# Participation in global value chains, human capital and total factor productivity in Morocco: Estimation using

# « ARDL bound testing ».

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## Abstract

The main objective of this contribution is to estimate empirically the long-run relationship and short-run dynamics between the level of TFP in Morocco and some factors that may affect it. We focus on human capital, participation in global value chains, the quality of institutions and the budget deficit. We use as an econometric tool an ARDL bound testing approach combined with the Toda-Yamamoto test to study causality.

Our research shows that the effects of these variables vary between the short and long term. In the short term, the impact of human capital and institutions is negative, the variable participation in global value chains has no instantaneous effect on TFP growth and the variable that captures macroeconomic stability, i.e. public budget deficit has an insignificant negative impact.

In the long term, the effects of human capital accumulation on TFP growth is positive. The quality of institutions has a positive impact on productivity. Differently with what we observed in the short-term, participation in global value chains has a negative impact on TFP**.**

Analysis of the impulse response function yields the following results. A shock to human capital results in an immediate increase in TFP, while a shock to the PVC variable results in an immediate drop in TFP. The immediate response of TFP to an impulse from the two variables INS and DB is negative, but becomes positive from the second year onwards.

**Key words:** Total factor productivity, Participation in value chains, Human capital, Morocco, ARDL bound testing.

## 1. Introduction

Total factor productivity (TFP) measures the efficiency with which resources are transformed into an output. TFP growth corresponds to output's growth that is not attributed to the growth of the factors of production. It corresponds to what is known as the Solow's residual (Solow, 1956). Assessing the contribution of TFP to economic growth allows us to get an idea about the extent to which the economy is improving its efficiency in the use of resources in the economy. Recent literature on economic growth emphasises the role of TFP growth as the main driver of long-term growth of the per capita GDP (Hall, 1999). Consequently, it is fruitful to examine the determinants of TFP which help to design economic policies needed to boost economic growth.

The determinants of TFP are often studied in order to identify the factors that have an indirect impact on economic growth. Indeed, it is necessary to see what factors and conditions ensure that TFP improves more in a country than what we observe in other countries (Loko & Diouf, 2009); (Kim & Loayza, 2017); (Kim & Loayza, 2019). Our aim is to spot potential levers for increasing growth via TFP growth.

The empirical literature highlights several potential determinants of productivity such as human capital, research and development, openness to foreign trade, and foreign direct investment (FDI), as well as other variables such as the quality of institutions, and macroeconomic stability. In addition to these traditional factors, there are other determinants that are not frequently used in the literature, such as participation in global value chains (GVC). This variable measures the degree of integration of an economy in the global value chains. It captures the value of intermediate products in international transactions of a country either in exports or in imports (Baldwin, 2013).

The main objective of this contribution is to estimate empirically the long-term relationship and short term dynamics between the growth of TFP in Morocco and the main factors we introduced. To achieve this, we present in section 2 a brief literature about the determinants of TFP. In section 3, we present an overview of the evolution of TFP and of its determinants in Morocco. The fourth section presents the methodology, the period of study, and the sources of data. The fifth section will present the econometric exercise and provide the results of the estimation of the impact of human capital, participation in global value chains, institutional quality, and the budget deficit on TFP in Morocco. The estimation is performed using an "ARDL bound testing" model combined with the Toda-Yamamoto approach for the study of causality. The sixth section concludes.

The particularity of this work lies in the following four aspects. Firstly, this study proposes a recent analysis of the determinants of TFP through a specific approach that combines estimation by an "ARDL" model with Toda-Yamamoto causality and cointegration tests at the bounds of Pesaran et al. This approach will, thus, make it possible to capture the short-term dynamics and long-term effects of the various determinants of TFP. Another distinctive feature of this study is that it includes other determinants not frequently considered in the literature, such as participation in global value chains (GVCs). Furthermore, our analysis explores the shock propagation mechanisms to track the dynamic effect of a shock to each determinant on TFP in Morocco, using exploring the determinants of the impulse response function (IRF).

## 2.      Brief literature review

The examination of the determinants of TFP responds to the imperative of assessing the medium and long term country's structural policies that can contribute to improve the efficient use of resources. Indeed, exploring the determinants of TFP is an essential step for the formulation of an economic policy. The existing literature identifies a number of determinants of TFP such as human capital, physical capital, infrastructures, trade openness, and participation in global value chains. foreign direct investment, the macroeconomic stability, institutions, and research and development activities, etc. In this section, we summarise a sample of the literature about the determinants of TFP.

Y. E.  and Kim and N. V. Loayza (2019) explored the determinants of TFP as measured by the Penn World Table for the period 1985-2015 for a sample of more than 100 countries. The authors construct an index of each of five groups of TFP determinants. These groups are infrastructure, education, innovation, market efficiency, and institutions. The main findings of these authors is that the variance of the TFP is linked to market efficiency in OECD countries and to education in developing countries. The effect of education is increasing over time and is the highest among the five group of determinants.

The paper of B. Loko and M. A. Diouf (2009) explored the determinants of TFP in the case of Maghreb countries over the period 1970-2005. The authors use a panel data model and synthetize the big number of candidate variables that affect TFP by using the principal component analysis to get a small number of factors that retain the main information contained in the initial sub-indicators. Their results show that "large government sector and a high share of value added in agriculture negatively affect productivity growth whereas increasing the share of women in the labour force has a beneficial impact on total factor productivity (TFP) growth. Besides, foreign direct investment does have a positive impact on TFP growth and this impact strongly depends on the domestic workforce's level of education. Macroeconomic stability,

greater trade openness, higher stock of human capital and strong institutions are also associated with higher productivity" (Loko and Diouf, 2009, p. 3).

S. U. Khan (2006) explored the determinants of TFP in Pakistan over the period 1960-2003 using a regression approach. This author takes as determinants "inflation, foreign direct investment, financial sector depth, private credit, budget deficit, population growth, investment, employment, and government consumption. Interestingly, the variables of education expenditures and openness of trade turn out to have negative association, while government consumption and foreign investment are positively associated with Pakistan's TFP" (Khan, 2006, p. 384).

As a determinant of productivity, the participation in GVCs become important since the data about this aspect become available. The OECD report (2014) provides a detailed analysis of how participation in Global Value Chains (GVCs) can enhance productivity and economic growth. The report utilizes the OECD Trade in Value Added (TIVA) database. The report argues that increased participation in GVC can lead to higher productivity. Indeed, countries with greater participation in GVC have experienced significant productivity growth in sectors where the potential for fragmentation is higher.

## 3. Overview of the evolution of TFP and of its main determinants

Analysis of the evolution of TFP in Morocco over the period 1983-2019 reveals that its growth rate is unstable, low and sometimes negative. TFP has grown at a very low rate, increasing by an annual average growth rate of just 0.3% between 1983 and 2019 (Figure 1).

**Figure 1. TFP and its growth rate in Morocco**
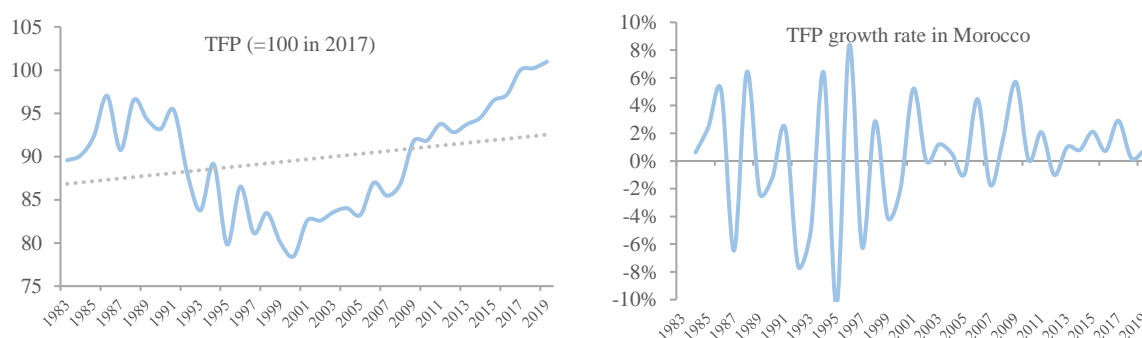


*Source: The authors using PWT data*

Although the Moroccan economy has undergone various structural economic and institutional reforms aimed at promoting economic growth, guaranteeing the development of its productive fabric and ensuring the improvement of its productivity, the profile of growth of TFP remains

characterised by strong fluctuations and it is below what was observed in many emerging countries (ADB, 2014).

## 3.1. Openness of the economy

Opening the economy is one of the major strategic choices that shape the Morocco's economic model since the 1980s. This choice has led to the signing of several free trade agreements. As a result, Morocco's rate of openness via trade in goods increased by almost 25 points between 1998 and 2019, rising from 38.5% in 1998 to 62.5% in 2019.

Morocco's policy of integration into the world economy and the efforts made under the various sectoral plans have certainly enabled the country to record a certain dynamism in exports over the last few years, but this improvement has in reality been at a slower rate than that of imports. The mechanic result has been a deterioration of the trade balance. This deficit had increased from MAD 30 billion in 1998 to MAD 206 billion in 2019. The rate at which goods imports are covered by exports is only 55.8% on average between 1998 and 2019 (Figure 2.). The rise in the value of imports can be explained mainly by the increase in purchases of investment goods and by the rise in the price of raw materials, particularly energy products.

**Figure 2. Trade Openness rate of Morocco in trade of goods**
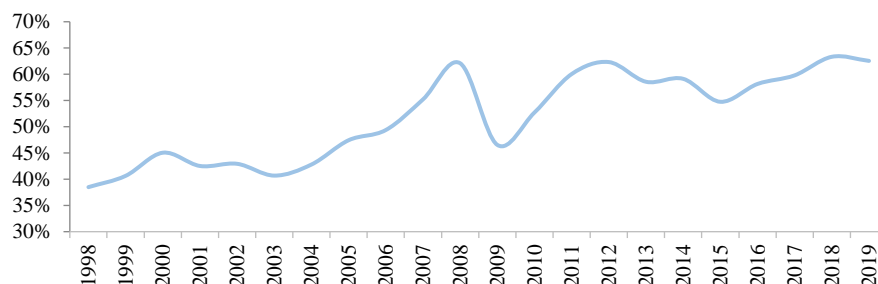


*Source: The Authors using Exchange Office and HCP data*

In this context, Morocco's share in the world market has risen only slightly, from 0.12% in 2000 to 0.15% in 2019 (Figure 3.). The poor performance of Morocco in terms of market share can be explained by several factors, both internal and external. Externally, Moroccan exports have been penalised by increased competition and by their concentration on the European market, which accounts for more than 64% of total Morocco's exports. Moroccan exports are also experiencing difficulties in accessing certain markets, mainly due to standards requirements (technical, sanitary, and environmental). Internally, this situation may be attributable to the fact that Morocco is lagging behind in its efforts to adapt and improve its exportable supply.

**Figure 3. Global market's share of Morocco**
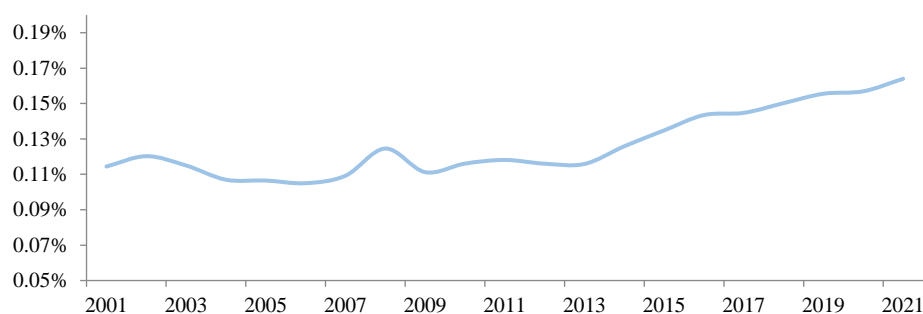


*Source: The Authors using Exchange Office and WTO data*

Several factors are behind Morocco's poor trade performance on the various markets. An examination of the structure of Moroccan exports shows, first of all, the quantitative and qualitative weaknesses of the products supplied for exports. Moroccan exports are dominated by finished consumer products and semi-finished products, which account for half of total exports. In 2019, these two groups accounted for 29.9% and 20.4% respectively.

This observation is confirmed by an analysis of the dynamics of Moroccan exports. The champion products, characterised by growth in international trade and gains in the market share for Morocco, consist mainly of equipment for electricity distribution, passenger cars, fertilisers and certain clothing products. On the other hand, Morocco has lost market share in non-performing products. These include, in particular, vegetables, fruit, lamps, tubes and valves, as well as certain textile and clothing products (Figure 4).

**Figure 4. Dynamics of Moroccan exports (Average 2016-2019)**
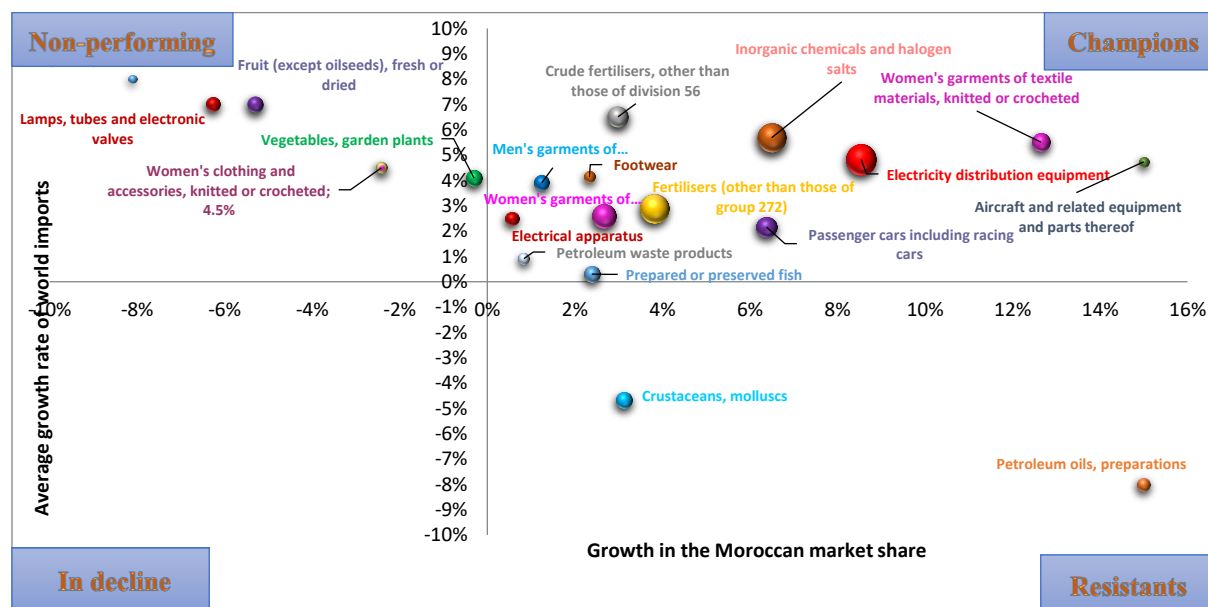


*Source: The Authors using Exchange Office and UNCTAD data*

It should be noted that the analysis is based on the most exported 20 products by Morocco during the period 2016-2019, which account for more than 80% of total exports, classified according to the Standard International Trade Classification (SITC). Moroccan exports are also characterised by a high import content of intermediate products. Morocco is highly dependent on energy imports, which account for more than 10% of total imports and on finished investment goods imports. In addition to its structural fragility, Morocco's exportable supply is characterised by its high content in low-skilled labour compared with its competitors, and a low content of innovation.

### 3.2. Participation in global value chains

The increased segmentation of production processes across global value chains has led to a significant surge in trade in intermediate goods. Understanding these changes has become complex and requires specific statistics to grasp the reality. Indeed, accounting for this trade in conventional world trade statistics, in gross terms, leads to a bias of overestimation of trade flows due to double counting of the value of intermediate products in international transactions. The valuation of these flows should take into account only the actual value added into the product, rather than the whole final value of the product.

The method of measuring trade in value added terms allows to eliminate the main bias generated by conventional trade statistics by taking into account only the foreign value added incorporated in exported goods and services. Trade data measured in terms of value added makes it possible to answer a number of questions, as it takes account of the value that each country adds during the production of goods and services on a global scale. In this respect, several value-added trade databases have been developed, specifically TiVA from the OECD, WIOD from the European Commission, EORA from the University of Sydney and the UNCTAD database.

(Koopman & al, 2012) have developed a GVC participation index to capture these two types of insertion. Backward participation refers to the proportion of exports that contain imported products, while forward participation represents the proportion of local value added embedded in other countries' exports in the form of intermediate components. When a country's upstream participation exceeds its downstream participation, it tends to specialise in the final stages of the production chain, as a processor or assembler. On the other hand, when a country's upstream shareholding is lower than its downstream shareholding, it tends to specialise in the early stages of the chain, as a supplier of intermediate components.

An examination of GVC participation index reveals that Morocco has gained only 6.7 points in a period of 24 years in its participation in global value chains (GVC), reaching 44% in 2019. Despite this improvement, upstream participation remains the main component of this index,

with 24.6%, compared with only 19.4% in 2019 for the downstream component (Figure 5). This indicates that domestic firms are more dependent on foreign inputs than foreign exporting firms are on Moroccan intermediate products (Mrani, 2022).

**Figure 5. Morocco's participation in global value chains (%)**
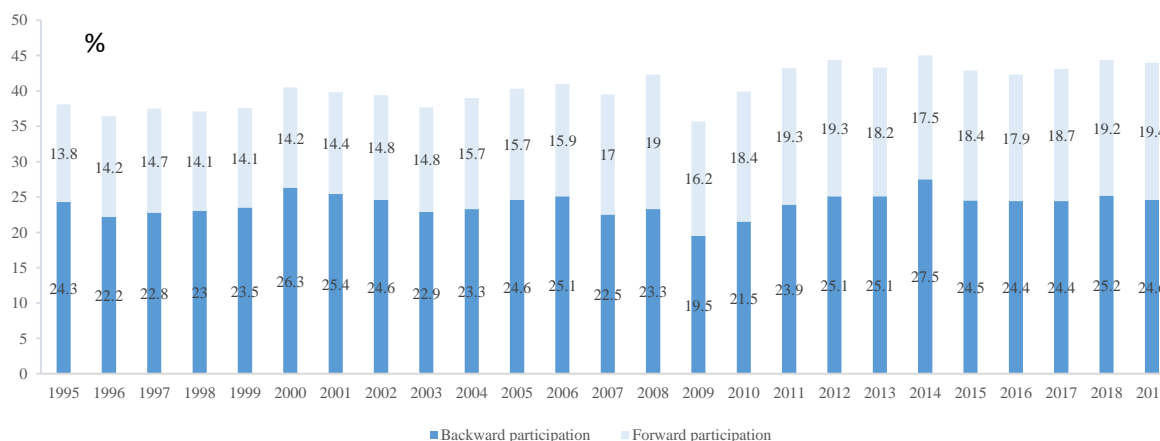


*Source: The authors using OECD data (TIVA)*

It should also be noted that a high rate of backward participation leads to an increased dependence of domestic companies on foreign companies. This makes the country more vulnerable to external shocks, such as disruptions of partner countries production systems or changes in their trade policies.

An analysis of the dependence of national production on foreign imports reveals that this dependence increased between 1995 and 2019 on the supply side, from 17.1% to 22.3%. On the demand side, it rose from 13.9% to 17.8% (Figure 6). It should be noted that the dependence of production on foreign supply is measured by dividing the value of imports of intermediate products to the sector's production. As for the dependence of production on foreign demand, it corresponds to the share of exports of intermediate goods in the sector's production.

**Figure 6. Dependence on supply versus dependence on foreign demand (Average 2013-2019)**
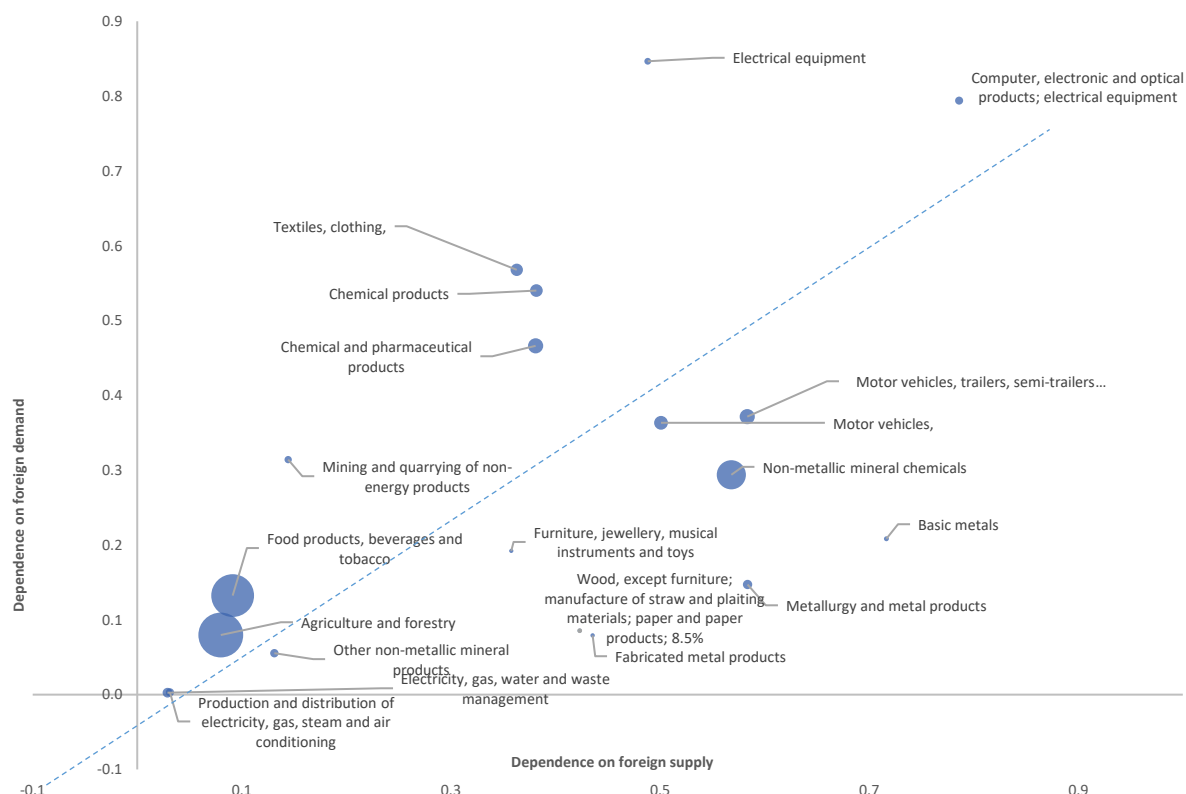


*Source: The authors using OECD data (TIVA)*

In terms of sectoral dependence, the Moroccan productive fabric is more dependent on foreign supply in several manufacturing sectors. Several major industries, such as the manufacture of motor vehicles and other transport equipment, textiles and clothing, chemicals, metallurgy and electrical equipment, are highly dependent on supply, because these sectors use large quantities of imported inputs.

## 3.3. Human capital

Human capital can be defined as 'the body of knowledge, skills, competencies and individual characteristics that facilitate the creation of personal, social and economic well-being' (OECD, 1998); (OECDE, 2001). (Stiglitz, 2007) defines human capital as 'the accumulated skills and experience that make people more productive' (p.190). It is imperfectly complementary to physical capital. Growth in the stock of human capital tends to increase the marginal productivity of physical capital, thus stimulating investment.

Human capital in Morocco, as measured by the gross enrolment rate in secondary education for all programmes, showed an upward trend over the period 1983-2019. This rate jumped from 26.8% to 81.2% over this period. This performance can be explained in particular by the

achievement of universal primary education and the reduction in the enrolment gap between urban and rural areas and between boys and girls (Figure 7).

The increasing social support for schooling has made a major contribution to the performance recorded. The network of school canteens and boarding schools has been expanded, and the number of beneficiaries has increased by 2.7% per year between 2009 and 2019. To support the generalisation of education and reduce school dropout, the number of beneficiaries of the 'Tayssir' programme also increased by 22% over the same period (Ministry of the Economy and Finance, 2023).

**Figure 7. Trends in secondary school enrolment in Morocco**
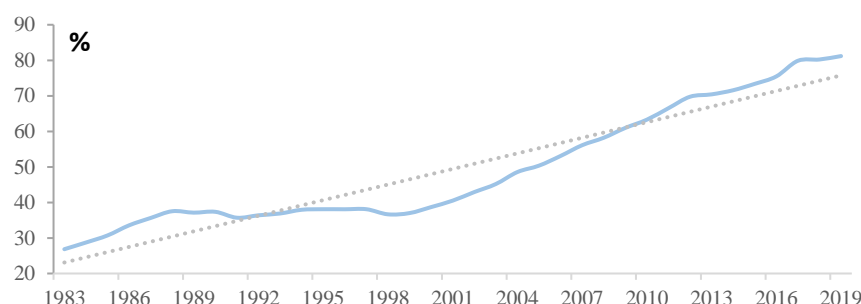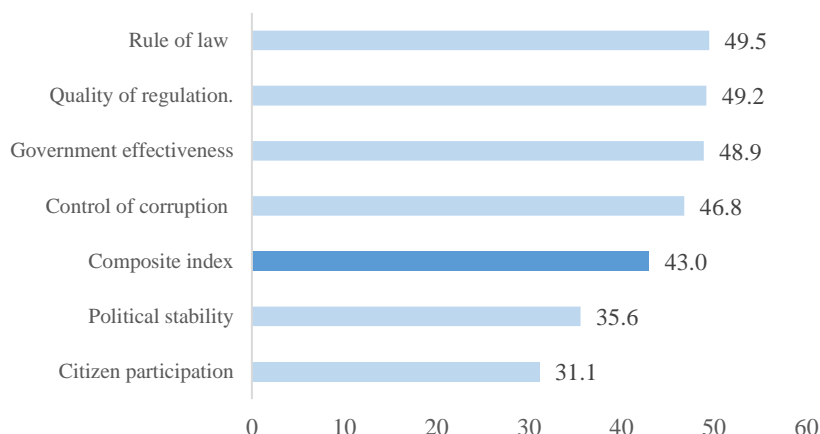


*Source: The Authors using WDI data*

However, the Moroccan education system continues to face a number of challenges, in particular the relatively low quality of learning, the low external performance of the education system, inequalities in access to education, and failure to attract high quality teachers. According to the results of the PISA-2018 survey, many students fail to achieve the minimum level of proficiency in reading, mathematics and science. Moreover, school performance in mathematics is largely influenced by students' social background, individual and family characteristics, and the environment in which the school is located (Abbassi & al, 2021). Matching training to employment is also a major challenge for Morocco's education system. There is a considerable gap between the skills acquired by students and the needs of the labour market.

### 3.4. The quality of institutions

(Kaufmann D. & Kraay A., 1999) have developed an indicator of the quality of governance in the public sector (IGSP) using the World Bank database (WGI), based on six dimensions reflecting the way in which a country is governed. They reflect aspects such as government effectiveness, justice, transparency, citizens' participation, the fight against corruption and the quality of regulation. These indicators are used to assess and compare governance in different countries around the world.

The World Bank's WGI used data for the period 1995-2019 to rank governance in 200 countries using an index on a scale ranging from 0 (the lowest level of governance) to 100 (the highest level of governance) that synthetizes six dimensions. According to this indicator, Morocco is in the 43rd percentile among this sample (the percentile rank indicates the country's rank among all countries). Morocco is, therefore, practically in the middle of the world rankings (Figure 8).

**Figure 8. World Bank Governance Index for Morocco (WGI)**

**(Average 1995-2019)**



*Source: The Authors using WGI data*

Morocco scores are better in the sub-indicators "rule of law" (49.5) and "regulatory quality" (49.2) than its performance in the composite indicator. It is still penalised in terms of citizens' participation (35.6) and political stability (35.6).

### 3.5. Fiscal policy

Macroeconomic stability is an essential element in creating an environment conducive to productivity. It implies low inflation, stable interest rates and a sustainable budget deficit. It is important to stress that the specific impact of the budget deficit on productivity can vary according to the economic context, the policies implemented and the reactions of the various economic players. A careful balance between budget deficit management, macroeconomic stability and productivity incentives is often required to support sustainable economic growth. Over the last two decades, Morocco has experienced significant fluctuations in its budget deficit, influenced by various economic factors. Between 2000 and 2006, the budget deficit was relatively contained, averaging around 2.1% of GDP. This period was marked by an overall downward trend, with efforts to consolidate public finances following years of large deficits. Between 2008 and 2013, the budget balance deteriorated significantly, reaching an average deficit of around 4.8% of GDP. This situation was exacerbated by the global financial crisis of 2008, which impacted tax revenues and increased public spending (Figure 9).

**Figure 9. Evolution of the budget's deficit as a ratio of GDP**
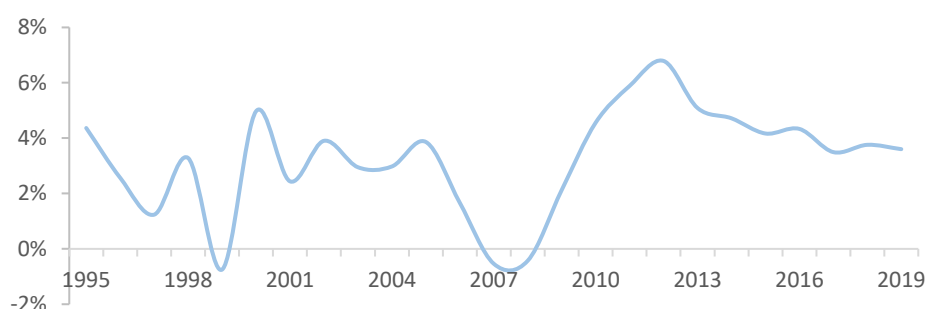


*Source: The authors using Ministry of Economy and Finance data*

Between 2014 and 2019, the actions taken by the public authorities in terms of fiscal policy resulted in a reduction in the budget deficit excluding privatisation to an annual average of 3.7% over this period. Measures have been taken to contain the cost of compensation (total decompensation of petroleum products). The aim is to reduce the State's cost of functioning and impose more restriction in the execution of investment expenditures. The situation of public finance has also been moderated by the mobilisation of donations, notably from the countries of the Gulf Cooperation Council. Measures have been taken to reduce the compensation burden (total decompensation of oil products and fuel oil for electricity generation in 2014 and diesel in 2015). The aim is to reduce the Government expenditures and save resources for investment projects.

## 4. Estimation methodology, variables, and sources of data

### 4.1 Estimation methodology

In our study, we seek to identify the main determinants of TFP in Morocco. We will use an autoregressive distributed lag model (ARDL) with the Pesaran boundary cointegration test (Pesaran M. & al, 2001) and the Toda and Yamamoto causality study approach (Toda & Yamamoto, 1995), which is suitable for modelling cointegrated variables with different orders of integration.

This approach allows to capture the short-term dynamics and long-term effects of the various determinants (explanatory variables) on the TFP (variable to be explained) using the cointegration test developed by Pesaran. This method is suitable for our estimation in the presence of variables integrated at different orders and a small sample size (25 observations).

### 4.2. Presentation of variables

On the basis of the literature presented above, the candidate determinants of *TFP* were identified according to their relevance in explaining its dynamics and the availability of data. The estimation uses data for the period 1995-2019. The aim of our exploration is to estimate

the impact of human capital accumulation (*HKS*), participation in global value chains (*PVC*), institutional quality (*INS*) and the budget deficit (*DB*) to *TFP* dynamics. The choice of period of study is due to the fact that the statistics on *PVC* variable and *INS* variables are only available since 1995. The following table gives the definition of each variable, the data sources, and the expected signs (Table 1).

**Table 1. Study variables: sources, definitions and expected effects**

| Variable | Definitions | Sources | Expected Effects |
|---|---|---|---|
| *TFP* | This index is equal to 1 at the reference year 2017. It is measured by PWT. It measures the efficiency with which resources are transformed into production. | Penn World Table (PW10.) | The endogenous variable |
| *HKS* | The gross enrolment rate in secondary education in all programmes. It corresponds to total enrolment in secondary education, regardless of age, expressed as a percentage of the population of secondary school age. | WDI | + |
| PVC | Synthetic indicator of upstream and downstream participation in global value chains expressed as a percentage of the country's total gross exports. | [Trade in Value Added (TIVA)](#) | + |
| INS | World Bank Governance Index. | WGI | + |
| DB | Budget deficit as a percentage of GDP. | Ministry of Economy and Finance | - |

*Source: The authors*

## 5. Empirical study: results and discussion

The model aims to estimate the impact of human capital (*HKS*), participation in global value chains (*PVC*), institutional quality (*INS*) and the budget deficit on total factor productivity (*TFP*). We proceed in three stages. In the first step, we study the stationarity of the time series. The second stage involves running Toda-Yamamoto causality tests. This involves estimating a level VAR, the optimal lag and the causality test. The third step consists of choosing the optimal model for the selected lag, according to the Akaike Information Criterion (AIC), then testing

its robustness and the cointegration relationship using the Pesaran et al. (2001) test to validate the model, and finally estimating the long- and short-term relationships (coefficients).

## 5.1. Descriptive analysis of variables

the scatter plots illustrating the link between productivity and its determinants (Figure10) and the correlation matrix between the model's variables show a strong correlation between the dependent variable and its explanatory variables, since the degree of association exceeds 0.3 in absolute value in the first column (Annexe 1). The correlation is positive between the TFP variable and the HKS and PVC variables. It also shows a negative correlation between the variable INS and the variable DB. The multi-collinearity test or the inflation factor variance test reveals that the explanatory variables are not multi-collinear, since the VIF values are all below 5% (Annexe 2).

**Figure 10. Productivity and its main candidate determinants**
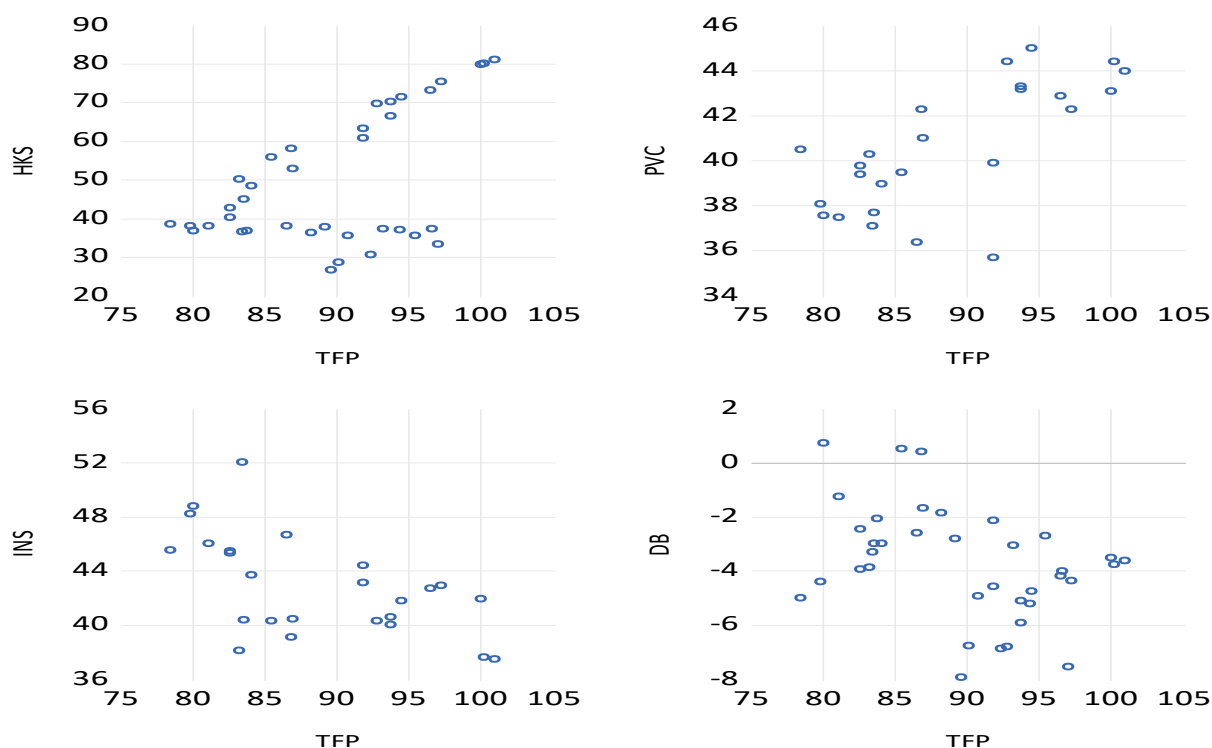


*Source: The authors*

## 5.2. Stationarity of variables

The variables TFP and institutions (INS) are integrated of order 1 (stationary after first difference), while the other variables: human capital (HKS), participation in global value chains (PVC) and budget deficit are stationary in level. The results of the PP and ADF stationarity tests are presented in the (Annexe 3). The variables are, thus, integrated at different orders, which makes the Engle and Granger (multivariate case) and Johansen cointegration tests

ineffective, and makes the Toda-Yamamoto causality test and the bounds cointegration test the appropriate procedure (Pesaran et al., 2001).

## 5.3. Toda-Yamamoto causality test

The Granger causality test in the sense of Toda and Yamamoto concerns a standard VAR in level which we have first estimated. We used the Akaike Information Criterion (AIC) to select the optimal lag. Causality in the Toda-Yamamoto sense in this model is confirmed, so the long-run relationship is verified and the optimal lag which minimises the information criteria for our estimation corresponds to the second-order lag.

## 5.4. Estimation of the ARDL model

The results show that an ARDL model (1, 1, 0, 2, 2) is the most optimal among the models tested because it has the smallest AIC value. The validity of this model was tested using the following diagnostic tests: normality of residuals, autocorrelation of errors, heteroscedasticity of errors as well as the specification test and stability of model coefficients. The following table summarises the results of these tests (Table 2).

**Table 2. Summary of model diagnostic tests**

| Hypothèse du test | Test | Value | Probability |
|---|---|---|---|
| Normality | Skewness & kurtosis | 0,78 | 0,678 |
| Autocorrelation | Durbin Watson | 2,11 | |
| Heteroscedasticity | White | 23 | 0,402 |
| Specification and omitted variables | Ramsey | 1,82 | 0,213 |
| Stability | Cosum | **Coefficient stable** | |

*Source: The authors based on the estimation*

According to table 5, the null hypothesis is accepted for all these tests because all the probabilities are greater than 5%. There is no autocorrelation of the errors, no heteroscedasticity and the errors are normally distributed. Furthermore, the model coefficients are stable (Figure 11). This model is, therefore, statistically valid. Indeed, the estimated ARDL (1, 1, 0, 2, 2) is good globally and explains 88% of TFP dynamics in Morocco over the period 1995-2019.

**Figure 11. Stability of the model's coefficients**
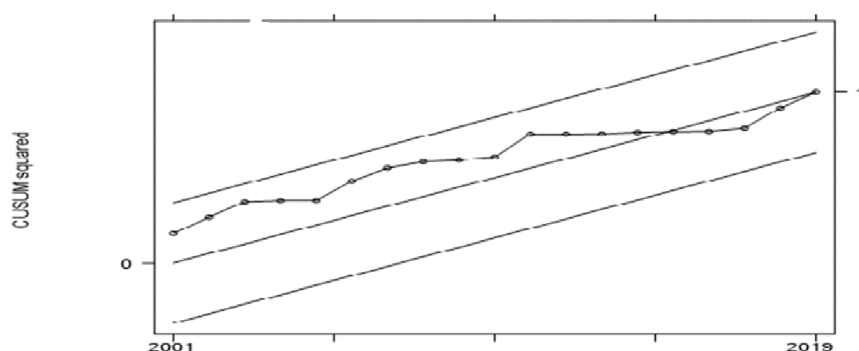


*Source: The authors based on the estimation*

## 5.5. Pesaran boundary cointegration test

The Pesaran et al. (2001) bound cointegration test is efficient in the case of series integrated at different orders. This test confirms the relationship of cointegration at the bounds between the variables studied, the value of F-stat is higher than the upper bound and the value of T-stat is higher than the upper bound. This confirms the existence of a cointegrating relationship. We can, therefore, estimate the long-term effects of *HKS, PVC, INS* and *DB* on *TFP* and the expected signs (Table 3).

**Table 3. Results of the cointegration test by Pesaran et al (2001)**

| *Variables* | *F(TFP HKS PVC INS DB)* | | | |
|---|---|---|---|---|
| Critical threshold | Lower limit I(0) | Upper limit I(1) | Lower limit I(0) | Upper limit I(1) |
| | *F computed* | ***9,07*** | *T computed* | ***-5,9*** |
| 1% | 2,45 | 3,52 | -2,57 | -3,66 |
| 5% | 2,86 | 4,01 | -2,86 | -3,99 |
| 10% | 3,74 | 5,06 | -3,44 | -4,6 |
| *Decision* | ***Cointegrated*** | | ***Cointegrated*** | |

*Source: The authors based on the estimation*

## 5.6. Long-term coefficient and short-term dynamics

The model is statistically robust overall: the explanatory power of the model is 0.88, close to 1. The probability (F statistic) is well below 0.05 and all the variables are significant except the budget deficit variable (Table 4). The error correction mechanism works and the adjustment coefficient is statistically significant, at -0.99 (the probability is well below 5%). It is negative and lies between zero and one in absolute value, which guarantees an error correction mechanism, and therefore the existence of a long-term relationship (cointegration) between the

variables studied. This means that 99% of the imbalance in the preceding period is adjusted in the following period.

The findings suggest that the effects of the variables on TFP in the short run differ from their effects in the long term. The effects of the variables human capital and institutions on TFP are significant but are negative in the short term. A one unit increase in human capital measure is associated with a decrease of TFP by 0.4 unit in the short term suggesting that the human capital of one year ago (with a one-year lag) is correlated negatively TFP level. The effect of the two year lagged institutions' variable is significant but negative. However, it is weaker than the effect of the human capital variable.

On the other hand, participation in global value chains has no instantaneous effect on TFP. The variable that captures macroeconomic stability, approximated by the share of the budget deficit in GDP, shows an impact that is not significant in the short term. The low level and volatility of productivity in Morocco would justify these counter-intuitive results in the short term.

**Table 4. Model estimation results**

|  | (1) | (2) | (3) |
|---|---|---|---|
| *Variables* | *ADJ* | *LR* | *SR* |
| *D.HKS* |  |  | -0.47* |
|  |  |  | (0.23) |
| *D.INS* |  |  | -0.14 |
|  |  |  | (0.16) |
| *LD.INS* |  |  | -0.25** |
|  |  |  | (0.11) |
| *D.DB* |  |  | -0.01 |
|  |  |  | (0.20) |
| *LD.DB* |  |  | -0.25 |
|  |  |  | (0.16) |
| *HKS* |  | 0.57*** |  |
|  |  | (0.04) |  |
| *PVC* |  | -0.40* |  |
|  |  | (0.19) |  |
| *INS* |  | 0.37** |  |
|  |  | (0.13) |  |
| *DB* |  | 0.01 |  |

| | | | |
|---|---|---|---|
| | | (0.22) | |
| *L.TFP* | -0.99*** | | |
| | (0.17) | | |
| Constant | | | 57.19*** |
| | | | (12.69) |
| Observations | 23 | 23 | 23 |
| R-squared | 0.88 | 0.88 | 0.88 |

*Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1*

*Source: The authors based on the estimation*

In the long term, the effects of improving human capital on productivity growth are positive. An increase in human capital by 1% accelerates productivity by 0.57 points in the long term. The quality of institutions has a positive and significant impact on long-term TFP. A one unit increase in the quality of institutions leads to a 0.37 increase in TFP. The budget deficit variable has no significant impact.

Moreover, contrary to the short-term results, participation in global value chains has a negative impact on TFP in the long term. This counter-intuitive result is probably due to the fact that upstream participation has grown at a higher rate than downstream participation.

Indeed, there has been a modest increase both in the incorporation of foreign value added into Moroccan exports and in local value added embedded in exports to other countries, although notable disparities persist in this respect at the level of the different economic sectors. However, upstream participation has progressed at a higher rate than downstream participation. This configuration makes the Moroccan economy more vulnerable to potential supply shocks from countries positioned further upstream from the GVC.

**5.7. Propagation of the shocks affecting the explanatory variables to TFP: the impulse response function**

Empirical economic analysis enables us to understand the impact of a change in one variable on other variables. This type of analysis corresponds to the examination of impulse responses, which is analogous to the analysis of dynamic multipliers (Gourieroux & Monfort, 1995)).

The impulse response function is used to determine the dynamic impact of a positive shock of one unit in each of the model's independent variables (*KHS, PVC, INS* and *DB*) on *TFP* over a 15 years' horizon (Figure 12).

**Figure 12. The impulse response function**
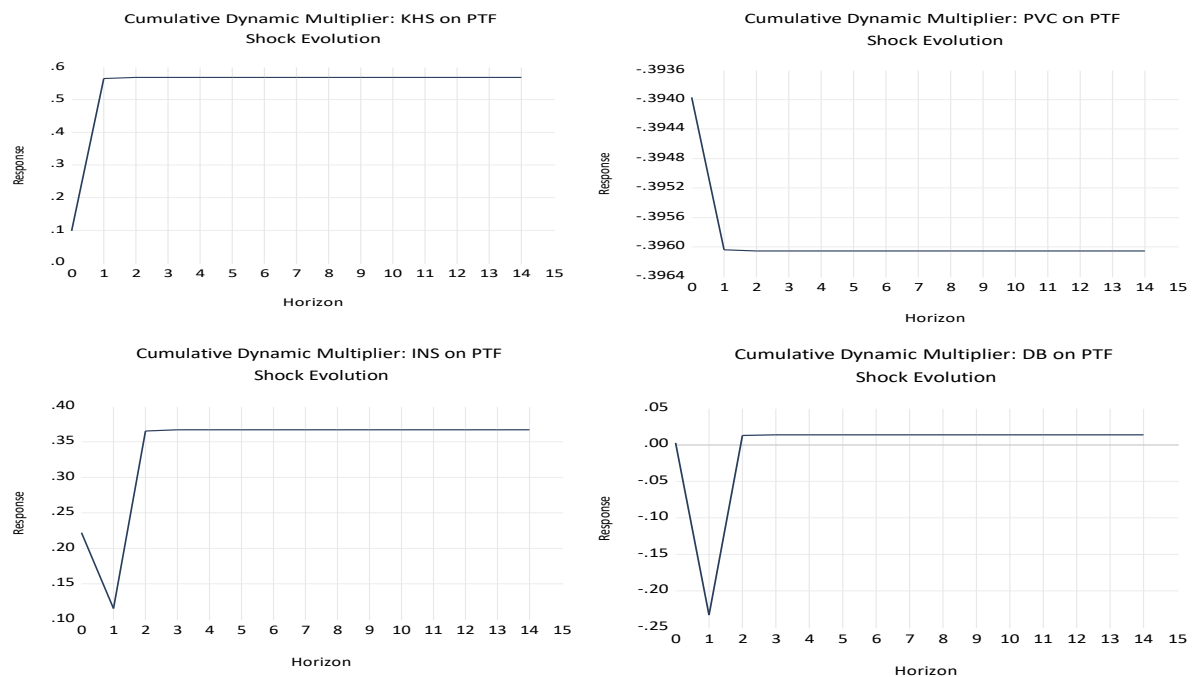


*Source: The authors based on the estimation*

In our case we find the shock to human capital results in an immediate increase in TFP, which stabilizes from the second year onwards. Concerning a shock on the PVC variable, it results in an immediate drop in TFP, which stabilizes from the second year onwards. The immediate reaction of TFP to an impulse from the two variables INS and DB is negative, but becomes positive from the second year onwards.

## 6. Conclusion

The analysis of the main determinants of TFP in the Moroccan economy reveals that a long-term relationship between TFP and participation in global value chains, human capital, the quality of institutions and the budget deficit is confirmed. The impact of these variables on TFP in Morocco varies between the short and long term. In the short term, the impact of human capital and institutions is significant and negative. The study shows that the variable participation in global value chains has no instantaneous effect on TFP growth.

In the long term, the effects of improving human capital on productivity growth becomes positive. The institutions' quality has a positive and significant impact on productivity. In contrast to the short-term results, participation in global value chains has a negative impact on TFP in the long term.

The very significant negative impact of the PVC variable on TFP in the long term can be explained by the nature of the country's integration into the international production process. Indeed, despite a modest increase in both the incorporation of foreign value added into national exports and local value added into imports from third countries, upstream participation has grown at a higher rate than downstream participation. This configuration makes the national economy more vulnerable to potential supply shocks from countries positioned further upstream in the GVC.

In the long term, improving the quality of institutions can have a significant impact on TFP. Reforms aimed at strengthening transparency, improving governance and fostering a competitive business environment can stimulate innovation and increase productivity. In the other hand, the insignificant impact of the budget deficit can be linked essentially to inefficient public spending and lack of productive investment. Another factor to consider is the crowding-out effect, as financing the deficit by borrowing limits the resources available for private investment. This can slow down TFP growth. Efficient public spending and support for productive investment are therefore essential to boost TFP.

Human capital has a positive impact on TFP over the long term. Improved productivity is closely linked to the development of human resources. Particular importance should, therefore, be attached to ensure a high quality training and to give more importance to vocational training, improving school enrolment rates, and guaranteeing that training is well matched to the needs of the labour market. This calls for reflection on more effective policies to enhance human resources qualification.

Morocco continues to face the dual challenge of moving into higher value-added segments and getting the local productive fabric more involved in global value chains in order to move

upmarket, speed up the process of structural transformation and boost TFP. On the other hand, the country is obliged to make additional efforts to develop its human capital to meet the challenge of foreign competition.

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## Annexe 1. Correlation matrix

| 1. | 2. TFP | 3. KH | 4. PVC | 5. INS | 6. DB |
|---|---|---|---|---|---|
| 7. TFP | 8. **1,000** | 9. | 10. | 11. | 12. |
| 13. HKS | 14. 0,961 | 15. **1,000** | 16. | 17. | 18. |
| 19. PVC | 20. 0,711 | 21. 0,809 | 22. **1,000** | 23. | 24. |
| 25. INS | 26. -0,572 | 27. -0,697 | 28. -0,659 | 29. **1,000** | 30. |
| 31. DB | 32. -0,378 | 33. -0,375 | 34. -0,475 | 35. 0,130 | 36. **1,000** |

## Annexe 2. Summary of multi-collinearity test

| Variable | VIF | 1/VIF |
|---|---|---|
| **PVC** | 3,55 | 0,282 |
| **HKS** | 3,38 | 0,296 |
| **INS** | 2,24 | 0,446 |
| **DB** | 1,41 | 0,708 |
| **Mean** | | **2,65** |

## Annexe 3. Summary of the Augmented Dickey-Fuller and Philips-Perron unit root tests

| Variables | Niveau | Intercept | | Trend & Intercept | | None | | Degree of integration |
|---|---|---|---|---|---|---|---|---|
| | | T_Statistic | P_value | T_Statistic | P_value | T_Statistic | P_value | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **TFP** | DF (niveau) | 1,043 | 0,996 | -2,774 | 0,219 | 2,368 | 0,994 | **I(1)** |
| | DF (1er dif) | -8,821 | 0,000*** | -9,785 | 0,000*** | -7,829 | 0,000*** | |
| | PP (niveau) | -0,134 | 0,935 | -2,611 | 0,279 | 2,453 | 0,995 | |
| | PP (1er dif) | -3,753 | 0,000*** | -9,808 | 0,000*** | -7,158 | 0,000*** | |
| **HKS** | DF (niveau) | 1,219 | 0,997 | -3,576 | 0,0537** | 6,837 | 1,000 | **I(0)** |
| | PP (niveau) | 0,866 | 0,993 | -3,452 | 0,0681* | 5,385 | 1,000 | |
| **PVC** | DF (niveau) | -1,958 | 0,302 | -4,278 | 0,0128*** | 0,886 | 0,893 | **I(0)** |
| | PP (niveau) | -1,958 | 0,302 | -4,285 | 0,0126*** | 1,284 | 0,945 | |
| **INS** | DF (niveau) | -1,993 | 0,288 | -2,962 | 0,162 | -1,033 | 0,262 | **I(1)** |
| | DF (1er dif) | -6,476 | 0,000*** | -6,326 | 0,000*** | -6,427 | 0,000*** | |
| | PP (niveau) | -1,877 | 0,337 | -2,962 | 0,162 | -1,565 | 0,109 | |
| | PP (1er dif) | -6,816 | 0,000*** | -6,619 | 0,000*** | -6,583 | 0,000*** | |
| **DB** | DF (niveau) | -2,969 | 0,0523** | -2,839 | 0,199 | -1,429 | 0,139 | **I(0)** |
| | PP (niveau) | -3,073 | 0,0423** | -3,450 | 0,068 | -1,348 | 0,160 | |

(***) significance at threshold 1% (**) significance at threshold 5% (*) significance at threshold 10%

*Source : The authors*