How Emergent Countries Banks Could Improve Their Performance by Adopting the Technology of Developed Countries: The Case of Tunisia?

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Abstract

This paper compares the performance of banks in emergent and developed countries in order to measure the efficiency gains that an emergent banking industry could extract by adopting the technology of more developed banking industries. In particular, the Tunisian banking industry is compared with the French, Spanish and Moroccan banking industries. The technologies of emergent and developed banking industries are compared by using the distance function approach, in order to see how this emergent country, i.e. Tunisia, could improve the performance of its banking industry. Results suggest that Tunisian banks could improve their performances by around 17-18% if they adopt the technology of French, Moroccan or Spanish banking industry.

كيف يمكن لمصارف الدول الناشئة من تحسين أدائها بتبني تقنيات الدول المتقدمة: حالة تونس؟

محمد الشافعي
ميشيل دتش
آنا لوزانو فيفاس

ملخص

تحاول هذه الورقة مقارنة أداء البنوك في الدول الناشئة بمثيلاتها في الدول المتقدمة، وذلك من أجل قياس الكفاءة في الربح التى يمكن للبنوك الناشئة أن تحققها باستخدام تقنيات البنوك المتطورة. فتناول البحث مقارنة أداء المصارف التونسية مع أداء كل من المصارف المغربية والفرنسية والأسبانية. استخدمت في هذه المقارنة طريقة دالة المسافة، وقد بينت النتائج أنه يمكن للمصارف التونسية أن تحسن أداءها بنسبة 17-18% وذلك إذا ما تبنت التقنيات المستخدمة في البنوك الفرنسية والأسبانية.

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Introduction

This paper compares the performances of banks located in emergent and developed countries. More precisely, the objective is to measure the efficiency gains the Tunisian banks could extract by adopting the technologies of the more developed banks of France, Spain and Morocco. An important prerequisite for economic growth is financial development (Berthélemy and Varoudakis, 1996). In this respect, it will be useful to know how to improve the performance of the banking industry in emergent countries by learning from the experiences of the more developed ones.

It is a fact that the liberalization of the European banking industry that occurred in the 1980s has led to an increase in the productivity and performance of European banks. Needless to say, increased productivity and better performance redound to the benefits of the banks' customers. In anticipation of opening the Tunisian banking industry to foreign competition, it would be interesting to know how the Tunisian banks could compete with the foreign banks. To answer this question, it is first necessary to determine the baseline of productivity and efficiency levels of Tunisian banks. In a previous study, Chaffai and Dietsch (1997) showed that Tunisian banks differ among themselves in their performances. Overall, Tunisian banks could improve their cost efficiency by approximately 20% if commercial banks had better control of their costs, i.e., if banks had better use of their inputs. However, the competitiveness of Tunisian banks could also be determined by the nature of the technology they use in the future. Differences in technologies could result in considerable differences in prices and margins in the banking industry. Therefore, it is of importance to compare the technology of Tunisian banks with that used by other competing banking industries.

In order to compare banks' performances, a pre-requisite is to determine whether the underlying banking technology across countries is similar or not. If the technology used by the banks of different countries is the same, then it should be possible to compare directly the efficiency levels of these banking industries by building a production or cost common frontier pooling the banks of all countries. However, if the technologies are different), then these efficiency level measurements derived from the estimation of separate country frontiers, cannot be directly compared. Therefore, knowledge of the deviations among separate frontiers is to able to measure efficiency and productivity and to determine the influence of technology on these levels.

Subsequently, the hypothesis is offered that the technologies used by the Tunisian banks and the French and Spanish banks are the same. Results suggest that this hypothesis should be rejected. It is apparent that the technology used by Tunisian banks proves to be different from that used by the countries under comparison. To measure the benefits that the Tunisian banks may obtain if the most appropriate technology is used, the position of the countries' production frontiers is compared. Because the banking technology is assumed to be a multi-product technology, it is not possible to use a standard production function.

The multi-product distance function approach is a new approach, which has been developed in recent researches. This seems to be the most appropriate measure for the purpose of this analysis. This approach allows the determination of how the banks of one country may improve performance (levels of production) if they choose an alternative technology, i.e., a more efficient technology used in another country. This is based on the assumption that the Tunisian banks may improve their production by around 17-18% with the adoption of the technology of French, Moroccan or Spanish banks.

Measuring Efficiency Gains

The Distance Function

A comparative analysis of performance between Tunisian banks, Spanish and French ban ks aims to determine the production gains that the Tunisian banks may obtain by using the technology of a more developed banking industry. Morocco is alsointoduced in this comparative analysis the reason being that Morocco has initiated financial innovation and deregulation earlier than Tunisia. Chaibainou (1993), claims that it may represent an intermediate banking development stage between that of Tunisia and Europe.

The methodology used in this paper is the distance function, introduced in the literature by Shephard (1970)[(1)]. This function allows the representation of the technology of multi-product firms. An alternative way is to estimate a production frontier by aggregating the different firm outputs. However, such an aggregation of outputs is not feasible in the banking industry. Moreover, a cost frontier or a profit frontier may also represent multi-output production technology. In this case, working with homogenous measure of input prices is necessary.

However, a homogenous measure of input prices for the countries in question is lacking. In addition, bank costs/profits are sensitive to country-specific regulatory constraints and to other differences in banking operations, labor and capital markets, all of which render the cost/profit frontier comparisons problematic. Consequently, the deviations among country cost/profit frontiers should be accounted for these environmental differences. In such cases, the dual approaches do not take into account with precision the differences in technology across countries. Hence, only in certain instances where market and regulatory conditions are quite similar in all countries, would the cost/profit frontier be able to represent without ambiguity the technology of different banking industries (Dietsch and Lozano-Vivas, 1996).

In order to represent the distance function, $Y=(y_1,..., y_p)$ is defined as the vector of banking output quantities and $X=(x_1,..., X_k)$ as the vector of input quantities. The production possibility set is denoted by T, and defined as:

$$T = \{ (X,Y), X \varepsilon\ R^k, y\ \varepsilon\varepsilon R^p; X \text{ can produce } Y \} \qquad \text{(Equation 1)}$$

The output distance function is defined by:

$$Do(Y,X) = \text{Inf} \{ \theta > 0, (X, Y/\theta)\ \varepsilon\ T \} \qquad \text{(Equation 2)}$$

The distance function measures the greatest proportional expansion of observed outputs possible to reach which remain in the feasible output set T, given the input quantities vector X. Thus, the technology is represented by the distance function (Equation 2). The optimal production levels are represented by the frontier of the production possibilities set T.

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(1) See Färe *et al*. (1993), and Coelli and Perelman (1996) for recent applications and survey.

Figure 1 illustrates the construction of the output distance function for the case of an industry which produces two outputs $Y=(y_1, y_2)$ with a given vector of inputs, X. Bank A is not technically efficient because it does not produce the maximum output with its inputs. This bank may increase by the same proportion y_1 and y_2 in order to reach a point on the production possibilities frontier (such asεpoint A'). The distance function, denoted by Do(Y,X) is defined by the ratio OA/OA'. This ratio measures the technical efficiency of this bank. All banks that fall within the production possibilities set curve are 100% efficient.

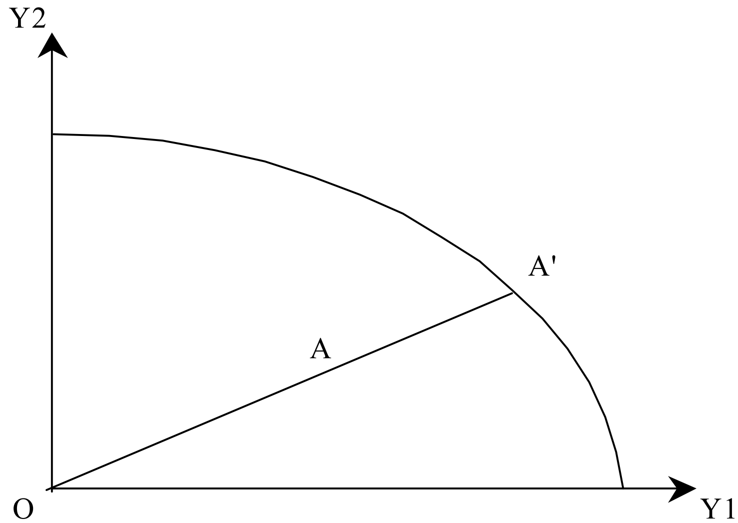

Figure 1: Distance function for two outputs

In this instance, the technology of four different banking industries has to be represented. To estimate country-specific frontiers, four different production possibilities sets are considered. There are two scenarios in consideration:

Scenario 1. The banking industries of the four countries use the same technology. In this case, the frontiers overlap.

Scenario 2. The banking industries use different technologies. In this other case, the country-specific frontiers do not have necessarily the same shape.

For Scenario 1, in order to compare the performances of the banks of different countries, it would suffice to estimate a common distance function by pooling the banks of each country, and then to compare the efficiency scores of each banking industry derived from this frontier.

In Scenario 2, it is not possible to build a common frontier insofar as this common frontier will be determined by the banking industry with the best technology. Therefore, it is necessary to estimate separate frontiers for each country to measure the efficiency scores. Moreover, the comparison of efficiency scores should take into account the deviations among the frontiers. These deviations represent the production gains a bank may obtain should it decide to substitute its technology with the dominant one.

This case is illustrated in Figure 2, which considers two banking Technologies I, and J where each one is represented by its own production possibilities set frontier. If the frontiers do not overlap, two different situations are possible: either the frontiers are parallel (Figure 2a) or they intersect (Figure 2b).

Figure 2a shows that the industry using Technology J dominates the industry using Technology I in each point of the production possibilities set of' 1. Bank B is technically efficient with respect to its own technology. B is located on the frontier for Technology I. However, Bank B could do better if it substitutes technology J for its own use. In this case, this bank could reach point B. The production gains due to the change of technology are measured by the ratio OB"/OB. Nonetheless, it may be noted that banks may still be inefficient even with the use of Technology I, as in the case of Bank C. With Bank C, the technical efficiency due to the use of Technology I is measured by the ratio OC/OC'. This bank could also use Technology J. The efficiency loss due to the use of Technology I in place of the better Technology J, is measured by the ratio 1-OC'/OC". This bank may increase its production either by improving its technical efficiency or by changing its technology.

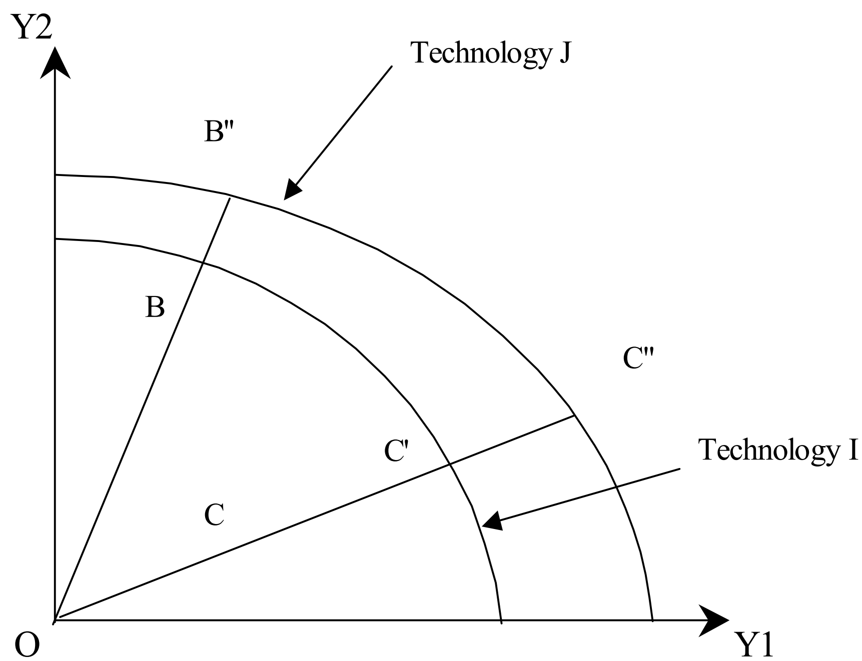

Figure 2(a): Distance functions when the two technologies give parallel frontiers

Figure 2b shows that Technology J does not dominate Technology I at each point of the production possibilities set. The two frontiers intersect. At the intersection point (yl*,y2*), the two technologies are found to be equivalent. For the combinations defined by yl<yl* (or y2>y2*), Technology J is superior to Technology I. Finally, the symmetric case to the latter, I dominates J, is found when $y1 > y1^*$ (or $y2 < y2^*$).

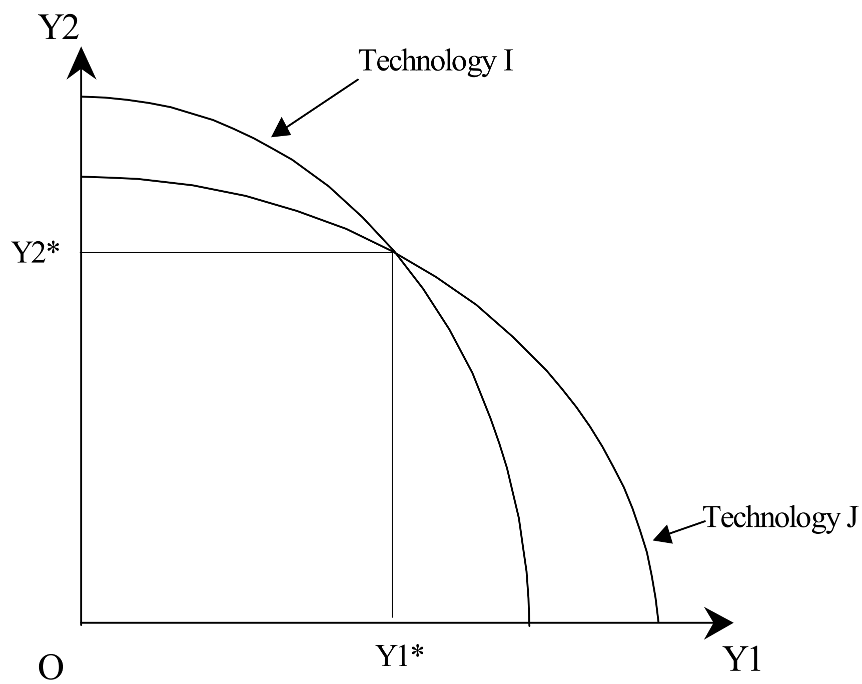

Figure 2(b): Distance functions when the two frontiers intersect

Hence, parametric distance functions may be estiamted in order to represent each banking technology and to verify whether the technologies are the same or not. It will then be possible to measure the efficiency scores for each bank and also the efficiency gains (or losses) the bank may obtain if its technology is changed.

The Banking Production Model

The Model

In this paper, the banking technology of each country is represented by a Cobb-Douglas distance function:

$$\ln D^{(J)}o(Y_{it},X_{it}) = \alpha^{(J)}{}_0 + \Sigma_j\beta^{(J)}{}_j \text{ Log } Y^{(J)}{}_{jit} + \Sigma_h \delta^{(J)}{}_h \text{ Log } X^{(J)}{}_{hit} \qquad \text{(Equation 3)}$$

where i = l, ..., N banks; t = l, ..., T periods, and J = countries (Tunisia, France, Spain, Morocco), the Y_j are the output quantities, and the X_h are the input quantities.

The output distance function should verify some general regularity conditions which are: (a) homogeneity of degree one in outputs; (b) concavity in outputs; and (c) non-increase in inputs (Fare and Primont, 1995). The following restrictions are thereby introduced.

$$\beta^{(J)}{}_j > 0 \text{ , } \delta^{(j)}h < O, \Sigma j \text{ } \beta^{(J)}j = 1 \qquad \text{(Equation 4)}$$

The first method which may be used to estimate the parameters of Equation 3, is the corrected least squares method (COLS) proposed by Lovell *et al.* (1994). The principle is as follows. The property of linear homogeneity of the distance function with respect to outputs is used. For example, if output Yl is arbitrarily normalized, Equation 3 may be written as:

$$- \ln Y^{(J)}{}_{jit} = \alpha^{(J)}{}_0 + \Sigma_j\beta^{(J)}{}_j \text{ Log } (Y^{(J)}{}_j / Y^{(J)}{}_1) + \Sigma_h \delta^{(J)}{}_h \text{ Log } X^{(J)}{}_{hit} - \varepsilon^{(J)}{}_{it} \qquad \text{(Equation 5)}$$

where $\varepsilon^{(J)}{}_{it} = 1nDo(Y^{(J)}{}_{it}, X^{(J)}{}_{it})$.

Knowing that $Do(Y^{(J)}{}_{it}, X^{(J)}{}_{it}) \leq 1$, the error term in Equation 5 is negative : $\varepsilon^{(J)}{}_{it} \leq 0$. A deterministic frontier model that is well known in the production frontier literature is obtained. It may be noted that the distance function is equal to one only for banks operating on the frontier of their production possibilities set.

Equation 5 by the COLS method may be estimated by applying ordinary least squares to this Equation and then shifting the residuals to have the asymmetrical property of the error terms (Greene, 1993). The technical efficiency may be evaluated according to the following formula.[2]

$$\text{Eff it} = \exp [-(\text{InDo}(Yit,Xit) - \text{Min InDo}(Yit,Xit)] \qquad \text{(Equation 6)}$$

The efficiency score obtained by this Equation gives a measure of the relative efficiency of a bank compared to the most efficient bank of the sample over the period.

The second method to estimate distance function is the application of the linear programming method (LP). It consists of minimizing the sum of deviations with respect to the frontier (Equation 3),

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(2) The efficiency scores and the distance function parameters are not sensitive to the choice of the output which is used for the normalization.

subject to the sample constraint 1n $D^{(J)}o(Yit,Xit) \leq 0$ and the constraints given by Equation 4. This method presents the advantage of giving absolute measures of technical efficiency. However, its main limitation is the absence of statistical properties (English *et al.*, 1993).

Controlling Technology and Productivity Gains Estimation

Once each country-specific distance function has been estimated, it is necessary to test whether the technologies are the same or not. This test consists of verifying the stability of the distance function parameters across countries (Chow-test). If the null hypothesis is rejected, it may be concluded that the technologies are different.

Hence, if the technology is different, the gains may be evaluated which would result from changing the technology. The efficiency gains (or losses) are denoted by EFFG. Industry I may be measured by the following ratio:

$$\text{EFFG I/J} = D^{J}o\,(Y^{I}, X^{I}) \,/\, D^{I}o\,(Y^{I}, X^{I}) \qquad \text{(Equation7)}$$

This ratio measures the gap between two frontiers: Technology I frontier against Technology J. It gives the productivity gains (or loss) a bank currently using Technology I would obtain should it change to Technology J. A value of the ratio greater than one infers that the bank uses a technology which is dominant In this case, the ratio measures the proportional increase of outputs the bank obtains, using the same quantity of inputs X^{I}, having chosen this dominant technology in preference to the other. A value lower than one indicates that the technology of the bank is dominated by the other technology. Subsequently, the ratio measures the proportional decreases in outputs resulting from the use of Technology I instead of Technology J.(3)

Discussion of Results

As mentioned earlier, one objective of this research is to compare the Tunisian banking technology with the technologies used by French, Spanish and Moroccan banking industries. The sample contains 9 Tunisian banks, 128 French banks, 67 Spanish banks and 9 Moroccan banks, all of which are commercial banks.(4)

Three outputs are defined:

- Total Loans (y_1);
- Total Deposits (y_2); and
- Other Earning Assets (y_3).

Three inputs are identified:

(3) Note that the circularity property of this ratio may be used to determine the efficiency gains (losses) between two alternative Technologies I and J’, knowing the EFFG ratios, according to the following formula: (EFFG I/J) / (EFFG I/J’) = EFFG J’/J.

(4) The Tunisian development banks were eliminated from the sample because their technology differs significantly from that of the commercial banks (Chaffai et Dietsch, 1997). For Morocco, the sample included only 9 of the 15 banks of this country because of lack of information.

- Physical capital (x_1) measured by the book value of total fixed assets;
- Labor (x_2) measured by the number of employees; and
- Financial Capital (x_3) measured by total liabilities.

All variables were converted into US dollars. Previously, using the price index of each country these variables were deflated. Table 1 presents descriptive statistics of the main variables.

Table 1. Descriptive Statistics of Bank Outputs and Inputs (US$)

Variables		Tunisia	Morocco	France	Spain
	Time period	1986-1995	1990-1995	1988-1992	1986-1995
Loans	Mean	586990	510790	1510990	2161700
(Y1)	Minimum	101720	52218	62191	40573
	Maximum	2119800	1580000	58922000	34640000
Total	Mean	475870	772220	955880	3362000
Deposits	Minimum	132720	96853	48865	71846
(Y2)	Maximum	1123900	2339000	48854000	41734000
Other earning	Mean	97958	71701	648070	462470
Assets	Minimum	13800	6239	48865	19.
(Y3)	Maximum	293650	280570	44963000	10430000
Physical	Mean	14573	33811	25603	144600
capital (XI)	Minimum	5763	6067	1161	17682
	Maximum	36724	159000	1667100	2690900
Labor	Mean	1323	1041	1276	2169
(X2)	Minimum	283	178	102	47
	Maximum	3052	2713	45376	33636
Total	Mean	961230	1108000	26618900	4789800
Liabilities	Minimum	202310	138540	1131,50	79121
(X3)	1 Maximum	12809200	13197000	1120310000	169195000

Source: Tunisia: Association Professionnelle des Banques; Morocco: Groupement Professionnel des Banques Marocaines; France: Banque de France- Commission Bancaire; Spain: Consejo Superior Bancario and Confederaci6n Espafiola de las Cajas de Ahorros.

Testing for Technology

In order to determine whether the different banking industries are using the same technology or not, a classical Chow-test is conducted to determine the stability of the coefficients of the distance functions estimated for the different couples of countries. Table 2 presents the results of this test.

Table 2. Test for the Identification of the Banking Technology of each Country

Countries	Fisher Statistics	Degrees of freedom
Tunisia/France	74.000	(6,755)
Tunisia/Spain	26.932	(6,860)
Tunisia/Morocco	7.22	(6,114)
France/Spain	97.879	(6,1447)

As the results show, the null hypothesis that the technology is the same, is rejected at a 99% confidence level for each pair of countries. These results suggest that there is a specific technology used in each country. Hence, it is not appropriate to define a common frontier for all the countries because only the technology of the technologically dominant country, would determine the frontier. Therefore, the efficiency scores have to be obtained from the estimation of separate distance functions.

The gap between each bank and the best practice frontier is the result of the combination of technical inefficiency (gap between the bank and its home country frontier) and the inefficiency due to the choice of the technology (gap between its home country frontier and the frontier it is obtained by using the best technology). As previously mentioned, if a distinction between two types of inefficiencies is desired, it is necessary to estimate one distance function for each country. This permits the determination of the pure technical inefficiency of each bank, as well as measuring the gap among the distance functions of the different countries. The latter permits the measurement of efficiency losses due to the choice of technology, should the country under comparison not use the dominant technology.

Efficiency Scores in Each Country

Efficiency scores have been calculated from the estimation of the Cobb-Douglas distance function. Two methods were used for the efficiency score measurement: the COLS method and the LP method.

Table 3 presents the efficiency scores obtained from the distance function with these two methods. It may be noted that the correlation between COLS and LP efficiency scores is very high, i.e. 0.87 for Tunisia, 0.68 for France, 0.81 for Morocco and 0.80 for Spain. Thus, the two methods give similar results.

Results show that there are no significant differences in technical efficiency between the Tunisian and the European banks, since the mean of the individual scores are close to each other with COLS, as well as with LP.(5) Nonetheless, single comparison of these efficiency scores does not allow one to say the Tunisian banks are as efficient as the European banks. Rather, the efficiency scores obtained from the individual frontier only give an indication of the average performance of the banks in each country. They show how much the domestic banks may improve their performance using the

(5) The efficiency scores of Moroccan banks are even higher: 94% with COLS and 97% with LP, on the average. However, this result must be taken with extreme caution. Firstly, the sample of Moroccan banks is limited and perhaps only composed of the most efficient banks in this country. Secondly, the labor prices of the Moroccan banks are extrapolated, because of data prices availability only for the last year of the period.

same technology of the other countries. The measurement of the gaps among country-specific frontiers is an indication of the improvement in performance resulting from the choice of technology.

Table 3. Efficiency Scores by Country (COLS And LP Methods)

Years	Tunisia	Morocco (see footnote 5)	France	Spain
	COLS / LP	COLS / LP	COLS / LP	COLS / LP
86				0.75 / 0.87
87	0.91 / 0.94			0.78 / 0.89
88	0.88 / 0.92		0.79 / 0.90	0.81 / 0.90
89	0.83 / 0.86		0.81 / 0.92	0.82 / 0.89
90	0.85 / 0.90	0.93 / 0.94	0.82 / 0.92	0.82 / 0.89
91	0.81 / 0.86	0.92 / 0.93	0.78 / 0.89	0.83 / 0.88
92	0.87 / 0.92	0.94 / 0.98	0.78 / 0.89	0.82 / 0.86
93	0.81 / 0.84	0.94 / 0.99		0.80 / 0.84
94	0.84 / 0.87	0.94 / 0.98		0.85 / 0.83
95	0.85 / 0.84	0.94 / 0.99		0.80 / 0.83
Mean	**0.85 / 0.88**	**0.9410.97**	**0.80 10.90**	**0.80 / 0.87**
STD	**(0.06) / (0.07)**	**(0.03) / (0.04)**	**(0.05) 1 (0.08)**	**(0.07)/ (0.09)**

Efficiency and Technology Improvements

The methodology used allows the evaluation of the efficiency gains that the Tunisian commercial banks may obtain should the technology of any other country is used. It may be recalled that these gains (EFFG) are measured by the difference between the actual efficient output of a bank and the potential efficient output that this bank could produce, holding their input quantities constant by using another technology as defined by Equation 7. The EFFG ratios are calculated for each Tunisian bank over the period.

Table 4 shows the mean values of the efficiency gains that Tunisian banks may obtain with the use of foreign technology. For example, a value of 0.85 means that a Tunisian bank may improve its efficiency by 15% with the adoption of the technology of another country.

Table 4. Efficiency Gains Associated with a Change of Technology

a. COLS Method

Countries	Mean	Minimum	Maximum
EFFG (Tunisia/France)	0.82 (0.08)	0.59	1
EFFG (Tunisia/Spain)	0.83 (0.065)	0.63	0.93
EFFG (Tunisia/Morocco)	10.91 (0.134)	0.54	1.14

(Standard deviation in parenthesis)

b. LP Method

Countries	Mean	Minimum	Maximum
EFFG (Tunisia/France)	0.85 (0.08)	0.62	11.0
EFFG (Tunisia/Spain)	10.72 (0.12)	10.41	10.90
EFFG (Tunisia/Morocco)	10.91 (0.14)	10.52	11.12

(Standard deviation in parentheses)

Results show that on the average, Tunisian banks may increase their activities by around 18%, 17%, and 9% using the COLS method, should they choose the technologies of French, Spanish, and Moroccan banks, respectively. Similar conclusions come from LP results.[6] On the other hand, from the comparison of Tunisia-France and Tunisia-Spain, it may be observed that the maximum value of the ratio is not higher than 1. The implication is that the Tunisian and European technologies are parallel. This means a situation shown in the Figure 2a. Therefore, Tunisian technology is dominated in every point of the Tunisian production possibilities set by the French and Spanish technology,

Table 4 also shows that the Tunisian and Moroccan frontiers intercept. Indeed, the minimum value of is less than 1, while the maximum is greater than 1. This result means that in some parts of the Tunisian production possibilities set, Tunisian technology dominates the Moroccan one, i.e., while some Tunisian banks are more productive than Moroccan banks, the reverse occurs in other parts.

The previous results were obtained using Cobb-Douglas distance functions, chosen for its simplicity.[7] However, the results are not sensitive to the choice of this functional form. Similar efficiency scores ranking and similar technological efficiency gains may be obtained using translog functions. For each country, the gap between the translog distance function and the Cobb-Douglas distance function scored close to 0.

(6) The results are not conditional to the variable return of scale assumption used when the model was estimated. The same LP model was re-estimated under the constant return to scale assumption. The EFFG ratios obtained were 0.86 (Tunisia/France), 0.70 (Tunisia/Spain) and 0.92 (Tunisia/Morocco). Thus, the results seem robust.

(7) Moreover, the authors' analysis did not need to calculate the derivatives of the function in order to measure allocative inefficiencies.

Three dimension graphs presented in Appendix A1, show the frontiers gaps between Tunisian and French banking industries. The purpose of these graphs is to show which output combinations could produce the greatest efficiency gains in Tunisian banks. In other words, the graphs show how much the changes in the proportion of the different outputs may increase the efficiency of Tunisian banks. The graphs show that the efficiency gains could be very high (banking activity could increase by 25% or more) for the Tunisian banks that currently hold deposit amounts less than US$790.000, loan amounts less than US$770.000, and securities amounts less than US$200.000, if these banks could substitute French technology for their own technology.

Reducing the Gap Between Banking Technologies

Results show that quite a large gap exists between banking technologies. There are also indications that Tunisian banks could obtain efficiency gains should they choose to adopt French or Spanish banking technology. At this point, it is interesting to determine which factors explain the differences between technologies and to investigate which changes Tunisian banks would have to introduce in order to improve their performance. It is necessary to point out that this analysis is limited due to the nature of the data coming from accounting information from official balance sheets. To develop this analysis further, it is necessary to obtain internal bank information

Different types of indicators were used to obtain a picture of the technological gaps across countries: the classical output / input ratios (such as loans by employee, loans by unit of financial capital, loans by unit of physical capital or by branch, etc) and the capital /labor ratio.

Table 5 reflects the average level of the different outputs per employee ratios over the time periods.[8] It may be observes that the loans per employee ratios have almost the same value in France and Spain. However, this ratio is about two times lower in Tunisia and Morocco implying that there are differences in the loans demand which are likely linked to economic development. These differences may partly be explained by the fact that the information and transaction costs associated with granting a credit are probably higher in developing countries than in industrialized ones. However, these differences may also be the result of differences in retail banking methods.

As far as the deposits per employee ratio is concerned, considerable differrences may be noted. One reason for these differences may be due to the competitive regime. In both France and Spain, strong price competition among banks caused an increased demand on the time and savings deposits in the 1980s. This has produced a major change in financial intermediation technology. The observed gap among the securities ratios reveals another technological gap. European banks are much more involved in investment banking activities, which generate a large part of the bank revenues. However, they need new expertise and concomitant development of financial markets.

[8] The time period used for Tunisia is 1986-1995. for Spain and France -1988-1995. and for Morocco 1990-1995.

Table 5. Mean of the Outputs per Employee Ratios by Country

Countries	Loans / Employee	Deposits / Employee	Securities / Employee	Total Assets /Employee
Spain	958.84	1588.1	184.17	2058.3
France	1187.4	650.22	291.90	1714.9
Tunisia	423.90	380.34	78.20	-722.09
Morocco	413.67	634.95	50.20	891.83

Sources: Tunisia: Association Professionnelle des Banques; Morocco: Groupement Professionnel des Banques Marocaines; France: Banque de France- Commission Bancaire; Spain: Consejo Superior Bancario and Confederaci6n Espafiola de las Cajas de Ahorros.

It is important to point out that the evolution of these output per employee ratios over the time period is different across countries. While the loans per employee and the deposits per employee ratios increased in France and Spain, the former remained almost constant in Tunisia, while the latter decreased. The large variation of the loans per employee ratio over time in Tunisia demonstrates that there is room for progress in this field in Tunisia. The same observation may be made concerning the evolution of the securities per employee ratio. Finally, the evolution of the total assets per employee ratio summarizes the gaps. This ratio tends to decrease in the second part of the period in Tunisia. One may infer from these observations that an increase in productivity could result from the introduction of new techniques of credit risk analysis and from an orientation toward relationship banking.

The branch network is another component of banking technology. Table 6 shows that the output per branch is highest in France. This result is due, in part, to the greater size of the French bank branches on the average. Branch activity is strongly determined by the environmental conditions, such as population density or type of banking competition (Dietsch and Lozano-Vivas, 1996).

Table 6. Average Values of Output Per Branch and Capital / Labor Ratios

Countries	Loans / Branch	Deposits / Branch	Capital Expenses / Employee	Capital Expenses / Employee
Spain	6429	10375	24.61	0.624
France	24448	13527	23.41	0.714
Tunisia	8690	7917	4.96	0.569
Morocco	5777	18930	17.23	0.530

Sources: Tunisia: Association Professionnelle des Banques; Morocco: Groupement Professionnel des Banques Marocaines; France: Banque de France- Commission Bancaire; Spain: Consejo Superior Bancario and Confederaci6n Espaflola de las Cajas de Ahorros.

While the loans per branch ratio increased in Spain and France over the period, it was almost constant in Tunisia. Furthermore, the deposits per branch ratio decreased in Tunisia and increased in the two European countries. These differences suggest that Tunisian banks could improve their performance by increasing the scale of their branches in order to benefit from economies of scale.

The capital / labor ratio is a classical indicator of production technology. Table 6 suggests that the technology of the European banks is more capital-intensive than that of Tunisia. Moreover, the evolution of the ratios shows a large substitution of capital for labor in Spain due to the deregulation and innovation process. This explains the gap among Tunisian, French and Spanish technologies.

Finally, ratio of financial capital is defined *vis-a-vis* the two other production factors, i.e. financial cost per employee ratio, and financial cost over physical capital expenses ratio. The financial cost per employee increased significantly at the end of the 1980s in Spain and France. During the same period, this rate fluctuated largely in Tunisia. However, the financial cost over labor expenses was not greatly different in Spain, France and Tunisia. This suggests that the substitution of financial capital for labor was higher in the two European countries than in Tunisia. The absence of any trend in financial cost / physical capital expenses for Spain and France shows that financial and physical capital grew at the same rate in these countries. This could have resulted from the financial innovation of the 1980s. In Tunisia, this ratio was very volatile and higher than in the European countries. This suggests that financial and physical capital in Tunisia are not yet as complementary as they are in the two European banking industries.

Table 7. Ratios of Financial Costs per Employee and Financial Costs / Physical Capital Costs

	Spain	France	Tunisia	Morocco
Financial costs / capital expenses	5.31	3.65	7.27	4.46
Financial costs / labor expenses	3.25	2.49	3.53	2.33
Financial costs by employee	129.78	83.58	30.76	32.47

Sources: Tunisia : Association Professionnelle des Banques; Morocco: Groupement Professionnel des Banques Marocaines; France: Banque de France- Commission Bancaire; Spain: Consojo Superior Bancario and Confederaci6n Espafiola de Ins Cajas de Ahorros.

Conclusion

This study shows that for Tunisian banks, the efficiency gains associated with a technological change could be very high, and probably even higher than the gains associated with an increase in managerial efficiency. This result was obtained by comparing the existing productivity level of the Tunisian banks with the potential level they could attain by adopting the banking technology of either the French or Spanish banks. More precisely, it may be inferred that Tunisian banks could improve their performances by adopting the technology of French and Spanish banks by about 17 and 18%, respectively. In this paper, the authors propose some preliminary explanations for the gaps in technology and tried to show how these gaps may be reduced. However, because a more in-depth analysis would require access to banks' internal information, this kind of analysis is beyond the scope of this paper.

It may be noted that the analysis presented some preliminary explanations for the gaps in technology as well as how these gaps may be reduced. Nonetheless, findings of this study could help lead to a better understanding of the link between financial development and economic growth. The paper emphasizes the microeconomic determinants of the performance of the financial industry in a developing country, i.e. Tunisia. The authors' approach is consistent with the propositions of the endogenous growth literature that advocates the micro-foundations of economic growth. It presents the advantage of a more in-depth investigation of the microeconomic mechanisms of financial development and of using precise microeconomic data, while the standard literature ordinarily uses aggregate data. Results show how much the availability of loans, financial liabilities and securities investments could increase as a result of the introduction of new banking technologies in Tunisia and how much technology adoption could stimulate economic growth in the country.

This research could further be improved in several ways. Firstly, it would be interesting to develop the analysis of the relationship between technical efficiencies and technological efficiency gains in order to determine which banks would actually benefit most from the introduction of new technologies. Secondly, because of the heterogeneity of the information and the statistical noise of the data, it would be useful to apply stochastic distance frontiers to the banking technology comparison. Finally, it would be very useful to extend this approach to other developing countries.

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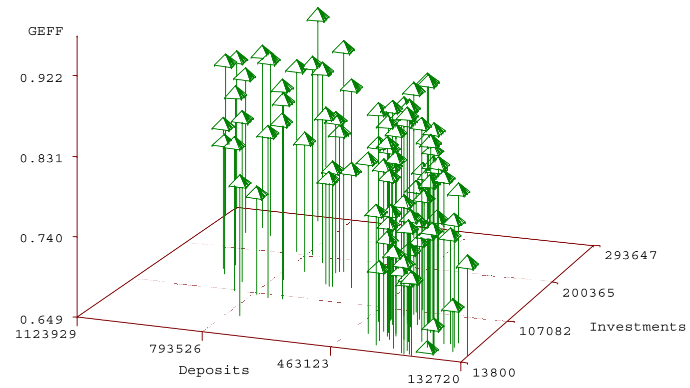
Appendix A1



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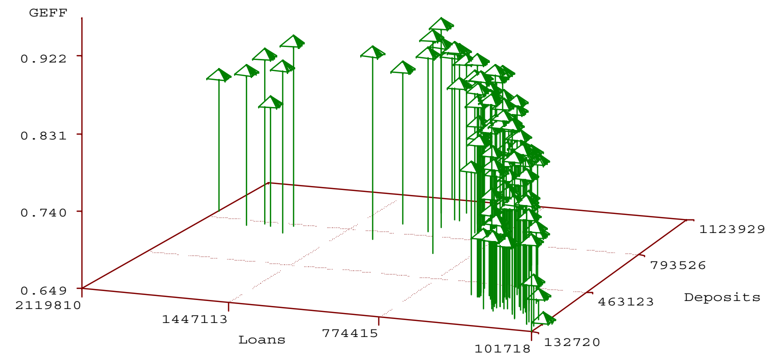

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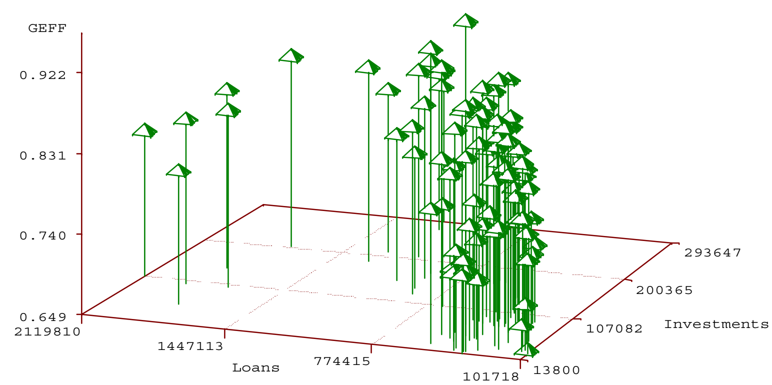

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Readers' Forum

On the Optimum Investment Duration: A Reply to Ali Abdel Gadir Ali

Steve Onyeiwu*

In Volume 3, Number 1 (December 2000) edition of this journal, Dr. Ali raised a number of questions about my article entitled *Foreign Direct Investment, Capital Outflows and Economic Development in the Arab World* which was published in Volume 2, Number 2 edition of the journal. The objective of this article is to respond to some of the salient issues raised by Dr. Ali. One of Dr. Ali's objections is the manner by which the capital inflow (CI) and capital outflow (CO) functions are specified on pages 36-37 of my article. He observes that ".the functional notation itself is confusing since the author writes CI = f(of CI components) and CO = f(of CO components)." Likewise, he also notes that "the author is not very clear about the level of aggregation on which the components are defined: the foreign investor or the country."

I wish to say that in specifying the CI and CO functions, I merely followed, with minor modifications, the procedures established by Lall and Streeten (1977: 130) – two internationally renowned experts on direct foreign investment. It is worth restating that the magnitude of CI and CO depends on the values of the various components indicated in each function in Equations 5 and 6. With regard to the level of aggregation used in specifying the CI function, Dr. Ali questions why foreign aid (a macro concept) should be regarded as a component of the CI associated with the foreign investor (a micro concept). It is generally known that bilateral and multilateral donors typically provide aid to developing countries for infrastructures such as telecommunications, power, water, roads, etc., for foreign investors. Indeed, countries with an "open door" policy for foreign investment tend to receive more foreign aid than countries with a hostile policy. For instance, Lall and Streeten (1977: 54) note that "…the free entry of private capital may stimulate, indeed sometimes may be a condition for, the flow of official aid from the home countries of the Transnational Corporation (as well as from international aid agencies)." One reason why the United States gives a $2 billion annual aid to Egypt and nothing to Libya is that the former is very receptive and protective of foreign investors,(1) while the latter wary of Western investors. Therefore, since the presence of foreign investors in a country helps the country obtain foreign aid, it should be considered as part of CI, albeit an indirect component.

Dr. Ali also raises a number of questions about Equation 8, one of which is that there is nothing in the model that links the objective function to the constraint. Given this lack of linkage, he argues, it is impossible to specify the optimality conditions for both

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(1) This also explains why Egypt is one of the largest recipients of FDI in the Arab world, second only to Saudi Arabia While Egypt received $1.1 billion and $1.5 billion worth of FDI in 1998 and 1999 respectively, Libya received $-152 million and $-100 million (UNCTAD, 2000: 283). In other words, there was divestment or net outflow of foreign investment from Libya during this period.

the Arab countries and the foreign investor. The relevant optimality conditions have not been specified because, as Dr. Ali himself notes, these conditions are not really essential to the empirical part of the paper. The theoretical model has not been conceived to be tested empirically in the paper. Rather than shaping the empirical part of the paper, the aim of the theoretical section is to shed some light on the dynamics of CI and CO, particularly from the point of view of Arab countries.

A major conclusion from the theoretical section, which Dr. Ali does not dispute, is that holding CI constant, a precondition for boosting the stock of foreign investment in the Arab world is to shift the CO function downward. This is a process that not only increases net foreign direct investments (FDI), but also increases the period during which CI exceeds CO. However, a formal relationship between the objective function and the constraint in Equation 8 may be established by re-formulating the model as follows:

$$\text{Max.} \sum_{t=1}^{n} \frac{CI(y) - CO(y)}{(1+r)^{n}}, \quad \text{subject to} \quad \sum_{t=1}^{n} U_I = \sum_{t=1}^{n} r^t f_I[\, y_I(CI - CO)\,] = \sum_{t=1}^{n} U_i^o$$

where y = the growth rate of Gross Domestic Product (GDP), and the other variables are as defined in the original article. This equation has been modified slightly with the assumption that CI and CO also depend on a country's growth rate, and that the growth rate in turn depends on net FDI (CI – CO). Assuming therefore that an Arab country wishes to maximize net FDI by reducing capital outflows (holding CI constant), the challenge for the country is to choose an optimal rate of growth of GDP that achieves this objective. The optimizing agent in this problem is the Arab country. Contrary to Dr. Ali's expectations, the foreign investor does not have (and should not have) an optimizing role in the model. On a more positive note, Dr. Ali's re-formulation and re-interpretation of Equations 9-12 in the original article, are very insightful and helpful.

It is quite interesting, however, to note that Dr. Ali does not dispute the central contention of the paper's theoretical section that, holding CI constant, the stock of FDI in the Arab world depends on the outflows of FDI, which analysts have shown to be quite substantial in absolute terms in the Arab world. For instance, during the period 1977-1983, there was a $49 billion outflow of FDI (in the form of repatriation of profits, fees, royalties, dividends, etc.) from the following Arab countries: Algeria, Egypt, Libya, Mauritania, Morocco, Oman, Qatar, Saudi Arabia, and Tunisia (UNCTAD, 1985: 93-96; World Bank).

A crucial policy question therefore centers on the kinds of macroeconomic policy that would help reduce CO from the Arab world. Beyond theoretical issues, the major objective of my paper is to identify some of the macroeconomic variables that Arab countries could manipulate to reduce CO from the region. On the basis of pooled data from 10 Arab countries covering a period of ten years, the paper concludes that macroeconomic variables such as the exchange rate, the rate of growth of real GDP, interest rate, the rate of inflation and net foreign assets, do have some impact on CO from the region.

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