

Analysis of Potential Production in Morocco

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Abstract

In recent years, economic developments in a number of advanced and developing countries have been marked by a decline in growth. Many studies have shown that a large part of this depreciation is explained by that of potential growth. In this respect, the development of potential growth has become one of the most important economic issues in that it affects the conduct of monetary policy and the management of public finances. The objective of this article is to propose an estimate of potential output in Morocco, based on econometric modeling of the Cobb Douglas function based on three variables: Real Gross Domestic Product (GDP), Capital Stock (K) and employment level (L). Using annual data covering the period from 1982 to 2019, representing a sample of 38 observations.

The results obtained show a decrease in potential output in Morocco from 2011 onwards, mainly due to the slowdown in the rate of change of GFCF to 3.8% on average between 2011 and 2019, the declining employment rate and also the negative contribution of overall factor productivity.

From the results of this study it would be possible to determine the output gap, that is, the gap between actual and potential output. The latter is an important variable for the conduct of monetary policy, as it is a major source of inflationary pressures in the economy.

Keywords: Potential growth, production function, total factor productivity, monetary policy, output gap.

JEL Classification : E00, E23, D2, D24

Paper type: Empirical research

1. Introduction

After years of neglect, potential output has received renewed attention as a component of monetary policy, appearing in a wide range of recent studies. If potential output measures the economy's ability to produce goods and services without adding to inflationary pressures, the objective of stabilization policy should be to keep the economy as close to its potential as possible.

During the last few years, the economic evolution in a number of developed and developing countries has been marked, by a regression of growth and by a multiplication of fluctuations. Many studies have shown that a significant part of this slowdown was explained by the slowdown of potential growth and more precisely the technical progress of TFP (Amine EL BASRI, 2016 P11).

In this context, potential output in Morocco since 2011 has been marked by a slowdown. Two Moroccan studies in 2017, those of the Directorate of Studies and Financial Forecasts and BANK AL-MAGHRIB, showed that this deceleration is due to a decline in the employment rate and a slowdown observed in the rate of growth of Gross Fixed Capital Formation (GFCF) and the negative contribution of Overall Factor Productivity (TFP).

This situation shows us that it is important to estimate the level of **potential output** for the implementation of an economic policy aimed at supporting the recovery of economic activity and stimulating growth and ensuring the situation of full employment.

For a monetary authority such as the central bank, determining the potential level of output is crucial for assessing the output gap, which is considered an important determinant of inflation. Thus, the estimate of the output gap allows the monetary authorities to proceed with a tightening or easing of monetary conditions.

In other words, the potential level of output is very useful for understanding inflation and output dynamics.

The concept of potential output was introduced by Arthur OKUN (1962) who defined it as the maximum level of output that achieves the optimal combination of employment maximization and price stability.

The potential level of output is therefore important to consider in the implementation process of any economic policy, as it allows for a trade-off between demand adjustment and supply support.

When there is an output gap, it means that the economy is operating inefficiently, either using too many resources or not enough. During an expansion, output exceeds its potential level, resulting in a positive output gap. In this case, the economy is said to be overheating, which creates inflationary pressures and may cause the central bank to "cool" the economy by raising interest rates.

During a recession, real economic output falls below its potential, creating a negative output gap. This underperformance may prompt a central bank to adopt a monetary policy aimed at stimulating economic growth by lowering interest rates to increase demand. To do this, economists often refer to potential output when measuring inflation.

The government can also use fiscal policy to close the Output Gap. For example, an expansionary fiscal policy, which increases aggregate demand by increasing government spending or lowering taxes, can be used to close a negative output gap.

Conversely, when the gap is positive, a restrictive fiscal policy is adopted to reduce demand and combat inflation by cutting spending and/or raising taxes.

Currently, the economic evolution in the majority of the countries of the world has been marked by an unprecedented fall because of the massive and brutal shock produced by the pandemic of coronavirus (COVID-19) and consequently the measures of stop of the activity taken to stop it plunge the world economy in a serious recession what will represent the

strongest planetary recession since the Second World War.

Emerging and developing countries will pay a heavy price for the Covid-19 health crisis, both in terms of **potential output** and productivity.

To this effect, Morocco is not an exception to this health crisis, several sectors have been affected and weakened and vulnerabilities accentuated. The repercussions of the pandemic and the negative effects of the drought fall Moroccan economic growth in a situation of shrinkage.

Prior to the outbreak of this COVID-19 pandemic, the Moroccan economy has already experienced a recession which is due to the deceleration of potential growth from 2011 with a growth remains still fragile and erratic in terms of job creation and wealth distribution, despite the structural reforms and efforts deployed, to promote the Moroccan labor market and achieve a sustainable and inclusive growth that contributes to the development of the country. In this context, this article has been written to answer the following questions: What is potential output? What is its usefulness? What is the structural method for estimating it?

In order to answer these questions, we will first present the theoretical framework of potential output and the empirical studies around this notion. In a second step, we will estimate the potential output in Morocco using the economic method of production function.

2. Review of theoretical and empirical literature

2-1 Review of theoretical literature

In general terms, potential output is a measure of the economy's overall productive capacity, or its equilibrium level of output. In other words, potential output is supposed to summarize the supply side of the economy, the main determinants of which are labor, capital and productivity.

An alternative but complementary definition of potential output exploits the link between output and inflation embodied in the aggregate supply curve. The aggregate supply function describes a positive relationship between real output levels and the rate of inflation, just as the famous Phillips curve describes the negative correlation between the unemployment rate and inflation. However, it has long been recognized that this trade-off between output and inflation works only in the short run, i.e., in the long run, the aggregate supply curve is vertical. Therefore, a stable inflation rate that is neither increase nor decreasing is only possible if output is equal to its potential.

This link between potential output and a stable inflation rate inspired Arthur Okun's (1962) definition of potential output as the maximum output without inflationary pressure.

Not all economists agree on the usefulness of describing business cycles in terms of deviations from potential output, a disagreement that appears in recent well-known middle-level macroeconomics textbooks. A discussion of potential GNP figures prominently in the introduction to Dornbusch and Fischer (1990).

Barro's omission of any discussion of potential GNP reflects the neoclassical approach to business cycles, as embodied in the Real Business Cycle (RBC) theory pioneered by Kydland and Prescott (1982). RBC theory asserts that economic fluctuations are the result of competitive equilibrium in which wages and prices adjust quickly to clear all markets. According to this view, supply shocks are the only source of fluctuations in real economic variables, such as output and employment. Demand shocks generally affect only nominal variables and the aggregate price level.

Classical theory: According to this theory, potential output is generally defined as the long-run growth rate of observed output. According to the proponents of this theory, it is mainly the exogenous productivity shocks on aggregate supply that determine the long-run trend growth rate.

Keynesian approach: this approach defines potential output as the maximum level of output that an economy is likely to achieve, without output growth leading to an acceleration in the rate of inflation (N'Guessan Berenger ABOU, 2012).

Arthur Okun (1962) : He proposed the notion of potential gross national product (PGNP) as a supply-side concept corresponding to maximum utilization of the economy's productive capacity without inflationary pressures. Based on the existence of a trade-off relationship between inflation and unemployment, Okun considers that the GNP is the level of production that achieves the optimal combination of employment maximization and price stability (**Omar CHAFIK, 2017**).

Table 1: Perceptions of potential output according to Okun (1962) and Perloff and Wachter (1979)

	OKUN(1962) (KEYNESIAN)	F AND WACHTER (1979) (MONETARIST)
Definition	Production level compatible with full employment	Level of output consistent with the natural rate of unemployment.
Price formation process	The level of inflation is a function of the unemployment rate only.	The level of inflation is a function of the output gap and agents' inflation expectations.
Growth target	Production must be maximized so as to achieve full employment.	Production must be maintained at its natural level corresponding to the natural rate of unemployment without accelerating inflation.
Inflation target	Inflation is a secondary objective after full employment.	Inflation is an overriding objective that takes precedence over full employment.
Place of monetary policy	Monetary policy acts to achieve the goal of full employment.	Action on monetary conditions the short term impact on the price of real demand and employment, which Allows inflation to stabilize around its long-run value.
Economic decisions	They are mainly political: the Government decides on the best mix between inflation and Unemployment.	Setting the policy rate is more of a technical decision than a political one. Thus, monetary policy is delegated to a And the output gap remains the most reliable guide to the direction of inflation in the short run.

Source: Chafik Omar BKAM (2017)

2-2 Empirical literature review

The concept of potential output has been developed and analysed in a large body of macroeconomic work applied to developed countries.

In their study, on a sample of eurozone countries, between 2000 and 2014, **the European Commission (2000)** finds that French potential growth was already low before the crisis: 1.7% in 2006-2007, it fell sharply in 2009 and has been only 1% since.

OECD & IMF (2008) find, for a group of OECD countries, that the crisis has been accompanied by a sharp slowdown in potential growth, particularly in the euro area, from 1.5% per year to 0.7% in 2008 and 2014.

To estimate potential output in France, a study done by the Bank of France on the impact of the crisis on potential growth, using the unobservable component model, shows a decline in potential growth from 1.7% in 2007 to 0.7% in 2012 (Mabrouk Chetouane et al, 2011).

In a study conducted on Morocco in 2017 and aimed at estimating the potential output, Bank Al Maghreb shows that the growth potential crossed the threshold of 4.7% in 2005; a stagnation between 2006 and 2008 and a reversal of the trend from 2009 (**Omar CHAFIK, 2017**). In the same vein, a study conducted by the Ministry of Economy and Finance, Shows that the deceleration of potential growth in recent years, standing at 3.7% per-

year between 2011 and 2016 (ABBAD Taoufik and AZROUAL Abdelhak, 2016).

Table 2: Summary of empirical studies on potential output

Organization	Method used	Estimation period	Country	Estimation results
Commission European	roduction function	2000-2014	Euro zone	France's potential growth was already low before thecrisis: 1.7% in 2006-2007.
OECD&IMF	roduction function	-	OECD countries	The crisis has been accompanied by a sharp slowdown in potential growth, particularly in the euro area, from 1.5% per year to 0.7% in 2008-2014.
The bank of France	Models with unobservable components	-	France	They described a decline in French potential growthfrom 1.7% in 2007 to 0.7% in 2012.
UEMOA	roduction function	1971-2010	West Africa	The growth rate of potential output averages 2.9% per year. This rate is still relatively low for developing countries.
BKAM	HP; FDP and MSS	1991-2016	Morocco	The potential growth of the Moroccan economy experienced a period of acceleration which continued until 2006. Then, the growth potential crossed the threshold of 4.7% in 2005.
DEPF (MEF)	κ; CF andFP	1990-2016	Morocco	A deceleration phase in recent years to 3.7% per yearbetween 2011 and 2016. The concomitant decline in the contribution of the capital stock and employment

Source:Developed by the authors

The above table shows that the most common method used by international and nationalagencies is the production function approach.

3. Work methodology

In order to put forward some answers to our problem, we opted for a quantitative studybased on an econometric modeling with a sample of 38 observations using the eviews software. Thus, the estimation of the potential output is done by two approaches: the statistical approach which is based on the filters: HP; BK and CF and the structural approach based on the production function. This last method will be our approach to estimate the potential output (Sawsen BEN NASER, 2016)[8]. In our estimation as a function of the variables of interest by a Cobb-Douglass function model, the determination of elasticity was carried out, followed by the calculation of total factor productivity (TFP) and its smoothing bythe Hodrick-Prescott (HP) filter to determine the potential TFP. Finally, replace the elasticity and the three variables in potential in the Cobb Douglass specification to determinepotential output.

3-1 Description of Study Variables and Data

Based on a Cobb Douglass model, we estimate the potential output in Morocco based on three variables with logarithmic specification, namely: The real Gross Domestic Product (GDPr), the Capital stock (Kt) and the employment level (L) (Table 3). The data are annual and cover the period from 1982 to 2019, representing 38 observations. They come from the statistics of the Ministry of Economy and Finance (Table 4).

Table 3: Description of study variables

Variables	Description	Nature of the impact
GDP _{Pr}	Real gross domestic product measured at constant prices	Endogenous
Capital	Observed physical capital stock	Exogenous
Employment	Observed" employment stock of 15 years and over	Exogenous

Source: Authors' compilation

Table 4: Expected effects of study variables

Variables	Description	Expected effect
Capital	Capital stock	Positive effect
Employment	Employment stock	Positive effect

Source: Authors' compilation

3-2 Model specification

3-2-1 Presentation of the model

The Cobb Douglas production function is generally used in growth analyses. This type of function offers a simplified representation and satisfies all the assumptions made in the neoclassical approach to growth: diminishing marginal returns to the factors of production L and K and constant returns to scale for these factors, and gives easily interpretable results.

It takes the form: $Y = A K^\alpha L^\beta$ With:

Y: Real GDP in volume¹.

A: The efficiency parameter that measures the effectiveness of the production process.

L: The labor factor represented by the active population. It consists of the population of working age and willing to work².

K: The physical capital stock constituted the whole of the goods (the buildings, machines, tools) used durably in the production. The reconstitution of the series is done according to the method of the perpetual inventory which consists in reconstituting the series of the capital stock K_t by starting from an initial level and by proceeding by an accumulation given by :

$K_t = K_{t-1} (1 - \delta) + I_t$ (1) With :

K : The capital stock at date t,

I : Gross fixed capital formation (GFCF) δ : The rate of capital depreciation.

3-2-2 Linearization of the model

The specification of the Cobb Douglas production function model is not linear. A logarithmic transformation leads to : $Y = AK^\alpha L^\beta$ (1)

Introducing the logarithm into equation (1), we get :

$\text{Log}(Y) = \text{Log}(AK^\alpha L^\beta)$

$\text{Log}(Y) = \text{Log}(A) + \text{Log}(K^\alpha) + \text{Log}(L^\beta)$
 $\text{Log}(Y) = \text{Log}(A) + \alpha \text{Log}(K) + \beta \text{Log}(L)$

4. Estimation of the model according to the economic approach

4-1 Estimation of the production function

Under this approach, the estimation of potential output is based on the Cobb Douglas production function as follows:

¹ That is, measured at constant prices

² Job holders and unemployed, in our case 15 years and older

- The determination of the elasticity (α and β): estimation of the production function³ ;
- Calculation of total factor productivity (TFP): $A = \frac{Y}{K^\alpha L^\beta}$
- Calculating potential total factor productivity (PGF^{pot}): Filter TFP by the Hodrick- Prescott (HP) method;
- Calculation of employment and capital stocks in potential⁴ ;
- Replace the elasticity and the three variables in potential in the Cobb Douglas specification to determine potential output.

Table 5: Estimation of the production function

Dependent Variable: LOG(PIBR)
 Method: Least Squares (Gauss-Newton / Marquardt steps)
 Date: 10/18/20 Time: 12:17
 Sample: 1982 2019
 Included observations: 38
 LOG(PIBR)=C(1) +C(2)*LOG(CAPITAL) +(1-C(2))*LOG(EMPLOI)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.681681	0.054233	12.56956	0.0000
C(2)	0.651744	0.010518	61.96679	0.0000
R-squared	0.996505	Mean dependent var		13.11657
Adjusted R-squared	0.996408	S.D. dependent var		0.443896
S.E. of regression	0.026605	Akaike info criterion		-4.364271
Sum squared resid	0.025481	Schwarz criterion		-4.278082
Log likelihood	84.92115	Hannan-Quinn criter.		-4.333606
F-statistic	10264.34	Durbin-Watson stat		1.786465
Prob(F-statistic)	0.000000			

Source: Authors' calculations, Eviews software

According to the estimation results, the coefficient of determination is close to 1 ($R^2=0.9965$), which means that the quality of our model is very good.

Second, the probabilities of the coefficients $c(1)$ and $c(2)$ are zero, indicating that the exogenous variables (employment stock and capital stock) are statistically significant.

Finally, the elasticity are respectively equal to **0.681** and **0.348** for the capital stock and the employment stock $a = \mathbf{0.6816}$ for the elasticity of output with respect to the capital stock and

$Q = \mathbf{0.3483}$ the elasticity of output with respect to the employment stock.

4-2 Residue tests

The validation of the model consists in studying the tests on the residuals of the model in order to verify the absence of autocorrelation, the normality and the homoscedasticity of the errors. These are the Breusch-Pagan Godfrey, Jaque-Bera and ARCH tests, the results of which are presented in the table below. The probabilities of the three tests are higher than 5%, which means that the errors of the model are normally distributed, not self-correlated and homoscedastic.

³ Based on observed variables and not potential

⁴ The method used is inspired by OECD and IMF studies

Table 6: Residue test results

	Test Applied	Probability	Decision
Normality	Jaque-Bera	0.871	Error Normality
Autocorrelation	Breusch-Pagan Godfrey	0.0642	No autocorrelation
Homoscedasticity	ARCH	0.0678	Homoscedasticity of errors

Source: Authors' calculations.

4-3 Determination of total factor productivity

Total factor productivity is derived based on the following production function Equation: $Y = A K^\alpha L^\beta$ (2)

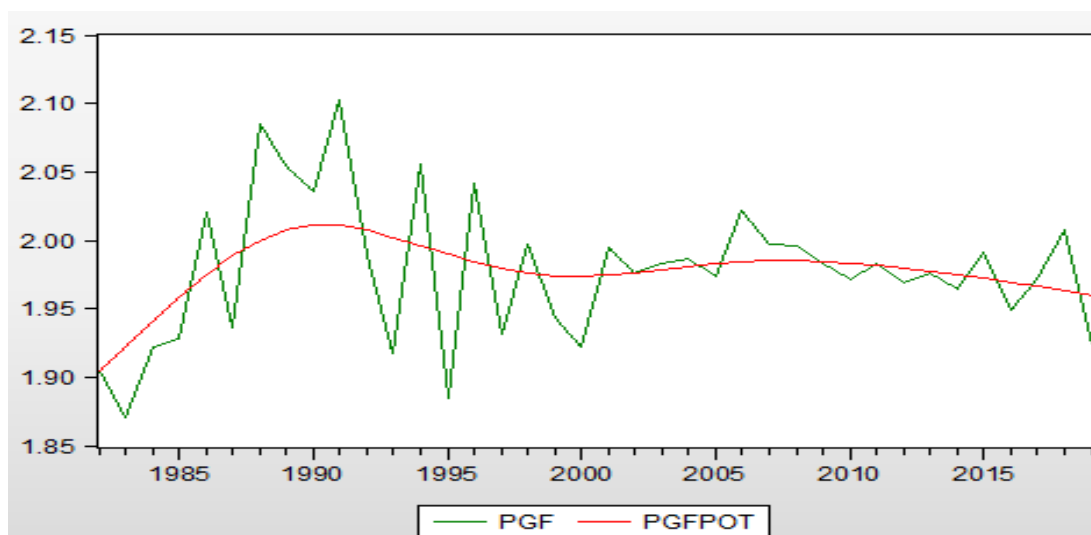
From equation (2), the observed TFP (A) can be determined: $A = \frac{Y_t}{e^{(\alpha \text{Log}(k_t) + \beta \text{Log}(L_t))}}$

If we replace the elasticity we find that: $A = \frac{Y_t}{e^{(0,681 \text{Log}(k_t) + 0,7348 \text{Log}(L_t))}}$

4-4 Total factor productivity smoothing

The TFP trend is obtained through a Hodrick-Prescott (HP) statistical filtering of the TFP derived from the production function.

Figure 1: Evolution of TFP and its potential



Source: Authors' calculations, Eviews software

The above graph shows that TFP has fluctuated during the estimation period, being below its potential in the first three years and the last seven years. The developments by sub-periods reveal an average potential TFP growth of 0.757% during the 1980s and which declined in the 1990s by an average of -0.166%, and by -0.037% during the period 2000-2019.

4-5 Estimated potential production

Potential output (GDP^{pot}) is a function of the potential levels of the three determinants identified in growth theory, namely: labour (L^{pot}), capital (K^{pot}) and total factor productivity (TFP^{pot}).

We have: $\text{Log}(GDP^{pot}) = \alpha \cdot \text{Log}(K^{pot}) + \beta \cdot \text{Log}(L^{pot}) + \text{Log}(TFP^{pot})$

With: The potential capital stock corresponds to the observed capital stock ($K^{pot}=K$).

The potential employment (L^{pot}) is obtained by the following relationship:

$$L^{pot} = POP(15-60) * TAA^{pot} * (1-NAIRU)$$

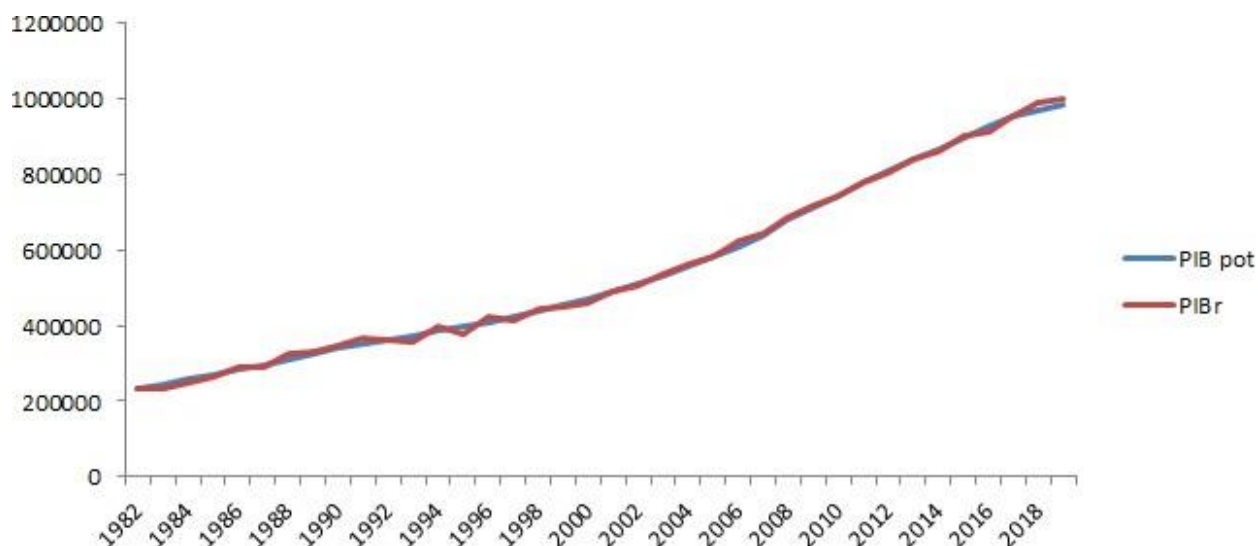
POP15-60: The population aged 15 to 60;

TAA^{pot}: the activity rate smoothed by the HP filter.

NAIRU: The structural unemployment rate is obtained by smoothing the unemployment rate through the Hodrick-Prescott filter.

Once the series are calculated in potential, we will incorporate these into the equation $\text{Log}(\text{GDP}^{pot}) = \alpha \cdot \text{Log}(K^{pot}) + \beta \cdot \text{Log}(L^{pot}) + \text{Log}(TFP^{pot})$ whose purpose is to obtain potential output.

Figure 2: Evolution of GDP and its potential



Source: Authors' calculations

Table 7: Potential growth of the Moroccan economy 1982-2019

Year	1982-1990	1991-2000	2001-2010	2011-2019
GDP Potential	4,888	3,44	4,71	3,14
Effective GDP	5,1	3,1	5,0	3,4

Source: Authors' calculations

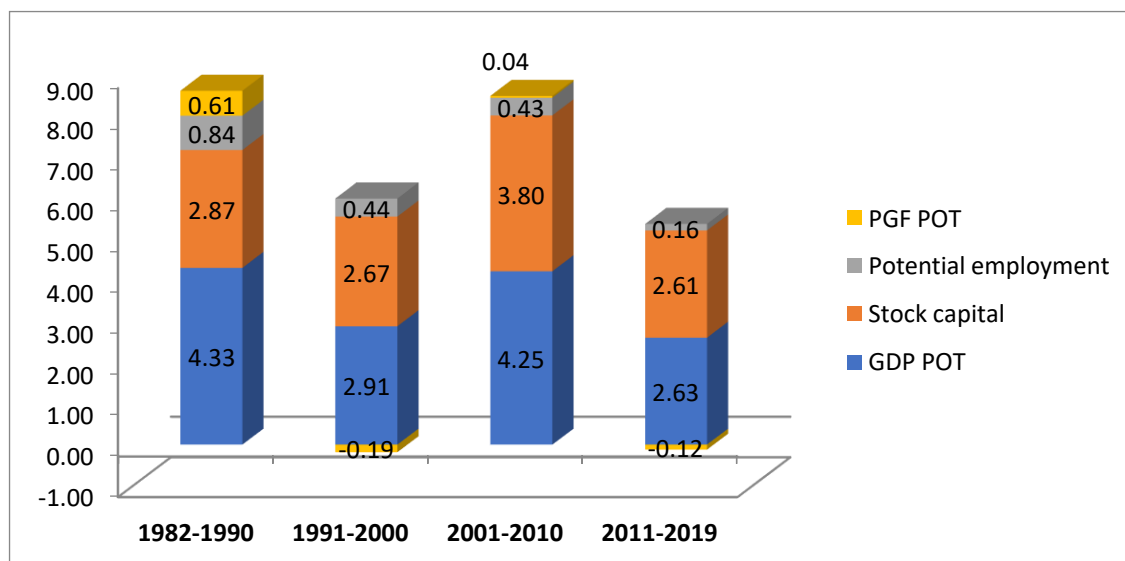
The graph and table above show that potential output is close to actual output. The evolution by sub-periods reveals an average potential growth of 4.88% during the eighties which was subject to a decline over the following decade to reach 3.44% before resuming its progression to reach 4.71% during the period 2001-2010 and it depreciated with an average of 3.14% during the period 2011-2019.

Table 8: Contribution of factors of production to potential growth

Contributions	1982-1990		1991-2000		2001-2010		2011-2019	
		As a % of		As a % of		As a % of		As a % of
GDP POT	4,3	100,00%	2,9	100,00%	4,2	100,00%	2,6	100,00%
Stock capital	2,9	66,26%	2,7	91,77%	3,8	89,33%	2,6	99,26%
Potential employment	0,8	19,29%	0,4	15,12%	0,4	10,14%	0,2	6,06%
PGF POT	0,6	14,04%	-0,2	-6,39%	0,04	1,02%	-0,1	-4,66%

Source: DEPF, authors' calculations

Figure 3: Contributions to Moroccan potential growth



Source: Authors' calculations

The fluctuations in potential growth from one period to the next reflect the different developments in these various determinants. The largest variations were observed in the capital stock. The deceleration of potential GDP between the two periods 2001-2010 and 2011-2019 is explained by the concomitant decline in the contribution of the capital stock from 3.8 to 2.61 and that of employment from 0.43 to 0.16.

The decline in the contribution of labor to potential growth is linked to the continuous fall in the activity rate (52.9% in 2000 to 49.6% in 2010 and 45.8% in 2019).

The contribution of potential TFP to potential growth was positive by about 14.04% in the 1980s and became negative by -6.39% in the 1990s and a contribution of -0.1% during the years 2011-2019.

5. Discussions and results

The main objective of the study is to examine empirically the analysis of potential output in Morocco, based on an econometric model over the period from 1982 to 2019.

The empirical results of the study show a fall of the potential growth of the Moroccan economy as from the year 2011 which is due, mainly, to the fall of the contribution of the capital stock, the depreciation of the activity rate and the negative contribution of the TFP. Indeed, the deceleration of potential GDP between the two periods 2001-2010 and 2011-2019 is explained by the concomitant decline in the contribution of the capital stock, which fell from 3.8 to 2.61 points, and that of employment from 0.43 to 0.16.

The decline in the contribution of labor to potential growth is linked to the continuous fall in the participation rate (52.9% in 2000 to 49.6% in 2010 and 45.8% in 2019).

Finally, the contribution of potential TFP to potential growth was positive by about 14.04% in the 1980s and became negative by -6.39% in the 1990s and a contribution of -0.1% in the years 2011-2019.

The results also show that TFP has been fluctuating during the above period, to the extent that it is below its potential in the first three years (1982-1984) and the last seven years (2013-2019).

Developments by sub-periods reveal an average potential TFP growth of 0.757% during the 1980s which declined to -0.037% during the period 2000-2019.

The objective of estimating potential output is to evaluate the output gap, which is the gap

between actual output and potential output. It is an economic indicator that explains inflation and the unemployment gap through the relations introduced by Philips and Okun. This gap plays an important role in the conduct of economic policy and in the management of public finances. Since one of the purposes of GDP gap assessments is to understand the inflationary pressures within an economy, it is important to assess whether these assessments can effectively explain some of the observed variations in the rate of inflation (Bulletin of French bank, 2002)[9].

Hence, this study opens a new avenue of research on the link between the output gap and inflation, on the one hand, and the output gap and unemployment on the other.

6. Conclusion

To the extent that Morocco is responsible for mitigating demand-driven fluctuations in the economy, it will base its policy, explicitly or implicitly, on some measure of the economy's potential output level. This paper proposes a new technique for rigorously constructing such a measure, using inflation and real growth data to determine the level of GNP consistent with stable growth and constant inflation. This new potential output series successfully captures gradual changes in the underlying growth rate of the economy, without introducing the abrupt breaks that characterize series based on segmentation trends. In addition, this new series is unique in that it provides a measure of the statistical uncertainty involved in constructing the series.

The measurement of potential output is a major economic policy issue. In the short term, the magnitude and persistence of the gaps between potential and actual activity allows us to assess the balance of forces between supply and demand and thus to evaluate inflationary pressures. In the medium term, the measure of potential output provides useful information on the sustainable, non-inflationary growth path of output and employment.

The results of our study show a decline in potential output in Morocco from the year 2011 due, mainly, to the slowdown observed in the rate of growth of GFCF to 3.8% on average between 2011 and 2019, the decline in the employment rate and also the negative contribution of the total productivity of factors.

The potential growth path of the economy is at the center of various fundamental economic issues. They are particularly relevant to the conduct of monetary policy and the management of public finances. The concept of potential GDP aims to measure the supply capacity of the economy in a sustainable regime, i.e. without inflationary or deflationary pressures.

Economic developments in some developing countries have been marked in recent years by a weakening of growth. Numerous studies have shown that a significant part of this slowdown can be explained by the slowdown in potential growth, more precisely in technical progress.

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