Tunisian Banks Performance Evolution in the Post Revolution Era. A Malmquist Productivity Index approach

Abstract

The Tunisian economy rely heavily on its banking sector to stimulate growth. After the Jasmin revolution, Tunisia encountered political uncertainty and significant level of insecurity. Although many researches investigate the impact of the revolution on the Tunisian Stock Market, none have focused on its implication in the banking industry. Our aim is to fill this gap by investigating how the Tunisian banks productivity behaved after the revolution using the Malmquist Productivity Index combined with the Data Envelopment Analysis approach.
Keywords: Malmquist Productivity Index, Data Envelopment Analysis, banking productivity
JEL: D24, G21, D74

1. Introduction

Many studies formalized a positive linkage between financial development and economic growth under an adapted regulatory environment and an effective governance [1]. Indeed, financial institutions may enhance economic growth by rising the quantity of capital available to entrepreneurs, improving the quality of investment and increasing the efficiency of intermediation [2].

Tunisia's financial system rely tremendously on its banking sector which is responsible in 2017 for roughly 90 percent of financing. Hence, assessing and monitoring banks productivity in Tunisia is of a major concern. [3] investigating the determinants of the Tunisian bank's performance during the 1980-1995 period find that labor productivity, bank portfolio composition, capital productivity and bank capitalization are the principal determinants. [4] point out a positive relationship between bank performance and capitalization, privatization and quotation.[5] considering the main 10 commercial Tunisian banks in the 1998-2011 period reveal that bank capitalization and managerial efficiency have a positive and significant effect on the bank performance.

Although these researches provide interesting insights on the Tunisian banking system's performance non of them address the Jasmine revolution's effect on it. Nonetheless, regarding this issue the stock market has been analyzed. [6] find the political uncertainty resulting from the Tunisian revolution to have an important impact on the volatility of major sectorial stock indices in the Tunisian Stock Exchange. In addition, [7] point out that during the period of political instability induced from the revolution, investor sentiment affected negatively the market return and volatility.

The research presented here focuses on the Tunisian Revolution implication on the Tunisian bank's performance. We consider the 2007-2017 period which includes a pre and post-revolution period.

2. Methodology

In out study, we assess the performance evolution using the Malmquist Productivity Index which is based on metrics calculated through the Data Envelopment Analysis (DEA) application. DEA is a non-parametric linear programming technique that measures the relative efficiency of a set of homogeneous Decision-Making Units (DMUs) that use an identical variety of inputs to produce an identical variety of outputs. While the application of DEA is not limited to banking it is the most widely operational research technique used to assess bank performance [8]. It is worth noting that DEA approach differs whether we're considering banking institutions or bank branches as DMUs. Due to the easier availability of data, the majority of the studies focus on banks at the institutional level. [9] find that among 257 DEA applications in the banking industry between 1985 and 2011, 195 evaluated performance at the institutional level.

Several DEA models have been applied in the banking sector, however three main approaches appear most often [10]:

- The production model
- the profitability model
- the intermediation model

The production and the intermediation model capture the two bank's primary role in the financial system [11]. The production approach measures how a bank produces transactions and related services for customers based on the use of capital and labor while the intermediation approach is interested at the bank as a financial intermediary that transfer funds from savers with a surplus to investors requiring funds. In other words, the intermediation model measures how a bank makes loans and investments based on the monetary assets it gathers [10, 11]. Finally, the profitability approach considers banks' efficiency in maximizing revenues and minimizing expenses. According to [12], the production approach is better suited for measuring the efficiency of branches while the intermediation approach is more adapted for banks comparison. Moreover, due to a greater difficulty in obtaining the transaction flow required to examine production efficiency, the intermediation approach has been more widely applied [8]. In our study, we consider the intermediation and the production approaches in order to determine the model's inputs and outputs. Furthermore, we rely on a CCR model with an input minimization orientation.

The CCR model initially developed by [13] considers the $i-th$ DMU and seeks as much as possible to radially contract its inputs or radially expand its outputs while still remaining within the feasible production set. Suppose we have m input variable with a marginal weights vector $v_i(i=1,...,m)$, s output variables with a marginal weights vector $u_r(i=1,...,s)$ and n DMUs. The envelopment form of the input-oriented model is:

$$min_{\theta,\lambda}\theta \tag{1}$$

Subject to

$$\theta x_0 - X\lambda \geq 0$$
$$Y\lambda \geq y_0$$
$$\lambda \geq 0$$

where x_0 and y_0 the column vector of inputs and outputs respectively for DMU_0. X and Y are the matrices of input and output respectively for all DMUs. λ is the column vector of intensity variables denoting linear combinations of DMUs. Finally, the objective function θ is a radial contraction factor that can be applied to DMU_0's inputs.

We measure the efficiency of each DMU once, therefore we need n optimization. The optimal value of θ, denoted θ^* represent the efficiency score of the DMU under study. Due to the model's constraints, the value of θ ranges from zero to one, inclusive. The CCR model looks for an activity in the production possibility set that guarantees at least the output level y_0 of DMU_0 in all components while reducing the input vector x_0 radially to a value as small as possible. If the efficiency measure θ^* is equal to 1, the DMU_0 is evaluated as efficient.

The Malmquist Productivity Index (MPI) measures DMUs' performance changes over time according to the technological progress and technical efficiency improvement. In our research we present the MPI theoretical framework using the development of [14]. Let $E(s,t)$ be a measure of DMU_0 performance in period s against the technology in period t. To measure DMU_0 improvement from period s to period t, we can look at the changes in efficiency compared to a fixed technology. If we use time s technology as our benchmark, we have:

$$M^s = \frac{E(t,s)}{E(s,s)} \tag{2}$$

If the DMU_0 has improved from period s to t, then $E(t,s) \geq E(s,s)$. M^s is larger than 1 when the DMU_0 improves and smaller than 1 if it moves away the frontier over time. M^s measures the improvement relative to the technology s, we might alternatively have used technology at time t as the fixed technology, in which case we get:

$$M^t = \frac{E(t,t)}{E(s,t)} \tag{3}$$

Because there is no reason to prefer one to the other, the Malmquist Productivity Index is simply the geometric average of the two:

$$M(s,t) = \sqrt{M^s M^t} = \sqrt{\frac{E(t,s)}{E(s,s)} \frac{E(t,t)}{E(s,t)}} \tag{4}$$

We can decompose the Malmquist measure according to two counteracting factors which are the technical change and the efficiency change by rewriting M as follows:

$$M(s,t) = \sqrt{\frac{E(t,s)}{E(t,t)} \frac{E(s,s)}{E(s,t)} \frac{E(t,t)}{E(s,s)}} = TC(s,t)EC(s,t) \tag{5}$$

Technical change (TC) evaluates the productivity gain or loss that is attributable to a technological evolution in the industry between the two periods. A value of TC superior to 1 represents technological progress in the sense that more can be produced using fewer resources. On the other hand, efficiency change (EC) measures the catch-up relative to the present technology. An EC greater than 1 means for a given DMU that it has moved closer to the frontier.

The Malmquist measure and its decomposition is useful in capturing dynamic performance development from one period to the next however one should be careful in interpreting results from several periods. Indeed, one cannot simply accumulate the changes because the index does not satisfy the circular test unless the technical change is particularly well-behaved [14].

Using the MPI, we investigate the average productivity change between 2007 and 2017 for each bank. Then we analyze the productivity evolution according to each year. Finally, in order to determine the effect of the Tunisian revolution on banking performance we decompose our period into four phases, each phase considers sub-periods as follow:

- $PhaseI$ [2007 – 2010]
- $PhaseII$ [2011 – 2012]
- $PhaseIII$ [2013 – 2015]
- $PhaseIV$ [2016 – 2017]

The Phase I includes the ante revolution era as the Tunisian revolution began in December 18th 2010 and ended in January 14th 2011.

3. Data Specification

The data consists of annual observation of 18 banks in Tunisia for the period between December 31st 2007 and December 31st 2017. Islamic banks are excluded from the scope of the analysis due to a different operating mechanisms. From the banks' financial statements we define our input and output variables as follow:

- inputs
  - Staff expenses
  - General operational expenses
- outputs
  - Net banking product
  - Customer total deposit

Our calculation are executed using the `Benchmarking package` written by [14] in R.

4. Findings

Table 1: Malmquist Productivity Index change and its components for each year (between 2007 and 2017).

Year	MPI	TC	EC
2008	1.0476	1.1029	0.9499
2009	0.9687	0.9997	0.9690
2010	1.0222	1.0849	0.9422
2011	0.9637	0.9288	1.0376
2012	1.0591	0.9224	1.1482
2013	0.9906	1.0623	0.9325
2014	0.9641	0.9646	0.9995
2015	0.9843	0.9787	1.0057
2016	0.9724	1.0256	0.9482
2017	0.9849	0.9872	0.9976
Mean*	**0.9952**	**1.0040**	**0.9913**

* All Malmquist indexes represent geometric means

According to table 1, the annual productivity decreased over the period of 2008-2017 as the mean MPI index is 0.9952. We observe that Tunisian banks achieve the highest productivity improvement in 2012 with an increasing rate of 5.91%. The year before, in 2011, Tunisian banks experienced the highest loss in productivity due to a deterioration of the production technology. Indeed, the MPI and the TC exhibit respectively a value of -3.36% and -7.12%. This is not really surprising as 2011 corresponds to the year following the revolution. Hence, the Tunisian revolution had a direct negative impact on banks' performance as they experience a significant technological retrogression. Furthermore, table 1 shows that between 2012 and 2017, Tunisian banks encountered a constant loss in productivity.

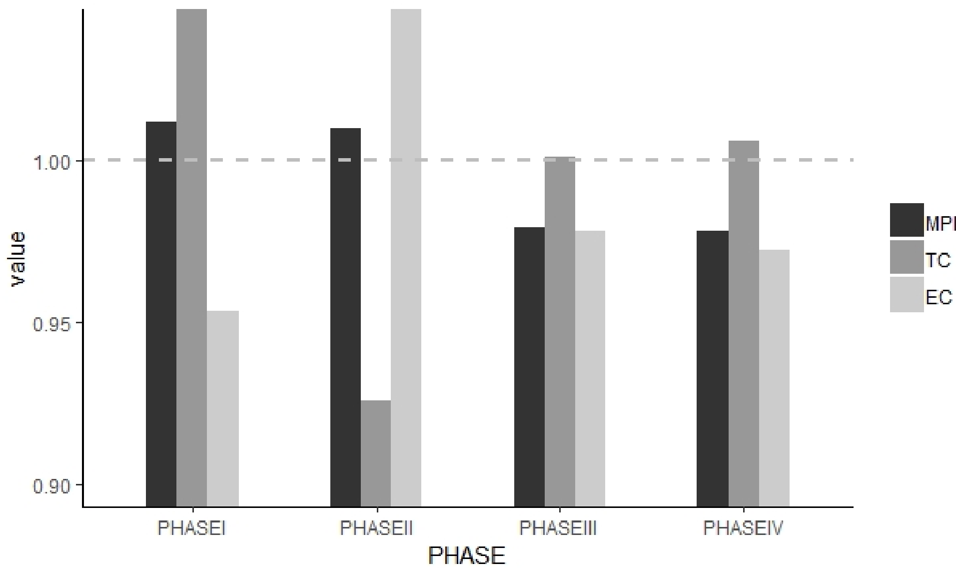
Table 2: Malmquist Productivity Index change and its components for each bank (between 2007 and 2017).

Banks	MPI	TC	EC
UIB	1.0497	1.0225	1.0265
CITI	1.0475	1.0475	1.0000
BIAT	1.0318	1.0236	1.0080
BTS	1.0280	0.9975	1.0306
BNA	1.0247	1.0094	1.0151
BH	1.0150	1.0031	1.0118
Amen	1.0148	1.0148	1.0000
QNB	1.0098	1.0143	0.9956
Attijari	1.0059	0.9842	1.0220
ABC	1.0018	1.0124	0.9895
UBCI	0.9956	0.9955	1.0001
BT	0.9939	0.9939	1.0000
ATB	0.9684	0.9904	0.9778
STB	0.9605	1.0004	0.9601
STUSID	0.9580	0.9854	0.9722
BTL	0.9502	1.0009	0.9493
BTK	0.9467	1.0041	0.9428
BTE	0.9236	0.9745	0.9478
Mean*	**0.9952**	**1.0040**	**0.9913**

* All Malmquist indexes represent geometric means

From table 2 we remark that the bank which improved the most in terms of productivity during the overall period is UIB. On the other hand, the bank which deteriorates the most is BTE. Indeed the former's productivity increased at an average rate of 4.96% while the latter's productivity decreased at an average rate of 7.64%. We also observe that the four worst banks in terms of performance evolution through the 2007-2017 period are all mixed banks : STUSID, BTL, BTK and BTE.

Figure 1: Malmquist Productivity Index change and its components according to different time phases



From figure 1 it's obvious that the Jasmin revolution impacted strongly Tunisian banks' performance. In Phase II which corresponds to the Tunisian revolution's short term effect, we observe a tremendous technological retrogression while the efficiency progressed considerably. This dual effect leads to only a slight decrease in productivity. In Phase III corresponding to the Tunisian revolution's middle term effect, we detect an important drop in the average MPI index induced by a technological and an efficiency loss. Finally, we see that the Phase IV, which corresponds to the long term effect, behave approximately the same way as Phase III.

5. Conclusion

Our study focuses on the Tunisian bank's performance evolution in the post revolution era. To that aim, we consider a period of 2007-2017 which encompass an ante revolution and a post revolution era. This helps us to contract the Tunisian revolution effect. To evaluate performance, we rely on the Malmquist Productivity Index of 18 Tunisian banks.

We observe that in the two year following the revolution, Tunisian banks suffered from a tremendous loss in technology. However, an important improvement in efficiency leads to only a slight decrease in global performance. Nevertheless, in the period between 2013-2017, included, Tunisian banks encountered a constant loss in productivity. These results lead to the conclusion that the Tunisian revolution have impacted negatively the Tunisian bank's performance.

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