صندوق النقد العربي
ARAB MONETARY FUND

# Assessing job losses due to the Coronavirus Pandemic (COVID-19) and the minimum required economic growth for job creation in the Arab labour markets

**EL Mostafa Bentour**

**Arab Monetary Fund**
**August 2020**

These economic studies are the product of the staff of the Economic Department at the Arab Monetary Fund (AMF). The Fund publishes these studies which survey issues pertinent to monetary, fiscal, banking, trade and capital market policies and their impact on Arab economies.

All correspondences should be addressed to:

Economic Department
Arab Monetary Fund
P.O. Box 2818
United Arab Emirates
Telephone No.: +9712-6171552
Fax No: +9712-6326454
Email: economic@amfad.org.ae
Website: www.amf.org.ae

Table of Contents

# Assessing job losses due to the Coronavirus Pandemic (COVID-19) and the minimum required economic growth for job creation in the Arab labour markets

By El Mostafa Bentour

**Abstract:**

We apply the Okun's Law linking the unemployment rate to GDP growth to assess the loss in terms of jobs following Covid-19 recession. Estimations were conducted on a benchmark of nine Arab countries, namely, Algeria, Egypt, Jordan, Lebanon, Morocco, Mauritania, Palestine, Sudan, and Tunisia. We adopt different economic outlook scenarios for the GDP forecasts, which all tend to have a consensus for the 2020 forecasts. The overall results show that the 2020 recession will lead to an increase in the unemployment rate by around 2 percent for the studied sample and 2.5 percent for the Arab region. However, the study revealed asymmetric effects which emphasize the increase in unemployment rate in times of economic recessions. Therefore, unemployment rate in 2020 is likely to increase from its level of 2019 by 3.6 to 3.8 percentage points in the studied sample and by 4.2 to 5 percentage points for the Arab world. This results in about 2.8 to 3 million job losses in the sample and about 6 to 7 million in the Arab world.

Furthermore, the paper estimates the minimum required economic growth as a threshold above which a country can create new jobs. For the studied sample, this threshold is estimated to around 3.9 for the panel of nine studied countries. According to IMF regional economic outlook update released in July 2020, the Arab world GDP growth is expecting to recover in 2021 by 3.5 percent. This number is below the estimated minimum growth threshold of 3.9 percent, necessary for new jobs creation that allows reducing unemployment rate from its previous level. This means that the 2021 GDP recovery will not be enough for the employment sector recovery, which may even see further accumulated increase in the unemployment rate. By individual level, this threshold varies across countries, from low values of 2.6 percent in Algeria, 3 percent in Lebanon to high levels of 5.7 percent in Palestine and 6.9 percent in Sudan. Over the recent past decades, the minimum required economic growth for jobs creation compared to the average actual economic growth, explains the fact that some countries succeeded to some extent in reducing unemployment rates while others still have major challenges in this issue.

# 1. Introduction

Since the start of the health crisis triggered by the coronavirus (COVID-19), countries around the world have quickly acted to curb the spread of the epidemic, by confining their populations. As a result, many economic sectors are partially or totally hibernated. Consequently, governments have found themselves forced to act to contain and curb the subsequent economic repercussions. For this purpose, a variety of measures have been implemented worldwide, ranging from the central banks' monetary actions to the government fiscal measures. In this regards, central banks reacted quickly by easing liquidity constraints through monetary policy actions (reduction of interest rates) and social actions (deferring credit payments for individuals and businesses). Furthermore, government designed urgent fiscal policy measures to limit the impacts on families and businesses. While these necessary short-term measures should ease the effects of the health crisis on economic sectors, they may not be enough to deal with the medium and long-term economic consequences on the main economic sectors, especially considering the severity of the crisis.

One of the sectors that would be hit hard is the employment sector. Particularly that the economic measures taken to preserve jobs would not be enough against the high impact of the current crisis. Challenge of high unemployment are mainly observed in countries where fiscal buffers are limited but also have pre-crisis high level of unemployment rates compared to the normal worldwide average. Besides the labor market government policies and regulations that could impact unemployment rate, a sufficient economic growth is required, particularly in intensive-labour sectors, which plays a crucial rule in absorbing unemployed population through creating new jobs while avoiding destroying existent ones.

With regards to the current economic outlook, following the sanitary crisis which leads to a twin negative supply and demand shocks, all the institutions and experts in economic forecasting are unanimous on the imminent recession of 2020. For example, the IMF in its April 2020 outlook reported a recession of around -3 percent for the world GDP and -6 percent for the advanced economies. These forecasts have been even slashed by an additional 1.9 percentage in an updated note in June 2020, expecting further deeper recession of the World economy of around -4.9 percent and -8 percent for the group of advanced economies. Similarly, many national institutions estimates are coming in the same range. Arab countries are also facing unequal repercussions depending on the degree of restrictions imposed on the mobility of people and freezes of economic activities, due to the number of revealed contaminations. Moreover, the additional downturns in the petroleum sector hit hard by the fall in oil prices add challenging consequences on the oil-exporting countries. These combined factors will weigh on the Arab countries' region for which GDP is expected to witness a recession with a GDP growth of -5.7 percent according to the last update of the IMF regional economic outlook, appeared in July 2020.

Following these outlooks, we apply the Okun's law (Okun, 1962) linking the unemployment rate to GDP growth to assess the loss in terms of jobs following the current recession. Econometric

analysis was conducted on a benchmark of nine Arab countries, particularly those with adequate long time series for national data on unemployment rate or ILO unemployment rate estimates. The sample of countries includes Algeria, Egypt, Jordan, Lebanon, Morocco, Mauritania, Palestine, Sudan, and Tunisia. Except some other countries, for which data on unemployment rate time series are not enough to run econometric estimations (Comoros, Djibouti, Iraq, Syria, and Somalia), the nine studied sample of countries are that experienced past (or still have current) unemployment issues. Indeed, the GCC countries are excluded as the labor markets in these countries are dominated by foreign labor and have no issues of unemployment over the past years which makes the Okun law not flexible enough to reflect a valid relationship.

In what follows, section 2 explains the economic logic of the Okun's Law relationship and its formulae. Section 3 discusses the recent literature about the asymmetric effects of the Okun's Law over the business cycle. Section 4 presents data sources and some calculations and descriptive statistics and section 5 presents estimations. Section 6 simulates unemployment increases and job losses following different outlook scenarios for the 2020 year. Section 7 estimates the required minimum economic growth for jobs recovery and section concludes.

## 2. On the logic behind Okun's Law: interpretation and formulations

The Okun's Law is an empirical relationship generally used by researchers to assess unemployment rate responses to GDP. In 1962, Arthur Okun derived three different Okun's relationships known respectively by; the differences version as the first version, the gap version as the second version, and the employment elasticity version as the third one (Okun, 1962). In the literature, the two first formulations are the most and widely used, for which we detail the economic interpretations and formulae in what follows. Estimating these relationships for the economy of the United States of America, Okun (1962) found a negative relationship between the unemployment rate and GDP with a coefficient of around -1/3. Accordingly, a GDP growth rate increase by 3 percent should reduce the unemployment rate by one percentage point.

### 2.1. The first differences version of the Okun's Law

The first version of the Okun's Law is connecting the changes in the unemployment rate (in percentage points) to the percentage changes in the real GDP (i.e. real GDP growth rate). This can be expressed by the following equation:

$$\Delta u_t = \alpha_{dif} + \beta_{dif}\, g_t + \varphi_t \,;\; \alpha_{dif} > 0 \; and \; \beta_{dif} < 0 \qquad (1)$$

Where, $\Delta u_t$ and $g_t$ are respectively the first differences in the unemployment rate and the real GDP growth rate. The parameter $\alpha_{dif}$ is a constant term expected to be positive while $\beta_{dif}$ is the associtated Okun's Law coefficient expected to have a negative economic sign, reflecting a

negative relationship between GDP growth and unemployment rate. Indeed, any GDP increase reflect firms' capacities expanding and more jobs are created which is likely leading to reduce unemployment rate, and vice versa. Using the United States of America quarterly data from 1947: Q2 to 1960 Q4, Okun (1962) found, for the differences' version, the coefficients $\alpha_{dif} = 0.3$ and $\beta_{dif} = -0.30$ with a coefficient of determination $R^2$=79%.

Another important conclusion that could be easily derived from the differences' version is the assessment of the GDP growth rate that is necessary for a net jobs creation allowing to reduce the unemployment from its previous level. Indeed, not any positive value of GDP growth is enough to create new jobs but, this can be possible from a certain positive growth rate threshold, and this can differ from country to another. This why the unemployment has tendency to persist or is very slowly reduced even when countries enjoy relatively good performances in terms of GDP growth. Knowing this GDP growth threshold, necessary for new jobs creation, is an important factor for the policymakers, would they desire to target unemployment reduction.

From the equation (1), the estimated equation is:

$$\Delta\hat{u}_t = \hat{\alpha}_{dif} + \hat{\beta}_{dif} g_t + \hat{\varphi}_t \qquad \textbf{(2)}$$

Where "hat" over parameters, endogenous variable, and residuals series specifies estimations. Applying the average relationship to the equation (2) yields:

$$\Delta\bar{u}_t = \hat{\alpha}_{dif} + \hat{\beta}_{dif} \bar{g}_t \qquad \textbf{(3)}$$

As $\overline{\hat{\varphi}_t} = 0$; the average of the residuals is zero by default (assumed to be white noise).

From equation (3), in the average, the unemployment is reduced if $\Delta\bar{u}_t$ is negative, which means the right-hand-side equation is also negative. This leads simply to say that:

$$\bar{g} > -\frac{\hat{\alpha}_{dif}}{\hat{\beta}_{dif}} = g_{mjc} \qquad \textbf{(4)}$$

The equation (4) will be used to generate the minimum required jobs creation for the sample of the Arab countries.

According to the Okun's estimations, we can easily deduce the minimum growth rate required for jobs creation in the United States of America is about 1% ($-\hat{\alpha}_{dif}/\hat{\beta}_{dif} = 1$). This means that the Unite States of America, at the period of estimations, could have created new jobs at the minimum level of 1 percent of GDP growth rate. The required growth is subject to rigidities and labour policies and can differ from a country to another. The required growth for jobs creation is higher in countries with rigid labour markets. This why in France for example, economists from the

"OFCE" indicate a threshold of 1.5 percent[1] higher than the 1 percent in the United States of America as the Euro countries labour markets seem to be less flexible compared to the United States labour market (Prescott, 2004). Furthermore, according to Aksoy and Manasse (2018), European countries lie on a trade-off between "resilience" and "persistence" of the unemployment, that is countries where unemployment is resilient to output fluctuations show typically higher unemployment persistence.

Although this notion of minimum growth is simply derived from the Okun's Law, to our best knowledge, there is no literature that indicate clearly any link between the notion of the minimum growth as we defined it here and the Okun's Law, particularly for the Arab countries. All what we found is some few reports and studies of the World Bank, indicating for some countries the threshold growth necessary for employment or poverty reductions. For example, based on an accounting growth model considering the Total Factor Productivity (TFP) estimations, the World Bank (2006) recommend about 5 to 6 percent of growth rate for Morocco in order to reduce the level of its unemployment rate.

## 2.2. The gap version of the Okun's Law

The gap version of the Okun's relationship links two components: the gap between the actual unemployment rate and the non-accelerating inflation rate unemployment (NAIRU) as the explained component, and the gap between GDP and its potential, as an explanatory component. This can be formulated as:

$$\boldsymbol{u_t - u_t^n = \beta_{gap} GAP_t + \epsilon_t \ ; \ \beta_{gap} < 0 \ and \ u_t^n > 0} \qquad \textbf{(5)}$$

Where $u_t$ is the unemployment rate at time t, $u_t^n$ the natural unemployment rate (Non-Accelerating Inflation Rate of Unemployment, the NAIRU), and $\boldsymbol{GAP_t = 100 * \left(y_t - y_t^p\right)/y_t^p}$, with $y_t$ the real GDP, $y_t^p$ the potential GDP and $\epsilon_t$ is the stochastic errors time series, assumed independent and identically distributed. The parameter $\beta_{gap}$ is the Okun's Law coefficient which is expected by Okun's Law economic interpretation to have a negative algebraic sign. The main issue in the gap version is the determination of potential variables that are not observable, namely the GDP potential and the natural unemployment rate. For this purpose, statistical techniques of smoothing and detrending series are solicited (see section 4.2).

The economic intuition behind this relationship is that actual GDP fluctuations around its potential are mainly driven by aggregate demand shifts, which leads firms to hire workers in time of favourable economic conditions while laying them off in time of economic downturns, which drives changes in the country's level of unemployment rate. For example, when economy is performing above its potential, this creates a positive output gap which should drag down the

[1] Le Figaro, 27, Avril 2015. https://www.lefigaro.fr/conjoncture/2015/04/27/20002-20150427ARTFIG00190-pourquoi-faut-il-15-de-croissance-pour-faire-baisser-le-chomage.php.

unemployment gap. Conversely, the negative output gap that opens up when the economy is performing below its potential, should leads to an upward shift on the unemployment gap. Formally, we can define GDP gap by the following formula:

$$GDP_{gap} = \underbrace{Actual\ GDP}_{\substack{Current\ unemployment \\ (Frictionnal+Structural+Cyclical)}} - \underbrace{Potential\ GDP}_{\substack{NAIRU \\ (Frictionnal+Structural)}}$$

As described by the above formula, the output gap or GDP gap is, simply, the actual Gross Domestic Product minus the potential Gross Domestic Product. The actual GDP is associated with the current unemployment, which could be decomposed to three components: frictional, structural, and cyclical unemployment. Frictional unemployment exists in any economy as a result of the job-seekers mobility between sectors or companies, while structural unemployment results from the production structure related rather to industrial reorganization, technological change, labour policies and mismatch skills, than fluctuations in supply or demand. Accordingly, frictional and structural unemployment is not necessarily affected by the business cycle, which leads to conclude that, Okun's Law is measuring particularly the responses of the unemployment cyclical component.

The potential GDP corresponds to the situation where the economy uses its full capacity without overstressing it. This leads to absorb the unemployment cyclical component (being zero) and the unemployment is at its natural rate called also the non-accelerating inflation rate unemployment (NAIRU). The level of the natural rate of unemployment differs across countries as it is particularly influenced by both frictional and structural unemployment, for which determinants are not necessarily the same across countries. The cyclical component does not have any impact on the NAIRU as the latter correspond to the GDP at its potential (the output gap=0) and the cyclical unemployment component is zero in this case. From this analysis, Okun's Law measures the cyclical unemployment responses to aggregate demand shifts determining output fluctuations. This constitutes an important measuring tool for jobs assessment (losses and recoveries as well) in time of high fluctuations over the business cycle (recessions and expansions alternations).

In the short term, the production structures do not necessarily change, therefore, the natural unemployment rate is assumed constant and approached by the positive parameter $\alpha_{gap}$ representing the average unemployment rate over a period of stable production structure. Equation (1) could be approached by:

$$u_t = \alpha_{gap} + \beta_{gap}(y_t - y_t^p) + \epsilon_t \ ; \ \beta_{gap} < 0 \ and \ \alpha_{gap} > 0 \qquad (6)$$

Using the United States of America quarterly data from 1947: Q2 to 1960 Q4, Okun (1962) found for this version the coefficients $\alpha_{gap} = 3.72$ and $\beta_{gap} = -0.36$, with $\alpha_{gap} = 3.72$ is the NAIRU

corresponding to full employment at that period. Sensitivity analysis on the potential path (for the GDP potential) show $\beta_{gap}$ ranging between -0.28 and -0.38. Since Okun's first estimations, the gap version relationship has been largely estimated particularly using quarterly data for the United States and some advanced economies. The estimations showed a high significant empirical support (Lancaster and Tulip, 2015; Ball and al., 2017).

However, this relationship could be challenged when using lower frequency data. Indeed, lack of quarterly data, especially in developing and low developed countries leads to use the annual frequency data. This could undermine determining accurately short-term business cycle fluctuations and could not produce robust outlook and clear visibility on short term unemployment responses that occur differently over quarters of the same year. Furthermore, it requires, before any econometric estimations, determining the GDP potential (trend) and the NAIRU which are unobservable aggregates[2]. The smoothing and filtering time series techniques which are developed and used to obtain potential aggregates have also their shortcoming (Lancaster and Tulip, 2015). See section 4 presents the HP filter as a widely used method of filtering data. For these reasons, the first version (the difference version) is widely used particularly with annual data.

There is a scarce literature applying the Okun's Law in the Arab countries in the past due to short data samples. Some studies are applied to few Arab countries but failed to conclude about strong any relationships, particularly at the individual level. For example, Moosa (2008) examined the Okun's Law for Algeria, Egypt, Morocco and Tunisia concluding that the relationship is not valid for the four countries. However, very recent studies tend to show the Okun's Law validity in some countries using longer time series or panel analysis. For example, Abou Hamia (2016), using an ARDL approach for 17 MENA countries, found the Okun's Law to be valid for Algeria, Egypt and Lebanon. Morover, Bouaziz and El Andari (2015) demonstrated the Okun's law validity in Tunisia, with a higher confident of -0.76, while Ezzahidi and El Alaoui (2014) found a valid Okun coefficient for Morocco around -0.14.

## 3. The asymmetric effect in the Okun's Law

In economics, many relationships between variables, whether theoretically based assumptions or empirically tested, are challenged by some issues distorting their formulations. This is principally caused by changeable behaviors of the economic agents following unstable economic environment creating different regimes, hence leading to different responses of the economic variables. Recent development in econometrics and data analysis highlighted more these issues leading to many

[2] There is a considerable literature of how to estimate the NAIRU particularly from a Phillips curve regression, combined with separate contributions from capital and technology in a production function (Examples are: De Masi, 1997; De Brouwer, 1998; Turner and al., 2001; Johansson and al, 2013).

empirical researchers and tests that consider such issues. One of the important phenomena are non-linearities leading to asymmetrical responses in explained economic aggregates.

In Okun's law, asymmetry occurs when there are unequal responses in unemployment following equal absolute increase and decrease in output (GDP gap in the gap version and GDP growth rate in the differences version). This is generally emphasized when transiting between two distinct regimes: expansionary regime and recessionary regime. Until the end of the 1990's, estimations of Okun's law assume a symmetric relationship, considering that responses of recessions and expansions in output have identical effect on unemployment.

Recently, asymmetric effects in the Okun's Law, that were ignored before, are becoming increasingly examined and confirmed by researchers. In addition to the above-mentioned business cycle alternating regimes of recessions and expansions, economic explanations for asymmetries in Okun's Law include also a variety of factors, such as, monetary policies (Garibaldi, 1997), shifts in labor force participation rates, sectoral economic growth (Harris and Silverstone 2001, Holmes and Silverstone, 2006), job-mismatch (Allen and Van der Velden, 2001), uncertainties and asymmetric adjustment costs between expanding and contracting firms (Foerster, 2014), and many other factors that impact differently jobless recoveries (Aaronson and al., 2004).

In estimating Okun's Law, different econometric models were used to account for asymmetry. Cuaresma (2003) used Markov regime-switching models applied to the United States of America quarterly data over the periods of 1965-1999. Cuaresma (2003) estimation lead to Okun coefficient of -0.20 following increasing output regime and -0.44 in decreasing output regime. Similarly, Silvapulle and al. (2004) proved asymmetric effects in the estimated Okun's coefficients using the United States data covering the period of 1947-1999. More specifically, they revealed that short-term effects of negative cyclical[3] GDP on cyclical unemployment are significantly different from those of positive ones, with the cyclical unemployment showing more sensitivity to negative than to positive cyclical output. The estimated Okun coefficient is about -0.25 following increases in the cyclical output while this coefficient drops to -0.61 following decreases in cyclical output. Recently, Lim and al. (2018) used an approach based on the market labour flows data, and confirmed the same coefficients as found approximately the same coefficient of Silvapulle and al. (2004) (exactly 0.24 and 0.61 for respectively positive and negative shocks on output).

However, Holmes and Silverstone (2006), using Markov-switching regime approach on the quarterly data of the United States of America over 1963-2004, were the first authors to investigate two forms of asymmetry: asymmetry across distinct regimes (expansionary versus recessionary) and within the same regime. Hence, in addition to confirmed asymmetry between two different

[3] In practice, the gap notion is called cyclical component regarding time series decomposition. Indeed, when dealing with data, the potential (defined as the long-term tendency) is the trendline derived by different statistical methods of smoothing or filtering the series (the HP filter for example). The cyclical component is deduced as the actual series *minus* the trend's series (the potential), which corresponds to the gap definition.

regimes, their results also suggested the presence of asymmetry within the same regime. Very recently, other works on this issue flourished, always confirming asymmetry in Okun's relationship over the business cycle. Particularly, the Okun's coefficient is higher in time of recessions than in time of expansions (Owyang and Sekhposyan, 2012; Cazes et al. 2013; Pereira, 2013; Belaire-Franch and Peiro, 2015).

The relationship is also revealed instable over time (Cazes and al. 2013) and particularly weaker in periods of economic expansion (Pereira, 2013). Furthermore, although the Okun's Law is evaluated to becoming weakening since the early 1980s by Valadkhani and Smyth (2015), Ball et al. (2017) found that this empirical law is a strong, reliable, and stable relationship and that a constant (not time varying) Okun coefficient seems to be a good approximation to reality (Lim and al. 2018). Furthermore, Dimitris and al. (2019) Using logistic smoothed transition regression (LSTR) showed that the unemployment gap is increasingly associated with a smaller output gap. For the Arab countries, and to our best knowledge, this paper is the first one to investigate asymmetric effects of the business cycle. This is important, particularly for the design of the Macroeconomic policies for recovery following the 2020 recession.

## 4. Data source, descriptive statistics, and GDP potential evaluation

This section displays different sources of the used data on real GDP and labour statistics as well as presenting the method of detrending real GDP allowing to estimate the potential GDP, hence the output gap.

### 4.1. Sources for real GDP and labour statistics

To estimate the two previously mentioned versions of Okun's Law, we used the longest unemployment time series available from different sources principally, the International Labor Organization (ILO), for national unemployment rate. Available data are observed on annual basis. For some countries, national time series on unemployment are short or have breakpoints and missing years. To remedy this issue, we used, the ILO estimates that complete the time series, whenever these are available too. Both series (national data and ILO estimates) for the unemployment are accessible through the World Development Indicators (WDI) database of the World Bank. For real GDP and economic growth data, we used the World Economic Outlook database of the International Monetary Fund (IMF). Descriptive statistics of unemployment rate and GDP growth data are displayed in appendix 1. For the rest of our application, involving simulations of jobs loss, we used national labour force data from the World Bank WDI database. We also used a variety of scenarios for economic growth forecasts for 2020 and 2021 from national and international sources (mentioned in section 6).

### 4.2. The potential GDP estimation

To estimate the gap version model, the potential GDP is obtained by applying the HP filter with a smoothing parameter equal to 100. To obtain a smooth estimate of the long-term trend component of a series, the Hodrick-Prescott filter (HP filter hereafter) is a widely used smoothing method among researchers. The method first, appeared in a working paper in the early 1980's, was applied to analyze the postwar U.S. business cycles and published later in 1997 (Hodrick and Prescott, 1997). A time series $Y_t$ could be decomposed to its long-term trend $G_t$ (a sum of growth component) and cyclical component $C_t$: $Y_t = G_t + C_t$. The HP filter algorithm works to smooth the original series by estimating its trend component, while the cyclical component results as the difference between the original series and its trend.

The trend component is the one that minimizes $\sum_1^T (C_t)^2 + \lambda \sum_1^T [(G_t - G_{t-1}) - (G_{t-1} - G_{t-2})]^2$, where *T* is the number of observations and λ is a positive parameter of smoothing that depends on the frequency of the time series. The higher the data frequencies, the larger the value of λ and the larger λ, the higher the penalty of changes in the trend's growth rate (represented by the second term of the previous equation) and the smoother the trend component. In practice, λ is set empirically to be 1600 for quarterly data as suggested by Hodrick and Prescott (1997), while for annual data, λ is set to 100 in many applications. In our case, the trend values are estimated using the HP filter with a smoothing parameter of 100 (Graphical presentation of the GDP gaps is displayed in appendix 2 and GDP growth rate in appendix 3).

## 5. Okun's Law estimations

This section presents, for the two versions of the Okun's Law discussed in section 2, all estimations based on individual country level (section 5.1) and panel regressions controlling for asymmetric effects over the business cycle as debated in the section 3.

### 5.1. Individual regressions

Table 1 presents Okun's Law estimations for the difference version model. The Okun's Coefficients are statistically significant and varies across countries and seems to be in the range values found in the literature for many countries in sample (including the Okun's (1962) results, see section 2.1), particularly Algeria (-0.3), Egypt (-0.37), Jordan and Morocco (-0.24), Palestine (-0.36) and Tunisia (-0.31). The three other countries show weak coefficients particularly Mauritania and Lebanon. The overall global association (as shown by Fisher statistics) is of good

quality for every country and the model seems not suffering from autocorrelations' issues as shown by the Durbin-Watson statistics.[4]

For the gap version model, table 2 shows the results confirming also the overall high global adjustments for every country and the expected economic sign and statistical significance for all the coefficients. The only issue with the gap version is the appearance of the positive autocorrelations (except for Lebanon) as proved by very weak Durbin-Watson statistics. The issue of serial autocorrelations is present particularly when estimating equations using transformed variables as averages, and filtered data which is the case with the output gap containing the potential GDP (filtered by Hodrick-Prescot filter).[5] The Okun coefficient ($\beta_{gap} = -0.81$) is abnormally high in Algeria compared to the literature range as well as to the first model results or also with the other countries in the sample. Corresponding Durbin-Watson statistics ( $DW$=0.11) is also the weakest amongst the sample of countries. Morocco seems having also higher coefficient in the gap model compared to the difference model ($\beta_{gap} = -0.47 \ \ versus \ \beta_{dif} = -0.24$). For the seven other countries, the Okun's coefficients are not significantly different between the two models.

[4] The Durbin-Watson statistic (DW) lies between 0 and 4, with DW= 2 indicates no autocorrelation. A Durbin–Watson statistic significantly less than 2, implies an evidence of positive serial correlation. As an approximative rule of thumb, econometricians consider that if Durbin–Watson is less than 1.0, there may be strong reason to worry about positive autocorrelations. If DW is significantly superior than 2, there is evidence of negative autocorrelations. Estimations and inference tests could be impaired in the presence of autocorrelations.

[5] Cointegrated series also present such issues but this case is not present in our applications as all the calculated outputs gap have no trend, which was clearly shown from the appendix 2 and checked with appropriate stationary tests.

**Table 1. Estimation results for the differences version of Okun's Law**

| ***Model 1. Differences version:*** $\Delta u_t = \alpha_{dif} + \beta_{dif}\, g_t + \varphi_t$ | | | | | | |
|---|---|---|---|---|---|---|
| ALGERIA | | Coefficient | t-Statistic | Prob. | *F-statistic* | 6.28 |
| *Constant term* | $\alpha_{dif}$ | 0.7742* | 1.7595 | 0.0868 | *F-Prob.* | 0.02 |
| *Okun Coefficient* | $\beta_{dif}$ | -0.3028** | -2.5052 | 0.0168 | *D.W-Stat.* | 1.78 |
| EGYPT | | Coefficient | t-Statistic | Prob. | *F-statistic* | 14.92 |
| *Constant term* | $\alpha_{dif}$ | 1.6478*** | 3.6454 | 0.0011 | *F-Prob.* | 0.00 |
| *Okun Coefficient* | $\beta_{dif}$ | -0.3717*** | -3.8620 | 0.0006 | *D.W-Stat.* | 1.76 |
| JORDAN | | Coefficient | t-Statistic | Prob. | *F-statistic* | 4.06 |
| *Constant term* | $\alpha_{dif}$ | 1.3264** | 2.1638 | 0.0395 | *F-Prob.* | 0.05 |
| *Okun Coefficient* | $\beta_{dif}$ | -0.2423* | -2.0144 | 0.0540 | *D.W-Stat.* | 1.63 |
| LEBANON | | Coefficient | t-Statistic | Prob. | *F-statistic* | 3.96 |
| *Constant term* | $\alpha_{dif}$ | 0.3279 | 1.1259 | 0.2893 | *F-Prob.* | 0.08 |
| *Okun Coefficient* | $\beta_{dif}$ | -0.0934* | -1.9895 | 0.0779 | *D.W-Stat.* | 2.37 |
| MAURITANIA | | Coefficient | t-Statistic | Prob. | *F-statistic* | 6.80 |
| *Constant term* | $\alpha_{dif}$ | 0.0809* | 1.8517 | 0.0888 | *F-Prob.* | 0.02 |
| *Okun Coefficient* | $\beta_{dif}$ | -0.0165** | -2.6082 | 0.0229 | *D.W-Stat.* | 1.91 |
| MOROCCO | | Coefficient | t-Statistic | Prob. | *F-statistic* | 9.27 |
| *Constant term* | $\alpha_{dif}$ | 0.8670** | 2.2611 | 0.0415 | *F-Prob.* | 0.01 |
| *Okun Coefficient* | $\beta_{dif}$ | -0.2399*** | -3.0441 | 0.0094 | *D.W-Stat.* | 2.55 |
| PALESTINE | | Coefficient | t-Statistic | Prob. | *F-statistic* | 15.77 |
| *Constant term* | $\alpha_{dif}$ | 2.0653** | 2.8372 | 0.0114 | *F-Prob.* | 0.00 |
| *Okun Coefficient* | $\beta_{dif}$ | -0.3615*** | -3.9714 | 0.0010 | *D.W-Stat.* | 2.65 |
| SUDAN | | Coefficient | t-Statistic | Prob. | *F-statistic* | 2.15 |
| *Constant term* | $\alpha_{dif}$ | 1.5120** | 2.2103 | 0.0456 | *F-Prob.* | 0.16 |
| *Okun Coefficient* | $\beta_{dif}$ | -0.2170* | -2.0234 | 0.0641 | *D.W-Stat.* | 1.82 |
| TUNISIA | | Coefficient | t-Statistic | Prob. | *F-statistic* | 8.97 |
| *Constant term* | $\alpha_{dif}$ | 1.1551** | 2.5709 | 0.0162 | *F-Prob.* | 0.01 |
| *Okun Coefficient* | $\beta_{dif}$ | -0.3131*** | -2.9957 | 0.0059 | *D.W-Stat.* | 2.29 |

**Notes:**

- Coefficients are statistically significant at 10% (*), 5% (**) and 1% (***) critical level.
- For Sudan, we used a dummy variable to correct the effects on growth that shrank by -21% in 2012 following the separation of South in July 2011. Without this correction, estimations are highly sensitive to the sample data variation.

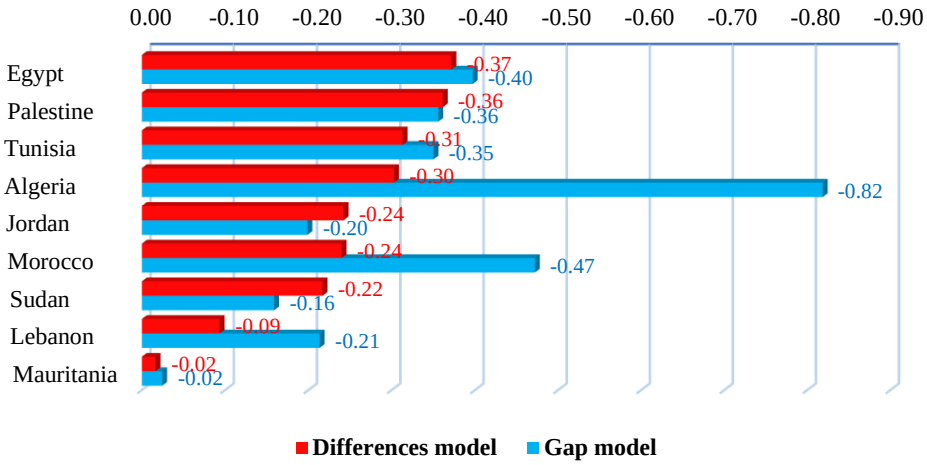
**Table 2. Estimation results for the gap version of Okun's Law**

| ***Model 2. Gap version:*** $u_t = \alpha_{gap} + \beta_{gap}(y_t - y_t^p) + \epsilon_t$ | | | | | | |
|---|---|---|---|---|---|---|
| ALGERIA | | Coefficient | t-Statistic | Prob. | *F-statistic* | 3.65 |
| *Constant term* | $\alpha_{gap}$ | 17.9267*** | 17.9816 | 0.0000 | *F-Prob.* | 0.06 |
| *Okun Coefficient* | $\beta_{gap}$ | -0.8185* | -1.9098 | 0.0637 | *D.W-Stat.* | 0.11 |
| EGYPT | | Coefficient | t-Statistic | Prob. | *F-statistic* | 8.40 |
| *Constant term* | $\alpha_{gap}$ | 10.2873*** | 38.2273 | 0.0000 | *F-Prob.* | 0.01 |
| *Okun Coefficient* | $\beta_{gap}$ | -0.3973*** | -2.8989 | 0.0074 | *D.W-Stat.* | 0.32 |
| JORDAN | | Coefficient | t-Statistic | Prob. | *F-statistic* | 3.39 |
| *Constant term* | $\alpha_{gap}$ | 14.4486*** | 39.0865 | 0.0000 | *F-Prob.* | 0.08 |
| *Okun Coefficient* | $\beta_{gap}$ | -0.1989* | -1.8419 | 0.0765 | *D.W-Stat.* | 0.29 |
| LEBANON | | Coefficient | t-Statistic | Prob. | *F-statistic* | 90.68 |
| *Constant term* | $\alpha_{gap}$ | 7.1339*** | 76.2638 | 0.0000 | *F-Prob.* | 0.00 |
| *Okun Coefficient* | $\beta_{gap}$ | -0.2135*** | -9.5225 | 0.0000 | *D.W-Stat.* | 1.61 |
| MAURITANIA | | Coefficient | t-Statistic | Prob. | *F-statistic* | 12.92 |
| *Constant term* | $\alpha_{gap}$ | 9.7212*** | 317.5270 | 0.0000 | *F-Prob.* | 0.00 |
| *Okun Coefficient* | $\beta_{gap}$ | -0.0244*** | -3.5947 | 0.0021 | *D.W-Stat.* | 0.96 |
| MOROCCO | | Coefficient | t-Statistic | Prob. | *F-statistic* | 4.42 |
| *Constant term* | $\alpha_{gap}$ | 10.6505*** | 28.1573 | 0.0000 | *F-Prob.* | 0.05 |
| *Okun Coefficient* | $\beta_{gap}$ | -0.4720** | -2.1027 | 0.0466 | *D.W-Stat.* | 0.44 |
| PALESTINE | | Coefficient | t-Statistic | Prob. | *F-statistic* | 7.85 |
| *Constant term* | $\alpha_{gap}$ | 18.6774*** | 18.6930 | 0.0000 | *F-Prob.* | 0.01 |
| *Okun Coefficient* | $\beta_{gap}$ | -0.3559** | -2.8026 | 0.0101 | *D.W-Stat.* | 0.29 |
| SUDAN | | Coefficient | t-Statistic | Prob. | *F-statistic* | 3.41 |
| *Constant term* | $\alpha_{gap}$ | 15.7837*** | 50.0343 | 0.0000 | *F-Prob.* | 0.09 |
| *Okun Coefficient* | $\beta_{gap}$ | -0.1588* | -1.8459 | 0.0878 | *D.W-Stat.* | 0.67 |
| TUNISIA | | Coefficient | t-Statistic | Prob. | *F-statistic* | 4.75 |
| *Constant term* | $\alpha_{gap}$ | 15.0018*** | 59.4914 | 0.0000 | *F-Prob.* | 0.04 |
| *Okun Coefficient* | $\beta_{gap}$ | -0.3503** | -2.1803 | 0.0381 | *D.W-Stat.* | 0.51 |

Note: Coefficients are statistically significant at 10% (*), 5% (**) and 1% (***) critical level.

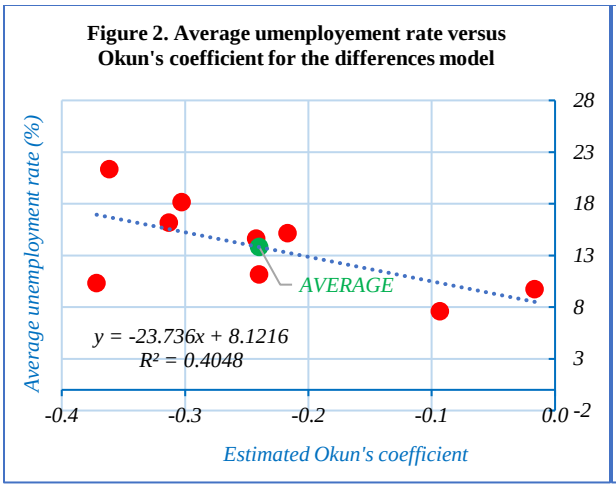
In figure 1, we plot the estimated Okun's coefficients for the sample of 9 countries for the two estimated models. The values are filtered form the largest to the smallest value according to the difference version results (model 1) showing three groups for model 1: Egypt, Palestine, Algeria and Tunisia having a coefficient ranging between -0.3 and -0.37. Morocco, Jordan, and Sudan with a coefficient between -0.22 and -0.24 and the group of Lebanon and Mauritania with very low coefficient.

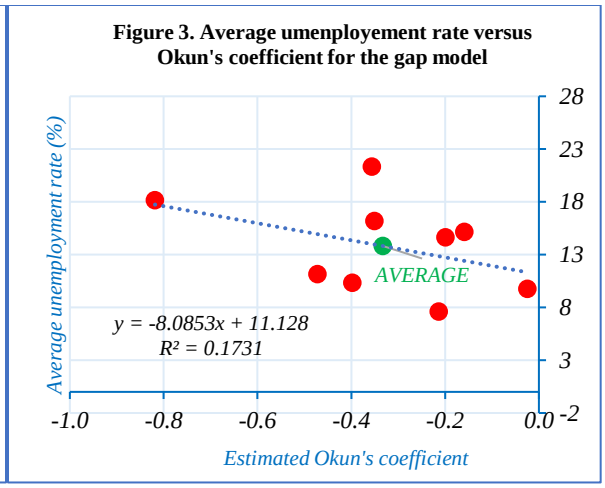
**Figure 1. Estimated Okun's coefficients**




In order to catch the sensitivity of the unemployment rate to the Okun's coefficient for both models, we plot averages of unemployment rate (over the period of estimations) with the coefficients in figure 2 for the differences model and in figure 3 for the gap model. Both figures show a negative association between the average unemployment and the beta coefficients. However, figures 2 and 3 show more adjustment of the unemployment rate with the coefficients in the differences version model than in the gap model with respectively coefficient of determination ($R^2$) of 40.5% and 17.3%.

Considering this comparison as well as the problem of autocorrelations revealed in the gap model, the difference model seems more performant to select for the exercise of simulating jobs loss in the coming sections. Moreover, the gap model uses estimating potential GDP for which the path is influenced by the filtering method. The Hodrick-Prescot method has its drawbacks particularly showing sensitivity to the end of the sample and causing spurious dynamics (Hamilton, 2017). The natural unemployment rate is also another issue as it is considered only represented by constant term $\alpha_{gap}$ in the gap version. Moreover, the difference version model allows to easily derive the required minimum growth for jobs creation as explained in section 2.1.




## 5.2. Robustness check: Testing for asymmetric effects

Following the discussion in the economic literature on the possible asymmetric effects over the business cycle (section 3), we run estimations controlling for economic expansions and recessions. For individual regressions, we could not control for the business cycle as the degrees of freedom (the number of adjusted sample observations for estimations) would be short for econometric estimations. Indeed, the sample of observations for each country would be split in two samples (recessions and expansions periods). Particularly, the number of observations corresponding to recessions are scarce. To remedy to this problem, we use the sample of nine studied countries to run panel regressions. We define two explanatory variables controlling for the business cycle states. The new explanatory variables $V_{g,t}^{rec} = \min(0, g_t)$ { $V_{g,t}^{rec} = \max(0, g_t)$} and $V_{gap,t}^{rec} = \min(0, gap_t)$ { $V_{gap,t}^{rec} = \min(0, gap_t)$} are used to control for the recessions {expansions} respectively in the difference version and the gap version of the Okun's Law. The variables $g_t$ and $gap_t$ are respectively the GDP growth rate and the GDP gap as previously defined in our estimations.

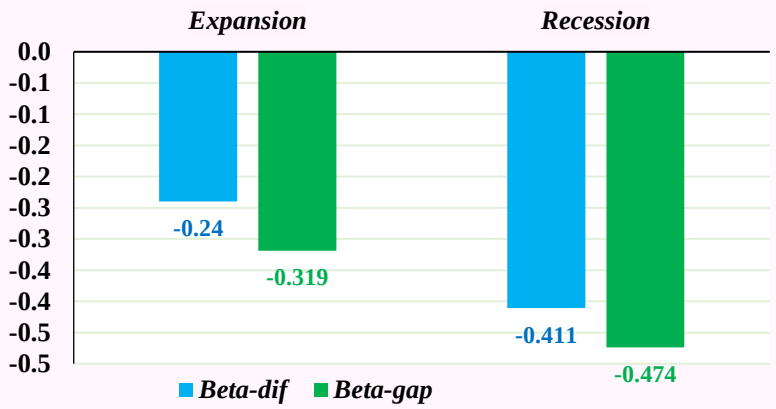
Tables 3 displays the panel estimations results for the differences model and the gap model. For each model, two models are estimated: first, controlling for expansions period, and second, controlling for recessions periods. Moreover, for each situation, we considered only the fixed effects panel option chosen by Hausman test. Reading table 3 by rows allows to transit from one model to another. Reading table by columns allows easily to compare the asymmetric effects caused by the business cycle (recessions versus expansions) and to transit between effects for the same model. Both models indicate high global adjustment and strong statistical significance of parameters in every situation. The only issue that was revealed and discussed in individual regressions too, is the presence of autocorrelations in the gap version model confirmed by low Durbin-Watson values.

Furthermore, the results' overview indicates very pronounced asymmetric effects in the Okun's coefficient. In times of recessions, the coefficient is higher and could be double the one estimated in normal times. For expansion periods, the coefficient lies between -0.20 and -0.24 for the differences model and is around -0.32 for the gap model. However, in times of recessions, the two models show higher coefficients than in times of expansions. The Okun's coefficient is about -0.42 for the differences model and is around -0.47 for the gap model. These values are in the range of those reported for many advanced countries in the literature (sections 2 and 3). Figure 4 summarizes the results of the table 3 for the two models and all estimations and cases.[6]

**Table 3: Panel estimation results over the business cycle for difference and gap models**

| **Okun's Law controlling for expansions** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| ***Differences model (model 1)*** | | | | | | ***Gap model (model 2)*** | | | | |
| | Coef. | t-Stat | Prob. | F-stat | 4.87 | | Coef. | t-Stat | Prob. | F-stat | 39.82 |
| $\alpha_{dif}$ | 1.018 | 4.584 | 0.000 | F-Prob | 0.00 | $\alpha_{gap}$ | 14.285 | 55.512 | 0.000 | F-Prob | 0.00 |
| $\beta_{dif}$ | -0.241 | -5.438 | 0.000 | D.W. | 1.78 | $\beta_{gap}$ | -0.319 | -3.418 | 0.001 | D.W. | 0.21 |
| **Okun's Law controlling for Recessions** | | | | | | | | | | |
| ***Differences model (model 1)*** | | | | | | ***Gap model (model 2)*** | | | | |
| | Coef. | t-Stat | Prob. | F-stat | 5.42 | | Coef. | t-Stat | Prob. | F-stat | 41.52 |
| $\alpha_{dif}$ | -0.116 | -0.922 | 0.358 | F-Prob | 0.00 | $\alpha_{gap}$ | 13.263 | 49.714 | 0.000 | F-Prob | 0.00 |
| $\beta_{dif}$ | -0.411 | -5.844 | 0.000 | D.W. | 1.77 | $\beta_{gap}$ | -0.474 | -4.240 | 0.000 | D.W. | 0.19 |

**Figure 4. Okun's coefficients over the business cycle**




[6] For the differences model, which is used in assessing job losses, confidence intervals for the Okun's coefficients, at 10%, 5% and 1% levels are presented in appendix 4.

# 6. Unemployment increase and job losses results following 2020 recession

## 6.1. Assumptions and GDP forecast scenarios

In order to assess the unemployment responses measured by the Okun's relationship in terms of job losses following the 2020 recession, additional information is needed, specifically the forecasted GDP growth rate and the projected labour forces in the 2020. The latter are projected for the sample of the countries and for the Arab world using the growth rate of the labour force in 2019. This is assumed as the labour force growth rate follows mainly the natural growth rate of the population and is not likely to change in the short-term. As we discussed in the previous sections, we consider the estimated parameters of the difference version Okun's Law for which also the GDP growth forecasts are available from different national and international sources, which is not the case for the potential GDP.

Table 5 presents the used Okun's coefficients that will be used in calculations (section 6.2) for the sample of countries and the Arab region as well as the labour force statistics and its projection over the year of 2020. The projected total labour force of the nine countries, for the 2020 year, is about 80.7 million which represents a share of 57 percent of total the labour force of the 22 Arab countries (141.2 million).

For the GDP growth rate forecasts, we considered different scenarios: The first scenario which I called the baseline scenario is based on a one percent decrease in GDP growth rate (-1 percent) in 2020. The second scenario is based on the IMF World Economic Outlook of April 2020 and the IMF regional economic outlook update for Middle East and Central Asia released on July 2020 (IMF, July 2020). The third, is based on the national sources' forecasts (whenever they are available) displayed in the AMF economic report outlook questionnaire filled by countries.[7] Finally, the fourth scenario is based on the World Bank Global Prospects (World Bank, June 2020). In what follows, we calculate for the four scenarios, the expected unemployment increases and the subsequent job losses for the difference model without controlling for any conditions on the business cycle (section 6.2). Considering the business cycle asymmetric effects for the whole sample, we redo the assessment of job losses for the whole panel sample and extrapolating the panel results to the entire Arab region (6.3).

[7] For the Arab region, the AMF calculates the growth rate average using an arithmetic average weighted by countries GDP shares. The individual forecasts are obtained by a questionnaire send to the countries or from national or international published sources for countries that didn't responded to the questionnaire.

**Table 5. Difference version Okun's coefficients and labour force projection in 2020**

| *Model 1 Okun's Coefficients* | | | *Labour force* | | *Labour force growth rate* | *Labour force projection* | |
|---|---|---|---|---|---|---|---|
| Countries | $\alpha_{dif}$ | $\beta_{dif}$ | 2018 | 2019 | 2019 | 2020 | 2020 (in millions) |
| Algeria | **0.77** | **-0.30** | 12173459 | 12303926 | 1.07% | 12435791.3 | 12.4 |
| Egypt | **1.65** | **-0.37** | 30177778 | 30828413 | 2.16% | 31493075.7 | 31.5 |
| Jordan | **1.33** | **-0.24** | 2579658 | 2637892 | 2.26% | 2697440.6 | 2.7 |
| Lebanon | **0.33** | **-0.09** | 2381501 | 2398864 | 0.73% | 2416353.6 | 2.4 |
| Mauritania | **0.08** | **-0.02** | 1210148 | 1248249 | 3.15% | 1287549.6 | 1.3 |
| Morocco | **0.87** | **-0.24** | 11918297 | 12067484 | 1.25% | 12218538.4 | 12.2 |
| Palestine | **2.07** | **-0.36** | 1214123 | 1260102 | 3.79% | 1307822.2 | 1.3 |
| Sudan | **1.51** | **-0.22** | 12055376 | 12410692 | 2.95% | 12776480.5 | 12.8 |
| Tunisia | **1.16** | **-0.31** | 4061682 | 4087299 | 0.63% | 4113077.6 | 4.1 |
| **The sample** | **1.02** | **-0.25** | **77772022** | **79242921** | **1.89%** | **80746129.5** | **80.7** |
| **Arab World** | **1.02** | **-0.25** | **135265885** | **138180908** | **2.16%** | **141158750.7** | **141.2** |

Note: The coefficients $\{(\alpha_{dif}, \beta_{dif}) = (1.02; -0.25)\}$ for the whole sample is based on a panel regression for a fixed effects model in normal economic conditions. These coefficients are assumed similar for the Arab region too.

## 6.2. Job losses and unemployment increases for the sample of nine Arab countries

For the unit scenario, a one percent in GDP loss leads to an increase in the unemployment rate by 0.85 percentage points in the sample average, representing about 795 thousand of unemployed people and around 1.2 million for the Arab world (based on the panel regressions coefficients for sample of nine countries). On individual level, the lost jobs for one percent growth rate recession scenario is dependent on the size of the labour force and the estimated Okun's coefficients (more results in table 6).

**Table 6. Unemployment increase and job losses following a one percent GDP growth decrease scenario**

| Unit Growth rate Scenario (bassline scenario) | Scenario based on one percent loss in GDP Growth rate | | |
|---|---|---|---|
| | Expected unemployment and Jobs loss for 2020 | | |
| | Unemployment rate change | Jobs loss | Jobs loss in |
| Algeria | 0.47 | 58622.3 | 58.6 |
| Egypt | 1.28 | 401883.1 | 401.9 |
| Jordan | 1.08 | 29243.0 | 29.2 |
| Lebanon | 0.23 | 5666.3 | 5.7 |
| Mauritania | 0.06 | 829.2 | 0.8 |
| Morocco | 0.63 | 76622.5 | 76.6 |
| Palestine | 1.70 | 22282.7 | 22.3 |
| Sudan | 1.30 | 165455.4 | 165.5 |
| Tunisia | 0.84 | 34632.1 | 34.6 |
| **The sample** | **0.85** | **795236.6** | **795.2** |
| **Arab World** | **0.85** | **1199849.4** | **1199.8** |

For the three coming scenarios, table 7 presents the considered forecasted GDP growth for 2020 (2nd column) as well as the unemployment rate increases and job losses following these forecasts. There is an apparent consensus for the 2020 forecasts which confirm that all the Arab countries will go into recession expect Egypt GDP is expected to grow by around 2 percent in the three scenarios. For Egypt, the World Bank reported a GDP growth of 3.1 percent for 2020 and 2.1 for 2021. The forecasts are calculated based on the fiscal year which starts July 1st, 2019 and end in June 30, 2020 for the year 2020. Therefore, we consider the 2.1 forecast for the 2020 year which lies also to the IMF (1.95%) and national source forecasts (2%).

The recession is deeper particularly in Lebanon, by -12 percent in GDP growth rate as reported by IMF and the national sources, and -10.9 percent by the World Bank. The forecast for Jordan is ranging between -3.7 and -3.4 percent in the three scenarios, Morocco between -5.2 and -3.7, Tunisia from -4.3 to -4 percent and Mauritania around -2 percent. Moreover, Palestine's GDP is forecasted by the World Bank to shrink by 7.6 percent and by 5.2 percent by the national source. Finally, Sudan's GDP is forecasted by the IMF at -7.2 percent and -4 percent by the World Bank.

For the IMF scenario, the forecasts are of the IMF WEO of April 2020. There is an updated regional economic outlook (MENAP) released in July 2020 but contain only aggregate levels (by groups of countries, oil exporters and importers) expecting the Arab world GDP to shrink by 5.7 percent which we adopted in this table for the Arab region. For the AMF scenario, there are five countries that responded to the AMF questionnaires, namely, Egypt, Jordan, Lebanon, Morocco, and Palestine. Furthermore, Egypt and Lebanon reported exactly the forecasted GDP growth of the IMF. For the other countries, Algeria, Mauritania, Sudan, and Tunisia, we kept the IMF forecasts as no national sources were provided.

**Table 7. Unemployment increase and job losses following the 2020 recession**

| IMF Scenario | Scenario based on IMF forecasted GDP Growth rate in 2020 | | | |
|---|---|---|---|---|
| | 2020 GDP Growth rate | Expected unemployment and Jobs loss for 2020 | | |
| | | Unemployment Change | Jobs loss | Jobs loss in 1000s |
| Algeria | -5.2 | 2.3 | 290467.7 | 290.5 |
| Egypt | 2.0 | 0.9 | 290442.2 | 290.4 |
| Jordan | -3.7 | 2.2 | 60190.4 | 60.2 |
| Lebanon | -12.0 | 1.5 | 35048.6 | 35.0 |
| Mauritania | -2.0 | 0.1 | 1463.5 | 1.5 |
| Morocco | -3.7 | 1.8 | 215679.9 | 215.7 |
| Palestine | -5.2 | 3.9 | 51594.9 | 51.6 |
| Sudan | -7.2 | 3.1 | 393410.1 | 393.4 |
| Tunisia | -4.3 | 2.5 | 102576.7 | 102.6 |
| **The sample** | **-2.7** | **1.8** | **1440874.0** | **1440.9** |
| **Arab World** | **-5.7** | **2.5** | **3564258.5** | **3564.3** |
| AMF Scenario | National sources growth forecasts based on the AMF outlook report questionnaires | | | |
| | 2020 GDP Growth rate | Expected unemployment and Jobs loss for 2020 | | |
| | | Unemployment Change | Jobs loss | Jobs loss in 1000s |
| Algeria | -5.2 | 2.3 | 290467.7 | 290.5 |
| Egypt | 2.0 | 0.9 | 284823.4 | 284.8 |
| Jordan | -3.4 | 2.2 | 58000.9 | 58.0 |
| Lebanon | -12.0 | 1.5 | 35048.6 | 35.0 |
| Mauritania | -2.0 | 0.1 | 1466.5 | 1.5 |
| Morocco | -5.2 | 2.1 | 258358.6 | 258.4 |
| Palestine | -5.2 | 3.9 | 51594.9 | 51.6 |
| Sudan | -7.2 | 3.1 | 393410.1 | 393.4 |
| Tunisia | -4.3 | 2.5 | 102576.7 | 102.6 |
| **The sample** | **-3.1** | **1.9** | **1511927.2** | **1511.9** |
| **Arab World** | **-4.1** | **2.1** | **2999623.5** | **2999.6** |
| WB scenario | Scenario based on the World Bank forecasted GDP Growth rate in 2020 | | | |
| | 2020 GDP Growth rate | Expected unemployment and Jobs loss for 2020 | | |
| | | Unemployment Change | Jobs loss | Jobs loss in 1000s |
| Algeria | -6.4 | 2.7 | 337273.6 | 337.3 |
| Egypt | 2.1 | 0.9 | 273117.4 | 273.1 |
| Jordan | -3.5 | 2.2 | 58654.5 | 58.7 |
| Lebanon | -10.9 | 1.3 | 32523.2 | 32.5 |
| Mauritania | -2.0 | 0.1 | 1466.5 | 1.5 |
| Morocco | -4.0 | 1.8 | 223183.8 | 223.2 |
| Palestine | -7.6 | 4.8 | 62941.6 | 62.9 |
| Sudan | -4.0 | 2.4 | 304080.2 | 304.1 |
| Tunisia | -4.0 | 2.4 | 99022.3 | 99.0 |
| **The sample** | **-2.9** | **1.8** | **1392263.1** | **1392.3** |
| **Arab World** | **-4.2** | **2.2** | **3034913.1** | **3034.9** |

Note: For the GDP growth rate sample average, it is approximated by a weighted average of the individual countries. The considered vector of weights is calculated by the shares of real GDP on the total GDP of the sample for the 2018 year.

Based on these forecasts, the unemployment rate is expected to increase for the sample of the nine countries by 1.8 to 1.9 percent and by 2 to 2.5 percent for the Arab region. This leads to job losses, for the sample, of 1440.9 thousand in the first scenario, 1511.9 thousand in the second scenario and 1392.3 thousand in the third scenario. For the Arab region, the job losses are expected to be around 3 to 3.6 million. On the individual level, the unemployment rate increase varies widely across countries from very low level of 0.1 percentage points expected for Mauritania to between 3.9 to 4.8 percentage points estimated for Palestine depending on the scenarios. For the other countries, particularly Algeria, Jordan, Morocco, Sudan and Tunisia, increases in unemployment rate is in the range of 2 to 3 percentage points. Egypt despite the positive growth rate, it will not be enough to create jobs and the unemployment will increase by 0.9 percentage points.[8] In terms of numbers and considering the labor force natural increase and its volume, the expected loss in jobs is higher in Sudan by around 393 thousand and around 290 thousand in Algeria and Egypt.

All the previous results are to be considered cautiously, given the asymmetric effects revealed by our estimations in section (5.2), particularly for the individual countries for which we could not run the asymmetric checks. According to the asymmetric effects revealed for the panel sample, job losses are very likely expected to be double what is found in studying normal economic conditions. Considering the estimations that control for such asymmetry over the business cycle (section 5.2), the coefficients are 150% to 200% higher in time or recessions than in time of expansions (table 3). This leads to a correcting factor increasing jobs between expansions and normal circumstances by 1.5 to 2. Therefore, the unemployment rate for the Arab region is expected to increase by 4 to 5 percentage points (figure 5) and job losses to stand between 6 and 7 million (figure 6).

**Figure 5. Asymetric effects on unemployement rate changes in 2020 (in percentage points)**

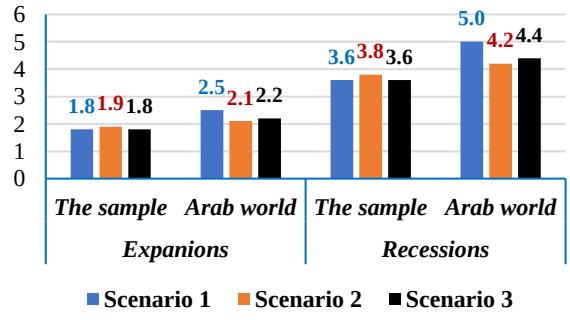
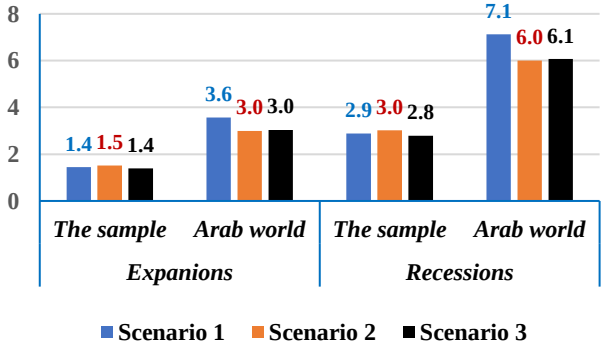



**Figure 6. Asymetric effects on job losses in 2020 (in million)**

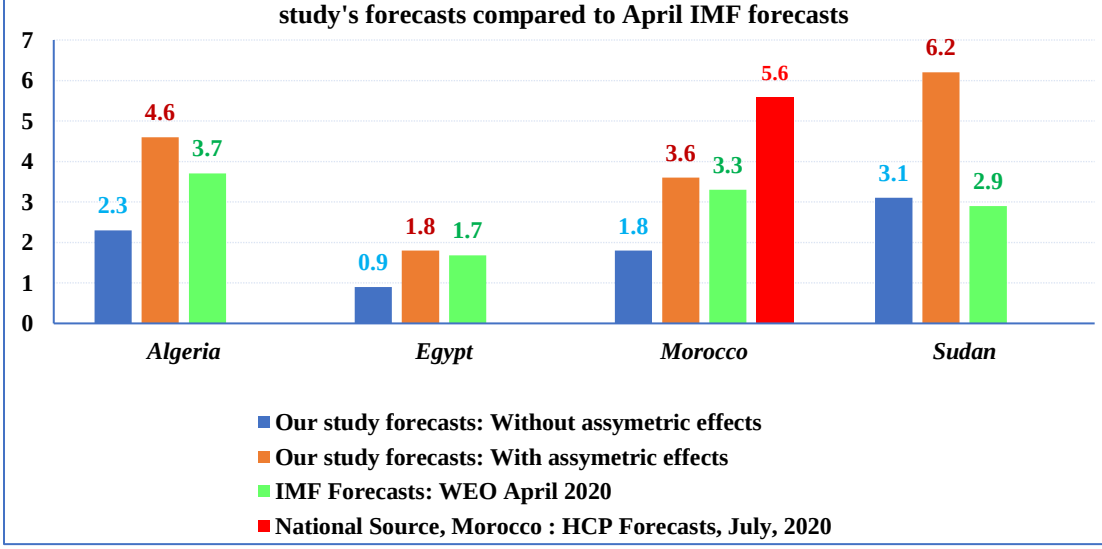



[8] Having a positive GDP growth rate does not mean necessarily reducing the economic growth. The latter is indeed reduced from a certain positive non-zero threshold. More discussion about this point is detailed in section 7.

To compare our results to some published forecasts, we find that the IMF released the unemployment rate forecasts in its World Economic Outlook of April 2020 for some countries covering four countries from our sample, namely, Algeria, Egypt, Morocco and Sudan (IMF, 2020).[9] These unemployment forecasts increases could be deepened if we take into account the timing in which they are released. In fact, economic growth is further cut in the WEO updated version of June 2020, which could be reflected in the unemployment rate (by a further increase). For the latter, no updated forecasts were released in June 2020. Furthermore, the High Commissioning for Planning in Morocco (HCP), in its forecasts released in July 2020 an increase of the unemployment forecasts for Morocco from 9.2 percent in 2019 to 14.8 percent in 2020, representing an increase of 5.6 percentage points.

We draw jointly our results for the scenarios where there is no control for the asymmetric effects of the business cycle and the case where these asymmetric effects are controlled (figure 9). We notice that the figures if considering the confirmed asymmetric effects are comparable to the IMF forecasts particularly for Algeria, Egypt and Morocco. Particularly, we expect an increase for Algeria by 4.6 percentage points (versus 3.7 for the IMF), 1.8 for Egypt (versus 1.7 for the IMF) and 3.6 for Morocco (versus 3.3 for the IMF). For Morocco, the latter results are far from the national source forecast. For Sudan, our forecasts are double those of the IMF if we consider asymmetric effects, while the two forecasts are nearly the same if we do not control for the asymmetric effects.

**Figure 9. Unemployment rates increases fowlling 2020 recession in our study's forecasts compared to April IMF forecasts**




[9] According to these forecasts, the IMF WEO reported that the unemployment rate is expected to increase, between 2019 and 2020, from 11.4 to 15.1 percent in Algeria; from 8.6 to 10.3 percent in Egypt, from 9.2 to 12.5 percent in Morocco and from 22.1 to 25 percent in Sudan.

## 7. Required GDP growth for jobs creation

Considering our previous estimations for the Okun's differences model and the derived formula (4) ($\bar{g} > -\hat{\alpha}_{dif}/\hat{\beta}_{dif} = g_{mjc}$) in section (2.1), we calculate the values of $g_{mjc}$ that defines the threshold of the minimum GDP growth required for jobs creation that allows reducing the unemployment from its previous level.[10] The $g_{mjc}$ calculations for countries yields, 3.34 for Algeria, 4.23 for Egypt, 5.47 for Jordan, 2.98 for Lebanon, 3.82 for Mauritania, 3.61 for Morocco[11], 6.09 for Palestine, 3.69 for Tunisia and 6.5 for Sudan (figure 8). We draw the numbers of the minimum required growth to reduce unemployment in the sample of countries with the growth rate averages of unemployment rate over the period of 1991-2019. The scatter plot shows a positive relationship with a coefficient of determination of 45.1% (figure 9).

**Figure 8. The minimum required GDP growth for jobs creation**

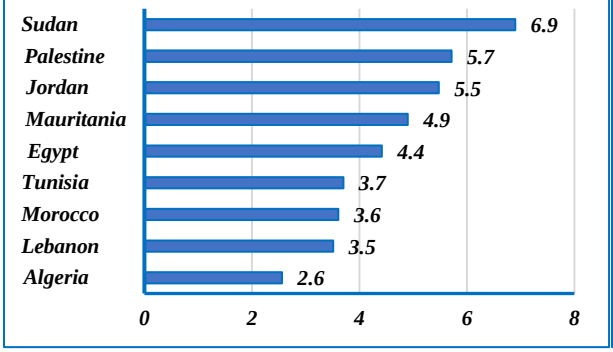
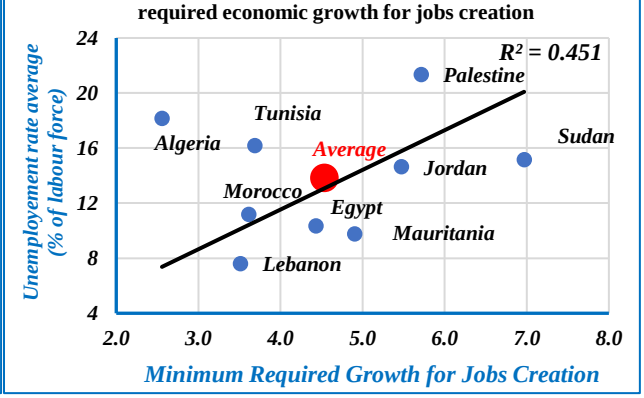



**Figure 9. Unemployemente rate and the minimum required economic growth for jobs creation**



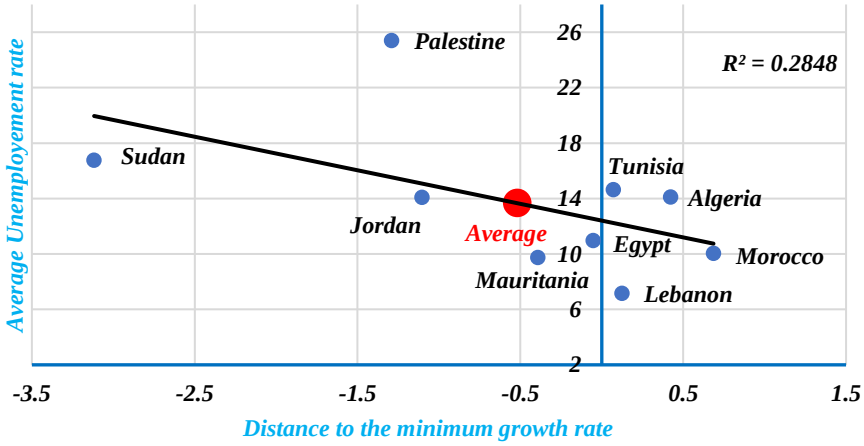

To measure the average effort of the actual performed GDP growth in reducing unemployment rate ($u$) over the past two decades in the considered sample of countries, we link the GDP growth average ($\bar{g}$) to the estimated minimum growth rate threshold ($g_{mjc}$) calculating a distance ($\bar{d}$) of the former to the latter ($\bar{d} = \bar{g} - g_{mjc}$). We plot the distance ($\bar{d}$) with the unemployment rate average over the period 1996-2019 (figure 10). The result shows that this distance is positive and relatively higher in Morocco (0.69) followed by Algeria (0.42), small in Tunisia (0.1), Lebanon (0.12) and Egypt (0.15). However, distances in Jordan, Mauritania, Palestine and Sudan are negative. Countries with relatively high positive distance should have reduced the unemployment rate over the past years. Appendix 5 shows the trend history of the unemployment rate for each

[10] If a country has a GDP growth equal the threshold it will have the same unemployment rate. If the growth rate is less than the threshold, the jobs created if any are less than the new arrivals form the labor force (net of retirees) resulting in an increase in the unemployment rate. The net flow of newly created job vacancies is positive starting from a growth rate higher than the threshold hence contributing to reducing unemployment rate.

[11] The 3.6 percent for Morocco is lower than the range of 5 to 6 percent recommended by the World Bank (2006) for this country. However, although the WB used a methodology different from ours, the sample of estimations differs as their calculations are based going back before 2005, while our sample extended to 2019.

country confirming our interpretation of these results. It seems that Morocco and Algeria performed quite well in reducing unemployment rate over the last two decades, while countries like Jordan, Palestine and Sudan shows an upward trend of the unemployment rate over history.

**Figure 10. Average unmeployement rate and the distance to the minimum growth rate for jobs creation**




Focusing on a single country, we consider the Moroccan case as an example for illustrating the evolution of the unemployment rate with regards to this economic growth threshold required for jobs creation. Over the last two decades (1996-2019), Morocco succeeded to significantly reduce its unemployment rate by almost 6.2 percentage points from a maximum of 15.5 percent in 1996 to around a minimum of 8.9 percent recorded in 2011, while GDP growth rate performed an average of 4.2 percent over the same period (figure 11, period of 1996-2019). This growth rate average is higher than the required GDP growth previously calculated for jobs creation ($g_{mjc}$=3.6<4.2), which accordingly, is likely explaining such unemployment rate abatement.

For more investigation on such declining trends in unemployment rate with regards to the minimum growth rate required for jobs creation, we analyze the series of unemployment decrease by sub periods of time over the period of 1996-2019. We can distinguish three sub periods of distinct unemployment rate general tendencies (trends). The first period of 1996-2006, the second period of 2007-2011 and the third period of 2012-2019. We plot unemployment rate trendline over these sub-periods, comparing the average growth rate over these sub periods with regards to the $g_{mjc}$ threshold (figure 11).

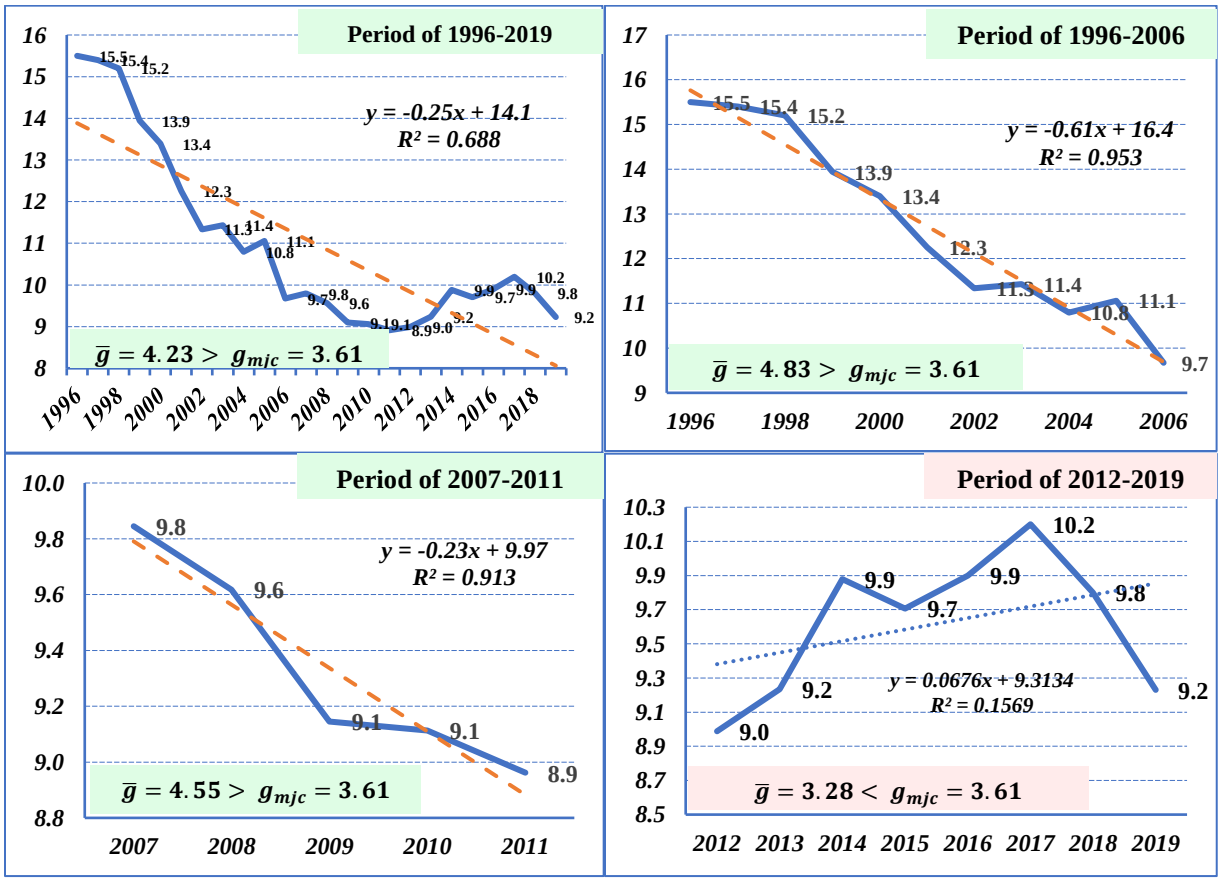
Figure 11 shows the unemployment rate time series over the period of 1996-2006, where the declining in unemployment rate is the fastest as shown by the trendline of the general tendency equation which has a high coefficient of determination of 95.3% and a negative slope coefficient of -0.61. In this period of time, the average GDP growth rate is around 4.83 larger than the required GDP growth for jobs creation by more than 1.2 percentage point ($\bar{g} = 4.83 > g_{mjc} = 3.61$). Consequently, the unemployment rate is significantly reduced between 1996 and 2006 by almost

6 percentage points, constituting about 40% of reduction from the first-year level to the last-year level, over this sub-period.

The second sub-period of 2007-2011 has a declining trendline in unemployment rate with a coefficient of determination equal 91.3% and a negative slope of -0.23. This means that the trendline is less vertiginous than the first sub-period trendline which has higher slope in absolute value (0.61>>0.23). The average growth rate over this period is about 4.5 which is still higher than the minimum required growth for jobs creation ($\bar{g} = 4.55 > g_{mjc} = 3.61$), but less than the average growth rate performed in the first sub-period. Therefore, the unemployment rate is reduced only by 0.9 percentage point between the first year and the last year of the 2007-2011 period.

Oppositely, the third period shows an upward linear general trendline with a positive slope of 0.07 and a moderate coefficient of determination of 15.7% as the period experimented also some small decline in unemployment rate in particular in 2015 and at the end of the period. Compared with the whole period and the two aforementioned sub periods, the average growth rate, over the third period, is lower than the threshold GDP growth for jobs creation ($\bar{g} = 3.20 < g_{mjc} = 3.61$). This resulted in an increase in unemployment rate by almost 1 percentage point.

**Figure 11. Unemployment rate evolution in Morocco over different periods**



The analysis over the whole and the three sub-periods shows the importance of calculating the minimum required GDP growth for jobs creation/recovery. This analysis also endorses the application of the Okun's law especially in the last decades where data on unemployment are frequently and accurately produced. The availability of the quarterly long time series is likely to enhance the quantitative policy-oriented research in the Arab region.

To derive the minimum required growth rate for the whole sample of countries, while controlling for the business cycle, we use panel estimations of the differences model for which results are presented in table 8. We used the fixed effects model as a valid option endorsed by Hausman test. The required minimum growth rate threshold for jobs creation is displayed in the last column for each estimation. In times of expansions, the minimum required growth rate is about 4.2 while it is around 3.9 for no control over the business cycle case. In times of recessions, the constant term is not statistically significant to draw any clear conclusion about this threshold.

**Table 8. Required minimum growth for jobs creation for the panel estimations**

| **Expansion** | | | | | | $g_{mjc}$ |
|---|---|---|---|---|---|---|
| | Coefficient | t-Statistic | Prob. | F-statistic | 4.87 | |
| $\alpha_{dif}$ | 1.018 | 4.584 | 0.000 | Prob(F-statistic) | 0.00 | 4.222 |
| $\beta_{dif}$ | -0.241 | -5.438 | 0.000 | DW-Statistic | 1.78 | |
| **Recession** | | | | | | |
| | Coefficient | t-Statistic | Prob. | F-statistic | 5.42 | |
| $\alpha_{dif}$ | -0.116 | -0.922 | 0.358 | Prob(F-statistic) | 0.00 | NA |
| $\beta_{dif}$ | -0.411 | -5.844 | 0.000 | DW-Statistic | 1.77 | |
| **No business cycle control** | | | | | | |
| | Coefficient | t-Statistic | Prob. | F-statistic | 7.55 | |
| $\alpha_{dif}$ | 0.884 | 5.252 | 0.000 | Prob(F-statistic) | 0.00 | 3.896 |
| $\beta_{dif}$ | -0.227 | -7.203 | 0.000 | DW-Statistic | 1.83 | |

Note: NA; not applicable as the constant term is not statistically significant.

## 8. Conclusion

This study applied the two well-known and relatively strong versions of Okun's Law, linking the unemployment rate GDP performances in the Arab countries. The purpose of this study is to analyse the responsiveness of the cyclical unemployment rate responsiveness to the GDP growth, allowing particularly to assess the jobs that would be lost due to the Covid-19 economic crisis. Estimating these relationships, this study confirmed the validity of the two Okun's versions for a sample of nine Arab countries, which was hard to obtain a decade before due to the short samples data on the unemployment rate. These countries are Algeria, Egypt, Jordan, Lebanon, Palestine, Mauritania, Morocco, Sudan and Tunisia.

To our best knowledge, in addition to highlighting the validity of the Okun's Law for these countries, the paper is the first to make two additional empirical contributions for the Arab region. The first contribution revealed the asymmetric effects in the way the business cycle affects the unemployment rate, showing particularly that in times of recessions, employment sector is hit hard compared to the periods of expansions. This is an important conclusion for the policy makers to

consider in their expectations for the crisis' impacts on the employment sector. In particular, expecting an eminent economic recession for the 2020, as forecasted by international institutions and confirmed by national sources as well, the Arab region would lost in 2020 around 6 to 7 million jobs, representing on the average an unemployment increase by 4 to 5 percentage points from its pre-crisis level of 2019. For the individual countries, the effects differ across countries depending, for each country, on the Okun's coefficient, the labour force, and the forecasted GDP growth in 2020.

The second contribution is the estimation of the minimum GDP growth rate required for jobs creation. In Fact, not any positive value of GDP growth is enough to create new jobs but, this can be possible from a certain positive growth rate threshold, and this can differ from country to another. Therefore; the unemployment has tendency to persist or is very slowly reduced even when countries enjoy relatively good performances in terms of GDP growth. Knowing this GDP growth threshold, necessary for new jobs creation, is an important factor for the policymakers, would they desire to target unemployment reduction. The estimated threshold varies across countries from the lowest value of 2.6 percent in Algeria to the highest value of 6.9 percent in Sudan, while it is estimated for the panel on the average to be around 3.9 to 4.2 percent. The IMF expects the Arab region to recover by a GDP growth rate of 3.5 percent in 2021. With regards to the threshold of jobs creation, this means that this growth will not be enough for the labour market to recover, indicating rather that the unemployment rate could see further increase, although slightly, in 2021. Furthermore, the determination of the minimum growth threshold for jobs recovery helped us understanding particularly why some countries succeeded to relatively reduce the unemployment rate while others struggle to do so.

## References


Aaronson D., Rissman E.R. and Sullivan D.G. 2004. "Assessing the jobless recovery", Federal Reserve Bank of Chicago, Economic Perspectives, vol. 28, pp. 2-20.

Abou Hamia M.A. 2016. "Jobless growth: empirical evidences from the Middle East and North Africa region". Journal of Labour Market Research, vol. 49, pp. 239–251.

Aksoy T. and Manasse P. 2018. "The persistence-resilience tradeoff in unemployment: The role of labor and product market institutions". Quaderni – Working Paper DSE, No. 1121

Allen J. and Van der Velden R. 2001. "Educational Mismatches versus Skill Mismatches: Effects on Wages, Job Satisfaction, and On-the-Job Search". Oxford Economic Papers, vol. 53(3), pp. 434-452.

Ball L., Leigh D., and Loungani P. 2017. "Okun's law: Fit at 50?", Journal of Money, Credit and Banking, vol. 49(7), pp. 1413-1441.

Belaire-Franch J. and Peiró A. 2015. "Asymmetry in the relationship between unemployment and the business cycle", Empirical Economics, vol. 48(2), pp. 683–697.

Bouaziz R. and El Andari C. 2015. "Is the Okun's law valid in Tunisia?". Online at https://mpra.ub.uni-muenchen.de/67998/.

Cazes S., Verick S., and Al Hussmi F. 2013. "Why did unemployment respond so differently to the global financial crisis across countries? Insights from Okun's Law", IZA Journal of Labor Policy, vol. 2, pp. 1-18.

De Brouwer G. 1998. "Estimating Output Gaps", RBA Research Discussion Paper No 98-09.

De Masi P.R. 1997. "IMF Estimates of Potential Output: Theory and Practice", IMF Working Paper No WP/97/177.

Dimitris C., Peter M., and Elias T. 2019. "Exploring Okun's Law Asymmetry: An Endogenous Threshold LSTR Approach". European Central Bank Working Paper Series, No 2345/December.

Ezzahidi, E., & El Alaoui, A. (2014). Economic Growth and Jobs Creation in Morocco: Overall and Sectors' Analysis. Online at http://mpra.ub.uni-muenchen.de/57841/.

Garibaldi, P. 1997. "The Asymmetric Effects of Monetary Policy on Job Creation and Destruction", IMF Staff Papers, vol. 44(4), pp. 557-584.

Hamilton James D. 2018. Why You Should Never Use the Hodrick-Prescott Filter", The Review of Economics and Statistics, vol. 100(5), pp. 831-843.

Haut Commissariat au Plan (HCP), 2020. "Budget Economique Exploratoire : La situation économique en 2020 et ses perspectives en 2021". Direction de la Prévision et de la

Prospective, Juillet 2020, Maroc. Link : https://www.hcp.ma/Budget-economique-exploratoire-2021_a2569.html.

Hodrick R. and Prescott E. C. 1997. "Postwar U.S. Business Cycles: An Empirical Investigation". Journal of Money, Credit, and Banking, vol. 29(1), pp. 1-16.

Holmes Mark J. and Silverstone B. 2006. "Okun's law, asymmetries and jobless recoveries in the United States: A Markov-switching approach", Economics Letters, Vol. 92(2), pp. 293-299.

IMF. 2020. Regional Economic Outlook Update: Middle East and Central Asia, July 2020.

Johansson and al. 2013. 'Long Term Growth Scenarios', OECD Economics Department Working Paper No 1000.

Lim G.C., Dixon R., and Van Ours J.C. 2018. "Beyond Okun's law: output growth and labor market flows", CEPR Discussion Paper 13369.

Moosa, Imad A. 1997. "A Cross-Country Comparison of Okun's Coefficient," *Journal of Comparative Economics*, vol. 24(3), pp. 335–56.

Moosa, Imad A. 2008 "Economic growth and unemployment in Arab countries: is Okun's law valid?" *International conference on the unemployment crisis in the Arab Countries*, Cairo.

Okun Arthur M. 1962. "Potential GNP: Its Measurement and Significance," *American Statistical Association, Proceedings of the Business and Economics Statistics Section*, pp. 98–104.

Owyang M.T. and Sekhposyan T. 2012. "Okun's Law of the business cycle: was the Great Recession all that different?", *Federal Reserve Bank of St. Louis Review*, vol. 94(5), pp. 399-418.

Pereira R.M. 2013. "Okun's law across the business cycle and during the Great Recession: a Markov switching analysis", College of William and Mary Working Paper 139.

Prescott, Edward C. 2004 "Why Do Americans Work So Much More Than Europeans?" *Federal Reserve Bank of Minneapolis - Quarterly Review*, vol. 28(1), pp. 2-14.

Silvapulle, Paramsothy, Imad A. Moosa, and Mervyn J. Silvapulle. 2004. "Asymmetry in Okun's Law," Canadian Journal of Economics, vol. 37(2), pp. 353–74.

Valadkhani A. and Smyth R. 2015. "Switching and asymmetric behaviour of the Okun coefficient in the US: Evidence for the 1948–2015 period", Economic Modelling, vol. 50, pp. 281-290.

World Bank. 2006. "Fostering Higher Growth and Employment in the Kingdom of Morocco". The W.B. Country Study, 37100. Washington, D.C.

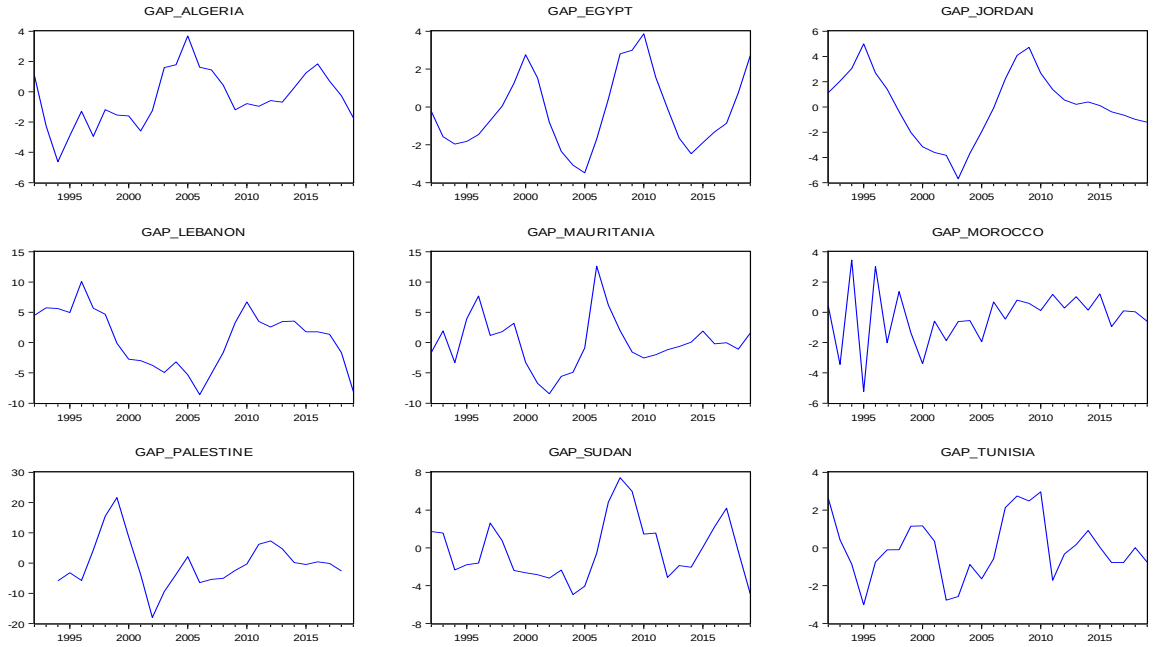
World Bank. 2020. "Global Economic Prospects", June 2020. Washington, DC. DOI: 10.1596/978-1-4648-1553-9.

# Appendices

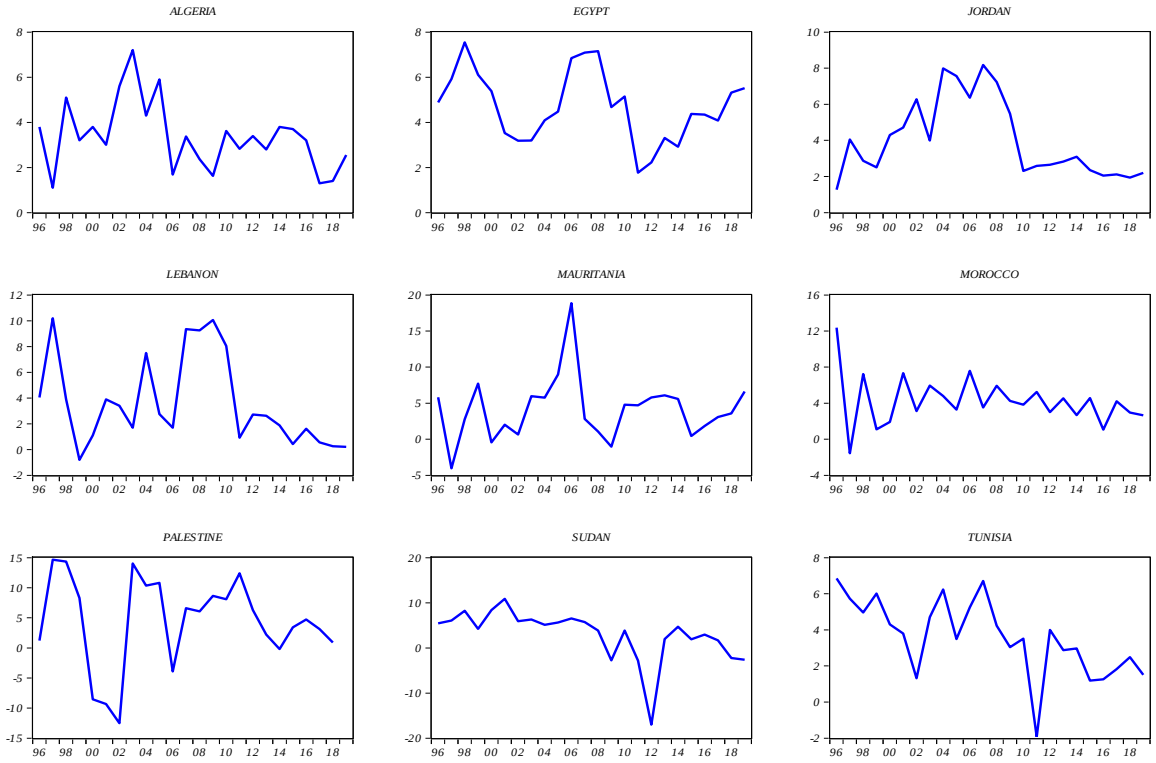
**Appendix 1. Unemployment rate and real GDP growth descriptive statistics, sample 1991-2019**

| ***Unemployment rate (in percent of labour force)*** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Algeria | Egypt | Jordan | Lebanon | Mauritania | Morocco | Palestine | Sudan | Tunisia |
| Mean | 18.15 | 10.34 | 14.64 | 7.60 | 9.75 | 11.17 | 21.34 | 16.18 | 15.16 |
| Median | 15.27 | 10.38 | 14.39 | 8.13 | 9.82 | 9.90 | 23.46 | 15.76 | 15.49 |
| Maximum | 29.50 | 13.37 | 19.60 | 8.98 | 9.95 | 16.00 | 31.22 | 22.10 | 18.89 |
| Minimum | 9.83 | 7.69 | 11.88 | 6.14 | 9.40 | 8.91 | 13.53 | 12.03 | 12.40 |
| Std. Dev. | 7.55 | 1.63 | 2.12 | 1.04 | 0.15 | 2.34 | 5.95 | 2.62 | 1.53 |
| Skewness | 0.29 | 0.27 | 0.91 | -0.32 | -0.96 | 0.97 | -0.19 | 0.74 | -0.25 |
| Kurtosis | 1.38 | 1.92 | 2.86 | 1.31 | 2.78 | 2.47 | 1.55 | 2.82 | 3.04 |
| Jarque-Bera | 3.57 | 1.76 | 3.86 | 3.97 | 4.51 | 4.19 | 2.62 | 2.70 | 0.30 |
| Probability | 0.17 | 0.42 | 0.15 | 0.14 | 0.11 | 0.12 | 0.27 | 0.26 | 0.86 |
| ***Real Gross Domestic Product (percent change)*** | | | | | | | | | |
| | Algeria | Egypt | Jordan | Lebanon | Mauritania | Morocco | Palestine | Sudan | Tunisia |
| Mean | 2.82 | 4.38 | 4.37 | 5.22 | 4.07 | 3.83 | 4.54 | 3.44 | 3.70 |
| Median | 3.20 | 4.37 | 3.10 | 3.40 | 4.14 | 3.82 | 6.18 | 4.67 | 3.63 |
| Maximum | 7.20 | 7.54 | 13.32 | 38.20 | 18.87 | 12.37 | 14.67 | 10.87 | 8.01 |
| Minimum | -2.10 | 0.30 | 1.26 | -0.80 | -4.05 | -5.41 | -12.49 | -17.01 | -1.92 |
| Std. Dev. | 2.04 | 1.72 | 2.69 | 7.17 | 4.45 | 3.66 | 7.41 | 5.25 | 2.09 |
| Skewness | -0.42 | -0.13 | 1.44 | 3.48 | 1.02 | -0.13 | -0.73 | -2.12 | -0.24 |
| Kurtosis | 3.49 | 2.75 | 5.20 | 16.68 | 5.72 | 3.70 | 2.88 | 9.01 | 3.39 |
| Jarque-Bera | 1.15 | 0.16 | 15.83 | 284.67 | 13.54 | 0.67 | 2.14 | 65.37 | 0.46 |
| Probability | 0.56 | 0.92 | 0.00 | 0.00 | 0.00 | 0.71 | 0.34 | 0.00 | 0.79 |

**Appendix 2. Estimated GDP gaps using Hodrick-Prescot filter with filtering parameter equal 100**

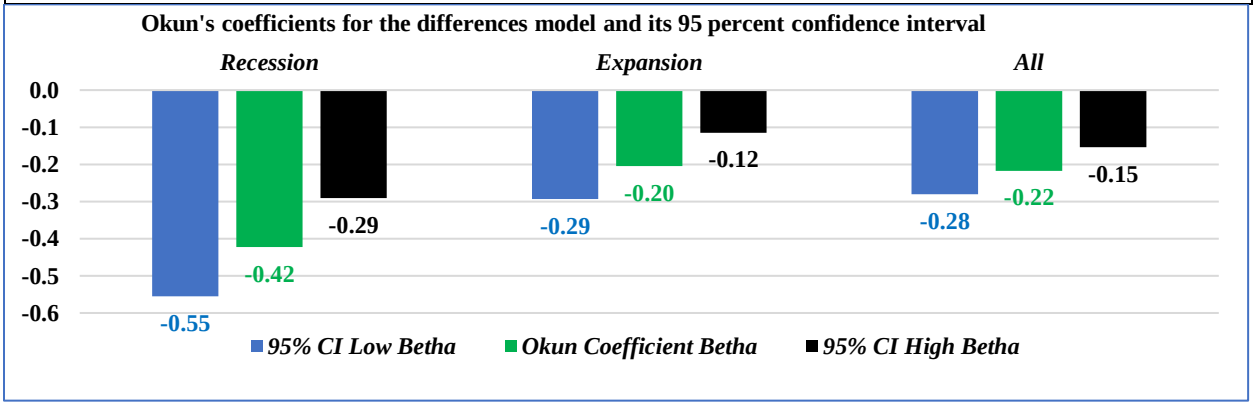


**Appendix 3. Real GDP growth rate over the period of 1996-2019 (%)**




**Appendix 4. Confidence intervals for the differences model considering business cycle cases**

| ***Recession*** | | 90% CI | | 95% CI | | 99% CI | |
|---|---|---|---|---|---|---|---|
| | Coefficient | Low | High | Low | High | Low | High |
| Constant term | -0.120 | -0.328 | 0.088 | -0.368 | 0.129 | -0.448 | 0.208 |
| Okun's Coefficient | -0.423 | -0.533 | -0.312 | -0.555 | -0.290 | -0.597 | -0.248 |
| ***Expansion*** | | 90% CI | | 90% CI | | 90% CI | |
| Variable | Coefficient | Low | High | Low | High | Low | High |
| Constant term | 0.865 | 0.488 | 1.241 | 0.415 | 1.314 | 0.272 | 1.458 |
| Okun's Coefficient | -0.204 | -0.279 | -0.130 | -0.293 | -0.115 | -0.322 | -0.087 |
| ***ALL*** | | 90% CI | | 90% CI | | 90% CI | |
| | | Low | High | Low | High | Low | High |
| Constant term | 0.847 | 0.561 | 1.132 | 0.506 | 1.187 | 0.397 | 1.296 |
| Okun's Coefficient | -0.217 | -0.270 | -0.164 | -0.280 | -0.154 | -0.301 | -0.134 |



**Appendix 5. Unemployment rate (percent of labour force) and its general trendline**