

Technology Climate of Algeria: Comparative Study (2008-2019)

Nassira Aoudia, Full time lecturer, University Center of Tipaza (Algeria),
aoudiaa.nassiraa@gmail.com*

*Ayoub Asri, Full time lecturer, Higher National School of Applied Statistics and Economics
(Algeria), asri.ayoub@enssea.edu.dz*

Received: 30/05/2023

Accepted: 22/08/2023

Published: 28/12/2023

Abstract:

This study assesses Algeria's technology climate, as measured by the Frontier Technology Readiness Index developed by the United Nations Conference on Trade and Development (UNCTAD). This index comprises ICT, skills, R&D, industry activity and access to finance. Giving the importance of digitalization in economic growth, this study answers the query of the technology climate in Algeria. It analyzes its positions in global, African and regional scales over the past decade, from UNCTAD data. The results reveal its poor technology climate. This study aims to explore the reasons behind its low rankings. It implicates the need to revise the Algerian economic growth model including technological factors.

Keywords: technology; innovation; skills; R&D; industry.

Jel Classification Codes: O140, O300, O550

*Corresponding author.

1. INTRODUCTION

Technology is very sensitive to time. Day to day, its evolution is both huge and unpredictable. Inventors (or entrepreneurs?) in technology (and other sectors) deals with what Joseph Schumpeter calls the “creative destruction”. There is a link between technology and innovation.

The definition of innovation according to Oslo Manual distinguishes between the four (04) following types of innovation: -product innovation, which involves introducing a new or significantly improved good or service with enhanced characteristics or intended uses, including notable advancements in technical specifications, components, materials, incorporated software, user-friendliness, or other functional aspects;- process innovation, which encompasses the adoption of a new or significantly improved production or delivery method, including substantial changes in techniques, equipment, and/or software;-marketing innovation, which entails the implementation of a new marketing approach with significant alterations in product design or packaging, product placement, product promotion, or pricing;-and organizational innovation, which involves implementing a new organizational method in the firm's business practices, workplace organization, or external relations.

The Oslo manual considers, in its innovation surveys, information about inputs, outputs and the behavioral and organizational dimensions of innovative activities of a firm. On the input side, innovation surveys measure a firm's intangible assets, which include, beyond R&D expenditure, spending on training, acquisition of patents, product design, trial production, and market analysis. As for the output side, data are collected on whether an enterprise has introduced a new product or process, the share of sales due to significantly changed or new products (“new” can mean new to the enterprise, new to the market or new to the world)(Organisation for Economic Co-operation and Development (OECD), 2009, pp. 11-12).

According to this definition, technology as related to software, is a kind of product innovation and process innovation. Organizational innovation has an impact on these two kinds as it includes investment in intangible assets, such as R&D, training and ICT. From this point of view,

it can be distinguished between technological (product, process) and non-technological (marketing, organizational) innovation, two concepts highlighting by OCDE (Organisation for Economic Co-operation and Development (OECD), 2009, p. 15).

Technology can be considered as an independent activity but also as a mean for improving other activities. In both cases, a country needs to have a certain threshold for conditions to get ready to innovate in technology, say “technology climate”.

The United Nations Conference on Trade and Development has developed the frontier technology readiness index: “It includes technological capacities related to physical investment, human capital and technological effort, and covers national capacities to use, adopt and adapt these technologies” (UNCTAD). More specifically, it is divided into five (05) “building blocks”: ICT deployment, skills, R&D activity, industry activity and access to finance (UNCTAD).

The importance of these technology “building blocks” has been reported by the economic literature which explains and measures their effects on economic growth. May be we can consider ICT deployment as technological change (Solow, 1956, pp. 65-46); skills as learning by doing (Arrow, 1962, pp. 155-173), knowledge (Romer, 1986, pp. 1002-1037), human capital (general skills level) (Lucas, 1988, p. 17) and human investments including education and training (Barro, 1988) (Barro, 1990, p. 105); R&D activity as “research technology producing new knowledge” or “investment in knowledge” (Romer, 1986, p. 1003) and as a consequence of human investments including education and training (Barro, 1988) (Barro, 1990, p. 105); and access to finance as government expenditure (Barro, 1990, pp. 103-125).

Thus, given the theoretical and empirical importance of issue of technology, this study aims to compare the “technology climate” of Algeria to some geographic areas (world, Africa, North Africa) for the period 2008-2019.

The main question of this study can be formulated as follows. How Algeria is ready for technology? Three research questions can be noted as follows:

-What is the position of Algeria in global, African and regional scales during the last decade?

-What is the poorest building block of technology climate in Algeria comparing to African countries?

-What are the main reasons which explain the poor ranking of Algeria in terms of technology climate?

These questions have been aroused the interest of researchers in Algeria and about Algeria. We can mention the following researches:

-“Algeria in economy of knowledge: What place?”(Written in French). It evaluates the position of Algeria in terms of knowledge economy based on two indices: Knowledge Economy Index (KEI) and Knowledge Assessment Methodology (KAM) which register, each one of them, a value around the half (5/10) (Bouredjan & Touta, 2020, pp. 288-299);

- “The Knowledge-Based Economy (KBE): A Lever for the Emergence of the Algerian Economy” (writing in French). It highlights some statistics related to knowledge economy. In fact Algeria spent only 0.76% of its GDP in R&D against 0.98% for Morocco, as reported by Beddi Boumediane (Godih & Lazreg, 2020, p. 303);

-“Development of the knowledge economy in Algeria and inflection growth model”(written in French). It discusses the question of the development of knowledge economy. It illustrates one (01) building block of the frontier technology readiness index: R&D activity. In actuality, R&D in Algeria represents less than 1% of GDP since 1998, and only 2% of patents are registering by universities and research centers, in 2010(Bouacida & Haudeville, 2015, pp. 105-106).

The plan of this study is as follows. It will begin with an explanation about methods and materials about measuring technology climate in Algeria with international comparisons. Next, it will give the results about the comparative state of technology climate of Algeria. Finally, it will turn to a discussion of what has been arrived at and of what is yet to be done.

2. Methods and Materials

2.1 Data collection and software

In order to avoid conceptual problems, we exploit one data website, which is the United Nations Conference on Trade and Development Data center (UNCTAD). The data analysis method relies on descriptive analysis. The results are illustrated in figures using the R software.

2.2 Data procedure

The principal variable is the “Frontier technology readiness index” developed by UNCTAD: an index value closer to one indicates that a country is ready for the use and adoption of frontier technologies. On the contrary, an index value closer to zero indicates that a country is less ready.

In this paper, we do not discuss the methodology of this indicator; we limit it in determining the big lines of its definition. The overall index is comprised of indices of the following five (05) “building blocks”: ICT deployment, skills, R&D activity, Industry activity and access to finance.

According to the same source: -ICT deployment is the level of ICT infrastructure. This becomes important, especially since Artificial intelligence (AI), Internet of Things (IoT), big data and blockchain are internet-based technologies; -Skills refer to equipped people with relevant skills. This indicator need to be interpreted with caution, especially in developing countries, because of the emigration of highly trained or skilled people, the “brain drain”, as a result of which the actual skill level could be lower than the official estimate; -R&D activity is essential for the production of frontier technologies, adoption and adaptation of technologies; -Industry activity considers three sectors that are early adopters: manufacturing, with high-tech manufacturing as the frontrunner; finance; and ICT; -and Access to finance assesses the availability of finance to the private sector (UNCTAD).

The analysis of this variable and its “building blocks” for Algeria and the geographic areas selected is explained in four (04) steps. In the first step, we establish a ranking from the best performance to the worst one in terms of overall index of technology readiness and its five (05) building blocks (ICT, Skills, R&D, Industry activity and Access to finance) for all

the countries, highlighting Algerian, Moroccan, Tunisian and South Korean positions. In sum, 158 countries are concerned by this analysis for which data are available for the year 2019. The second step consists in establishing rankings in an African scale, by the same method and goals. In total, 41 African countries are concerned by this analysis for the year of 2019. The performance of Algeria in 2019 is the subject of our third step compared to some regional African countries like Morocco and Tunisia and to non-African country like South Korea. The selection of these three (03) countries is explained by two (02) reasons. The first reason is geographical; we want to know whether geography affects the economy. The second reason is a historical; we measure the technological “gap” between Algeria and South Korea that started their first industrial strategies at the same time, with the same level of GDP. The fourth and last step examines whether Algeria has improved its performance since 2008.

The period of study encompasses all the data published by UNCTAD, with the initial year of observation being 2008 and the final year being 2019. However, we have selectively chosen specific years of observation for each step of the data procedure elucidated earlier. For all the global ranking, we observe the results only for the last year (2019). The same observation above is applied for the African ranking. As for the individual comparisons, we calculate the mean of each “building block” of technology readiness, for the following sub-periods: 2008-2009, 2010-2014, 2015-2017 and 2018-2019. For the whole data availability period (2008-2019), Algeria's technological performance evolution has been observed through yearly observations.

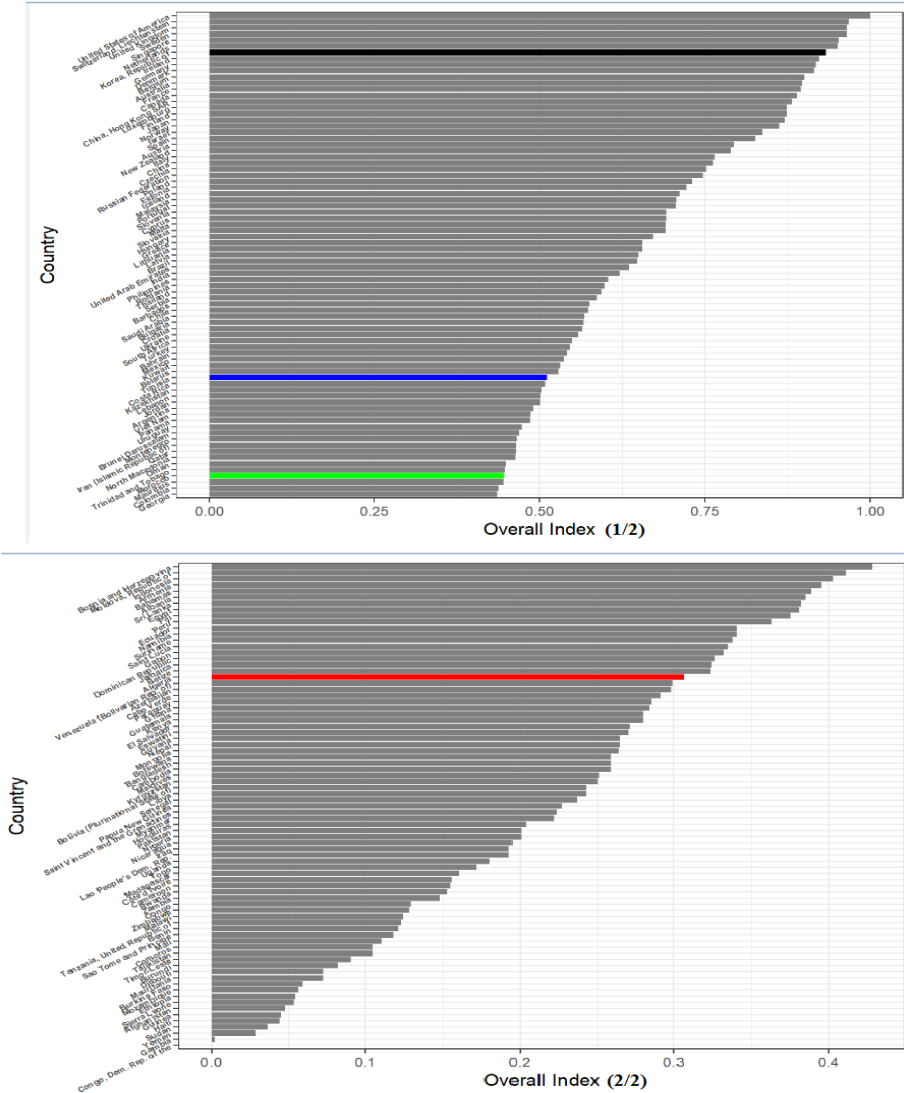
3. Results and discussion

3.1 The place of Algeria in global and African scales: 2019

We exhibit the results, first, at the global level, and then, at the African level as follows.

-Overall, Algeria is scored 98 while South Korea, Tunisia and Morocco are ranked 07, 60 and 76, respectively. The USA heads the list (Fig.1). The Algerian overall index is the result of the combined effects of its constituent parts, each of which will be examined separately.

Fig.1. Frontier technology readiness index, overall index, World: 2019

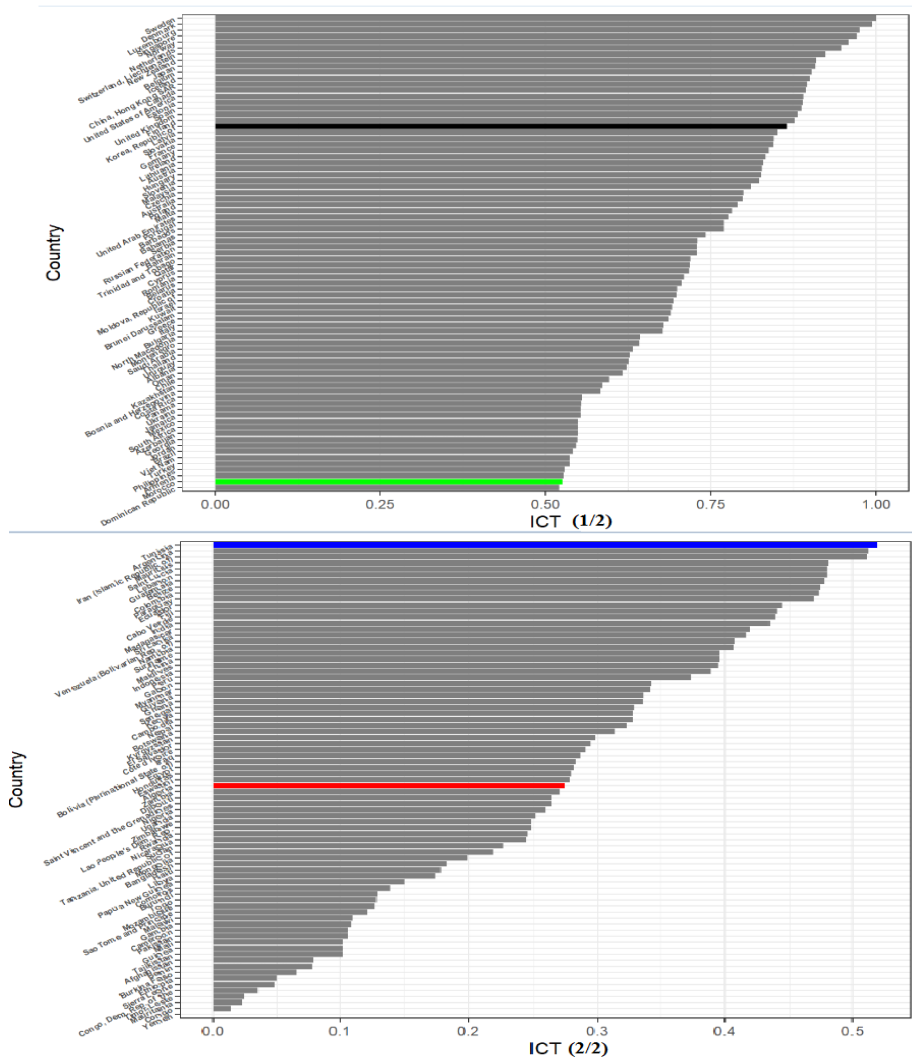


Source:Aoudia and Asri, 2023

-As for ICT, Algeria occupies the 120th rank against the 19th for South Korea, the 78th for Morocco and the 80th for Tunisia. Sweden is the 1st (Fig.2). Although the ICT sector is interconnected with other economic sectors in a way that improves their performance, it is a separate industry whose traded goods and services can be measured. The importance of TIC services increases in the internet era. However, Algeria is falling short in

terms of TIC service exports, as defined by UNCTAD in a 2015 in its Technical Note Development” (UNCTAD, 2015) as computer and telecommunications services. In actuality, South Korea, Morocco, and Tunisia hold the 20th, the 43rd, and the 71st spots in terms of the global proportion of ICT service exports, respectively. Algeria is considerably behind the North African nations, ranking 101st out of 155.

Fig.2.ICT, World: 2019

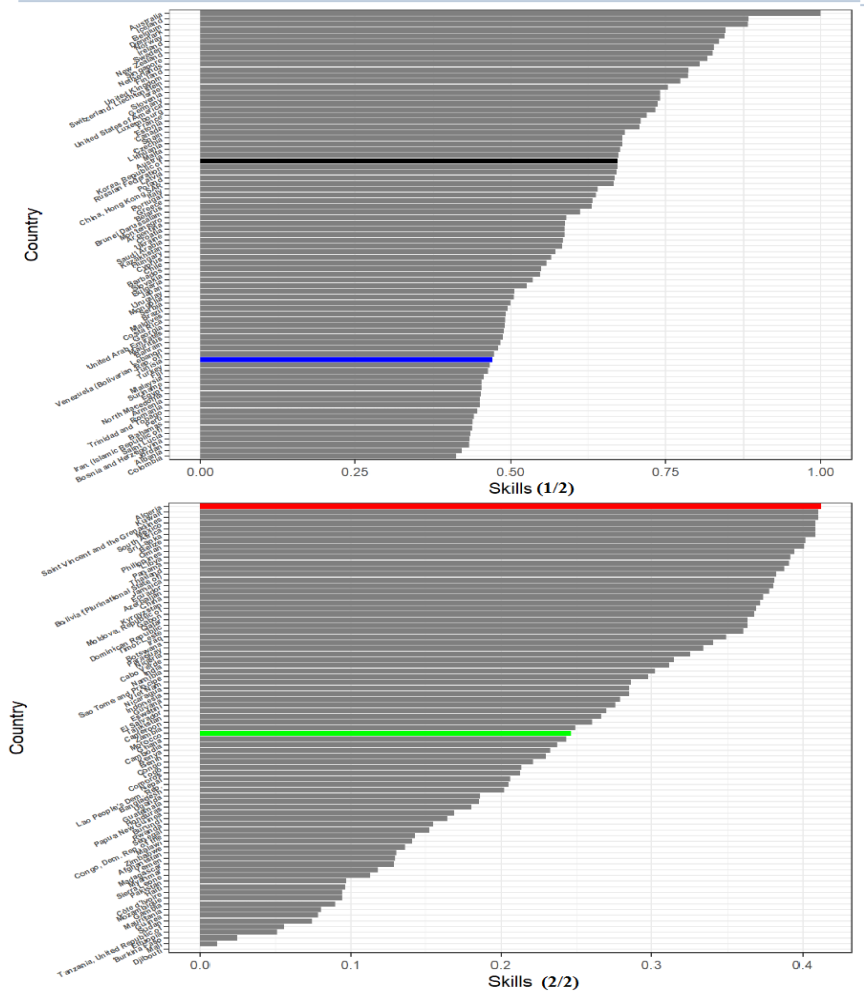


Source:Aoudia and Asri, 2023

-Concerning skills, Algerian performance (80/158) is better than Moroccan one (120/158) but worse than those of South Korea (27/158) and

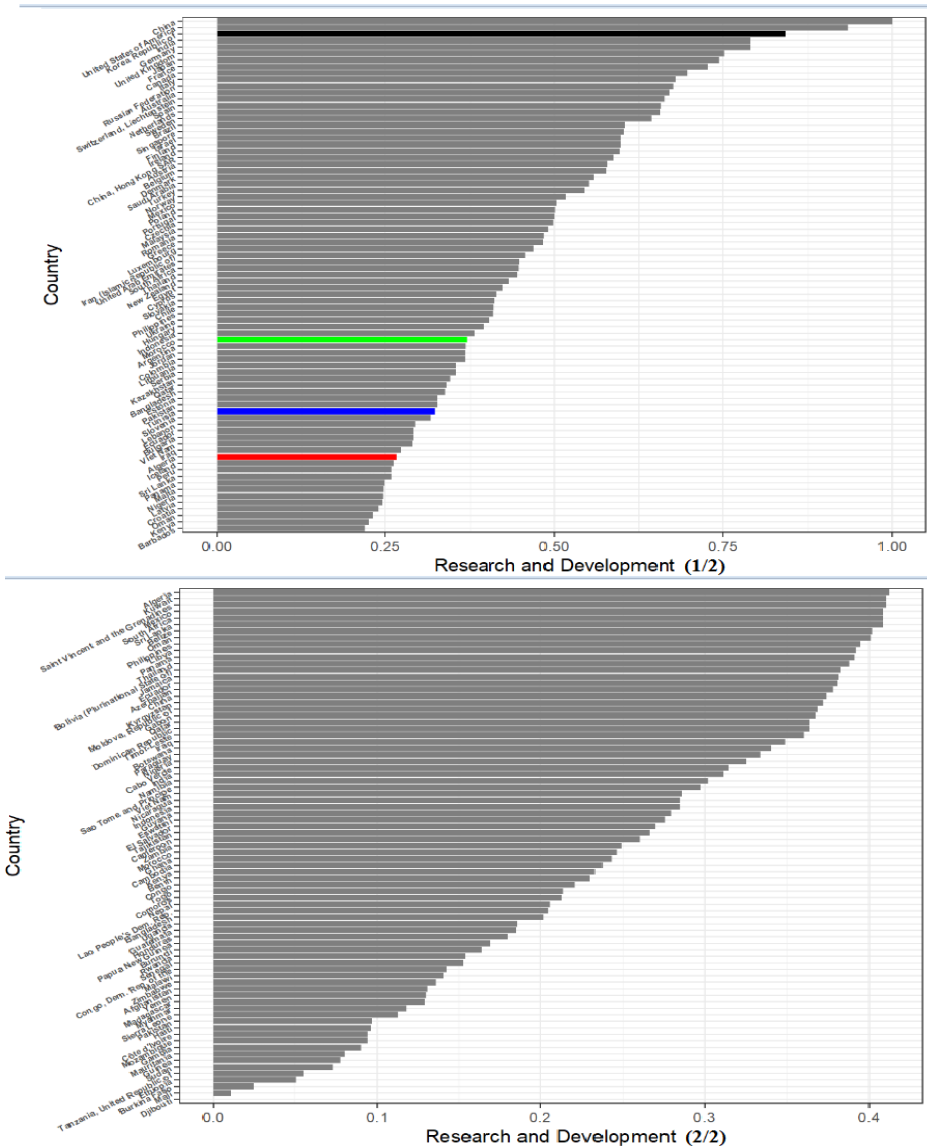
Tunisia (62/158). Australia registers the best performance (Fig.3). According to the International Labor Organization (ILO) in the context of African countries, a skills gap can be partially explained by the weakness of the role of social partners and public–private partnerships (PPPs), the poor quality apprenticeship and the underdevelopment of labor market information systems (State of Skills - Country briefs, 2020).

Fig.3. Skills, World: 2019



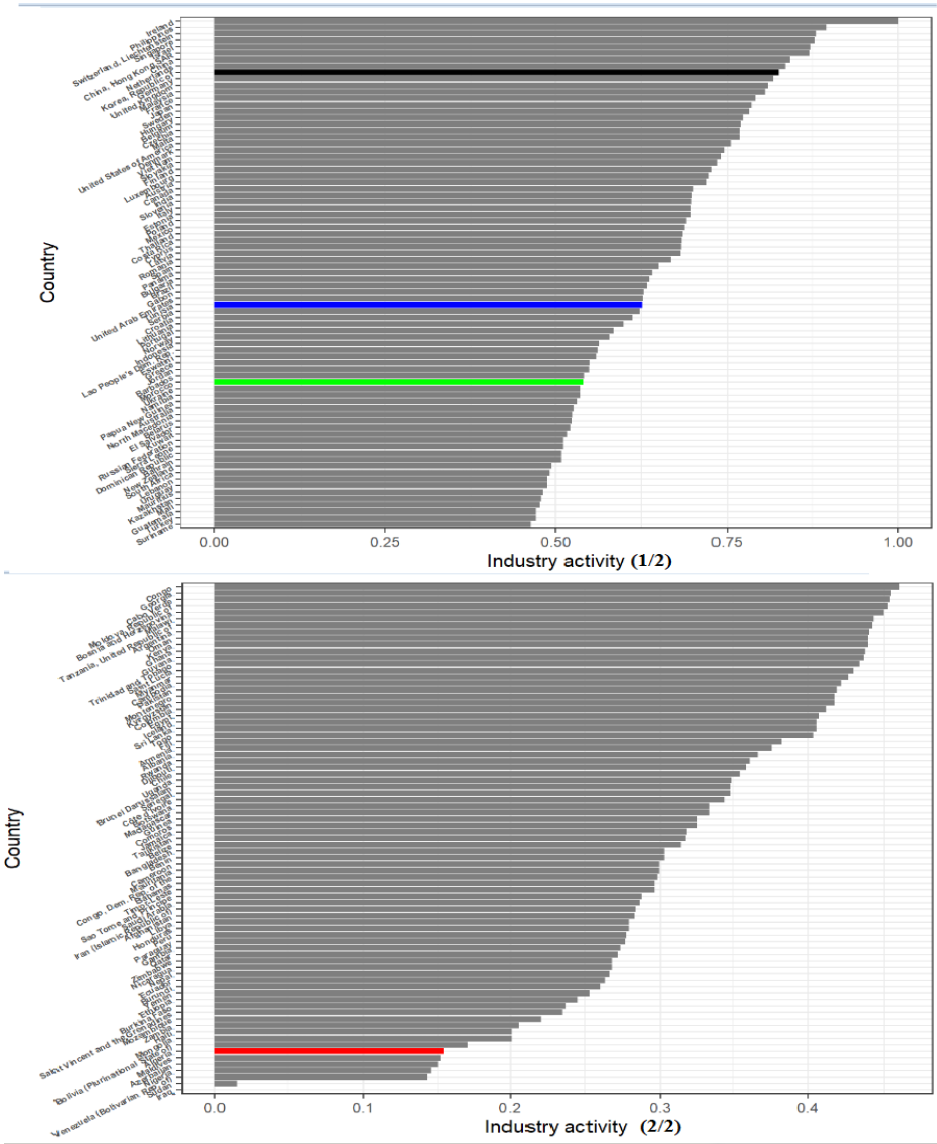
Source:Aoudia and Asri, 2023

-In R&D, Algeria registers the 68th rank against the 3rd for South Korea, the 50th for Morocco and the 61st for Tunisia. China is in the 1strank (Fig.4). This is significant since, according to World Bank data, China, the



Causes range from internal factors like the business climate (157 out of 190 in 2020) (World Bank, 2020, p. 4) to external factors like competition from developed and developing countries.

Fig.5.Industry activity, World: 2019

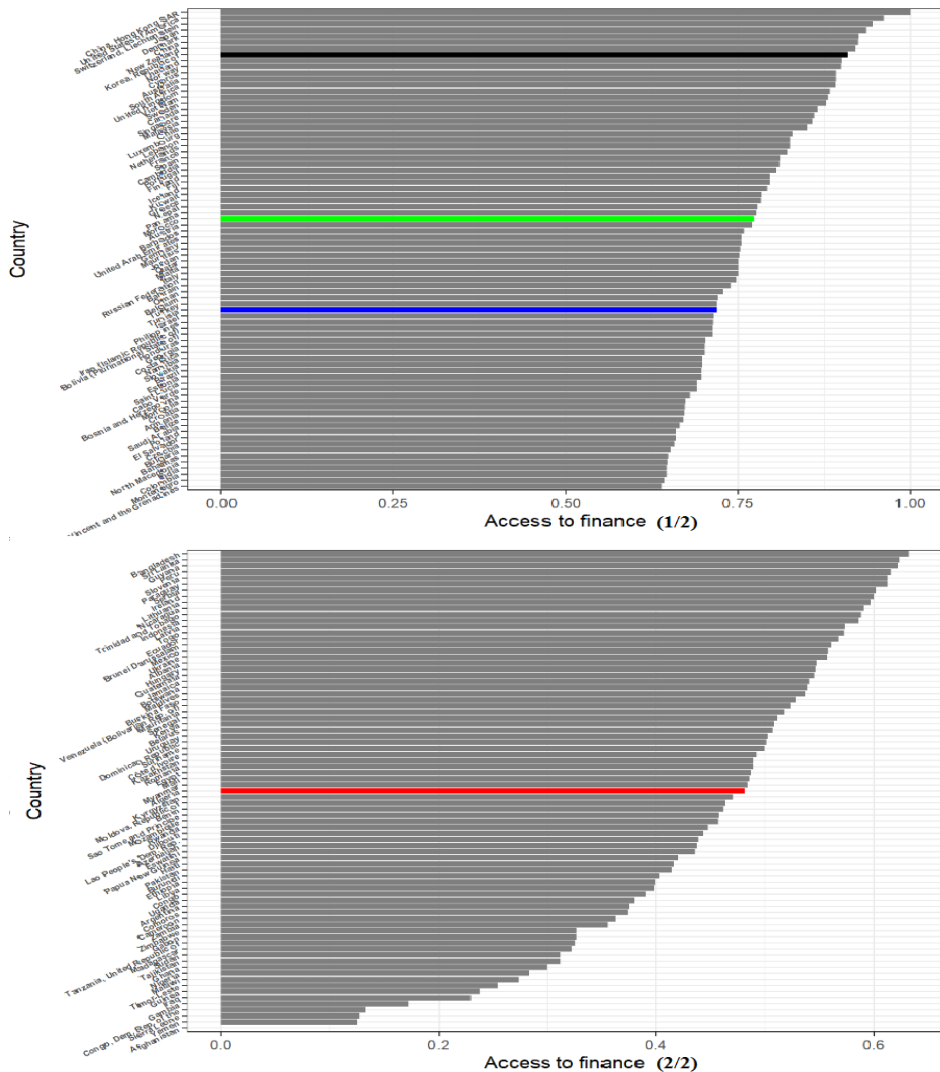


Source:Aoudia and Asri, 2023

-Access to finance in Algeria is too far from the regional mean: 119 against 50 for Tunisia and 35 for Morocco. South Korea is well ranked (8). Hong Kong is the leading the global list (Fig.6). On 2019, Algeria ranked 178 out of 190 countries on the World Bank's Doing Business indicator for

"getting credit," compared to South Korea's 60, Morocco's 112, Tunisia's 99, and South Korea's 60. Below is an explanation of the structure of this indicator (World Bank, Doing Business 2019, 2019, pp. 153,181, 190,210).

Fig.6.Access to finance, World: 2019



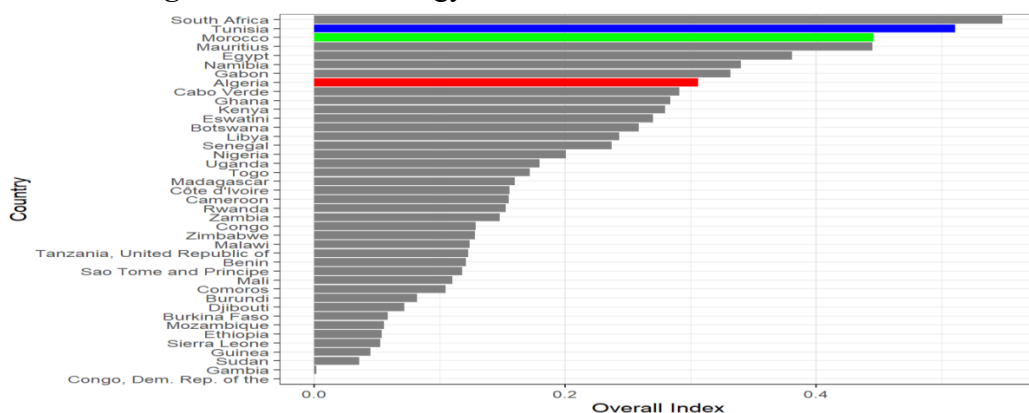
Source:Aoudia and Asri, 2023

Concerning the African level, the same method is adopted. We will compare the Algerian performance in technology to African countries, including regional African countries specifically Morocco and Tunisia.

-In terms of the overall index, Algeria is ranked 08 against 02 for Tunisia and 03 for Morocco. South Africa holds the top spot (Fig.7). Below,

we'll provide a brief explanation.

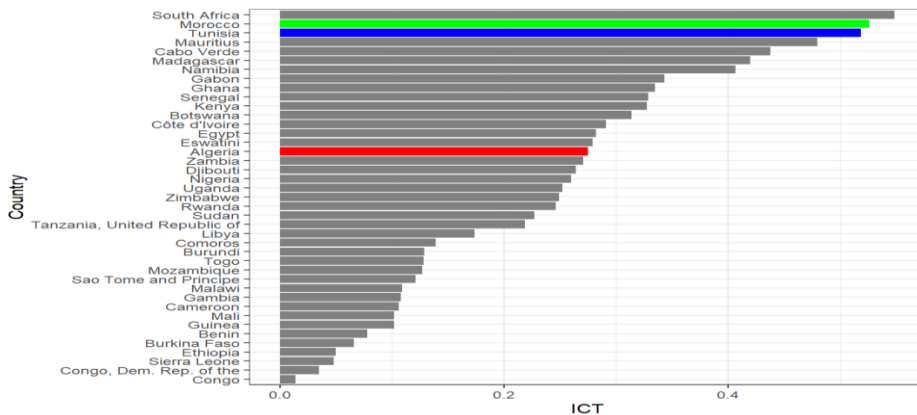
Fig.7.Frontier technology index, overall index, Africa: 2019



Source:Aoudia and Asri, 2023

-As for ICT, Algeria occupies the 16th rank against the 2nd and 3rd ranks for Morocco and Tunisia, respectively. South Africa is the 1st (Fig.8). In the real sphere, Algeria is not competitive in exporting ICT services to Africa according to the UNCTAD data. In fact, Morocco is ranked 1st, followed by Egypt (rank 2) and Tunisia (rank 4). Algeria is ranked 16th out of 44.

Fig.8. ICT, Africa: 2019

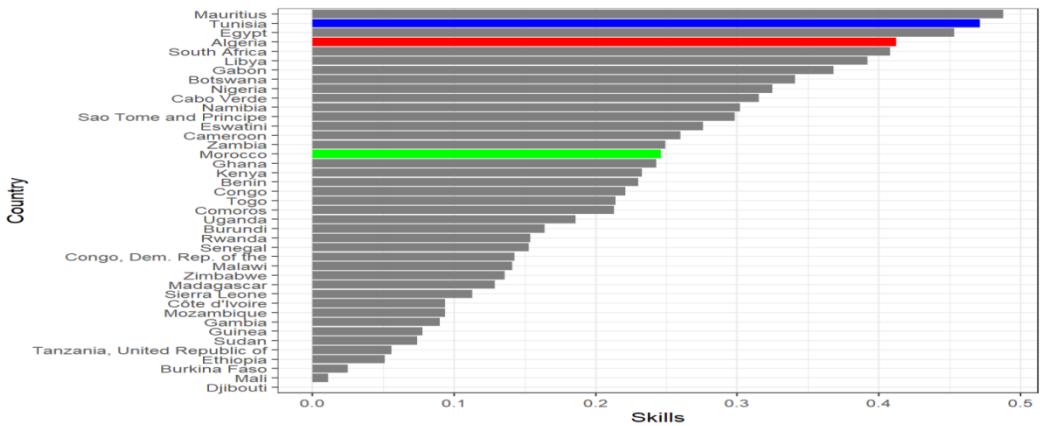


Source:Aoudia and Asri, 2023

-Algeria's performance in terms of talents is better than Morocco's (16), but poorer than Tunisia's (02). Mauritius heads the list (Fig9). According to ILO, a skills deficit requires a list of crucial recommendations including adopting “innovative” approaches; skills anticipation and monitoring; coordinating and prioritizing investment in skills development; and increasing work-based learning programs (State of Skills - Country

briefs, 2020).

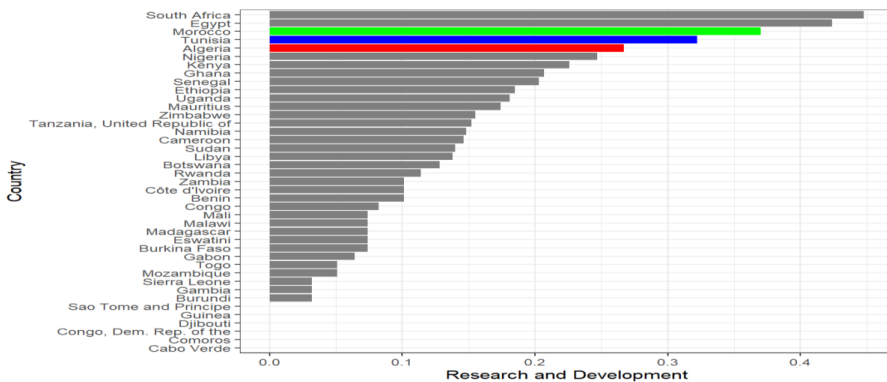
Fig.9. Skills, Africa: 2019



Source:Aoudia and Asri, 2023

-In R&D, Morocco, Tunisia and Algeria register the 3rd, 4th and 5th places, respectively. South Africa occupies the 1st place (Fig10). Scientific works demonstrate that there is a positive relationship between the enterprises size and R&D (Anderson & Kindlon, 2019). In the light of this fact, it is noteworthy that 97.58% of Algerian companies employ fewer than 10 employees (Ministry of Industry, Small and Medium-sized Enterprises, 2022).

Fig.10.R&D, Africa: 2019

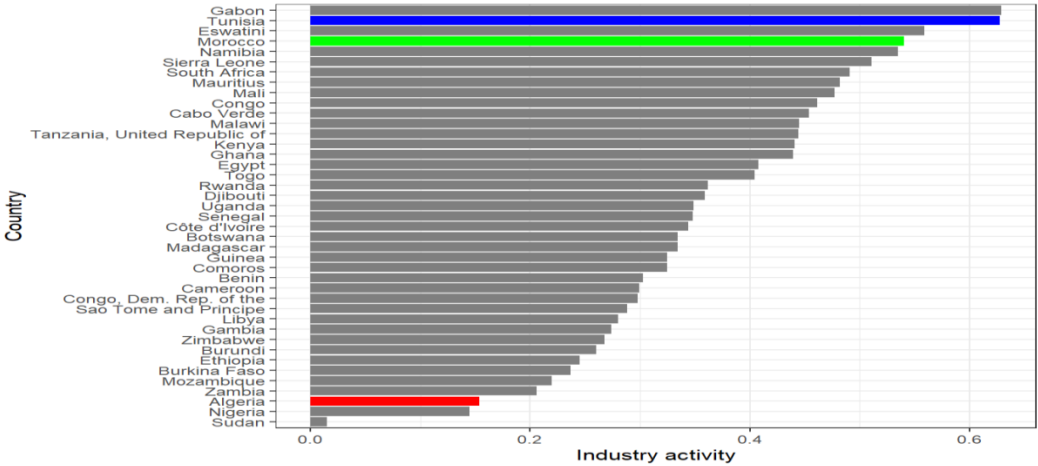


Source:Aoudia and Asri, 2023

-The Algerian industrial state is among the poorest ones: 39 out of 41, against 4 for Morocco and 2 for Tunisia. Gabon is the most industrialized African country (Fig.11). The State has abandoned any real industrialization attempt since 1986. In addition, the private sector cannot be promoted given

Algeria's 157/190 raking in the ease of doing business in 2020 compared to 5 out of 190 for South Korea (World Bank, Doing Business 2020, 2020).

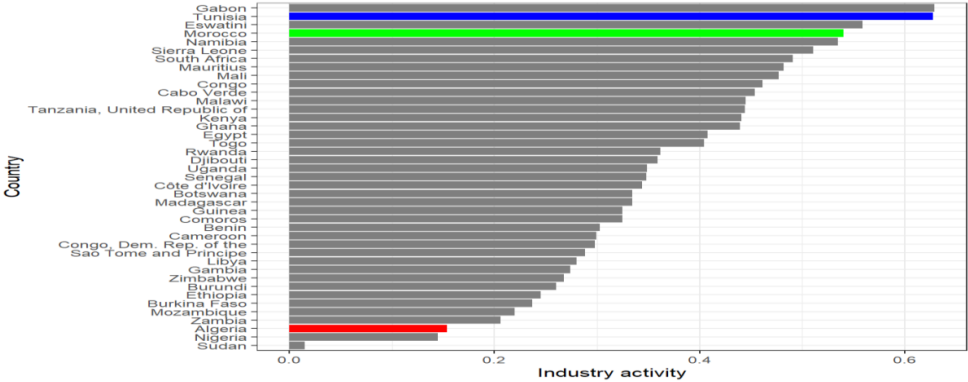
Fig.11.Industry activity, Africa: 2019



Source:Aoudia and Asri, 2023

-Access to finance in Algeria is at 14th rank. Tunisia registers the 4th rank. Morocco is the 2nd. South Africa heads the continent (Fig12). The evaluation of the financial climate by the World Bank shows that the depth of credit information index is null, compared to Morocco and Tunisia's 7/8 and South Korea's full score (World Bank, Doing Business 2019, 2019).

Fig.12.Access to finance, Africa: 2019



Source:Aoudia and Asri, 2023

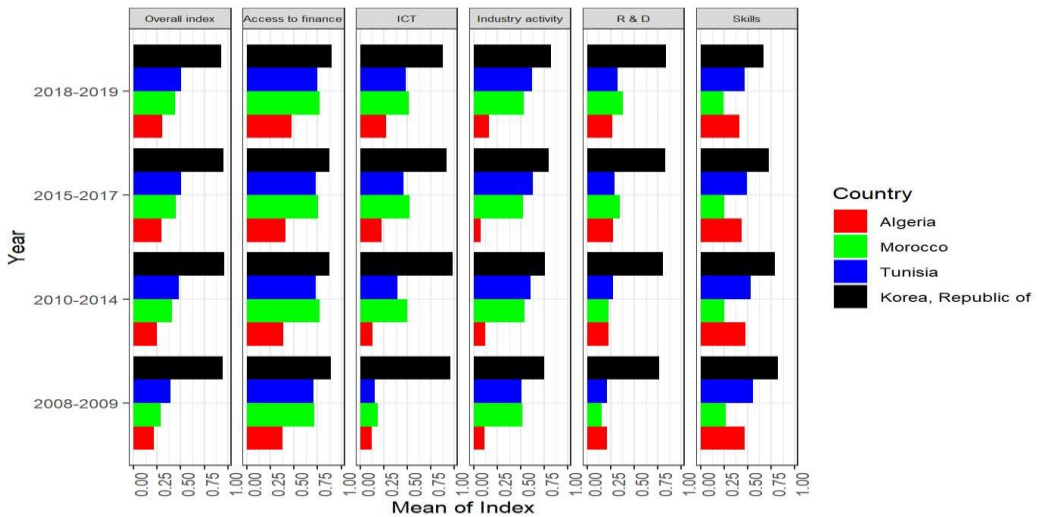
3.2The evolution of technology climate of Algeria: spatial and temporal comparisons (2008-2019)

In this point, we compare, first, the Algerian performance in

technology to those of Morocco, Tunisia and South Korea, for the period 2008-2019. Then, we compare the Algerian technology climate to its self, in a historical perspective to find out if there is a remarkable evolution, and conclude that there is not. The results are the following:

-Algerian skills level is better than Moroccan one for all the period. Same observation goes to R&D for only the period 2008-2009. Algerian performance in others technology “building blocks” is the worst one, especially for industry activity. For the overall index, skills and industry activity, Tunisia performs better than Morocco. For the rest of the building blocks, Morocco is better for the last period 2018-2019. South Korea ranked highest in all climate technology components, during the research period (Fig.13). It is challenging to identify and explain both the strong and weak technological aspects at the same time in this comparison study.

Fig.13. Frontier technology readiness index and its building blocks, Algeria, Morocco, Tunisia and South Korea: 2008-2019

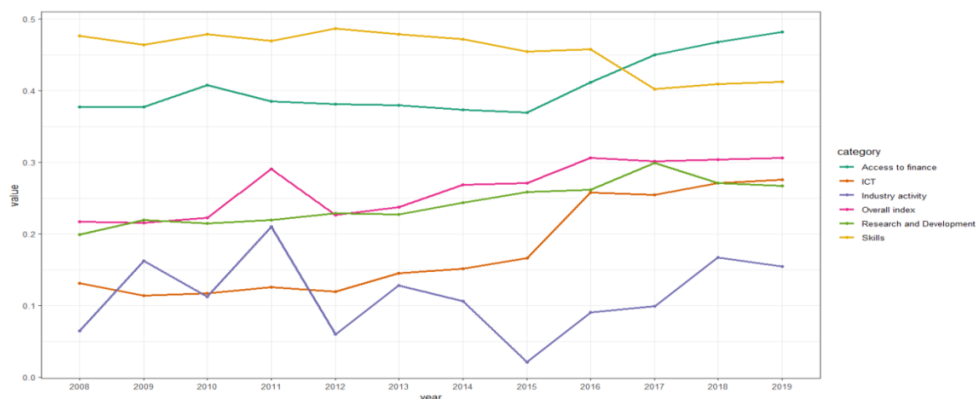


Source: Aoudia and Asri, 2023

-Algeria had not improved its technology climate during the period 2008-2019. The overall index and the best value for all its blocks is less than the mean (0,5). The overall index had registered a poor evolution during the period 2008-2016, from 0,22 to 0,31, with a trend of stagnation since 2016 to 2019, under the combined effect of increasing values (Access to finance, ICT) and decreasing ones (Skills, R&D). Industry activity in the bottom of

the list. It had fluctuated between 0,1 and 0,2! Algeria had been witnessing “brain drain”(Fig.14). It may be assumed that the Algerian technological climate had probably improved during this study period, but less significantly than the combined effect of the other countries. This “optimist” hypothesis is nevertheless negative in the sense that Algeria had not make sufficient effort.

Fig.14.Frontier technology readiness index and its building blocks, Algeria: 2008-2019



Source: Aoudia and Asri, 2023

4. CONCLUSION

The "technology climate" of Algeria is not favorable. We have investigated this question using data about frontier Technology readiness index which is structured in five (05) buildings blocks (ICT, Skills, R&D, Industry activity and Access to finance) developed by UNCTAD. We determined the place of Algeria in African and global scales. Besides, we observed the evolution of Algeria in technology readiness since 2008 to 2019.

Based on the analysis, we have concluded the four (04) following facts about the Algerian technology readiness. First, Algeria is not well ranked in international and African levels (98/158; 08/41) and far behind its geographic neighbors (Morocco (76/158; 03/41) and Tunisia (60/158; 02/41)). Second, comparing to South Korea, Algeria had been registering a huge “technology gap”, (07/158), in the light of their historical industrial strategies. Third, Algeria was not well improving its technology readiness from 2008 to 2019. Fourth, “Industry activity” was scored in the bottom of

the global list (152/158) and in the African list (39/41).

It is not easy to present a roadmap to improve the technology climate in Algeria: is it a top-down reform (Government, Universities and research centers)? Or a bottom-up reform (society and family boundaries)? Alternatively, both of them? Another question that could be interesting to the young generation: How time Algeria will take to change its technology climate?

We do not have answers to the questions we have asked. All what we may assume is that Algerian inventors in technology are generally tending to seek an external solution which consists in moving into countries which are already well ranked in this subject, such the United State of America (01/158). This assumption is argued in some negative statements from Algerian inventors stating: “we would never have done anything if we had stayed in Algeria”. As for the present, the connection between having the brilliant brain and seeing its concrete results is absent in Algeria. In concrete terms, the “Skills” indicator was witnessing a negative evolution during this study: the brain drain hypothesis.

5. Bibliography List :

1. Journal articles :

- Arrow, K. J. (1962, 06). The Economic Implications of Learning by Doing. *Review of Economic Studies*, 29(3), 155-173.
- Barro, R. J. (1990). Government spending in a simple model of endogenous growth. *Journal of Political Economy*, 98(5), 103-125.
- Bouacida, R. Y., & Haudeville, B. (2015). Développement de l'économie de la connaissance en Algérie. (E. b. Review, Ed.) 15, 101-113.
- Bouredjan, S., & Touta, N. (2020). L'Algérie dans l'économie de connaissance :Quelle place ? *Journal of economic and management researches*, 1(1), 280-303.
- Godih, D. T., & Lazreg, M. (2020, 12). L'économie fondée sur la connaissance (EFC): levier d'action pour une émergence de l'économie algérienne. *El-Tawassol: Economie, Administration et Droit*, 26(4), 294-311.
- Lucas, R. E. (1988, 07). On the Mechanics of Economic Development. *Journal of Monetary Economics*, 22(1), 3-42.

- Romer, P. M. (1986, 10). Increasing Returns and Long-Run Growth. *Journal of Political Economy*, 94(5), 1002-37.
- Solow, R. M. (1956, 02). A Contribution to the Theory of Economic Growth. *The Quarterly Journal of Economics*, 70(1), 65-94.

2. Report:

- UNCTAD. (2015). *International Trade in ICT Services and ICT-enabled Services : Proposed Indicators from the Partnership on Measuring ICT for Development*.
- Ministry of Industry, Small and Medium-sized Enterprises. (2022). *Statistical Information Bulletin*. Ministry of Industry, Small and Medium-sized Enterprises.
- Organisation for Economic Co-operation and Development (OECD). (2009). *Innovation in firms: A microeconomic perspective*. OECD.
- World Bank. (2019). *Doing Business 2019*. Washington, DC: World Bank.
- World Bank. (2020). *Doing Business 2020*. Washington, DC: World Bank.

3. Internet website:

- Anderson, G., & Kindlon, A. (2019, December 31). *Indicators of R&D Performance by Size of Company*. Consulté le September 18, 2023, sur National Science Foundation:
<https://www.nsf.gov/statistics/2019/nsf19316/overview.htm>
- Dépenses en recherche et développement (% du PIB) - China*. (2020, December 31). Consulté le September 18, 2023, sur World Bank:
<https://donnees.banquemondiale.org/indicateur/GB.XPD.RSDV.GD.ZS?locations=CN>
- State of Skills - Country briefs*. (2020, April 1). Consulté le September 18, 2023, sur International Labour Organization:
https://www.ilo.org/skills/projects/skill-up/WCMS_742315/lang--en/index.htm
- UNCTAD. (n.d.). Retrieved 04 15, 2023, from UNCTADSTAT:
<https://unctadstat.unctad.org>