

**Performance of Telecommunication Firms Following Ownership Restructuring via
Privatization**

by

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Abstract

Resolution of the continuing debate on whether or not ownership changes accompanying privatization events lead to performance improvements of firms requires newer approach to address this very significant current research question. This paper reports findings using two parallel methods namely financial measures and production efficiency measures to pin down if both approaches could corroborate stronger evidence for or against maintained hypothesis of performance improvements. The performance gains/declines over four years before and four years after privatization of a large sample of telecommunication firms around the world are tested. The overall finding indicates significant improvements in both financial performance and production efficiency. Further research is warranted to extend this parallel-methods approach to other firms in other industries.

Key words: Ownership; DEA Malmquist; productivity gains; telecommunications; technical efficiency; total factor productivity; financial performance

JEL Classification: G11

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1. Introduction

This paper reports new findings on *corporate performance* assessed as both financial performance and production efficiency of a large sample of telecommunication firms from forty countries. The ownership and management control of these state-owned firms passed to private sector following their privatization. An assessment of performance and efficiency gains before and after privatization, while useful for public policy debate, is expected to reveal whether privatization, thus ownership-cum-management changes in these firms, actually help to secure performance gains. Evidence on financial performance gains have been alleged in few recent studies (Megginson *et al.*, 1994; Madden and Savage, 1999; Harper, 2001; and Ariff and Cabanda, 2002) and earlier ones.

This paper attempts to include both financial performance *and* production efficiency measures. Efficiency in securing total factor productivity, TFP, thus the ability of management to secure output values greater than the input values, is widely accepted as a very precise measure of efficiency of operating a firm. It is based on classical economics theory of production function (Box-Cox). Some evidence from this method are reported in recent literature relating to service industries such as government agencies (libraries, hospitals, etc.), and banks. There is as yet a study using both financial and production measures applied to a large sample of firms from any industry, over a lengthy period of about ten years: we use telecommunication firms. The finding reported here expands performance assessment debate by employing two parallel measures.

Section 2 provides a brief literature review on privatization with references to selected papers on service industries including telecommunications. Section 3 describes the research methods and the data: it also includes a description of production efficiency and financial performance ratios. The findings are presented in Section 4. Significant changes in performance, both financial and production, are reported, indicating strong support for performance and efficiency gains hypothesis of privatization. Section 5 is a summary assessment drawing some inferences from the results reported in this paper.

2. Corporate Performance and Production Efficiency Theory & Evidence

Corporate performance is traditionally analyzed using accounting-cum-financial measures: Madden and Savage *op cit.* and Ariff and Cabanda *op cit.* are such studies using telecommunication firms *before* and *after* privatization. The traditional measures applied include return on equity (ROE), return on asset (ROA), profit margin, etc., all of which can be extended by using decomposition of these ratios to derive other ratios. While under state ownership, firms are known to incur losses, hence such profit-based ratios are seldom useful. A number of studies has reported results from applying *production efficiency* measures, TFP and others, to study performance. TFP method is well-grounded in economics literature as production theory. The DEA-Malmquist method, which will be detailed in the ensuing pages, is a non-parametric version of the long-established production function described as Box and Cox model.

The TFP measures obtained by applying DEA-Malmquist ratios can be shown to be the product of (a) efficiency change (EFFCH) and (b) Technical change (TECHCH). Efficiency change, which occurs from adopting newer and better technology, is the

TECHCH whereas efficiency gain from managerial efficiency is indicated by the EFFCH. In the literature popularized by the original work of Fare *et al.* (1994), the TECHCH is referred to as efficiency due to innovation: hence an efficiency gain from *non*-innovation from technology is assumed to arise from managerial efficiency.

It could be hypothesized that production efficiency of a firm before and after ownership restructuring following privatization may be investigated carefully by decomposing production efficiency, the TFP, as being driven by two efficiency measures. If a privatized entity is able to show both financial performance gains *and* efficiency improvements after privatization is implemented, such results would suggest a stronger evidence of the effect of privatization on corporate performance. Further, any evidence about gains in managerial efficiency (EFFCH) as well as technical efficiency (TECHCH) would enable a researcher to make stronger inferences about corporate performance than would be the case by simply examining financial performance ratios.

Several papers in the literature examine privatization effect and its associated causes. Villalonga (2000) is a significant article which includes macro-level variables to account for ownership change effect associated with privatization. Most of the reported findings in the literature is limited to examination of financial performance or production efficiency of few selected industries over short periods. That too, not many report measurements before and after privatization. Financial indicators of performance over short periods have also been the primary focus of reports while a growing number of reports have begun to apply Data Envelopment Analysis (DEA), which is a non-parametric method to characterise the Box-Cox production function without the strong parametric assumptions needed in the latter. Boussofiane (1997) is a specific example of

an application – limited to technical efficiency – to study production efficiency relating to ownership changes and corporate performance. Charnes *et al.* (1978) was the first to apply this approach to not-for-profits U.S. organizations.

Madden and Savage, (1999); Harper, (2001); and Ariff and Cabanda, (2002) Villalonga (2000) Boussofiane (1997) Charnes *et al.* (1978) and Banker *et al.* (1984) adapted the original DEA method to study efficiency under variable returns to scale: the original DEA assumed constant returns to scale. Fare *et al.* (1994) applied this method to 17 OECD countries estimating a world frontier for a sample of industrial firms to study productivity trends. Their conclusions drawn from this method about U.S. productivity growth as being slightly higher than that of the world average is widely cited: they attributed that to technical efficiency (TECHCH). Japan's productivity efficiency was the highest in that study with almost half coming from technical efficiency.

Several studies applied this method to banking industry: Rebelo *et al.* (2000); Griffel-Ttji and Lovell (1997); Fukuyama (1995); Miller and Noulas (1994); Banker *et al.* (1984); Chu and Guan (1998); and Quey-Jen Yhe (1996). Rebelo (2000) on Portuguese banking reported that small and large banks experienced higher productivity and technical efficiency while mid-sized banks' productivity gains were due to catching-up policies, i.e. adopting technical changes. Miller and Noulas (1994) studied 201 banks and reported relative technical efficiency which suggested that larger and more profitable banks have higher levels of technical efficiency. Fakuyama (1995) suggests that productivity gains of Japanese banks were primarily due also to technical change: thus, productivity losses were due to efficiency reductions and not due to technical regression. Also see Griffel-Ttje and Lovell (1997) for a study of Spanish banks. Thus, the study of

banking sector provides evidence indicating contemporary gains in production efficiency (also gains in financial performance) is largely due to adoption of newer technology, and not due to improved management efficiency.

Norwegian motor vehicle inspection agencies were studied by Odeck (1999): these firms reduced input volumes and thus, increased capacity resulting in production efficiency. Again that was due to garnering technical change, as also shown in the OECD study. That study also observed that efficiency scores are not affected by the size of agencies. Chirikos and Sear (2000) examined acute-care hospitals in the U.S. and found evidence for hospital efficiency although individual characteristics of specific hospitals did explain why some of the hospitals did not gain efficiency. Mahadevan (2002) found that service sector output growth in Singapore is largely input-driven with a negative TFP growth over the time period 1975-1994. Thus some studies have shown failure to gain improvements.

Employing total factor productivity measures – along with the financial ratios – has the potential to characterize whether telecommunications firms could secure performance gains *after* privatization. A beginning has been made by few researchers using telecommunications firms in this regard. Madden and Savage (1999) obtained results for a large sample of firms using financial ratios only. Countries with low-level telecommunications development enhanced telecommunications productivity growth through catching-up and innovation for high-income countries. Ariff and Cabanda (2002) estimated financial ratios to study telecommunication performance across Asian entities.

3. Methodology

As remarked in an earlier section, production efficiency is a legitimate measure of corporate performance since it addresses a firm's ability to make informed choices to combine valuable inputs to maximize output(s) of a firm. If this combination is done efficiently, the result is a positive TFP. The management of a private firm are required to demonstrate that they have the capacity to garner positive TFP. They do so either by adopting newer technology (adopting innovations or catching-up with technology) and/or secure gains from operating a firm more and more efficiently, holding the technical change constant. The gains from the former lead to technical gain or TECHCH and those from the latter leads to EFFCH, managerial efficiency. The combined effect of these two accounts for the positive TFP. The production efficiency as described below could be applied – along with financial ratios – to measure corporate performance.

DEA: A Non-parametric Approach

DEA is "... non-parametric programming method used for assessing the (*production*) efficiency of decision-making units, where the presence of incommensurate inputs and outputs makes the measurement of overall efficiency difficult." (Boussofiane *et al.*, 1997: 127): the emphasis is added. This method adjusts for correlation of inefficiency with inputs (Gong and Sickles, 1992). There are other advantages in using it (see Mahadevan, 2002): no statistical tests need be used as in a typical parametric approach since the measures from DEA are non-parametric. Hence we do not test the efficiency changes with any statistical tests. This can be viewed as the either an advantage or disadvantage.

The Malmquist Productivity Index

The Malmquist TFP growth index involves computing an index of productivity changes over each subsequent year and then decomposing the changes into TECHCH or technical efficiency change and EFFCH or management efficiency change based on the algorithm reported in Coelli (1996).

The productivity index typically measures the TFP growth change between two data points: period t technology (observations) relative to other period $t+1$ technology. The output distance function is used to calculate the expansion of output from given inputs. Fare *et al.* (1994) specify the output-orientated productivity change index as:

$$m_0(y_{t+1}, x_{t+1}, y_t, x_t) = \left[\frac{d_0^t(x_{t+1}, y_{t+1})}{d_0^t(x_t, y_t)} \times \frac{d_0^{t+1}(x_{t+1}, y_{t+1})}{d_0^{t+1}(x_t, y_t)} \right]^{1/2} \quad (1)$$

The m_0 represents the productivity index that measures the change over time, $t+1$ and t , of input and output (x_{t+1}, y_{t+1}) respectively relative to input and output at a starting production point (x_t, y_t) . The input(s) are represented by x_t , while the output(s) are represented by y_t . TFP growth is the geometric mean of two outputs-based indices from period t to period $t+1$. It is a ratio of the distances between the two data points in a given output (y) and an input (x). The TFP score can be decomposed into efficiency change or EFFCH and technical change or TECHCH as:

$$\mathbf{TFP} = m_0(y_{t+1}, x_{t+1}, y_t, x_t) = \mathbf{EFFCH} \times \mathbf{TECHCH} \quad (2)$$

Further, a value of m_0 greater than one indicates a *positive* TFP *growth* (indicates gains if the index value less one gives positive measure) over period t to period $t+1$, and a value less than one indicates a *decline* in TFP growth, i.e. TFP growth has been negative.

A constant return to scale is assumed in the DEA Computer Program (DEAP) 2.1, which is used in this study and is widely accepted by researchers. Coelli (1996) is chosen as his method has wide following and DEAP 2.1 program yields accurate estimates. The same program provides the growth decomposition as in Equations (2). The program uses a mathematical linear programming technique applied to the sample of telecommunication firms from across the world.

Data for inputs and outputs relate to the financial years from 1989 to 1998. These were taken from the *ITU Yearbook of Statistics-Telecommunication Services Chronological Time Series 1989-1998*, published by ITU, Switzerland. The two inputs used were (a) capital investments and (b) number of employees. Output data available were (a) total revenue, (b) total fixed line, (c) international-outgoing telecom minutes, and (d) teledensity, which refers to the number of telephones per 100 residents in a country. The results were obtained separately for the whole sample and for each region as follows: the sample were distributed as follows: four in African, seven in North America, thirteen in Asia and Australia (Asia Pacific) and sixteen in Europe.¹

Financial Performance Ratios

Financial performance ratios applied are defined in Table 1. Five ratios were computed from available data in the ITU database. Since pre-privatized firms normally have losses and no profits, it would be not feasible to use any ratios that employ net income or even operating margin. Hence, it was decided that the ratios be based upon sales, capital and labor (data on number of employees were available, not wages) were selected. Sales divided by the number of direct telephone-exchange lines provided a

¹ We would like to acknowledge Tim Coelli and Prasada Rao for making this software available for us to run the DEA-Malmquist tests.

financial ratio *sales performance* (see no. 1 in table); *capital turnover* (no. 2) is akin to the asset turnover ratio in finance; *capital performance* is defined as total revenue divided by total fixed lines;

Table 1: Definitions of Financial Performance Indicators

| <i>Number</i> | <i>Performance Ratios</i> | <i>Definition</i> | <i>Interpretation</i> |
|---------------|---------------------------|------------------------------------|---------------------------------|
| 1. | Revenue improvement | Total revenue/Total fixed lines | Sales performance |
| 2. | Revenue-to-capital ratio | Total revenue/Capital invested | Capital turnover |
| 3. | Capital usage ratio | Capital invested/Total fixed lines | Capital performance |
| 4. | Labor contribution | Total revenue/Employee number | Sales contribution per employee |
| 5. | Labor-to-capital ratio | Capital invested/Employee number | Capital usage per employee |

The possible ratios that could be computed are limited by data availability in the ITU database. Data converted to U.S. dollar and adjusted for inflation in each year using average exchange rate and price index.

labor contribution is the sales per employee; and *labor-to-capital ratio* represents capital usage per employee.

It is hypothesized that privatization would lead to improvements in all these financial ratios after ownership changes following privatization. Some of these ratios in prior studies cited earlier have been shown to have improved giving evidence of privatization gains. Other ratios are used in this study for the first time. The ratios are computed over the years and then averaged across four years (a) before privatization and (b) after privatization for each firm, and then aggregated across the firms. The privatization year is included in the period before. The resulting average ratios before and after are tested using the Wilcoxon tests. This test is appropriate given an assumption-free

statistical distribution of the ratios and the fact that number of observations available for each firm is over just eight years in each case. The period of study is 1989-1998.

4. Findings

Production Efficiency Indices

Table 2 reports the Malmquist productivity index values of countries in Africa, Asia Pacific, North America, and Europe. The results are obtained by averaging the three production efficiency indices for each firm over the whole period 1989-1998.

The average indices show that, in Africa, South Africa was the only one with the average TFP growth of less than 1 (productivity decline); Algeria, Senegal, and Zambia obtained averages of more than 1, which indicate positive productivity gains over the test period. In North America, three countries (namely Canada, Peru, and Uruguay) had averages of less than 1 in TFP growth index. On the other hand, Honduras, Mexico, the United States, and Venezuela obtained more than 1 value for their TFP growth. Similarly 11 out of 13 Asia Pacific countries had averages of more than 1, which indicates positive TFP. However, some among them namely Singapore and Myanmar had averages less than 1 indicating negative productivity. The same results were obtained in Europe: 12 countries out of 16 obtained TFP growth averages of more than 1 (positive TFP) and the remaining 4 countries (Denmark, Iceland, Poland, and Romania) obtained values of less than 1 (negative TFP).

Table 2: Malmquist Cumulated Productivity Index Means 1989-1998

| Countries | TFP | EFFCH | TECHCH |
|---------------------|------------|--------------|---------------|
| <i>Africa</i> | | | |
| Algeria | 1.006 | 1.000 | 1.006 |
| South Africa | 0.975 | 1.000 | 0.975 |
| Senegal | 1.212 | 1.000 | 1.212 |
| Zambia | 1.099 | 1.000 | 1.099 |
| <i>America</i> | | | |
| Canada | 0.976 | 0.959 | 1.017 |
| Honduras | 1.063 | 0.921 | 1.154 |
| Mexico | 1.130 | 1.067 | 1.059 |
| Peru | 0.780 | 0.898 | 0.869 |
| United States | 1.110 | 1.000 | 1.110 |
| Uruguay | 0.995 | 1.000 | 0.935 |
| Venezuela | 1.307 | 1.000 | 1.037 |
| <i>Asia Pacific</i> | | | |
| Australia | 1.040 | 1.045 | 0.996 |
| China | 1.148 | 1.040 | 1.104 |
| Hongkong | 1.006 | 0.971 | 1.036 |
| Japan | 1.021 | 1.000 | 1.021 |
| Korea | 1.122 | 1.000 | 1.122 |
| Malaysia | 1.069 | 0.981 | 1.089 |
| New Zealand | 1.083 | 1.071 | 1.011 |
| Philippines | 1.011 | 0.983 | 1.029 |
| Singapore | 0.957 | 0.981 | 0.976 |
| Taiwan | 1.045 | 1.036 | 1.008 |
| Fiji | 1.075 | 1.000 | 1.075 |
| Myanmar | 0.854 | 0.881 | 0.969 |
| Macau | 1.033 | 1.000 | 1.033 |
| <i>Europe</i> | | | |
| Belgium | 1.072 | 1.039 | 1.031 |
| Cyprus | 1.053 | 1.000 | 1.053 |
| Denmark | 0.974 | 0.988 | 0.986 |
| Finland | 1.069 | 1.079 | 0.991 |
| France | 1.054 | 1.079 | 0.997 |
| Germany | 1.191 | 1.154 | 1.031 |
| Greece | 1.083 | 1.020 | 1.062 |
| Iceland | 0.963 | 0.994 | 0.969 |
| Luxembourg | 1.033 | 1.000 | 1.033 |
| Malta | 1.004 | 1.000 | 1.004 |
| Morocco | 1.154 | 1.149 | 1.004 |
| Poland | 0.842 | 0.879 | 0.958 |
| Romania | 0.914 | 0.892 | 1.025 |
| Spain | 1.178 | 1.127 | 1.045 |
| Switzerland | 1.082 | 1.000 | 1.082 |
| Turkey | 1.422 | 1.000 | 1.422 |

Figure 1 contains the average TFP growth indices as plots for all countries

Figure 1: TFP Change Indices Decomposed as Technical and Efficiency Changes

Figure 1-a: Total Factor Productivity Change Index over 1989-1998

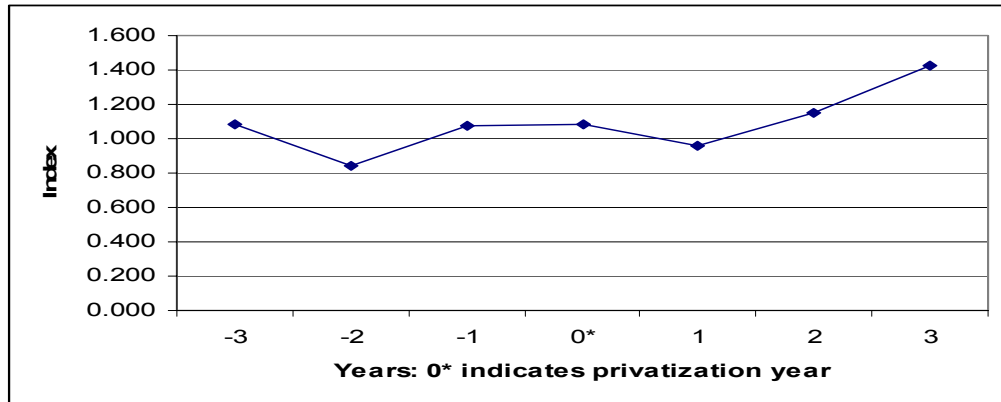


Figure 1-b: Technical Change Index Values over 1989-1998

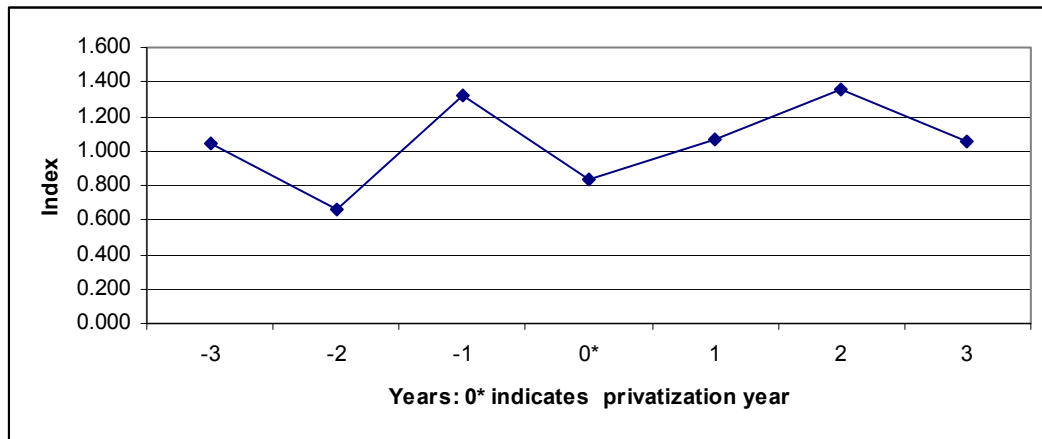
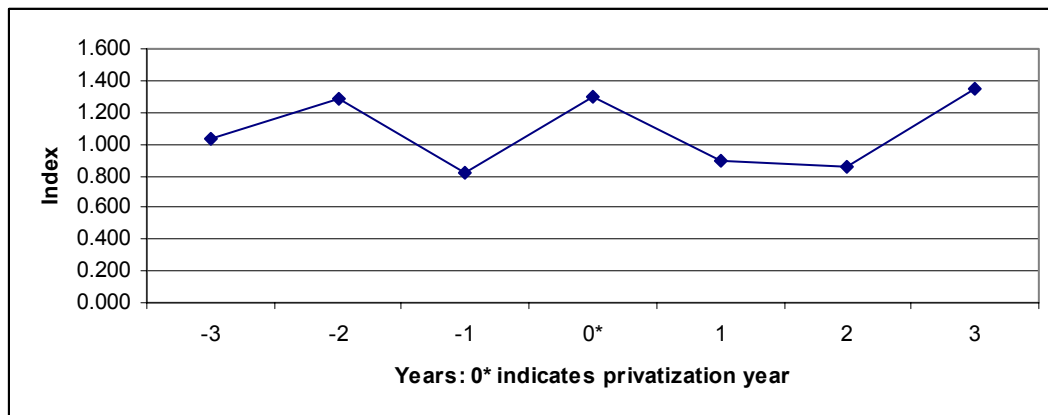


Figure 1-c: Efficiency Change Index Values over 1989-1998



over the test period 1989-1998. To have a balanced sample, only eight years were used using the privatization year to select the before and after four years. Figures a, b and c denote the TFP, the TECHCH and EFFCH ratios across the period. It is evident that the TFP (see Figure 1-a) has an upward trend particularly after the privatization year. This is indicative of the source of production efficiency across all firms after ownership change following privatization.

Figure 1-b indicates also an upward trend in the technical efficiency values. But the managerial efficiency change (EFFCH) shown in Figure 1-c indicates no upward trend at all. This is consistent with findings in the literature that efficiency changes in telecommunication firms are mainly from adoption of new technology after privatization. Ownership change which vests the control of the privatized firms in the private sector appears to have led to economic choices being made by new owners to secure efficiency through technical changes.

The averages for the four regions and the grand average for all countries on the production efficiency indices are summarized in Table 3. The Malmquist productivity index (see Panel A) increased to 1.061 from 0.992 for the sample of firms in all countries. This means that there is positive TFP of 6.1 percent (TFP of 1.06 minus 1.00) during the four years after privatization. African countries had the most gain since the index is showing a gain of 63.4 percent; for Asia Pacific region, it is 24.2 percent; America's case is 5.7 percent; and there is decline in Europe as the number is -9.6 percent (0.904-1.00). The gains are essentially from technical change as can be seen from the numbers in columns (3) and (2).

Table 3: Summary Productivity Efficiency of Telecommunication Firms

| | After privatization | | | Before privatization | | |
|---|---------------------|---------|---------|----------------------|--------|---------|
| Panel A: Malmquist productivity index values for different regions | | | | | | |
| | EFFCH | TECHCH | TFP | EFFCH | TECHCH | TFP |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| All Countries | 0.996 | 1.066 | 1.061 | 1.027 | 0.966 | 0.992 |
| Africa | 1.000 | 1.634 | 1.634 | 1.000 | 0.904 | 0.904 |
| Asia Pacific | 1.061 | 1.171 | 1.242 | 0.946 | 1.046 | 0.851 |
| America | 1.000 | 1.057 | 1.057 | 1.000 | 1.051 | 1.051 |
| Europe | 1.014 | 0.891 | 0.904 | 1.000 | 1.007 | 1.007 |
| Panel B: Annual Growth Rates in respective indices | | | | | | |
| | EFFCH | TECHCH | TFP | EFFCH | TECHCH | TFP |
| All Countries | 7.70% | 10.70% | 10.80% | -6.60% | 32.10% | 100.00% |
| Africa | 0.00% | 153.60% | 153.60% | 0.00% | 43.20% | 43.20% |
| Asia Pacific | 20.30% | 50.10% | 5.20% | 0.70% | -4.90% | 100.00% |
| America | 0.00% | 59.50% | 59.50% | 8.50% | 25.70% | 26.30% |
| Europe | 0.00% | -0.03% | -0.05% | -7.50% | 24.60% | 15.40% |

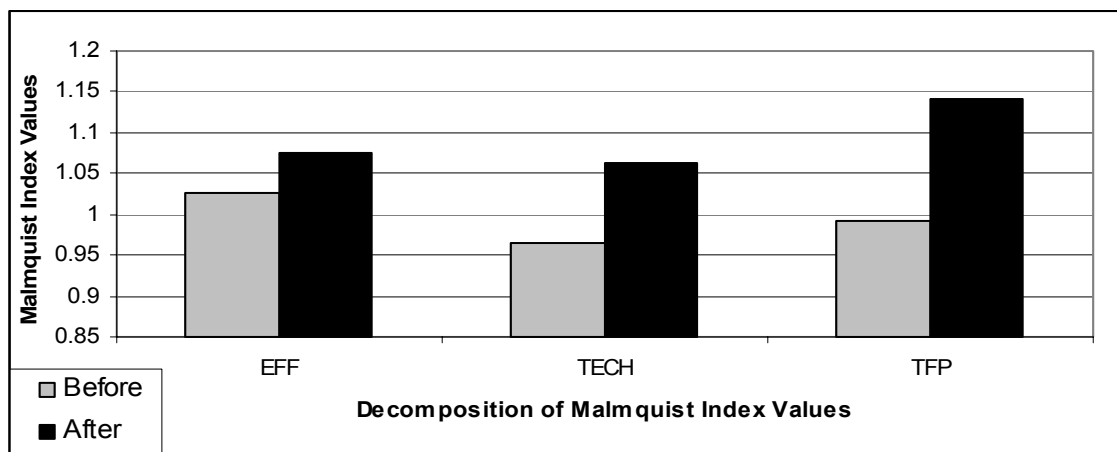
The EFFCH is just about around 1.00 in column (2) whereas the TECHCH ranges from 1.057 to 1.634 (the decline in Europe is excluded). These results are consistent with other studies on telecommunications firms (Madden and Savage, 1999).

The numbers in Panel B are the percentage changes in respective efficiencies in the regions. As can be noted in columns (7) and (4), the rate of change during the four years before privatization is smaller than the rate of change during the four years after the privatization. For example, African telcos had 153.6 percent improvement in TFP in the four years after compared to a 43.2 percent increase in the period before privatization. America also had significant within period changes: 59.5 percent during the four years since privatization compared to the 26.3 percent in the prior years. Consistent with the numbers in the Panel A for all regions, the numbers in the Panel B for TECHCH appears to suggest the same trend. That is, the rate of change in the efficiency arising from

technical changes is far more than the rate of changes from management efficiency. Whether this regularity observed in the cases of technical efficiency change is particular to the telecommunications firms is an interesting issue worth further investigation using other industries. Perhaps this reflects the easy portability of technology in the case of telecommunication firms compared, for example, firms in aerospace industries.

The efficiency gains following the ownership changes are plotted in Figure 2. The efficiency gain in TFP is the largest, made of EFFCH and TECHCH. From the index value at less than 1.00 during the four years before the event, the value increased to 1.15. The EFFCH over the same periods is the smallest from slightly above 1.00 to 1.075. The technical efficiency has greater difference than is the case with EFFCH. A possible reason for the smaller gain in EFFCH relative to technical change may be the relative ease of adopting new technology. Managerial efficiency is perhaps likely to take longer time period than the four years used in this study.

Figure 2: Malmquist Productivity Index Values Before and After Privatization



Considering the evidence discussed from production efficiency measures - total factor productivity, managerial efficiency change and technological efficiency change – two facts stand out. There are significant increased gains suggested by all measures for

the period *after* privatization. It seems reasonable to assume that most of the changes arose from adoption of new technologies in the same period. It also appears, as a corollary, that the magnitude of efficiency change from managerial efforts is very large in the period prior to privatization. One potential reason for the management-related efficiency in the prior period may be the attention that these firms received during the four years when the policy changes were brought to the attention of the state-appointed managers, who may have engaged in some efforts to improve management efficiency. There is some evidence for this if one is to consider that many of these firms were under corporatization during at least two years in the period prior to privatization bills being passed into laws. Another reason for higher technical efficiency in the privatized period is due to the availability of new capital once the firms had passed to the private sector ownership and management. With more money, management could secure better technology to show a quick increases in capital to modernize operations. That indeed is the case will be evident in the ensuing discussion on capital usage financial ratios.

Financial Performance Ratios

Statistics relating to financial performance gains before and after privatization are summarized under three categories. Revenue is used since a number of firms had losses in periods prior to privatization, which made it not possible to examine net-income-based measures such as returns on equity or assets nor other measures such as margin, etc. Also, financial measures to be used are aligned to those related to outputs and inputs to link these measures to those used in the TFP analysis.

The first two ratios are computed as measures of *revenue performance improvement* before and after ownership changes. The performance relating to capital usage is indicated by total capital used divided by total fixed line or *capital used* per line. The third financial measure is represented by ratios relating to labor. Since wage costs were unavailable, we used the number of full-time equivalent employees to measure (a) revenue per employee and (b) capital usage per employee, both of which is meant to indicate *labor performance*.

Revenue Performance: The scores on revenue performance along with the test statistics from Wilcoxon rank test are summarized in Table 4

Table 4: Revenue Performance Gains Before and After Privatization during 1989-1998

| Measures | Countries | Mean | | Standard Deviation | | Test of Significance Wilcoxon Tests | |
|-----------------------------------|---------------|----------|----------|--------------------|--------|--|-------------|
| | | After | Before | After | Before | | |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | |
| 1. Revenue Improvement | Africa | 943.08 | 1,084.18 | 370.91 | 353.02 | 0.560 | (0.288) |
| | Asia Pacific | 1,254.36 | 937.83 | 968.52 | 633.56 | 3.840 | (0.000)*** |
| | America | 1,159.82 | 417.04 | 1,409.87 | 624.08 | 2.589 | (0.005)*** |
| | Europe | 842.640 | 649.70 | 634.98 | 351.33 | 0.597 | (0.275) |
| | All Countries | 1,079.96 | 778.40 | 930.54 | 560.18 | 4.363 | (0.000)*** |
| 2. Revenue to Capital Improvement | Africa | 2.68 | 2.96 | 1.32 | 0.59 | 1.680 | (0.046)** |
| | Asia Pacific | 4.15 | 2.92 | 3.99 | 1.58 | 2.095 | (0.0018)*** |
| | America | 2.37 | 3.40 | 1.15 | 17.65 | 1.412 | (0.790) |
| | Europe | 3.91 | 5.07 | 2.18 | 10.01 | 1.774 | (0.038)** |
| | All Countries | 3.60 | 3.64 | 2.95 | 9.19 | 1.210 | (0.113) |

Significant at .01 (***); .05 (**); and .10 (*) probability levels. (.) contains probability values.

Revenue improvement in the period after privatization amounted to \$1,079.96 per direct exchange lines installed compared to \$778.40 in the period before the privatization for all

countries: 39 percent increase. Wilcoxon rank test shows that the increase is statistically significant at 0.00 level. Revenue-to-capital ratio however has been held at about the same level over the same periods. That is, the asset turnover has been held at about \$3.60 sales to a dollar of capital applied. Hence, these turnover ratios are not significantly different as indicated by the acceptance level 0.113. Therefore, the financial performance suggested by revenue factor appears to be higher in the post-privatization period.

Examining the regional differences reveals some interesting results. These two ratios are systematically higher in all regions except in Africa as indicated by positive differences across the before vs after (see columns (3) and (4)). Telcos in Africa and Europe had no significant gains in revenue per line but those in Asia Pacific and America had significant increases in revenue per line following privatization. American telcos had almost a 50 percent increase while Asia Pacific telcos gained by a third, both significant at 0.00 level. Revenue-to-capital ratios increased significantly in all but American telcos. That implies that the American firms secured high revenue gains without increasing the capital turnover ratios whereas the others had large increases in turnover ratios that perhaps dented the revenue gains. For example, an increase of 44 percent in capital turnover - from 2.37 to 3.40 - in American telcos secured a revenue per line increase of 178 percent (417.04 to 1,159.82). Compare this result with the ratios for Asia Pacific firms; capital turnover rose from 2.92 (before) to 4.15 (after) or 42 percent; revenue per line increased 34 percent from \$937.36 (before) to \$1,254.36 (after). Evidently the American telcos had higher revenue gains with lower turnover ratio changes.

Capital Usage: In Table 5 are the summary results relating to capital usage of the firms during the respective four years around the privatization event.

Table 5: Capital Usage Performance Gains Before and After Privatization during 1989-1998

| Measures | Countries | Mean | | Standard Deviation | | Test of Significant Wilcoxon Tests |
|------------------------|---------------|--------|--------|--------------------|--------|------------------------------------|
| | | After | Before | After | Before | |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Capital Usage per line | Africa | 395.34 | 622.30 | 122.93 | 104.53 | 0.840 (0.401) |
| | Asia Pacific | 374.01 | 411.78 | 274.14 | 448.36 | 1.047 (0.148) |
| | America | 516.71 | 160.79 | 486.50 | 226.28 | 2.824 (0.003)*** |
| | Europe | 202.95 | 263.86 | 112.99 | 162.61 | 0.224 (0.412) |
| | All Countries | 351.39 | 348.75 | 290.49 | 327.09 | 2.230 (0.013)*** |

Significant at .01 (***); .05 (**); and .10 (*) probability levels. (.) contains probability values.

Capital usage financial ratio measures the expenditure of capital to create one direct exchange line. Across the industry in the World, this ratio has gone up from the before-privatized \$348.75 per line to \$351.39 (after): this is less than one percent increase. However, there are wide variations across the regions. African and European telcos had decreased capital expenditures though the declines are not significant. The increase from \$160.79 to \$516.71 in Americas indicates a very large capital investment plan, which is statistically significant at 0.00 level. The statistics for Asia Pacific firms also suggest an insignificant decline. In short, capital expenditure per line is being held at about the same level, in fact slightly lower in the period after privatization, although all telecommunication firms increased line capacity. One potential reason for this ratio being steady (except for the Americas) is the falling prices of capital equipments in the 1990s as a result of integration of information technology and telephony.

Labor Performance: Improvements in labor performance have been predicted by economists. Financial performance gains resulting from labor are summarized as two ratios in Table 6. Labor performance suggested by the average values of two labor

financial ratios are similar and are significant for all countries as well as for individual regions. Revenue per employee increased from \$140,522 (before) to \$182,040 (after) for all countries: this is a 29 percent change in labor contribution to revenue.

Table 6: Labor Performance Gains Before and After Privatization during 1989-1998

| Measures | Countries | Mean | | Standard Deviation | | Test of Significant Wilcoxon Tests | |
|-------------------------|---------------|---------|---------|--------------------|---------|------------------------------------|------------|
| | | After | Before | After | Before | | |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | |
| 4. Revenue per employee | Africa | 103,500 | 71,161 | 38,285 | 22,745 | 1.820 | (0.035)** |
| | Asia Pacific | 188,240 | 183,715 | 204,109 | 466,609 | 3.735 | (0.000)*** |
| | America | 182,925 | 183,715 | 218,464 | 65,073 | 2.746 | (0.003)*** |
| | Europe | 204,236 | 167,583 | 171,343 | 169,447 | 1.792 | (0.037)** |
| | All Countries | 182,040 | 140,522 | 184,909 | 316,666 | 5.175 | (0.000)*** |
| 5. Labour Contribution | Africa | 43,824 | 41,653 | 12,628 | 8,264 | 2.380 | (0.009)*** |
| | Asia Pacific | 56,847 | 57,672 | 82,357 | 117,189 | 2.323 | (0.010)*** |
| | America | 81,124 | 15,430 | 72,190 | 23,732 | 2.824 | (0.003)*** |
| | Europe | 73,502 | 65,288 | 107,699 | 66,169 | 0.448 | (0.327) |
| | All Countries | 64,490 | 50,573 | 83,716 | 85,465 | 3.141 | (0.001)*** |

Significant at .01 (***); .05 (**); and .10 (*) probability levels. (.) contains probability values.

The difference is significant since the Wilcoxon rank test has a probability value equal to 0.00. Capital-to-labor ratio Equation no. 5 for all telcos across the world increased by 27 percent: from \$50,573 (before) to \$64,790 (after). Again this is statistically significant as suggested by the probability value of 0.00.

Across regions too there are significant gains in these financial ratios, the only exception being that for American telcos with before-privatization average of \$183,715 declining marginally to \$182,925, a decline of 4 percent, which is significant at 0.00 level. The other telcos in other regions had significant gains in all labor-related financial ratios. Figure 3 contains plots of the numbers across the test period.

Figure 3: Plots of Selected Financial Ratios Before and After Privatization

Figure 3-a: Revenue Improvement Following Privatization over 1989-1998

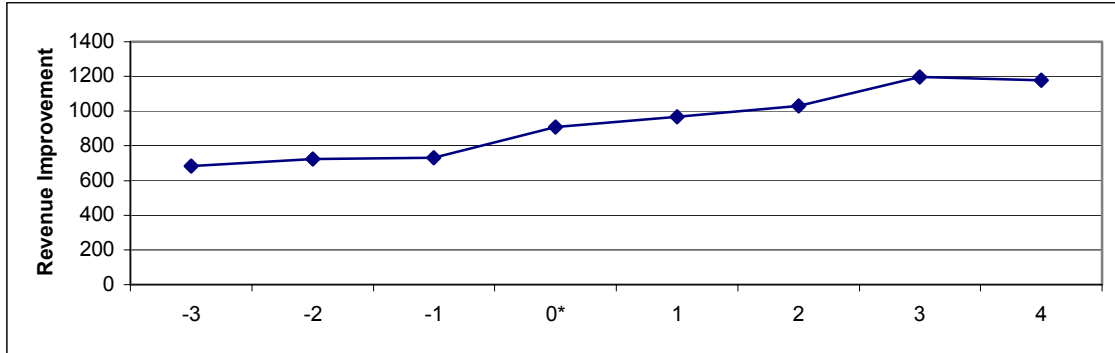


Figure 3-b: Capital Usage Financial Ratios Before and After Privatization

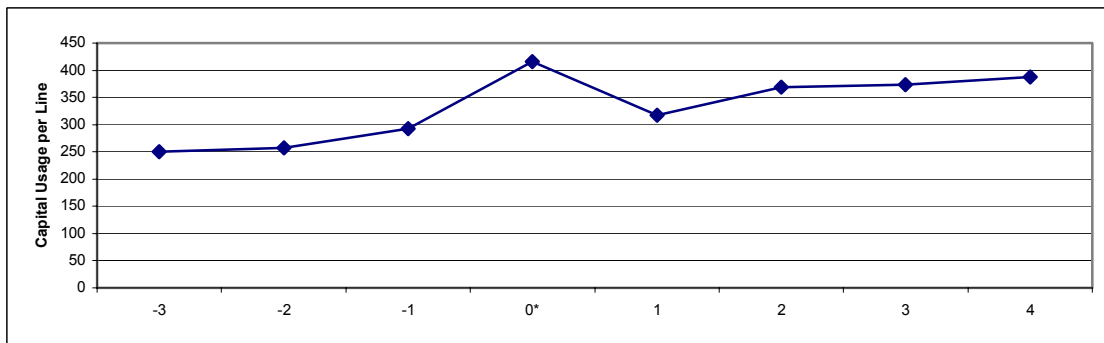
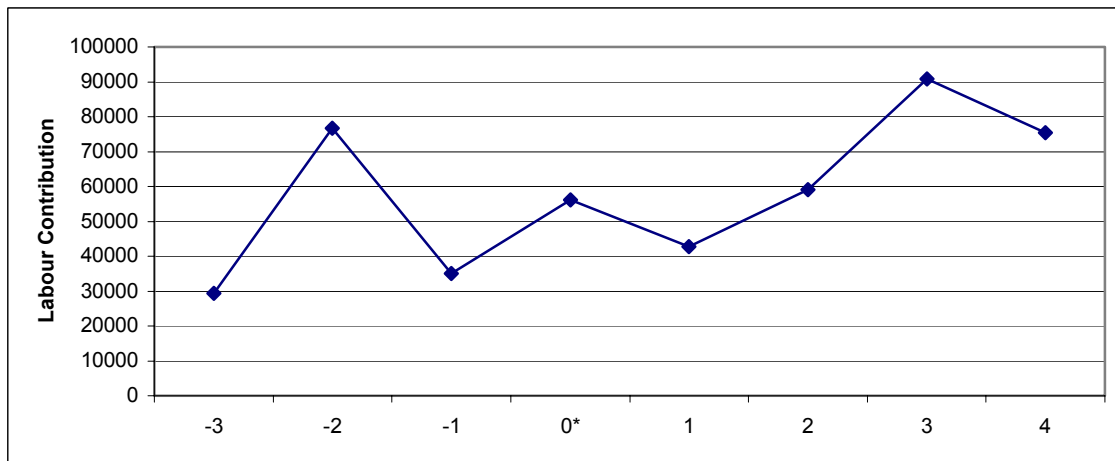


Figure 3-c: Labor Contribution Financial Ratios Before and After Privatization



Our results are consistent with the maintained hypothesis although there is some contrary evidence reported in few studies in the literature.

The plots of these ratios also reveal the up-trends in these ratios tested in connection with the interpretations of these three tables of financial performance statistics. The statistically significant upward trends in all three ratios are quite evident in the trends seen in the plots. In Figure 3-a one can see the marked increase in the up-trend in revenue gains starting from the year before the privatization, which trend is sustained at high levels in years 0 through to year four. That would appear to argue that the revenue gains started to commence in the years of corporatization in -1 year and were sustained through perhaps tariff increases, released from long held back at uneconomic prices. The capital usage is also on up-trend as shown in Figure 3-b. The marked increases in labor performance are evident in the Figure 3-c as well. In short, these charts lend credibility to the average numbers tested, and show significant trends that underlie the numbers as discussed in the earlier sub-sections.

5. Conclusions

There is a lack of consensus on whether privatisation – therefore the ownership changes of state-owned firms – leads to improved performance once these firms are returned to face market signals and competition. Providing a set of more reliable evidence than exists on this important applied policy research issue motivated this study. It is possible to bring corroborated evidence by extending the traditional reliance on case studies and financial performance measures to include production efficiency measures.

Production efficiency has a long and respectable history going back to Box-Cox's production function, which has been recently recast as non-parametric indices. These indices are capable of yielding reliable measurements on whether (a) managerial efficiency and (b) technical efficiency can lead to securing total factor productivity gains. Employment of these three measures produces reliable indicators that could shed new evidence on this issue to judge if there are improvements after privatisation events. This is attempted, and the results are reported in this paper along with statistical test results on financial ratios of privatized firms. Telecommunications firms are selected across the World since the telcos use homogeneous technology, and have been the favourite targets of governments' preferred choices for privatization during the last fifteen years. Access to unique data and recently-developed algorithms to measure production efficiency enabled this research to be undertaken.

The findings provide twin-methods-based evidence different from those in existing studies, which are mostly based on cases and small samples using financial ratios. The findings reported in this report point to a strong evidence in support of the hypothesis that privatization leads to consistent gains in financial performance as well as production efficiency. Further applications of this research design in this study could go a long way to create some degree of consensus on this important policy research issue by bringing to bear corroborating evidence from more than one approach.

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