The Impact of Market Liberalization on Firm Performance: Evidence From U.S. Telecommunications Industry

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ABSTRACT

This paper examines the impact of market liberalization on various dimensions of firm performance in the U.S. telecommunications industry. Using a new multi-period, multi-output ratio analysis model which disaggregates performance measures into several detailed components, the paper evaluates the performance of thirty-nine major companies in the local exchange sector over three time periods 1981, 1984 and 1987. The empirical results indicate that market liberalization has had significant impacts on different dimensions of firm behavior and performance in the telecommunications industry.

Keywords: Market Liberalization, Firm Performance, Ratio Analysis, Telecommunications Industry, Profitability

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I. INTRODUCTION

Market liberalization is a dramatic environmental change, providing a profound challenge in today's business world. While much is expected by way of resulting performance improvements in general, in several industries it is assumed that the effect will be deleterious. According to Crandall (1991), for example, in the telecommunications sector many hold that the liberalization of market will engender wasteful investments in capacity and have a negative impact on the performance of the existing core telephone business. Yet, very little is empirically known about the relationship between market liberalization and firm performance. Smith and Grimm (1987) are among very few researchers to carry out an industry-wide study, finding substantial changes in the performance of firms in the U.S. railroad industry following deregulation, and in a spirit similar to theirs, this paper reports the results of an industry grounded study which examines the impact of market liberalization on the performance of firms providing telecommunications services in the U.S.

Traditionally, a firm's performance is measured by its returns on investment (ROI). But ROI can be affected by many other factors such as its profitability, productivity, ability to recover high prices and focus on products (services) yielding higher profits, and efficient use of its assets. Market liberalization changes the nature of a firm's environment and impacts all of these factors. For instance, productivity increases because of competitive pressures brought about by new entrants (Leibenstein, 1975), competition tends to drive prices down to marginal costs (Kahn, 1988), emerging market opportunities enable shifting corporate focus to products with the highest margins (Porter, 1980), and efficient in the use of assets results because rate of return driven incentives no longer occur in a liberalized market (Morrison and Winston, 1985). Therefore, market liberalization has differential impacts on different aspects of a firm's performance.

In the U.S. telecommunications industry, a major restructuring has taken place in the last decade with increasing competition in the market. The world's biggest monopoly has been gradually opened to competition, and a natural experiment begun to assess what impact a competitive environment has in the world's largest

telecommunications market. Given such dynamic events taking place in a once staid industry, the principal question of interest in this paper is whether the pattern of performance of firms providing telecommunications services in the U.S. has changed significantly as a result of market liberalization.

In carrying out the empirical investigation, this study uses a new multi-period, multi-product model of performance measurement. Traditional performance measures in accounting research include the ROI (and/or RI) formula, while economic performance is measured by various productivity indices. The method employed in this paper integrates the ROI formula with productivity measurement frameworks from economics to derive a distinct set of five ratios which capture the disaggregated elements that influence a firms profitability, and yield richer insights into the performance of the telecommunications firms as their regulated environment unravels. By undertaking a longitudinal study, this paper gauges the impact that the changing environment has on firms in the telecommunications industry, and also shows how the ratios are useful in explaining the accounting and economic performance of firms in general.

The rest of the paper is structured as follows. Section two describes the telecommunications industry and derives hypotheses about the impact of market liberalization on firm performance. Section three presents the research setting, which includes a description of sample data and a definition of the ratios. Section four discusses the empirical results and section five concludes the paper.

II. TELECOMMUNICATIONS INDUSTRY AND RESEARCH HYPOTHESES

A. Description of the U.S. Telecommunications Industry

A series of experiments have been undertaken in liberalizing the U.S. telecommunications industry and permitting competition. The genesis of the anti-trust action against AT&T goes back to 1949 when the first suit was filed. A consent decree was reached in 1956 and between 1956 and 1977 some competition enhancing

moves took place, culminating in the 1977 FCC Execute decision when price competition was first allowed in the long distance market. Between 1978 and 1981 technology-driven product competition evolved faster than it had ever before, however, no moves to liberalize the industry took place, and the period before 1981 can be considered as one of full regulation.

1981 marks a period when moves to liberalize the industry commenced with the revival of the suit against AT&T. In 1982 an agreement was reached whereby the 1956 consent decree was modified, and in 1983 an industry reorganization plan was approved. In 1984 the reorganization plan was implemented, with the divestiture by AT&T of its twenty-two operating companies and many sectors of the industry were opened to competitive entry. The period 1981 to 1984 can be considered to be one of political transition, with 1981 an appropriate starting point and a suitable year in which to anchor the study. The year 1981 was one of full regulation, and 1984 denotes a year of transition plus of partial regulation. By 1987 liberalization had increased, and the phase between 1984 and 1987 is therefore one of increasing competition.

B. Theory and Research Hypotheses

Market liberalization is a measure going to the heart of attempts to improve the economic performance of industries. While it is intuitive that different patterns of firm behavior will result in a liberalized market, at the level of the firm a pertinent issue is what are the significant differences in its performance over time as regulation gives way to liberalization. Towards deriving a framework to address such an issue, a key question is why are there differences in the performance of firms in regulated versus liberalized environments, especially when the same collection of employees who managed the old regulated firms are in charge of the new regime (Kay and Thompson, 1986)？

Market liberalization is expected to enhances the competitive environment of firms, thereby stimulating them to become internally efficient and better performance. But, there can be differential impacts of such enhancement. For example, changes in

market structure drive changes in performance with new firms eating into old firm territories (Kahn, 1988). While incentive structures change as firms try to fit their new environments, competitor pressure force them to be simultaneously efficient and innovative (Burton and Obel, 1986).

Impact on Profitability

Because market liberalization makes entry easier, a primary effect is to increase the number of suppliers and reduce market concentration, with no much concomitant change, however, in the number of buyers. This results in declines in the price-cost (profitability) margins because new entrants come in with a lower price to capture market share, causing a loss of monopoly power and forcing existing firms to drop their prices (Porter, 1980; Spence, 1977).

In the context of a market becoming competitive and where firms undertake measures to improve their efficient, Spence (1986) states that "Competition has two conflicting effects on process R&D and technical efficiency. It creates downward price pressures for individual firms that have increasing incentives to carry out R&D and to improve technical efficiency. However, as the number of firms increases, market shares fall. Reduced sales dilute the incentives to reduce costs because the cost-reduction expenditures are fixed given the rate of cost decline, while the benefits decline as market shares fall."

The impact of increasing competition then can be ambiguous. In some cases dynamic profitability can rise as existing firms take advantage of the liberalized environment to make higher sales through new product introductions, and as concentration declines are also spurred towards better internal performance. But, with increasing entry profitability is likely to fall as market shares decline, and this will be regardless of the ability of firms to maximize revenues or minimize costs. Therefore, profitability will fall because benefits from cost savings are eventually going to be less than the revenue losses from decline in prices. Nevertheless, there may be an early period following market liberalization in which profitability rises because newer

entrants have not yet made their marks in the market.

While the empirical studies of market liberalization that exist none have specifically looked at profitability margin changes, Ruefli (1986) looks at several sub-sectors of the transportation industry such as air lines, pipelines, railroads and trucking and finds increasing volatility of profit rates after deregulation. Given that market liberalization has a deconcentrating effect on the structure of an industry, and based on the theoretical arguments the first hypothesis (H1) is proposed as follows:

H1: With initially increasing market liberalization there will be a rise in the profitability margin, but as liberalization intensifies and a competitive environment becomes more pervasive there will be a decline in the profitability margin over time.

Impact on Productivity

A competitive environment is a big spur to efficiency in operations, since costs cannot be passed on to consumers any longer through the mechanism of rate-of-return regulations. Wastage and slack in resource utilization are no longer tolerated. Without increasing productivity, the long-run survival of the firm can be in doubt in increasingly competitive environments (Stevenson, 1982).

Competition creates more pressures and incentives than a monopoly situation does. With the increasing environmental pressures generated, the concerns by employees to consider the multitude of new constraints also generated on the firm rise, as a result of signals to alter behavioral patterns, which emanate from persons in positions of vertical and horizontal relationships with these employees. Thus, effort levels rise within the firm, and this leads to a decline in the unit costs of products supplied by the erstwhile regulated firm (Leibenstein, 1975; Selten, 1986).

Studies of the airlines industry (Bailey, 1986; Morrison and Winston,1985), and recent studies of the telecommunications industry(Crandall, 1991) also show rising productivity following deregulation, and based on the theory and evidence to hand, the following hypothesis (H2) is proposed:

H2: With increasing liberalization in the U.S. telecommunications industry, there will

be an increase over time in the productivity.

Impact on Price Recovery

Control of market entry often gives monopoly status to firms through regulation. In a monopolistic or oligopolistic market, demand for a firm's products may be inelastic, for example when an airline has captured routes with heavy traffic, or a telecommunications firm has an exclusive operating area from which others are excluded. In such situations a monopolist equates marginal revenues with marginal costs to maximize profits, and can thus earn "super profits."

However, in a progressively competitive market, as in telecommunications industry, the demand curve becomes flatter and more elastic because new competitors can enter the market and may charge lower prices to attract customers. As a result of the demand curve faced by service suppliers flattening, the price chargeable for products also falls. Market liberalization and competition imply that customers who did not have choices of changing their suppliers earlier now do have such choices. That is, existing suppliers have to drop their prices to the marginal costs of supply to such customers in order to retain them, and such measures lead to further declines in the price-recovery ability of firms.

Bailey (1986) in the context of the airlines, telecommunications, financial services and trucking finds that prices are lowered as a result of deregulation. However, studies looking at whether the price recovery ability of firms have declined do not exist as such. Given the theoretical underpinnings and also the above evidence, albeit marginal and very indirect, to hand, the third hypothesis (H3) is proposed as follows:

H3: With increasing market liberalization, there will be price decline pressures which will be reflected in the reduction of a firm's ability to recover higher prices for its products over time.

Impact on Product (Service) Mix

In a regulated milieu "cream skimming" is possible and more profitable products can be used to cross-subsidize those which are less profitable. No strategic focus other

than one of providing "universal service," is necessary . Firms enter only into business areas they are mandated to. However, in a liberalized environment the potential rewards for successful strategies increase because regulators do not now influence the formulation of strategy; on the other hand guaranteed rate structures are no longer available. Hence, in a liberalized environment rate structures keeping inefficient firms in business no longer exist and the possibilities of earning returns from notable entrepreneurial achievements are no longer precluded.

Because ensuring long-term product-market success means aligning the firm properly with its market environment, in a liberalized environment the incentives for such alignment become much greater. Firms are thereby influenced to pay attention to their distinctive competencies (Prahalad and Hamel, 1990) and adopt focused strategies with certain areas emphasized and more resources allocated to those (Smith and Grimm, 1987); this is an example of increasing allocative efficiency within the firm.

While the empirical studies of such intra-firm allocative efficiencies, whereby firms concentrate more resources on those products yielding greater returns, are absent for industries which have been deregulated, Smith and Grimm (1987) conclude that focusing after market liberalization leads to superior performance in general. Thus, based on the above discussion hypothesis four (H4) is proposed:

H4: With increasing liberalization within an industry there will be an increase in intra-firm allocative efficiencies and firms will focus their resources on that mix of services and products which have the highest profitability margin.

Impact on Capacity Utilization

With the transition from regulation to a competitive environment rates of return driven motivations to over invest in asset capacity reduce, as shown empirically by Courville (1974). Further, concomitant with motivations to increase operating efficiency and productivity, firms have incentives to increase asset capacity utilization since asset economic lives come down in a liberalized environment. This puts pressure on profits, because greater cost allocations are now made per each unit of output. If

full price recovery is not possible because of competition, the alternative for firms is to extract as much output as possible given their asset investments in place, thus leading to higher capacity utilization.

Several airlines studies(Bailey, 1986; Morrison and Winston, 1985) have found that fleet utilization and load factors have improved because of competition induced operational changes, whereby more output was extracted from the available assets. Therefore, extant empirical evidence shows that capacity is used more wisely following deregulation in spreading given fixed costs over a greater level of output. While evidence on the telecommunications industry is unavailable, the nature of deregulatory changes that have occurred is similar to that which has taken place in the airline sector, and thus the fifth hypothesis (H5) is proposed as follows:

H5: With the transition to market liberalization within an industry, firms will improve over time the utilization of their existing physical asset capacity.

III. RESEARCH SETTING

A. Choice of Sector for Study

This paper validates the hypotheses and formulates performance measures in the context of the local operating companies. The performance of these companies is calculated over three time periods 1981, 1984 and 1987. 1981 is a proxy year for no or low competition, 1984 is a proxy year for intermediate and emerging competition, and 1987 is a proxy period for almost full competition. The three-year gap between each time period enables dynamic lags to be factored through and change in performance over these periods hence enables us to test the validity of the proposed hypotheses.

The local exchange companies form a very visible and important sector of the telecommunications industry. They have a mix of regulated and unregulated business, with the unregulated proportion steadily increasing. The primary regulated business is the provision of local household services which is regulated. Provision of local

business services are also partially regulated, however, market entry is allowed in many areas such as private line and value-added services. Revenues from big business customers account for a substantial part of revenues of the companies (Langdale, 1982), and these customers are free to choose from a host of alternative suppliers. Thus, among the local companies the extent of competitive pressure is keenly felt, even though ostensibly they are subject to regulation.

Local operating companies also provide long distance services within their jurisdictional areas, called Local Access and Transport Areas (LATA). While for some of these companies intra-LATA long-distance services are regulated, in several highly populated states (such as Florida) these services are fully deregulated and progressive liberalization has occurred elsewhere. Hence, for local operating companies the competitive pressures faced have significantly exacerbated over time, and these companies provide an ideal subject for analysis.

B. Sample Data

There are about fifty major local telephone operating companies in the U.S., with 1987 annual revenues of $100 million or more. They include all erstwhile Bell operating companies, independents such as Rochester Telephone, companies belonging to GTE, United Telecommunications, Central and the Continental groups. This paper calculates performance measures for thirty-nine of these for three discrete time periods: 1981, 1984 and 1987. The other companies are not used because of missing data problems. A list of these companies is given in appendix 2.

Data on the thirty-nine companies is obtained from the annual Federal Communications Commission publication titled " Common Carrier Statistics." All telephone companies subject to reporting requirements, and even those not so subject, file financial and operating data with the Federal Communications Commission(FCC). These include detailed breakdown of revenues, costs, assets, physical outputs and physical assets, and the format of reporting remain unchanged for several years until 1988.

C. Measures of Outputs and Inputs

There are two physical output measures used in this study, annual total minutes of local and toll calls. Financial output measures are local and toll call revenues. Toll revenues also include access revenues earned by the companies because they permit their networks to be used by other long-distance companies, and miscellaneous revenues are split between local and toll revenues in the proportion that each bears to total operating revenues.

The physical resources of these firms are their total access lines in place, and this signifies their ability to service customers. Allied to the measures of output and physical capacity are the operating costs incurred. Maintenance and depreciation costs are categorized as fixed costs which are based on plant capacity, while traffic, commercial, general office and other expenses are classified as costs which vary with the volume of activity.

D. Performance Ratios

Traditionally the ROI formula has been decomposed into its component parts as follows:

$$\begin{aligned} \text{ROI} &= \text{profit/assets} \\ &= (\text{profit/revenues}) * (\text{revenues/assets}) \\ &= (1- \pi^{-1}) \text{ x (revenues/assets)} \end{aligned} \qquad (1)$$

where π^{-1} is the reciprocal of the profitability margin computed as revenues divided by costs. The profitability margin[1] (American Productivity Center, 1981) can be defined for some period t generally as:

$$\pi^t = \sum_m P_m^t y_m^t \,/\left(\sum_v W_v^t X_v^t + \sum_f W_f^t X_f^t\right) \qquad (2)$$

where:

y_m^t = actual quantities of output m during period t, m=1, 2, M; t=1, 2, T

[1] The conventional definition of profit margin" in accounting is the ratio of profits to revenues.

p_m^t = price per unit of output m during period t

x_v^t = actual quantity of variable cost input v, v=1, 2, V, during period t

w_v^t = cost per unit of variable cost input v during period t

x_f^t = actual quantity of fixed cost input f, f=1, 2, F, during period t

w_f^t = cost per unit of fixed cost input during period t

To analyze performance over time, the profitability change ratio can be defined as a ratio of ratios, the ratio of the profitability margin ratio for period t to the profitability margin ratio for some base level 0:

$$\text{PFTBLT} = \frac{\pi^t}{\pi^0} = \frac{\sum_m p_m^t y_m^t / (\sum_v w_v^t x_v^t + \sum_f w_f^t x_f^t)}{\sum_m p_m^0 y_m^0 / (\sum_v w_v^0 x_v^0 + \sum_f w_f^0 x_f^0)} \quad (3)$$

For multiperiod analysis an approach suggested by the American Productivity Center (APC, 1981; Miller, 1984), can be used to decompose the profitability change ratio in (3) into its productivity and price recovery components. These APC ratios are useful if one only wants to measure the extent to which firms may be pursuing strategies of efficiency as a low cost producer, or trying to maximize prices of outputs sold as a differentiator (Porter, 1980). However, to attain sustained profitability firms have to not only be technically efficient, but effective in realizing higher prices at the same time (Porter, 1985). Such overall results can be attained only when firms are correct in their internal resource allocation decision. To the extent that they are able to identify and sell outputs having a greater rate of profitability, and to the extent that firms utilize existing assets in place better, they can significantly improve their profitability.

Such overall improvements are unlikely to be signaled only by the productivity and price recovery ratios. In addition, changes in the APC productivity and price recovery ratios can be confounded by changes in sales mix and the volume of operations (Banker, Datar and Kaplan, 1989). To address these issues, this paper

follows Banker, Chang and Majumdar work(1993) which extends the ratio formulation process and derives an alternative set of four ratios that augment the profitability measure and are useful in understanding firm-level differences in performance.

Described below are the four ratios developed by Banker, Chang and Majumdar(1993)[2].

Productivity Change Ratio: This ratio shows how resource utilization within the firm is changing over time, and enables us to assess whether firms are becoming more or less technically efficient in their operations. The ratio compares actual usage of inputs to the industry data set as a whole given the actual outputs and output capacities of a firm for each time period.

Price Recovery Change Ratio: This ratio shows how effective the firm is maximizing output prices while minimizing input prices, and thereby measures the price efficiency of firms. The ratio compares the value of outputs and input at base level prices to the value at current period prices, while holding both outputs and inputs constant at current levels.

Product Mix Change Ratio: This ratio shows what impact changing the product mix or the service mix of a firm has on its profitability over time. What is measured is the improvements in allocative efficiency within the firm, particularly with regard to how the firm concentrates its resources on those products having a greater impact on profitability.

Capacity Utilization Change Ratio: While the productivity ratio measures the change in technical efficiency of a firm with regard to its utilization of resources in generating outputs, the capacity utilization change ratio measures efficiency of a

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2 The assumptions about technology, standard quantities, the base level quantities and calculations needed to formulate the ratios are presented in appendix 1.

different kind. There is a fixed stock of some physical capital in a firm, and hence a standard output is expected based on technical considerations. To the extent that such capacity utilization improves we can expect to see a greater than standard level of output from such physical capital and infer that assets already in place are being used to generate greater amounts of output.

Each of the ratios captures a different dimension of firm performance. The profitability change ratio helps us in evaluating how the overall profitability of the firm is fluctuating over time, enabling us to ascertain the validity of the first hypothesis (H1). The productivity change ratio helps us in assessing the validity of the second hypothesis(H2). The price recovery change ratio helps us in assessing the validity of hypothesis three(H3). The product mix change ratio helps us in evaluating hypothesis four(H4) and the capacity utilization change ratio helps us in evaluating hypothesis five(H5). Expectations regarding the behavior of the ratios over time are summarized in Table 1.

Table 1 Expectations Regarding Behavior of the Performance Ratios

Hypothesis	Performance Ratios	Behavior of The 1987 Ratio versus the 1981 Ratio	Behavior of The 1984 Ratio versus the 1981 Ratio	Behavior of The 1987 Ratio versus the 1984 Ratio
H1	Profitability Change Ratio	1987>1981	1984>1981	1987<1984
H2	Productivity Change Ratio	1987>1981	1984>1981	1987>1984
H3	Price Recovery Change Ratio	1987<1981	1984<1981	1987<1984
H4	Product Mix Change Ratio	1987>1981	1984>1981	1987>1984
H5	Capacity Utilization Change Ratio	1987>1981	1984>1981	1987>1984

3.5 Tests Carried Out to Validate the Hypotheses

Having calculated the performance ratios, the Welch's mean test procedures are performed to validate the proposed hypotheses. Or more specifically, for each of the five ratios, this paper tests (i) whether the 1984 mean of that ratio is greater (or less) than the 1981 mean of that ratio, (ii) whether the 1987 mean of that ratio is greater (or

less) than the 1984 mean of that ratio and (iii) whether the 1987 mean of that ratio is greater (or less)than that of the 1981 mean.

IV. EMPIRICAL RESULTS

The performance ratios calculated for the U.S. telecommunications firms over three time periods 1981,1984 and 1987 are given in Table 2 and plotted in Figure 1.

Table 2 The Performance Ratios for the U.S. Telecommunications Industry

	Year		
Performance Ratios	1981	1984	1987
Profitability Change Ratio	0.9067	1.0064	0.9861
Productivity Change Ratio	0.8607	1.0009	1.0423
Price Recovery Change Ratio	1.4633	1.0010	0.8381
Product Mix Change Ratio	0.9870	1.0388	1.1184
Capacity Utilization Change Ratio	0.7708	1.0828	1.0853

Figure 1 AVERAGE PERFORMANCE OF ALL FIRMS

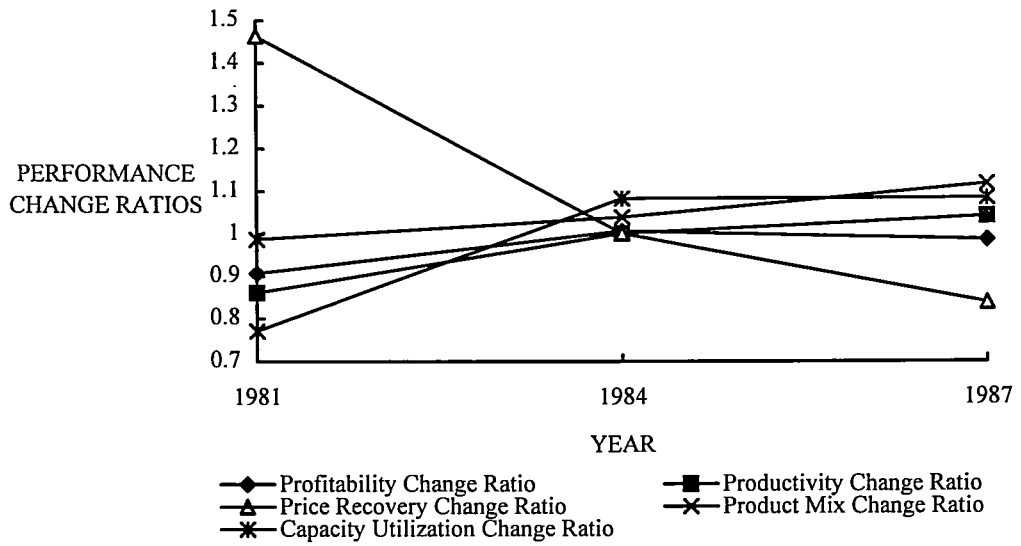

Figure 1 reveals that profitability rises in 1984 relative to 1981 following partial market liberalization, and then falls in 1987 relative to 1984. The productivity change ratio rises both in 1984 relative to 1981, and in 1987 relative to 1984. The price recovery change ratio falls consistently, in 1984 relative to 1981 and 1987 relative to 1984. The product mix change ratio on the other hand rises in 1984 relative to 1981, and keeps rising in 1987 relative to 1984, while the capacity utilization ratio rises dramatically from 1981 to 1984, but declines somewhat between 1984 to 1987.

Hence, from Figure 1 it appears that the rise in the profitability change ratio that takes place between 1981 and 1984 has been mainly due to increasing productivity and capacity utilization. While the product mix ratio has improved too, it is not as steep as the improvements in productivity and capacity utilization. On the other hand, though the price recovery ratio has dropped dramatically, its negative impact has been more than adequately counter-balanced by the positive impact of the three other ratios. In Contrast, the drop in the profitability change ratio between 1984 and 1987 seems to have taken place because of not only a continuing drop in price recovery, but also a drop in the capacity utilization ratio, and the rises in the productivity change ratio and the product mix change ratio are inadequate to counter their impacts. Detailed results of the statistical tests carried out on each of the five ratios are given in Tables 3 through 7.

Impact on Profitability

Hypothesis one posits that as markets became more competitive due to liberalization profitability over the short run will increase because of greater opportunities to maximize revenues, while incentives to reduce costs will also increase. However, relative to such early increases in the profitability margin, there will be a compression in profitability in later periods as increasing competition brings severe pressures to bear on the revenue streams of extant firms. The test results are presented in Table 3.

Table 3 Results of the Statistical Test Carried Out on the Profitability Change Ratio

	Years Compared		
	1981 and 1984	1984 and 1987	1981 and 1987
Mean:	0.90671.0604	1.06040.9861	0.90670.9861
Welch's Test: t	-8.2388	4.6433	-5.9764
d.f	72.2	52.5	59.8
p	.0001	.0001	.0001

A reading from Table 3 shows that the mean of the profitability change ratio for 1984 is greater than that for 1981 ($p < .0001$), suggesting that profitability margins do increase significantly immediately after key events in liberalization process, such as AT&T divestiture. The 1987 mean of the ratio is also significantly greater than that for 1981 ($p < .0001$) when competition was increase. This gives positive support for the implicit and intuitive assumption that in a deregulated environment profitability margins will be significantly higher than in a regulated era as a result of firms undertaking measures to increase the scope of their more profitable activities, while trying to control costs. However, the 1987 mean of the ratio is significantly lower (again $p < .0001$) than that for 1984. While firms are consistent in a post-deregulation era in trying to undertake activities that increases their profits, nevertheless, the opening of markets do bring in competitive pressures on such profit streams. Thus the evidence of these results indicates the validity of the first hypothesis.

Table 4 Results of the Statistical Test Carried Out on the Productivity Change Ratio

	Years Compared		
	1981 and 1984	1984 and 1987	1981 and 1987
Mean:	0.86071.0009	1.00091.0423	0.86071.0423
Welch's Test: t	-3.5009	-.6329	-4.1186
d.f	64.2	75.8	62.2
p	.0008	.5287	.0001

Since a firm can face pressures to be cost efficient or focus on generating revenues to generate greater profits, improving productivity is a key component that contributes to a firm's profitability. Reviewing Figure 1 we see that the productivity ratio increases consistently from 1981 to 1984 and from 1984 to 1987. Details of the statistical tests are presented in Table 4.

The increase in the productivity change ratio between 1981 to 1984 is statistically significant ($p < .0008$) for the mean of the ratio, however, while the 1987 mean is greater than the one for 1984 the difference is not statistically significant. The fact that the productivity ratio has monotonically increased over the entire period 1981 to 1987 is also supported by the fact that the 1987 mean is greater than that for 1981. The second hypothesis, that with increasing liberalization the productivity of telecommunications firms will increase, is also validated. However, the results do indicate a tapering off after an initial rapid growth of productivity in the period immediately following the initiation of environmental change, suggesting that impacts of one-off changes engendering productivity increases are difficult to sustain beyond a certain length of time, unless of course there are other "stock" to the firms' systems which trigger other reactions. The findings are, nevertheless, consistent with several studies looking explicitly at the issue of productivity increases following market liberalization referred to earlier.

Impact on Price Recovery

In hypothesis three, this paper proposed that the ability of a regulated firm to recover high prices for its products will decline as liberalization leads to the intensification of competition. And, such declines are expected to continue if a liberalized environment becomes intrinsic in an industry. As shown in Figure 1, the price recovery change sharply declines from 1981 to 1984, and further declines from 1984 to 1987 though not as sharply. This suggests that competition from new entrants brings extremely strong pressures on the erstwhile monopoly telecommunications firms to reduce their prices. Statistical tests results on this ratio is given in Table 5.

Table 5 Results of the Statistical Test Carried Out on the Price Recovery Change Ratio

	Years Compared		
	1981 and 1984	1984 and 1987	1981 and 1987
Mean:	1.46331.0010	1.00100.8381	1.46330.8381
Welch's Test: t	6.4201	2.9676	9.6317
d.f	72.1	68.9	60.1
p	.0001	.0041	.0001

It's evident from Table 5 that the decrease in the price recovery ratio is monotonic throughout the period of the study. The mean of the ratio is significantly lower for 1984 than in 1981 ($p < .0001$), the mean for 1987 is significantly lower than that for 1984 ($p < .0041$), and the mean is significantly lower for 1987 than for 1981 ($p < .0001$). These differences, all very highly significant as shown by the result in Table 5, validate the third hypothesis, and again the evidence is consistent not only with theory, but also with other extant studies.

Impact on Product Mix

Hypothesis four states that with the onset of a liberalized environment firms will focus their activities on those products yielding a greater margin, since cream-skimming opportunities available in a regulated milieu will disappear. As a result, it's expected to find that the product mix change ratio capturing the ability of firms to concentrate on products or services with higher margins will increase over time. The results of the statistical tests are in presented Table 6.

Table 6 Results of the Statistical Test Carried Out on the Product Mix Change Ratio

	Years Compared		
	1981 and 1984	1984 and 1987	1981 and 1987
Mean:	0.98701.0388	1.03881.1184	0.98701.1184
Welch's Test: t	-1.6644	-2.3819	-3.9773
d.f	76.0	75.1	74.7
p	.1001	.0198	.0002

Clearly, Table 6 shows that the product mix change ratio also increases monotonically over the period examined. However, the test results do reveal an interesting pattern. While clearly the 1987 mean of this ratio is significantly greater than that for 1981 (p =.0002), only the 1987 mean is significantly greater than that for 1984. However, the 1984 mean is not significantly greater than the one for 1981. While the proposition four is validated, certain behavioral predilections of the firms seem apparent. The firms have initially concentrated on cost containments following the immediate initiation of environmental change. This is apparent from a joint review of the productivity change ratio and the capacity utilization change ratio. Both of these increase significantly between 1981 and 1984, but not between 1984 and 1987. However, as market opportunities have increased the attention of these firms have shifted more towards product and market oriented activities, as is shown by the step increase in the product mix change ratio between 1984 and 1987, relative to the increase between 1981 and 1984.

Impact on Capacity Utilization

Capacity utilization can be a major factor contributing to the profitability of firms in industries where there is a large amount of fixed, immobile capital stock. If firms are able to generate greater outputs with this stock they can thereby spread costs over a larger volume and increase their profitability margin. Hypothesis five predict that with liberalization asset utilization will increase since incentives to over invest in capital stock will disappear. Statistical tests results with regard to this issue are contained in Table 7.

Table 7 Results of the Statistical Test Carried Out on the Capacity Utilization Change Ratio

	Years Compared		
	1981 and 1984	1984 and 1987	1981 and 1987
Mean:	0.7708 1.0828	1.0828 1.0753	0.7708 1.0753
Welch's Test: t	-13.0786	.3182	-14.2966
d.f	73.5	72.9	76.0
p	.0001	.7512	.0001

As expected, a rapid increase in the capacity utilization change ratio, which captures firms' asset utilization, between 1981 to 1984, and in the overall period between 1981 and 1987 is observed. However, there is a plateauing of this ratio between 1984 and 1987. The mean of the ratio shows that the 1984 ratio is greater than the 1987 ratio or in other words there is a decline in relative capacity utilization in 1987, but such a decline is insignificant.

The implications of such a plateauing are two-fold. One is that after the initial liberalization slack has been squeezed out, firms are content to keep a level of capacity that will enable them to provide other products or services as markets open. The second is that after a period of adjustment to liberalization firms have adjusted their scale of operations to one which is most productive, and future improvements in the capacity utilization ratio will only occur because of major technical change.

While hypothesis five is validated, these results which should be read in conjunction with the results obtained for the productivity change ratio show several interesting dynamic patterns at work in the industry. In the immediate shock of the initiation of a more competitive environment firms have an impetus to be operationally efficient, contain costs and improve the utilization of existing asset capacity. However, with the continuation of liberalization market opportunities increase and firms find that concentrating on revenue enhancement activities augment the profitability margin more. Thus, an analysis on the movements in the underlying dimensions of performance over time, enables us to isolate patterns in how firms seem to respond to the emerging competitive environment.

V. CONCLUDING REMARKS

This paper demonstrates that market liberalization has significantly impacted the different dimensions underlying the performance of firms in the U.S. telecommunications industry. Admittedly, much has been written on the topic, but comprehensive evidence of changing patterns in the performance of all major firms in one major industry has been absent. This paper presents such evidence, and its

combined weight enables us to positively affirm the articulate research question. It was feared that the opening of technology-rich telecommunications markets to incumbent telephone companies and new entrants would induce incumbents to steer away from existing, and supposedly boring telephone activities. Such lack of attention would have a negative impact on performance, since management would be more interested in developing their business expertise in the newer, more exciting areas. The results, admittedly over a relatively small, seven-year period 1981 to 1987, do not provide evidence that such has been the case. On the contrary, existing operations have improved across a majority of the underlying performance dimensions.

The results of this study validate several assumptions underlying theoretical frameworks in the accounting, strategic management, economic and public policy literature as to how environmental changes affect firm performance. While the changing environment may allow easy entry and exit, market opportunities also simultaneously open up and existing firms are allowed to undertake activities hitherto closed to them. Again, while pressures on margins and prices are likely to develop, firms will be given greater incentives to specialize and extract rents that can arise, given their specific micro-market situations. At the same time, pressures of competition induce efficiency oriented behavior, leading to increase in operating and asset utilization efficiency. All these expectations hold up in this study of the U.S. telecommunications industry over a period of major strategic changes between 1981 to 1987.

This paper also demonstrates that while profitability margins may rise and then fall as a result of the market forces, separate components of firm performance that impact such profitability also change significantly. With increasing competition the price recovery ability of firms is expected to drop as more suppliers entered the markets of existing players sought their customers. However, to counteract such trends firms increase their operational efficiencies through increasing productivity and asset utilization, and by focusing their attention to products having a higher margin. As a result of such focusing and paying attention to operating efficiencies, firms are able to counteract and offset the decline in profits likely to be caused by a decline in

the price recovery ratio.

Although this study is anchored in one industry, the implications are generalizable elsewhere. Since there are several other industries which have undergone deregulatory changes, both in the U.S. and overseas, it would be useful to apply the ratio analysis framework to such sectors as financial services in the US and Taiwan or telecommunications services in Taiwan and Japan, to understand the temporal patterns of behavior underlying the different dimensions of firms performance. Such comparative studies will also enrich our perspectives of how different firms, in different industries, perhaps in different countries, react to similar phenomena.

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Appendix 1: Procedures For Calculating The Ratios

The ratios proposed by Banker, Chang and Majumdar (1993) and described in sections 3.4 are defined in detail here. The productivity change ratio is defined as the productivity raito for the period t to the base level productivity ratio.

It is expressed as

$$\text{PRDTVT}=\frac{(\sum_v w_v^t z_v^t + \sum_f w_f^t z_f^t) \div (\sum_v w_v^t x_v^t + \sum_f w_f^t x_f^t)}{(\sum_v w_v^o z_v^o + \sum_f w_f^o z_f^o) \div (\sum_v w_v^o x_v^o + \sum_f w_f^o x_f^o)} \quad (4)$$

The price recovery change ratio is expressed as:

$$\text{PRCREC}=\frac{\sum_m p_m^t y_m^t \div \sum_m p_m^o y_m^t}{(\sum_v w_v^t z_v^t + \sum_f w_f^t z_f^t) \div (\sum_v w_v^o z_v^t + \sum_f w_f^o z_f^t)} \quad (5)$$

The product mix change ratio is expressed as:

$$\text{PRODMIX}=\frac{\sum_m p_m^o y_m^t \div \sum_m p_m^o y_m^o}{(\sum_v w_v^o z_v^t \div \sum_f w_f^o q_f^t) \div (\sum_v w_v^o z_v^o \div \sum_f w_f^o q_f^o)} \quad (6)$$

and the capacity utilization change ratio is expressed as under:

$$\text{CAPUTIL}=\frac{(\Sigma_v w_v^o z_v^t + \Sigma_f w_f^o q_f^t) / (\Sigma_v w_v^o z_v^t + \Sigma_f w_f^o z_f^t)}{(\Sigma_v w_v^0 z_v^0 + \Sigma_f w_f^0 q_f^0) / (\Sigma_v w_v^0 z_v^0 + \Sigma_f w_f^0 z_f^0)} \quad (7)$$

where y_m^t, p_m^t, x_v^t, w_v^t, x_f^t, and w_f^t are as previously defined and

z_v^t = standard quantity of variable cost input v, v=1,2,V required in period t, t=1,2,T.

z_f^t = standare quantity of fixed cost input f, f=1,2,F required in period t.

q_f^t = standard average quantity of fixed cost input f in period given standard industry capacity utilization.

It can be easily verified that the product of the four ratios in (4),(5),(6), and (7) equals profitability ratio in (3) as follows:

PFTBLT=PRDTVT*PRCREC*PRODMIX*CAPUTIL (8)

To calculate the ratios certain assumptions are required to be made. First, the resources available with the firm can generate multiple outputs. Second, substitution possibilities among inputs are not high. third, production of services may be characterized as one using fixed proportions technology, and fourth, input requirements can be approximated linearly within relevant ranges.

The standard quantity z_v^t of variable cost input v required in any period t is based on the standard input requirement α_{mv} per unit of product m. The quantity required is defined as:

$$z_v^t = \sum_m \alpha_{mv} y_m^t \quad (9)$$

The standard input requirement α_{mv} is the industry average industry requirement for an input v to produce product or service m and is calculated by regressing pooled inputs, by cost type, on pooled outputs without an intercept term. The two outputs that we use to calculate α_{mv} are local and toll call minutes.

Similarly the standard quantity z_f^t of fixed cost input f required in period t is based on the standard input requirement β_f per unit of output capacity available to produce all products. It is defined as:

$$z_f^t = \beta_f \; k^t \quad (10)$$

where k^t denoted quantities of plant capacity available for outputs during period t. The standard input requirement β_f is based on output capacity available and not on product volume. It is calculated by regressing pooled inputs, by cost type if there are two or more types of fixed costs, on pooled output capacity available without an intercept.

Having calculated the above, we gain an idea of what standard industry average fixed costs are to produce various outputs given available physical plant capacity. However, the computation of an average industry fixed cost presupposes average industry capacity utilization given that physical resource capacity is fixed and unique. Hence, we need to calculate a standard industry load factor for each period. This is again calculated as an average by dividing the sum of pooled outputs by the sum of

pooled plant capacity. It is defined as:

$$\frac{\sum_m y_m^o}{k^o} \qquad (11)$$

The pooled outputs used are total local and toll call minutes and the pooled plant capacity is the total number of telephone lines for all firms in all periods. The standard load factor gives us an idea of what average industry capacity utilization is and is used to calculate the standard average quantity of fixed cost input f in period t based on input requirement β_f, given standard industry capacity utilization. This is defined as:

$$q_f^t = \beta_f \Psi^o y_m^t \qquad (12)$$

where Ψ^o is the inverse of the standard load factor.

Since the question of interest is to compare performance across companies and across time. it is necessary to calculate common base level prices and quantities. Using pooled data for all firms in all time periods (i.e, data for the years 1981, 1984 and 1987 in this study), the base output and input prices are calculated as follows:

$$p_m^o = \sum_n \sum_t p_m^t y_m^t \div \sum_n \sum_t y_m^t \qquad (13)$$

$$w_v^o = \sum_n \sum_t w_v^t x_v^t \div \sum_n \sum_t x_v^t \qquad (14)$$

$$w_f^o = \sum_n \sum_t w_f^t x_f^t \div \sum_n \sum_t x_f^t \qquad (15)$$

Where n=1,2,...,N denotes individual companies and t=1,2,...,T denotes the time periods.

Similarly, the base actual output and output capacity quantities are calculated as averages over all firms and all time periods, as below:

$$y_m^o = \sum_n \sum_t y_m^t \div NT \qquad (16)$$

$$k^o = \sum_n \sum_t k^t \div NT \qquad (17)$$

Finally, the base actual and standard input quantities are calculated using eatimated input standard α_{mv} and β_f, the estimated standard load factor $\frac{\sum_m y_m^o}{k^o}$, where

$$\Psi^o = 1 / \frac{\sum_m y_m^o}{k^o} \tag{18}$$

and the base output and base capacity details, as under

$$x_v^o = z_v^o = \sum_m \alpha_{mv} y_m^o \tag{19}$$

$$x_f^o = z_f^o = \beta_f k^o = q_f^o = \beta_f \Psi^o \sum_m y_m^o \tag{20}$$

By incorporating technical or other standard input requirements, actual outputs and actual output capacities in the calculation, each component of the productivity ratio (4) only captures deviations between actual and standard usages, and so the productivity change ratio provides a purer measure of productivity change for period t. The price recovery change ratio (5) also incorporates standard input requirements, given current period actual outputs and output capacities. Since z_v^t and z_f^t are functions of y^t, the ratio is driven only by differences in prices.

The product mix change ratio (6) incorporates the same standard inputs for variable inputs as the other two previous ratios. However, to disentangle the effects of changes in product mix from capacity utilization, for fixed inputs the standard inputs given actual outputs (q_f^t and q_f^o) are incorporated in the denominator ratio. These same standard inputs given actual outputs and the standard load factors for fixed inputs are incorporated in the numerator of the capacity utilization change ratio (7), while the standard inputs for fixed inputs are used in the denominator. However, $q_f^o = z_f^o$ in (20) and the capacity utilization change ratio therefore reflects only deviations between q_f^t and z_f^t.

Appendix 2: List of Companies Studied

Bell of Pennsylvania
Cincinnati Bell
Continental of California
Continental New York
Continental Virginia
Carolina Telephone
Central Telephone
C&P Maryland
C&P Virginia
Chesapeake & Potomac Telephone
C&P West Virginia
Diamond State Telephone
GTE California
GTE Florida
GTE North
GTE Northwest
GTE Southwest
Illinois Bell
Indiana Bell
Wisconsin Bell
Michigan Bell
Mountain State Telephone
New England Telephone
New Jersey Bell
Nevada Bell
Northwestern Bell
New York Telephone
Ohio Bell
Pacific Bell
Pacific Northwest Bell
South Central Bell
Southern New England Telephone
Southern Bell
Southern Telephone
United Indiana
United Missouri
United Ohio
United Pennsylvania
United Inter-Mountain

市場自由化對公司企業績效之影響：以美國電信業為證

張錫惠*

摘 要

本研究應用多重期間多項產品的比率分析模式檢視市場自由化對公司企業年度績效之影響。以美國電信業公司為證之研究結果顯示，市場自由化對公司企業之經營行為、策略及績效有顯著性之影響。

關鍵詞：市場自由化、企業績效、比率分析、電信業、獲利率

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