Measuring human development in MENA region*

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Abstract

This paper aims to assess welfare improvements in the Middle East and North Africa (MENA) region, using the Human Development Index (HDI). Following Pinar et al (2013) we obtain weighting schemes that yield the best- and worst-case scenarios for measured human development, relying on consistent tests for stochastic dominance efficiency (SDE), with the official equally-weighted HDI taken as a benchmark. In the best-case scenario index, life expectancy and GDP indices receive the highest weights for the 1975-2005 period, while the education index is the dominant contributor to the worst-case scenario in the same period. Additionally, we observe a relative change in the best- and worst-case scenarios between two 15-year periods. The GDP index is the main contributor to the best-case scenario between 1975 and 1990, whereas the education index is the main contributor to the worst-case scenario during that period. Life expectancy is the main contributor to the best-case scenario in the 1990-2005 period, while the GDP and education indices are the primary contributors to the worst-case scenario during that period.

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1 Introduction

Over the last several decades, the Middle East and North Africa (MENA) region has seen the lowest growth, with the exception of Sub-Saharan Africa, among all regions of the world (Nabli and Véganzonès-Varoudakis 2007; Bhattacharya and Wolde 2012). Additionally, the MENA region displays greater volatility in economic performance than other regions (Makdisi et al. 2006), mainly due to the majority of its member countries' dependence on oil (Bhattacharyya and Blake 2010; Bhattacharya and Wolde 2012 among many others) and the relative weakness of its governance quality compared with other regions of the world (Guetat 2006). Although most studies of the MENA region have exclusively considered per capita income levels and growth, it has been suggested that GDP per capita alone is not a satisfactory measure of social welfare in a country or region (see, e.g., Becker et al. 2005).

Over time, composite indices and multivariate welfare analysis have become more popular (see, e.g., Fleurbaey (2009) for an overview). The most popular of the multivariate development indices is the United Nations Development Program's Human Development Index (HDI), which measures achievements in three classical dimensions of welfare: health, education and standard of living. Therefore, in analyzing social welfare across the MENA region, we will focus on the official HDI to complement previous studies that have mainly considered income per capita. Until recently, HDI has been calculated as a country's average achievements with respect to three basic aspects of human development: longevity, knowledge and a decent standard of living using fixed equal weights.

The HDI has been subject to major criticisms since it was first released in 1990. The main criticism has focused on its use of equal weights for each dimension, as it is suggested that the official HDI is highly correlated with each sub-index, and therefore, different weights assigned to each sub-index (education, life expectancy and GDP) would result in indices that are statistically similar to the original one (Cahill 2005). Other papers in the literature that address the shortcomings of the equal weighting scheme of HDI include Ravallion (1997), Noorbakhsh (1998) and Ravallion (2012). In the present paper, rather than relying on the official HDI levels of MENA countries, we will adopt a data-driven alternative weighting scheme to arrive at a composite index that sheds a different light on this issue. Specifically, we will follow the stochastic dominance efficiency (SDE hereafter) approach recently employed by Pinar, Stengos, and Topaloglou (2013) (PST hereafter), to derive the best-case scenario for the HDI. It is worth noting that the SDE-based approach directly addresses an additional problem that plagues the construction of the official HDI, namely, the presence of measurement errors in the data. HDI is constructed from data that may suffer from serious measurement errors, due to a lack of census

data, incomplete coverage and estimated data sets (see Ogwang (1994), Srinivasan (1994) and Chamie (1994) for detailed discussions of measurement errors in the HDI). These measurement errors may lead to excessive variability in each sub-index, an issue that we will confront in this paper. We derive two extreme cases of measured human development levels for the MENA region, indices that not only provide the maximum (minimum) measured development level for the MENA region but also indicate the least volatile measure over time.

Given the caveats associated with the official equally-weighted HDI, we adopt the SDE methodology to derive weights that maximize (minimize) measured human development levels for the MENA region, weights that ensure the least volatility over time. Earlier stochastic dominance (SD) methodologies have been applied in a pair-wise fashion that allowed for cross-time comparisons only for a given set of countries (see, e.g., Barrett and Donald 2003; Linton et al. 2005). However, Scaillet and Topaloglou (2010) extended pair-wise comparisons to a full diversification of weights to compare a given portfolio with an optimal diversified portfolio constructed from a set of assets. The same approach has been extended to the construction of HDI by PST, who obtained a best-case scenario that identifies education as the main driver of measured development levels over time. In such a case, weighting education more heavily would result in the most optimistic view of human development. Similarly, one can obtain the most pessimistic HDI combination by weighting education least heavily. In this paper, we adopt the same methodology to obtain weights for the HDI sub-indices that produce the most optimistic (and pessimistic) measured development levels for the MENA region. We will obtain two extreme cases of measured human development levels for the MENA region, cases that highlight the weakest (strongest) dimension when the whole region is considered. We first analyze the 1975-2005 period to obtain insights about MENA regional development over the whole period. We then obtain the best- and worst-case scenario weighting schemes for the two 15-year periods to shed light on the dimensions that have been moving fast (i.e., improving development levels within the region) and those dimensions that have been moving relatively slowly (i.e., holding back development).

Our cross-time analysis suggests that GDP has shifted from the most optimistic (i.e., best-case) scenario to the most pessimistic one. If one were to weight the GDP component higher in earlier periods, that would result in an optimistic view of development; however, the reverse is true if one were to more heavily weight the GDP component in later periods. Recent literature supports this finding. For example, Nabli and Véganzonès-Varoudakis (2007) suggest that the MENA region experienced lower economic growth between 1970 and 1999 compared with other regions. Additionally, Makdisi et al. (2006) analyze growth performance of the MENA region between 1960 and 2000, suggesting that the region experienced greater economy volatility than

other regions, as capital has been less efficiently utilized in this region than in other regions. Most importantly, many economies in the MENA region depend on oil, the price of which is very volatile (Bhattacharyya and Blake 2010; Bhattacharya and Wolde 2012 among many others). Other potential factors in the relative weakness of GDP in later periods in the MENA region are corruption and bureaucratic quality (Guetat 2006).

When we consider other components of the HDI, we find that educational attainment shows the lowest achievement among the human development indicators for the majority of countries in the initial period (i.e., between 1975 and 1990). Although there have been improvements in the education index in the region over time, it remains a major contributor to the worst-case scenario in later periods. Moreover, we have seen a major improvement in life expectancy in the region, and thus, the life expectancy index has gradually become more heavily weighted over time. We find that life expectancy has been the fastest-moving component among all indicators for the MENA region and was the dominant contributor to the best-case scenario for the 1990-2005 period. On the other hand, GDP has been the slowest-moving component over time, transitioning from the dominant contributor to the best-case scenario between 1975 and 1990 to the dominant contributor to the worst-case scenario between 1990 and 2005.

We also compare the official HDI rankings of the MENA region with the rankings of the best- and worst-case scenarios of the HDI. In the initial periods of the index, countries exhibited unbalanced achievements in different dimensions and thus experienced major rank reversals between best- and worst-case scenarios. However, between 1990 and 2005, countries ranked in the highest and lowest positions in the official HDI also attained the highest and lowest positions in the best- and worst-case scenarios, respectively. In other words, the countries that were ranked highest and lowest in the official HDI between 1990 and 2005 have displayed balanced improvement in all dimensions compared with other countries in the MENA region. Finally, it is worth noting that regardless of how development is measured, Israel has always been the most developed country within the region and has maintained the highest ranking in almost all best- and worst-case scenarios and official statistics of the HDI.

The remainder of the paper is organized as follows. In section 2, following PST, we present the main framework of the analysis. We present the stochastic dominance efficiency test of the ST methodology and its mathematical formulations. In section 3, we present the formulation of the HDI and its descriptive statistics. In section 4, we present the most optimistic and pessimistic weights for the different constituent components for the MENA region for different periods to examine the welfare improvements among the separate components and in the official HDI over time. Finally, we conclude in section 5.

2 Model Set-up

In this section, we briefly discuss the stochastic dominance efficiency methodology, which yields the most optimistic and pessimistic measurements of human development levels for the MENA region over different sub-periods. The approach is based on the methodology of PST; below, we offer a short summary of this approach. Let us consider a strictly stationary process $\{\boldsymbol{Y}_t; t \in Z\}$ that takes values in $\mathbb{R}^3$. Observations consist in realizations of $\{\boldsymbol{Y}_t;\ t = 1, ..., T\}$. These data correspond to observed values of the three different components of the HDI (i.e., education, life expectancy and GDP indices). We denote by $F(\boldsymbol{y})$ the continuous cdf of $\boldsymbol{Y} = (Y_1, ..., Y_3)'$ at point $\boldsymbol{y} = (y_1, ..., y_3)'$. Let us take the composite index with equal weights (i.e., $\boldsymbol{\tau}'\boldsymbol{Y}$) as a benchmark ($\boldsymbol{\tau}$ is the weighting vector for $\frac{1}{3}'s$) to examine whether the equally-weighted index is SD efficient In this case, the benchmark is the official HDI index. Consider an alternative hybrid composite index with a weighting vector $\boldsymbol{\lambda} \in \mathbb{L}$, where $\mathbb{L} := \{\boldsymbol{\lambda} \in \mathbb{R}^3_+ : \boldsymbol{e}'\boldsymbol{\lambda} = 1\}$ and where $\boldsymbol{e}$ is a vector of ones. This specification implies that all the different components have positive weights that sum to one. Let us denote by $G(z, \boldsymbol{\lambda}; F)$ the cdf of the hybrid index value $\boldsymbol{\lambda}'\boldsymbol{Y}$ at point z, a given development level. Although $\boldsymbol{\lambda}$ and $\boldsymbol{\tau}$ are weighting vectors, we use them interchangeably with the index that they represent for simplicity. We will test whether the official HDI, $\boldsymbol{\tau}$, i.e., equal weights given to each sub-index, is the best-case (worst-case) scenario in the sense that it provides the maximum (minimum) value and lowest variability of measured human development levels across countries and over time in the MENA region or whether we can construct another composite index $\boldsymbol{\lambda}$ (alternative weighting scheme) from the given set of components that dominates (or is dominated by) it.

Define for $z \in \mathbb{R}$:

$$\begin{aligned}
&\mathcal{J}_1(z, \boldsymbol{\lambda}; F) := G(z, \boldsymbol{\lambda}; F), \\
&\mathcal{J}_2(z, \boldsymbol{\lambda}; F) := \int_{-\infty}^{z} G(u, \boldsymbol{\lambda}; F)du = \int_{-\infty}^{z} \mathcal{J}_1(u, \boldsymbol{\lambda}; F)du,
\end{aligned}$$

and so on. The empirical counterpart $\mathcal{J}_j(z, \boldsymbol{\tau}; \hat{F})$, for the SD order of $j \geq 2$ is obtained by integrating with respect to the empirical distribution $\hat{F}$ of F, see Davidson and Duclos (2000).

The hypotheses for testing whether the equally-weighted risk index, $\boldsymbol{\tau}'\boldsymbol{Y}$, is the worst-case scenario (i.e., the riskiest combination of factors) is as follows:

$$\begin{aligned}
H_0^j &: \mathcal{J}_j(z, \boldsymbol{\tau}; \hat{F}) \leq \mathcal{J}_j(z, \boldsymbol{\lambda}; \hat{F}) \ for\ all\ \ z \in \mathbb{R}\, and\ for\ all\ \boldsymbol{\lambda} \in \mathbb{L}, \\
H_1^j &: \mathcal{J}_j(z, \boldsymbol{\tau}; \hat{F}) > \mathcal{J}_j(z, \boldsymbol{\lambda}; \hat{F}) for\ some\ \ z \in \mathbb{R}\ or\ \ for\ some\, \boldsymbol{\lambda} \in \mathbb{L}.
\end{aligned}$$

Under the null Hypothesis H_0^j, there is no hybrid index $\boldsymbol{\lambda}$ constructed from the set of components that dominates the index $\boldsymbol{\tau}$ at order j. On the other hand, under the alternative hypothesis H_1^j, there exists an alternative index $\boldsymbol{\lambda}$ for some arguments z, where the function $\mathcal{J}_j(z, \boldsymbol{\tau}; F)$ is greater than the function $\mathcal{J}_j(z, \boldsymbol{\lambda}; F)$. In this case, when $j = 1$, the index with $\boldsymbol{\lambda}$ dominates the index with $\boldsymbol{\tau}$ in a first-order sense, and therefore, there is an alternative weighting for the best-case scenario. For the worst-case scenario, one can reverse the inequality signs in the null and alternative hypotheses. In this case, the null hypothesis suggests that the given index, $\boldsymbol{\tau}$, is the worst-case scenario, whereas the alternative hypothesis suggests that there exists an alternative weighting for some development level z that corresponds with the worst-case scenario. SD efficiency tests can be specified at first- and second-order when $j = 1$ and $j = 2$, respectively (SD1 and SD2, hereafter).

In particular, we use the weighted Kolmogorov-Smirnov type test statistic to test whether the equally-weighted risk index is the worst-case scenario as follows:

$$\hat{S}_j := \sqrt{T}\frac{1}{T}\sup_{z,\boldsymbol{\lambda}}\left[\mathcal{J}_j(z, \boldsymbol{\tau}; \hat{F}) - \mathcal{J}_j(z, \boldsymbol{\lambda}; \hat{F})\right],$$

and a test based on the decision rule:

$$\text{“}reject\ H_0^j\text{”} \quad \text{if} \quad \hat{S}_j > c_j\,,$$

where c_j is some (appropriate) critical value. To make the results more operational, we must find an appropriate critical value c_j**.** Because the distribution of the test statistic depends on the underlying distribution, we rely on a block bootstrap method to simulate p-values (see PST for details).

As the test statistic allows for full diversification of weights at all possible development levels, we require a mathematical maximization method. We use a mixed integer program to obtain a test statistic for first-order SD dominance that maximizes the distance between the sum over all scenarios of two binary variables, $G(z, \boldsymbol{\tau}; \hat{F})$ and $G(z, \boldsymbol{\lambda}; \hat{F})$ (the empirical cdf of development indices with equal weights, $\boldsymbol{\tau}$, and an alternative weighting scheme, $\boldsymbol{\lambda}$, at a given developmental level z), where the binary variables take a value of one when $z \geq \boldsymbol{\tau}'\boldsymbol{Y}$ and $z \geq \boldsymbol{\lambda}'\boldsymbol{Y}$ respectively, and zero otherwise. This formulation allows us to test the dominance of the official HDI index with equal weights ($\boldsymbol{\tau}$) relative to any other potential hybrid development index with an alternative weighting scheme $\boldsymbol{\lambda}$. If the first-order SDE does not hold, then second-order dominance efficiency can be tested. We refer to Scaillet and Topaloglou (2010) and PST for details and for a formulation of the problem as a mixed integer programming problem.

In the next section, we offer the descriptive statistics of the HDI and its components for the MENA region and derive the best-case (most optimistic) and the worst-case (most pessimistic) scenarios for the MENA region for the period of 1975-2005. Findings for the 1975-2005 period are complemented by the best- and worst-case scenario weighting schemes for different sub-periods to highlight the dynamic progress of development in the MENA region.

3 Empirical Analysis of SD efficiency of HDI

3.1 Data and Descriptive Statistics

We use the United Nations Development Program's HDI and its components - life expectancy, education and GDP indices for the 1975-2005 period in 5-year increments - to analyze progress in the human development levels in the MENA region. Each index takes values between 0 and 1 (from lowest to highest in terms of well being). The HDI represents the simple arithmetic average of the three individual indices.

The life expectancy index (LE) is given by $LE = \frac{LE-25}{85-25}$, and the life expectancy raw data series has an upper bound of 85 and a lower bound of 25 years. The value of a country's life expectancy index is equal to the country's life expectancy in years minus 25 divided by 60, yielding a number between 0 and 1. The education index (E) is defined as $E = \frac{2}{3}$(adult literacy index) + $\frac{1}{3}$(gross enrollment index). This index is constructed so that a 2/3 weight is given to literacy (percentage of the population that is considered literate) and a 1/3 weight is given to gross school enrollment as a percentage of the eligible school age population. The index is bounded by 0 and 1. Finally, the GDP per capita index is defined as $GDP\ Index = \frac{\log(\text{GDP per capita}) - \log(100)}{\log(40000) - \log(100)}$ and is derived in a manner similar to LE, where the upper bound for the raw GDP per capita series is 40,000 and the lower bound is 100 US dollars per capita. The values taken by the index lie in the (0,1) range. Each separate index is then equally weighted to create the HDI.[1]

Table 1

Table 1 presents descriptive statistics for the HDI and the individual component indices over time for the MENA region. One can see that there has been a constant increase in the LE, E and HDI, on average, between 1975 and 2005, whereas the GDP index, on average, increased between 1975 and 1980, decreased between 1980 and 1990, and finally increased again between

[1]Starting in 2010 and updated in 2011, the UNDP has made adjustments to the construction of the HDI˙See the 2011 Human Development Report technical report for details. http://hdr.undp.org/en/media/HDR_2011_EN_TechNotes.pdf

1995 and 2005. The GDP index has the largest mean between 1975 and 1985, whereas the LE index has the largest mean between 1990 and 2005. Finally, the E index increased over the whole period, attaining its second largest mean after 2000. Given variation among the components of the HDI, we not only consider the best- and worst-case scenarios for the whole period but also the best- and worst-case scenarios for two 15-year sub-periods to capture the dynamic progress of human development in the MENA region. In the next section, we examine the SD dominance results for these indices separately to determine the most optimistic and pessimistic development levels in the MENA region over the 30-year period.

3.2 SDE Results for HDI of the MENA region

In this section, we first test for SD efficiency of the official HDI for the MENA region between 1975 and 2005. Second, we test different sub-periods to analyze the evolution of the best- and worst-case scenarios over the whole period, thereby shedding light on improvements and/or deteriorations in the components of the HDI. In other words, the sub-period analysis will reveal information about the fast- and slow-responding components of the HDI over time.

We first test whether the equally-weighted HDI offers the best- or worst-case scenario for the 1975-2005 period. We find that the equally-weighted HDI is not the best-case scenario, as we can construct many other composite indices, $\boldsymbol{\lambda}$, consisting of the three components of the HDI (life expectancy, education and GDP indices) that stochastically dominate the equally-weighted HDI, $\boldsymbol{\tau}$, in the first-order sense. Table 2 summarizes the results. As indicated in the first line of the table, we find that 112 different composite indices dominate the equally-weighted index, and we present the average weight for each component. We find that the GDP and life expectancy indices have the highest weights in the best-case scenario, with weights of 54.63% and 41.59%, respectively. On the other hand, the education index has a weight of 3.78% in the best-case scenario. As the equally-weighted index does not correspond to the best-case scenario, we test whether it corresponds to the worst-case scenario. The second line of Table 2 presents the results for the worst-case scenario for the 1975-2005 period. We find that 111 composite indices are dominated by the official HDI and thus indicate poorer measured development levels for the MENA region than the HDI does. We find that the education index is the major contributor to the worst-case scenario, with a weight of 84.34%. On the other hand, the GDP and life expectancy indices are weighted at 8.69% and 6.97%, respectively. This result contrasts with PST, who find that education is the most important driver of development, based on weights from all countries.

Table 2

The SD inefficiency of the official HDI indicates that the equal weighting scheme produces neither the best- nor the worst-case scenario but that countries achieve moderate levels of measured development, as alternative weighting schemes assign both higher and lower measured development levels to the MENA region. Our findings for the MENA region differ from the PST findings, where the most optimistic weighting scheme considered for all countries in the world identifies the education index as the major contributor to the best-case scenario. However, PST also observe that, although most countries achieve higher levels of measured development when education is more heavily weighted, some countries have performed poorly in that dimension, most of them in the MENA region. In the MENA region over the last 30 years, the best-case scenario is achieved mainly through attainments in the GDP and life expectancy dimensions. On the other hand, the dimension of lowest attainment by MENA countries over the last 30 years has been education. To achieve higher measured development levels in the MENA region, it is therefore necessary to focus on this dimension.

Additionally, we conducted analysis of different sub-periods to examine the dynamic evolution of best- and worst-case scenarios over time. We tested the SD efficiency of the official HDI for the 1975-1990, 1980-1995, 1985-2000, and 1990-2005 periods, with results presented in Table 2 above. This analysis not only sheds light on how the best- and worst-case scenarios have changed over time but reveals which dimensions have been improving and/or deteriorating over time.

First, testing whether the equally-weighted HDI is the best- or the worst-case scenario for the 1975-1990 period, we find that the official HDI is neither the best- nor the worst-case scenario over this period. As can be seen in Table 2, for this period, we find 56 composite indices that dominate the equally-weighted HDI, indicating that the equally-weighted HDI is not a best-case scenario, and 59 composite indices that are dominated by the equally-weighted, indicating that the equally-weighted HDI is not a worst-case scenario. For the first 15-year period, GDP has been the dominant contributor to the best-case scenario, with a weight of 84.39%, whereas the education index has been the dominant contributor to the worst-case scenario, with a weight of 89.50%. Therefore, during the first 15-year period, the GDP and education indices have been the highest and lowest achieving dimensions, respectively, in the MENA region.

When we move to the 1980-1995 period, we find that the GDP and life expectancy indices have been the main contributors to the best-case scenario, with weights of 54.76% and 40.73%, respectively. Compared with the best-case scenario in the 1975-1990 period, life expectancy is accorded greater weight, and the GDP index is accorded less weight in the best-case scenario, as there were major improvements in life expectancy and a slight deterioration in GDP between 1975 and 1995. Indeed, life expectancy was the fastest-improving dimension in the

MENA region over the 20-year period, while GDP remained steady (i.e., was a slow-responding dimension). In the worst-case scenario for the 1980-1995 period, the education index is the dominant contributor, with a weight of 90.28%. Although there was an improvement in the education index between 1975 and 1995, the other dimensions supported higher levels of measured development.

For the 1985-2000 period, we find that life expectancy is clearly the main contributor to the best-case scenario, with a weight of 65.90%, whereas GDP is weighted at 29.78%. In the worst-case scenario, however, education is the main contributor, with a weight of 74.63%, while GDP is weighted at 18.80%. For the 1990-2005 period the results suggest that life expectancy has clearly contributed the most to the best-case scenario, with a weight of 89.4%, while GDP has contributed the least, with a weight of 0.64%. For the worst-case scenario, the GDP and education indices are the major contributors, with weights of 54.05% and 41.45%, respectively.

Overall, best- and worst-case scenarios for the MENA region have changed gradually over a period of 30 years. MENA countries have experienced major improvements in life expectancy, which has thus become the major contributor to the best-case scenario. GDP was the major contributor to the best-case scenario during the first 15-year period; however, it has become the main contributor to the worst-case scenario during the last 15-year period. Countries in the MENA region have experienced major improvements in life expectancy and education over time, but GDP has remained relatively stagnant (slow-responding). Furthermore, although education was the main contributor to the worst-case scenario in the earlier periods, recently, most MENA countries have seen their educational achievements gradually improve.

Next, we present country rankings for the years 1975 to 2005 for the MENA region, using both the most optimistic and most pessimistic scenarios and the equally-weighted official HDI. For the most optimistic and pessimistic scenarios, we use the weighting schemes derived in Table 2. Table 3 illustrates the rankings of countries, using the best-case and worst-case scenarios of the HDI in the 1975-1990 period, with the weights indicated, respectively, in the first two rows (representing the 1975-2005 period) of Table 2. Similarly, Table 4 reports the best- and worst-case scenario rankings for the 1990-2005 period, using the weighting schemes from the last two rows (representing the 1990-2005 period) of Table 2.

Table 3 and 4

For example, for 1975, Israel is ranked first in the official HDI but fourth in the best-case scenario and first in the worst-case scenario. Malta, Turkey, Syria, Tunisia and Egypt moved to lower rankings in the best-case scenario. However, except for Tunisia, they obtained higher rankings in the worst-case scenario compared with their respective rankings based in the official

HDI. On the other hand, the United Arab Emirates, Saudi Arabia, Algeria, and Oman obtained higher rankings in the best-case scenario but moved to lower rankings in the worst-case scenario. These countries exhibited improved GDP per capita but were the worst group in the worst-case scenario, mainly owing to their educational levels. A similar pattern is observed for these countries from 1975 to 1990.

In Table 4, we report the rankings of the best- and worst-case scenarios for the period from 1990 to 2005. Between 1975 and 1990, improvements in different dimensions of the HDI were seen in many countries in the MENA region; thus, the best-case and worst-case scenarios changed during this period. In this period, countries ranked in high positions based on the official HDI also achieved higher rankings in the best- and worst-case scenarios, suggesting that the most highly ranked countries experienced balanced improvements in all dimensions compared with other MENA countries. Therefore, regardless of which weighting scheme is used, these countries retain their high rankings. For example, Israel has always ranked in the first position among countries in the MENA region, based on the official HDI and the best-case and worst-case scenarios. Similarly, Malta, Bahrain, the United Arab Emirates, and Kuwait ranked second through fifth under the official HDI and the best- and worst-case scenarios, and the same is true for countries ranked in lower positions. Egypt, Morocco, Djibouti and Yemen were ranked 15th through 18th, with minor changes among them in the best- and worst-case scenarios, suggesting that these countries exhibited relatively low achievement in both cases.

Table 5 and 6

To make the differences in ranking between the best- and worst-case scenarios of the HDI clearer, we present the rank differences between the best- and worst-case scenarios for a given year in Tables 5 and 6. Both tables report the difference between the ranking of a country in the worst-case and best-case scenarios. A positive difference suggests that a given country ranks higher in the best-case scenario, whereas a negative difference suggests that a given country ranks higher in the worst-case scenario. Both panels shed light on whether the various countries in the MENA region experienced balanced improvements in all dimensions relative to other countries (i.e., retained their relative rankings in the best-case and worst-case scenarios). Between 1975 and 1990, the countries that held the highest rankings in the best-case scenario compared with the worst-case scenario are Oman, Saudi Arabia, the United Arab Emirates, and Algeria, with at least a four position difference, due to their high achievement levels in GDP per capita and low achievement levels in educational attainment. On the other hand, Lebanon, Syria, Jordan, Turkey and Malta achieved higher rankings in the worst-case scenario compared with the best-case scenario, due to their relatively superior achievements in educational attainment. Finally, between 1995 and 2005, Syria and Lebanon held high rankings in the

best-case scenario compared with the worst-case scenario, due to their better life expectancy levels relative to their educational and standard of living achievements (see Table 6).

Because we have full country coverage for the last three 5-year periods, we analyzed the improvements and/or deteriorations in the rankings in the official HDI and the best- and worst-case scenarios for the 5-year periods, 1995 to 2000 and 2000 to 2005. Table 7 reports the rank changes over time in each index. Most countries exhibited a stable relative ranking over time. Specifically, the maximum rank change in each index is one position between 1995 and 2000 and two positions between 2000 and 2005. Between 2000 and 2005, there is somewhat greater volatility in the rankings compared with the ranking changes between 1995 and 2000. Among all countries, only Bahrain and Lebanon moved to a lower ranking, while Kuwait and Turkey exhibited an improvement in their rankings by two positions in the official HDI in the 2000-2005 period. In that context, Kuwait exhibited an improvement in its worst-case scenario, showing major improvement in its education and GDP indices, and Turkey moved to a higher ranking in the best-case scenario by two positions, exhibiting a sizeable improvement in its life expectancy.

Table 7

Finally, we examine improvements in the relative levels of human development when the best- and worst-case scenario weighting schemes are compared with the equally-weighted official HDI. Table 8 summarizes the numbers of countries that fall into low, medium, high and very high human development groups under the official HDI and the best- and worst-case weighting schemes. Each group consist of countries that have HDI values of less than 0.5, between 0.5 and 0.799, between 0.8 and 0.899, and above 0.9. For the 1975-1990 period, we employ weights obtained for the 1975-1990 period with the weights in first two rows of Table 2 to obtain the best- and worst-case scenario distribution of countries, with results reported in Table 8. For example, in 1975, there were three countries in the low development group, based on the official HDI, whereas there were one and seven countries in the same group in the best- and worst-case scenarios, respectively. Only one country fell into the high development group, based on the official HDI, whereas two countries fell within that group in the best-case scenario, and no countries fell within it in the worse-case scenario. Over time, changes across groups have been less evident and the results overall suggest that improvements in MENA countries in the earlier years were relatively rapid compared with the later periods.

Table 8

4 Conclusion

In this paper, we have assessed welfare improvements in the MENA region by employing the SDE approach to derive best- and worst-case weighting schemes for the three components of the HDI. We have found that the best- and worst-case scenarios for the MENA region have gradually changed over a 30-year period. MENA countries have experienced major improvements in life expectancy, which consequently has become the dominant contributor to overall improvements in human development. Hence, any further improvements must be achieved with respect to the other two components, GDP and education. GDP was the major contributor during the first 15-year period to the best-case scenario. However, it has become the dominant contributor to the worst-case scenario in the last 15-year period. Hence, policies that lead to market liberalization and trade openness may be beneficial, as they may enable GDP to grow at a more rapid rate. Finally, although education has been the main contributor to the worst-case scenario in the earlier periods, most MENA countries have shown gradual improvement in educational attainment in recent years. However, additional improvements in education policies are needed in these countries, if they are to improve their overall development standing.

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Tables and Figures

Table 1: Descriptive statistics

Human development index							
Year	1975	1980	1985	1990	1995	2000	2005
Sample size	13	15	15	16	18	18	18
Mean	0.594	0.641	0.677	0.681	0.705	0.731	0.763
Median	0.567	0.614	0.65	0.682	0.711	0.744	0.773
Standard deviation	0.189	0.176	0.138	0.204	0.248	0.248	0.23

Life expectancy index							
Year	1975	1980	1985	1990	1995	2000	2005
Sample size	13	15	15	16	18	18	18
Mean	0.587	0.641	0.689	0.711	0.735	0.761	0.785
Median	0.545	0.617	0.673	0.715	0.747	0.769	0.785
Standard deviation	0.146	0.124	0.097	0.114	0.198	0.196	0.182

Education index							
Year	1975	1980	1985	1990	1995	2000	2005
Sample size	13	15	15	16	18	18	18
Mean	0.483	0.554	0.616	0.648	0.677	0.72	0.769
Median	0.454	0.563	0.63	0.65	0.687	0.723	0.792
Standard deviation	0.355	0.323	0.276	0.319	0.309	0.301	0.236

GDP index							
Year	1975	1980	1985	1990	1995	2000	2005
Sample size	13	15	15	16	18	18	18
Mean	0.714	0.728	0.725	0.684	0.702	0.711	0.737
Median	0.657	0.683	0.695	0.667	0.674	0.698	0.735
Standard deviation	0.34	0.29	0.193	0.358	0.386	0.398	0.407

Table 2: Scenario weighting scheme human development index (1975-2005)

Scenario	Period	Highest distance	Number of observations	Number of indices that dominate fixed weighted HDI	Stochastic efficient weights		
					Life expectancy index	Education index	GDP Index
Best	1975-2005	0.0243	113	112	0.4159	0.0378	0.5463
Worst	1975-2005	0.0424	113	111	0.0697	0.8434	0.0869
Best	1975-1990	0.0615	59	56	0.1204	0.0357	0.8439
Worst	1975-1990	0.0711	59	59	0.0485	0.895	0.0565
Best	1980-1995	0.0317	64	62	0.4073	0.0451	0.5476
Worst	1980-1995	0.0508	64	58	0.0305	0.9028	0.0667
Best	1985-2000	0.0262	67	60	0.659	0.0432	0.2978
Worst	1985-2000	0.0711	67	60	0.0657	0.7463	0.188
Best	1990-2005	0.028	70	47	0.8942	0.0994	0.0064
Worst	1990-2005	0.0318	70	66	0.045	0.4145	0.5405

Table 3: Country rankings in MENA region in the years 1975, 1980, 1985 and 1990

Equally-weighted official HDI ranking	Country	The best (worst) case scenario ranking in 1975	Country	The best (worst) case scenario ranking in 1980	Country	The best (worst) case scenario ranking in 1985	Country	The best (worst) case scenario ranking in 1990
1	Israel	4 (1)	Israel	4 (1)	Israel	2 (1)	Israel	2 (1)
2	Kuwait	2 (3)	Kuwait	2 (3)	Malta	7 (2)	Malta	4 (2)
3	UAE	1 (5)	UAE	1 (6)	UAE	1 (6)	Bahrain	3 (3)
4	Malta	7 (2)	Malta	6 (2)	Bahrain	3 (3)	UAE	1 (5)
5	Saudi Arabia	3 (8)	Bahrain	5 (4)	Kuwait	4 (4)	Saudi Arabia	5 (10)
6	Turkey	9 (4)	Saudi Arabia	3 (10)	Saudi Arabia	5 (10)	Oman	6 (13)
7	Iran	6 (7)	Jordan	10 (5)	Jordan	10 (5)	Jordan	11 (6)
8	Syria	11 (6)	Turkey	11 (7)	Turkey	11 (7)	Turkey	7 (7)
9	Tunisia	10 (9)	Syria	13 (8)	Oman	6 (14)	Lebanon	15 (4)
10	Algeria	8 (11)	Tunisia	12 (11)	Syria	13 (8)	Tunisia	9 (11)
11	Oman	5 (13)	Iran	9 (9)	Tunisia	12 (11)	Iran	10 (9)
12	Egypt	13 (10)	Algeria	8 (12)	Iran	9 (9)	Algeria	8 (12)
13	Morocco	12 (12)	Oman	7 (14)	Algeria	8 (12)	Syria	13 (8)
14			Egypt	15 (13)	Egypt	15 (13)	Egypt	14 (14)
15			Morocco	14 (15)	Morocco	14 (15)	Morocco	12 (15)
16							Yemen	16 (16)

Note: The ranking of countries with the best and worst case scenarios of the HDI are obtained by using the stochastic efficient weights offered in panels (a) and (b) of Table 5 respectively. Countries in the MENA region are ranked according to their official HDI. Each country's best and worst case scenario rankings are given for the years 1975, 1980, 1985 and 1990. The best-case scenario rankings are reported on the left panel for each year and the worst-case scenario rankings of countries are reported in parentheses.

Table 4: Country rankings in MENA region in the years 1990, 1995, 2000 and 2005

Equally-weighted official HDI ranking	Country	The best (worst) case scenario ranking in 1975	Country	The best (worst) case scenario ranking in 1980	Country	The best (worst) case scenario ranking in 1985	Country	The best (worst) case scenario ranking in 1990
1	Israel	1 (1)	Israel	1 (1)	Israel	1 (1)	Israel	1 (1)
2	Malta	2 (4)	Malta	2 (2)	Malta	2 (2)	Kuwait	4 (2)
3	Bahrain	4 (2)	Bahrain	5 (3)	Bahrain	5 (3)	Malta	2 (4)
4	UAE	3 (3)	UAE	4 (4)	Kuwait	4 (4)	UAE	3 (5)
5	Saudi Arabia	10 (5)	Kuwait	3 (5)	UAE	3 (5)	Bahrain	5 (3)
6	Oman	6 (7)	Saudi Arabia	11 (6)	Oman	6 (6)	Oman	6 (7)
7	Jordan	9 (8)	Oman	6 (7)	Saudi Arabia	11 (7)	Saudi Arabia	10 (6)
8	Turkey	12 (6)	Lebanon	8 (9)	Lebanon	9 (9)	Turkey	12 (8)
9	Lebanon	5 (10)	Turkey	13 (8)	Jordan	10 (10)	Jordan	9 (11)
10	Tunisia	8 (12)	Jordan	10 (10)	Turkey	14 (8)	Lebanon	11 (9)
11	Iran	13 (9)	Tunisia	7 (12)	Tunisia	7 (11)	Tunisia	8 (12)
12	Algeria	11 (11)	Iran	14 (11)	Iran	13 (12)	Iran	14 (10)
13	Syria	7 (13)	Syria	9 (14)	Algeria	12 (13)	Algeria	13 (13)
14	Egypt	15 (14)	Algeria	12 (13)	Syria	8 (14)	Syria	7 (15)
15	Morocco	14 (15)	Egypt	16 (15)	Egypt	15 (15)	Egypt	15 (14)
16	Yemen	16 (16)	Morocco	15 (16)	Morocco	16 (16)	Morocco	16 (16)
17			Djibouti	18 (17)	Djibouti	18 (17)	Djibouti	18 (17)
18			Yemen	17 (18)	Yemen	17 (18)	Yemen	17 (18)

Note: The ranking of countries with the best and worst case scenarios of the HDI are obtained by using the stochastic efficient weights offered in panels (a) and (b) of Table 5 respectively. Countries in the MENA region are ranked according to their official HDI. Each countrys best and worst case scenario rankings are given for the years 1975, 1980, 1985 and 1990. The best-case scenario rankings are reported on the left panel for each year and the worst-case scenario rankings of countries are reported in parentheses.

Table 5: Major differences between best-case and worst-case scenario rankings in the years 1975, 1980, 1990.

Δ 1975		**Δ 1980**		**Δ 1985**		**Δ 1990**	
Oman	8	Oman	7	Oman	8	Oman	7
Saudi Arabia	5	Saudi Arabia	7	UAE	5	Saudi Arabia	5
UAE	4	UAE	5	Saudi Arabia	5	UAE	4
Algeria	3	Algeria	4	Algeria	4	Algeria	4
Kuwait	1	Kuwait	1	Morocco	1	Morocco	3
Iran	1	Morocco	1	Bahrain	0	Tunisia	2
Morocco	0	Iran	0	Kuwait	0	Bahrain	0
Tunisia	-1	Bahrain	-1	Iran	0	Turkey	0
Israel	-3	Tunisia	-1	Israel	-1	Egypt	0
Egypt	-3	Egypt	-2	Tunisia	-1	Yemen	0
Malta	-5	Israel	-3	Egypt	-2	Israel	-1
Turkey	-5	Malta	-4	Turkey	-4	Iran	-1
Syria	-5	Turkey	-4	Malta	-5	Malta	-2
		Jordan	-5	Jordan	-5	Jordan	-5
		Syria	-5	Syria	-5	Syria	-5
						Lebanon	-11

Note: Δ represents the difference between the ranking of a country in the worst case scenario and the ranking in the best case scenario. If Δ is a positive value, then the country ranks in a higher position in the best case scenario when compared to the worst case. Whereas, if Δ is a negative value, then the country ranks in a lower position in the best case scenario when compared to the worst case. The countries rank according from the highest positive difference to the lowest positive difference.

Table 6: Major differences between best-case and worst-case scenario rankings in the years 1995, 1995, 2000, 2005.

Δ 1990		**Δ 1995**		**Δ 2000**		**Δ 2005**	
Syria	6	Syria	5	Syria	6	Syria	8
Lebanon	5	Tunisia	5	Tunisia	4	Tunisia	4
Tunisia	4	Kuwait	2	UAE	2	Malta	2
Malta	2	Oman	1	Algeria	1	UAE	2
Oman	1	Lebanon	1	Yemen	1	Jordan	2
Morocco	1	Algeria	1	Israel	0	Oman	1
Israel	0	Morocco	1	Malta	0	Yemen	1
UAE	0	Yemen	1	Kuwait	0	Israel	0
Algeria	0	Israel	0	Oman	0	Algeria	0
Yemen	0	Malta	0	Lebanon	0	Morocco	0
Jordan	-1	UAE	0	Jordan	0	Egypt	-1
Egypt	-1	Jordan	0	Egypt	0	Djibouti	-1
Bahrain	-2	Egypt	-1	Morocco	0	Kuwait	-2
Iran	-4	Djibouti	-1	Iran	-1	Bahrain	-2
Saudi Arabia	-5	Bahrain	-2	Djibouti	-1	Lebanon	-2
Turkey	-6	Iran	-3	Bahrain	-2	Saudi Arabia	-4
		Saudi Arabia	-5	Saudi Arabia	-4	Iran	-4
		Turkey	-5	Turkey	-6	Turkey	-4

Note: Δ represents the difference between the ranking of a country in the worst case scenario and the ranking in the best case scenario. If Δ is a positive value, then the country ranks in a higher position in the best case scenario when compared to the worst case. Whereas, if Δ is a negative value, then the country ranks in a lower position in the best case scenario when compared to the worst case. The countries rank according from the highest positive difference to the lowest positive difference.

Table 7: Major improvements and deteriorations in the rankings of the official, best-case and worst-case scenario HDI between 1995 and 2000, and 2000 and 2005

Country	**1995-2000 Difference**			**Country**	**2000-2005 Difference**		
	O	**B**	**W**		**O**	**B**	**W**
Algeria	1	0	0	Algeria	0	-1	0
Bahrain	0	0	0	Bahrain	-2	0	0
Djibouti	0	0	0	Djibouti	0	0	0
Egypt	0	1	0	Egypt	0	0	1
Iran	0	1	-1	Iran	0	-1	2
Israel	0	0	0	Israel	0	0	0
Jordan	1	0	0	Jordan	0	1	-1
Kuwait	1	-1	1	Kuwait	2	0	2
Lebanon	0	-1	0	Lebanon	-2	-2	0
Malta	0	0	0	Malta	-1	0	-2
Morocco	0	-1	0	Morocco	0	0	0
Oman	1	0	1	Oman	0	0	-1
Saudi Arabia	-1	0	-1	Saudi Arabia	0	1	1
Syria	-1	1	0	Syria	0	1	-1
Tunisia	0	0	1	Tunisia	0	-1	-1
Turkey	-1	-1	0	Turkey	2	2	0
UAE	-1	1	-1	UAE	1	0	0
Yemen	0	0	0	Yemen	0	0	0

Note: The ranking changes over time are obtained by subtracting the ranking in the previous year from the following year for the official, best-case and worst case scenario HDI. Positive differences suggest a rank improvement over time, whereas the negative differences suggest deterioration in the ranking. "O", "B", and "W" columns represent the ranking changes in the official, best-case scenario and worst-case scenario over time, respectively.

Table 8: Country distributions in different human development groups with the official HDI, the best-case and worst-case scenarios of the HDI in 1975, 1980, 1985, 1990, 1995, 2000, and 2005.

Human dev. level	1975			1980			1985			1990			1995			2000			2005		
	O	B	W	O	B	W	O	B	W	O	B	W	O	B	W	O	B	W	O	B	W
Low ($HDI < 0.5$)	3	1	7	2	0	6	0	0	3	1	1	2	2	1	2	2	1	2	0	0	1
Medium ($0.5 \leq HDI < 0.8$)	9	8	6	12	10	8	14	11	10	11	11	11	11	12	11	11	12	11	11	10	10
High ($0.8 \leq HDI < 0.9$)	1	2	0	1	4	1	1	3	2	4	3	3	5	5	5	4	4	4	6	7	6
Very high ($HDI \geq 0.9$)	0	2	0	0	1	0	0	1	0	0	1	0	0	0	0	1	1	1	1	1	1

This table presents the percentages of countries that fall into four human development groups specified by the United Nations Development Programme in the years 1975, 1980, 1985, 1990, 1995, 2000, and 2005 with the official HDI (represented in the table as O) the best-case scenario (represented in the tables as B), and the worst-case scenario (represented in the table as W). Low, medium, high and very high human development groups consist of countries that have HDI values less than 0.5, between 0.5 and 0.799, between 0.8 and 0.899, and above 0.9 respectively. Between 1975-1990 and 1995-2005 the distribution of the best-case and the worst-case scenarios are obtained by using the weights from the first and the last two rows of Table 2 respectively.