

Do ICTs Reduce Youth Unemployment in MENA Countries?

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This paper examines the impact of Information and Communication Technologies (ICTs) on youth unemployment in MENA countries. The study employs a dynamic panel data for a sample of 17 countries, over the period 1995-2012. We investigate the effect of ICTs on total, male and female youth unemployment. The empirical results show that fixed telephones and internet have a negative and significant effect on youth unemployment, on both aggregate and gendered levels. The results also indicate that for both aggregate and the gendered levels of youth unemployment in the MENA region, the impact of mobile phones is found to be negative but it is not significant. The paper ends with some recommendations that aim to improve the employability of young workers in MENA countries, benefiting from the diffusion of ICT facilities in the region.

Keywords: ICTs, Youth unemployment, MENA countries

JEL Classification: C23, J21, J23.

1. Introduction

The effect of Information and Communication Technologies (ICTs)² on unemployment has been an interesting topic that raised considerable debate in the literature. A huge body of empirical studies point out that ICT innovations enhance productivity and efficiency, provide access to new markets and services, create job opportunities, generate new activities, and in turn improve employment (Smolny (1998) and Vivarelli and Pianta (2000)). On the other hand, a number of researchers

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² ICT refers to any activity involves gathering, processing, storing and presenting information. While the common use of ICTs tends to refer to the modern technologies like mobile phone and internet, the term ICT is also include the more traditional communication media such as radio and television.

argued that ICTs lead to jobs loss and increases in the unemployment rates (e.g. Brouwer et al., 1993; Machin et al., 1991).

In the last two decades, MENA countries have experienced an intensive use of technologies and communication equipments, such as computers and mobile phones. The recent statistics also show that MENA region has one of the highest rates of using ICTs in the world (ITU World Telecommunication/ICT Indicators database, 2014). For example, the ratio of mobile cellular subscriptions is more than 100 percent in MENA countries, implying that each person has more than one mobile phone. In addition, MENA embodies a large number of internet users among other regions.

On the other hand, the MENA region has a large number of young people, which accounts for more than 40% of the total population. Although young population could be a potential demographic asset for the region, youth employment is a critical development challenge that faces all the MENA countries. Indeed, among the major regions of the world, MENA countries hold the highest rate of youth unemployment. According to International Labor Organization's (ILO) statistics of 2013, the youth unemployment rate in MENA region was about 24%, which is approximately twice the global average. In the context of such 'youth bulge' (the increase in the proportion of 15-to-24-year-olds in the total population) in the MENA countries, ICT diffusion would be useful to expand the production base and to provide more job opportunities for youth in the region. In addition, policies that motivate utilization of ICTs for the sake of promoting economic growth and employability will be crucial.

Moreover, gender disparity in labor markets and education is a dominant phenomenon in MENA countries. Thus, understanding the gender-specific impact of ICT would be useful. Therefore, beside the aggregate effect of ICT, this study investigates whether ICT reduces female versus male youth's unemployment rates. Furthermore, understanding the gender-differentiated youth unemployment impacts of ICTs would help in guiding effective strategy that promotes gender equality.

Against this background, this paper contributes to the ongoing literature on ICT and youth unemployment in three main ways. First, the paper

will contribute to the existing literature; as to the best of my knowledge, there are no empirical studies on the impact of ICTs on youth unemployment in MENA countries. Second, it investigates the impact of ICTs on both aggregate and gendered levels of youth unemployment. Finally, the paper highlights the effect of some economic, demographic, institutional and natural resources variables on youth unemployment in MENA countries.

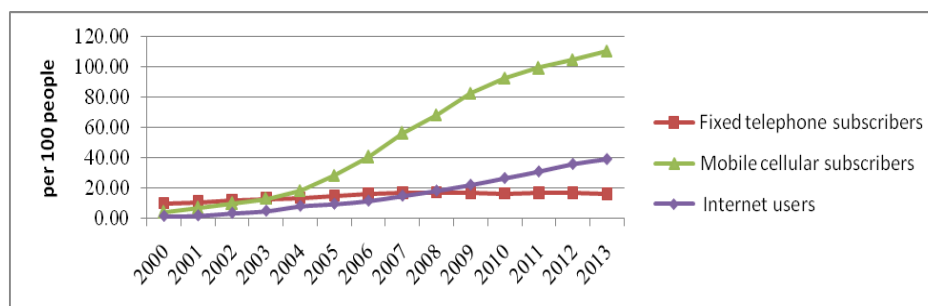
The remainder of this paper is organized as follows. The next section outlines some stylized facts about ICT development and youth unemployment in MENA countries. Section three reviews the theoretical and empirical literature on the impact of ICTs on employment. Section four outlines methodology and data used in the study. While section five presents the empirical results, section six concludes with some policy implications.

2. Evolution of ICT and Youth Unemployment in MENA Countries: Some Stylized Facts

2.1. The trend of ICTs in MENA

Before analyzing the impact of ICT penetration on youth unemployment in MENA countries, it is useful to highlight the situation of ICTs in the MENA region. In the past twenty years, MENA countries have witnessed a tremendous diffusion of ICTs in all aspects of life. Figure 1 shows the trend of ICT facilities during the period 2000-2013.

Figure 1: Trend of ICTs in MENA region

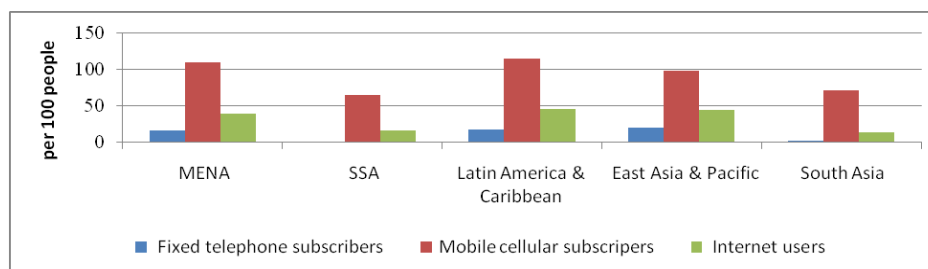


Source: ITU World Telecommunication/ICT Indicators database

Figure 1 indicates that the number of mobile phone subscribers has increased remarkably, owing to the global communication revolution. As illustrates in the figure, the number of mobile cellular subscribers in the MENA countries has augmented from about six subscribers in 2000 to more than 100 in 2013. The number of internet users also has increased from about two users in 2000 to 16 users per 100 people in 2013. Regarding the fixed telephone lines, the figure reveals that the number of telephone subscribers has remained constant over such period and fluctuated around the average of 15 lines per 100 people.

According to ITU World Communication Statistics (2014), MENA countries reported a high rate of using ICTs facilities like mobile phones and internet, in comparison to other regions of the world. Figure 2 shows the distribution of fixed telephone, mobile subscriptions and internet users among the developing regions. As indicated in Figure 2, MENA region reported the second largest number of mobile subscribers, after Latin America and Caribbean. This could be attributed to the huge flow of foreign direct investment into MENA countries, which is mainly directed to communication and services sectors. Regarding the number of internet users, the figure reveals that MENA countries exhibit high rate of internet users, estimated to be about 40 users in 2013. Similar to other developing countries, it can be indicated that the number of fixed telephone in MENA countries is low.

Figure 2: Fixed telephone, Mobile Subscriptions and Internet Users per 100 people (2013)

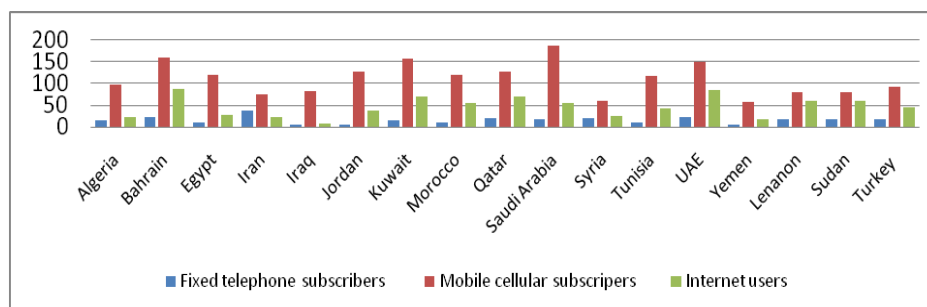


Source: ITU World Telecommunication/ICT Indicators database

Regarding the distribution of ICT services in the MENA region, Figure 3 shows that there is a variation in the usage of ICTs from one country to another. As the Figure illustrates, the Gulf Cooperation countries

(GCC) have the highest rate of using mobile, fixed phones and internet services in the region. For example in Bahrain, Kuwait and Saudi Arabia, the number of mobile cellular subscribers is more than 150 per 100 people. The rate of using internet also is higher in GCC compared to non GCC. For some non-Gulf states like Egypt and Jordan, the usage rate of mobile phones is also high. However, the number of fixed telephone and internet users in non GCC is relatively low. Therefore, this implies that GCC undergo a huge ICTs usage in the last decade.

Figure 3: Fixed telephone, Mobile Subscriptions and Internet in MENA countries (2012)



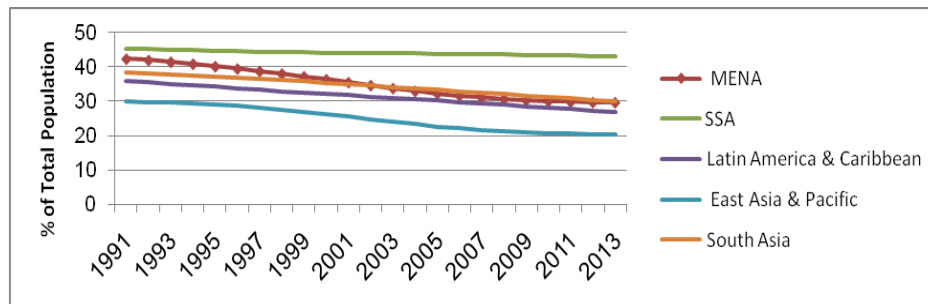
2.2. Youth Unemployment in the MENA: An Overview

During the past 20 years, MENA countries have undergone remarkable demographic transformations, in terms of population growth, fertility rate, migration as well as the age structure of the population (Ebaidalla, 2014). All these have had a significant impact on labor markets and employment in the region. Recent statistics show that MENA countries suffer from high and persistent unemployment rates (United Nations, World Population Prospects, 2010). Official estimates point out that about 12 million workers, or around 11.5% percent of the MENA labor force, were unemployed in 2013 (World Bank, 2014). Youth unemployment is also very high, estimated at 24% in 2013 (ILO, 2014). This chronic problem of unemployment may be responsible for the unfavorable economic performance and low development outcomes as well as political instability in MENA.

Recent estimates of ILO (2014) indicate that MENA countries host the fastest-growing and most youthful population in the world. It indicates that more than 20 percent of MENA's population are between the ages

of 15 and 24 and over 40 percent under 15 (World Bank, 2013). Thus, the size of the youth population represents a potential human resource for the present and future development of the region. The high youth rate makes the situation of unemployment in general even more critical and difficult as such a population structure has prompted the need to restructure the labor market in order to create more jobs and is expected to pose more pressure in the future, as demand for jobs in MENA countries will continue to rise (Ebaidalla, 2014). Figure 4 below presents data on the population under 15 in the developing regions.

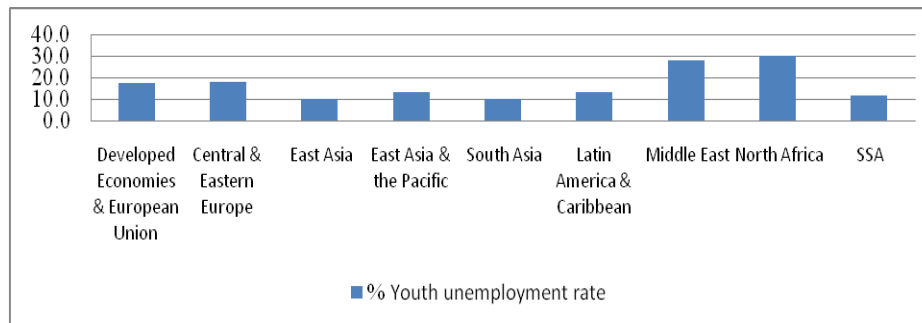
Figure 4: Young People (under 15 year) as % of Total Population (1991-2013)



Source: World Bank's Development Indicators

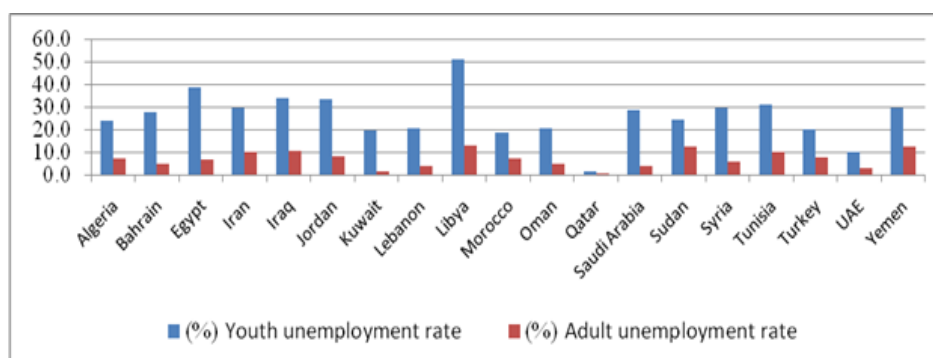
Figure 4 shows that MENA countries hold a high rate of youth under 15 year, after Sub-Saharan Africa and South Asia. The figure also indicates that for most developing regions of the World, the trend of youth population has declined between 1980 and 2010. Even for MENA region the trend has decreased remarkably in last decade. This implies a persistence of the problem of youth unemployment in the next decades. However, the high youth population ratio in MENA region indicates a high share of youth in the total labor force, which causes MENA to face the highest rate of youth unemployment in the world.

Figure 5 shows the situation of youth unemployment in the most developing regions. As indicated, the rate of youth unemployment is high in all developing regions. The Figure also indicates that Middle East and North Africa (i.e. MENA) have the highest rate of youth unemployment, exceeding the rates in the populous regions like East and South Asia.

Figure 5: Youth Unemployment Rate by Region- Latest Data

Source: ILO (KILM)

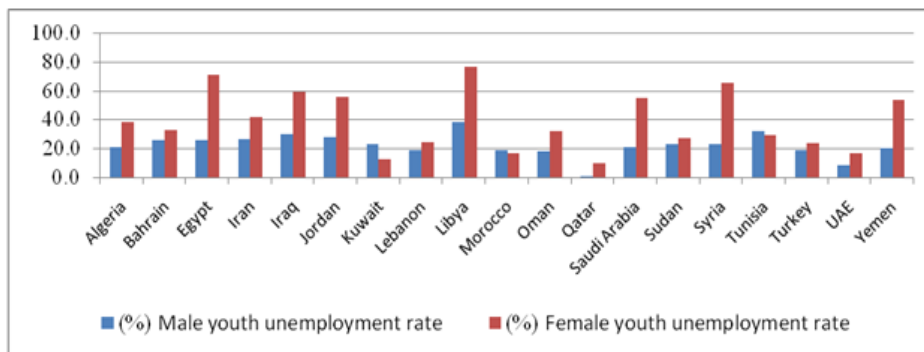
Regarding the distribution of youth unemployment in the MENA region, the statistics show that there is a variation in the level of youth unemployment from one country to another. As indicated in Figure 6, the rate of youth unemployment varies from 7% in Qatar to about 51% in Libya. Moreover, the rate of youth unemployment is much higher than the adult unemployment rate, in most of the MENA countries is double, in some countries like Bahrain, Egypt and Jordan even more than triple. In fact, in most of the MENA countries the ratio of youth to adult unemployment is considered among the highest rates in the world. This situation has attributed to many factors including the high unemployment ratio in the youth cohort compared to the total population besides the weak absorptive capacity of the MENA economies.

Figure 6: Youth and Adult Unemployment in MENA- Latest Data

Source: Adapted from KILM ILO database

In accordance with the distribution of youth unemployment according to gender in the MENA region, Figure 7 below indicates that females suffer over-proportionally as reflected by the high ratio of male to female youth unemployment. The figure also shows that more than 60% of the female labor force aged 15-24 is unemployed in Egypt, Libya and Syria. Also about half of the youth female labor forces are without jobs in Iraq, Jordan, Saudi Arabia and the Yemen. The high rate of female youth unemployment in the MENA countries is attributed to low skills and experience of women. In addition, MENA countries are dominated by some norms and traditions, which prevent women from work, besides early marriage and low education attainment.

Figure 7: Youth Unemployment in the MENA Region by Gender



Source: Adapted from KILM ILO database.

Given the fact that MENA countries are experiencing a huge boom of ICT revolution with sizable numbers of young people, it is necessary to understand the effect of ICT facilities on youth unemployment. This would guide an appropriate strategy that helps in harnessing ICT revolution to improve the employability of young people in MENA countries

3. ICT Innovations and Employment: A Literature Review

A huge body of empirical studies has emerged in the last decades to investigate the effect of ICT on economic performance in both developing and developed countries. However, most of the research has focused on the effect of ICTs on economic growth and development, but the unemployment impact of ICT has received little attention. In this

section, we briefly review the theoretical and empirical studies about the influence of ICT innovations on unemployment.

In the literature, there is a long debate on the effects of ICTs and innovations on employment (see Vivarelli (2012) and Vivarelli and Pianta (2000)). Some empirical studies reveal a positive effect of ICT on employment (e.g., Entorf and Pohlmeier, 1990; Smolny, 1998) while others indicate that ICTs have a negative effect on employment (e.g.s Brouwer et al., 1993; Machin et al., 1991).

The view of the positive impact of ICT innovations on unemployment is based on the compensation theory developed by Karl Marx (1961). This theory postulates a number of market compensation mechanisms that are triggered by technological change itself and which can counterbalance the negative effects that emerge from labor-saving impact of technological innovations (Vivarelli, 1995 and 2007). First, innovations may create additional employment in the capital goods sector. That is, while some technologies displace workers in the labor intensive industries, others create new jobs in the capital sectors where the new machines are produced (Vivarelli, 2007). Second, the compensation impact may channel via a reduction in prices, meaning that technologies lead to a decrease in the unit costs of production; in turn, decreasing prices create a new demand for products and also additional production and employment. Third, new technologies provide opportunities for unemployed workers via creating new investments. That is, in a competitive world, it is observed that during the gap between the decrease in costs due to technological progress and the consequent fall in prices, extra profits may be achieved by the innovative entrepreneurs. These profits are invested and new production and new jobs are thus created. Fourth, the direct effect of labor-saving technologies may be compensated within the labor market through a decrease in wages. According to the neoclassical framework, with free competition and full substitutability between labor and capital, a decrease in wages leads to an increase in the demand for labor. Finally, the loss of jobs due to the process of new technologies may be compensated for by new products. This indicates that technical change and ICT innovation can create new products that develop new economic branches and create additional jobs (Vivarelli, 2007).

Based on the above arguments, many empirical studies confirmed the compensation theory, and argued that technology exerts a positive impact on employment, since it allows for the development of entirely new goods or increases the productivity of existing ones (e.g., Freeman et al,1982; Freeman and Soete, 1987 and 1994; Vivarelli and Pianta, 2000). For example, Whitley and Wilson (1982) used a multi -sectoral dynamic model to investigate the employment impact of technological change based on the compensation framework. They estimated the employment levels in 1990 for most sectors of the British economy and found that technology innovation promotes the employment level and compensates the initial job losses due to the adoption of innovation. Among the compensatory forces, the mechanism via a decrease in prices is found to be the more effective, accounting for more than 50% of compensation of the initial labor displacement.

In the same vein, Meyer-Krahmer (1992) examined the employment effect of technology adopted for a sample of 51 German sectors covering the entire economy in the 1980s. The author measured technology innovation by research and development (R&D) spending and purchase of R&D knowledge. His results support the view that technological progress implies overall labor-saving effects; yet important sectoral differences emerge: while purchased R&D involves job losses in industries like textile, clothing and electronic equipment, in house R&D stimulates the demand for labor in sectors like chemicals and computer industries.

Simonetti et al., (2000) employed a simultaneous equations macroeconomic model to investigate the direct labor-saving effect of innovation processes. They applied different compensation mechanisms to examine the job-creating impact of product innovation. Using data for four countries, namely the US, Italy, France and Japan, over the period 1965-1993, the authors pointed out that the more effective compensation mechanisms were "via decrease in prices" and that "via increase in incomes," especially in European countries till the mid-1980s.

Nevertheless, the theory of compensation has been criticized in explaining the counterbalancing of initial labor-saving effect of process innovation. Most of the critiques emphasized the inefficient role of the main mechanisms of compensation. For instance, the mechanism "via decrease in prices" does not hold in the reality since decreasing prices

reduce demand and more than counterbalance the initial decrease in the aggregate purchasing power. Also, this mechanism relies on Say's law and does not take into account that demand constraints might occur. In addition, the effectiveness of the mechanism "via decrease in prices" depends on the hypothesis of perfect competition; thus, if an oligopolistic regime is dominant, the whole compensation would not hold (Viverelli, 2012). Second, the compensation mechanism "via new investments" is based on Say's law, which assumes that the accumulated profits due to innovation are entirely and immediately translated into additional investments. However, according to Keynesian views about Say's law, there is doubt about the full effectiveness of this compensation mechanism. Moreover, the intrinsic nature of the new investments does matter; if these are capital-intensive, compensation can only be partial. Finally, the mechanism "via decrease in wages" contrasts with the Keynesian theory of effective demand. On the one hand, a decrease in wages can induce firms to hire additional workers, but - on the other hand - the decreased aggregate demand lower employers' business expectations and so they tend to hire less workers (Vivarelli, 2007).

Empirically, a few studies have supported the evidence of a negative relationship between ICT innovations and employment. For example, Brouwer et al. (1993) examined the influence of innovation on growth rates of employment in 859 Dutch manufacturing firms during the period 1983–1988. They found that employing advanced innovation has a slight negative impact on employment. Likewise, Machin et al. (1991) using the 1984 British Workplace Industrial Relations Survey, find a negative relationship between ICTs adoption and employment. Moreover, Zimmermann (1991) found similar results using microdata from 16 German industries, concluding that technological change was one of the determinants of the employment decrease in Germany during the 1980s.

The above discussion has made clear that the literature on the impact of technology and innovations on employment is intensive and diverse. Some empirical evidence confirms the view that technologies and innovations exert a positive impact on employment. On the other hand, a number of empirical studies points out that ICTs have negative effect on employment. These conflicting results could be attributed to the difference in measurements of ICT innovations, model specifications

and the type of data used. To overcome these limitations, this paper has many contributions to existing literature compared to previous studies. First, unlike the previous studies that used a single indicator for ICT diffusion, this paper uses three measures of modern ICTs, which are the numbers of fixed telephone, mobile and internet users. Second, a wide range of empirical studies uses sectoral and micro data, this study uses cross-country data. Third, most of empirical studies have focused on the advanced countries and there is a little research attention given to this issue in the developing regions, particularly MENA countries. Fourth, to overcome the problem of potential endogeneity that may arise due to correlation between the explanatory variables and error term, the study uses the GMM dynamic panel data. Finally, the study examines the gender specific impact of ICTs on youth unemployment, as male and female are differentiated obviously in the MENA region.

4. Methodology and Data

4.1. Model Specification

To investigate the effect of ICTs diffusion on youth unemployment in MENA countries, the study employs a panel data method. The specification of unemployment model used in our analysis will follow the previous empirical studies on youth unemployment such as, Choudhry et al. (2012), Anyanwu (2013) and (2014). However, our model is extended by ICT variables to capture the effect of ICT on youth unemployment. Thus, the model to be employed in the analysis could be specified as follows:

$$YU_{it} = \beta_0 + \beta_1 YU_{i,t-1} + \beta_2 X_{it} + \beta_3 ICT_{it} + \mu_{it} \quad (1)$$

$$\mu_{it} = \eta_i + \lambda_t + \varepsilon_{it} \quad (2)$$

Where YU_{it} is the youth unemployment in country i at time t . $YU_{i,t-1}$ is the lagged value of youth unemployment, X_{it} is the set of the control variables, and ICT_{it} is the set of ICT variables. Finally, μ_{it} is the general disturbance term which includes, η_i is an unobserved country-specific effect, λ_t is a time-specific effect, and ε_{it} is the error term.

The control variables involve all factors that are hypothesized to influence the youth unemployment, such as economic, demographic and

institutional factors. Therefore, the control variables include: per capita GDP, inflation rate, domestic investment, foreign direct investment (FDI), trade openness, education level and fertility rate. We add also the bureaucracy quality to capture the institutional quality effect, since efficient institutions are conducive to labor productivity and growth (Acemoglu et al., 2004). In addition, to capture the effect of oil exports on youth unemployment, the paper uses oil export variable, which measured as a share of oil exports to total exports. Finally, the ICT variables include the fixed telephone subscriptions, mobile cellular subscriptions and number of internet users. These variables reflect the ICT development. The definition and sources of variables used in the study are presented in Appendix I. In addition to the full sample estimation, we estimate the model of equation (1) for two sub-samples: female and male youth unemployment.

According to the theoretical and empirical literature, the impact of per capita GDP is expected to be negative, as an increase in country's income will reduce the employment level. The inflation rate would be negative, since there is negative association between the unemployment rate and inflation, as suggested by Philips (1958). The impact of domestic and foreign investment is expected to be negative, as investment would create more jobs for young people. The coefficients of trade openness and education are expected to be negative. The effect of fertility rate also is expected to be positive, because an increase in the fertility level raises the number of young people, and hence their unemployment rates. The bureaucracy quality coefficient is expected to be negative, since countries with bad institutions tend to suffer from unfavorable labor conditions and, hence, high rate of youth unemployment. This is also supported by several studies on economic growth, which assume that good institutions are necessary for labor and human capital progress (e.g., Acemoglu et al., 2004). Finally, the expected signs of ICT variables are inconclusive, as there is no consensus in the literature regarding the impact of ICT innovations on unemployment.

4.2. Estimation Approach

To examine the effect of ICTs on youth unemployment in MENA countries, the paper employs a dynamic panel model based on the Generalized Method of Moments (GMM), developed by Arellano and Bond (1991). The dynamic method of GMM has many advantages over the traditional panel data methods such as, fixed effects and random effects models. First, the GMM model considers the time series dimension of the data and thus it accounts for the short run effect. Second, it includes the non-observable country specifics. Finally, GMM model treats all the explanatory variables as endogenous variables, hence it overcome the problem of endogeneity that may result from the correlation between the error term and the lagged dependent variables.

Empirically, there are two types of GMM models that have been commonly used in estimating panel regressions: the first-difference GMM estimator, developed by Arellano and Bond (1991) and the system GMM estimator which developed by Arellano and Bover (1995) and Blundell and Bond (1998). However, the recent literature has shown that there are some possible statistical problems associated with the adoption of first-difference GMM estimator (Bond et al., 2001). According to Blundell and Bond (1998), the System GMM estimators will be derived from the estimation of a system of two simultaneous equations: one in levels (with lagged first differences as instruments) and the other in first differences (with lagged levels as instruments). However, one possible problem that might be arising when adopting the GMM system is the invalidity of the lagged differences of the explanatory variables as instruments. Therefore, we examine the validity of the instruments by two tests: the Sargan test of over-identifying restrictions and the Arellano and Bond (AB) test of serial correlation. Furthermore, to justify the adoption of the GMM method the study tests the endogeneity problem, applying Durbin (1954), Wu (1974) and Hausman (1978) endogeneity tests.

4.3. Data Sources

The study used annual data for a sample of 17 MENA countries over the period 1995-2012. The data on employment and economic variables are gathered from several sources including International Labor Organization (ILO), the World Bank's development indicators and IMF Financial Statistics (IFS). Data on institutional quality (bureaucracy

quality) is collected from the International Country Risk Guide (ICRG) statistics³. Finally, data on mobile subscriptions and internet users are obtained from ITU World Telecommunication/ICT Indicators database.

The summary statistics of the variables used in the study are presented in Appendix II. It is clear that the total, male and female youth unemployment rate varies across countries. The result of descriptive statistics also shows that female youth unemployment is high and varies greatly in comparison to total and male unemployment. The standard deviation of per capita GDP is relatively high, implying high income inequality across MENA countries. Interestingly, the standard deviation of mobile subscriptions is high, indicating a disparity in using mobile phones in the MENA region.

5. Empirical Results and Discussion

The estimation results of equation (1) using the GMM method for total, male and female youth unemployment are presented through Table 1 to 3. For the purpose of robustness and sensitivity analysis, the youth unemployment equation is estimated in the context of four model specifications, reflecting all proxies of ICT as described in equation (1).

First, the results of GMM estimation for the total youth unemployment are provided in Table 1 below.

³ The International Country Risk Guide (ICRG)' political stability indicators comprises 12 institutional measures - government stability, socioeconomic conditions, investment profile, internal conflict, external conflict, corruption, military in politics, religious tensions, law and order, ethnic tensions, democratic accountability, and bureaucracy quality.

Table 1: GMM-System Estimation: Total Youth Unemployment

Dependent Variable: Total Youth Unemployment				
Variable	Model 1	Model 2	Model 3	Model 4
Constant	7.675** (2.54)	8.632** (2.145)	7.911** (2.345)	9.098* (1.98)
Youth unemployment (-1)	0.543*** (12.23)	0.345*** (15.20)	0.428*** (13.50)	0.324*** (10.19)
Real per capita GDP	-0.108** (-2.43)	-0.089** (-2.76)	-0.054* (-1.79)	-0.0976** (-2.60)
Inflation	-0.019 (-1.21)	-0.022 (-1.45)	-0.031 (-1.51)	-0.056* (-1.71)
Domestic investment	-0.176*** (-3.87)	-0.201*** (-3.67)	-0.212*** (-3.65)	-0.256*** (-3.87)
FDI	-0.071 (-0.91)	-0.092 (-0.76)	-0.043 (-0.47)	-0.025 (-0.79)
Trade openness	0.012 (0.23)	0.043 (1.34)	0.076 (1.20)	0.070 (0.89)
Education	0.764** (2.76)	0.645** (2.06)	0.532** (2.05)	0.790** (2.24)
Fertility	-0.053 (-0.71)	0.067 (0.79)	0.081 (0.97)	-0.076 (-1.08)
Bureaucracy	-0.253 (-0.86)	-0.119 (-0.65)	-0.225 (-0.89)	-0.187 (-1.05)
oil export	0.256 (1.23)	0.167 (1.42)	0.086 (1.25)	0.054 (1.11)
Fixed telephone	-0.127* (-1.89)			-0.123** (-2.28)
Mobile subscriptions		-0.032 (-0.89)		-0.076 (-0.53)
Internet users			-0.087* (-1.79)	-0.054** (-2.43)
Observations	306	306	306	306
Sargan Over-identification Test	2.426 (0.765)	2.313 (0.801)	1.952 (0.976)	2.782 (0.587)
Durbin–Wu–Hausman Test	0.987 (0.042)	1.231 (0.024)	1.073 (0.030)	1.065 (0.031)
AB- test for AR(1)	-4.318 (0.000)	-5.120 (0.000)	-4.326 (0.000)	-6.324 (0.000)
AB- test for AR(2)	1.098 (0.598)	1.237 (0.512)	1.301 (0.436)	1.563 (0.378)

Notes: Figures in Parentheses are t-statistics

***, ** and * denotes significance at the 1, 5 and 10 percent level

The estimation is two steps System GMM, instruments used in the analysis are the first lagged difference and the second lagged level of dependent and explanatory variables.

Durbin–Wu–Hausman and Sargan tests are asymptotically chi-sq distributed, with p values reported in brackets.

The results show that the Sargan and Arellano-Bond tests indicate that all the regressions do not suffer from any problem with the instruments, and there are no second order serial correlation problems in the estimated models. The Durbin–Wu–Hausman test statistic also rejects the null hypothesis that all regressors are exogenous at any reasonable degree of confidence. Thus, we conclude that there is an endogeneity problem among the variables and this constitutes a suitable justification for using the GMM method.

The results of GMM revealed that all the variables carry their expected signs, except trade openness, education and fertility. The results also show that most of estimated coefficients are statistically significant. The results show that the per capita GDP has a negative and significant impact on youth unemployment, implying that improvement of economic situation reduces youth unemployment in the MENA countries. This result supports the Okun's Law, which suggests a positive relationship between income and employment. This finding also confirms the fact that high income countries in MENA like Gulf States have low rates of youth unemployment in the region. Contradicting with the Philips Curve' hypothesis, the coefficient of inflation is found to be negative but it is not significant. In addition, the results reveal that the coefficient of domestic investment is negative and significant, implying that a country with high rate of investment tends to suffer from low rate of youth unemployment. This finding is in line with many empirical studies (e.g. Anyanwu, 2014 and Choudhry et al., 2012).

Unexpectedly, the effect of foreign direct investment is found to negative but it is not significant, suggesting that FDI has no important role in reducing youth unemployment in MENA countries. This finding supports the fact that most of FDI flow into MENA is a resource seeking, directed toward extractive sector like oil industry which employs a few number of worker. The impact of trade openness is positive but it is not statistically significant, implying that the trade openness has no significant effect on youth unemployment. Therefore, we conclude that economic environment plays a crucial role in explaining youth unemployment in the MENA countries. This also implies that the demand side of labor market has an important influence on youth unemployment in MENA region.

Contradicting to our prior expectations, the coefficient of education is found to be positive and statistically significant, suggesting a positive relationship between education level and youth unemployment. This result

suggests that there is a mismatch between education and demand for labor in MENA region. This result could be attributed to the high education attainment in MENA countries in comparison to other regions. Moreover, the results of the GMM model indicate that the coefficient of fertility is negative but it is not significant. Furthermore, the results reveal that the impact of bureaucracy quality is found to be negative⁴. Finally, the coefficient of oil exports is negative but it is not significant.

Regarding the impact of ICT on youth unemployment, the coefficients of fixed telephone subscriptions in column 2 and 5 are negative and significant as expected, implying that the usage of telephone lines discourage youth unemployment in the MENA countries. In addition, the coefficients of mobile phone subscriptions in column 3 and 5 are negative but it is not statistically significant. Finally, the coefficients of internet in column 4 and 5 are found to be negative and significant, confirming our expectations. These results suggest that the boom of ICT in MENA countries during the last decade has played a significant role in reducing youth unemployment. Indeed, ICT offers several jobs for youth, including telephones maintenance and distribution as well as internet services. In addition, internet service facilitates exchange of information in the labor market, hence matching between demand and supply of labor, and eventually reduces youth unemployment.

Second, the results of the male youth unemployment model are presented in Table 2. Similar to the analysis of total youth unemployment, the results in Table 2 indicate that the Sargan and Arellano-Bond tests reveal that all the regression models do not suffer from any problem with the instruments and second order serial correlation. The result of Durbin–Wu–Hausman statistic also rejects the null hypothesis that all regressors are exogenous at any reasonable degree of confidence. Like the analysis of the total youth model, the results of male youth in Table 2 show that most of control variables carry their expected signs. Unlike the total youth analysis, the results of male youth indicate that the coefficients of foreign direct investment (FDI) are significant in the most estimated models, implying that FDI in MENA provide jobs opportunity for young male.

Interestingly, the results indicate that all ICT variables are negative and statistically significant, except, mobile phone, confirming the results of the

⁴ Bureaucracy quality index is scaled from zero to six. Higher scores indicate more bureaucracy quality.

total youth unemployment. These findings suggest that ICT diffusion has a negative impact on youth male unemployment in the MENA countries.

Table 2: GMM-System Estimation: Male Youth Unemployment

Dependent Variable: Male Youth Unemployment				
Variable	Model 1	Model 2	Model 3	Model 4
Constant	10.256** (2.54)	9.331** (2.02)	10.022* (1.86)	11.123* (1.91)
Youth unemployment (-1)	0.331*** (12.02)	0.418*** (14.09)	0.278*** (13.89)	0.281*** (14.18)
Real per capita GDP	-0.089** (-2.89)	-0.065*** (-3.23)	-0.134*** (-3.56)	-0.087** (-2.20)
Inflation	-0.024 (-0.98)	-0.034 (-1.27)	-0.028 (-0.79)	-0.018 (-0.79)
Domestic investment	-0.089*** (-3.20)	-0.097*** (-3.31)	-0.077*** (-3.23)	-0.080*** (-3.10)
FDI	-0.001 (-1.24)	-0.008* (-1.67)	-0.005* (-1.79)	-0.013** (-2.30)
Trade openness	0.026 (0.16)	0.037 (0.22)	0.027 (0.15)	0.028 (0.16)
Education	0.312* (1.89)	0.319* (1.93)	0.271 (1.04)	0.337* (1.84)
Fertility	-0.438 (-1.25)	-0.345 (-1.08)	-0.219 (-1.45)	-0.326 (-1.29)
Bureaucracy	0.087 (0.73)	0.123 (0.87)	0.189 (0.63)	0.183 (1.04)
oil exports	0.067 (1.08)	0.098 (0.89)	0.068 (0.65)	0.099 (1.11)
Fixed telephone	-0.534** (-2.88)			-0.634** (-2.89)
Mobile subscriptions		-0.029 (-0.92)		-0.075 (-1.14)
Internet users			-0.136** (2.67)	-0.165** (2.03)
Observations	306	306	306	306
Sargan Over-identification Test	3.871 (0.403)	3.078 (0.578)	3.230 (0.512)	3.241 (0.500)
Durbin–Wu–Hausman Test	1.023 (0.053)	1.123 (0.048)	0.987 (0.067)	1.234 (0.039)
AB- test for AR(1)	4.234 (0.000)	5.234 (0.000)	5.112 (0.000)	4.672 (0.000)
AB- test for AR(2)	0.850 (0.512)	0.834 (0.532)	0.912 (0.467)	0.756 (0.598)

Notes: Figures in Parentheses are t-statistics

***, ** and * denotes significance at the 1, 5 and 10 percent level

The estimation is two steps System GMM, instruments used in the analysis are the first lagged difference and the second lagged level of dependent and explanatory variables.

Durbin–Wu–Hausman and Sargan tests are asymptotically chi-sq distributed, with p values reported in brackets.

Finally, the estimation results of equation 1 for female youth unemployment are presented in Table 3.

Table 3: GMM-System Estimation: Female Youth Unemployment

Dependent Variable: Female Youth Unemployment				
Variable	Model 1	Model 2	Model 3	Model 4
Constant	15.435*** (2.01)	9.123** (2.20)	10.431 (1.26)	13.089** (2.29)
Youth unemployment (-1)	0.342*** (10.43)	0.456*** (14.29)	0.521*** (14.15)	0.409*** (12.59)
Real per capita GDP	-0.034*** (-3.45)	-0.043*** (-3.12)	-0.089*** (-3.76)	-0.065*** (-3.18)
Inflation	-0.045 (-0.91)	-0.076 (-0.98)	-0.112 (-1.09)	-0.0765 (-1.31)
Domestic investment	-0.067** (-2.12)	-0.081** (-2.23)	-0.075** (-2.87)	-0.063** (-2.18)
FDI	0.013 (0.65)	-0.076 (-0.98)	-0.043 (-0.78)	-0.034 (-0.91)
Trade openness	-0.132 (-1.10)	-0.097 (-1.07)	-0.078 (-1.14)	-0.045 (-1.05)
Education	0.543 (1.21)	0.321 (1.12)	0.345 (1.05)	0.731 (1.21)
Fertility	-0.231 (-0.97)	-0.543 (-0.87)	-0.601 (-0.79)	-0.876 (-0.76)
Bureaucracy	0.432 (0.76)	0.573 (0.54)	0.601 (0.61)	0.309 (0.56)
oil export	0.078 (1.24)	0.062 (1.19)	0.076 (1.12)	0.065 (1.41)
Fixed telephone	-0.231** (-2.42)			-0.341** (-2.19)
Mobile subscriptions		0.034 (0.67)		0.082 (0.72)
Internet users			-0.082** (-2.51)	-0.057** (-2.30)
Observations	306	306	306	306
Sargan Over-identification Test	3.231 (0.362)	2.921 (0.463)	2.532 (0.521)	3.021 (0.410)
Durbin–Wu–Hausman Test	0.924 (0.039)	0.976 (0.034)	0.850 (0.046)	0.820 (0.055)
AB- test for AR(1)	5.012 (0.000)	5.452 (0.000)	5.312 (0.000)	4.783 (0.000)
AB- test for AR(2)	1.121 (0.522)	1.115 (0.528)	1.201 (0.509)	1.491 (0.489)

Notes: Figures in Parentheses are t-statistics

***, ** and * denotes significance at the 1, 5 and 10 percent level

The estimation is two steps System GMM, instruments used in the analysis are the first lagged difference and the second lagged level of dependent and explanatory variables.

Durbin–Wu–Hausman and Sargan tests are asymptotically chi-sq distributed, with p values reported in brackets.

The results of the female youth analysis show that the estimated models do not suffer from any problems with the instruments and serial correlation, as indicated by Sargan and Arellano-Bond tests. The Durbin–Wu–Hausman test statistic also confirms the existence of endogeneity problem among the variables of regressions. Like the previous analyses of total and male youth, most of the variables in Table 3 bear the expected signs. Unlike the analysis of total and male youth unemployment, the results of female youth reveal that the coefficient of education is positive but it is not significant, suggesting that education has no impact of female youth unemployment in MENA countries. This finding could be explained by low rate of female school enrollment in comparison to male youth. This also indicates gender inequality in education and labor market, which is obvious phenomenon in MENA countries. Interestingly, the coefficients of ICT variables are negative as expected, confirming the analysis of male and total youth unemployment. Specifically, the magnitude of ICT coefficients in female youth unemployment model is less than their counterparts in male youth model. This result implies that male youth in MENA benefits more from ICT diffusion than female youth, suggesting a symptom of gender disparity in access to ICT facilities in MENA region.

Overall, the negative coefficients of ICT variables indicate that technological process in the MENA region reduces youth unemployment, since new technologies may increase productivity and generate new activities that absorb the unemployed workers. The results also indicate that ICT facilities have a negative effect on both aggregate and gendered levels of youth unemployment in MENA. Therefore, these findings suggest that the boom of information and communication technologies in the MENA region could contribute effectively to economic growth and development via fixing the problem of youth unemployment in the region.

6. Conclusion and Policy Implications

Motivated by the huge ICT boom and high rates of youth unemployment in MENA countries, this study examines the effect of ICTs on both the aggregate and gendered levels of youth unemployment in MENA countries. The study applied dynamic panel data model based on the GMM system method for a sample of 17 MENA countries, over the period 1995-2012. The empirical results show that per capita GDP, domestic investment, FDI, inflation rate and institutional quality exert a negative impact on youth employment. The results also show that the education rate has a positive and significant effect on youth unemployment in MENA countries. Interestingly, the coefficients of ICT variables are found to be negative, indicating that ICT penetration in MENA reduces the unemployment rate of total male and female youth. Specifically, the effect of fixed telephone and internet is found to be negative and significant. Moreover, the results revealed that for total male and female youth, the impact of mobile phone subscribers is negative but it is not significant, implying an inefficient role of mobile phone in reducing youth unemployment in MENA. Furthermore, the effect of ICT on male youth unemployment is found to be higher than the impact on female youth unemployment, indicating a gender variation in the response of youth unemployment to ICT facilities.

Based on the above findings, many policy implications can be drawn, aiming at utilizing the potential of ICT to improve the employability of young people in MENA countries. Since a large proportion of the population of MENA countries is youth, serious efforts should be exerted to enhance the access of youth to ICT facilities and innovations. First and foremost, access of youth to ICTs in terms of internet and broadband should be at the top of the development agenda of MENA countries. Besides, improving technical education and ICT skills should be paid a great attention from policymakers in such a way that eases the entering of young people into the labor market. In addition, policies that enhance gender equality in access to ICT facilities should be adopted to improve the employability of both males and females in MENA countries. Moreover, foreign direct investment should be directed to ICT infrastructure that provides significant job opportunities for young people. Furthermore, innovation legislation also should be revised to encourage participation of young people in innovation and ICT industries. Finally, modern ICT facilities, like e-government, should be adopted to enhance bureaucracy quality and transparency so as to improve the employability of young people.

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Appendices

Appendix I: Description and Sources of Variables used in the Regression Analysis

Variable	Definition	Source
Youth unemployment	Measured as the proportion of the labor force that does not have a job and is actively looking and available for work. Youth refers to persons aged 15-24 years.	ILO, Key Indicators of Labor Markets (KILM)
Real per capita GDP	GDP per capita based on purchasing power parity (PPP)	World Bank's World Development Indicators
Inflation Rate	Annual inflation rate measured by the change in consumer price index.	IMF Financial Statistics and World Bank's World Development Indicators
Domestic Investment	Measured by the ration of gross capital formation to GDP	
FDI	Measured by the ratio of foreign direct investment to GDP	
Trade Openness	Measured by the ratio of (Exports +Imports) to GDP	IMF Financial Statistics and World Bank's World Development Indicators
Fertility Rate	Measured by births per woman	United Nations, World Population Prospects and World Bank's World Development Indicators.
Education	Measured by ratio of total secondary enrolment to the population	World Bank's World Development Indicators
Bureaucracy Quality	Bureaucracy quality, measures autonomy from political pressure and strength and expertise to govern without drastic changes in policy or interruption in government services. (scale from zero to six)	International Country Risk Guide (ICRG), (2010)
Mobile subscriptions	Mobile cellular subscriptions per 100 people	World Telecommunication/ICT Indicators database (2014)
Internet Users	Internet users per 100 people	World Telecommunication/ICT Indicators database (2014)

Appendix II: Summary Statistics of Sample Data

Variable	Mean	Std. Dev.	Minimum	Maximum
Total youth unemployment	24.15	11.45	0.8	53.1
Male youth unemployment	21.13	10.17	0.2	51.2
Female youth unemployment	35.43	19.04	2.5	77.4
Real per capita GDP	10998.75	14888.43	484.69	60290.18
Inflation	12.16	28.17	-16.11	387.31
Domestic investment	23.33	7.50	7.90	46.87
FDI	2.42	3.58	-5.11	33.56
Trade openness	79.56	32.20	14.77	173.29
Education	6.31	1.79	1.67	9.79
Fertility	3.31	1.09	1.82	7.57
Bureaucracy	1.78	0.61	0	3
Fixed telephone	13.25	8.68	0.248	33.92
Mobile subscriptions	42.90	48.42	0.007	193.45
Internet users	14.23	19.14	0.006	88

Appendix III: List of Countries Considered for the Study

No	Country Name	No	Country Name
1	Algeria	10	Qatar
2	Bahrain	11	Saudi Arabia
3	Egypt	12	Sudan
4	Iran	13	Syria
5	Iraq	14	Tunisia
6	Jordan	15	Turkey
7	Kuwait	16	UAE
8	Libya	17	Yemen
9	Morocco		