Efficiency and Productivity Growth in Turkish Commercial Banking Sector: A non-parametric approach[1]

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ABSTRACT

The financial liberalisation policies adopted in 1980 brought radical changes to the heavily regulated commercial banking sector in Turkey. The sector attracted many domestic and foreign banks, which created vigorous competition. As a result, increased competition in the market raised important questions on bank performance and efficiency. In this context, we aim to analyse the technical efficiency and productivity change over the period 19992-1996. Utilising non-parametric methodologies, Data Envelopment Analysis (DEA) and DEA based Malmquist indices, we estimate the individual bank efficiencies and productivity changes which took place within this period. Further, we decompose the productivity index into frontier shifts (technical change) and catching up (technical efficiency) components.

Keywords: *Efficiency; productivity; Data Envelopment Analysis; Malmquist index; banking; Turkey.*

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1. Introduction

The banking sector in Turkey was heavily regulated before the '1980 Stabilisation Program' was initiated. Entry to the sector by domestic and foreign banks was highly restricted, along with strictly regulated interest rates. This lack of interest rate competition pushed banks to compete with an increased number of branches across Turkey which created excess employment in banking.

The main objective of the economic reforms in the '1980 Stabilisation Program' was to create a free market economy. The financial policies undertaken aimed in particular to increase efficiency by stimulating competition in the banking sector. Therefore, interest and foreign exchange rates were significantly liberalised and new entries from both domestic and foreign banks were allowed. As a result, the competitive environment aimed at by the Program also emerged in the Turkish banking sector.

With liberalisation, the number of banks increased from 42 in 1981 to 56 in 1996. Due to the increasing concern to reduce costs, the closing of unprofitable bank branches were encouraged and the number of employed in the sector was reduced. However, the state still plays a major role in Turkish banking. It is the owner of five commercial banks in 1996 and these banks own 38% of total assets. (Banks Association of Turkey, 1996 and Zaim, 1995).

It seems that the liberalisation policies also motivated the expansion of banking services in the private sector. The market share of private banks in terms of assets increased from 50% in 1981 to 53.1% in 1996. On the other hand, the share of total assets owned by foreign banks remained unchanged, 3% if compared with the 1981 and 1996 figures. (Banks Association of Turkey, 1996 and Zaim, 1995). It is strongly suggested that the decline in the number of employees as a result of structural improvements in the high-tech investments increased the productivity performance of Turkish banking.

Turkish banking system consists of commercial banks, investment and development banks. Commercial banks, however dominate the banking system in Turkey. In 1996, they owned the 94% of the total assets of all banks whereas the investment and development banks possessed only 6%. Turkish commercial

banking is particularly interesting in the sense that it consists of different ownership forms: state-owned, privately-owned and foreign owned banks.

The coexistence of state, private and foreign banks provide us a good opportunity to establish a relationship between productivity performance and ownership forms. In this study, therefore, we only focus on the commercial banks in Turkey. Moreover, it is of great interest to investigate the recent productivity record of Turkish banking to assess the results of liberalisation reforms in the 1990s. To measure productivity performance, we utilise Data Envelopment Analysis (DEA) based Malmquist indices in a panel data. Further, we decompose any productivity change into the effects of technological advancement and to changes in technical efficiencies.

This study is organised as follows: in section 2, the Malmquist index is defined and DEA methodology is briefly introduced. Section 3 introduces the data and discusses the selection of the variables. Section 4 presents the empirical findings. Finally, in section 5 we conclude with a brief discussion of the policy implications of our empirical findings.

2. Methodology

2.1 The Malmquist Index

The Malmquist index was originally presented in the consumer theory context by Malmquist (1953). This index is also called the quantity index since it is interpreted as a ratio between two proportional scaling factors or distance functions. The idea of using distance functions in productivity analyses was developed by Caves, Christensen and Diewert (1982) in a general production function framework. They introduced two types of productivity, namely an output-based and an input-based index. Caves et al defined productivity as a geometric mean of two Malmquist indexes expressed in distance functions. The component distance functions then are equivalent to the reciprocal to Farrell's (1957) measures of technical efficiency. Building on this work, Färe and his colleagues (1990, 1992 and 1994) developed empirical models to directly calculate the Malmquist index using Farrell's (1957) efficiency measures.

Contrary to Caves et al, their models do not require any assumption on the economic behaviour of production units. That means there is no need to assume that the firms are cost-minimising or revenue-maximising. There is also no requirement on the resource prices. This is a distinct advantage when prices information is unavailable or when prices are distorted. Again, in contrast to Caves et al, Färe et al's productivity index can be decomposed into two components, one measuring the change in efficiency (the catching up effect), the other measuring the technological change (the frontier effect). This is an important contribution in that it provides insight into the measurable sources of productivity change.

To construct the Malmquist index for a panel data set, we can use two methods which refer to the adjacent and the fixed-based periods. With the adjacent method, the Malmquist index is calculated for each period, for example for adjacent periods t+1, t; for adjacent periods, t+2, t+1, continuing to the end of the sample. In the fixed based version, the Malmquist index is calculated for all periods but to a relative fixed base period. Even though these two methods generate the same values for the relative technical efficiency change component, they can produce different values for the technical change component if the production frontiers coincide. The Malmquist productivity index, then, differs for these frontiers. Figure 1 below

illustrates the construction of the Malmquist index for bank K which uses the inputs, x and x+1 in periods, t and t+1 to produce the output y and y+1.

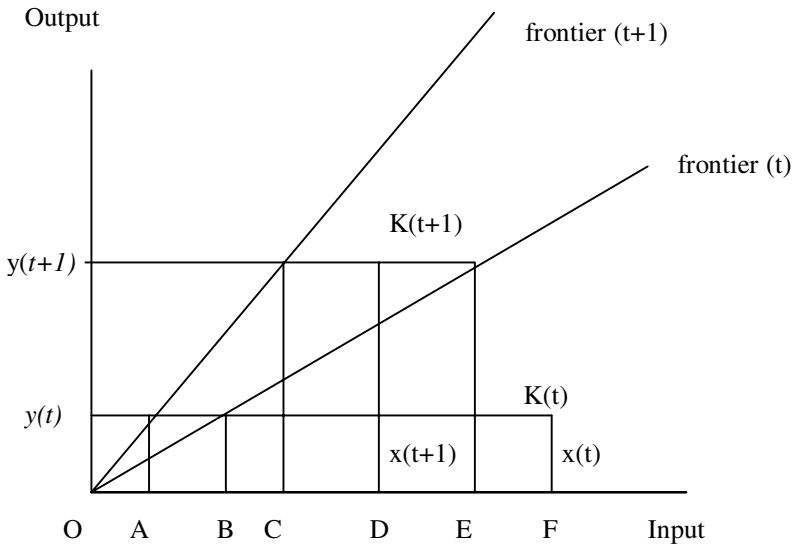


Fig 1. Construction of Malmquist productivity index

K(t) and K(t+1) are the bank's input-output bundles for the periods t and t+1. Between these bundles in time, the frontier shifts from f(t) and f(t+1). K(t) is an inefficient bundle when compared relative to frontier t. However K(t) can be efficient if it is reduced by the horizontal distance function OB/OF. If the situation is compared with period, t+1, K(t+1) should be multiplied by the horizontal distance ratio OD/OE. The reason is to obtain a comparable technical efficiency. Since there has also been a movement in the frontier, OD/OE is now above f(t). However K(t+1) is still inefficient when compared with its own frontier, t+1. As a result, the Malmquist index can be constructed with the ratio of these two distance corrections between t and t+1, that is

$$M = \frac{D_{t,t+1}}{D_{t,t}} \qquad (1)$$

or it can be defined as

$$M = \frac{OE / OD}{OB / OF}$$

The Malmquist index of growth can be decomposed into two components: MC, which represents the catching-up effect or the change in efficiency relative to the frontier, is computed by the relative efficiency distances of each bank from its own frontier:

$$\text{MC} = \frac{D_{t+1,t+1}}{D_{t,t}} = \frac{OC / OD}{OB / OF} \tag{2}$$

while MF, which denotes the frontier shift effect or the technical change effect, is computed by the relative distance between the frontiers, between t and t+1, or between the pre- and post-liberalisation periods:

$$\text{MF} = \frac{D_{t,t+1}}{D_{t+1,t+1}} = \frac{OE / OD}{OC / OD} \tag{3}$$

As a result, the total productivity growth, M, is the product of MC and MF:

$$\text{M} = \left[\frac{OC / OD}{OB / OF}\right] * \left[\frac{OE}{OC}\right]$$

$$\text{M} = \text{MC} * \text{MF} \tag{4}$$

The Malmquist index will indicate productivity growth when the index is more than unity and productivity decline when it is less than unity.

2.2 Computing Malmquist Productivity Indices using DEA

The component distance functions shown in figure 1 are the reciprocal of Farrell's (1957) measure of technical efficiency. This seminal work of Farrell's has been extended to different methodologies to measure relative efficiency. Data Envelopment Analysis (DEA) is one of the methodologies initiated by Charnes, Cooper and Rhodes (1978). DEA is non-parametric, which does not require any functional form. Using linear programming techniques, this method could handle multiple inputs and multiple outputs.

In this study, we will utilise the strength of DEA to establish the non-parametric frontier which could be used as a benchmark for efficiency measures. The component distance functions of the Malmquist index will then be computed on the basis of these DEA efficiency measures. DEA methodology has been applied to many hundreds of studies (see Seiford, 1996 for an extensive bibliography). The

main focus, however, has been on cross-section analyses. DEA-based Malmquist productivity indices have recently gained popularity in the panel data applications to question the influence of certain government policies. [See Berg et al (1990) for the deregulation of Norwegian banking, Price and Weyman-Jones (1996) for the privatisation in UK gas industry, and Grifell-Tatje and Lovell (1996) for the deregulation of Spanish savings banks].

Within the DEA framework in this study, we aim to examine the productivity performance of Turkish commercial banks over the period 1992-96. Furthermore, we decompose productivity change into two components: the catching up effect and the frontier-shift effect. This is important in the sense that the growth in productivity over time can be attributed either to banks' catching up with their own frontier or the frontier's shifting over time, or both. Since DEA-based Malmquist indices have the property of being a local index, both productivity change and its sources can be allowed for bank-specific and time-varying. (Lovell, 1996: 338).

Having adopted the framework from the studies by Färe et al (1992) and Price and Weyman-Jones (1996), we can classify the observations either into A, and B periods, or state them as pre- and post-deregulation periods. In our case, period B is regarded as the base year, t (i.e. 1992), and period A, t+1 (the consecutive years). We assume input saving measures due to the Turkish commercial banking sector's expressed interest in reducing cost.

To obtain the DEA efficiency scores, the LP problems can be stated as follows:

- Efficiency of a bank in period t+1

$$\min \ \theta^{A}$$

$$\text{s.t. } X^{A}\lambda^{A} - \theta^{A-}x^{A} \leq 0$$

$$\mathrm{Y}^{A}\lambda^{A} \geq y^{A}$$

$$\lambda^{A} \geq 0 \qquad (5)$$

where θ^{A} represents the relative efficiency of a bank in period A compared to the period A frontier.

- Efficiency of a bank in period t

$$\min \ \theta^{B}$$

$$\text{s.t. } X^{B}\lambda^{B} - \theta^{B-}x^{B} \leq 0$$

$$Y^B \lambda^B \geq y^B$$

$$\lambda^B \geq 0 \qquad (6)$$

where θ^B represents the relative efficiency of a bank in period B compared to the period B frontier.

- Efficiency of a bank in t+1 period relative to the t period

min θ^C

s.t. $X^B \lambda^C - \theta^{C-} x^A \leq 0$

$$Y^B \lambda^C \geq y$$

$$\lambda^C \geq 0 \qquad (7)$$

where θ^C represents the relative efficiency of a bank in period A compared to the period B frontier. The Malmquist index of productivity change, M is then decomposed into: the catching up effect, MC and the frontier effect, MF:

$$M = \frac{\theta^C}{\theta^B}$$

$$= \frac{\theta^A}{\theta^B} * \frac{\theta^C}{\theta^A} \qquad (8)$$

$$= MC * MF$$

3. Bank data

Our data set is compiled from the annual publications of the Banks Association of Turkey where income statements and balance sheets are provided for each bank. In 1996, there were 56 commercial banks in total. According to the availability of data, we included the entire population of state banks, 76 percent of private banks, and 33 percent of foreign banks in our sample. As a result, we have usable data for 38 commercial banks over the 1992-96 period.

In the banking literature, there is no consensus on the specification of bank outputs. The main disagreement concentrates on whether deposits should be treated as inputs or outputs. Our selection of variables in this study is mainly guided by the objectives of the Turkish banking system. In Turkey, commercial banks act as intermediaries with the objective of collecting deposits. This was highly significant in the pre-liberalisation period where there was no price competition. However, the role of deposits as the traditional main source of funds is still prevalent in the post liberalisation period. We treat them as outputs since deposits are regarded as 'resource-consuming activity', and thus contain a significant portion of the value added in the Turkish banking system. This also corresponds to the 'value added' approach to bank modelling suggested by Berger and Humphrey (1992), Berg et al (1991, 1992) and Grifell-Tatje and Lovell (1997).

The alternative approach to bank modelling is the 'production approach'. This approach treats banks as firms which utilise capital and labour inputs to produce physical quantities of outputs, whereas in the value added approach, outputs are measured in value terms. [See Berger et al. (1987) for a comprehensive discussion of alternative approaches].

In this study, we adopt Grifell-Tatje and Lovell's (1997) value added approach to specify the inputs and outputs. The number of employees, and the sum of non-labour operating expense, the direct expenditure on buildings and amortisation expenses are specified as the two inputs whereas the outputs are the loans, demand deposits and time deposits. Descriptive statistics for all five variables are provided for three ownership forms in Table 1; all output variables and non-labour operating expenses are measured in billions of US dollars.

Table 1. ***Summary statistics for Turkish Commercial Banks, 1992-1996***

1992	**NEMP**	**NONLOP**	**LOANS**	**DEMDEP**	**TIMDEP**
Pooled sample (38 banks)					
MEAN	3755.658	47.13158	426.6053	275.5526	644.4737
STD. DEV.	7307.914	95.82167	546.6826	509.307	1027.014
MIN.	63	1	2	2	1
MAX.	38969	471	2216	2570	4850
State (6 banks)					
MEAN	13037.17	180.6667	732	832.6667	2110.333
STD. DEV	13797.94	192.5769	629.2602	908.4124	1579.276
MIN	788	20	99	115	688
MAX	38969	471	1814	2570	4850
Private (25 banks)					
MEAN	2494.92	26.6	457.4	212.44	464.44
STD. DEV	3993.357	31.85383	558.7499	356.9527	651.8812
MIN	63	1	14	4	11
MAX	16880	110	2216	1447	2497
Foreign (7 banks)					
MEAN	302.7143	6	54.85714	23.42857	31
STD. DEV.	463.7865	9.780934	75.86485	33.49058	56.95027
MIN.	70	1	2	2	1
MAX.	1347	28	215	96	158

1993					
Pooled sample (38 banks)					
MEAN	3667.5	49.44737	490.0789	289.4474	622.2895
STD. DEV.	7106.162	126.956	608.0734	509.4954	1005.158
MIN.	62	1	1	2	1
MAX.	38203	766	2467	2570	4991
State (6 banks)					
MEAN	12758.83	176.8333	604.3333	836	1897.333
STD. DEV	13531.53	291.8982	466.1406	916.7438	1820.57
MIN	792	2	1	7	7
MAX	38203	766	1241	2570	4991
Private (25 banks)					
MEAN	2452.84	31.52	583.84	233.04	481.32
STD. DEV	3743.019	45.85586	675.5917	355.0246	581.4237
MIN	178	4	57	15	46
MAX	16243	213	2467	1444	2035
Foreign (7 banks)					
MEAN	213	4.285714	57.28571	22.42857	32.85714
STD. DEV.	230.553	5.707138	71.86031	33.15548	47.96328
MIN.	62	1	5	2	1
MAX.	718	17	203	95	136

Table 1 (continued)

1994	NEMP	NONLOP	LOANS	DEMDEP	TIMDEP
Pooled sample					
MEAN	3569.658	37.63158	342.2895	230.7105	627.9474
STD. DEV.	6857.994	61.42912	476.3695	380.393	1028.709
MIN.	54	1	3	7	2
MAX.	36954	318	1944	1605	5143
State (6 banks)					
MEAN	12410.33	109.6667	514	572	1825.333
STD. DEV	13049.11	112.9879	481.2816	582.8331	1859.628
MIN	703	5	3	7	24
MAX	36954	318	1298	1605	5143
Private (25 banks)					
MEAN	2355.52	29.56	386.76	205.68	508.32
STD. DEV	3581.436	38.28847	513.9442	332.0301	657.608
MIN	129	4	28	9	23
MAX	15538	177	1944	1439	2234
Foreign (7 banks)					
MEAN	328.1429	4.714286	36.28571	27.57143	28.85714
STD. DEV.	516.4034	6.550173	53.27825	31.98363	45.80549
MIN.	54	1	6	7	2
MAX.	1490	19	155	94	131
1995					
Pooled sample (38 banks)					
MEAN	3610.342	40.84211	483.7105	286.5263	865.5
STD. DEV.	6670.339	59.16332	613.6037	447.7959	1336.021
MIN.	52	1	6	6	8
MAX.	35962	282	2553	2040	6989
State (5 banks)					
MEAN	14539.8	103.4	840.4	831.2	3014.6
STD. DEV	12772.64	71.84219	521.7454	731.7566	2490.575
MIN	2436	15	68	155	313
MAX	35962	209	1512	2040	6989
Private (26 banks)					
MEAN	2389.077	38.26923	529	248.9615	666.8077
STD. DEV	3354.859	56.66502	659.1056	363.7833	711.1162
MIN	258	5	51	12	81
MAX	14858	282	2553	1598	2528
Foreign (7 banks)					
MEAN	339.7143	5.714286	60.71429	37	68.42857
STD. DEV.	482.1887	5.992058	81.1618	46.68333	61.02966
MIN.	52	1	6	6	8
MAX.	1413	17	235	135	188

Table 1 (continued)

1996	NEMP	NONLOP	LOANS	DEMDEP	TIMDEP
Pooled sample (38 banks)					
MEAN	3677.474	64.42105	622.1579	390.3421	1089.921
STD. DEV.	6396.643	152.8314	732.4952	707.6303	1673.897
MIN.	53	2	12	4	7
MAX.	34566	928	2926	3488	9121
State (5 banks)					
MEAN	14056.8	264.8	891.6	1517.2	3519.8
STD. DEV	12261.9	376.8179	675.5992	1358.132	3528.909
MIN	2231	3	19	15	55
MAX	34566	928	1778	3488	9121
Private (26 banks)					
MEAN	2572.923	41.19231	719.1923	269.1538	885.3846
STD. DEV	3248.179	48.3504	780.2728	375.6464	809.9789
MIN	336	4	82	10	136
MAX	14137	228	2926	1520	2897
Foreign (7 banks)					
MEAN	366.2857	7.571429	69.28571	35.57143	114
STD. DEV.	520.614	8.202787	98.7146	40.04521	173.5723
MIN.	53	2	12	4	7
MAX.	1518	20	291	111	501

Notes: NEMP: Number of employment; **NONLOP:** Non labour operating expenses; **DEMDEP**: Demand deposits; **TIMDEP**: Time deposits

It is apparent from the table that the Turkish commercial banking sector experienced growth with the exception of 1994. The banking sector in Turkey in this year has contracted sharply due to the economic crisis. This shows up with a drastic fall in demand deposits and loans, with 20.3% and 36.3% respectively. However, the sector recovered in 1995 when stability and economic growth were established. The use of funds increased from abroad but still remained insufficient. Hence, deposits constituted the source of growth in 1995 and 1996. (Banks Association of Turkey, 1996).

Another feature of data is related with the trend to substitute labour with non-labour inputs. The number of employed in the sector declined between 1992 and 1996 whereas non-labour operating expenses in 1996 boomed with high-tech investments in banking.

The last feature of the data is that there are enormous variations among banks in the sample. This is evidenced by the large standard deviations of the variables. It is interesting to note that state banks dominate over the period with respect to the

input and output variables even though they constitute the smallest portion in the sample. As part of the Turkish privatisation program, a state bank, Sumerbank, was privatised in 1995 and the number of state banks dropped to 5 in 1996.

4. Empirical findings

4.1 Estimation of Malmquist Productivity Indices

In this section, we examine the performance of Turkish commercial banks in terms of their ability to provide outputs with minimum input consumption. We solve the linear programs described in Section 3.2 to compute the input distance functions which are required to construct the Malmquist productivity index. Table 2 compares the efficiency scores under different scale assumptions. It seems that a greater number of banks appear efficient under the variable returns to scale technology in each year. In 1992, for example, more than half of the entire sample appears efficient, including 67 percent of the largest state banks. Nevertheless, in the same year, under CRS technology, only 18 percent of the banks appear efficient.

Table 2. ***Number of efficient banks under different technologies***

	1992		**1993**		**1994**		**1995**		**1996**	
Ownership form	**CRS**	**VRS**	**CRS**	**VRS**	**CRS**	**VRS**	**CRS**	**VRS**	**CRS**	**VRS**
State	2	4	1	3	1	2	1	3	1	3
Foreign	5	12	4	11	8	10	6	11	8	4
Private	-	4	-	3	1	3	-	2	-	11
Total	**7**	**20**	**5**	**17**	**10**	**15**	**7**	**16**	**9**	**18**

Notes: CRS: Constant returns to scale; **VRS:** variable returns to scale

In our study, we assume CRS technology in order to compare large banks with smaller ones. A study by Zaim (1995) also reports that Turkish banking operates at the CRS in both pre- and post-liberalisation periods. Zaim (1995) selects only 2 representative years (1981 and 1990) to distinguish the pre- and post-liberalisation eras and compares the efficiency scores of different organisation forms and their scale adjustments. There are contrary results in other countries. Bhattacharyya et al (1997) for Indian commercial banks, and Drake and Weyman-Jones (1992) for UK building societies report that most banks in their samples operate at DRS.

It is worth to note that the efficiency results in Table 2 belong to each year separately. Therefore, we cannot make inferences regarding the change in absolute efficiency over time. Hence, this leads us to the construction of the Malmquist productivity index which would provide not only the efficiency changes which evolve through time, but the sources of changes too.

Table 3 below summarises the Malmquist productivity index. We apply the fixed-base version of the Malmquist productivity index and select 1992 (the first year in our sample) as a base year. Therefore, assuming the productivity of all banks to be equal to 1 in 1992, we proceed to compute the productivity change between the base year and the successive years. We utilise the nonparametric strength of DEA to compute the technical efficiency scores which will be used to construct the Malmquist productivity index (M). The computations were carried out with the Warwick DEA Software.

We note that since the Farrell technical efficiency measure is the reciprocal of the input distance functions, M>1 will represent productivity growth or gain, but productivity regress when M<1.

Table 3. ***Characteristics of Malmquist indices***

1992-93	**M>1**	**M<1**	**M=1**
State	1	4	1
Private	16	7	2
Foreign	5	2	0
Total	22	13	3
1993-94			
State	1	5	0
Private	10	14	1
Foreign	5	2	0
Total	16	21	1
1994-95			
State	3	2	0
Private	12	12	2
Foreign	6	1	0
Total	21	15	2
1995-96			
State	3	1	1
Private	14	8	4
Foreign	6	1	0
Total	23	10	5

Notes: M>1 productivity growth**; M<1** productivity regress**;**
M=1 no change

Table 3 shows that the Malmquist index varies across the sample. Of 38 banks in the 1992-93 period, 22 show productivity growth and 13 show productivity regress. The productivity of 3 banks stay at 1 in 1993, that is, they do not show any

productivity change. However, the number of banks which show productivity growth decrease to 16 in the 1993-94 period. This could be explained by the economic crisis in 1994 which badly affected the banking sector, thus caused contraction in the system.

High real growth in the Turkish economy, and thus in banking, was achieved in the later periods, that has also reflected onto the productivity indices. The total number of banks with productivity growth increases to 21 and 23 in the 1994-95 and 1995-96 periods respectively. The number of banks which experience regress in 1995-96 also decrease from 15 to 10 in 1994-95. The productivity indices of 5 banks in the last period do not show any change. As a result, with the exception of 1993-94, most Turkish commercial banks experience productivity growth. Zaim's (1995) study on the Turkish commercial banks also reports efficiency increase between 1981 and 1990, the representative selection of the pre- and post-liberalisation years.

Utilising the decomposition property, more explanation can be provided on the sources of productivity growth. Recall that MC and MF are the technical efficiency (catching up) and technological efficiency (frontier shift) changes respectively. Using this information, we were able to examine the sources behind the productivity growth or regress. Productivity growth can be achieved either by an increase in technical efficiency or the upward shift in the frontier (a technological change), or both. On the other hand, productivity loss can be attributed to technical efficiency decrease or technological regress, or both.

A close inspection of Table 4 below indicates that the source of productivity growth mainly stems from the frontier shift in the 1992-93 period. Of 22 banks, there are 13 achieve productivity gain due to the technological advancements in the sector. The rest of the banks improved productivity due to an increase in their technical efficiencies. In the same period, only 2 banks show a loss due to technological regress whereas the rest (11 banks) show a loss because of technical inefficiencies. In other words, the banks exhibit productivity gain due to the technological progress, but those, which exhibit loss, do so because of their technical efficiencies being low.

Table 4. ***Major sources of productivity growth or regress***

Period 1992-93		**Loss**		**Gain**		
Org. form	**No. of banks**	**MC**	**MF**	**MC**	**MF**	**No change**
State	6	3	1	1	0	1
Private	25	6	1	7	9	2
Foreign	7	2	0	1	4	0
Total	38	11	2	9	13	3
Period 1993-94						
State	6	1	4	1	0	0
Private	25	6	8	10	0	1
Foreign	7	2	0	5	0	0
Total	38	9	12	16	0	1
Period 1994-95						
State	5	1	1	3	0	0
Private	26	11	1	12	0	2
Foreign	7	1	0	5	1	0
Total	38	13	2	20	1	2
Period 1995-96						
State	5	1	0	1	2	1
Private	26	8	0	12	2	4
Foreign	7	1	0	6	0	0
Total	38	10	0	19	4	5

Notes: MC: technical efficiency change**; MF:** technological change

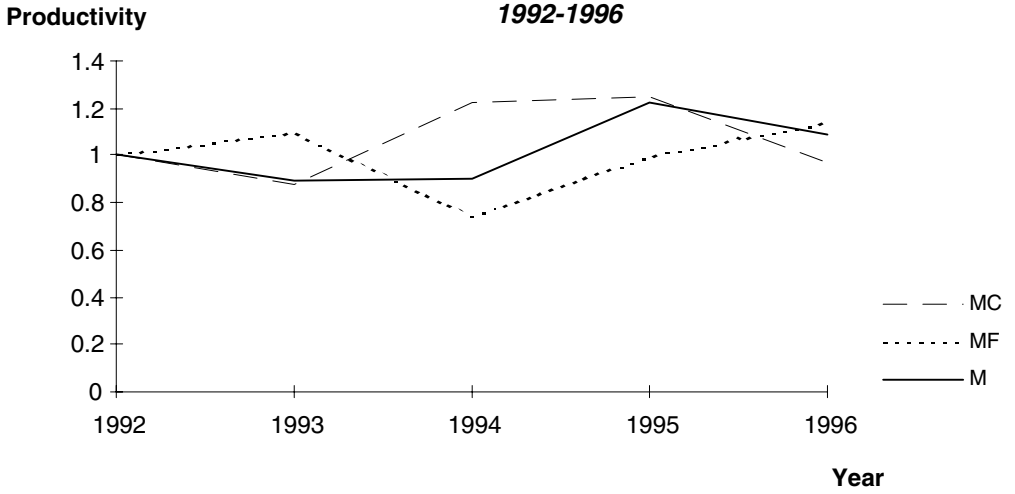
Nevertheless, the situation changed drastically for the next periods. It seems that the predominant source of productivity growth is the change in technical efficiencies with the exception of 1993-94. Interestingly, this year also reports a productivity loss which is explained by the decrease in technical efficiencies. This is probably due to the fact that the banks could not cope with the changing economic environment which arose from the economic crisis in 1994. However, with the establishment of stability and economic growth, which reflected onto the structural improvements in the industry, it is observed that the main source of productivity growth is that the banks improved their technical efficiencies in the last two periods. High tech investments played a crucial role in banks' efficiency increase and thus productivity growth in the years 1995 and 1996.

Table 5. ***Productivity growth in Turkish Commercial Banking Sector, 1992-1996***

Overall Malmquist index, *M*	1.02218
Catching up effect, *MC*	1.06222
Frontier shift effect, *MF*	0.99576

Table 5 describes the overall Malmquist indices results based on the weighted means of θ^A, θ^B and θ^C. This indicates that the productivity growth was achieved in Turkish commercial banking over the period. Further dissagregation of this figure shows that the observed productivity growth is associated with the increase in the technical efficiencies or catching up of individual banks.

Fig. 2 ***Malmquist indices of Turkish Commercial Banking 1992-1996***



In the figure we plot the output weighted mean Malmquist index and show the output weighted catching up and output weighted frontier shift effects between the years, 1992-96. The dark line (Malmquist productivity index, M) shows an increasing trend, again with the exception of the period, 1993-94. It is important to note that the productivity growth decreased from 1.23 in 1995 to 1.09 in 1996. Still, productivity growth is achieved, but in this case, it is the frontier shift or technological advancements which caused this achievement. A further research is needed to identify what characterises these shifts in the frontier. It is evident that the sector was marked by major developments in the high tech banking operations which shifted the frontier upwards.

4.2 Ownership Issues in Turkish Commercial Banking

Radical reforms in the regulatory environment and privatisation attempts have made the Turkish commercial sector rather attractive. The coexistence of different ownership forms in the Turkish commercial banking sector provides us with another opportunity to evaluate the relative performance of public and private banks. Judging from the observed productivity differentials across banks, we expect to find variations across groups of banks. Therefore, we further analyse the possible relations between productivity and three ownership forms, which has been postulated by the property rights (Alchian, 1965) and public choice literatures (Niskanen, 1971). They suggest that public ownership has the inability to influence the incentives to reduce costs so that private ownership is more productively efficient than public ownership.

Theoretically, the recent trend towards privatisation is justified on these grounds. The large number of studies which have been conducted to investigate the effect of ownership on the performance of public and private companies, has not produced clear-cut results. [See the surveys in Vickers and Yarrow, 1988 and Boardman and Vining, 1989]. Some authors suggest that it would be wrong to judge efficiency purely on the ownership effect. According to Jackson and Price (1994:26) 'competition rather than privatisation per se seems to be the main stimulus to the efficiency improvements'.

In this section, specifically we aim to investigate whether ownership matters or not in the Turkish commercial banking sector. The table below provides a summary to show the frequency of the banks which achieved productivity growth in different periods. Of the 18 banks which achieve productivity growth in more than 2 periods, the majority is private banks. The 12 privately owned banks constitute the 67% of the total. Foreign banks and state owned banks, however achieve only 28% and 5% respectively. There was only 1 state bank which records productivity growth in 4 periods. However, the 3 state banks achieve productivity growth only in 2 periods: 1995 and 1996.

Table 6. ***Number of banks with bank productivity growth***

). of Periods	State	Foreign	Private	Total
4	1	4	6	11
3	0	1	6	7
2	3	1	5	9
1	0	1	5	6
0	2	0	3	5

It seems that the state banks are also affected by the overall improvement in the sector. The rest of the state banks do not achieve any growth in any of the periods. It is interesting to note, however that even though a state bank, Sumerbank, never experienced productivity growth within our study period, it is observed that there was a drastic increase in this banks' productivity indices after the company was privatised in 1995. The bank suffered from productivity loss in the pre-privatisation period with Malmquist productivity indices of 18.6% and 11.9% in the years 1993 and 1994. However, in the post privatisation period, the productivity jumped to 77.9% and 88.5% in the years 1995 and 1996 respectively.

5. Conclusion

We have analysed productivity growth in the Turkish commercial banking sector during the period 1992-96 within the framework of the Data Envelopment Analysis and DEA-based Malmquist productivity index. This has allowed us to analyse not only the productivity performance of the sector, but also the sources of any productivity change which occurred in the sector.

In general, Turkish commercial banking experienced productivity growth with the exception of 1993-94. That productivity loss in the sector can be attributed to the economic crisis that contracted the banking system in Turkey. Overall, the decomposed figures indicate that there was little productivity growth at the frontier. The major investments in high tech bank operations however, shifted the frontier upward only in the final year of the sample period. Nevertheless, the substantial improvements occurred in the relative efficiency of most banks during the period.

The observed productivity differentials can also be explained by the different forms of organisation. Among the three ownership types, private and foreign banks showed greater productivity growth compared to state owned banks. Sumerbank, which was privatised in 1995, experienced enormous productivity growth in the post privatisation period.

Our analysis, which aimed to investigate the recent productivity record of Turkish commercial banking in 1992-96, concluded that in the post liberalisation era, productivity growth had been observed. The increase in the productivity of both private and state owned banks were due to the technological advancements, that is, the outcome of the competition which arose in the post-liberalisation era.

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