AMERICAN UNIVERSITY OF BEIRUT

INCOME CONVERGENCE IN THE MENA REGION: AN
EMPIRICAL ANALYSIS

by
KAREN KHALIL EL HAJJ

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# AN ABSTRACT OF THE THESIS OF

Karen Khalil El Hajj   for   Master of Arts
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Title: Income convergence in the MENA region: an empirical analysis

Per capita convergence of income is an important field of development economics that has been widely examined and attracted a wide array of scholars. The convergence debate has stemmed from the Solow model prediction of equalizing long run growth levels of GDP/capita. This thesis's main aim is to increase the amount of literature that examines the theory of income convergence. The test applied for confirming the presence of convergence for both absolute and conditional convergence is done using panel data fixed effects approach aimed at testing the hypothesis.

The thesis is divided into the following sections: chapter one is an introduction into the topic of convergence as well as a brief overview of the main aspects of the MENA region; chapter two is a literature review of the theoretical and empirical literature of the convergence hypothesis; chapter three provides an overview of the MENA region economic outlook; chapter four tests an empirical model using dynamic panel data fixed effects model; chapter five concludes with a brief re assessment of the model and future examination.

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# CHAPTER I

# INTRODUCTION

MENA countries have lagged behind in the development process. Generally the region has throughout suffered from a lack of economic and political conditions that sustain growth and prosperity.

Recent studies show that abundant oil wealth and the prevalence of multifaceted conflicts are two main factors that have hindered sustained development as well as moves toward democracy in the region (Elbadawi and Makdisi, 2011). Conflicts (among others, the Arab/Israeli conflict, the Iranian revolution of 1979, the two Gulf wars, and the Lebanese civil war) have led to a high level of instability and uncertainty not to mention disruption of the development process. The Middle East and North Africa region has been one of the most volatile areas witnessing a very high level of armed conflicts since world war two.

As to oil wealth, according to the World Bank the region holds 60% of the world's oil reserves as well half of the natural gas reserves of the world. Saudi Arabia, Kuwait, and Iran combined provide 12.075 Million barrels a day and are considered the first three oil producers in the world. Along with oil comes the abundance of natural gas resources in Bahrain, Qatar, Iran, Saudi Arabia, and Oman.This abundance of oil and gas wealth has permitted the Gulf countries to trade off relative economic welfare for political rights of citizens ( Elbadawi and Makdisi 2011).

The MENA region is one of the most researched regions in the world, with its culture, traditions, history, and natural resources. Nonetheless, not only has it failed to move significantly along the path of democracy, as other regions have done, but it has failed to achieve sustained and equitable development and generally prevent rising levels of unemployment. Indeed, the uprisings of 2011 were motivated by the economic and political frustrations of the populace with autocracy, economic inequality and lack of job opportunities. They demonstrated the region's need for political, social, and economic transformation that would set the start of a new era.

With the above in mind a primary purpose of this thesis is to empirically test the convergence hypothesis for selected MENA countries to examine the catch up theory in both its conditional and absolute aspects of β convergence. This concept specifies that, over time, poor countries catch up with rich countries in terms of per capita income levels (Islam, 2003).

Since post World War II the concept of income convergence has been researched extensively in the literature. With the Solow model as a starting point, development economists have examined different frameworks, data spans, regions, and econometric models to apply the convergence theory.

Starting off with the Solow model that predicts economic growth in the form of labor, capital, and technology. It is an important starting point to understand the theories of economic growth. In his model, Solow predicts that the growth a country exhibits comes from the accumulation of capital and labor, moving the economy towards the long run equilibrium. As well as predicting the driving forces of economic growth he also estimates that poorer countries would catch up to richer countries in terms of per

capita GDP rates. This prediction is in line with the higher rate of return that poorer countries enjoy since they have a less amount of accumulated capital to start with. Thus in the Solow model the convergence of income between countries is assumed to exist, yet a main assumption towards this prediction is the similar technological and preference aspects that are assumed the same for all economies (Solow, 1956)

Income convergence is specified in two forms: $\beta$ convergence and $\sigma$ convergence. The concept of beta convergence take on two types conditional or absolute beta convergence. Along the beta convergence framework the absolute beta convergence is said to exist if there exists for countries reaching a long run equilibrium. Whereas conditional beta convergence is estimated when the convergence of countries is conditional to some control variables.

The concept of sigma convergence is another step aimed at testing convergence. Researchers argue that the sign in the beta convergence test is not sufficient to depict the existence of convergence or reject it (divergence) (Quah, 1993a). Yet, the concept of sigma convergence is measured via the dispersion of the data of GDP across time as well as across countries.

This thesis tests for convergence in the MENA region based on a selected pool of countries consisting of Bahrain, Egypt, Iran, Jordan, Kuwait, Lebanon, Morocco, Oman, Qatar, Saudi Arabia, Syria, Turkey, and Tunisia. We employ data from the Summers-Heston database and also rely data from the World Bank as well as the United Nation Database. The time frame ranges from 1980-2010 using annual data of GDP/Capita rates for all thirteen countries examined.

The thesis is divided as follows: chapter two is a literature review of the theoretical and empirical literature of the convergence hypothesis; chapter three provides an overview of the MENA region economic outlook; chapter four presents the empirical model using a panel data fixed effects model; chapter five concludes.

# CHAPTER II

# LITERATURE REVIEW

The literature of convergence has been evolving and gaining more insight and research throughout the past fifty years. Especially for the MENA region, since many of growth economists disregard it due to data deficiency and reliability. Growth economists have been delving into the research behind convergence. Primarily that the convergence debate stems out of the Solow model as well as its extensions.

What the literature review aims at is approaching first the theoretical part of the convergence debate, starting off from Robert Solow's starting point about convergence using a Cobb Douglas production function, and adding limiting assumptions of diminishing marginal returns to scale as well as a constant technological progress. The limiting assumptions of exogenous neutral technological progress which is labor augmenting (Solow, 1956).

After the examination of the Solow model which pertains the theoretical aspect that initiated joining growth empirics and the theoretical aspects behind it. We move on to the literature which has been the starting point of the convergence experiments which have had the basic impact to starting off with the interpretations that have been of the preliminary work on the convergence debate that helped stem out further implications on the topic.

The study done by Baumol in 1986 is an examination of the convergence of output per labor among industrialized countries after World War two giving evidence of convergence between economies have been increasing. The convergence signs are visible for both countries that are centrally planned and industrialized ones.

However, no convergence has been regarded in what are namely less developed economies. He also verified the existence of convergence graphically of the following countries which are Australia, UK, Holland, US, Italy, and Japan. The graphical relationship between these variables shows that the rate of growth of these six selected countries reaches a long run steady level.

Baumol in his study also highlights the issue of the nature of growth being a public good giving the example of two countries A and B with both fixing on a certain type of production being capital intensive for country A and consumer product for country B. the example given in his paper of cars and shoes. When country A specializes in cars it raises the real wages for the workers as well as the import of shoes due to specialization in cars thus driving the demand for country B's products. Thus investment and increase in technology witnessed in country A results in a spillover effect towards neighboring country of B. he exemplifies this observation to technology and increase in investment to that of a public good where everyone benefits from the investment or surge in technology.

Then after stating the public good nature Baumol moves on to validating the non-neediness for a country level policy implication but he addresses the issue since in most western economies the investment process is that of the private sector in which the government has a few interference with and such little gains can be attained from the free rider implied at the beginning of his analysis.

What is most relevant in Baumol's research is the analysis of convergence clubs amongst countries he also was the pioneer of observing the presence of this phenomena between country groups. The observation was found through examining productivity data for a period of 110 years for seventy two countries presents a form of convergence

clubs where Madisson's sixteen countries have been in their own upper hand boundary whereas the other club formed by the countries of planned economies mainly being Bulgaria,China,Chezslovakia, East Germany ,Hungary,Poland,Romania,USSR,and Yugoslavia exhibits a heavier bound across them.  The findings of the first and second convergence club indicate the presence of a  third club which is one for poor less developed countries. Those which are on the lowest bound and near the origin. The boundary is less visible than the first two however, convergence within the group is still visible. He finally concludes his observations and models with the policy briefing required as in long run equilibrium must be a focus for economists so that they would be efficient towards directing long run levels (Baumol, 1986).

Moreover, the appeal of the convergence hypothesis to economists has been kindled with thoughts about the observations that the catch up hypothesis might entail more than just productivity variables.  The paper done by Abramowitz leads to the introduction of what ascribes an important determinant other than that of the backwardness of the country at hand.  He starts first by introducing the catchup hypothesis in which the gap between the leader and follower countries demonstrates ability of the follower countries to increase their productivity.  He introduces a new factor which in his opinion causes the backwardness present in the initial state. A social factor according to his theory is a huge influencer with the countries' ability to accept and allow for technological advancement. He also adds that such a concept which along with the backwardness present in the country allows for the catch up process to exist.  Thus having such social capability aids in this process.

The convergence process experienced to countries is conditional having the backwardness and social capabilities to absorb the advancement in technological levels (Abramowitz, 1986).

One of the pioneer work done on the convergence topic is by Robert Barro and Xavier Sala-I-Martin in 1992. The paper considers the idea of catching up of poor countries towards the growth levels of rich countries however they examine the case of the United States 48 states. The time period of examination is that of 1840-1880 for data of personal income provided by the US department of commerce whereas the other data set used to measure per capita income or product as well as the GDP values from year 1963. They use the neo classical growth model developed by Ramsey 1928, Solow1956, Cass 1965, and Koopmans 1965. Whereby the neoclassical growth rate tends to be inversely related to that of the starting level of output per person. This has been the starting theoretical background for all the convergence theories that have been widely examined empirically. They derive the Solow model and result to a neo classical growth regression which is a pillar in their methodological approach. The extension they provide is from a nonlinear least square regression whereby they continue the Solow Model to test for it amongst the forty eight selected US states. They use a cross country examination in order to examine the convergence hypothesis. In their regression they indicate that higher levels of $\beta$ indicate greater responsiveness of the average growth rate to the gap between the steady state value of GDP and that of the initial GDP level. Through their cross country regression the benefit of examining the convergence throughout the US states is the similar value of steady state as well as X. The variations in the US states is of minimal variation therefore absolute and

conditional convergence in the united states examined in their research is quite in differentiable.

The methodology employed in the research is a nonlinear regression where they test the convergence hypothesis in the US states that show the confirmation of the convergence hypothesis as well as the test is performed for the 98 OECD countries on the period ranging from 1960-1985 the results indicate that conditional convergence exists however the authors add some important structural variables that account for structural differences amongst the selected group.  They consist of :Primary and secondary education as well as average ratio of government consumption expenditure, a political stability index, a measure of market distortion based on purchasing power parity ratios for investment goods.  Such conditional variables resulted in the existence of a conditional convergence in the OECD countries.  The data investigated indicate the presence of convergence for all selected countries of OECD and for those for 48 US states. The research done by the authors has extended the launch of several econometric and regional differences that set the path towards future convergence literature primarily that with different econometric tests via time series analysis, cross section data, and panel data tests.

We start off the empirical examination within the MENA from the paper published by Guetat and Serranito in 2007, they applied the convergence test for 20 countries in the MENA region using a panel unit root approach which they state according to previous tests done by Karras and Jones 1996.  The data spans from 1960 to 1990 and is used from the Summers Hesston data set 5.6 and 6.1.  They test for both absolute and conditional convergence in the MENA region.  The panel unit root was estimated using a Monte Carlo simulation to test the best estimator to yield the best

results. Their regression results conclude that there is conditional convergence and absolute convergence through the selected countries of the MENA region the countries that were examined in their data set would encompassAlgeria,Egypt,Morocco,Tunisia,Iran,Iraq,Israel,Jordan,Saudi Arabia, Syria, Turkey, and they also dropped the two countries due to no data present. Which are Saudi Arabia and …..

The results conclude conditional and absolute convergence in the MENA region, which is somewhat interesting since the selected MENA countries have specific differences that are usually known in research. The drawback of the paper is primarily the non-specification of what are the conditioning or control variables used in the test for conditional convergence. However, they use regional dummies that tend to classify or divide the MENA region into the following categories according to what they have done: Maghreb, Middle East, Oil, non-Oil. At the end of their study Guetat and Serranito also find the existence of convergence clubs in the MENA region (Guetat and Serranito, 2007).

Another addition is the paper by Andreano et al in 2013 aimed to test the conditional $\beta$ convergence in the MENA region in twenty six countries for the period ranging 1950-2007. They use three sets of conditional variables to control for the structural differences that face the MENA region. They use a wide set of state and environmental variables that they believe are relatively significant to explain the growth determinants in the MENA region. They find evidence confirming conditional convergence across the MENA region however they reject the test of absolute convergence in the MENA region since the $\beta$ coefficient is insignificant in their resulting regression.(Add the problems that rise from the convergence hypothesis)

Another paper that has tested the convergence hypothesis for the MENA region however using time series technique is that by Tunali et al. in 2010 where by the sample examined is of nineteen MENA countries in attempt to find an income convergence. The data is from Maddison data and the time spans from 1950-2006. Using time series data the convergence hypothesis is examined by long run output movements, which basically measures the deviations around long run output which is basically the deviation around the mean. The results they encountered through their study is that the selected countries are diverging and reject the convergence hypothesis. (Tunali et al., 2010). The results in the paper differ than those selecting the MENA region but may be partly due to different time periods and that might be due to the technique used through their research.

In an attempt to deviate from the panel data approach used in the MENA region by most authors we review a paper done by Erlat in 2007 which aims at examining the convergence hypothesis however, from a time series unit root approach. The data selected for the convergence test is from the Penn World Tables Version 6.1 (Heston, Summers, and Aken, 2002). The data examined consists of annual Purchasing Power adjusted per capita real GDP series constructed in international dollars at 1996 prices. The data was intended to span from 1951-2000. Yet due to missing data they used instead the 1961-2000 dataset for which the country specific data exists for the following chosen countries: Algeria, Egypt, Iran, Israel, Jordan, Morocco, Syria, Tunisia, and, Turkey which was selected the same as Guetat and Serrantino in 2004. After the data briefing we move on to examine the methodological aspect of the paper which is mainly stated by pair wise testing for the countries as opposed to the panel unit root approach adopted by Guetat and Serranito(2004). They subject the nine countries

to a Weber and White descriptive procedure they then applied unit root tests for the variables to include and exclude structural tests. After examining several unit root tests ADF, KPSS stationarity tests different results were obtained depending on the time span and base year the tests were run during which tests performed with different base years yielded various results. When 1961, 1980, and 1990 where chosen as the base year the number of converging pairs were less than those diverging. Whereas, as long as the number of time increased the number of diverging pairs decreases and converging pairs increase.

Convergence test increased when subjecting the converging pairs to the unit root test. The KPSS yielded eleven converging pairs whereas the ADF resulted in four converging pairs.

Along with testing for convergence there was as well an attempt by the author to examine the existence of converging clubs however, it turned out sterile.

In conclusion, the time series unit root analysis approach to testing convergence for the same countries turned out diverging whereas the tests attempted by Guetat and Serranito(2004) turned out converging for the MENA region.

Apart from the MENA region countries have been studied towards their convergence to the European Union. In the paper by Begoulla et al. they investigate the convergence hypothesis of the MENA countries towards the European Union rather than amongst each other reaching a certain threshold. The main motivation behind the consideration of the EU is due to relevant new developments to the Euro-Mediterranean policy. Furthermore, another addition towards the broad literature of convergence is the examination of the determinants of income growth between the European Union and the MENA region selected areas. The methodology used in the paper is a panel data

econometric model of conditional β convergence using the Summer Hesston data set for growth.  What is novel in their approach towards the convergence hypothesis is basically examining a γ convergence that focuses on convergence of the relative HDI's of the MENA regions towards those of the EU and exploring that of σ convergence throughout. The countries used in the analysis are the following: Algeria, Morocco, Tunisia, Egypt, Syria, and Turkey.  The EU reference group entails countries that of Greece, Spain, Portugal, and Ireland. Upon testing for the convergence hypothesis they find convergence between European Union countries and the all the selected MENA countries except for barely rejecting the convergence of Syria and reject the convergence hypothesis for Algeria, and Jordan(Begoulla,…)

The paper an exhaustive set of conditioning variables for the examination of the determinants of the convergence rates of the MENA region towards the European Union.  The indicators have been compiled in accordance with an extensive revision of the empirical literature presented towards the significance of the variables.  The variables are: Human capital and technology, patterns of specialization and trade openness, economic geography, transportation and communication, public funds, investment price, government consumption, investment share, population density, life expectancy, colonies, and corruption. Of these variables the ones that do contribute towards explaining the convergence are first education as well as Research and Development.

A paper done by Phillipe Monfort in 2008 in an attempt to study the convergence process on the EU countries, whereby he addresses the issue of convergence in a novel approach deviating away from the regular econometric regression analysis and moving on to statistical measures to understand the ability to

measure income inequality.  He uses to measure the convergence theory the following

measures which are the Coefficient of variation, Gini coefficient, Atkinson index, the

Theil index, and finally the Mean Logarithmic deviation.  The five indexes are

examined for the period of 1995-2005 with two sets of EU countries the first are EU15

and the second being EU-27.

EU 15 countries which are  Austria, Belgium, Denmark, Finland, France,

Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain,

Sweden, United Kingdom. Whereas the EU 27 countries are

Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland,

France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania,

Luxembourg, Malta, The Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia,

Spain, Sweden, and the United Kingdom.

Through the coefficient of variation index Monfort found evidence of strong

convergence between EU-15 countries up to the nineties but after the nineties the

convergence has lost its momentum.  Whereas the convergence has appeared from

1995-2005 in the EU-27 countries since new countries have entered the Eurozone and

began the catch up process. Now moving to the Gini coefficient the EU 15 countries

have witnessed a decline in their Gini coefficient and declined from 17.7% in 1980to

14.6% in 2005.  Whereas the EU-27 Gini coefficient has declined at a faster rate from

24.4% to 21.1% in 2005.  Whereas the Atkinson index which is another measure of

income inequality, it's able to emphasize the movements in particular segments of the

distribution. The way it measures inequality is through the value of $\varepsilon$ approaching 0, it

shows that income inequality aversion is decreasing and signs of convergence exist.

The Theil index is another measurement of income inequality however during the examination of inequality amongst the EU region has shown a decrease of disparities amongst these regions. Finally the last measure used in the examination is that of Mean Logarithmic Deviation is a decomposable measure between and within the EU regions examined. As well as having the property of being more responsive towards deviations in the lower end of the distribution. The result from using the technique is that among the EU countries examined there has been a decrease in the deviation and within countries regional disparities have slightly increased. Monfort in his approach has developed an alternative way of assessing convergence, but from an income inequality approach rather than using a standard econometric regression. His approach is quite different and he as well has deduced a convergence or catching up between the EU-15 and EU-27 countries.

A paper done by Kolluri, Panik,Rassekh in 2001 developed a convergence test that would rid the econometric problems that researchers face while encountering the topics of β and σ convergence. The ARMA method is a time series approach towards the topic of convergence. The convergence via ARMA method is developed to examine the convergence of 24 OECD countries from the periods 1950-1990, and that of 1950-1977. The convergence results are of only modest support of authors.

The paper written by Islam has given a tremendous inclusion or summary of the evolution of the econometric data usage done by the literature covering the topic of convergence. Whereby he examines the timeline of the using of different proxies such as TFP, GDP/Labor,

# CHAPTER III

# MENA OUTLOOK

The MENA region as a whole encompasses a wide spread variety of economic structures and policies. In this macroeconomic outlook we provide what is foreseen as relevant to introduce the nature of the MENA region as a whole providing an insight to relevant economic variables that contribute to economic growth.

Countries in the MENA range in democracy levels, GDP structure and variation, as well as the general climate that surrounds the region. However, as a whole the region still has the similar attributes of high unemployment levels which appear to be much lower than other developing regions in the world.

A few conclusions can be derived from the International monetary fund and the World Bank in order to give out an appropriate assessment of the outlook and prospects of the region as a whole.

Starting off with the current events shaping the region as a whole which are the civil wars spreading in Syrian Arabic republic, Yemen, and instability of elsewhere countries that have already undergone the Arabic spring primarily including Egypt, and Tunisia.  The other effects from the high war concentration is the influx of refugees towards the other parts of neighboring countries those mainly of Lebanon and Jordan due to the geographical presence (IMF, MENA outlook, 2015).

Such spillover has resulted in labor market distortions in neighboring countries and resulted in  a regional call for help towards the national and world level deeming the intervention of the United Nations,IMF,and World bank both necessary in aid and economic structuring, as well as that for the cease fire agreements. Furthermore, what

ascribes as a recent characteristic is the presence of new terrorist movements feeding off of emerging conflicts that of ISIS and others.

Along with the terrorist uprising there is a key factor that causes fluctuations on the Macro level of the region due to the fluctuation of the oil prices. Oil exporting countries more interestingly GCC ones have witnessed the fluctuations in the GDP rates due to lack of diversity as well as the dependence heavily on oil revenue as a resource of growth and prosperity. (Regional Economic Outlook, Middle East and Central Asia, 2015)

After the brief overview of the economic and social attributes that concern the MENA we'll examine a few economic variables that aid us in analyzing the convergence theory. Such variables include GDP,Inflation,education levels, unemployment rate, and private investments.

## A. GDP levels

In a comparison with other regional groups such as Latin America, OECD members, and Sub-Saharan Africa. The region fairs at an average of 10% in GDP rates over the past forty years yet it has witnessed more volatility or fluctuations in its trend over the period.
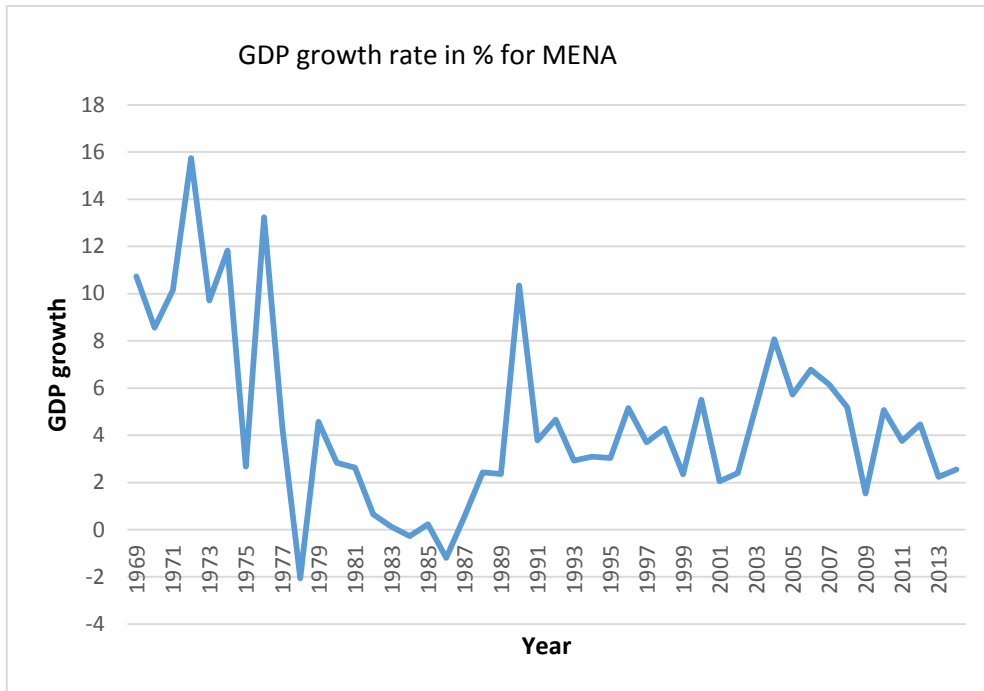
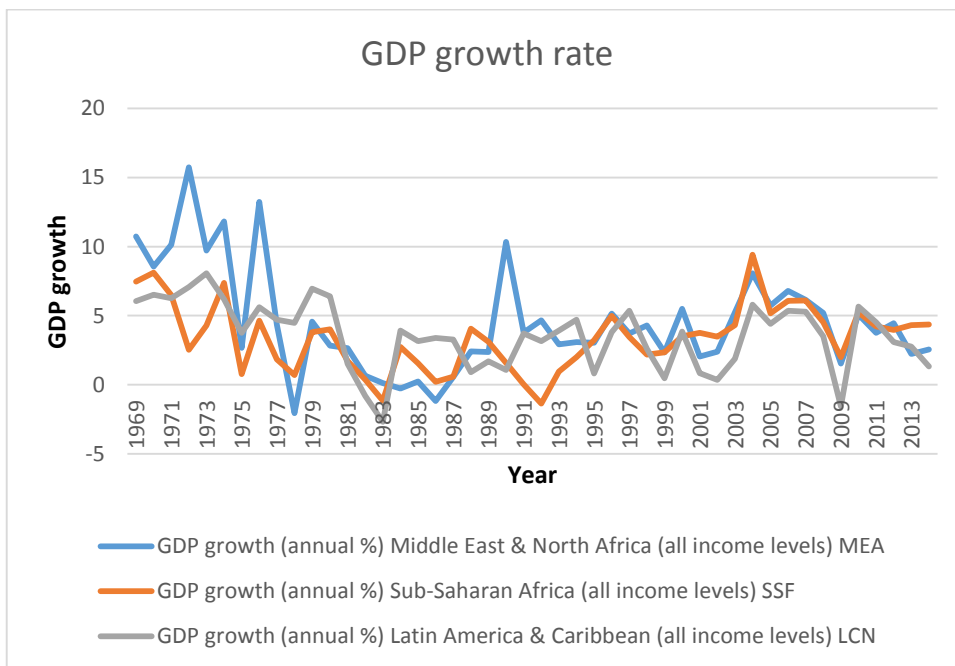**Figure 1: GDP growth rate MENA[1]**



**Figure 2: GDP growth rate across regions**

[1] All tables of the MENA outlook are from the World Bank data base.

## B. Unemployment Rates

The unemployment rates differ amongst countries of the MENA region however the overall trend witnessed an average of 12% in the period from 1991-2015. Such trend is expected to rise due to the increase of the influx of refugees and overall stagnation of growth the region has been witnessing since early 2013.
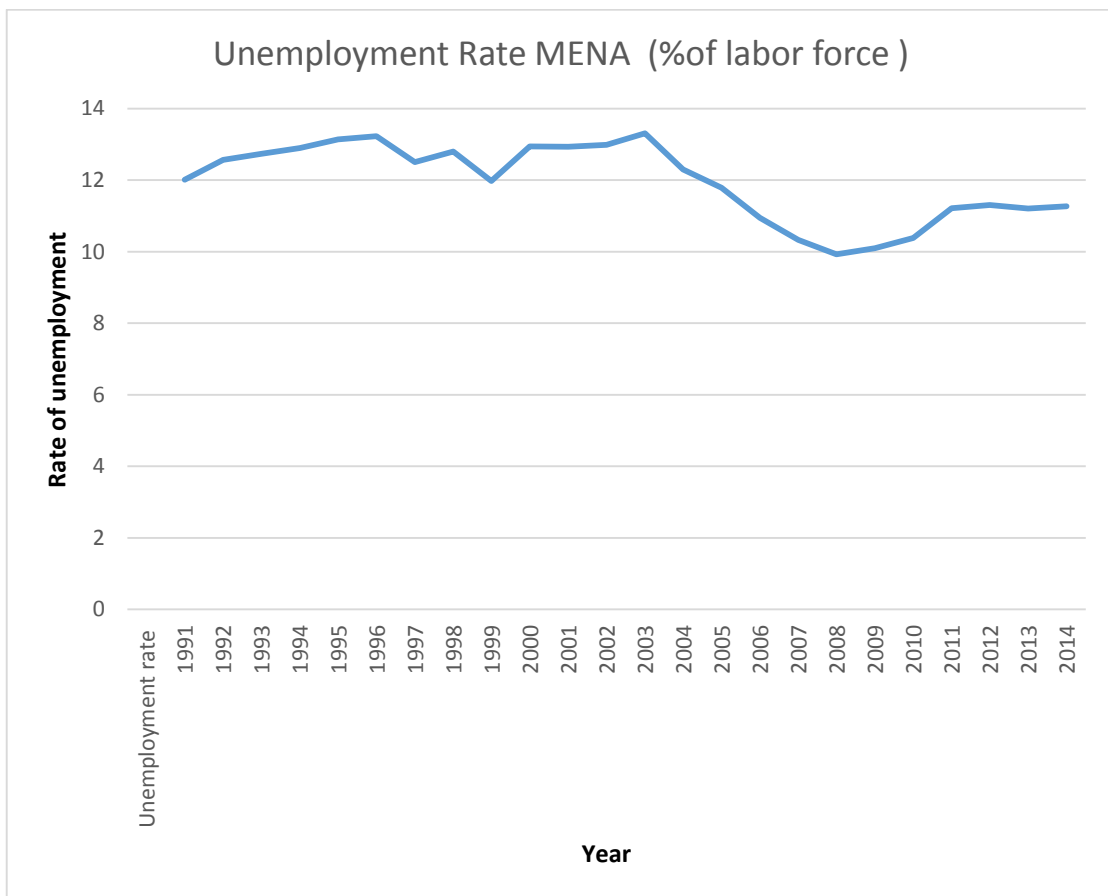


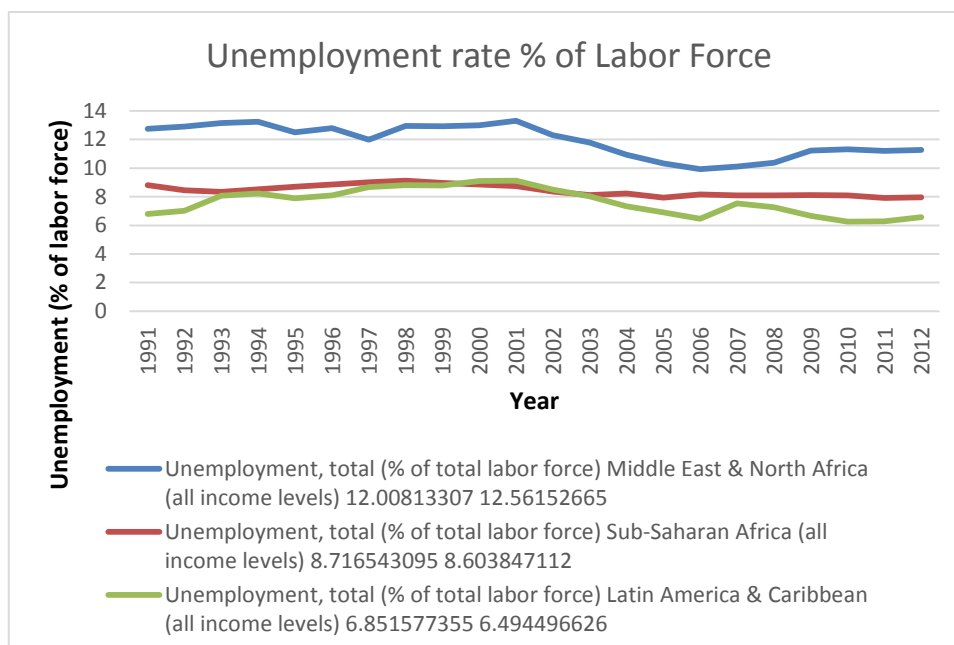**Figure 3: Unemployment Rate (% of labor force)**

**Figure 4: Unemployment rate % of Labor Force[2]**

The overall performance of the MENA region is quite higher than the regional samples developed and shows the need for strong economic policies aimed at targeting not only the problem of unemployment in the countries composing it but as well addressing the key variables or causes behind the upward trend since 2010. Which might be due to the wave of uprising that have loomed over the region.

**C. Gross enrollment ratio**

The gross enrollment ratio has been used in our study and provides a key indicator towards the path the MENA region as a whole is undergoing in terms of education. Since education is a critical factor that aids in the buildup of economic growth. To compare the overall MENA performance the below graph aids in the assistance of the analysis.

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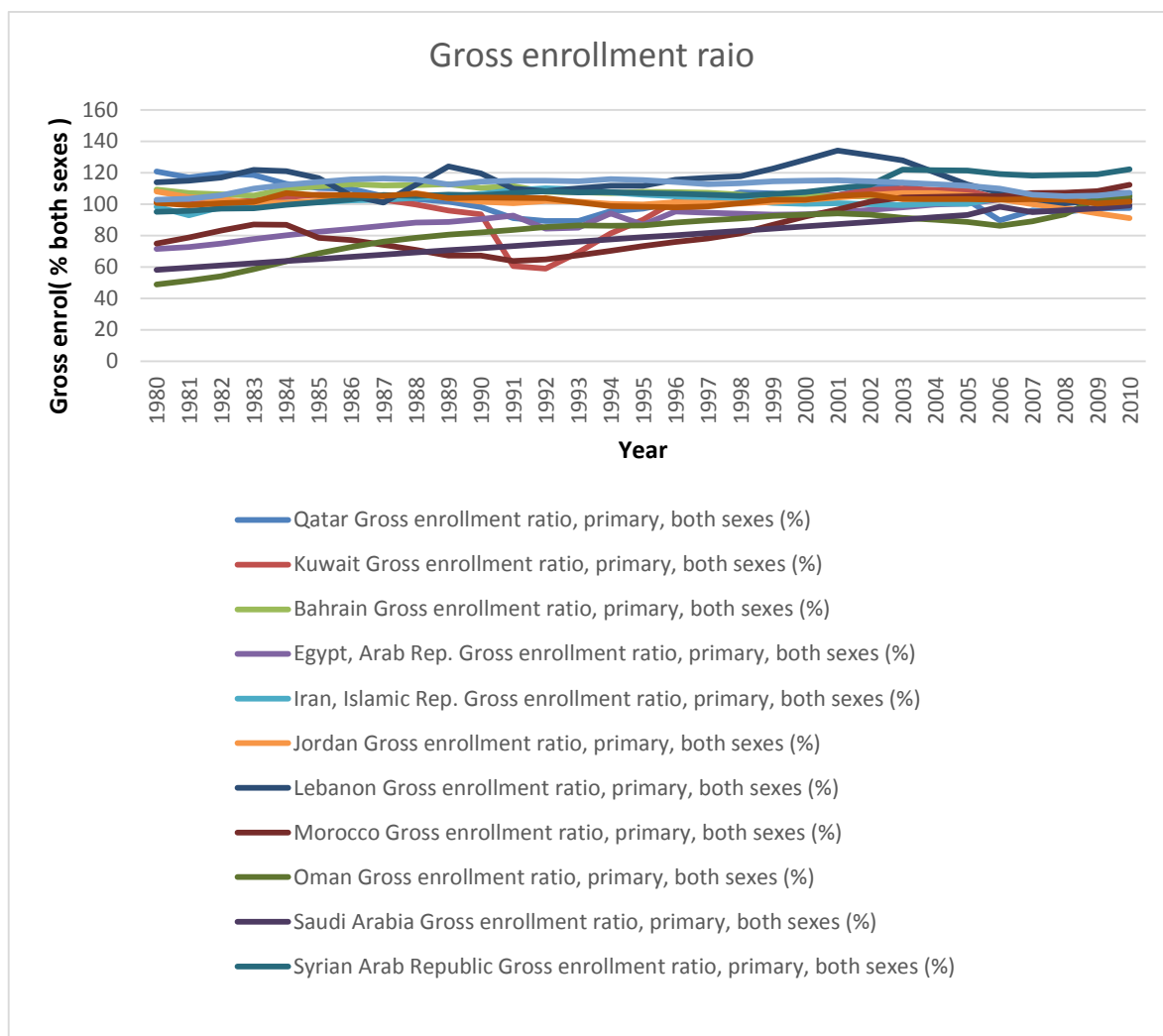[2] Table source: World Bank database

**Figure 5: Gross enrollment ratio**

As observed in the above graph the graph implies a similar trend in the in selected Mena region the trend of gross enrollment or what is regarded as education has witnessed a growing trend since 1980.

**D. Gross capital Formation**

Gross capital formation is used in our study as a proxy for private investment levels in each selected country of the thirteen countries. The gross capital formation has witnessed an increasing trend in the MENA region.
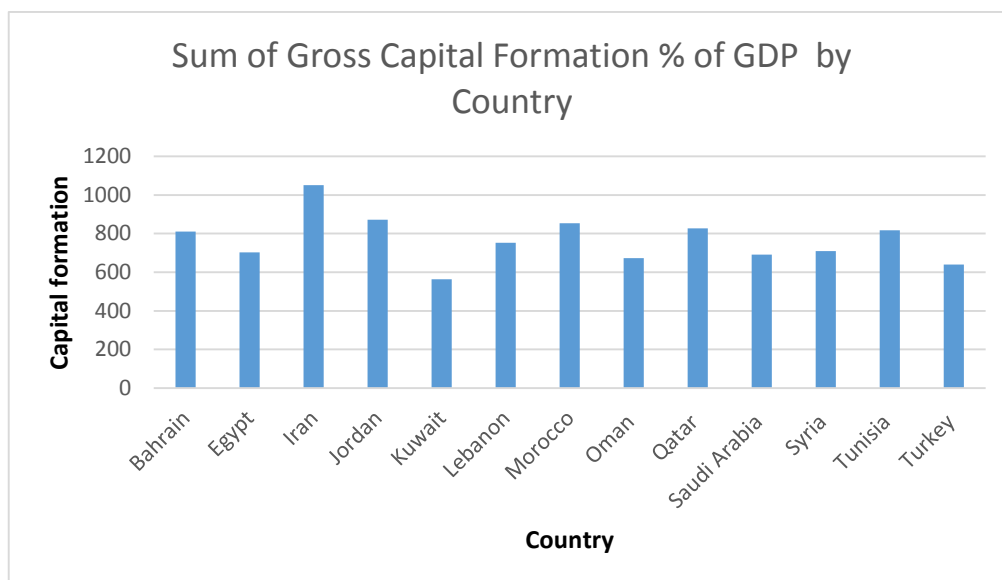
**Figure 6: Sum of Gross Capital Formation % of GDP by Country**

**E. Inflation Rates**

As for the inflation rate in the MENA region it has been fluctuating around the years of 1970-2015 around an average of 6%. The inflation rate is quite harmful due to many factors since it decreases the general purchasing power ability of the consumer along with the erosion of disposable income. Throughout the sample of thirteen countries Lebanon has witnessed the highest inflation level in all thirteen countries which is attributed to the general climate of Lebanon that is perceptive to outside shocks and movements.

As for the regional level the MENA region enjoys a relatively non-volatile inflation rate along its counterpart sub regions.
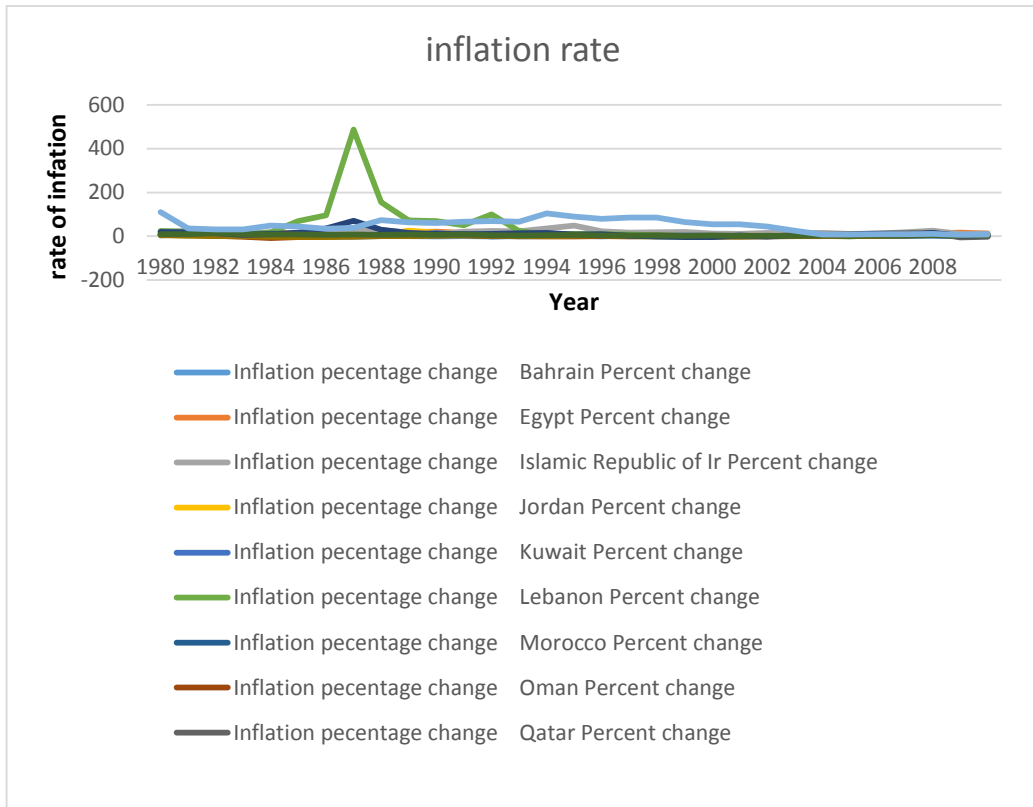
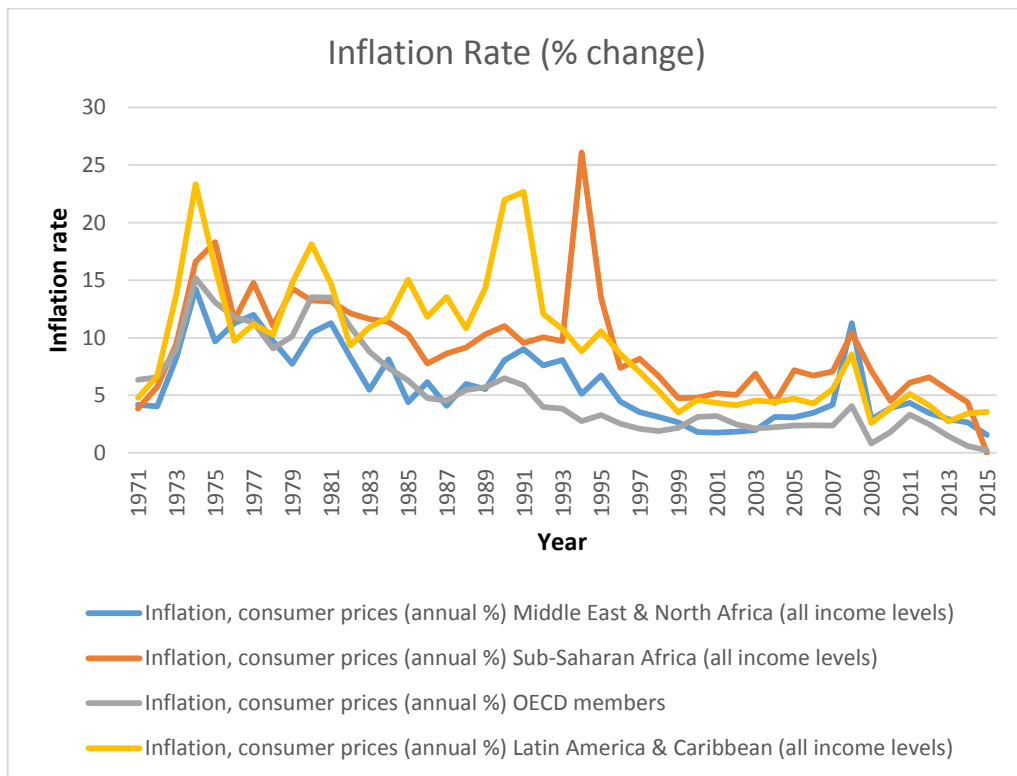**Figure 7: Inflation Rate**



**Figure 8: Inflation Rate (% change)**

Along with the graphical representation of a few determinants or influencers of economic growth it is noteworthy to add that the MENA as a whole suffers from corruption which is one of the highest levels. Along, with corruption there exists red tape, bureaucracy, as well as the inward looking state oriented policies the region suffers from (Guetat, Serranito, 2007). As well as undiversified economies of oil exporters depending on the abundance of oil wealth as well as the oil importing countries that base their economic structures on services and trade. Thus both economic structures have a heavy dependence on exogenous variables that are outside their country boundaries. The combination of non-diversification along with the tremendous amount of regional and political volatility render the economic structures of most of the MENA countries of vulnerable nature towards shocks which causes low growth rates as well as a bad investment climate prohibiting the proper expansion of certain industries such as industry and ones that rely on research and development.

The implication of inflation as a deterrent of growth arises from the paper examined by Barro,1995 deduces that if inflation rates increase by ten percentage points leads to a reduction of growth rate of GDP/capita by 0.2-0.3 percentage points as well as a decline in the overall investment ability of the economy.

# CHAPTER IV

# EMPIRICAL TESTING

**A. Methodology and Theoretical Framework**

Panel data is the method used since we need to allow for differences in country specific variables used in testing the convergence hypothesis.

The technique used in our dynamic panel data model of estimating the convergence hypothesis would be that of Fixed Effects. Fixed Effects is used due to the need to explore the relationship between GDP or in our case, log (GDP/cap) and that of the inflation rate of the country as well as the effect of government expenditure, gross enrollment education (primary), polity IV scores and finally gross capital formation. Such variables are country specific and relative, thus are different for different countries.

In his paper of Islam has attempted to select the best possible estimator for panel data. His work on panel data comes with great attribute towards the convergence literature (Islam, 1998). The most popular approach towards the convergence debate where the cross section application of this topic in the growing span of literature is the importance of the negativity and significant results estimated. However, the cross section estimation has its econometric drawbacks which has lead researchers to adopt new methods of examining or testing the convergence hypothesis mainly panel data estimation.

Such approach using panel data has the ability of removing the omitted variable bias which is also allowed to enter the regression since it accounts for country variables or specifics. Omitted variable bias is an econometric problem that arises in applying the

convergence regressions. GMM on the other hand solves for endogeneity bias present in the growth regressions.

The paper written by Islam and mentioned above is the base of the empirical approach of this thesis. He addresses in the paper the different estimates that can predict the best approach of panel data. Through the investigation he conducts a Monte Carlo simulation of a selected variety of econometric models in an attempt to cypher which is the best for the convergence theory in a small sample setting (Islam, 1998).

The reasoning mentioned above as well as the paper by Islam[3] are the relevant application of panel data of the regression used throughout testing convergence in the MENA region.

However, the move from the Solow model which initiated the growth equations towards the panel data method employed is derived from the paper by Barro and Sala-I-Martin (1992), using a non-linear least square regression the equation results is

$$\frac{1}{T} * \log(\frac{Y_{i,t_0+T}}{Y_{i,t_0}}) = \beta - \left(\frac{1-e^{-\beta T}}{T}\right) * \log\left(Y_{i,t_0}\right) + u_{i,t_0,t_0+T} \qquad (1)$$

The panel data model to test convergence in this framework is the following

$$lny_{i,t} = \delta + \Phi lny_{i,t-1} + \delta X_{i,t} + \varepsilon_{i,t} \quad (2)^4$$

The above model is deduced after some parametric manipulation

Ln Yi, t: log GDP/capita

$\delta$      : intercept

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[3] Islam, 1998.
[4] Equation 1 is estimated by ( Montero, Casto. Del Rio, Marco (2013).Upon the author's derivation of the model from the one used in Barro and Sala-I-Martin,1992)

$\phi$      : is the estimated coefficient

$X_{i,t}$ :    is the controlled variables vector included in the model

$\varepsilon_{i,t}$ : is the error term of the regression

He concludes the research with the validation of the use of LSDV as an appropriate method of data estimation since it rids the regression or the estimation of the convergence hypothesis of omitted variable bias.

The absolute convergence theory is translated econometrically via the following equation:

$$y_{i,t} = \beta_0 + \beta_1 y_{i,t-1} + \varepsilon_{i,t-1} \tag{2}$$

The absolute convergence hypothesis is that of estimating log GDP on its past or t-1 value. The estimated equation (2) is an autoregressive regression estimated using fixed effects.

The test for conditional convergence will be the following:

$$y_{i,t} = \beta_0 + \Phi y_{i,t-1} + \beta_1 X_{i,t} + \varepsilon_{i,t} \tag{3}$$

The conditional convergence estimated in the equation has a vector X which is a vector of structural differences that allow for different cross country variables or as called in the convergence literature structural attributes that are country specific.

**B. Data Criterion:**

The data selected in this dynamic panel data approach is from the Summers Hesston Penn world table version 6.2. That is the primary source of the other conditional variables for the conditional β convergence is relied exhaustively on the World Bank, and the International Monetary Fund.

The convergence hypothesis to be examined in the thesis is from 1980-2015 ,along with the following countries which are Bahrain, Egypt, Iran, Jordan, Kuwait, Lebanon, Morocco, Oman, Qatar, Saudi Arabia, Syria, Turkey, and Tunisia. The data is selected based on the availability not only for the GDP/capita measure from the Summers Hesston Penn world tables but on the measures of the controlling variables of the convergence theory. The other conditioning variables include the following: Inflation percentage change, Gross Capital Formation % of GDP, Polity Score, Trade (% of GDP), government expenditure as % of GDP, Gross enrollment ratio primary education. The control variables are presented as the structural deviations that are country specific and serve as conditioning variables that are attributable towards the conditional convergence test.

| Label | Description | Source |
|---|---|---|
| Trade as a share of GDP | Trade is the sum of exports and imports of goods and services measured as a share of gross domestic product. | World Bank(WDI) |
| Gross Enrollment | education, regardless of age, expressed as a percentage of the population of official | World Bank(WDI) |
| govexpenditure (% of GDP) | General government final consumption expenditure (formerly general government consumption) includes all government current expenditures for purchases of goods and services (including | World Bank(WDI) |
| gross capital formation | Gross capital formation (formerly gross domestic investment) consists of outlays on additions to the fixed assets of the economy plus net changes in the level of inventories | World Bank(WDI) |
| inflation rate | percentage change in rates | IMF |
| polity IV scores | state's elections for competitiveness and openness, the nature of political participation in general, and the extent of checks on executive authority | center for systematic peace |
| GDP/Capita | Penn World Tables | Heston, Alan and Summers, Robert. |

**Table 1: List of Independent Variables**

The table above shows that these control variables are selected on the basis of their ability to contribute to growth.

Inflation is selected from the study that Barro discussed as significant leading to growth, as well as in the paper written by ……… during their study of the convergence hypothesis in the MENA region has come up with significant values(Barro,1995)

Gross capital formation is used as a proxy for the level of private investment that a country possess thus to some level display the climate the country has with its level of private investment.

The polity IV score is used as a measure for democracy whereby throughout the time period selected displays the level of democracy or autocracy the country possesses. Generally while reading Polity IV scores the continuum ranges from -10 to + 10 whereby -10 is a complete autocracy and +10 is a full democracy. Values ranging from a -10 to a -6 spectrum are called an autocracy (having the supreme power in the hand of one ruling person or party). A polity score from -5 to +5 would indicate that of an anocracy or which is identified with an incoherent mix of democratic and autocratic application of governance. Finally, a score 6 to a 10 indicates that the citizens of the society have a voice in the way of ruling of their country.

The trade as percentage of GDP is a proxy to which the level of openness the country has and it's calculated in the following manner [5] the index has been used in previous study of the MENA region as well in previous studies and has been accounted for as a conditioning variable.

Government consumption as a percentage of GDP is one of the attributes that control the growth rate of a country some researchers argue that the increase of government expenditure leads to a decrease in growth levels a country.

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[5] Trade as a percentage of GDP is calculated via the formula $\frac{imports_t + exports_t}{GDP_t}$

Gross enrollment ration in primary education is used as a proxy for the educational level of the country. However, we employ another indicator to test for the attribution that education has on the growth process. Thus another conditional convergence regression is performed using only tertiary education instead that of primary.

## C. Empirical Testing

In order to estimate the following regressions which are equations (2) and (3) the choice of estimation is panel data fixed effects used on STATA program. First we log the GDP/capita growth rate that we have acquired from the Summers-Heston Penn World table .Then, the time period selected values of GDP/capita and the selected controlling variables have been averaged to make the observation of the two consecutive years that follow their average as follow

$$y_{1980,1981} = \frac{y_{1980,i} + y_{1981,i}}{2}$$

The following method has been used to average the whole 13 countries and their respective observations. Hence, yielding the amount of observations that result into half. As well as averaging the log GDP/cap growth rate the method was carried out to all six controlling variables as well.

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| 2 years average | | | | |
| φ | 0.845*(0.043) | 0.948*(0.037) | 0.761*(0.045) | 0.761*(0.062) |
| Gross enrollment | -0.001(0.001) | - | - | - |
| Inflation | 0.0009(0.000) | - | 0.005(0.005) | 0.005(0.001) |
| Gvt Exp | -0.787*(0.183) | - | 0.748*(0.171) | 0.748(0.251) |
| Trade | -0.001(0.001) | - | 0.001(0.001) | 0.001(0.001) |
| Polity | 0.0176*(0.007) | - | 0.123**(0.007) | 0.123(0.101) |
| Average cap formation | 0.002**(0.002) | - | 0.004(0.002) | 0.004(0.003) |
| Tertiary education | - | - | 0.008*(0.002) | 0.008*(0.003) |
| $R^2$ | 0.94 | 0.96 | 0.9352 | 0.9352 |

**Table 2: Econometric results**

[1] Coefficients denoted with a * represent significance at 5% level

Those with ** represent significance at 10 % level

### D. Convergence Test

The table above indicates four convergence tests attempted model (1) is the absolute convergence test of the thirteen countries.  Whereas model (2) is the conditional convergence test which the controlling variables of gross capital formation, government expenditure as a share of GDP,trade as a percentage of GDP,inflation rates, polity scores, and gross enrollment ratio in primary education.

Model (3) serves as a robustness check so that education might turn out significant had another proxy been used thus we resort to tertiary education.

Model (4) is only a change in standard errors after checking for heteroscedasticity in the regression.

In Model (1) the test of absolute convergence results in a positive and significant level of 0.948*(0.037) which is significant at the 5% level. Thus indicating the presence of a single equilibrium level of all thirteen selected MENA countries. The presence of absolute convergence leads us to conclude that there might be evidence of conditional beta convergence as well thus we run model two.

The results indicate the presence of a conditional convergence in the selection. As well as a few factors which turn out significant in the conditional process. The significant variables are government expenditure as a share of GDP. The sign and significance are of predicted value since the increase of government expenditure in a country leads to a further gap between the country and its long run steady state level. Whereas, the polity index has a positive and significant value indicating that the more democratic ruling a country enjoys is contributing towards the attainment of positive growth levels. Finally average capital formation which is a proxy used to account for private investment at the country level yields the expected positive significant sign which indicates that the increase in investment increase the growth of GDP in a country.

Model (2) consist of the conditional convergence using equation (3) where by conditioning convergence to six variables as well leads to the presence of a conditional convergence. As well as a few factors which turn out significant in the conditional process. The significant variables are government expenditure as a share of GDP(-0.787*(0.183). The sign and significance are of predicted value since the increase of government expenditure in a country leads to a further gap between the country and its long run steady state level.

Whereas, the polity index has a positive and significant value [(0.0176*(0.007)] indicating that the more democratic ruling a country enjoys is contributing towards the attainment of positive growth levels. Finally average capital formation which is a proxy used to account for private investment at the country level yields the expected positive significant sign [0.002**(0.002)] which indicates that the increase in investment increase the growth of GDP in a country.

The results here confirm the presence of the conditional convergence hypothesis indicating a significant and positive sign of β. Such results are inline and expected from a panel data approach towards applying the convergence test. The overall indication of only three significant variables leads to conclude that such variable which are gross capital formation, government expenditure as a share of GDP, as well as polity IV scores contribute in allowing the structural differences to that of the countries selected. Thus the countries of the MENA region experience the catch up theory which poor countries catch up towards those rich countries.

The r squared of the regression is quite high thus indicating that the independent variables do contribute in explaining 94% of the model estimated by equation 2.

Since model (2) results conclude the absence of any significant role of education we employ model (3) as a robustness check. The inclusion of tertiary education as a proxy for education instead reveals a significant level of tertiary education and a positive sign as expected [0.008*(0.002)].Hence, proving that education does contribute towards economic growth. In a study conducted by Barro he states that a country approaches its steady state faster if it possess a higher level of human capital in the form of education and health (Barro, 1995).

Whereas model (4) serves a correction of the heteroscedasticity in the model thus changing the standard errors making them instead robust standard error after solving for heteroskedasticity

***Speed of convergence ß and the implied Half-life calculation***

The final attribution to account for is estimating the speed of convergence The procedure to estimate the half-life and the speed of convergence are done as follows

| Half life and Speed | |
| --- | --- |
| | Value |
| ß(F.E.) | 0.845 |
| Speed of convergence | 8.40% |
| Half-life estimated | 49 years |

**Table 3: Half-life and Speed**

The equations used to estimate the half-life and speed of convergence are represented as follows

$$\beta = \frac{-ln\Phi}{T}$$

The value $-ln\Phi$ is the value that we attained during our regression analysis of conditional convergence represented by $0.845 y_{i,t-1}$. As well as the T which is the number of averaged years. In our regression we use the average of 2 years hence our T =2.

As for the calculation of the half-life then the equation is the following

$$Half\ life = \frac{-\ln(1 + T\beta)}{T}$$

Thus it takes 49 years for the 13 MENAcountries to catchup to the richer countries in the group.

# CHAPTER V

# CONCLUSION

The convergence hypothesis is a byproduct of the growth model initiated by the Solow model (Solow, 1956).It has been of great interest for growth economists and has undergone a large amount of research in the past fifty years in terms of the econometric models employed to address the catch up theory. Empirical extensions of the model have attempted to understand why and how low per capita income levels of poor countries would tend to catch up with the per capital income levels of rich countries.

Throughout the thesis we briefly review the literature on the growth theory beginning with the basic Solow model and then move to the empirical testing and the various econometric representations of the model given by Barro and Sala-I-Martin **(1992)** and the solutions provided by Islam in his papers in 1995, 1998 that represent an excellent survey of the topic as well as an econometric base that has been employed in the convergence debate. This is followed by testing the convergence hypothesis in the MENA region. For the selected MENA countries we obtain results that are in line with that of previous research done on the region relating to both absolute and conditional beta convergence.

For the conditional β convergence the tests show that there also multiple equilibria that these countries converge when we allow for the presence for structural differences. The speed of the β convergence is 8.4%, implying the half-life needed to move towards the long run is 49 years.

The main explanatory variables of convergence are government expenditure (as a percentage of GDP) and polity scores (as a proxy for democracy) and capital formation.

The first two are significant at the 5% level while the third is significant at the 10% level.

The signs of the independent variables (positive for democracy and capital formation and negative for government expenditure) are in line with other research supporting the catch up theory.  These results thus confirm the presence of conditional and absolute convergence in the selected MENA countries. This is the main contribution of this thesis.

Finally we would like to note that further research to identify possible convergence clubs may be worth undertaking as it may throw additional light on the question of convergence in the region

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