An Analysis of Real Convergence and its Determinants: Evidence from MENA Countries[1]

Nicolas Péridy[2], Corinne Bagoulla[3] and Ahmed Ghoneim[4]

Abstract

This article analyses and explains the real convergence process in MENA countries over the past 50 years. It provides a threefold contribution. Firstly, given the recent increasing attention paid to the Euro-Mediterranean area, it focuses on the convergence of MENA countries towards the EU per capita income. Second, it provides an econometric modelling of the determinants of convergence. Finally, it is based on a wide set of convergence indicators (including the Kendall index of rank concordance), applied to various measures of per capita income as well as the Human Development Index (HDI). Results show that despite a lack of σ-convergence for the MENA region taken as a whole, the convergence hypothesis is accepted using the γ and β-convergence tests, especially for Tunisia, Egypt, Turkey and Morocco. However, there is evidence of divergence for Jordan and Algeria. It is also shown that the convergence process strongly depends on education, R&D, transport and infrastructure as well as public investment. By contrast, there is no direct impact of the Barcelona Agreement, although the EIB loans positively contribute to the convergence process. Finally, trade specialization and firm agglomeration have been detrimental to convergence of MENA countries.

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[2] Corresponding author : Université du Sud Toulon-Var (France), LEAD, UFR Sciences Economiques et Gestion. Avenue de l'Université, BP 20132, F-83957 La Garde Cedex. Phone : +33 494 142 982. email : nicolas.peridy@univ-tln.fr

[3] Université de Nantes (France), LEMNA, Institut d'Economie et de Management- IAE

[4] Cairo University (Egypt), Faculty of Economics and Political Science.

Introduction

Middle East and North African (MENA) countries have experienced a rather disappointing macroeconomic performance in the past decade, especially when compared with some Asian countries. As an illustration, according to the classification of the World Bank, the average growth rate of these countries reached only 3.8% in the 90s and 4.1% from 2000 to 2006, whereas at the same time, East Asia and Pacific countries registered respectively 8.5% and 8.4% and South Asian countries 5.6% and 6.5% (World Bank, 2008).

This modest performance questions the capacity of MENA countries to converge toward EU per capita income levels. This problem is particularly important since the persistence of huge gaps in the standards of living between the two sides of the Mediterranean is likely to reinforce economic and political problems linked to poverty, illegal migration as well as political instability in these countries.

In this regard, the implementation of the Barcelona Agreement in 1995 was intended to reinforce the economic relationship between the EU and MENA countries, as a means of boosting trade, FDI and also economic growth of these countries. This objective was stated again in the European Neighborhood Policy (ENP) and more recently when the Union for the Mediterranean (UMed) was initiated.

Despite the importance of the concept of real convergence for both the EU and MENA countries, there is currently only a few empirical studies available applied to these countries. Rey (2005), Guétat and Serratino (2006, 2007), Erlat (2007) and Pesaran (2007) concentrate on an analysis of convergence of MENA countries across themselves. This means that the convergence test applies to the income threshold of these countries and not of the EU. Results suggest that the convergence process is not uniform over time and across countries. For example, there may be some differences between oil countries and non oil countries (Rey, 2005), or the existence of convergence clubs as argued by Guetat and Serratino (2007). In any case, the convergence hypothesis is not clearly established for Mediterranean countries.

A few other studies choose another income reference threshold, such as Southern EU countries and France (Guétat and Serratino, 2008, 2009). Using time series tests for income convergence, these authors conclude that there is generally no convergence of MENA countries toward Southern EU countries levels, with the exception of Tunisia and Egypt.

The article presented here complements the studies cited above in several aspects. First, it selects the EU as the reference threshold. The question is thus to assess whether MENA countries have converged towards EU levels, and not toward MENA countries' income long run equilibrium or Southern EU countries' income. This difference may be important because Southern EU countries have experienced higher per capita GDP income growth than the rest of the EU. As a result, MENA countries could have converged toward EU levels without converging toward Southern countries' income. In addition, taking EU countries as the reference is particularly relevant with regard to the new developments of the Euro-Mediterranean policy, especially since the Barcelona agreement in 1995.

A second contribution relates to the analysis of the determinants of convergence (or more generally income growth differential between MENA countries and the EU). For that

purpose, a panel data econometric model of *conditional β–convergence* is implemented, with alternative estimators addressing the endogeneity bias. The impact of R&D and human capital, trade and openness, economic geography as well as transport and infrastructure is tested. In addition, the effects of the EU regional policy is also investigated, especially through the implementation of the Barcelona agreement in 1995 and the European Investment Bank (EIB) loans granted to these countries.

As a final contribution, several convergence indicators are tested. These are not only the traditional σ and *β-convergence*, but also the *γ-convergence* developed by Boyle and McCarthy (1999), based on a Kendall index of rank concordance. Similarly, the analysis does not only focus on convergence of various per capita income indicators (PPP, Laspeyres, chain series, per adult equivalent, per worker), but also on convergence of the Human Development Index (HDI).

This paper is organised in three sections. The first one analyses the convergence hypothesis through stylised facts and the calculation of various convergence indicators. The second section focuses on modelling the determinants of the per capita income differential between MENA countries and the EU. Section 3 concludes and discusses the main policy implications of the results.

1. **An analysis of per capita GDP convergence in MENA countries.**

a) Changes in per capita GDP: some stylised facts

A first insight about convergence can be provided by looking at changes in GDP per capita in MENA countries compared to those of the EU. Several country groups can be identified. The first is the EU as a reference group. The EU-6 is first identified as the core reference countries. The EU-15 is also used as an alternative. MED-7 corresponds to the selected MENA countries, including Algeria, Morocco, Tunisia, Egypt, Jordan, Syria as well as Turkey. Since data for Lebanon are often unavailable, this country is excluded from the Mediterranean country group but data are presented separately when available. Similarly, Israel is considered separately, given the huge gap between GDP per capita in this country and that in the other Mediterranean countries.

Statistics are presented over the period 1960-2007 using yearly averages[5]. More detailed results are displayed in three sub-periods. The first ranges between 1960 and 1977. It corresponds to the conclusion of the first preferential agreements between the EU and some MENA countries (Association agreements). The second period (1978-1994) corresponds to the implementation of the Global Mediterranean Policy. Finally, 1995-2007 coincides with the period of the Barcelona agreement.

[5] When per capita GDP growth is calculated for a country group, this statistic is weighted by the share of each country in the total GDP of its group.

As a sensitivity analysis, several indicators of GDP are considered alternatively: GDP in US constant price, GDP in purchasing power parity (PPP), the Laspeyres GDP per capita[6], the chain per capita GDP[7], the real GDP chain per equivalent adult[8] as well as the real GDP chain per worker[9] (Heston et al., 2006).

Tables 1 and 2 report these various statistics (see also Figure 1). Several major features emerge from these tables. If we first consider the whole period (1960-2007) (Table 1), it is striking to observe that the per capita GDP growth in MENA countries (MED-7) is very close to that recorded for the EU (EU-6 and EU-15), whatever the GDP indicator used. However, this result masks significant differences across countries. As a matter of fact, countries like Tunisia, Morocco as well as Egypt show per capita GDP growth rates above that of the EU. On the other hand, Algeria exhibits growth rates well below the EU average, whereas for Turkey and Syria, it is similar to that of the EU.

Considering changes over time, it is worth mentioning that the EU per capita GDP rate of growth is declining over time whatever the indicator considered. For example, taking the Laspeyres indicator, the rate of growth for the EU-6 declined from 3.35% in 1960-77 to 1.91% in 1978-1994 and down to 1.34% in 1978-2007 at yearly average. Regarding MED-7 countries on the other hand, this rate of growth declines first (from 2.51% to 1.62%) before recovering in the last period up to 2.13%. This means that in the first two periods, the MED-7 rates of growth are generally lower than those recorded for the EU before rising above those of the EU from 1995 onward[10].

Again, there are some differences across countries. Tunisia, Turkey and Jordan follow this general declining-recovering trend, whereas Morocco, Egypt and Syria show a declining trend over the whole period. As a result, these differentiated trends modify the ranking of the countries in terms of GDP growth over time. As a matter of fact, taking the most recent period (1995-2007), the best performance is recorded for Tunisia and Turkey (increasing trend), still followed by Egypt despite its declining trend. These three countries are above the EU average. On the other hand, Morocco moves from above to EU-average (declining trend) and Syria moves from above to below EU-average. Algeria and Jordan generally remain below the EU-average.

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[6] It is obtained by adding up consumption, investment, government and exports, and subtracting imports in any given year.

[7] This is a chain index obtained by first applying the component growth rates between each pair of consecutive years, t-1 and t, to the current price component shares in year t-1 to obtain the domestic absorption (DA) growth rate for each year. This DA is then applied backwards and forwards from 1996, and summed to the constant price net foreign balance to obtain the Chain GDP series.

[8] The equivalent measure used here assigns a weight of 1.0 to all persons over 15, and 0.5 for those under age 15 (refer to Heston et al. (2006) for additional details).

[9] Worker for this variable is usually a census definition based on an economically active population. The underlying data are from the International Labour Organization, and have been interpolated for other years.

[10] The only exception concerns real GDP per capita per worker, for which the MED-7 rate of growth also declines in the last period.

Considering finally the special cases of Lebanon and Israel, there is some evidence of convergence for Lebanon in the late period (for which data are available). However, these figures must be taken cautiously because of the effects of the war and of the reconstruction of Beirut. With regard to the performance of Israel, it first is above EU averages before moving below.

To sum up, Tunisia is the country which is the most likely to have converged toward EU rates, because its growth rate remains higher than that of the EU whatever the period and whatever the indicator taken into consideration[11]. Turkey and Egypt are also likely to have converged toward EU rates, though their performance is not always above the EU-average depending on the period and the indicator taken into consideration. Morocco is an intermediate case, where the rate of growth was initially above the EU levels, but moved recently to the EU average. Finally, there is no evidence of convergence for Algeria, Jordan and Syria looking at their per capita GDP growth rates.

A final interesting set of statistics relates to the comparison of growth rates with the four cohesion EU members (Greece, Spain, Portugal as well as Ireland) (Figure 2). Over the whole period, it is obvious that these four countries perform better than MED-7 countries. In fact, only Tunisia approaches these growth rate levels. However, the evolution over time changes this picture to some extent. As a matter of fact, the growth gap between MED-7 and cohesion countries is very significant in the first period. However, this gap is narrowing in the second and last periods. In 1995-2007, the per capita GDP growth in MED-7 countries becomes greater than that of Portugal and approaches that of Spain (this is particularly true for Tunisia, Morocco, Egypt and Turkey). The gap is only increasing with Ireland, which has taken advantage of the growth wave in the financial economy.

b) The calculation of convergence indicators.

In the past few years, there has been considerable progress in the statistical measurement of convergence. Indeed, starting with the traditional indicators of convergence, i.e. rank, Gini and Theil indexes, some new concepts have been developed since Sala-i-Martin (1996). The first is *σ-convergence*, which states that a group of countries is σ-converging if the dispersion of their real per capita GDP levels decreases over time:

$$\sigma = \frac{\text{var}(GDPC_{it}) \big/ mean(GDPC_{it})}{\text{var}(GDPC_{i0}) \big/ mean(GDPC_{i0})} \qquad (1)$$

Where var(GDPC) and mean(GDPC) refers respectively to the variance and the mean of per capita GDP for country i at year t, using the reference period 0.

A related concept *is β-convergence*. It is derived from the neoclassical growth theory and is based on the idea that if poor countries tend to grow faster than rich ones, there is absolute *β-convergence*. More precisely, denoting y_{it} as the real gross domestic product per capita in

[11] With the exception of the per capita GDP chain per worker, for which Tunisia is close to the EU average.

country i at year t, the linearization of the neoclassical growth model yields to the following *absolute β-convergence* specification, often called the Barro regression (Mankiw et al., 1992; Ramajo et al., 2008):

$$\Delta y_{it} = \frac{\log y_{it} - \log y_{it-1}}{t} = \alpha + \beta \log y_{it-1} + \varepsilon_{it} \qquad (2)$$

where Δy_{it} is the annual rate of growth of GDPC. α and β are the parameters to be estimated with $\beta=(1-e^{-\theta t})/t$ and θ is the rate of convergence to the steady state. In case of convergence, β is expected to be negative (the lower the initial GDPC in country i, the higher its growth rate, which suggests convergence.

Since the initial conditions can be different across countries and can explain persistent inequality in per capita income, equation (1) can be amended in order to account for a set of k control variables $x_1, \ldots x_k$, which condition the steady state of each country. This makes it possible to write a second model which can be used for testing *conditional β-convergence*:

$$\Delta y_{it} = \alpha + \beta \log y_{it-1} + \gamma_1 x_{1it-1} + \gamma_2 x_{2it-1} + \ldots + \gamma_k x_{kit-1} + \varepsilon_{it} \qquad (3)$$

The application of the Barro regression to a convergence test concerning MED-7 countries with regard to the EU GDP per capita threshold can be made as follows. Starting from equation (2) and defining the reference country as the EU-15, the calculation of the *absolute β-convergence* between MED-7 countries and the EU can be implemented by estimating the following equation in panel data econometrics:

$$\Delta y_{it} - \Delta y_{EUt} = \alpha + \beta\left(\log y_{it-1} - \log y_{EUt-1}\right) + \mu_i + \lambda_t + \varepsilon_{it} \qquad (4)$$

where μ_i and λ_t are country and time-specific effects, which can be considered as fixed or random depending on the final specification of the model. The calculation of the *conditional β-convergence* is left for the next section when investigating the determinants of convergence.

As shown by Quah (1996) and Sala-i-Martin (1996), *β-convergence* is necessary but not sufficient for *σ-convergence*, while *σ-convergence* is sufficient but not necessary for *β-convergence*. This implies that the absence of *σ-convergence* indicator does not mean that there is no *β-convergence*.

Given that the *β-convergence* test has been criticized because of biases (notably because it neglects dynamics of changing national income distribution), the *γ-convergence* concept has also been introduced as a complement (Boyle and McCarthy, 1997 and 1999). It is based on the calculation of the Kendall index of rank concordance:

$$\gamma = \frac{\Delta(Ry_t + Ry_0)}{\Delta(Ry_0 * 2)} \qquad (5)$$

where Ry is the rank of per capita GDP. This index is generally stronger than the σ and *β-convergence* measures, since it captures changes in ranking across countries. More precisely, Boyle and McCarthy (1999) show that if there is no σ-*convergence*, the *γ-convergence* measure can be used to ascertain whether the *β-convergence* exists.

The remainder of this section focuses on the calculation of these convergence indicators. This analysis is applied to GDP per capita in MED-7 countries over the period 1960-2007. It is supplemented by an application to convergence of the Human Development Index (HDI).

Looking first at the *σ-convergence*, it is striking to observe that over the period 1960-2007, there is some evidence of divergence between MED-7 countries and the EU[12]. As a matter of fact, starting from unity, σ ranges between 3 and 3.5 in 2007 depending on the GDP indicator used (Figure 3a)[13]. However, it is worth mentioning that despite a continuously increasing value of σ, a decrease is observed for the first time in the very late period, i.e. from 2001 onward, which is an indication of recent convergence. More detailed information is provided at country level (Figure 3b). Although the evidence of divergence is globally confirmed for all MENA countries, there are significant differences. Tunisia shows the least increasing trend (from 1 to 1.8 over the period) with a significant decrease since 2000 (from 2.1 to 1.8). Tunisia is thus the country which has diverged the least. It has even converged in recent years. Turkey follows the same pattern, as well as Egypt and Morocco to a lesser extent. At the other extreme, Jordan, Algeria as well as Syria to a lesser extent experience a continuous and important increase in σ over the whole period, even since 2001. For these countries, divergence with the EU is very sharp.

These results complement those found in the previous section when observing per capita GDP growth. The same country ranking is found here with better performance for Tunisia and Turkey than for Morocco (intermediate case) whereas Jordan, Algeria and Syria are diverging the most. However, results somehow differ from the previous section in the case of Tunisia, because despite a continuous per capita GDP above EU levels (which would indicate convergence at first sight), this has not impeded the global variance to increase, except in the recent period.

A comparison with the four EU cohesion countries is provided in Figure 3c. With regard to Spain and Portugal, it is striking to observe a strong convergence process since their accession to the EU in 1985[14]. In recent years, the value of sigma has become very low, especially for Spain (0.25). The convergence of Ireland with EU-6 is even more striking since the late 80s (the value of σ reached 0 in 2001). This means that per capita GDP in Ireland reached the EU-6 level. After 2001, σ has increased, but in this case, this means that the Irish per capita GDP became higher than the EU-6 one. Greece is the only country for which there is less evidence of convergence during the past 45 years. These results suggest that there is a significant difference in the convergence process of the cohesion countries (generally converging rapidly to EU levels) and MENA countries, which have not *σ-converged* to EU per capita GDP.

To sum up, the *σ-convergence* indicator provides evidence of divergence between MENA countries and the EU, except in recent years for specific countries, such as Tunisia, Turkey as well as Egypt and Morocco to a lesser extent. These results contrast with cohesion countries,

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[12] The EU-6 is taken as the reference country group. However, calculations carried out with EU-15 provide similar conclusions.

[13] σ is not presented for PPP GDP per capita in Figure 3a. In fact, it follows a more acute upward trend (from 1 to 7.94).

[14] This result is supported by specific papers on cohesion countries, such as Barry (2003), Martin and Sanz (2003) as well as Ramajo et al. (2008).

especially Ireland, Spain and Portugal which show a rapid convergence process to the EU-6 per capita GDP levels.

However, as already stated previously, the absence of *σ-convergence* does not mean an absence of convergence process. This is why the *γ-convergence* indicator, based on the country ranking of per capita GDP, can be used together with the *σ-convergence* to infer about *β-convergence* (Boyle and McCarthy, 1999). The application of this indicator to the Euro-Mediterranean area complements the previous findings. As a first result, despite a stable or even increasing *σ-convergence* indicator, there is some evidence of *γ-convergence* between MENA countries and the EU-15, especially since the mid-80s. As a matter of fact, the value of γ decreases down to about 0.8 or 0.9 in 2007 depending on the measure of GDP[15] (Figure 4a). A breakdown by country shows that Tunisia tends to converge (0.56) (Figure 4b). This performance is comparable to that found for Mediterranean cohesion countries (Greece, Spain and Portugal) (see figure 4d). In fact, Tunisia greatly improved its ranking, moving from the 57th to the 43rd position over the period (Figure 4c).

Turkey and Egypt also show a decrease in γ since the mid 80s (down to 0.74 and 0.77 respectively). As a matter of fact, Turkey moved from the 54th to the 48th position, whereas Egypt moved from the 64th to the 54th position. Morocco and Syria remain stable around 0.8 all throughout the period, whereas Jordan and Algeria show an upward trend which suggests divergence. Indeed, Jordan moved from the 34th to the 65th rank, whereas Algeria moved from the 36th to the 50th rank.

Overall, compared to the *σ-convergence*, the *γ-convergence* analysis is generally not supporting divergence. However, the relative performance of the countries is unchanged whatever the convergence indicator used. As a matter of fact, the best performance in terms of convergence is that of Tunisia, followed by Turkey and Egypt. Morocco and Syria are in a intermediate position, whereas Algeria and Jordan are diverging whatever the convergence indicator used.

A last insight can be given through the calculation of *β-convergence*. In this regard, the estimation of equation (4) supports the results found with the *γ-convergence* analysis. First, there is some evidence of convergence between MED-7 countries and EU per capita GDP levels, whatever the way GDP is measured and whatever the estimator chosen (Table 3a). This result is also valid whatever the reference countries taken into consideration (EU-6 or EU-15) In this regard, it is worth mentioning that the Hausman test is generally significant. This favours the use of the fixed effects model (FEM).

More detailed results at country level indicate that the convergence hypothesis is clearly accepted (at 1% level) for Tunisia, Turkey, Egypt and Morocco (Table 3b). It is barely accepted for Syria (10% level) and clearly rejected for Algeria and Jordan.

One last insight about real convergence can be provided by applying the convergence indicators to the HDI. This index is particularly interesting, since it does not only take into account GDP per capita, but also life expectancy and education (literacy rate). As a result, it

[15] However, when GDP is measured per worker, the value remains close to 1, which does not suggest convergence.

provides a wider view of a country development convergence process than the GDP per capita only.

The calculation of the *σ-convergence* unambiguously concludes that there is a HDI convergence of all MED-7 countries. This conclusion is somewhat different than that previously calculated for GDP per capita. This difference is due to the fact that MED-7 countries have generally progressed at a greater rate for life expectancy and education than for standards of living. In the 60s for example, life expectancy was generally lower than 50 years for most MED-7 countries. In 2005, it is always greater than 70 years, whereas in most EU countries during the same period, life expectancy increased by only 10 years, i.e. from 70 to 80 years.

As a result, the HDI index tended to progress more rapidly in MED-7 countries than in the EU-6 (Figure 5). As a matter of fact, it moved for 0.54 to 0.73 in MED-7 countries and from 0.86 to 0.94 in EU-6 countries[16]. At country level, it is striking to observe that the countries which enjoyed the greatest convergence of the GDP per capita are the ones which experienced the greatest convergence in the HDI index, i.e. Tunisia, Turkey and Egypt. This means that these countries have a better performance than the others in the three components of the HDI. On the other hand, Jordan and Algeria to a lesser extent converge at a slower pace.

Results of the *γ-convergence* confirm the previous results, though the evidence of convergence is less established for Jordan and Algeria (Table 4).[17]Calculations of the *β-convergence* between MED-7 countries and the EU also support the convergence hypothesis, with a β-parameter significant at 5%-level (Table 5).

To sum up, the results obtained at this stage show that despite a lack of σ-convergence for the MENA region taken as a whole (except when tests are applied to the HDI), the convergence hypothesis is accepted using the γ and β-convergence tests, especially for Tunisia, Egypt, Turkey and Morocco. However, there is evidence of divergence for Jordan and Algeria.

2. The determinants of convergence between MENA countries and the EU

Starting from equation (3) and (4), the final model of *conditional β-convergence* can be written as;

$$\Delta y_{it} - \Delta y_{EUt} = \alpha + \beta\left(\log y_{it-1} - \log y_{EUt-1}\right) + \gamma_1 x_{1it-1} + \gamma_2 x_{2it-1} + ... + \gamma_k x_{kit-1} + \mu_i + \lambda_t + \varepsilon_{it} \quad (6)$$

where x corresponds to a set of control variables. For the same reasons as in equations (2) to (4), β must be negative to assume convergence. Indeed, the lower GDP per capita in country i relative to the EU, the higher should be its per capita GDP growth compared to the EU.

[16] Calculations of average HDI in EU-6 or EU-15 provide very close figures.

[17] The differences can be explained by the fact that the ranking in HDI is sensitive to the very small differences in HDI levels across two countries which differ for one rank. For this reason, the use of the *γ-convergence* seems less reliable when it applies to GDP per capita ranks.

As a sensitivity analysis, several alternative dependent variables are tested, as in the previous section. They include GDP in US constant price, GDP in purchasing power parity (PPP), the Laspeyres GDP per capita, the chain per capita GDP, the real GDP chain per equivalent adult as well as the real GDP chain per worker (source: Heston et al., 2006). Additionnally, the HDI is also included as an alternative dependent variable.

The choice of the control variables is guided first by the theoretical literature. In fact, although the neoclassical growth theory does not provide a unique and comprehensive framework which identifies all the determinants of growth, several major theoretical contributions make it possible to select a set of variables which are expected to explain growth and thus convergence. A first set of variables is related to human capital, such as education and R&D, which have been explicitly introduced in endogeneous growth models (Romer, 1990).

Trade and international factor mobility also play a certain role in the convergence process. In the standard neoclassical model, this is due to the fact that factor mobility makes it easier for capital to flow to capital-scarce countries, in order to benefit from higher return. However, the existence of a direct positive relationship between openness (or regional economic integration) and growth is still debated in the empirical literature[18].

The new literature on economic geography also contributes to this analysis by showing the role of firm location and agglomeration in the growth process (Krugman (1991), Redding and Venables (2004)). Additionally, some authors recently mixed growth models with economic geography (Martin and Ottaviano (1999), Fujita and Thisse (2002) as well as Baldwin and Martin (2004)). They stress the complementarity between growth and within country spatial concentration in a mutually self-reinforcing process. However, the link between agglomeration and growth has been recently revisited by showing non linearities (Bertinelli and Black (2004), Brülhart and Sbergami (2009)). This is the Williamson hypothesis which suggests that agglomeration matters more at early stages of development. Moreover, this relationship also depends on the type of specialization. Indeed, when countries specialize in (high) low value added products, this can (positively) negatively affect growth and convergence. This literature can also be related to papers on international trade, which tend to show that when countries specialize in high-tech industries, growth is increased and convergence occurs (Amable, 2000).

A final factor which can influence convergence is the use of public funds, like structural and cohesion funds. These funds are accompanying the regional integration process and directly aim at reducing income inequality across regions. In a stochastic endogenous growth model, Kutan and Yigit (2007) recently showed that in the presence of knowledge spillover effects, cohesion funds lead to more convergence in a regional economic area. More generally, Rodrik et al. (2004) stress the role of institutions as one major determinant of per capita income.

Summing up, the determinants of income convergence depend on various factors, such as return to capital, technology, human capital and knowledge spillover effects, the existence of agglomeration economies, the pattern of comparative advantages and specialization, public capital (especially infrastructure) as well as public policies which can affect the long-run growth through various incentives in terms of capital accumulation, technical innovation as well as the use of structural funds.

[18] For example, refer to Milanovic, 2006, Frankel and Romer, 1999 as well as Baier et al. 2009 for a survey.

Given the absence of a global growth theory which simultaneously includes all these factors, the empirical analysis is needed to identify the determinants of convergence. This is why the choice of the control variables is also guided by several empirical studies, especially Sala-i-Martin (2004), who empirically identifies 18 significant variables which determine long-run growth, from a Bayesian Averaging Classical Estimates (BACE) approach[19].

Based on the theoretical and empirical literature mentioned above, the control variables selected here include six groups:

- human capital and technology
- patterns of specialisation and openness (including regional integration and FDI)
- economic geography (agglomeration indexes)
- transportation and communication
- public funds (European Investment Bank (EIB) loans)
- other variables, mainly defined in Sala-i-Martin (2004), such as investment price, government consumption, investment share, population density, life expectancy, colonies as well as corruption.

For each group, several alternative variable measurements are suggested as a sensitivity analysis. The complete description of variables, data and sources can be found in the Appendix.

The choice of the estimators is guided by the specificity of the dataset, which contains panel data with both time-varying and time-invariant variables. Preliminary estimations are driven with standard fixed effects (FEM) and random effect models (REM). However, given that preliminary Hausman tests on REM indicate the presence of endogeneity problems, the estimator finally selected is Hausman and Taylor (HT). It assumes that some of the explanatory variables are correlated with the individual-level (country i) random effect μ_i. As an alternative, the generalized two-stage least squares instrumental variables estimator (G2SLQ IV) and the error component two-stage least squares instrumental variables estimator (EC2SLQ IV) are also used, since they consider that some independent variables are correlated with the idiosyncratic error ε_{it}. The first has been developed by Balestra and Varadharajan-Krishnakumar (1987). It uses the exogenous variables after they have been passed through the feasible GLS transform. The second one has been developed by Baltagi, where the variables are passed through the Within and Between transform (Baltagi, 2005; Baltagi and Li, 1992). In all cases, the estimation is based on instrumental variables and the initial income is used as the instrumented (endogenous) variable[20].

[19] These include some of the variables already identified in the theoretical models cited above as well as variables related to geography and demography (fraction of tropical area, population density, life expectancy), investment price, government share in consumption and colonization.

[20] In the HT estimator, additional variables are assumed to be endogenous. These are education, specialisation, openness, R&D as well as regional integration.

As alternative estimators, we present the Baltagi-Wu (BW) GLS which assumes a panel autocorrelation of the residuals (Baltagi and Wu, 1999), as well as the GLS for heteroskedastic error structures (HGLS)[21].

Tables 6a and 6b show the results for the model estimated for the whole period (1960-2007), using a) alternative estimators and b) alternative independent variables as a sensitivity analysis. Some secondary variables are dropped from the estimations because they are non significant and introduce multicolinearity problems. These are life expectancy, population density and coastal population density, corruption as well as colonization[22].

Basically, the results are fairly stable whatever the choice of the independent variable and whatever the choice of the estimator. As a matter of fact, the initial income level is always negative and significant at 1%-level. This means that MED-7 countries are converging to the EU level over the period 1960-2007, conditionally to the other independent variables included in the model. This result correlates with those found with the *absolute β-convergence* calculated the previous section.

Some other variables are also very significant. These are first education and R&D, which both significantly contribute to convergence in MED-7 countries. Second, transport and communication also play a determinant role for explaining growth and convergence. As a matter of fact, roads, telephone lines and even internet all show a positive and significant sign whatever the estimator.

Trade, specialization and economic geography also matter. Indeed, inter-industry specialisation exhibits a negative sign. This means that specialization in MED-7 countries is detrimental to convergence. This result can be explained by two reasons. The first is that the absence of intra-industry trade reveals the lack of product differentiation and scale economies. Following the new international economics (Krugman, 1995), this deprives MED-7 countries from important trade and growth gains related to product varieties and lower prices due to scale economies. A second and more important reason is that MED-7 countries generally specialize in low-value added products, i.e. textile and clothing, fuel products, basic chemicals or agriculture. This type of specialization is less growth creating than specialization in higher value added products (electronics, car industry, etc…). This result is supported by the economic geography variable which is negative. This suggests that the agglomeration of economic activities (measured first by urbanization) is detrimental to convergence because it concerns low value added industries, as stated by economic geography theory. In this regard, it is interesting to observe that the variable related to the share of primary exports is also negative.

The openness parameter is generally positive and significant. However, the significance level never exceeds 10% whatever the model specification. This indicates that openness is not a primary variable which explains growth, as is also shown by numerous empirical studies.

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[21] The other standard tests, such as LM, multicolinearity (VIF), omitted variables, etc… have been preliminary implemented and are available upon request.

[22] The reason for these variables to be insignificant can be found in the restricted sample of the study, i.e. the Euro-Mediterranean area. Sala-i-Martin (2004) uses a worldwide model, which better highlights the impact of these variables, especially because the data sample includes less developed countries (Subsaharian Africa, South Asia, etc…).

The direct impact of the Barcelona agreement is measured in three alternative ways. First, a temporal dummy is introduced in the model (it is equal to unity since 1995 and zero before). In tables 6a and 6b, this variable is positive but insignificant. Second, the model has been estimated in two distinct periods, i.e. 1961-94 and 1995-2007. For each model, the *β-convergence* parameter is estimated. Results show that this parameter does not significantly differ in these two periods. As a last exercise, the model is estimated by multiplying the initial income variable with a yearly dummy. This makes is possible to estimate a β-parameter for each year. Again, results show that the β-parameter is not changing significantly over time[23].

Amongst the remaining variables, the share of government consumption in GDP has an expected negative sign. This can be explained by the fact that public consumption is financed by distortionary taxes which reduce the growth rate (Sala-i-Martin, 2004). However, the share of public sector investment in GDP exhibits a positive sign. This result supports the role of public investment in MED-7 countries, especially concerning transport, infrastructure and technology.

To sum up, Tables 6a and 6b stress the primary role of education, technology, transport and communication as growth determinants. Trade specialization and firm agglomeration play a negative role due to specialization in low value added activities. However, at this stage, there is no evidence that the Barcelona agreement has made a significant impact.

The results presented above are complemented with additional sensitivity analysis. For that purpose, the model is re-estimated with an extended number of variables, used as different proxies for R&D, agglomeration, specialization and regional integration. However, since these extended variables are not available for the whole period, the estimation period is restricted to 1995-2007 (Table 9)[24]. Results are the following. First, using the patents applications as an alternative proxy for R&D provides similar results (positive and significant parameter estimate). Second, the alternative proxies for specialization are significant. As a matter of fact, the high-tech export specialization is positive[25]. Again, this supports the positive growth impact of high-value added product specialization. Trade dissimilarity presents an expected negative sign, because as trade in MED-7 countries becomes more dissimilar to that of the EU, it poorly matches international demand.

FDI is also introduced in the model as a complement of trade, specialization and openness but this variable proves to be insignificant. This means that there is no clear direct link between FDI and convergence in MENA countries. Again, it may be that openness and FDI inflows are a necessary but not sufficient condition for convergence. It depends on whether they apply to high-value added products.

The use of alternative economic geography variables support and complement the results found previously. Indeed, when replacing the urbanization index by a concentration index or

[23] Detailed results are available from the authors upon request.

[24] As a means of saving space, results are presented by using the Laspeyre GDP per capita as the independent variable. The complete set of results which includes the estimations for the other independent variables is available upon request.

[25] This variable is significant at 10% level because of muticolinearity problems with primary exports and R&D (inverse correlation). When removing these two variables, the high-tech export variable becomes significant at 1% level.

an entropy variable, these variables have both a significant and negative sign. This reinforces the idea that economic agglomeration in MED-7 countries has not supported convergence in recent years, because of the low value added of the products involved.

Finally, the indirect impact of the Barcelona agreement is tested by introducing a variable which accounts for EIB loans. This variable is unambiguously positive and significant at 1%. This means that although the convergence rate has not significantly changed since the Barcelona agreement implementation in 1995, the EIB instrument is a useful tool for promoting growth and convergence in MED-7 countries.

3. Conclusion and policy implications

This article has shown that despite a lack of σ-convergence for the MENA region taken as a whole, there is some evidence of γ and β -convergence between MED-7 countries and the EU, although some countries are not converging, especially Algeria and Jordan.

The analysis of the determinants of convergence revealed that some variables are crucial for explaining the convergence process. These are first education and R&D. In this regard, it is worth mentioning that some MED-7 countries have made significant efforts in the past decades. As a matter of fact, the secondary enrolment rate, which was below 50% in most MENA countries before 1990, has reached in 2005 more than 75 % in Turkey (76%), Tunisia (83%), Egypt (86%), Jordan (88%) as well as Algeria (83%). Significant progress has also been made in Syria and Morocco, although this rate is still below 70% in these countries. This progress must be pursued in the coming years in order to reach the 100% rate of developed countries.

Similarly, given the importance of R&D for explaining growth, MED-7 countries should go on investing in this field. Some countries have already made significant progress in recent years, especially Tunisia, Turkey and Morocco. In these countries, the R&D expenditures approach 1% of GDP. This is close to the levels reached in Southern EU countries, but still far from those in France and Germany (greater than 2%) as well as Sweden and Finland (more than 3.5%). However, Algeria, Egypt, Jordan and Syria exhibit rates which are lower than 0.35%. These countries should make considerable efforts in the coming years to improve their research capacity as a means of bridging the GDP per capita gap with the EU.

MED-7 countries should also continue to invest in transport and communication. For instance, Turkey, Tunisia, Jordan and Morocco have significantly improved their roads and developed highways and other transport infrastructure. These countries (including also Egypt) have also considerably improved telephone access, with more than 100 telephone lines per 1000 inhabitants. The internet access is also progressing. As a matter of fact, in 2005, Morocco has counted 24 internet users for 100 people, Jordan 23, Tunisia 17. However, these countries still remain far from EU levels (generally greater than 50 users per 100 people). As a result, investments in this area must be a priority. This remark applies particularly to Algeria, Egypt and Syria which generally show a wider gap with EU levels. In this regard, the econometric results showed that public investment play a significant role in the convergence process. This means that governments must give priority to investments in the areas mentioned above (R&D, education, transport and communication), even if public investment must be complemented by private investment.

MED-7 countries should also increase their efforts to open their economies even if openness and FDI are not sufficient conditions for growth. In addition, these countries must accompany their specialization process toward more high-tech (value-added) products more similar to international demand. As a matter of fact, these countries still face a detrimental specialization process which is growth-reducing simply because of the nature of the goods involved. In addition, the geographical concentration and agglomeration process is also detrimental to growth for the same reasons. A move toward higher value added industries specialization and concentration process would change this detrimental relationship by promoting growth. Again, the development of education and R&D and more generally human capital may be helpful for change in this process.

Finally, it has been shown that the Barcelona agreement has not made it possible to directly stimulate convergence. However, the EIB loans have significantly contributed to convergence. As a result, these loans must be encouraged and developed, especially for projects in line with human capital, transports and infrastructure. The contents of the Barcelona program should also be reconsidered in the light of the Union for the Mediterranean so as to include more growth-creating projects.

As a final point, some countries still face detrimental demographic and migration indicators (Table 9). The case of Jordan is particularly significant. Indeed, the population in this country has increased much more than in the other MENA countries, i.e. from 3 to 6 million inhabitants since 1990. This is due to both higher natural increase and also the inflow of foreign population after the two Gulf wars (especially from Iraq). As a consequence, in order to maintain the same growth in per capita GDP as the other MENA countries, this country needs to attain considerable GDP growth. Although economic theory does not directly relate population growth to standards of living, Jordan is likely to be negatively affected by population growth, partly due to the inflow of migrants. Syria and Egypt also face high growth rates (more than 2% each year) though it is not due to migration. Still, these countries should also accelerate their efforts to control population growth.

Appendix: Measurement, data and sources.

Human capital and technology:

- Education: it is measured by the secondary schooling enrolment rate. Source: WDI (2008)

- Technology: Two proxies are defined to account for technology (Source: WDI 2008)

    - Research and Development expenditures as a percentage of GDP

    - Patents applications, resident and non resident (data from 1985 to 2007)

Trade, specialization and openness

- Pattern of specialization. Following Amable (2000), two alternative variables are used to capture the impact of specialization on convergence:

    - Inter-industry specialization: $I_j = \frac{1}{2}\sum_i \left| \frac{X_{ij}}{X_{.j}} - \frac{M_{ij}}{M_{.j}} \right|$ with $0<I_j<1$

      The higher I_j, the more trade balances are dissimilar across industries, and then the higher inter-industry trade (source: own calculations from UNCTAD, 2008, Handbook of Statistics)

    - Trade dissimilarity: $A_j = \frac{1}{2}\sum_i \left| \frac{X_{ij}}{X_{.j}} - \frac{X_{i.}}{X_{..}} \right|$ with with $0<A_j<1$

      The higher A_j, the less the export structure of country j matches international demand (the more trade is dissimilar). This is expected to negatively affect growth, since in this case, trade patterns of country j is at odds with that of international demand. (source: UNCTAD, 2008, Handbook of Statistics)

- Openness. It is calculated in two alternative ways:

    - Trade in goods and services as a percentage of GDP at current price (WDI 2008) and Heston et al. (2006)

    - Trade in goods and services as a percentage of GDP at constant price (Heston et al. (2006))

- Regional integration: dummy which accounts for the various regional agreements between the EU and Mediterranean countries, especially the Barcelona agreement in 1997.

- FDI: flows and stocks in million US dollars. Source: UNCTAD, World Investment Report, 2008 (data from 1970 to 2007)

- Endowment in natural resources: primary exports as a percentage of total exports. Source: UNCTAD 2009 (Comtrade)

Economic Geography variables:

- Agglomeration: The sign is expected to be negative for countries which are specialised in low value added products, like MED-7 countries. However, it can be positive for other countries, since the agglomeration of firms of industry i in country j leads to a rise in productivity and thus a rise in wages and growth.

- Concentration (specialisation index): We denote first X as the variable of interest (output*), i*, the industry and *j*, the country and *t*, the year.

  Defining *Sijt* as the specialization ratio at industry-level:

$$S_{ijt} = \frac{X_{ijt}}{X_{jt}}$$

  And

$$S_{it} = \frac{\sum_j X_{ijt}}{\sum_i \sum_j X_{ijt}}$$

  With $X_{it} = \sum_j X_{ijt}$ and $X_{jt} = \sum_i X_{ijt}$

  Thus, the specialization (concentration) index is equal to:

$$D_{jt} = \sum_i |S_{ijt} - S_{it}|$$

  It measures to what extent the shares of the various industries i in country j output differ from those in the other countries (data from 1980 to 2003 from UNCTAD, INDSTAT 2008)

- Entropy-specialization index. As an alternative, this index is based on the Balassa location index L_{jt}, which measures the ratio of industry i's production to country j's total output, corrected by the ratio of country j's production to that of the whole Euro-Mediterranean area (data from 1980 to 2003 from UNCTAD, INDSTAT 2008)

$$E_{jt} = \sum_i S_{ijt} ln(L_{ijt})$$

- Urban: people living in areas defined as urban in each country, as a share of total population. Source: World Bank, Global Development Network Growth database

Transportation and Communications

- transportation: roads paved as a percentage of total roads (source: WDI 2008);

- communications:

  - telephone lines per 1000 inhabitants (Source: World Bank, Global Development Network Growth database)

  - internet users (per 100 people, source: WDI 2008).

Public funds:

- European Investment Bank loans: EIB Group, Annual Report, various issues (data from 1996 to 2007)

Other factors:

- Investment price: price level of investment expenditure basket on PPP basis. Source: Heston et al. (2006) (the related coefficient is expected to be negative, since a relative initial high price reduces future possible income growth).

- Government consumption: share of government consumption in GDP. Source: Heston et al. (2006). A negative sign is expected because public consumption is financed by distortionary taxes which reduce the growth rate. It is alternatively measured either as a percentage of GDP in PPP (Heston et al. 2006), as a percentage of gross domestic income in PPP (Heston et al. 2006) or as a percentage of constant GDP (WDI).

- Investment share: public-sector investment as a share of GDP (negative sign expected) (Heston et al. (2006). It is measured either as a percentage of GDP in PPP or as a percentage of gross domestic income in PPP (Heston et al. 2006).

- Coastal population density: share of population in costal area. Source: Gallup et al. (2001) (expected positive sign)

- Population density. Source: WDI 2008 (positive sign expected).

- Life expectancy (at birth in total years). Source: WDI 2008 (positive sign expected)

- Colonies : Source: Gallup et al. (2001)

- Corruption. It is measured by the Transparency International Corruption Perception index (2008). The index defines corruption as the abuse of public office for private gain and measures the degree to which corruption is perceived to exist among a country's public officials and politicians. It is a composite index, drawing on 14 polls and surveys from 12 independent institutions, which gathered the opinions of businesspeople and country analysts. Since this index ranges from zero (highly corrupted) to 10 (no corruption), an increase in this index denotes a reduction in corruption. Thus, a positive sign is expected.

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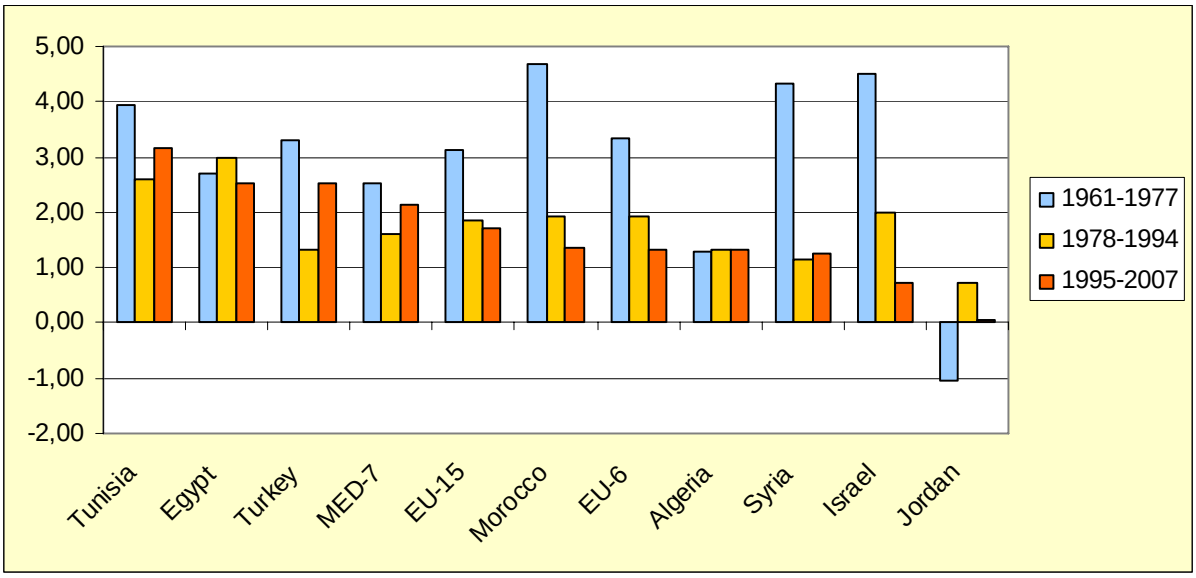
Tables and Figures

Table 1: GDP per capita growth rates (%, yearly averages)

1960-2004	Constant	PPP	Laspeyres	Chain series	GDP chain p. eq. adult	GDP chain per worker
Tunisia	3,20	6,20	3,24	3,23	2,97	2,53
Morocco	2,19	6,60	2,77	2,80	2,61	2,53
Egypt	3,10	6,09	2,76	2,73	2,61	2,41
Israel	2,82	6,19	2,55	2,48	2,37	1,77
Turkey	2,94	5,84	2,38	2,40	2,22	2,08
Syria	2,47	6,74	2,33	2,32	2,19	2,11
EU-6	2,50	6,36	2,28	2,31	2,16	2,06
EU-15	2,38	6,26	2,28	2,31	2,18	2,08
MED-7	2,50	5,78	2,08	2,09	1,91	1,64
Algeria	1,44	5,81	1,31	1,34	1,13	0,78
Jordan	2,77	4,35	-0,11	0,03	-0,20	-0,48

Source: own calculations from Heston et al. (2006)

Figure 1: Trends in GDP per capita growth rates (%, Laspeyres, yearly averages)



Source: own calculations from Heston et al. (2006)

Table 2: Trends in GDP per capita growth rates (%, yearly averages)

GDP constant

	1961-1977	1978-1994	1995-2007
Tunisia	4,20	1,89	3,61
Turkey	4,36	1,31	3,23
MED-7	3,62	1,01	2,99
Egypt	3,49	2,94	2,79
Morocco	2,71	1,45	2,50
Jordan	4,38	1,48	2,35
Algeria	2,60	-0,36	2,28
EU-15	3,21	1,92	1,91
Lebanon			1,71
Israel	4,23	2,27	1,67
EU-6	3,75	2,00	1,54
Syria	4,59	1,42	1,07

GDP PPP

	1961-1977	1978-1994	1995-2007
Tunisia	6,82	6,63	4,83
Egypt	6,81	6,52	4,52
Algeria	8,34	4,37	4,39
MED-7	7,35	5,72	3,79
Syria	11,50	4,25	3,75
EU-15	8,02	6,51	3,61
Lebanon			3,32
Turkey	7,45	6,15	3,32
EU-6	8,57	6,50	3,22
Morocco	9,51	6,29	3,21
Jordan	4,31	5,51	2,86
Israel	8,28	6,85	2,61

GDP Laspeyres

	1961-1977	1978-1994	1995-2007
Lebanon			4,82
Tunisia	3,93	2,60	3,16
Egypt	2,70	3,00	2,53
Turkey	3,31	1,34	2,53
MED-7	2,51	1,62	2,13
EU-15	3,14	1,87	1,70
Morocco	4,69	1,94	1,36
EU-6	3,35	1,91	1,34
Algeria	1,29	1,33	1,32
Syria	4,34	1,14	1,26
Israel	4,49	2,01	0,71
Jordan	-1,04	0,71	0,05

GDP chain series

	1961-1977	1978-1994	1995-2007
Lebanon			4,76
Tunisia	3,99	2,51	3,17
Turkey	3,29	1,39	2,54
Egypt	2,65	2,97	2,53
MED-7	2,55	1,60	2,13
EU-15	3,24	1,85	1,69
Morocco	4,84	1,86	1,37
Algeria	1,46	1,24	1,33
EU-6	3,50	1,89	1,32
Syria	4,32	1,14	1,25
Jordan	-0,09	-0,97	0,71
Israel	4,30	2,02	0,70

GDP chain per equivalent adult

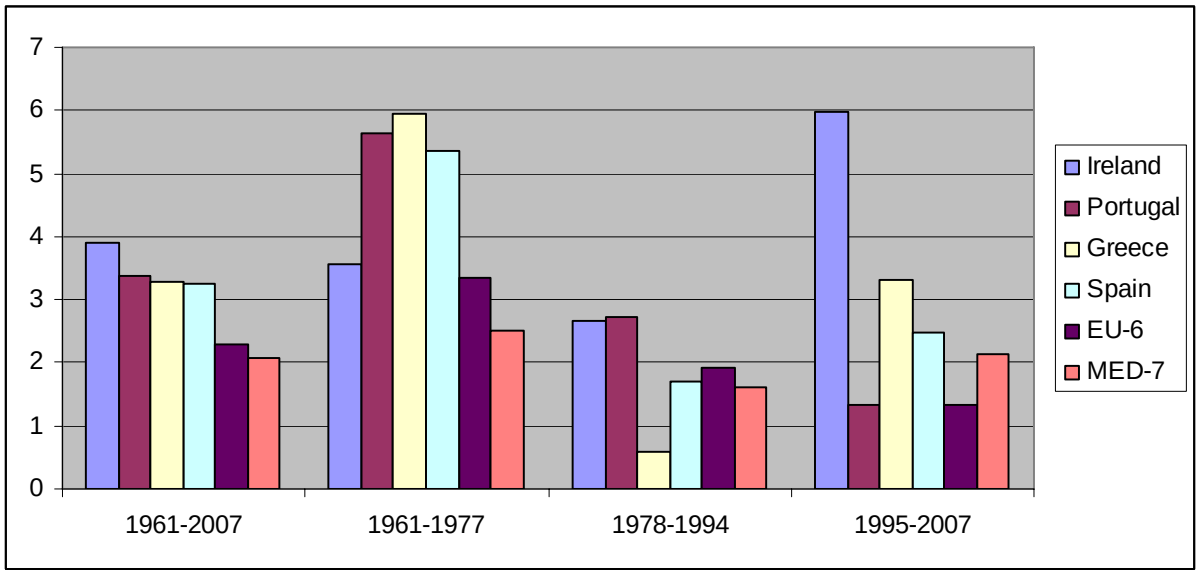
	1961-1977	1978-1994	1995-2007
Lebanon			4,12
Tunisia	3,98	2,22	2,65
Turkey	3,24	1,11	2,32
Egypt	2,60	2,90	2,22
MED-7	2,56	1,36	1,80
EU-15	3,09	1,68	1,62
EU-6	3,28	1,73	1,25
Morocco	4,87	1,55	1,05
Syria	4,45	1,01	0,77
Algeria	1,58	0,99	0,75
Israel	4,18	1,90	0,61
Jordan	-0,83	0,49	-0,26

GDP chain per worker

	1961-1977	1978-1994	1995-2007
EU-15	3,06	1,45	1,61
Tunisia	3,91	1,86	1,60
Egypt	2,76	2,83	1,40
EU-6	3,16	1,51	1,32
Morocco	5,10	1,39	0,66
MED-7	3,12	1,07	0,47
Turkey	4,29	1,16	0,38
Syria	5,04	0,97	-0,24
Algeria	2,50	0,28	-0,82
Israel	4,08	1,47	-0,86
Jordan	-0,25	-0,13	-1,25
Lebanon			3,25

Source: own calculations from Heston et al. (2006)

Figure 2: Trends in GDP per capita growth rates: a comparison with cohesion countries (Laspeyres, %, yearly averages)



Source: own calculations from Heston et al. (2006)

Figure 3a: σ-convergence between MED-7 countries and the EU

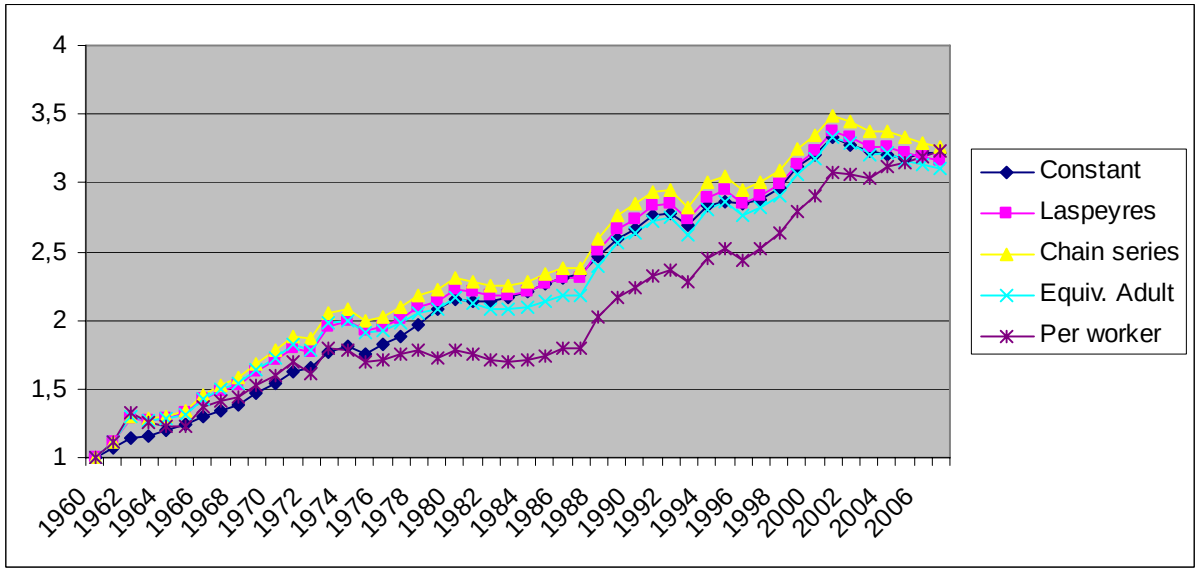


Figure 3b: σ-convergence between MED-7 countries and the EU (breakdown by country, Laspeyres)

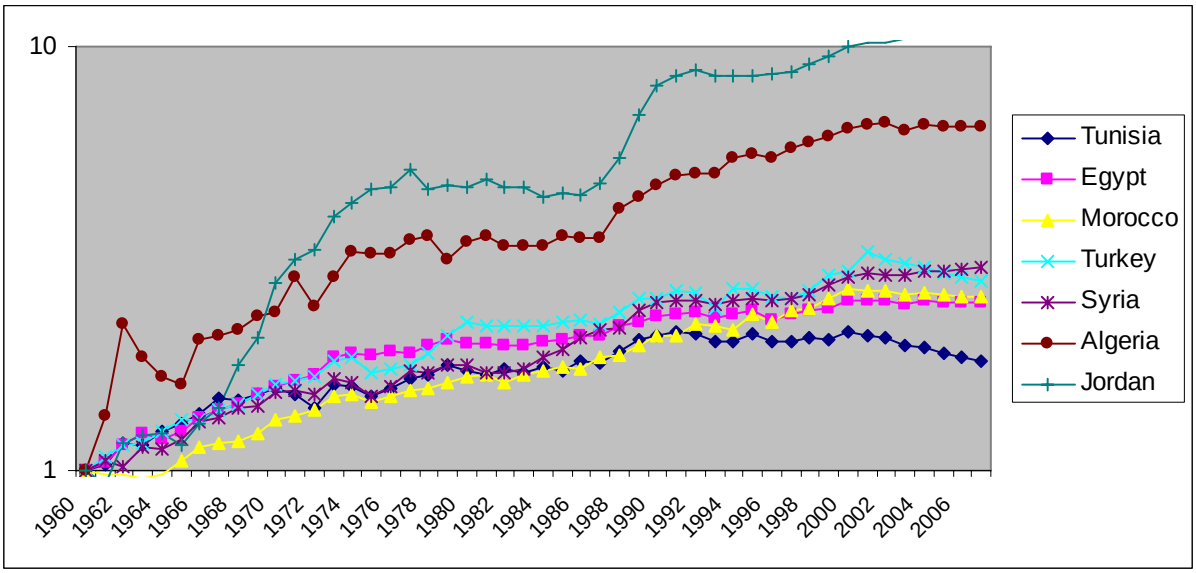


Figure 3c: σ-convergence between Cohesion Countries and the EU (Laspeyres)

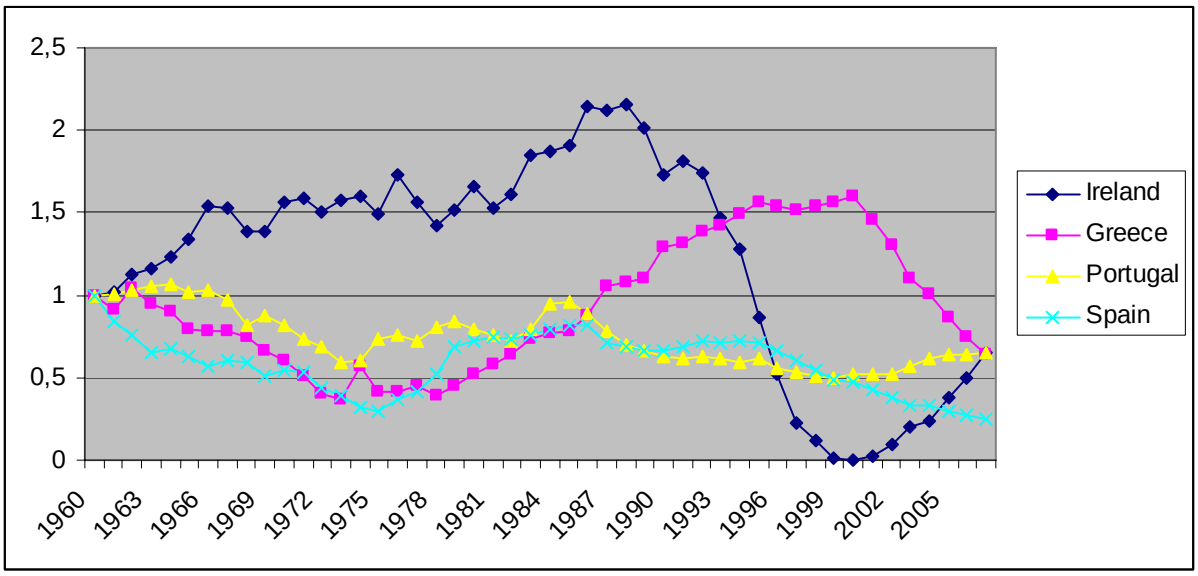


Figure 4a: γ-convergence between MED-7 countries and the EU

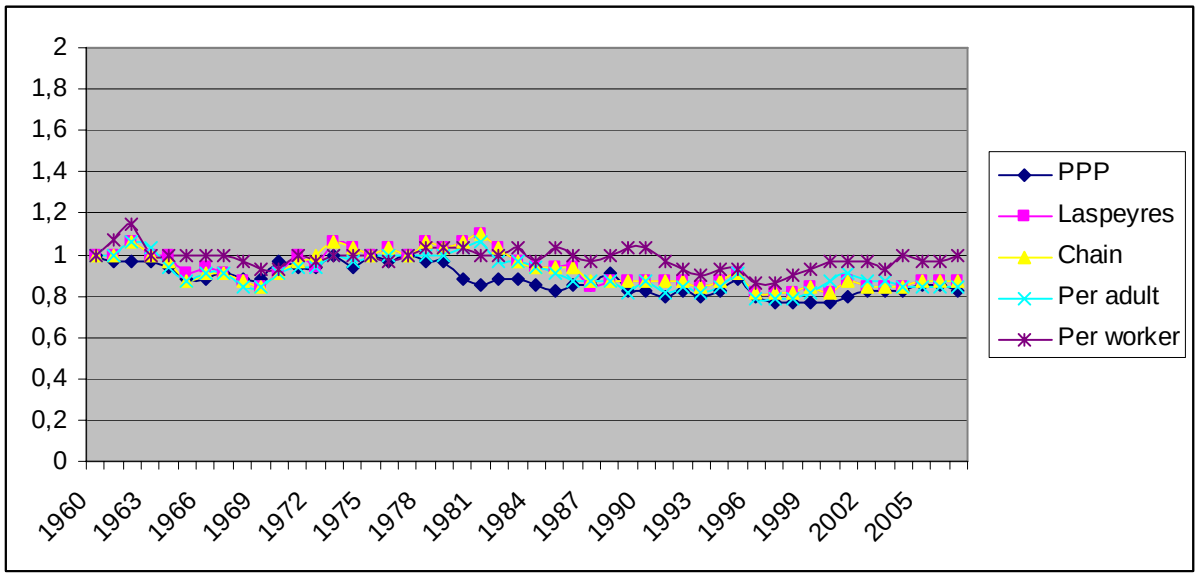


Figure 4b: γ-convergence between MED-7 countries and the EU (breakdown by country, Laspeyres)

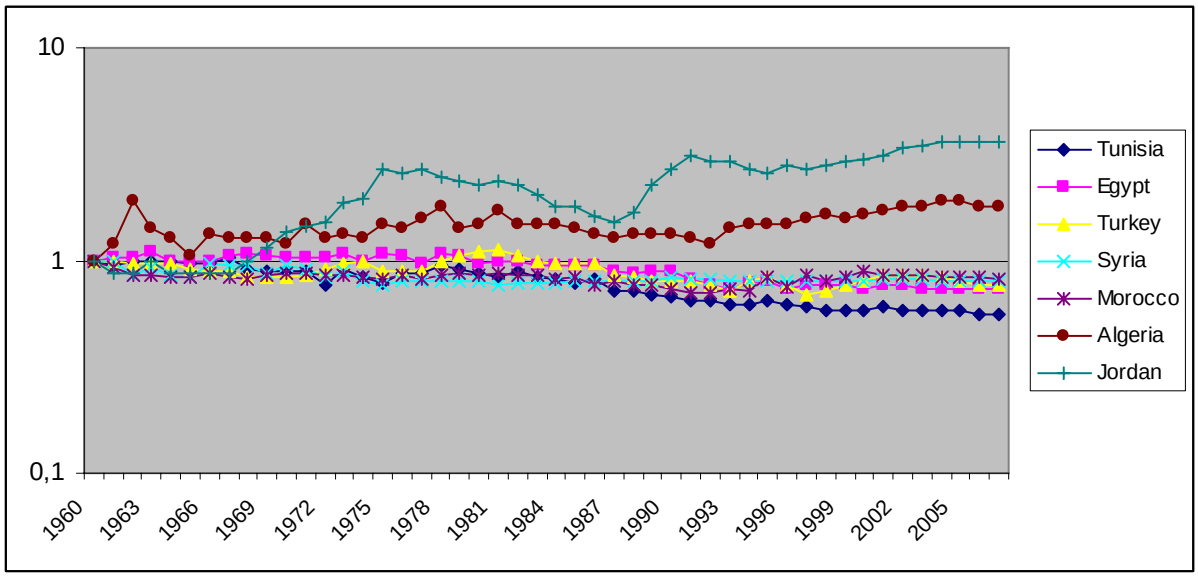


Figure 4c: Evolution of country ranking in terms of GDP per capita (1961-1995, yearly, Laspeyres)

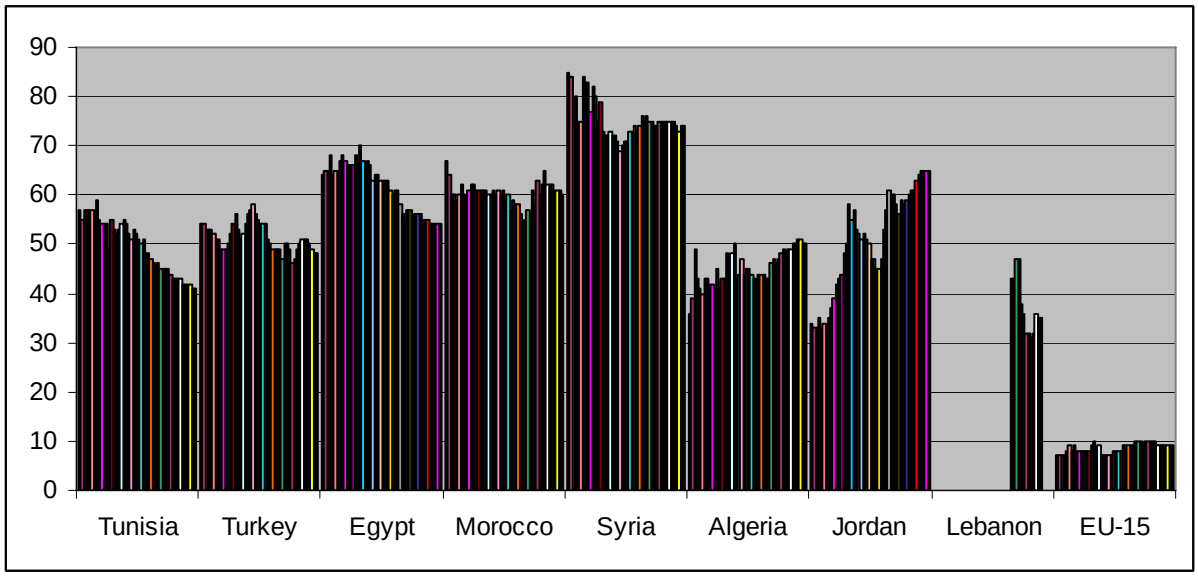


Figure 4d: γ-convergence between Cohesion countries and the EU (Laspeyres)

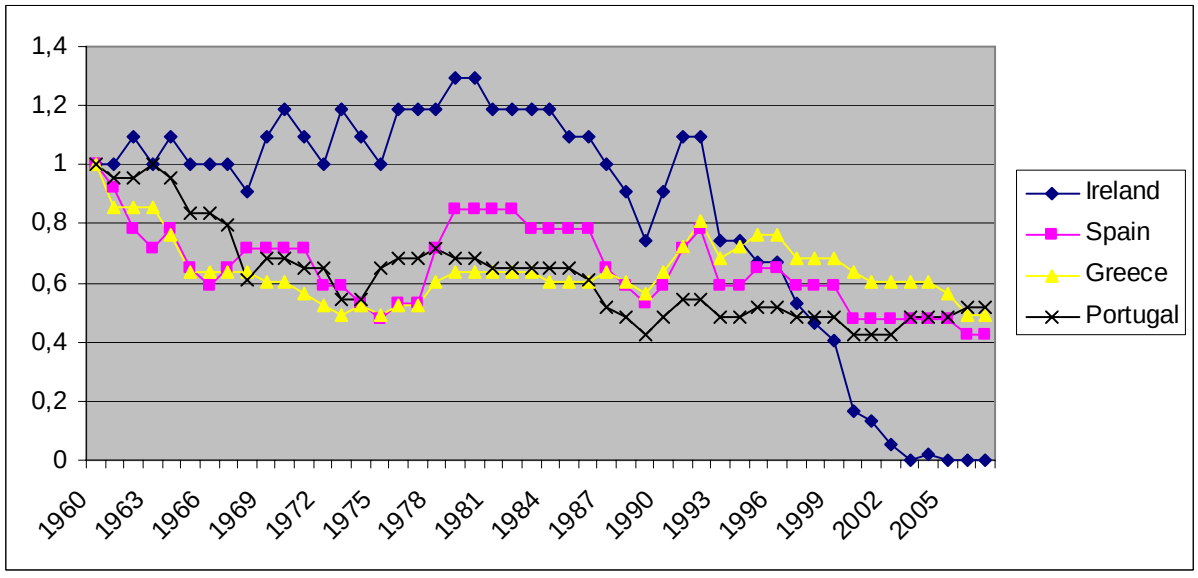


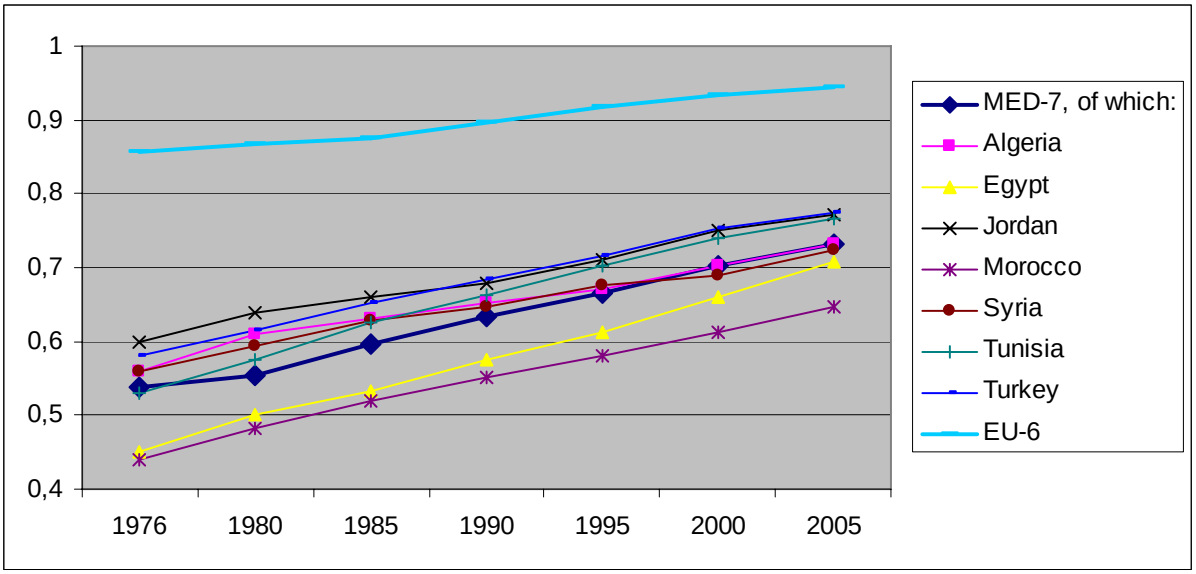
Table 3a: β-convergence between MED-7 countries and the EU

	EU-6			
	OLS	FEM	REM	Hausman
GDP constant price	-1.872**	-11.348***	-1.674**	17.04***
GDP PPP	-2.872***	-9.803***	-2.674***	12.94***
GDP Laspeyres	-2.018***	-6.183***	-1.904***	5.75***
GDP chain value	-2.029***	-6.396***	-1.896***	6.17***
GDP per adult	-2.121***	-6.026***	-2.019***	4.99**
GDP per worker	-2.201***	-3.549**	-2.257***	0.74
EU-15				
	OLS	FEM	REM	Hausman
GDP constant price	-1.817**	-11.082***	-1.817**	16.24**
GDP PPP	-2.631***	-8.711***	-2.631***	9.66***
GDP Laspeyres	-1.946***	-5.853***	-2.587***	4.73**
GDP chain value	-1.939***	-6.018***	-2.493***	5.32***
GDP per adult	-2.031***	-5.569***	-2.429***	4.14**
GDP per worker	-2.120***	-3.129**	-2.131***	0.43

Table 3b: β-convergence between MED-7 countries and the EU (breakdown by country, Laspeyres)

	EU-6	EU-15
Tunisia	-37.264***	-37.237***
Turkey	-35.627***	-36.903***
Morocco	-32.041***	-32.722***
Egypt	-18.442***	-19.728***
Syria	-14.274*	-13.320*
Algeria	-13.283	-11.470
Jordan	-4.082	-3.060

Figure 5: The Human Development Index (HDI) in Mediterranean countries.



Source: UNCTAD (2009)

Figure 6: σ-convergence of the HDI between MED-7 countries and the EU

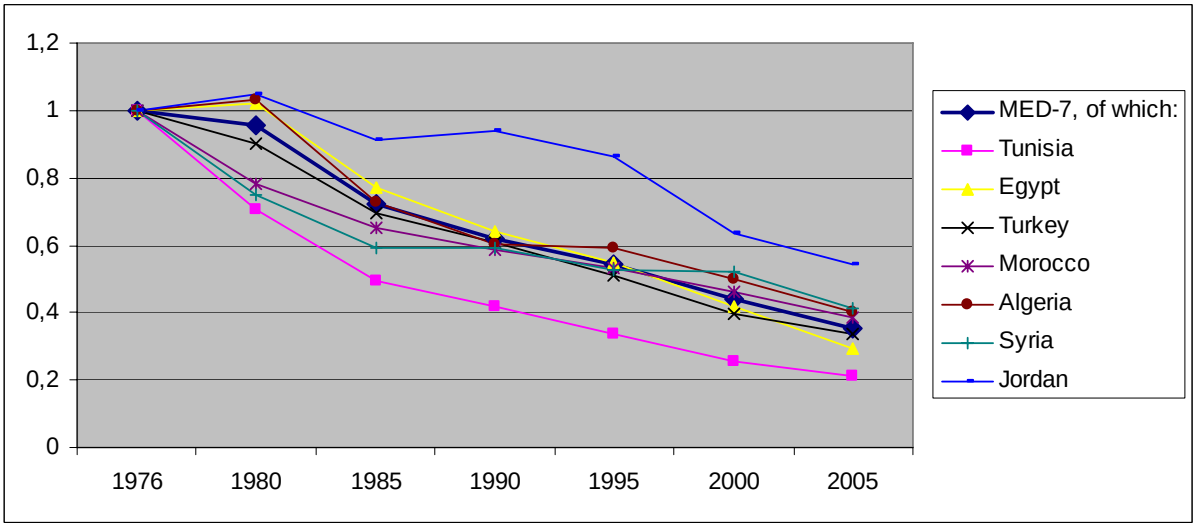


Table 4: γ-convergence of the HDI between MED-7 countries and the EU

	MED-7, of wh	Turkey	Tunisia	Egypt	Morocco	Syria	Algeria	Jordan
1980	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
1985	0,98	0,93	0,96	0,98	1,00	1,05	1,00	1,03
1990	0,98	0,86	0,96	0,98	0,98	1,17	1,07	1,08
1995	0,92	0,84	0,94	0,96	0,98	1,23	1,14	1,05
2000	0,96	0,84	0,94	0,95	0,96	1,05	1,05	1,00
2005	0,92	0,79	0,82	0,91	0,93	0,98	1,02	1,03

Table 5: β-convergence of the HDI.

OLS	FEM	REM	Hausman
-2.274**	-0.457*	-2.274***	1.11

Table 6a: Estimation results (1960-2007, various estimators, Laspeyre GDP per capita)

	HT	G2SLQ IV	EC2SLS IV	BW GLS	HFGLS
initial income level (beta)	-10.546***	-10.550***	-10.549***	-11.8911***	-10.487***
Human Capital and Technology					
Education	0.0111**	0.0119**	0.0111**	0.0236**	0.0123*
R&D	7.549**	7.515**	7.5485**	8.2272**	7.492**
Trade, specialization and openness					
Inter-industry specialization	-1.283**	-1.273**	-1.273**	-1.506**	-1.270**
Openness	0.0558*	0.0560*	0.0559*	0.0635*	0.0555*
Endowment in natural resources	-0.2332*	-0.2314*	-0.2314*	-0.2780**	-0.2305*
Barcelona agreement (dummy)	0.183	0.228	0.229	0.008	0.183
Economic geography					
Urban	-0.0042*	-0.0038*	-0.0038*	-0.0107*	-0.0010
Transport and communication					
Road	2.006**	1.994**	1.995**	2.384**	1.988**
Telephone	0.0221**	0.0211**	0.0212**	0.0253**	0.0213**
Internet	2.5949**	2.5799**	2.5792**	3.0942***	2.5733**
Other:					
government share in consumption	-0.2714**	-0.2712**	-0.2712**	-0.2809**	-0.2705**
public investment	0.1603*	0.1647*	0.1647*	0.1666*	0.1630*
investment price	0.0153	0.0156	0.0155	0.0162	0.0156
Wald test (country)	39.36***	25.17***	25.16***	40.12***	41.79***

Table 6b: Estimation results (1960-2007, alternative independent variables, HT estimator)

	constant	PPP	Laspeyres	chain series	per aduldt	per worker	HDI
initial income level (beta)	-20.441***	-11.782***	-10.546***	-10.576***	-10.987***	-8.9049***	-32.2502***
Human Capital and Technology							
Education	0.0187**	0.0514**	0.0119**	0.0113**	0.0146*	0.0163**	0.0102***
R&D	14.065***	8.0356***	7.515**	7.705**	7.719***	6.5772**	0.7896**
Trade, specialization and openness							
Inter-industry specialization	-1.040**	-0.6652*	-1.283**	-1.2393**	-1.3117**	-1.1900**	-0.0682*
Openness	0.0055	0.0296	0.0558*	0.0559*	0.0556*	0.0458*	0.0094*
Endowment in natural resources	-0.4957***	-0.0793	-0.2332*	-0.2153*	-0.2297*	-0.1864*	-0.1234***
Barcelona agreement (dummy)	0.439	1.399	0.183	0.286	0.155	0.126	0.187
Economic geography							
Urban	-0.2598***	-0.0647*	-0.0042*	-0.0225	-0.0354*	-0.0722**	-0.0463**
Transport and communication							
Road	2.8776***	1.1210*	2.006**	1.9214*	2.0331**	1.6599*	0.2343**
Telephone	0.0209**	0.0112*	0.0221**	0.0213**	0.0236**	0.0156*	0.0076**
Internet	4.3601***	1.2084*	2.5949**	2.4519**	2.6014*	1.9465*	0.1940*
Other:							
government share in consumption	-0.3575***	-0.3961***	-0.2714**	-0.2907**	"-0.2767**"	-0.2185*	-0.0074
public investment	0.2716***	0.2578***	0.1603*	0.1982**	0.2085**	0.2075**	0.0221
investment price	0.0224	0.0125	0.0153	0.0116	0.0177	0.0187	0.0017
Hausman test	4.25	3.94	5.55	3.33	1.88	4.40	2.22
Wald test (country)	64.26***	39.41***	39.36***	40.25***	39.71***	36.76***	38.84***

Table 7: Estimation results (1995-2007, alternative dependent variables, HT estimator)

initial income level (beta)	-25.8223***	-19.1627***	-25.0531***	-25.7795***	-47.8599***	-47.1601***
Human Capital and Technology						
Education	0.0052*	0.0172**	0.0371**	0.0051*	0.3042***	0.3234***
R&D	***3.6453****		*5.2525***	*3.9958***	*3.9200***	*2.5675***
Patents applications		***0.0126****				
Trade, specialization and openness						
Inter-industry specialization	***-0.4522****	***-0.5922****			*-0.8185***	*-0.8277***
high tech specialization			***0.1291****			
trade dissimilarity				***-0.4471****		
Openness	0.0183*	0.0109*	0.0171*	0.0173*	0.2237*	0.2151*
FDI	**0.0001**	**0.0002**	**0.0003**	**0.0004**	**0.0001**	**0.0002**
Endowment in natural resources	-0.1486*	-0.5442**	-0.2005*	-0.0802	-0.3815**	-0.3876**
Economic geography						
Urban	***-0.2222****	*-0.1347**	*-0.1584**	*-0.1678**		
specialization (concentration)					***-9.8046****	
entropy						***-7.3959****
Transport and communication						
Road	1.019**	1.9190**	1.365**	1.083**	0.1770*	0.2049**
Telephone	0.0952*	0.0497*	0.1015*	0.0241*	0.0702**	0.0748**
Internet	1.9844**	1.0666**	0.8959*	1.8035**	0.3215**	0.1719*
Other:						
government share in consumption	-0.6761***	-0.7194***	-0.7082***	-0.6802***	-1.407**	-1.6029***
public investment	1.2097***	0.9075***	11819***	1.1722***	1.0113***	1.0248***
investment price	0.0041	0.0055	0.0368	0.041	-0.0641	-0.0666
Public funds						
EIB loans	**0.0051*****	**0.0059*****	**0.0497*****	**0.0050*****	**0.0195*****	**0.0120*****
Hausman test	4.10	6.66	5.08	4.54	4.56	5.99
Wald test (country)	47.57***	50.74***	47.01***	47.02***	59.57***	59.44***

Table 8: basic demographic indicators (2000)

	Total population growth (%)	Natural rate of growth (%)	Migration rate (%)
Algeria	1,47	1,52	-0,05
Egypt	2,00	2,04	-0,04
Jordan	3,10	2,36	0,74
Morocco	1,74	1,86	-0,12
Syria	2,58	2,58	0,00
Tunisia	1,08	1,15	-0,07
Turkey	1,60	1,52	0,08

Source: US Census