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Abstract

This paper examines the impact of Information and Communication Technologies (ICTs) on youth unemployment in MENA countries. The study employs 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 the aggregate and gendered levels. The results also show that for both aggregate and gendered levels of youth unemployment in the MENA region, the impact of mobile phones is found to be negative but 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.

JEL Classification: C23, J21, J23.

Keywords: ICTs, Youth unemployment, MENA countries

ملخص

تبحث هذه الورقة تأثير تكنولوجيا الاتصالات (تكنولوجيا المعلومات والاتصالات) والمعلومات على بطالة الشباب في بلدان المنطقة. تستخدم الدراسة بيانات مسح ديناميكي لعينة من 17 دولة، خلال الفترة 1995-2012. نقوم في هذه الورقة بدراسة تأثير تكنولوجيا المعلومات والاتصالات على بطالة الشباب. أظهرت النتائج التجريبية أن الهواتف الثابتة والإنترنت لها تأثير سلبي وكبير على بطالة الشباب على حد سواء في مجموع النوعين (ذكور واناث) والمستويات الاجتماعية في منطقة الشرق الأوسط. تنتهي الورقة ببعض التوصيات التي تهدف إلى تحسين فرص العمل للشباب في بلدان المنطقة، مستفيدة من انتشار مرافق تكنولوجيا المعلومات والاتصالات في المنطقة.

1. Introduction

The effect of Information and Communication Technologies (ICTs)[1] on unemployment has been an interesting topic that raised considerable debate in the literature. A considerable 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 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 equipment, such as computers and mobile phones. The recent statistics also show that the MENA region recorded the highest share 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 the 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 countries in MENA[2]. 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 the 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 the labor market 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 level 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.

[1] ICT refers to any activity that involves gathering, processing, storing and presenting information. While the common use of ICTs tends to refer to modern technologies like mobile phones and the internet, the term ICT also includes more traditional communication media such as radio and television.

[2]The youth unemployment rate is the proportion of youth (persons aged 15-24) who are unemployed.

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

2.1 The trend of ICTs in MENA

In the past twenty years, MENA countries have witnessed a tremendous diffusion of ICTs in all aspects of life. ICT equipment like mobile phones, fixed telephone lines and internet have increased remarkably, owing to the global revolution of ICT innovations. Figure 1 shows the trend of ICT facilities during the period 2000-2013.

Figure 1 indicates that the number of mobile cellular subscriptions in MENA has increased sharply from about six subscribers in 2000 to more than 100 subscribers in 2013. The number of internet users also has increased from about two users in 2000 to 16 users per each 100 people in 2013. Regarding the fixed telephone lines, the figure reveals that the number of subscribers has remained constant over such period and fluctuated around the average of 15 lines per each 100 people.

According to ITU World Communication Statistics (2014), MENA 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 reported the second largest number of mobile subscribers, after Latin America and Caribbean. The number of mobile phones per 100 people is estimated to be more than 100. Regarding the number of internet users, the figure reveals that MENA exhibits a high rate of internet users, estimated to be about 40 users in 2013. Similar to other developing countries, it indicated that the number of fixed telephones in MENA countries is low.

2.2 Youth unemployment in MENA: An overview

Before analyzing the impact of ICT penetration on youth unemployment in MENA countries, it is useful to highlight the situation of ICTs and unemployment in the MENA region. In fact, 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 3 below presents data on the population under 15 in the developing regions.

Figure 3 show MENA holds a high rate of youth under 15 year, after Sub-Saharan Africa and South Asia. The figure also shows that for most developing regions of the World, the trend of youth population has declined between 1980 and 2010. Even for the 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 the MENA region implies a high share of youth in the total labor force, which causes MENA to face high rates of youth unemployment.

Figure 4 shows the situation of youth unemployment in the most developing regions of the world. As indicated the rates of youth unemployment is high in all developing regions. The Figure also indicates that Middle East and North Africa (MENA) have the highest rate of youth unemployment, exceeding the rates in the populous regions like East and South Asia.

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 5, youth unemployment rates vary 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 it is double, and in some countries like Bahrain, Egypt and Jordan it is even more than triple. In fact, in most of MENA countries the ratio of youth to adult unemployment is considered among the highest in the world. This situation can be 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.

In accordance with the distribution of youth unemployment according to gender in the MENA region, Figure 6 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 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 educational attainment.

Given the fact that MENA countries experienced 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 the ICTs 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 no consensus regarding the effect of ICTs and innovations on employment. Some empirical studies reveal a positive effect of ICT on employment (e.g., Entorf and Pohlmeier, 1990; Smolny, 1998) while others found evidence of negative effects for ICTs (e.g.s Brouwer et al., 1993; Machin et al., 1991). These conflicting results could be attributed to the difference in measurement of ICT innovations, model specifications and the type of economic sector studied. Therefore, there is a long debate on the effects of technological change and innovations on employment (see Vivarelli (2012) and Vivarelli and Pianta (2000)).

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.

Sinclair (1981), employed a macro IS/LM framework to examine the effect of technology innovation on employment in the US. He argued that positive employment compensation can occur if the demand elasticity and the elasticity of factor substitution are sufficiently high. Using macroeconomic data from the US economy, the author finds strong evidence supporting the mechanism via a decrease in wages but not the mechanisms via decreases in prices.

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 reveals that the literature on the impact of technologies and innovations on employment is intensive and diverse. Most of the empirical evidence confirms the view that technologies and innovations exert a positive impact on employment. On the other hand, a few studies reveal negative effects on employment. However, most of the empirical studies have focused on the advanced countries and there is little research attention given to this issue in the developing regions, particularly MENA countries. Unlike the previous studies that used sectoral and micro data, this study uses cross-country data. In addition, although most of the previous studies focused on technology and product innovation using many proxies such as, spending in R&D and firm innovation; this study uses advanced measures of technology like fixed telephone, mobile subscriptions and the number of internet users. Indeed, moreover, the study examine 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 ICT diffusion on youth unemployment in MENA countries, the study employs a panel data method. The specification of the 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 the youth unemployment. Thus, the model to be employed in the analysis could be specified as follows:

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

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

Where $\mathrm{YU_{it}}$ 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 the ICT

variables. Finally, μ_{it} is the general disturbance term, which includes, η_i as an unobserved country-specific effect, λ_t as a time-specific effect, and ε_{it} as the error term.

The control variables involve all factors that are hypothesized to influence 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 also add the quality of bureaucracy 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 on youth unemployment, we use a dummy variable, with value of one for net oil exporters and zero otherwise. 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 the variables used in the study are presented in Appendix I. In addition to the overall estimation, we also estimate our model separately for female and male youth unemployment in MENA.

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 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 use of first-difference GMM estimator (Bond et al., 2001). That is, when the regressors are highly persistent, the instrumental variables used in difference GMM, such as, lagged levels of the dependent variable and of the explanatory variables might be weak instruments. In this situation, the first-differenced GMM model potentially suffers from a downward bias, especially when the time periods (T) is small (Blundell and Bond, 1998). On the other hand, the system GMM estimator overcomes the weak instruments problem by allowing the use of the lagged differences and lagged levels of the

explanatory variables or other variables as instruments. Therefore, the analysis in this paper relies solely on the system GMM method.

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 uses 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 the 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) statistics[3]. 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. The results show that the Sargan and Arellano and Bond tests indicate that all the regressions do not suffer from any problems 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 the 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 MENA countries. This result supports 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 a low rate youth unemployment. In consistence with the Philips Curve' hypothesis, the coefficient of inflation

[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.

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

Contradicting 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 in MENA countries. 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 negative[4]. Finally, the coefficient of dummy variable for net oil exporters 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 diffusion of telephone lines discourage youth unemployment in 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 during the last decades 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 reducing youth unemployment.

Second, the results of the male youth unemployment model are presented in Table 2. Similar to the analysis of total youth, the results in Table 2 indicate that the Sargan and Arellano and Bond tests reveal that all the regression model do not suffer from any problems 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 total youth, 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 coefficient of foreign direct investment (FDI) is significant in all estimated models, implying that FDI in MENA provides job opportunities for young males.

Interestingly, the results indicate that all ICT variables are negative and statistically significant, except, mobile phone subscribers, conforming the results of total youth. These findings suggest that ICT diffusion has a negative impact on youth male unemployment in MENA economies. Finally, the estimation results of equation 1 for female youth unemployment are presented in Table 3.

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

The results of 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 and 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 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 value of ICT coefficients in the female youth unemployment model is less than their counterparts in the 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 level 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 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 level of youth unemployment in MENA countries. The study applied a 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, technical education and developing ICT skills should be paid a great deal of attention by 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.

Finally, to provide a complete view on ICT and youth unemployment in MENA countries, this issue needs further research on many aspects. First, a study to explore the channels through which ICT diffusion affects youth unemployment would be useful. Second, it is important to investigate gender inequality in access to ICT facilities, as our results reveal a variation in the gender-specific effects of ICTs. Finally, empirical studies need to be conducted to assess the impact of foreign direct investment on ICT diffusion, on both the aggregate and gendered levels.

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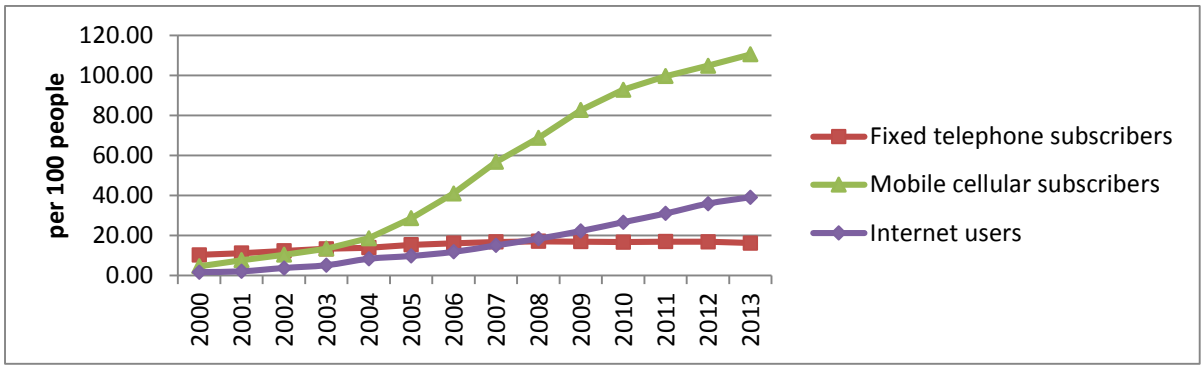
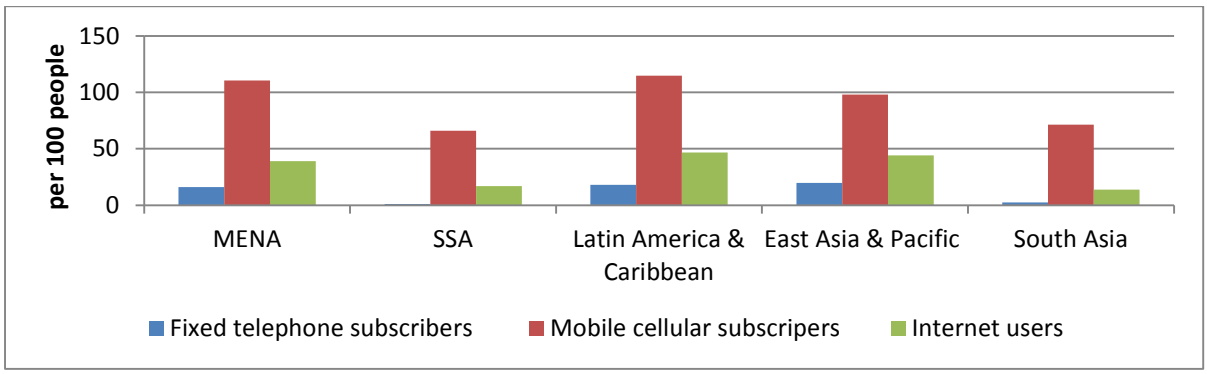
Figure 1: Trend of ICTs in MENA Region



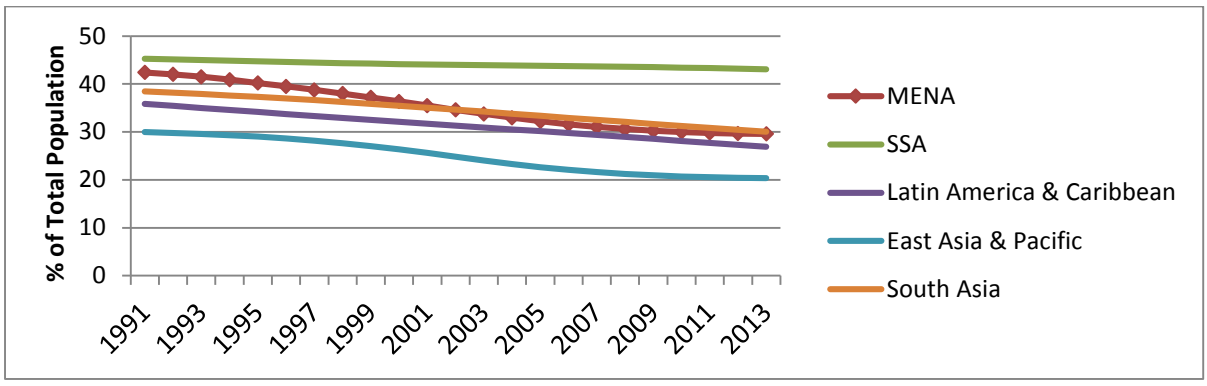
Source: ITU World Telecommunication/ICT Indicators database

Figure 2: Fixed Telephone and Mobile Subscriptions and Internet Users per 100 People



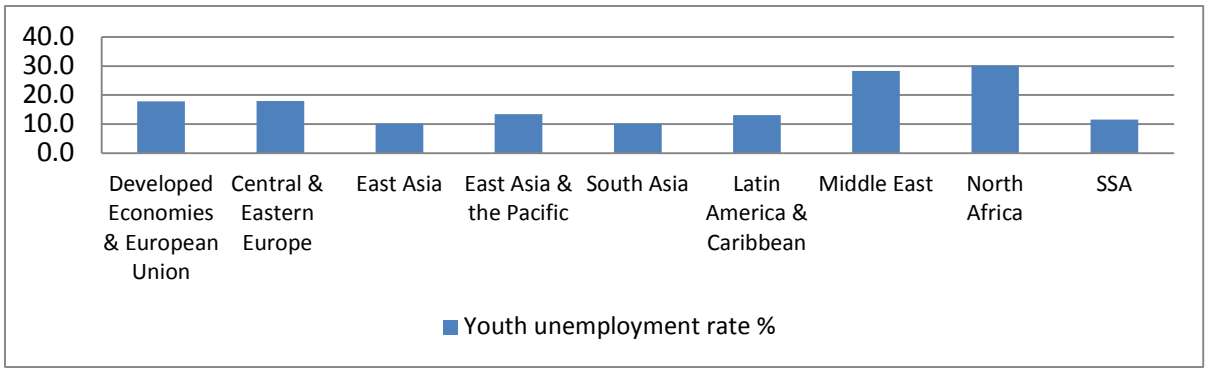
Source: ITU World Telecommunication/ICT Indicators database.

Figure 3: Young People (under 15 year) as Percentage of Total Population (1991-2013)



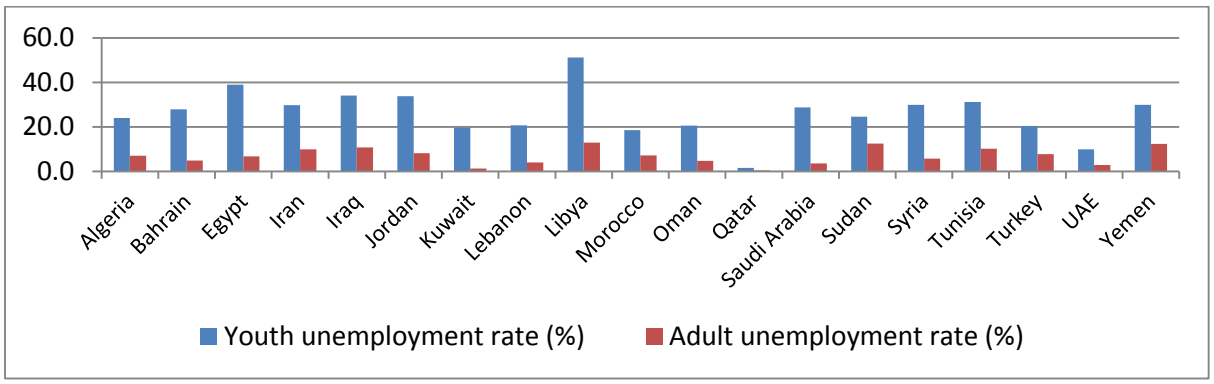
Source: World Bank's Development Indicators

Figure 4: Youth Unemployment Rate by Region- Latest Data



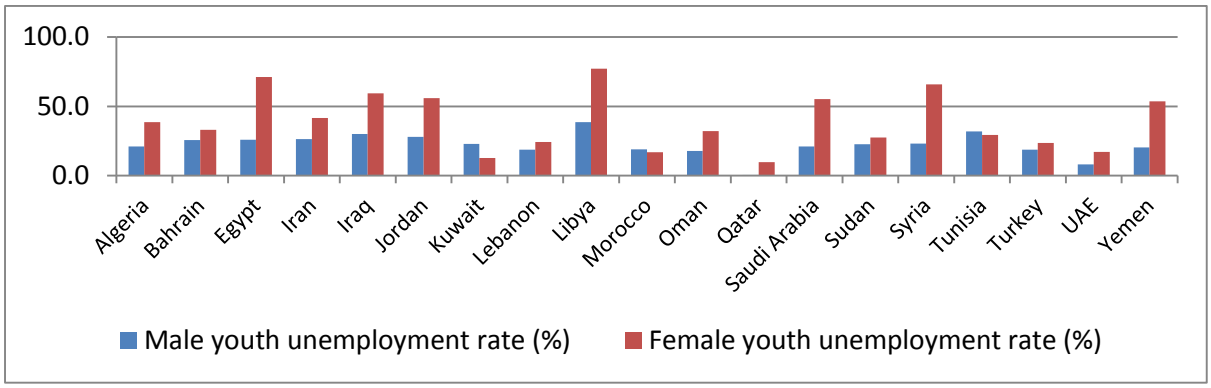
Source: ILO (KILM).

Figure 5: Youth and Adult Unemployment in MENA- Latest Data



Source: Adapted from KILM ILO database.

Figure 6: Youth Unemployment in the MENA Region by Gender



Source: Adapted from KILM ILO database.

Table 1: GMM-System Estimation: Total Youth Unemployment Dependent Variable: Total Youth Unemployment

Variable	Model 1	Model 2	Model 3	Model 4
Constant	8.896*	4.248	4.315	8.918*
	(1.72)	(0.83)	(0.86)	(1.69)
Youth unemployment (-1)	0.697***	0.738***	0.737***	0.694***
	(16.63)	(18.44)	(18.40)	(16.28)
Real per capita GDP	-0.085**	-0.021***	-0.021***	-0.081**
	(-2.13)	(-3.50)	(-3.56)	(-2.04)
Inflation	-0.027	-0.026	-0.023	-0.022
	(-1.40)	(-1.28)	(-1.17)	(-1.13)
Domestic investment	-0.162***	-0.161***	-0.163***	-0.168***
	(-3.24)	(-3.14)	(-3.19)	(-3.29)
FDI	-0.039	-0.034	-0.031	-0.046
	(-0.61)	(-0.51)	(-0.47)	(-0.68)
Trade openness	0.003	0.014	0.012	0.006
	(0.18)	(0.08)	(0.07)	(0.36)
Education	0.929**	0.808**	0.821**	1.090**
	(2.50)	(1.77)	(2.01)	(2.37)
Fertility	-0.026	0.176	0.127	-0.291
	(-0.50)	(0.29)	(0.21)	(-0.47)
Bureaucracy	-0.326	-0.266	-0.294	-0.255
	(-0.41)	(-0.34)	(-0.37)	(-0.32)
Net oil excerpters	1.78	3.800	3.894	1.702
	(0.80)	(0.96)	(0.71)	(0.82)
Fixed telephone	-0.216**			-0.238**
	(-2.62)			(-2.71)
Mobile subscriptions		-0.025		-0.042
		(-0.04)		(-0.05)
Internet users			-0.060*	-0.016**
			(-1.83)	(-2.16)
Observations	306	306	306	306
Sargan Over-identification Test	3.235	2.578	2.265	3.412
	(0.231)	(0.420)	(0.445)	(0.211)
Durbin–Wu–Hausman Test	1.123	0.965	1.112	0.832
	(0.017)	(0.036)	(0.022)	(0.048)
AB- test for AR(1)	-5.245	-6.234	-5.234	-5.221
	(0.000)	(0.000)	(0.000)	(0.000)
AB- test for AR(2)	1.939	1.711	1.000	1.739
	(0.367)	(0.421)	(0.619)	(0.413)

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.

Table 2: GMM-System Estimation: Male Youth Unemployment (Dependent Variable: Male Youth Unemployment)

Variable	Model 1	Model 2	Model 3	Model 4
Constant	9.439**	6.928	7.665*	8.689*
	(2.03)	(1.51)	(1.70)	(1.83)
Youth unemployment (-1)	0.685***	0.692***	0.694***	0.674***
	(17.09)	(17.29)	(17.50)	(16.38)
Real per capita GDP	-0.012*	-0.024***	-0.019***	-0.012*
	(-1.79)	(-3.60)	(-3.57)	(-1.71)
Inflation	-0.010	-0.011	-0.009	-0.009
	(-0.52)	(-0.58)	(-0.48)	(-0.49)
Domestic investment	-0.178***	-0.173***	-0.177***	-0.172***
	(-3.71)	(-3.55)	(-3.66)	(-3.55)
FDI	-0.048*	-0.044*	-0.041*	-0.039**
	(-1.76)	(-1.79)	(-1.70)	(-2.59)
Trade openness	0.026	0.037	0.027	0.028
	(0.16)	(0.22)	(0.15)	(0.16)
Education	0.628*	0.695	0.546	0.926**
	(1.78)	(1.63)	(1.46)	(2.19)
Fertility	-0.470	-0.477	-0.380	-0.730
	(-0.92)	(-0.87)	(-0.70)	(-1.28)
Bureaucracy	0.105	0.296	0.297	0.078
	(0.15)	(0.42)	(0.40)	(0.11)
Net oil excerpters	1.618	1.175	1.830	1.22
	(1.39)	(1.30)	(0.84)	(1.02)
Fixed telephone	-0.609**			-0.729**
	(-2.46)			(-2.58)
Mobile subscriptions		-0.083		-0.091
		(-0.55)		(-0.98)
Internet users			-0.101**	-0.193*
			(262.88)	(1.82)
Observations	306	306	306	306
Sargan Over-identification Test	4.312	3.123	3.324	4.517
	(0.421)	(0.525)	(0.509)	(0.383)
Durbin–Wu–Hausman Test	0.987	0.965	0.893	0.879
	(0.061)	(0.066)	(0.081)	(0.088)
AB- test for AR(1)	4.987	5.345	5.563	4.189
	(0.000)	(0.000)	(0.000)	(0.000)
AB- test for AR(2)	0.939	0.789	0.989	0.842
	(0.667)	(0.542)	(0.613)	(0.500)

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.

Table 3: GMM-System Estimation: Female Youth Unemployment (Dependent Variable: Female Youth Unemployment)

Variable	Model 1	Model 2	Model 3	Model 4
Constant	18.231***	10.740	11.285	19.081**
	(2.01)	(1.20)	(1.26)	(2.29)
Youth unemployment (-1)	0.661***	0.714***	0.712***	0.657***
	(12.70)	(14.29)	(14.15)	(12.59)
Real per capita GDP	-0.013**	-0.028**	-0.027**	-0.010**
	(-2.19)	(-2.84)	(-2.81)	(-2.94)
Inflation	-0.019	-0.020	-0.023	-0.039
	(-0.59)	(-0.58)	(-0.63)	(-0.11)
Domestic investment	-0.104**	-0.076***	-0.075*	-0.127**
	(-2.27)	(-2.90)	(-1.89)	(-2.46)
FDI	0.027	-0.048	-0.022	-0.012
	(0.25)	(-0.04)	(-0.02)	(-0.01
Trade openness	-0.037	-0.041	-0.042	-0.032
	(-1.16)	(-1.23)	(-1.26)	(-0.97)
Education	0.704	0.659	0.593	1.128
	(0.98)	(0.80)	(0.73)	(1.36)
Fertility	-0.967	-0.612	-0.631	-1.508
	(-0.85)	(-0.46)	(-0.49)	(-1.14)
Bureaucracy	0.457	0.628	0.624	0.563
	(0.36)	(0.47)	(0.47)	(0.44)
Net oil excerpters	1.872	1.145	1.099	1.401
	(1.47)	(0.98)	(1.14)	(1.31)
Fixed telephone	-0.335**			-0.429**
	(-2.60)			(-2.88)
Mobile subscriptions		0.019		0.071
		(0.15)		(0.40)
Internet users			-0.073**	-0.060**
			-2.20)	(-2.41)
Observations	306	306	306	306
Sargan Over-identification Test	2.676	2.218	1.941	2.519
	(0.452)	(0.520)	(0.642)	(0.492)
Durbin–Wu–Hausman Test	0.976	0.982	0.899	0.850
	(0.032)	(0.030)	(0.043)	(0.051)
AB- test for AR(1)	4.786	5.112	5.012	5.031
	(0.000)	(0.000)	(0.000)	(0.000)
AB- test for AR(2)	1.139	1.250	1.000	1.239
	(0.562)	(0.510)	(0.612)	(0.518)

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.

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	15	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		