Tunisia and Morocco, on the other hand, have a moderate share of public jobs but with higher wages than the private sector. These high public wages drive youth to seek education that qualifies them to work there contributing to "*wait for unemployment*" whereby university graduates queue up waiting for public positions. Even after the fall in public sector employment, this hasn't resulted in a growing and dynamic private sector. Moreover, the public sector has crowded out the private sector in finance leading to a lower credit share available to the private sector (Tamirisa, & Duenwald, 2018). So, governments in the region should manage public employment and compensation system by reducing hiring and reforming the compensation system. Moreover, they should work on inserting innovation in governmental institutions (E-government).

6. Methodology

6.1 Data

To study the impact of innovation on employment during the period from 2011 to 2020, panel data from six countries are used to construct the study's model. Four of them are NACs countries, in specific: Egypt, Tunisia,

Morocco, and Algeria, in addition to Jordan and Iran which share similar levels of income. Unfortunately, innovation data for Syria, Libya, and Mauritania aren't available. Similarly, Lebanon is excluded from the research because of the shortage in its education data. Data were collected from the world bank, the international labor organization, and Cornell University.

6.2 The variables

The variables considered to study the relationship between innovation and employment in countries under study are reported and described in **Table (3)** as follows.

Table 3: The Variables Included in the Econometric Model

The proxy	Description	Source
EMP	Employment to population ratio	International labor organization (ILO)
GII	Global innovation index	Cornell University, (INSEAD and WIPO)
EDUC	School enrollment in primary school as % of the gross population of this age group	World Bank (WB)
LFPR	Labor force participation	International labor organization (ILO)
GCF	Gross capital formulation	World Bank (WB)
GDPP	Gross domestic product per capita growth rate	World Bank (WB)

6.3 The Econometric Model

Taking into consideration the economic theory and literature, and the circumstances of the countries of the study, the variables are chosen as in section 4.2 and the model is constructed as in **Equation 1**. Moreover, to check the robustness of the estimated coefficients, the study used GDPP instead of GCF in the second model (**Equation 2**) as follows.

$$EMP_{it} = \alpha + \beta_1 GII_{it} + \beta_2 EDUC_{it} + \beta_3 LFPR_{it} + \beta_4 GCF_{it} + \varepsilon_{it} \dots\dots\dots\dots\dots\dots\dots (1)$$

$$EMP_{it} = \alpha + \beta_1 GII_{it} + \beta_2 EDUC_{it} + \beta_3 LFPR_{it} + \beta_4 GDPP_{it} + \varepsilon_{it} \dots\dots\dots\dots\dots\dots\dots (2)$$

where EMP_{it} is the measure of employment in country i at year t. The $LFPR_{it}$ is the labor force participation rate variable, and GII_{it} is the global innovation index, the GCF_{it} is the gross capital formulation as % of GDP, $EDUC_{it}$ is the number of students enrolled in the primary schools as a percentage of gross population of this age group, $GDPP_{it}$ is the gross domestic product per capita growth rate. Finally, ε_{it} is the error term.

Since GII is a recent index measured at an annual rate making the number of observations relatively low and decreasing the time dimension, we preferred to use panel data, since it deals with problems that appear in the case of short time dimensions and provides better results than time series methods in the

case of small data. In addition, the panel data method offers methods to deal with individual heterogeneity. Finally, it offers variability in data, increases the degrees of freedom, and improves the reliability and stability of the parameter estimates. Though in the case of low-frequency series, time series analysis problems may exist in panel data. Therefore, first, to check for time series problems, we examine the unit root problem to determine the stationarity status of each variable and accordingly decide the appropriate econometric technique for the model. Cross dependence problem - using the Pearson CD test 2004- is examined first to determine the appropriate unit root test (Erdogan, Yildirim, & Gedikli, 2020).

According to CD test results as can be seen in **Table (4)**, countries under study are correlated in the case of all variables except in GCF, EDUC, and GII at the 5% level of significance. Thus, second-generation unit root tests, that assume cross dependence in series are used for all the other model's variables, for instance, Mandala and Wu, 1999 test, while the Pearson panel unit root test (Pearson, 2007) can be used in the case of GCF, EDUC, and GII.

Table 4: CD Test Results

Variable	**CD-test**	**p-value**
EMP	3.804	0.000
GII	1.896	0.058
EDUC	1.467	0.142
LFPR	4.485	0.000
GCF	0.219	0.826
GDPP	2.281	0.023

Unit root tests, both first-generation (Pesaran, 2007) and second-generation (Maddala & Wu, 1999) are performed and presented in **Table (5)**.

Table 5: The Results of the Unit Root Test

Variable	**Test**	**Chi^2 or Z-statistics**		**Stationarity Condition**
		Intercept	**Trend**	
EMP	Maddala and Wu (1999)	3.440 (0.992)	10.528 (0.570)	I(1)
GII	Pesaran (2007)	-0.224 (0.411)	1.041 (0.851)	I(1)
EDUC	Pesaran (2007)	-0.700 (0.242)	-2.599 (0.005)	I(0)

LFPR	Maddala and Wu (1999)	4.635 (0.969)	18.826 (0.093)	I(1)
GCF	Pesaran (2007)	0.310 (0.622)	0.092 (0.5371)	I(1)
GDPP	Maddala and Wu (1999)	8.071 (0.780)	2.012 (0.999)	I(1)

Note: Probability values are shown in parentheses

Examining the results of Table 5, we cannot reject the null hypothesis of the nonstationary variable for GII, LFPR, GCF, EMP, and GDPP - which means they are integrated of order (1) variables. In contrast, we can reject the null hypothesis in the case of EDUC at the 5% level of significance. Thus, we can deduce that our variables are a mixture of I (1) and I (0) variables.

Finally, the co-integration relation among all the variables is examined using Pedroni's (1999) co-integration test which allows for examining co-integration in the case of dynamic heterogeneous data (Pedroni, 1999). The results show that we can reject the null hypothesis, which states that there is no co-integration, at the 5% level of significance as can be illustrated in **Table (6)**. Thus, a co-integrating relation is detected between the variables, therefore, regression using the level of variables can be used without taking differences and the long-run effect of all the independent variables on employment can be estimated and explained.

Table 6: The Results of the Pedroni Test of Co-Integration

Statistics	**Model 1**	**Model 2**
Modified Phillips–Perron	3.0683 (0.000)	3.6104 (0.000)
Phillips–Perron t	-6.9604 (0.000)	-2.1934 (0.014)
Augmented Dickey-Fuller t	-3.9259 (0.000)	-1.6773 (0.047)

Note: Probability values are shown in parentheses

Although NACS, Jordan, and Iran all share the same level of income between the lower middle and upper middle, they differ in their employment rates as we referred to before. Thus, we check for heteroscedasticity problem using modified Wald statistics for Group Wise heteroscedasticity (its variance differs across entities). The test results show that the errors suffer from heteroscedasticity (Greene, 2000). Moreover, we test for cross-dependence in the residuals using the Breusch-Pagan LM test of independence, which indicated also that residuals are correlated between countries as illustrated in

Table (7). So, we preferred to use a Feasible Generalized Least Square Model (FGLS) using an iterated method that repeats the model multiple times until it reaches the least desperate parameters providing the best estimates to deal with heteroscedasticity and cross dependence that the data suffers from.

Table 7: The Results of Heteroscedasticity and Cross Dependence Test

Test-Statistics	Model 1	Model 2
Breusch-Pagan LM test for cross dependence (**Chi^2**)	41.672 (0.0003)	29.725, (0.0130)
Modified Wald test for Group-Wise heteroscedasticity (**Chi^2**)	1491.51 (0.000)	112.93 (0.000)

Note: Probability values are shown in parentheses

The FGLS estimator is widely used in econometric models where cross-sectional co-variances are often addressed parametrically. The FGLS estimator has few advantages over other panel data approaches. The FGLS model fits cross-sectional time-series linear models and permits estimate in the presence of autocorrelation within panels, cross-sectional correlation, and/or heteroscedasticity across panels (Erik, 2010). As a result, no remedial or diagnostic testing is necessary to run the model. Second, the FGLS estimator is thought to be the most trustworthy in panel data when the time period exceeds the number of entities (T>N). This study's sample data is 10 years and for 6 nations (T>N), indicating that FGLS is a trustworthy approach. Therefore, the FGLS estimator can be considered an appropriate tool for empirical analysis.

6.4 Estimation Results

Using the FGLS technique to model the effect of innovation on employment in 6 countries, the following results are obtained and represented in **Table (8)**.

Table 8: The Results of the Econometric Model

Dependent variable: EMP	Model 1		Model 2	
	Coefficient	**t-statistics**	**Coefficient**	**t-statistics**
GII	0.139 (0.000)	136.480	0.134 (0.000)	77.22
EDUC	0.022 (0.000)	37.870	0.040 (0.000)	34.81
LFPR	1.008 (0.000)	556.46	0.781 (0.000)	264.17

GCF	0.005 (0.000)	6.15	NA	NA
GDPP	NA	NA	0.052 (0.000)	36.92
Constant	-12.331 (0.000)	-93.20	-4.244 (0.000)	-69.06
R-square	**0.8367**		**0.833**	

Note: Probability values are shown in parentheses

Note: the researcher used the option correlated in Stata 16 to deal with heteroscedasticity and cross dependence

All the variables are significant at the 1% level of significance, indicating that the model as a whole is very significant. 83% of the variation in employment can be explained by the variation of innovation, education, labor force, and gross capital formation jointly across countries over time. From an economic perspective, all the estimated coefficients are consistent with the economic theory and literature.

Innovation

As can be seen in Table (9), employment turns out to be positively linked with innovation. As the country`s GII score increases by 1 point, the employment rate increases by 0.139% of the population other variables being constant, which proves that innovation in the Mediterranean countries is a friendly environment. The labor-saving effect of innovation is concurrent with the classical compensation theory which states that the displacement effect of process innovation can be compensated through the new jobs created during the production of new machines needed to update the production process.

Moreover, process innovation increases the efficiency of the production process, decreasing the cost of production and consequently decreasing the good prices in the case of a competitive market or the fall in cost can be translated into further profits thus new investment and jobs are created. However, this effect is conditioned on the usage of new investment which has to be devoted to labor-intensive industries، not capital-intensive ones. Finally, product innovation leads to the emergence of completely new economic sectors like ICT and AI where new jobs can be created (Vivarelli, 2007).

Education

Regarding education, the coefficient of the number of primary students is positive and significant at the 1% level of significance. A 1% increase in enrolment in primary school tends to increase employment by 0.022% of the population, *ceteris paribus*. Some economists believe that the only way to survive in the labor market is to concentrate on talents, where humans have a comparative advantage over machines. In their book “The Second Machine

Age", Erik Brynjolfsson and Andrew McAfee argue that "there's never been a better time to be a worker with special skills or the right education because these people can use technology to create and capture value" (Brynjolfsson & McAfee, 2014, 11). These economists realize that the kind of work that robots can currently perform is restricted. Moreover, they discussed that inputs from both robots and people are complementary and that improvements in robot activities will most likely raise the economic worth of human work (Autor, 2015).

Labor Force

Regarding the labor force, we can find that growth in the labor force leads to more employment rates. A 1% increase in the labor force tends to increase employment by 1.001% of the population, *citrus paribus*. This can be explained by the fact that a rise in the labor force reflects more Labor supply, thus more jobs are created.

Gross capital formation

The study results illustrate that an increase of 1% in the capital accumulation ratio of GDP would imply an increase of 0**.**005% in the employment rate, *ceteris paribus*. This means that capital formation increases the demand for labor through its increase in production, and saves labor through process innovation embodied in the new machinery (Piva & Vivarelli, 2018). Moreover, Keynes (1937) had already proposed that investment expenditures are one of the main factors determining unemployment where the increase in capital accumulation is a reflection of an increase in investment, thus more jobs are created.

Economic growth

For robustness checks, the study used GDPP in model 2, instead of GCF in model 1 to guarantee that our results are reliable and not biased. The results of the second model, as can be seen in Table (9), are all consistent with what was found in the first model. The coefficients of all the other variables are almost similar across the two models despite including GDPP instead of GCF.

The study includes country-level GDPP to control for the state of the business cycle and the country's level of economic development to make sure it does not bias innovation variables and how that may affect their ability to adapt and develop technological innovations. The higher the country's income, the higher its technological frontier curve and therefore the greater the likelihood of important technical innovations. More specifically, a 1% increase in the capital accumulation ratio of GDP would imply an increase of 0**.**052% in the employment rate, *ceteris paribus*.

7. Conclusions and Policy Implications

People have frequently expressed concern about the future of work as a result of technological advancement. With the emerging threat of AI, their worries increased. To provide readers with a more complete view of the topic, this study examined the present relationship between innovation and employment in the Mediterranean countries from 2011 to 2020, as there has been insufficient research into this field applied to the region.

The research found that the displacement effect is less than the productivity effect, implying that innovation is not displacing workers. However, workers should begin preparing for the prospect that innovation is rapidly advancing after the fourth industrial revolution.

The study moreover inferred, in general, that innovation, education, labor force, capital formation, and economic growth have positive effects on employment in the countries under the study during the study period (2011-2020). We can also deduce that the political environment, the regulatory environment, the business environment, the financial sector, and the collaboration between innovation stakeholders are among the main weaknesses of the national innovation system in Mediterranean countries.

7.1 Recommendations

- Improve educational programs and create successful active labor market policies, especially for the young. North African governments must deal with the issue of skills mismatch by developing the education system, reforming the curriculum to be dependent on critical skills, not memorization, inculcating creative and critical thinking, and increasing competency in science, technology, engineering, and mathematics, investing in teacher training and facilities, increasing business contribution in curricula design and delivery and increasing investment in career guidance. Short-term investments in public employment services and active labor-market policies are moreover required to facilitate the effective transition of youth to the labor market
- each university's primary purpose should be to translate research into commercial items that can be sold/licensed or spun off into a company.
- Policymakers must address structural barriers to strengthening the business and regulatory environments and financial sector and modernize them to raise the private sector's potential for job creation.

- All of this is likely to occur when the internal intellectual property policy is written, updated, and distributed to students and teachers. Furthermore, various actions, such as curriculum changes and the introduction of entrepreneurial extracurricular activities, should take place to build and cultivate a culture of innovation inside institutions.
- Furthermore, in most nations, bankruptcy rules are in their infancy or are even criminalized. Acceptance of failure is required for a thriving innovation environment, as is the speed at closing down a failing enterprise. Arab governments may assist accelerate the growth and impact of innovative technology enterprises by upgrading regulatory frameworks to match twenty-first-century economic realities.
- To provide further incentives for private-sector innovation, with an emphasis on more labor-augmented manufacturing technology. This will supplement utilized capital while moreover advancing total factor productivity.
- R & D investment should be increased to keep up with global trends. This will enhance knowledge output, new product innovation, market expansion, and employment creation. Innovations moreover boost capital and labor productivity and promote manufacturing competitiveness. Simultaneously, authorities should devise effective and equitable income redistribution measures to close the gap between capital owners and employees. Moreover, governments may consider giving financial assistance to creative Digital entrepreneurs.

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