منتدى البحوث الاقتصادية
ECONOMIC RESEARCH FORUM

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# Technologie de l'information et de communication et croissance économique dans des pays de MENA et Africains A l'épreuve des modèles non linéaires à seuil

# ICT and Economic Growth in MENA and Africans countries: Evidence from non –linear – threshold model

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As digital technology becomes more and more important in the daily lives of individuals and businesses, digital technology itself is becoming an unprecedented lever for the global economy, including those in developing countries.

In developing countries, particularly in Africa, despite the growing importance of Internet penetration (Internet penetration has increased tenfold since the beginning of the first decade of the 20th century), especially due to mobile connectivity,

technological, economic and social gaps remain to be filled

**To what extent could digital transformation impact the economic growth of developing countries?**

**Several empirical investigations have been conducted to measure aspects of the digital economy.**

**These investigations have employed different approaches to determine the value of the digital economy.**

**Despite a general preference for the existence of a positive relationship between ICT diffusion and economic growth, these studies have conflicting results.**

The impact of technology on growth has not yet been unanimously accepted by economists. It is difficult to compare the results of different studies, particularly because:

1

economic structure of developing countries

2

ICT sector characteristics

3

Choice of ICT indicators

4

choice of the econometric methods

**First:**

**Developing countries are characterized by:**

**-the ineffectiveness of the industrial infrastructure**

**-the leading position of agriculture in the GDP**

**-low incomes**

**-Low levels of human capital formation, and specifically**

**- The absence of a real ICT producing sector**

**This specificity leads to questions about the mechanisms by which ICT can influence economic growth**

**H1: ICT has an indirect effect on economic growth that is mediated by macroeconomic variables**

**Second**

**The externalities of communication networks suggest that there may be a "threshold effect" at play, which implies that ICTs only have a lasting impact on the national level after a certain percentage of economic participation.**

**H2: There are thresholds above which the ICT development index induces direct changes in the growth dynamics of these countries**

**Third**

**The ICT indicators used emerge separately as determinants of economic growth**

**However, the manifestation of these effects on economic growth depends on the chosen indicator**

## Fourthly

**In general, authors establish that the relationship between fixed broadband and economic growth is linear.**

**Several studies, including those by Jean C. Kouam et al (2022) and Albiman, M. M., & Sulong, Z. (2017), shows that the econometric specifications measuring the effect of ICT on growth are not linear and that these effects are different according to the level of impact of ICT.**

**As a result, understanding the link between ICT and economic growth must be done in a new line of thinking that the concept of digital transformation and how the role of ICT should be considered in the development of the economy.**

1. **Digital transformation is a broad concept**

**This article focuses on two aspects of this concept…**

**First aspect**

**Digital Connectivity: The ability to access and use technology to connect to the Internet and exchange digital information.**

**Based on an index published by the International Telecommunications Union (ITU)**

**ICT Development Index (IDI) is a composite indicator, uses 11 internationally agreed ICT indicators, grouped in three clusters:**

**Access to ICTs 40%**

**Use of ICTs 40%**

**and**

**ICT skills 20%**

**1. Digital transformation is a broad concept**
**This article focuses on two aspects of this concept**

**<u>Second aspect</u>**
**Digital penetration: the digital part of activities and transactions, especially through online connectivity and the development of automated systems**

**Indicators of digital penetration are even rarer.**

**Macroeconomic variables as indicators of the spread of digital transactions in private and public sector activities**
**Openess rate, inflation rate, domestic private sector credit above GDP, and government consumption**

# 2. Panel threshold model

- The use of threshold effect panel models to capture the effect of non-linearity and data heterogeneity

- These transitional models that are gradual (PSTR) are more appropriate for describing the evolution of economic phenomena.

**The transition mechanism is triggered by an observable transition variable, a threshold, and a transition function.**

**This study aims to investigate the threshold effect of ICT development on the economic growth.**

**To do so, we apply a panel smooth transition regression model initially developed by González et al. (2005), estimated from World Bank data over the period 2000- 2020 on a panel of 30 MENA and African countries**

$$Y_{it} = \mu_i + \beta_0' X_{it} + \sum_{j=1}^{m} \beta_1 X_{it} G\left(q_{it}, \gamma_j, c_j\right) + u_{it}$$

**Y: The annuel percentage growth rate of real GDP per capita**
**γ is the threshold value to be computed**

$\mu_i$ **est le vecteur des effets fixes individuels**

$X_{it}$ **is a set of control variables including; Trade openness, Inflation rate, Domestic credit to the private sector (% of GDP) and Government final consumption expenditure (% of GDP)**

**$G(qit;\ \gamma,\ c)$is the continuous and normalized transition function and associated with the threshold variable $qit$ (which in our case is the ICT development index), with the threshold parameter $c$ and a smoothing parameter $\gamma$,**

**$\beta 0$ and$\beta 1$ respectively denoting the vector of the parameters of the linear model and of the non-linear model,**

**uit a vector of the error terms iid (0,$\sigma\varepsilon$ 2 )**

- **The signs of the slope coefficients (β1) indicate the direction of the relationship between the explanatory variable and the explained variable based on the transition variable.**

- **A positive sign of (β1) indicates that as the transition variable increases, the associated slope coefficients grow.**

**Idi : ICT Development Index**

**Is the main independent variable is the threshold variable and is the transition variable**

**Trade openness**

**Inflation rate presented by the growth rate of consumer price index**

**The coefficient of trade is expected to have a (+) sign, as it affects economic growth through rising income per capita, considering its effect on telecommunication**

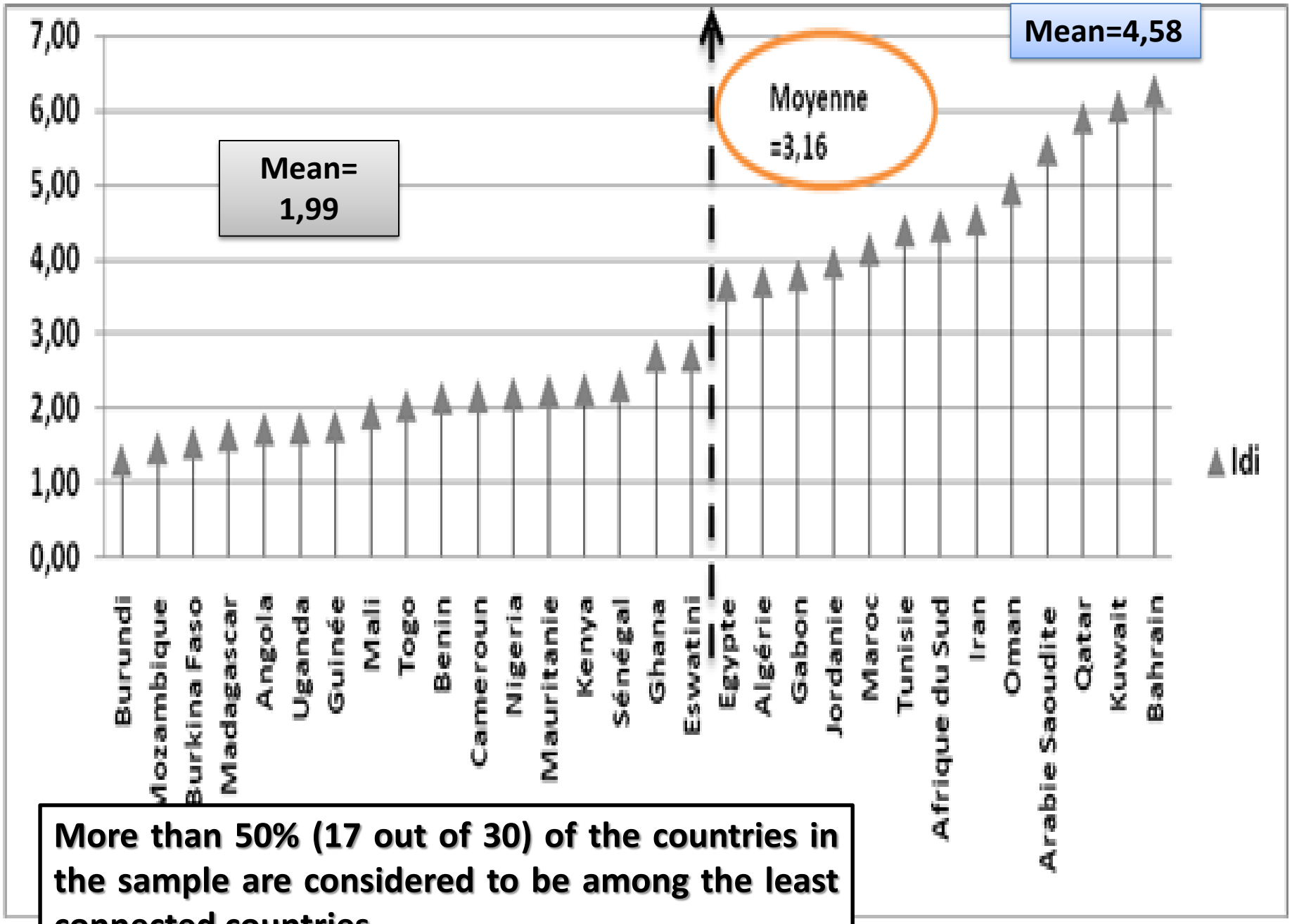
**The coefficient of deflator is expected to be (-) as a high tariff regime is associated with low economic growth**

Domestic credit to the private sector (% of GDP)

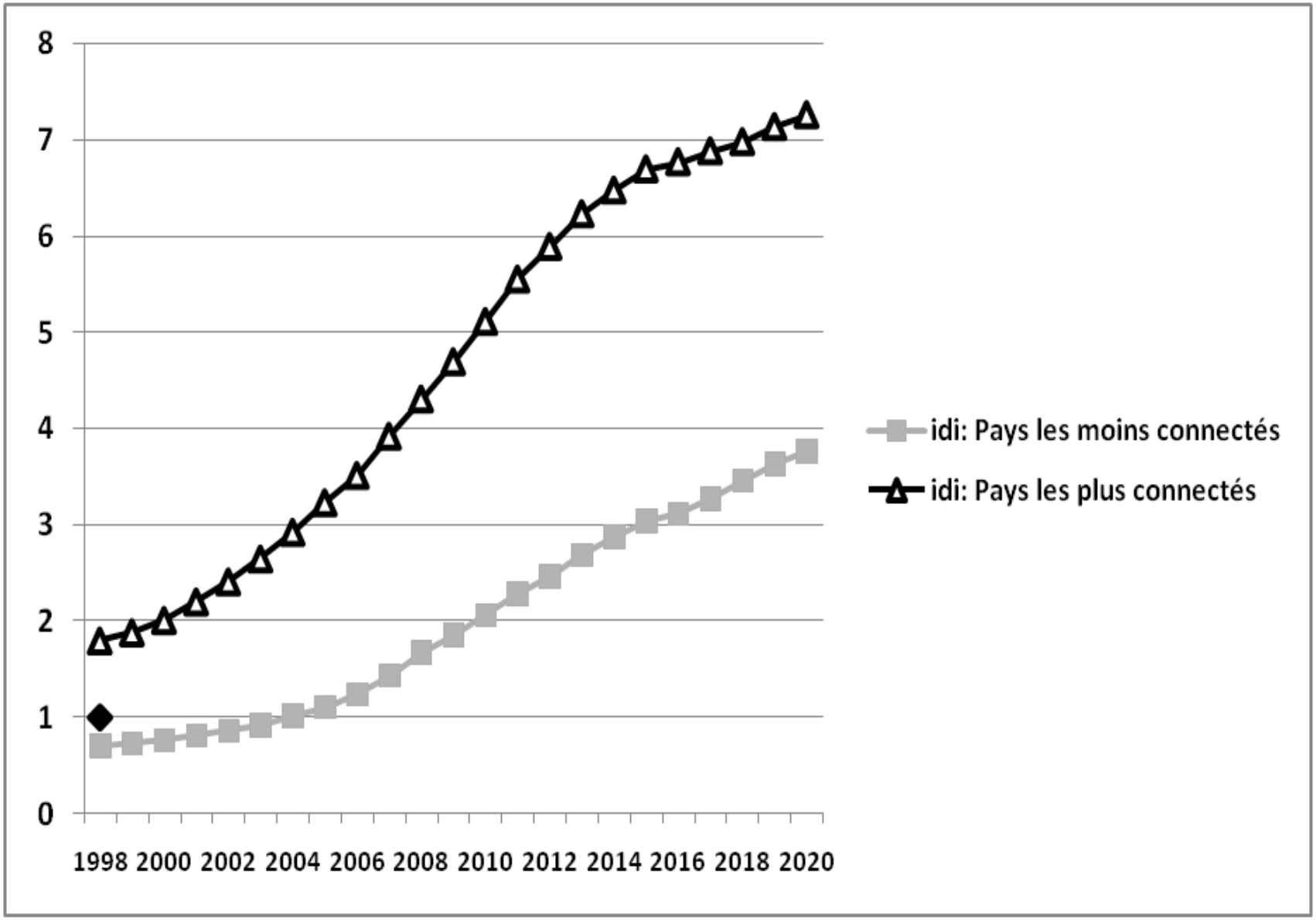
Government final consumption expenditure (% of GDP)

The coefficient of credit is expected to have a (+) sign as a booster to private sector investment

The coefficient of government is expected to be (-) negative as withdrawal to the private sector influences private decisions




**More than 50% (17 out of 30) of the countries in the sample are considered to be among the least connected countries.**


8
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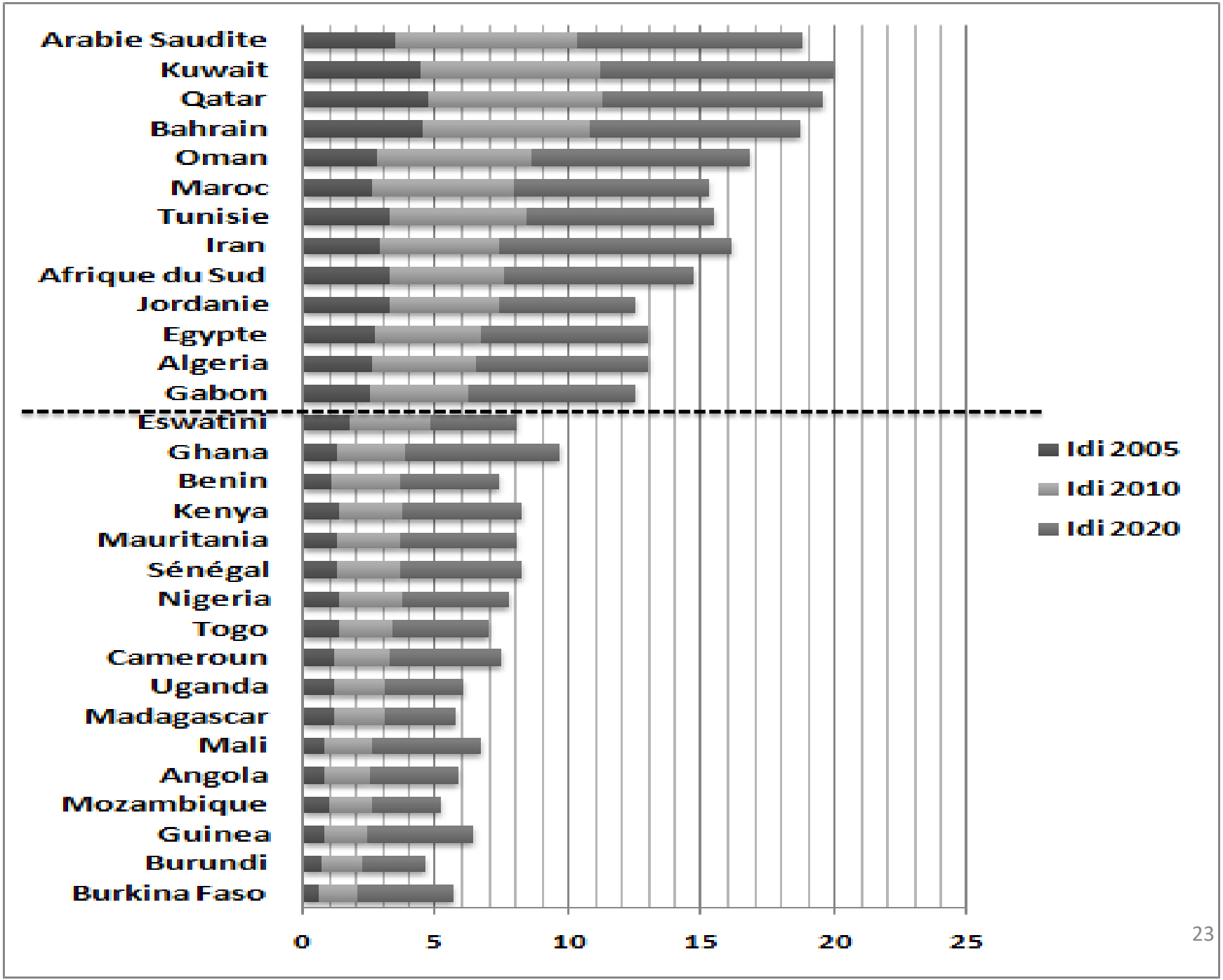
1998 2000 2002 2004 2006 2008 2010 2012 2014 2016 2018 2020
idi: Pays les moins connectés
idi: Pays les plus connectés


Arabie Saudite
Kuwait
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Afrique du Sud
Jordanie
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Ghana
Benin
Kenya
Mauritania
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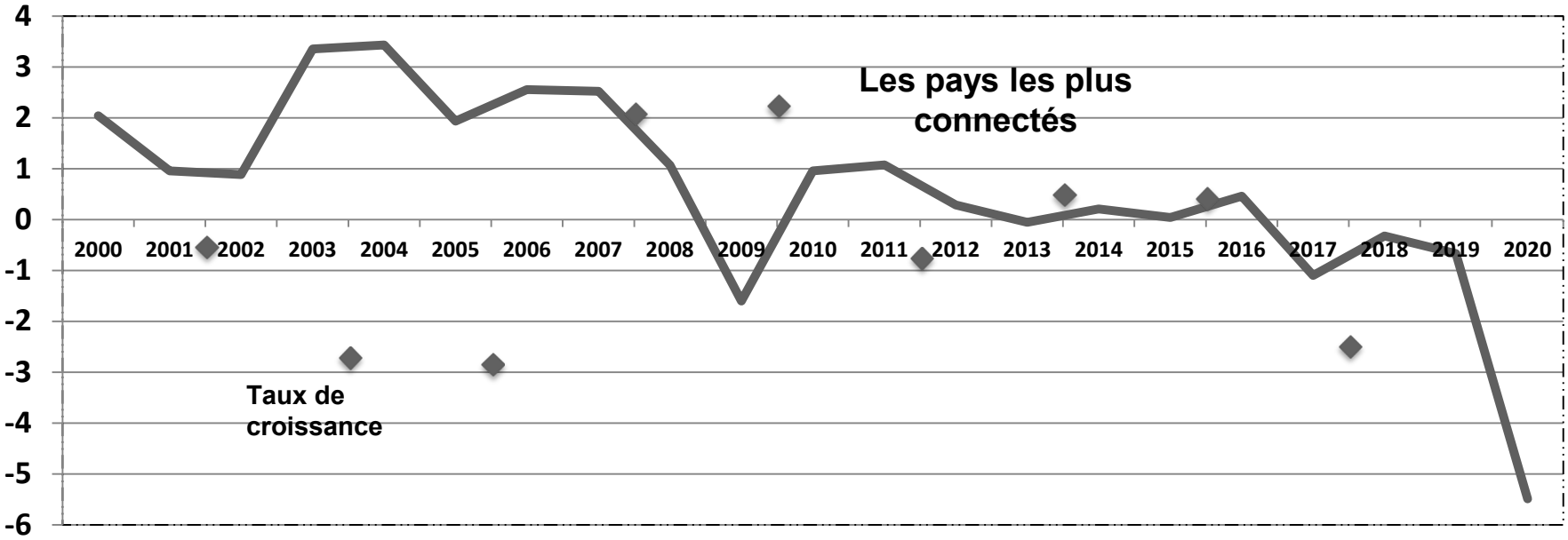
Les pays les plus connectés
Taux de croissance
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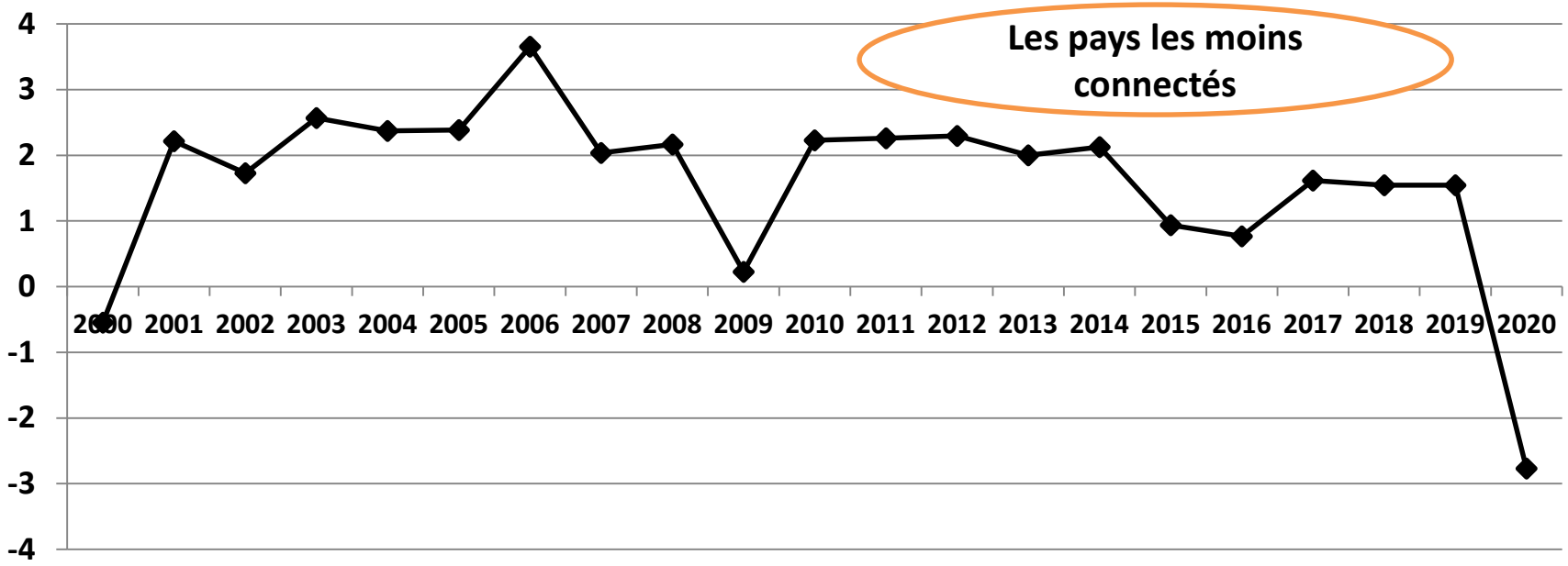
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020


Les pays les moins connectés
4
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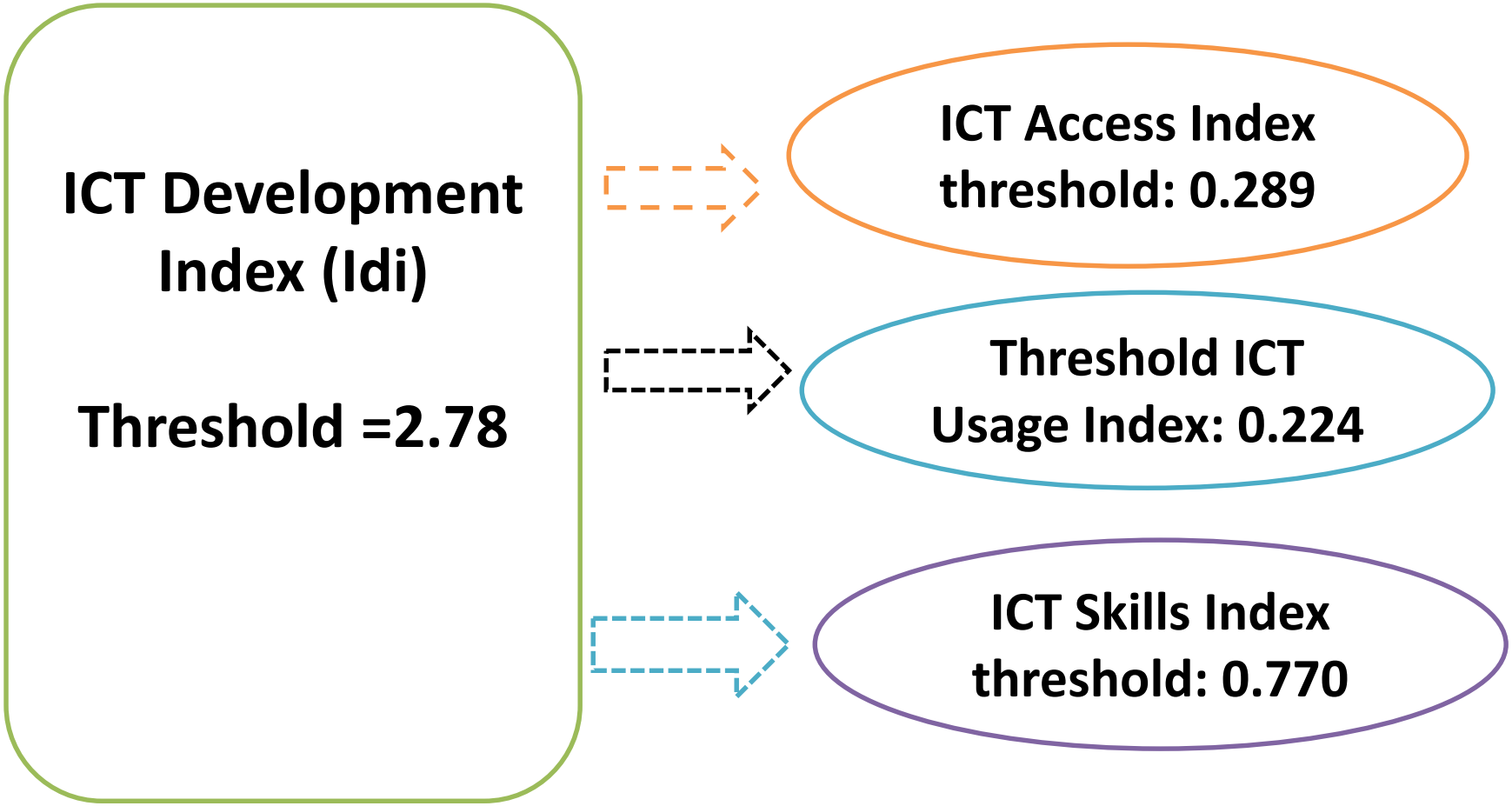
**Dans la première étape, il s'agit de tester le modèle linéaire (H0 :r=0) contre un modèle à effets de seuils avec un minimum d'une fonction de transition (H0 :r=1).**

**Si le modèle linéaire est rejeté, nous testons le nombre de fonctions de transition à admettre dans le modèle. Nous testons d'une manière itérative le nombre de fonctions possibles et la procédure s'arrête quand l'hypothèse alternative est rejetée (H0 :r=i versus H1 :r=i+1) avec (i=1,…r).**

**Dans la troisième étape, nous déterminons le nombre de seuils(m).**

**Enfin, dans la dernière étape nous estimons les paramètres du modèle PSTR par les moindres carrés non linéaires (NLS).**

**The results of the model linearity tests show that the null hypothesis of model linearity is rejected at 1% for m=1 while for m=2, the model is linear.**



## Estimation du modèle PSTR à deux régimes

| dependent variable economic growth | Transition Variable : Idi | | | |
|---|---|---|---|---|
| | Parameters for regime changes | | | |
| | Less connected countries | | The most connected countries | |
| | β0 | β1 | β0 | β1 |
| Inflation | -0.015* | -0.175*** | 0.103* | -0.109 |
| Trade | 0.019*** | 0.064*** | -0.003 | 0.032** |
| Credit | -0.096* | 0,149*** | 0.042*** | - 0.084*** |
| Government | 0.15** | -0.407*** | 0.011 | -0.007 |
| C | 2.36 | | 4.68 | |
| Seuil γ | 2.78 | | 2.78 | |

**The least connected countries**

Above a threshold of 2.78, The openness rate and the credit granted to the private sector have a significant (+) effect on growthA significant (-) relationship is recorded between the inflation rate and government spending and economic growth

**The most connected countries**

Above the threshold of 2.78, economic growth is particularly less sensitive to inflation and government spending. The credit granted to the private sector has a negative influence on economic growth, whereas the openness rate has a positive and significant effect

- Our results show that the effects of Idi on growth through macroeconomic variables are larger in the less connected countries than in the more connected countries.
- This non-convexity has the effect of increasing the country's growth's sensitivity to macroeconomic variables in countries that are less connected.

Conversely, in countries with a high degree of technological advancement, the growth rate is less dependent on changes in macroeconomic variables: inflation and government spending.

**The first hypothesis of this study is verified.**

## Estimation of the PSTR model with two regimes

| dependent variable economic growth | Transition Variable : Idi | | | |
|---|---|---|---|---|
| | Parameters for regime changes | | | |
| | Less connected countries | | The most connected countries | |
| | β0 | β1 | β0 | β1 |
| Inflation | -0.008 | -0.262*** | 0.099 | -0.243*** |
| Trade | 0.010 | 0.063*** | -0.003 | 0.001 |
| Government | 0.026 | -0,266*** | 0.05 | - 0.369*** |
| Idi | 1.39 | 3.7* | 0.343 | 2.02*** |
| C | 2.25 | | 5.02 | |
| Seuil γ | 2.78 | | 2.78 | |

- **The direct impact of ICT development on growth is positive, more pronounced in the most connected countries.**

**the second hypothesis of this study is verified.**

- **The sensitivity of growth to the Idi index is represented by 3.7*g(.) for the least connected countries and 2.02*g(.) for the most connected countries**

# In summury

**1. Despite the remarkable progress and efforts observed in the adoption and diffusion of ICTs in developing countries, particularly in Africa, this study argues that the majority of African countries are still lagging behind in the adoption and use of ICTs**

Only the most connected countries in the sample exceeded this threshold (2.78), namely Bahrain, Kuwait, Qatar, Saudi Arabia, Oman, Iran, South Africa, Tunisia, Morocco, Jordan, Gabon, Algeria and Egypt.

The findings demonstrate that there is a fundamental discrepancy between these two categories of countries regarding the importance of ICT development to economic growth.

**2.** The originality of our study lies in the fact that it shows that the effects of ICT development on economic growth are rather non-linear in African and MENA counries

**3. Beyond a threshold, the development of ICTs influences economic growth in different ways and more particularly according to the availability of ICT infrastructure and the skills to use them**

**4. The direct effects of Idi on growth are greater in the more connected countries than in the less connected countries.**

**5. Investment in infrastructure and modernization of the education system are among the main pillars on which the digital strategy must be based.**

**Policymakers must work together to build the ICT infrastructure and develop the ICT skills needed to foster inclusive economic growth and enable more people to access a multitude of services.**

# Indice de développement des TIC , Idi

40%

Accès aux TIC

40%

Utilisation des TIC

20%

Compétences en TIC

**1. Abonnements au téléphone fixe pour 100 habitants**
**2- Abonnements au téléphone mobile par 100 habitants**
3- Bande passante Internet internationale (bits/s) par utilisateur d'Internet
4- Pourcentage de ménages avec un ordinateur
5- Pourcentage de ménages ayant accès à Internet

**6 - Pourcentage de personnes utilisant Internet**
7 - Abonnements fixes à large bande pour 100 habitants
8 - Abonnements mobiles à large bande pour 100 habitants

**9 - Taux d'alphabétisation des adultes**
**10 - Taux brut de scolarisation secondaire**
**11 - Taux brut de scolarisation supérieure**