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The Productivity and Growth Assessment Framework (PGAF)

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Abstract

The Productivity and Growth Assessment Framework (PGAF) is an analytical tool that provides a comprehensive assessment of the contributions of Total Factor Productivity (TFP) and the other production factors, capital and labor, to economic growth across 183 countries from 1990 to 2023. Moreover, PGAF introduces an insightful and informative description of the countries' economic characteristics using various macroeconomic indicators. The main objective of the PGAF is to assess the macroeconomic situation of Arab countries relative to other countries worldwide and to design the necessary economic reform policies. In the PGAF, TFP is estimated using a Cobb-Douglas function as residual, to represent the part of the growth that is not explained by the changes in capital and labor, then the initial TFP estimates are revised using a Kalman filtering approach to capture the structural dynamics. The note discusses the PGAF tool's estimation methodology and the related assumptions, data sources, and processing approach, results of sensitivity tests, and robustness check.

Keywords: Productivity and Growth Assessment Framework, Total Factor Productivity, Economic Growth.

ملخص:

يعد إطار تقييم الإنتاجية والنمو أداة تحليلية توفر تقييمًا شاملًا لمساهمة الإنتاجية الكلية لعوامل الإنتاج، وكذلك عوامل الإنتاج الأخرى والتي تشمل العمالة ورأس المال في النمو الاقتصادي، وذلك لنحو 183 دولة خلال الفترة من 1990 إلى 2023. علاوة على ذلك، يقدم الإطار توصيفاً شاملًا للخصائص الاقتصادية للدول باستخدام مجموعة متنوعة من المؤشرات الاقتصادية الكلية. يتمثل الهدف الرئيسي من إطار تقييم الإنتاجية والنمو في تقييم الوضع الاقتصادي الكلي للدول العربية مقارنة مع بقية دول العالم، وبالتالي القدرة على صياغة سياسات الإصلاح الاقتصادي اللازمة. في هذا الإطار، تم تقدير الإنتاجية الكلية لعوامل الإنتاج باستخدام دالة كوب-دوغلاس كبواقي للدالة، لتعبر عن ذلك الجزء من النمو الذي لا يفسّر من خلال التغيرات في رأس المال والعمالة، كما تم مراجعة التقديرات الأولية للإنتاجية باستخدام تصفية كالمان للأخذ في الاعتبار الديناميكيات الهيكلية. تتناول هذه الورقة الخلفية النظرية لمنهجية التقدير والافتراضات التي تم الاستناد إليها في إطار تقييم الإنتاجية والنمو، وكذلك ومصادر البيانات وأسلوب معالجتها، ونتائج اختبارات الحساسية واختبار المتانة.

الكلمات المفتاحية: إطار تقييم الإنتاجية والنمو، الإنتاجية الكلية لعوامل الإنتاج، النمو الاقتصادي.

Contents

Introduction

Labor and capital are the main production inputs at the macroeconomic level, and the more available these inputs are, the greater the chances for improving economic growth. Still, many countries with large inputs in terms of labor and capital are not at the forefront of economies in terms of economic production and growth rate. This situation results mainly from productivity weakness, leading the economy to lose its comparative advantage in terms of production factors.

Productivity refers to the amount of additional production that can be achieved by using the same amount of production inputs (capital and labor)[1]. Economies with high productivity can achieve greater production compared to other economies by relying on the same quantity of inputs or even less. In contrast, the low productivity of the economy impedes the optimal utilization of resources, reducing the effectiveness of production inputs at the macroeconomic level and decreasing economic production and growth rates.

The contribution of production factors to growth is an important indicator of growth sustainability. For example, when high rates of capital formation drive economic growth, it might be unsustainable over long periods of time, since there is a tradeoff between achieving capital accumulation and consumption[2]. In contrast, a high economic growth driven primarily by productivity gains requires less sacrifice of current consumption and might be more sustainable.

Researchers have highlighted the role of productivity at least since the 1940s when some economists proposed the "Productivity Efficiency Index" by calculating the value of output to input. Economists have long realized that economic growth can't be explained by only labor and physical capital, as they used to believe; there was an unexplained part contributing significantly to production growth, which they called initially "technological progress" and later "Total Factor Productivity (TFP)"[3].

Since then, TFP has become one of the most important economic concepts for economists and policy makers, and improving the economy's productivity is one of the primary criteria of a relevant macroeconomic policy. Therefore, improving the TFP of economies needs to be a priority

[1] For more details, see Seker and Saliola (2018).

[2] Achieving capital accumulation requires saving accumulation, which means scarifying consumption.

[3] For more details, see Griliches (1995), Espinoza (2012), and Kim and Loayza (2019).

policy objective. To do so, it is required to assess TFP and its contribution to economic growth, which could be a challenging task given the unobservable nature of TFP.

As an unexplained part contributing to growth, TFP is estimated as a residual based on the observed components, capital and labor, and this raises many theoretical and empirical issues. Some of these issues might lead to misleading interpretations and inappropriate policy recommendations. The analytical framework described in this technical note, PGAF[4], attempts to surpass these issues by providing more relevant inputs for macroeconomic policy making.

The PGAF offers a comprehensive assessment of the contribution TFP to economic growth, alongside capital and labor, across 183 countries. The results are presented in an integrated framework that incorporates a wide range of macroeconomic indicators, providing valuable context for interpretation. To address key limitations of traditional estimation methods, the PGAF employs a refined TFP estimation approach based on a state-space model and Kalman filtering.

The primary objective of the PGAF is to deliver timely and insightful information on countries economic conditions, structural characteristics, and comparative global position, all within a unified analytical framework. This information serves as a foundation for designing reform programs tailored to each country's specific context and current economic realities. Additionally, the PGAF provides a robust database that supports further analysis and research.

The first section of this document provides the theoretical background of the estimation methodology and the related assumptions. It also discusses some of the issues related to the methodology and the suggested solutions. The second section sheds light on the data sources and processing approach, and the third section presents the results of the sensitivity tests and robustness check.

1. Growth decomposition and productivity assessment methodology

The PGAF relies on the widely used Cobb-Douglas function to obtain an initial estimation of TFP and then applies a state-space model and Kalman

[4] PGAF stands for Productivity and Growth Assessment Framework

filtering. The Cobb-Douglas function links production to the inputs in terms of capital, labor, and TFP as follows:

$$Y_t = K_t^{\alpha} * L_t^{1-\alpha} * A_t \qquad equation\ (1)$$

where (Y_t) refers to production during the year (t), (K_t) refers to capital, (L_t) refers to labor, and (A_t) refers to TFP.

The coefficient (α) determines the contribution of production inputs (capital and labor) to the production process. Previous studies outline that the value of (α) ranges between 0.2 and 0.6[5]. In the PGAF framework, the parameter (α) is estimated by income group, and the values are 0.43 for high-income countries, 0.39 for middle-income countries, and 0.34 for low-income countries[6].

Based on Equation (1), TFP is obtained through a reversing process resulting in equation (2) as follows:

$$A_t = \frac{Y_t}{K_t^{\alpha} * L_t^{1-\alpha}} \qquad Equation\ (2)$$

While (Y_t) and (L_t) are approximated by real GDP and labor force respectively, capital is estimated using the perpetual inventory approach (equations (3) and (4)) as follows:

$$\begin{cases} K_0 = I_0/(g+\delta) & Equation\ (3) \\ K_t = (1-\delta) * K_{t-1} + I_t & Equation\ (4) \end{cases}$$

where (I_t) refers to investment during the year (t), and the coefficients (g) and (δ) denote the average investment growth rate and capital depreciation rate over time, respectively. The average investment growth is calculated for each country separately based on national accounts data, while the capital depreciation rate is determined based on the country's income level classification and Gupta *et al.* (2014) estimates of the capital consumption rate by countries income-class.

Relying on the Cobb-Douglas production function may appear restrictive, as it assumes both constant elasticity of substitution between inputs and constant returns to scale. While these limitations are valid concerns in microeconomic or sectoral-level analyses, they are less problematic at the macroeconomic level.

[5] See for example Senhadji (1999), Mitra *et al.* (2015) and An, Kangur and Papageorgiou (2019).

[6] See Appendix 1 for more details.

Firstly, the assumption of constant elasticity of substitution is arguably more plausible at the aggregate level, particularly in the short to medium term. For instance, even if the labor share fluctuates within specific sectors, it tends to remain relatively stable across the overall economy, given that labor remains within the economy.

Secondly, when the objective is not to compare sectoral production techniques, any improvement (or deterioration) in aggregate returns or substitution elasticity is inherently captured by changes in aggregate productivity within the Cobb-Douglas framework. These changes reflect shifts in the efficiency of input utilization, which aligns closely with the concept of productivity gains or losses.

Moreover, the Cobb-Douglas function offers a practical advantage in international comparisons due to its minimal assumptions. It provides a standardized measurement framework, enhancing objectivity across countries. In contrast, more flexible alternatives—such as the TRANSLOG function—require extensive parameter estimation and introduce complexity that may compromise the comparability of results across different economies.

Still, assessing the economy's productivity based on the Cobb-Douglas framework as it is might also be misleading. In fact, TFP estimates from equation (2) are residual, showing part of the growth that is not explained by the changes in capital and labor. Consequently, TFP estimates from equation (2) might be subject to over/underestimation as they incorporate the improvement/deterioration in the production related to non-structural factors, such as the business cycle dynamics, the measurement and estimation errors.

Therefore, the initial TFP estimates need to be revised to better capture the structural dynamics of TFP in line with the structural capacities of the economy. Using a simple moving average or the HP filtering to smooth those estimates might also be misleading, as the productivity is not necessarily isolated from economic shocks and the overall state of the economy. In fact, an economy might experience some events that lead to an acceleration or deceleration of productivity gains, temporarily or permanently. The productivity of an economy can also be influenced by cyclical dynamics and recessions, leaving permanent scars (hysteresis).

To overcome these limitations, the PGAF suggests capturing the structural TFP level through a Kalman filtering process that relies on the state-space model defined as:

$$\begin{cases} X_t = \bar{X}_t + X_t^{cycle} + \varepsilon_t \ , \quad \varphi_t \sim N(0, \sigma_t^X) & Equation\ (5) \\ \bar{X}_{t+1} = \bar{X}_t + \bar{G}_t + \varphi_t, \quad \varphi_t \sim N\left(0, \sigma_t^{\bar{X}}\right) & Equation\ (6) \\ \bar{G}_{t+1} = \bar{G}_t + \vartheta_t \ , \quad \vartheta_t \sim N\left(0, \sigma_t^{\bar{G}}\right) & Equation\ (7) \end{cases}$$

where (X_t) refers to the logarithm of TFP estimates (A_t) from equation (2) at time (t), $(\bar{X}_t)$ the logarithm of the structural TFP at time (t), (X_t^{cycle}) the cyclical component of the TFP estimates[7], $(\bar{G}_t)$ the growth rate of the structural TFP level, and (σ_t^X), $(\sigma_t^{\bar{X}})$ and $(\sigma_t^{\bar{G}})$ are shocks to the TFP level, the structural TFP level and structural TFP growth rate, respectively. All shocks are assumed to follow a zero-mean gaussian law of motion with non-null variances. The state-space model defined by equations (5)-(7) is estimated using an optimization process following Nelder and Mead (1965) approach, which estimates simultaneously the unknown variances and the state variable $(\bar{X}_t)$.

To determine the contribution of each production factor to economic growth, the same Kalman filtering process is applied to labor and capital time series, and the log-linear version of equation (1) is used to calculate the contributions. The methodology is iteratively applied to each country separately[8].

As mentioned earlier, the Kalman filtering process captures shocks at the structural level of variables (temporary shocks) and at the growth rate of the structural level of variables (permanent shocks). This is an important feature in the macroeconomic context where domestic economies might be subject to substantial domestic and external shocks impacting the structural capacities of the economy temporarily or permanently.

However, it is worth noting that despite the advantages of our estimation methodology, the TFP estimation practice is by itself subject to some shortcomings. Particularly, the dimensionality analysis limit, as the units of the quantities in the Cobb–Douglas equation could be barely interpretable. In practice, economists and statisticians focus on the growth rates, making the analysis unitless to overcome this shortcoming. Other drawbacks can be raised, such as the validity of the Cambridge critique regarding the

[7] The cyclical component follows a trigonometric form specification as defined by the general matrix formulation of structural time series that can be found in Durbin and Koopman (2012, Chapter 3). Our specification does not consider a seasonal component.

[8] The countries included in the framework are listed in Appendix 3.

macroeconomic application of the TFP assessment[9]. Therefore, the TFP estimation results need to be interpreted along with other indicators.

By providing an inclusive framework that incorporates many other macroeconomic indicators related to the overall economic situation and structure, the PGAF allows contextualizing the interpretation of productivity and other factors' contributions to growth.

2. Data, sources, and processing

The PGAF reports data for 47 indicators, including TFP and the other factors of production contributions to growth for 183 countries, and from 1990[10]. The PGAF includes data from the United Nations Statistics Division (UNSD) database, the World Economic Outlook (WEO) database published by the International Monetary Fund (IMF), the World Development Indicators (WDI) database published by the World Bank Group (WBG), and the ILOSTAT database published by the International Labor Organization (ILO).

The data used to estimate the TFP and the production factors contributions to growth are the real gross domestic product (GDP), the real gross fixed capital formation (GFCF), and the labor force. GDP and GFCF data are gathered from the UNSD database, and labor force data are collected from the ILOSTAT database. The estimation period starts in 1990 until the latest available year of the national accounts data published by the United Nations Statistics Division (UNSD).

To capture the outlook, the estimation period is extended to the three years following the end of historical data. For GDP, the priority is given to the IMF WEO projections when available; otherwise, the latest five-year average growth rate is used. The GFCF projections are also based on the GFCF average growth rate for the last five years. For the labor force outlook, the PGAF uses the ILO projections.

GDP, GFCF and labor force data are used to estimate the production factors (capital, labor and TFP) contributions to growth as described in section 2. The other indicators reported by the PGAF cover some of the main macroeconomic indicators, and other growth-related indicators. Table 1 presents the indicators included in the framework[11].

[9] See for example Cohen and Harcourt (2003), and Sickles and Zelenyuk (2019).

[10] Sudan and Puerto Rico data start in 2008 and 1995, respectively.

[11] Appendix 2 provides additional details about these indicators and Appendix 3 lists the countries covered by the framework.

Table 1: Indicators included in the final PGAF database

Real Gross Domestic Production (GDP)	Exports growth rate
Real Gross Fixed Capital Formation (GFCF)	Imports growth rate
Labor force	Agriculture, hunting, forestry and fishing contribution
Real GDP growth	Mining, Manufacturing and Utilities contribution
Inflation rate	Manufacturing contribution
Unemployment rate	Construction contribution
Net Government lending/borrowing to GDP	Trade, restaurants and hotels contribution
Primary net Government lending/borrowing to GDP	Transport, storage and communication contribution
Government gross debt to GDP	Other Activities contribution
Government net debt to GDP	Agriculture, hunting, forestry and fishing value added growth rate
Current account balance to GDP	Mining, Manufacturing and Utilities value added growth rate
Exchange rate	Manufacturing value added growth rate
GDP per capita	Construction value added growth rate
GDP per capita growth rate	Trade, restaurants and hotels value added growth rate
GDP nominal	Transport, storage and communication value added growth rate
Total value-added (LCU[12])	Other Activities value added growth rate
Private consumption contribution	Potential GDP
Government consumption contribution	Potential GDP growth
Gross fixed capital formation contribution	Capital contribution
Exports contribution	Labor contribution
Imports contribution	TFP contribution
Private consumption growth rate	Arab countries

[12] Local currency unit.

Government consumption growth rate	Income class
Gross fixed capital formation growth rate	

The data processing process starts with independent processing for the data from each source. This first step allows the unification of the countries names and codes as well as the indicators units across the different databases. It also transforms the original data representation format from the source to a panel data format.

The second processing step merges the databases from the previous step to build a unique database. The merging is based on the country name and the data year and done through looping by countries. A random data accuracy check is conducted after this step by comparing the new database with the original data.

The third processing step applies the growth decomposition and productivity assessment methodology presented in the previous section to estimate the production factors (capital, labor and TFP) contributions to growth. These estimates are added to the database from step two and the final database is embedded in a user-friendly framework[13], allowing access to the database and the data details in addition to graphical representation of countries data.

3. Sensitivity tests and robustness check

This section assesses the sensitivity and the robustness of the estimated TFP, and answers two main questions: how sensitive are the TFP contribution to growth estimates to the assumptions? And how robust are these results to the data inputs? To answer these questions, we compare the baseline TFP contribution estimates to alternative scenarios estimates.

For the sensitivity analysis, we measure the variation from baseline estimates for different values of the coefficient (α), which determines the share of capital in the production process. Three alternative scenarios are used to simulate 1%, 5% and 10% increases of capital share, respectively.

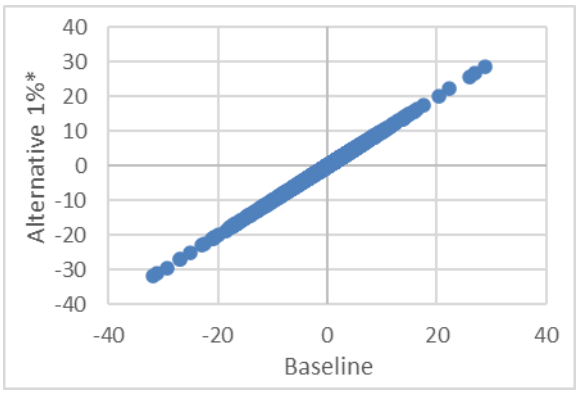
For the robustness check, we measure the variation from baseline estimates for shorter data periods than the one used for the baseline scenario which

[13] Appendix 4 presents a user-guide for the PGAF solution.

starts from 1990[14]. Three alternative scenarios are used to simulate 1-, 5- and 10-year shorter data periods, respectively.

The sensitivity analysis shows that our results vary by 0.01 percentage point on average when the capital share increases by 1%. This variation increases to 0.06 and 0.13 percentage points on average when the capital share increases by 5% and 10%, respectively. The weak sensitivity of our estimates to the capital share assumption is confirmed by the calibration plot assessments showing that all points are close to the diagonal line, and for all the alternative scenarios. In other words, estimated values from alternative scenarios are highly close to the baseline estimates (Figures 1, 2 and 3).

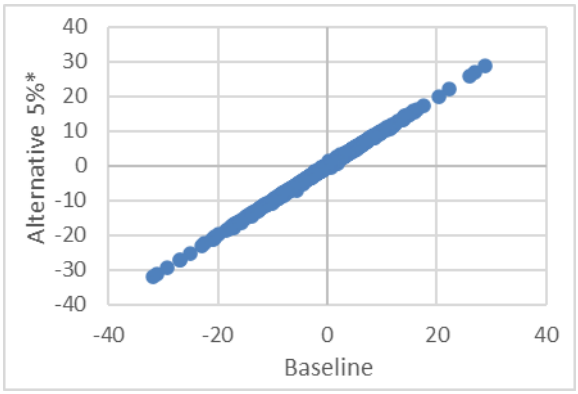
Figure 1: TFP contribution estimates sensitivity, 1% increase of the capital share assumption



	Alternative 1%*
Minimum	0.00
Median	0.01
Mean	0.01
Maximum	0.18
Std. deviation	0.01

*Baseline minus Alternative in absolute value percentage point.

Figure 2: TFP contribution estimates sensitivity, 5% increase of the capital share assumption

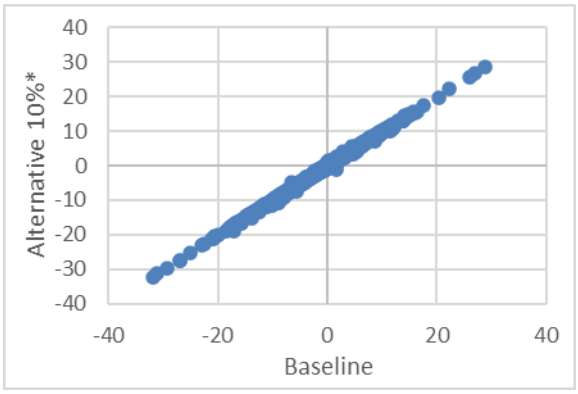


	Alternative 5%*
Minimum	0.00
Median	0.05
Mean	0.06
Maximum	1.73
Std. deviation	0.08

*Baseline minus Alternative in absolute value percentage point.

[14] Sudan and Puerto Rico data start in 2008 and 1995, respectively.

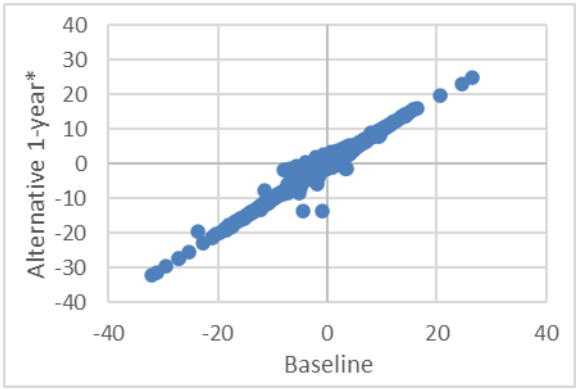
Figure 3: TFP contribution estimates sensitivity, 10% increase of the capital share assumption



	Alternative 10%*
Minimum	0.00
Median	0.10
Mean	0.13
Maximum	2.62
Std. deviation	0.14
*Baseline minus Alternative in absolute value percentage point.	

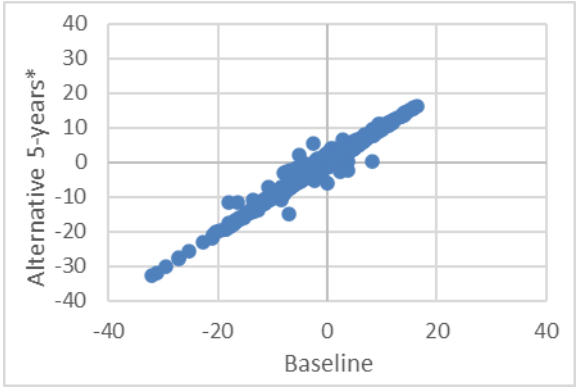
Regarding the robustness check, the analysis shows that our results vary by 0.11 percentage point on average when a 1-year shorter data period is used. This variation increases to 0.21 and 0.33 percentage points on average when the data period is 5- and 10-year shorter, respectively.

Figure 4: TFP contribution estimates robustness, 1-year shorter data period



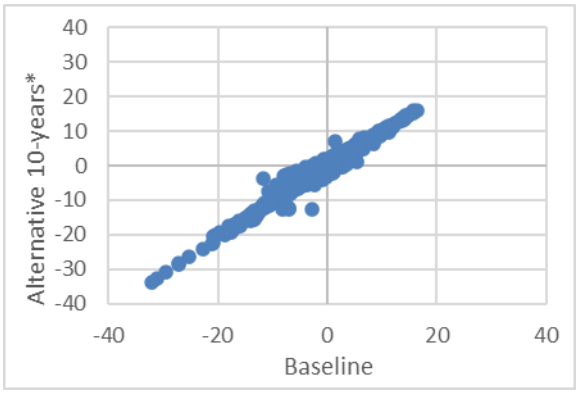
	Alternative 1-year*
Minimum	0.00
Median	0.03
Mean	0.11
Maximum	12.63
Std. deviation	0.36
*Baseline minus Alternative in absolute value percentage point.	

Figure 5: TFP contribution estimates robustness, 5-year shorter data period



	Alternative 5-years*
Minimum	0.00
Median	0.10
Mean	0.21
Maximum	7.95
Std. deviation	0.43
*Baseline minus Alternative in absolute value percentage point.	

Figure 6: TFP contribution estimates robustness, 10-year shorter data period



	Alternative 10-years*
Minimum	0.00
Median	0.20
Mean	0.33
Maximum	9.69
Std. deviation	0.48
*Baseline minus Alternative in absolute value percentage point.	

It is worth mentioning that the 1-year shorter data period alternative scenario includes data up to 2022, while the 5- and 10-year shorter data periods alternative scenarios include data up to 2018 and 2014, respectively. In other words, the 1-year alternative scenario covers the Covid-19-related shock and the following recovery period, and the 5- and 10-years alternative scenarios cover the pre-Covid-19 period.

Considering the implications of the Covid-19-related shock on the global economy, and that the baseline scenario covers that shock and the following recovery period, the low variation of our estimates points out the robustness of our estimates. The calibration plot assessments confirm this result and show that most of the points are close to the diagonal line for all the alternative scenarios (Figures 4, 5 and 6).

Conclusion

The PGAF provides an assessment of the TFP contribution to economic growth, along with assessments of other factors, for 183 countries worldwide. The results are presented in an integrated way that incorporates many other macroeconomic indicators.

The TFP estimation methodology used within the PGAF employs the Cobb-Douglas function to obtain an initial estimation of the TFP. Then, a state-space model and Kalman filtering are applied to overcome some main shortcomings of conventional estimation approaches. The sensitivity and robustness analysis highlights the low variation of the estimates to different assumptions and data periods.

The PGAF groups various growth and productivity indicators in a unique ready-to-use database. It also provides a powerful user-friendly graphical solution presenting meaningful and up-to-date insights about countries' economic situation and structural characteristics, in addition to a global comparison.

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Appendix 1: The share of capital (α) estimation

The estimation of the share of capital (α) used in the PGAF is based on a panel regression analysis by income group for the 183 countries between 1990 and 2023.

The regression equation is obtained from the standard Cobb-Douglas function, which is log-linearized and transformed as follows,

$$\ln(Y_t) = \alpha \ln(K_t) + (1-\alpha)\ln(L_t) + \ln(A_t)$$

As the TFP is unknown, its term is embedded in the regression's intercept (β), and the distributive and associative properties of multiplication are used to group the variables by coefficients,

$$\ln(Y_t) - \ln(L_t) = \alpha(\ln(K_t) - \ln(L_t)) + \beta$$

The quotient rule of the logarithm allows rearranging the equation into a form suitable for standard OLS, where the dependent and independent variables are the respectively the output per worker and the capital per worker

$$\ln(Y/L)_t = \alpha \ln(K/L)_t + \beta$$

The estimation is run by income group and considers country and year effects, and the capital data is approximated by the gross fixed capital formation from the national account data.

Table 2: Estimation results of the capital share

	High-income	Middle-income	Low-income
Share of capital (α)	**0.43*** ** (27.2353)	**0.39*** ** (51.7854)	**0.34*** ** (24.4738)
Obs.	1,543	3,272	1,805

*** p<0.01; ** p<0.05; * p<0.1

Appendix 2: Data Details

Indicator	Source	Description
GDP	(1) The UNSD, for historical data. (2) The IMF world economic outlook database when available or last five-year growth rate average for projections.	Gross domestic production (GDP) at constant 2015 prices. Unit: national currency.
GFCF	The UNSD, for historical data, and last five-year growth rate average for projections.	Gross fixed capital formation (GFCF) at constant 2015 prices in National currency, including acquisitions less disposals of valuables. Unit: national currency
Labor Force	The International Labour Organization	Labor force. Unit: millions of people.
Real GDP growth	(1) The UNSD, for historical data. (2) The IMF world economic outlook database when available or last five-year growth rate average for projections.	Year-on-year growth rate of the GDP at constant 2015 prices. Unit: percent.
Inflation rate	The IMF world economic outlook database.	Yearly average rate of variation of the consumer price index. Unit: percent.
Unemployment rate	The IMF world economic outlook database.	Unit: percent.
Net Government lending/borrowing to GDP	The IMF world economic outlook database.	General government net lending/borrowing to GDP ratio. Unit: percent.
Primary net Government lending/borrowing to GDP	The IMF world economic outlook database.	General government Primary net lending/borrowing to GDP ratio. Unit: percent.

Indicator	Source	Description
Government gross debt to GDP	The IMF world economic outlook database.	General government gross debt to GDP ratio. Unit: percent.
Government net debt to GDP	The IMF world economic outlook database.	General government net debt to GDP ratio. Unit: percent.
Current account balance to GDP	The IMF world economic outlook database.	Current account balance to GDP ratio. Unit: percent.
Exchange rate	The UNSD, National Accounts Section.	IMF based exchange rate. Unit: national currency to USD.
GDP per capita	The UNSD, National Accounts Section.	GDP per capita at constant 2015 prices. Unit: USD.
GDP per capita growth	The UNSD, National Accounts Section.	Year to year growth rate of the GDP per capita at constant 2015 prices. Unit: percent.
GDP nominal	The UNSD, National Accounts Section.	Gross domestic production (GDP) at current prices. Unit: national currency.
Total value-added (LCU)	The UNSD, National Accounts Section.	Total economy value-added (VA) at current prices. Unit: national currency.
Private consumption Contribution	The UNSD, National Accounts Section.	Contribution of the household consumption expenditure, including Non-profit institutions serving households, to nominal GDP. Unit: percent.
Government consumption Contribution	The UNSD, National Accounts Section.	Contribution of the general government final consumption expenditure to nominal GDP. Unit: percent.

Indicator	Source	Description
Gross fixed capital formation Contribution	The UNSD, National Accounts Section.	Contribution of the gross fixed capital formation to nominal GDP. Unit: percent.
Exports Contribution	The UNSD, National Accounts Section.	Contribution of the exports of goods and services to nominal GDP. Unit: percent.
Imports Contribution	The UNSD, National Accounts Section.	Contribution of the imports of goods and services to nominal GDP. Unit: percent.
Private consumption growth rate	The UNSD, National Accounts Section.	Year to year growth rate of the household consumption expenditure at constant 2015 prices in National currency. Unit: percent.
Government consumption growth rate	The UNSD, National Accounts Section.	Year to year growth rate of the general government final consumption expenditure at constant 2015 prices in National currency. Unit: percent.
Gross fixed capital formation growth rate	The UNSD, National Accounts Section.	Year to year growth of the gross fixed capital formation at constant 2015 prices in National currency. Unit: percent.
Exports growth rate	The UNSD, National Accounts Section.	Year to year growth rate of the exports of goods and services at constant 2015 prices in National currency. Unit: percent.
Imports growth rate	The UNSD, National Accounts Section.	Year to year growth rate of the imports of goods and services at constant 2015 prices in National currency. Unit: percent.

Indicator	Source	Description
Agriculture, hunting, forestry and fishing contribution	The UNSD, National Accounts Section.	Contribution of agriculture, hunting, forestry, fishing activities (ISIC A and B) to nominal VA. Unit: percent.
Mining, Manufacturing and Utilities contribution	The UNSD, National Accounts Section.	Contribution of Mining, Manufacturing, Utilities activities (ISIC C to E) to nominal VA. Unit: percent.
Manufacturing contribution	The UNSD, National Accounts Section.	Contribution of Manufacturing activities (ISIC D) to nominal VA. Unit: percent.
Construction contribution	The UNSD, National Accounts Section.	Contribution of Construction activities (ISIC F) to nominal VA. Unit: percent.
Trade, restaurants and hotels contribution	The UNSD, National Accounts Section.	Contribution of Wholesale, retail trade, restaurants and hotels activities (ISIC G to H) to nominal VA. Unit: percent.
Transport, storage and communication contribution	The UNSD, National Accounts Section.	Contribution of Transport, storage and communication activities (ISIC I) to nominal VA. Unit: percent.
Other Activities contribution	The UNSD, National Accounts Section.	Contribution of Other Activities (ISIC J to P) to nominal VA. Unit: percent.
Agriculture, hunting, forestry and fishing value added growth rate	The UNSD, National Accounts Section.	Year to year growth rate of agriculture, hunting, forestry, fishing activities value added (ISIC A and B) at constant 2015 prices in National currency. Unit: percent.
Mining, Manufacturing and Utilities	The UNSD, National Accounts Section.	Year to year growth rate of Mining, Manufacturing, Utilities activities value

Indicator	Source	Description
value added growth rate		added (ISIC C to E) at constant 2015 prices in National currency. Unit: percent.
Manufacturing value added growth rate	The UNSD, National Accounts Section.	Year to year growth rate of Manufacturing activities value added (ISIC D) at constant 2015 prices in National currency. Unit: percent.
Construction value added growth rate	The UNSD, National Accounts Section.	Year to year growth rate of Construction activities value added (ISIC F) at constant 2015 prices in National currency. Unit: percent.
Trade, restaurants and hotels value added growth rate	The UNSD, National Accounts Section.	Year to year growth rate of Wholesale, retail trade, restaurants and hotels activities value added (ISIC G to H) at constant 2015 prices in National currency. Unit: percent.
Transport, storage and communication value added growth rate	The UNSD, National Accounts Section.	Year to year growth rate of Transport, storage and communication activities value added (ISIC I) at constant 2015 prices in National currency. Unit: percent.
Other Activities value added growth rate	The UNSD, National Accounts Section.	Year to year growth rate of Other Activities value added (ISIC J to P) at constant 2015 prices in National currency. Unit: percent.
Potential GDP	Authors estimation.	Estimated potential GDP at constant 2015 prices. Unit: national currency.

Indicator	Source	Description
Potential GDP growth	Authors estimation.	Year to year growth rate of the potential GDP. Unit: percent.
Capital contribution	Authors estimation.	Capital contribution to potential GDP growth. Unit: percentage point.
Labor contribution	Authors estimation.	Labor force contribution to the potential GDP growth. Unit: percentage point.
TFP contribution	Authors estimation.	TFP contribution to the potential GDP growth. Unit: percentage point.
Arab countries	According to Arab Monetary Fund membership.	Arab countries indicator, takes "Arab ccs" for Arab countries experiencing or had experienced challenging conditions (Libya, Sudan, Somalia, Yemen, Iraq, Lebanon, Syria, Palestine), "Arab" for the other Arab countries, and "Non Arab" for the rest of the world.
Income class	World Bank Group.	Income class indictor according to World Bank Group classification.

Appendix 3: Countries

Country code	Country name	Country code	Country name
AFG	Afghanistan	LSO	Lesotho
ALB	Albania	LBR	Liberia
DZA	Algeria	LBY	Libya
AGO	Angola	LTU	Lithuania
ARG	Argentina	LUX	Luxembourg
ARM	Armenia	MDG	Madagascar
AUS	Australia	MWI	Malawi
AUT	Austria	MYS	Malaysia
AZE	Azerbaijan	MDV	Maldives
BHS	Bahamas	MLI	Mali
BHR	Bahrain	MLT	Malta
BGD	Bangladesh	MRT	Mauritania
BRB	Barbados	MUS	Mauritius
BLR	Belarus	MEX	Mexico
BEL	Belgium	MNG	Mongolia
BLZ	Belize	MNE	Montenegro
BEN	Benin	MAR	Morocco
BTN	Bhutan	MOZ	Mozambique
BOL	Bolivia	MMR	Myanmar
BIH	Bosnia and Herzegovina	NAM	Namibia
BWA	Botswana	NPL	Nepal
BRA	Brazil	NLD	Netherlands
BRN	Brunei Darussalam	NCL	New Caledonia
BGR	Bulgaria	NZL	New Zealand
BFA	Burkina Faso	NIC	Nicaragua
BDI	Burundi	NER	Niger
CPV	Cabo Verde	NGA	Nigeria
KHM	Cambodia	MKD	North Macedonia
CMR	Cameroon	NOR	Norway
CAN	Canada	OMN	Oman
CAF	Central African Republic	PAK	Pakistan
TCD	Chad	PAN	Panama
CHL	Chile	PNG	Papua New Guinea
CHN	China	PRY	Paraguay

Country code	Country name	Country code	Country name
HKG	China, Hong Kong SAR	PER	Peru
MAC	China, Macao SAR	PHL	Philippines
COL	Colombia	POL	Poland
COM	Comoros	PRT	Portugal
COG	Congo	PRI	Puerto Rico
CRI	Costa Rica	QAT	Qatar
CIV	Côte d'Ivoire	KOR	Republic of Korea
HRV	Croatia	MDA	Republic of Moldova
CUB	Cuba	ROU	Romania
CYP	Cyprus	RUS	Russian Federation
CZE	Czechia	RWA	Rwanda
COD	D.R. of the Congo	LCA	Saint Lucia
DNK	Denmark	WSM	Samoa
DJI	Djibouti	STP	Sao Tome and Principe
DOM	Dominican Republic	SAU	Saudi Arabia
ECU	Ecuador	SEN	Senegal
EGY	Egypt	SRB	Serbia
SLV	El Salvador	SLE	Sierra Leone
GNQ	Equatorial Guinea	SGP	Singapore
ERI	Eritrea	SVK	Slovakia
EST	Estonia	SVN	Slovenia
SWZ	Eswatini	SLB	Solomon Islands
ETH	Ethiopia	SOM	Somalia
FJI	Fiji	ZAF	South Africa
FIN	Finland	SSD	South Sudan
FRA	France	ESP	Spain
PYF	French Polynesia	LKA	Sri Lanka
GAB	Gabon	VCT	St. Vincent and the Grenadines
GMB	Gambia	PSE	State of Palestine
GEO	Georgia	SDN	Sudan
DEU	Germany	SUR	Suriname
GHA	Ghana	SWE	Sweden
GRC	Greece	CHE	Switzerland
GTM	Guatemala	SYR	Syrian Arab Republic
GIN	Guinea	TJK	Tajikistan

Country code	Country name	Country code	Country name
GNB	Guinea-Bissau	THA	Thailand
GUY	Guyana	TLS	Timor-Leste
HTI	Haiti	TGO	Togo
HND	Honduras	TON	Tonga
HUN	Hungary	TTO	Trinidad and Tobago
ISL	Iceland	TUN	Tunisia
IND	India	TUR	Türkiye
IDN	Indonesia	TKM	Turkmenistan
IRN	Iran (Islamic Republic of)	TZA	U.R. of Tanzania: Mainland
IRQ	Iraq	UGA	Uganda
IRL	Ireland	UKR	Ukraine
ISR	Israel	ARE	United Arab Emirates
ITA	Italy	GBR	United Kingdom
JAM	Jamaica	USA	United States
JPN	Japan	URY	Uruguay
JOR	Jordan	UZB	Uzbekistan
KAZ	Kazakhstan	VUT	Vanuatu
KEN	Kenya	VEN	Venezuela (Bolivarian Republic of)
KWT	Kuwait	VNM	Viet Nam
KGZ	Kyrgyzstan	YEM	Yemen
LAO	Lao People's DR	ZMB	Zambia
LVA	Latvia	ZWE	Zimbabwe
LBN	Lebanon		

Appendix 4: PGAF User Guide

Overview

The PGAF is an integrated framework that provides indicators on economic growth for 183 countries. It also provides estimates for productivity and the production factors (capital and labor) contribution to growth for all the countries under study.

The PGAF is developed using Microsoft Excel and has three main components:

1. Database

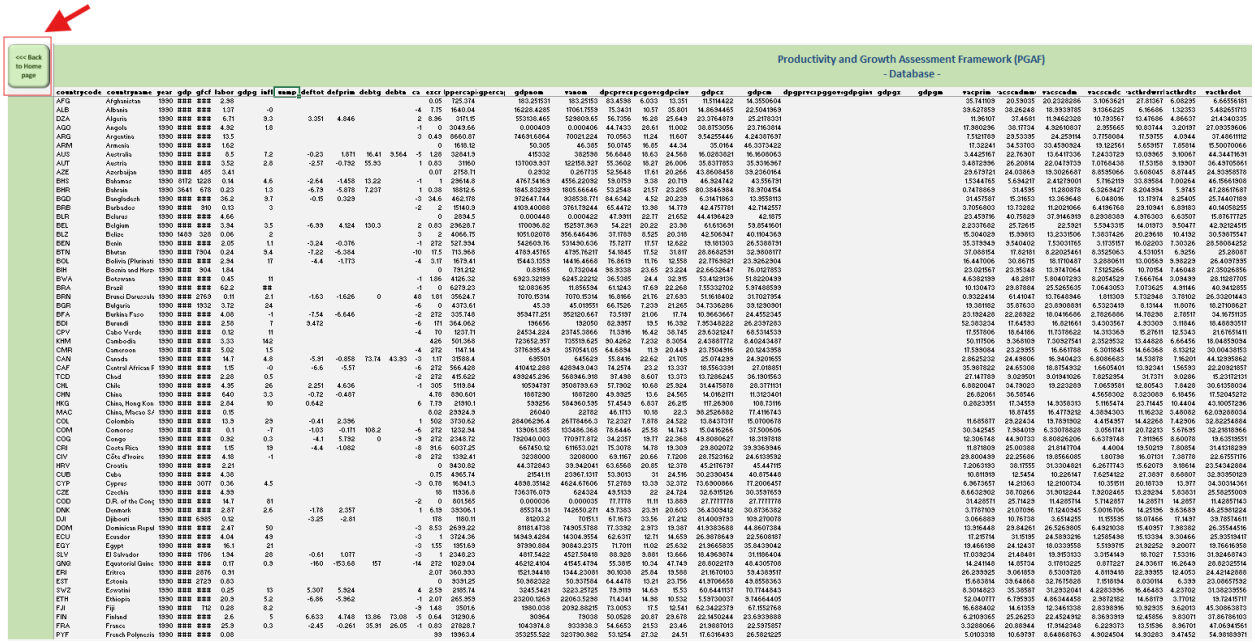
This part presents the data used in the PGAF, including:

- GDP.
- Production factors.
- GDP breakdown by expenditure components.
- Value added by economic activities.
- Other macro-economic indicators (inflation, unemployment, general government debt, current account, government lending/borrowing).

The data are collected from the following sources:

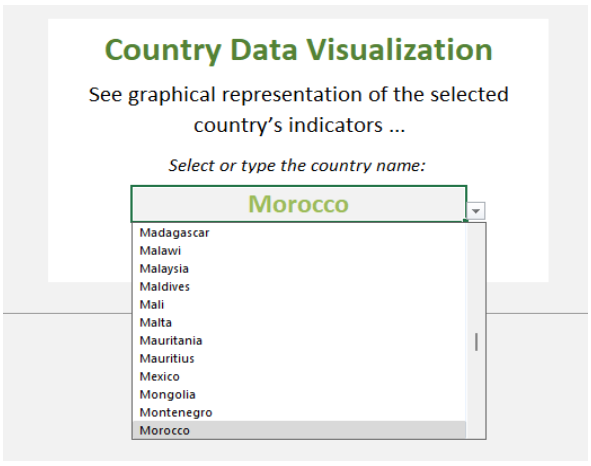
- IMF-World Economic Outlook database (WEO).
- World Bank-World Development Indicators (WDI).
- UN- UNSTATS database.
- ILO database.

The PGAF database covers 183 countries for the period from 1990 to 2023, with forecasts up to 2026 for some indicators (GDP, production factors, net government lending/borrowing, general government debts, and current account).



2. Country Data Visualization

In this part, a graphical presentation of the selected indicators is introduced for all countries.



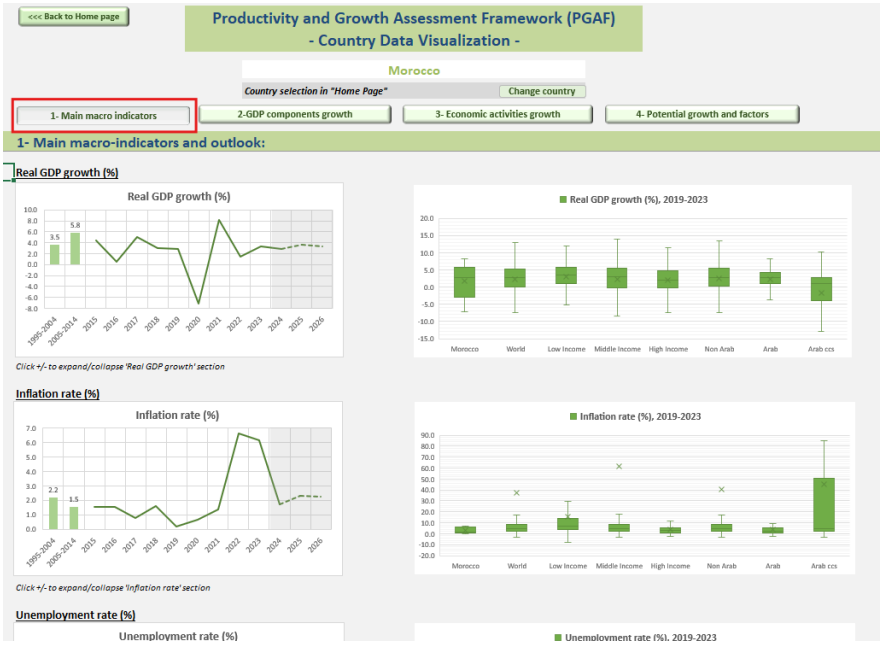
The first step is to choose the country of interest and then log into the country's page.

In the country graphical visualization page, there are four components:

2.1. Main macro indicators

It presents the trend line (on the left) of some macro indicators for the selected country from 1995 to 2023 and forecasts up to 2026 (if available). The presented macro indicators include:

- Real GDP growth (%).
- Inflation rate (%).
- Unemployment rate (%).
- Net Government. lending/borrowing to GDP (%).
- Primary net Government lending/borrowing to GDP (%).
- Government gross debt to GDP (%).
- Government net debt to GDP (%).
- Current account balance to GDP (%).
- Exchange rate (LUC to USD).



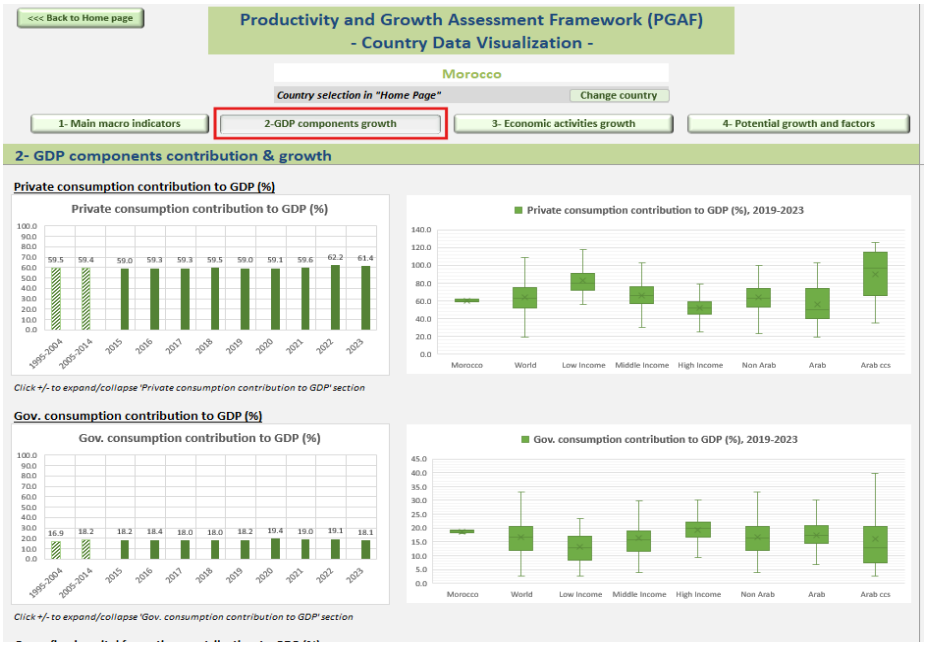
On the right side of the page, a dispersion of each indicator is presented using box plot during the last five years (2019-2023) for the selected country compared to the average of other counties, in addition to some specific country groups such as Arab countries, non-Arab countries, as well as income groups. The dispersion graph shows the concentration and variation in the macro indicators during the last five years for the selected country compared to the other country groups for the same period.

2.2. GDP component growth

In this page, the graphical presentation of the GDP breakdown is introduced for the selected country. This includes the contribution to GDP as well as the growth rate:

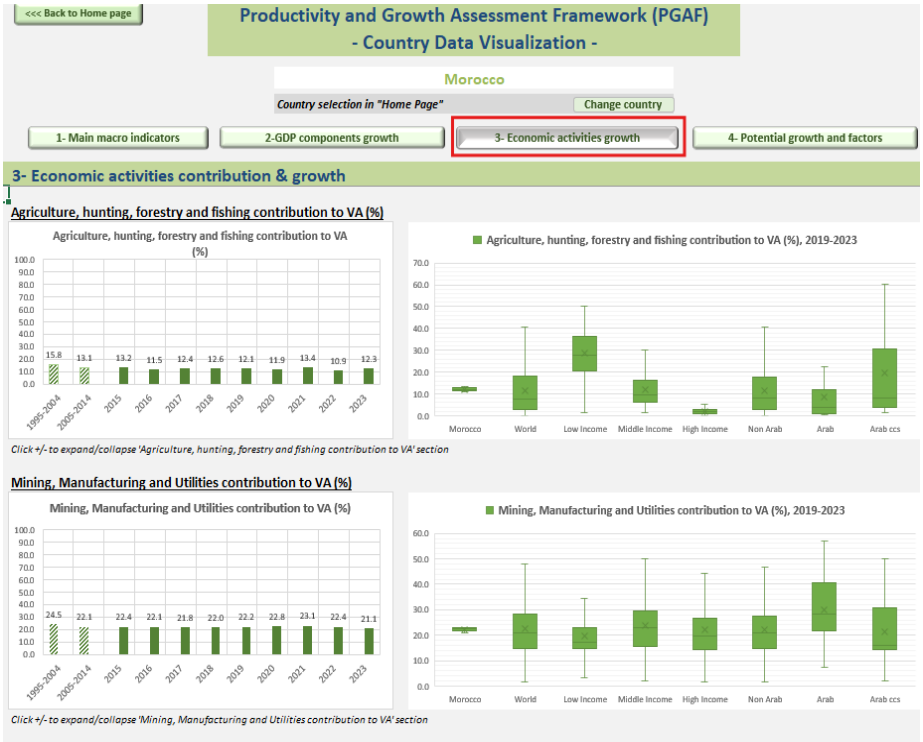
- Private consumption contribution to GDP (%).
- Government consumption contribution to GDP (%).
- Gross fixed capital formation contribution to GDP (%).
- Exports contribution to GDP (%).
- Imports contribution to GDP (%).
- Private consumption growth rate, constant prices (%).
- Government consumption growth rate, constant prices (%).
- Gross fixed capital formation growth rate, constant prices (%).
- Exports growth rate, constant prices (%).
- Imports growth rate, constant prices (%).

The trend and dispersion of each indicator are also presented in this page.



2.3. Economic Activities growth

This page shows the contribution to GDP and the growth rate of the value added of the main economic activities.



The economic activities included in the analysis are:

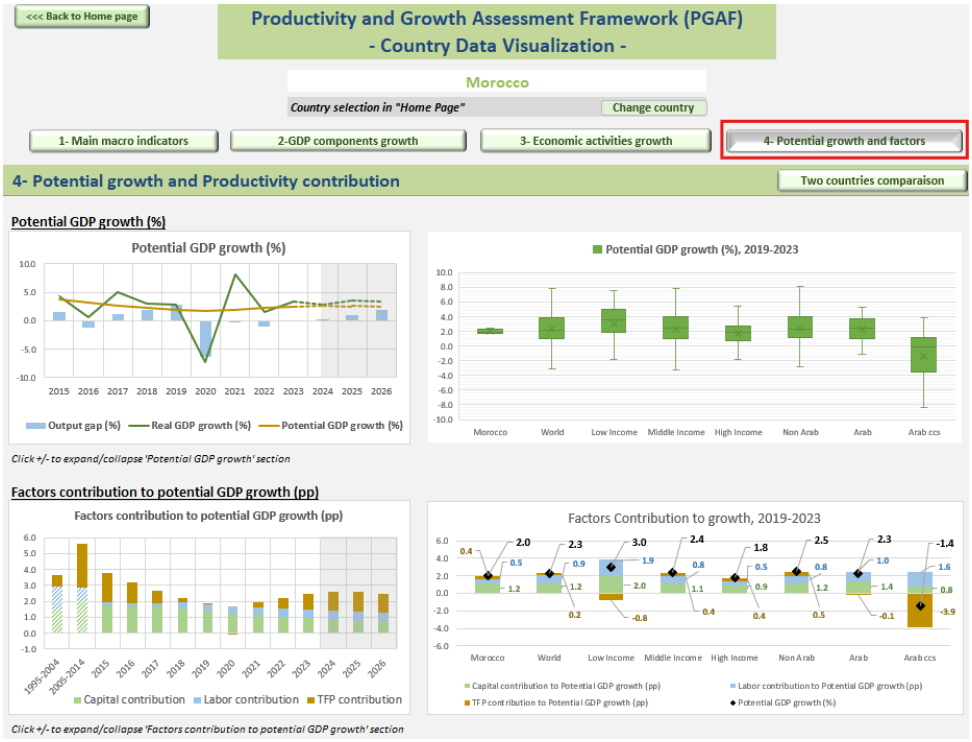
- Agriculture, hunting, forestry and fishing.
- Mining, Manufacturing and Utilities.
- Manufacturing.
- Construction.
- Trade, restaurants and hotels.
- Transport, storage and communication.
- Other Activities.

The trend and dispersion of each indicator are also presented in this page.

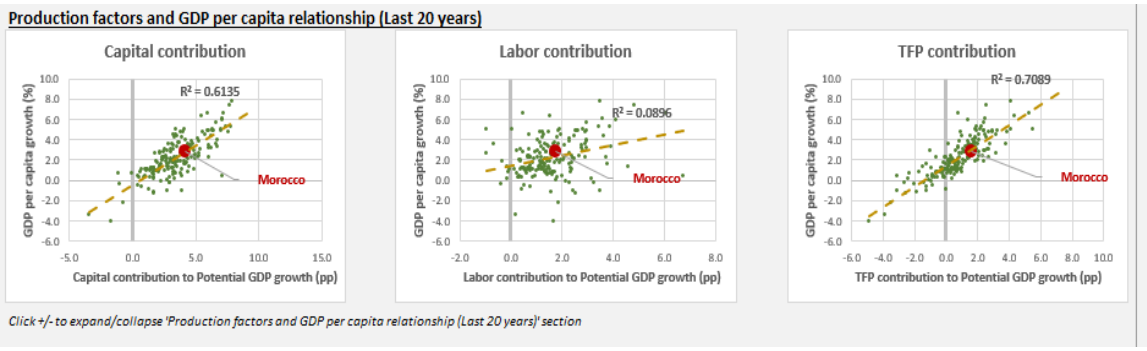
2.4. Potential growth and factors

This page presents different graphical views with multiple purposes, as follows:

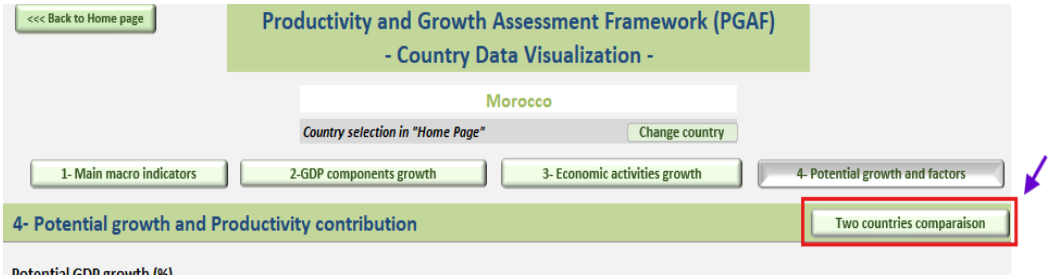
- The change over the last ten years of the potential GDP growth rate, the real GDP growth rate, and the output gap.
- The factors' contribution to potential GDP growth (capital, labor, and TFP) over the 1995-2026 period.
- The box plot is used to show the dispersion of the potential GDP growth and factors contribution to potential GDP in comparison with the specified groups.



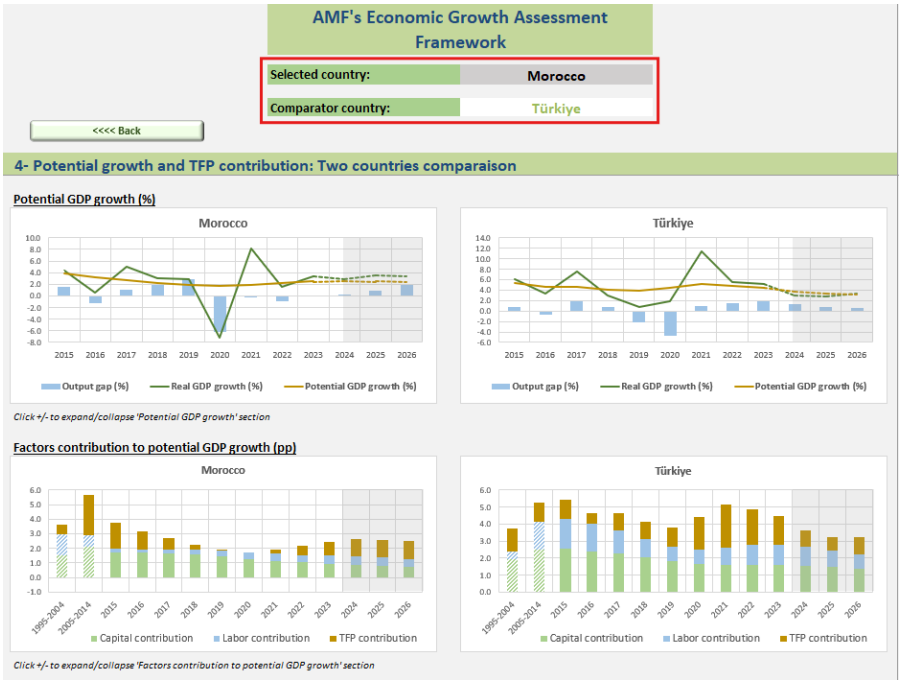
- In addition, a scatter plot is used to show the relationship between the GDP per capita growth and the factor contribution to potential GDP for all countries.



- The comparison between two countries is available in this page.
  - First, you should press the tab “two countries comparison”.

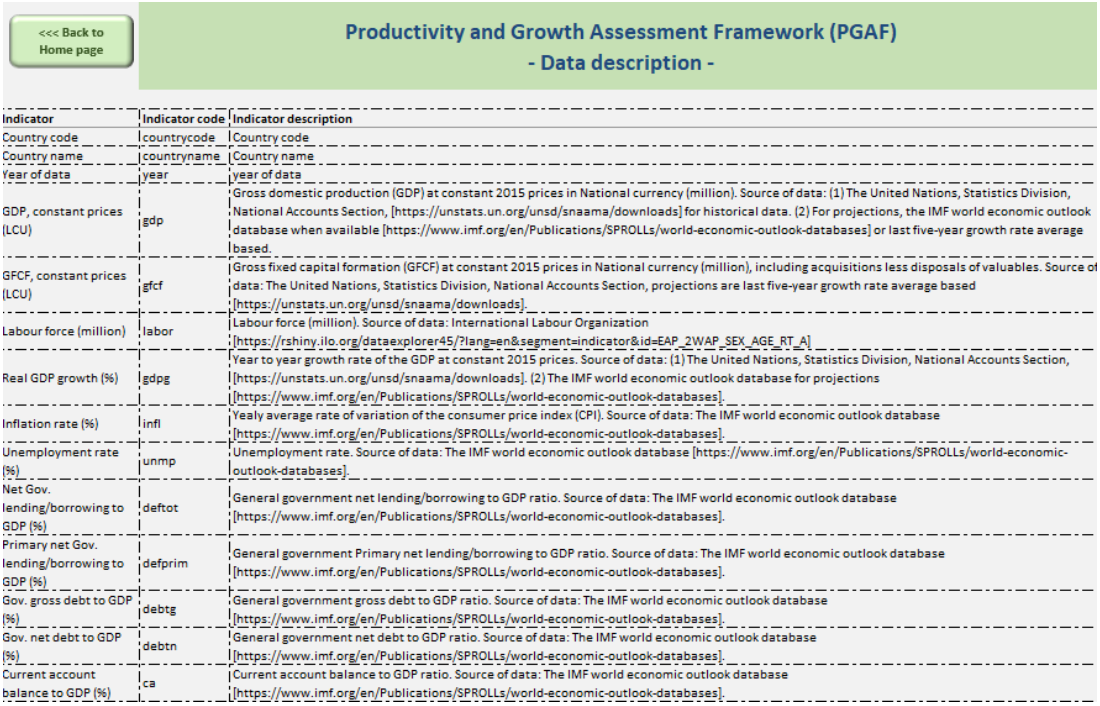


  - Then, you can choose comparator country from the list or by typing the country name in the specified box.



3. Data details

This section presents metadata, or a data description, of the indicators used in the analysis. This description covers many aspects of the indicators, including the name, code, definition, and data sources for each indicator.



Indicator	Indicator code	Indicator description
Country code	countrycode	Country code
Country name	countryname	Country name
Year of data	year	year of data
GDP, constant prices (LCU)	gdp	Gross domestic production (GDP) at constant 2015 prices in National currency (million). Source of data: (1) The United Nations, Statistics Division, National Accounts Section, [https://unstats.un.org/unsd/snaama/downloads] for historical data. (2) For projections, the IMF world economic outlook database when available [https://www.imf.org/en/Publications/SPROLLs/world-economic-outlook-databases] or last five-year growth rate average based.
GFCF, constant prices (LCU)	gfcf	Gross fixed capital formation (GFCF) at constant 2015 prices in National currency (million), including acquisitions less disposals of valuables. Source of data: The United Nations, Statistics Division, National Accounts Section, projections are last five-year growth rate average based [https://unstats.un.org/unsd/snaama/downloads].
Labour force (million)	labor	Labour force (million). Source of data: International Labour Organization [https://rshiny.ilo.org/dataexplorer45/?lang=en&segment=indicator&id=EAP_2WAP_SEX_AGE_RT_A]
Real GDP growth (%)	gdpg	Year to year growth rate of the GDP at constant 2015 prices. Source of data: (1) The United Nations, Statistics Division, National Accounts Section, [https://unstats.un.org/unsd/snaama/downloads]. (2) The IMF world economic outlook database for projections [https://www.imf.org/en/Publications/SPROLLs/world-economic-outlook-databases].
Inflation rate (%)	infl	Yealy average rate of variation of the consumer price index (CPI). Source of data: The IMF world economic outlook database [https://www.imf.org/en/Publications/SPROLLs/world-economic-outlook-databases].
Unemployment rate (%)	unmp	Unemployment rate. Source of data: The IMF world economic outlook database [https://www.imf.org/en/Publications/SPROLLs/world-economic-outlook-databases].
Net Gov. lending/borrowing to GDP (%)	deftot	General government net lending/borrowing to GDP ratio. Source of data: The IMF world economic outlook database [https://www.imf.org/en/Publications/SPROLLs/world-economic-outlook-databases].
Primary net Gov. lending/borrowing to GDP (%)	defprim	General government Primary net lending/borrowing to GDP ratio. Source of data: The IMF world economic outlook database [https://www.imf.org/en/Publications/SPROLLs/world-economic-outlook-databases].
Gov. gross debt to GDP (%)	debtg	General government gross debt to GDP ratio. Source of data: The IMF world economic outlook database [https://www.imf.org/en/Publications/SPROLLs/world-economic-outlook-databases].
Gov. net debt to GDP (%)	debtn	General government net debt to GDP ratio. Source of data: The IMF world economic outlook database [https://www.imf.org/en/Publications/SPROLLs/world-economic-outlook-databases].
Current account balance to GDP (%)	ca	Current account balance to GDP ratio. Source of data: The IMF world economic outlook database [https://www.imf.org/en/Publications/SPROLLs/world-economic-outlook-databases].

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