Pricing Behavior in the U.S. Railroad Industry: Lessons for South Africa.

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Abstract

Deregulation of the United States (US) rail industry's culminated in the passage of the Stagger's Act of 1980. This was brought about by the realization that the distortionery regulatory constraints were adversely impacting on the financial performance of the industry. Thus deregulation was aimed, in part, at giving railroads more freedom in improving their financial performance and increasing the level of competition in the industry. This paper analyzes the pricing behavior of railroads in the coal transportation market in the US, with special reference to the transportation of coal to electric utilities.

Using AAR data, parameters of a railroad's translog cost model are estimated. From the estimated model, marginal cost of hauling coal is determined. Together with the rate/price data from the CTRDB, market power indices are computed. These market power indices are found to be consistent with non-competitive behavior, suggesting failure of deregulation in bringing competition into the industry.

Important lessons that South Africa (SA) can learn from US rail deregulation are discussed. These lessons are important not only to the rail industry in South Africa but also to other industries undergoing restructuring.

1. Introduction

There exist substantial evidence, both theoretically and empirically, that absence of competition in an economy can be a serious impediment to growth. Most countries today have some form of regulatory policies whose aim, amongst others, is to prohibit non-competitive behavior by firms or to promote competition.

Recent empirical work by Nickel (1996) points to a positive correlation between product market competition and productivity growth within a firm or industry. Competition forces firms to innovate in order to survive. Without competition economic growth is likely to be restricted to low non-optimal levels.

In economics, regulation can be considered a "second best" solution when markets are not competitive. However, regulation itself, if not carefully implemented, can be an obstacle towards effective competition. This seems to have been the case in the United States (U.S.) railroad industry. Prior to 1980 the U.S. railroad industry was regulated. It is claimed that regulation brought about financial bankruptcy and financial losses to many of the U.S. railroads. As a result, the government passed the Staggers Act in 1980, which was a milestone towards the deregulation of the industry. It gave railroads total freedom to price their services subject to some minor residual regulation. One of the main aims of the Act was to bring about competition in the railroad industry. Though the rates did decline somewhat, but the process was accompanied increase by mergers and consolidations which have seen the number of Class I railroad freight carriers declined from 38 in 1978 to 11 in 1994 [AAR 1978-1997]. This is likely to have reduced the level of competition in the railroad industry.

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The South African rail industry is undergoing some restructuring - an issue which has generated growing controversy. Privatization, which has become a "buzz" word recently, will undoubtedly bring about additional regulatory challenges. It is within this context, that this paper looks at the pricing behavior of U.S. railroads post deregulation, and attempt to find out what South Africa (SA) can learn from U.S. experiences. Though this study is based on the railroad industry, lessons are drawn that are applicable to other industries undergoing such transformation. This paper is organized as follows. First, the theories of market power and railroad cost modeling are discussed. Empirical estimations of the cost function as well as the computation of market power indices follow this. Finally some lessons for SA are discussed.

2. Modeling Market Power and Railroad Cost Functions

2.1 Market Power

Consider a railroad which provides $m = 1,...,M$ rail services /outputs. Let $y = (y_{1,}\ldots,y_M)$ be a vector of these outputs. Assume that the railroad obtains $n = 1,\ldots,N$ inputs or factors of production from competitive markets. Let $x = (x_1,\ldots,x_N)$ be a vector of those inputs. The vector of prices for these inputs is represented by $w = (w_1,\ldots,w_N)$

Now suppose that there are $r = 1,\ldots,R$ railroads, and assume that the railroad's behavioral objective is to maximize profits. Let $P(p,w)$ represent profits for railroad r, where $p = (p_1,\ldots p_M)$ is a vector of output prices. Let $p_m(Y_m)$ be an inverse demand function for output m where Y_m is industry output of product m. Two simplifying assumptions are made. First, it is assumed that railroads chose their profit maximizing output level with the assumption that rival railroads' quantity is fixed[1]. Second, it is assumed that demands for different kinds of rail outputs are independent. Thus a railroad solves the following profit maximization problem:

$$\underset{y_m}{Max}\prod(p,w) = \sum_{m=1}^{M} p_m(Y_m) * y_m - C(y\ ,w) \qquad (1)$$

Where the subscripts in $C(y,w)$, which is total cost, are suppressed to simplify the notation. Assume that the profit function is continuous, convex and homogenous of degree one in prices[2]. The optimality conditions corresponding to the above maximization problem can be derived by taking the derivative of (1) with respect to y_m . From the first order conditions for interior solution and after some algebraic manipulations it can be shown that:

$$p_m *[1-\frac{q}{e_{mm}}] - C'_m(.) = 0 \qquad (2)$$

Where

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[1] This assumption can be relaxed by introducing conjectural variation into the model. In short conjectural variation is a "firm's output decision based on the perceived response of other firms in the industry." Hazilla, [1991]. That is, a firm's rival quantity is no longer assumed given. See also Scherer and Ross [1990] for a detailed discussion of this concept. For our purposes, however, we will maintain fixed rival quantity.

[2] See Mas-Colell, et.al [1995] and Kreps, [1990], amongst other texts, for detailed exposition of these properties.

$$e_{mm} = \frac{\partial Y_m}{\partial p_m} * \frac{p_m}{Y_m} \quad and \quad q = \frac{y_m}{Y_m}$$

It is clear from (2) that θ/ε_{mm} indicates the relative mark-up i.e. the ratio between the profit margin (i.e. price minus marginal cost) and the price. To see this, let $\theta/\varepsilon_{mm} = \Im$ in (2) and then simplify to get:

$$\Im = \frac{p_m - C'_m(.)}{p_m} \qquad (3)$$

Equation (3) is nothing other than the well-known Lerner Index [3], which varies from zero to one. In a perfectly competitive market one would expect firms to charge price equal to marginal cost, implying that a positive value of $\Im$ indicates the presents of firm specific market power.

In equation (3) information on rates and marginal costs of hauling coal is required. Once the marginal costs are estimated, together with available data on transport rates, then Lerner indices for each coal move can be constructed[4].

An important pitfall with respect to this index has been documented in a number of studies[5]. The index does not posses a systematic way of accounting for variable and fixed factors. This leads to difficulties in evaluating the null hypothesis of presence of market power because if the firm uses some fixed factors, as railroads do, it is not clear how capital costs can be recovered. Nonetheless, these indices are useful in detecting the existence of market power. Because of the difficulty of systematically accounting for fixed factors, it will be assumed in this study that they are relatively small.

2.2 Railroad Costs

First, a basic assumption is made that the railroad industry is a capital-intensive industry, and that there are some factors of production that cannot be altered in the short run. For example, to adjust the amount of rail in place would take some time. Thus capital can be thought of as essentially fixed in the data period in this study and consequently railroads do not reach their long run cost function in each period. When at least one factor of production is fixed, the firm is said to be operating in the short run [Braeutigam, 1999]. Total cost in the short run comprised of fixed plus variable costs (VC), i.e. cost that vary with the level of output. In symbols, it is:

$$C(y_m, w) = r * K + VC \qquad (4)$$

Since railroads cannot adjust their fixed cost in the short run, they will try to minimize short run variable costs. Following Braeutigam et.al. [1981] and McCullough [1993], amongst others, this study proposes to estimate a short run variable cost function which can generally be represented as:

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[3] It should be noted from the onset that the derivation of the Lerner index is well known. It is presented here to provide a complete discussion of the theoritical basis of measuring market power

[4] Of course there are other methods through which (3) can be estimated. See for example Applebaum[1979], Hazilla, 1991, etc.

[5] See for example Bresnahan [1989] and Chirinko & Fazarri [1994], amongst others.

$$VC = VC(y_m, w, z, T, K) \qquad (5)$$

Where y and w are defined as before, and other variables that could be thought of as having an impact on variable costs, i.e. z, T, and K are also included. The *variable* $z = (z_1,\ldots,z_K)$ represents some technological factors, such as average length of haul etc., that are thought to impact costs in addition to output and factor prices. T is a counter for years, and K is the fixed capital.

It is important at this point to think about the nature of rail outputs y_m. Railroads transport a variety of commodities, with different service attributes. Several authors have pointed out that the cost structure with respect to transportation of each commodity conceivably differs from one commodity to the other. Most studies use aggregate ton-miles as a measure of output. Braeutigam [1999] pointed out that:

> ".... grossly aggregated measure of outputs such as ton-miles and passenger miles failed to capture adequately the complexity of the services produced by the typical transportation enterprise." [Braeutigam, 1999. p68].

One of the reasons why some of those studies used aggregate ton-miles is because data on disaggregated ton-miles are not available. Because one of the aims of this study is to calculate marginal cost of transporting coal, a measure of "coal transport output" is desired. It is not possible to obtain such a measure using ton-miles, since only gross ton-miles are provided in the AAR data. Hence, this study follows McCullough [1993] and uses car-miles as a measure of output. Data on car miles are available by equipment type. Since different car types are involved in freight services that have different cost characteristics, this makes it easier to disaggregate car-miles into different outputs. These car-miles are aggregated into three outputs, namely high-value car-miles, bulk car-miles and "other" car-miles.

To estimate equation (5) an appropriate functional form is required. Following Berndt, et.al. [1993] and McCullough [1993], amongst others, a translog cost function, proposed by Christen, Jorgenson and Lau [1973], is employed.

The translog cost function belongs to a class of so-called flexible functional forms, since it can be viewed as a second order Taylor's series expansion in logarithm of variables. It is written as:

$$\begin{aligned}
\ln VC(y,w,z) = {} & a_0 + \sum_{n=1}^{N} a_n \ln w_n + \sum_{m=1}^{M} b_m \ln y_m + \sum_{k=1}^{K} d_k \ln z_k \\
& + \frac{1}{2}\sum_{n=1}^{N}\ \sum_{i=1}^{N} aa_{ni} \ln w_n \ln w_i + \sum_{n=1}^{N}\sum_{m=1}^{M} ab_{nm} \ln w_n \ln y_m + \\
& + \sum_{n=1}^{N}\sum_{k=1}^{K} ad_{nk} \ln w_n \ln z_k + \frac{1}{2}\sum_{m=1}^{M}\sum_{j=1}^{M} bb_{mj} \ln y_m \ln y_j \\
& + \sum_{m=1}^{M}\sum_{k=1}^{K} bd_{mk} \ln y_m \ln z_k + \frac{1}{2}\sum_{k=1}^{K}\sum_{h=1}^{K} dd_{kh} \ln z_k \ln z_h \qquad (6)
\end{aligned}$$

where *ln VC (y,w,z)* is the log of short run variable costs. Note that K and T are included in z to simplify the notation.

Of course, one could estimate (6) directly, but gains in efficiency can be realized by estimating it together with input cost share equations [Berndt, E. R., 1990]. The cost share equations are derived by invoking Shepherd's Lemma, i.e.:

$$S_n = a_n + \sum_{n=1}^{N} aa_{ni} \ln w_i + \sum_{m=1}^{M} ab_{nm} \ln y_m + \sum_{k=1}^{K} ad_{nk} \ln z_k \qquad (7)$$

Equation (6) and (7) comprise a system of cost and share equations to be estimated. Note that $n = 4$, since we have four inputs in our model. Thus, specifically the system will comprise of (6) and four share equations. Note that since the total shares for all four shares equations must sum to unity, which means that there are only three linearly independent share equations. Therefore one of the share equations need to be dropped when estimating.

Furthermore, one of the properties of the cost function is that it must be homogenous of degree one in prices and thus appropriate restrictions has to be made[6]. The primary aim of estimating the above equations is to derive the marginal costs of hauling coal. Taking the necessary derivative of the cost equation and performing the necessary transformation we get marginal cost as follows:

$$MC_{ym} = [b_m + \sum_{n=1}^{N} ab_{nm} \ln w_n + \sum_{j=1}^{M} bb_{mj} \ln y_j + \sum_{k=1}^{K} bd_{mk} \ln z_k][\frac{\hat{VC}}{y_m}] \qquad (8)$$

Where VC is estimated variable cost. In our case, of course, we are interested in the case where m is coal. Using (8) and (3), $\Im$ can then be computed.

3. The Data

Sources for the data used in this paper are the annual Analysis of Class I Railroads (ACR) and the quarterly Cost Indices published by the Association of American Railroads (AAR) are used. Data from ACR are based on regulatory reports that railroads submit to the Surface Transportation Board (STB), and the Cost Indices are computed by AAR for regulatory purposes. Table 3.1 gives details of the sample of an unbalanced panel of 13 Class I railroads[7] for the period 1982 - 1997.

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[6] See for example, Caves et.al. [1979] for a more detailed description of these restrictions.

[7] It is important to note that though data from 1978 are available, data for the period 1978 through 1981 have been excluded. By excluding these data, the potential impact of regulation on the data is removed. This is important for the following reasons. Firstly, this was the period of regulation during which railroads were bound by fixed labor contracts and large labor force (primarily due to regulation). Thus during this period it becomes problematic to consider labor as fixed or variable cost. Excluding this period removes this problem. Secondly, excluding this period makes it much easier to model railroad behavioral objective without complications which may arise by the need to include some form of regulatory constraints.

Table 3.1		
US Class I Railroads		
Railroad	**Abbreviation**	**Period**
Atchison, Topeka \& Santa Fe	ATSF	1982 – 1995
Burlington Northern	BN	1982 – 1997
Chicago \& Northwestern	CNW	1982 – 1994
Consolidated Rail Corp	CRC	1982 – 1997
CSX Corp.	CSX	1982 – 1997
Denver, Rio Grande Western	DRGW	1982 – 1993
Grand Trunk Western	GTW	1982 – 1997
Illinois Central Gulf	ICG	1982 – 1997
Kansas City Southern	KCS	1982 – 1997
Norfolk Southern	NSC	1982 – 1997
Soo Line	SOO	1982 – 1997
Southern Pacific	SP	1982 – 1996
Union Pacific Southern Pacific	UPSYS	1982 – 1997

Rail variable costs are computed by using freight services expenditures detailed in the ACR. These include expenditures on labor, fuel, materials and economic cost of equipment[8]. Car-miles by equipment type are given in the ACR. Following McCullough [1993] these are aggregated into three outputs, namely; bulk car-miles (y_b), high value car-miles (y_v) and "other car-miles" (y_e).

We have four input price variables which include indices for fuel ($w_{f,}$) , labor; (w_l), materials (w_m), and equipment prices ($w_{e,}$). These indices are based on AAR survey of member firms. Technological variables include average length of haul (H), miles of road (R), capital[9] (K) and the counter of years (T). These variables are summarized in Table 3.2[10]

Table 3.2				
Railroad Cost Data				
Variable	Unit	Mean	Min	Max
Variable Costs	$82 (000)	1514559	200155	5367762
Labor Share	Percent	0.5061	0.2219	0.6889
Equipment Share	Percent	0.1151	0.0188	0.2805
Fuel Share	Percent	0.0919	0.0455	0.1753
Material Share	Percent	0.2870	0.1251	0.5399
High-Value Car-miles	(000)	410772	8452	1821951
Bulk Car-miles	(000)	568142	16576	2842841
Other Car-miles	(000)	684542	76719	3129676
Labor Price	Index	2.3916	1.6680	3.0210
Equipment Price	Index	0.1817	0.1570	0.2280
Fuel Price	Index	1.8516	1.2880	2.7350
Material Price	Index	1.6512	1.3230	2.3150
Average Haul	Miles	490.316	175	1105
Year	Year	8.41	1	16

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[8] Note that accounting depreciation is ignored in the construction of variable costs, instead economic cost of equipment is added to VC. See McCullough [1993] for the construction of this variable.

[9] The procedure for calculating K is detailed in McCullough [1993].

[10] See Todani [2001] for details of this data.

Road	Miles	8.41	582	34946
Capital	(000)	14.889	12.578	16.372
Rate	$/Car-mile	2.22	0.29	22.79

Data on transportation rate *(p)* which is the rate which utilities have paid under each coal shipment contract, comes from the Coal Transportation Rate Database (CTRDB) compiled and maintained by the Energy Information Administration's (EIA). CTRDB is a compilation of data drawn from the Federal Energy Regulatory Commission's (FERC) Form 580, "Interrogatory on Fuel and Energy Purchase Practice".

4. Cost Function Estimation and Results

The cost function estimated comprises variable costs (VC) as a dependent variable. Independent variables comprise three outputs y_b, y_v, y_e; four input prices, w_f, w_m, w_e, w_l; and three technological factors, (R), (H), and (T) as well as quasi fixed capital stock (K). Miles of road owned (R) is intended to measure the network size. Average length of haul (H) is intended to capture the differences in railroads that transport relatively large tonnage of coal for shorter distance and those that ship relatively small tonnage for longer distances. This variable was later dropped because it did not add to the explanatory power of the model. Ivaldi and McCullough [1999] also found this variable to have insignificant impact on costs.

To estimate the parameters of the cost model, disturbance terms are added to the cost function (6) and the share equations (7). Then a system of equations to estimate is obtained by stacking the cost and factor share equations. One of the share equations is omitted when estimating; otherwise the covariance matrix of the errors on the share equations would be singular due to the adding up constraint. To simplify the notation, the model can be written compactly as:

$$Y_{grt} = X_{grt} b_g + e_{grt} \qquad (9)$$

Where Y and X denote dependant and independent variables respectively. Also $g = 1...G$ indexes equations, $r = 1...R$ indexes firms and $t = 1...T_r$ indexes time periods. Note here that since we are dealing with unbalanced data the time length T_r is specific to firm r since it gives the number of consecutive time periods for which data on this firm are available.

It is assumed that error term both in the variable cost and share equations is decomposed into two components, i.e.:

$$e_{grt} = m_{gr} + x_{grt} \qquad (10)$$

The component μ_{gr} is a firm specific error term, assumed to be constant over time, which captures unobserved differences between firms, such as the network differences. Estimation of this component is taken care of by introducing a firm dummy variable in each equation.

The component ξ_{grt} is a normally distributed error term assumed to be contemporaneously correlated across equations. Thus the system, (comprising equations (6) and (7)) is estimated using Zellner's [Zellner, 1962] Seemingly Unrelated Regression (SUR) procedure in Gauss 3.2. The overall results are shown in Table 4.1

Table 4.1

Translog Cost Function Parameter Estimates

Variable	*Parameter*	*Estimate*	*Std Error*	*T-Statistic*
w_l	*a1*	*0.09530*	*0.26738*	*0.35642*
w_e	*a2*	*-0.26125*	*0.17207*	*-1.51823*
w_f	*a3*	*0.22582*	*0.07329*	*3.08109*
w_m	*a4*	*0.94013*	*0.23852*	*3.94143*
y_b	*b1*	*0.09706*	*0.06831*	*1.42078*
y_v	*b2*	*1.46619*	*0.85430*	*1.71625*
y_e	*b3*	*-0.83597*	*1.75678*	*-0.47585*
K	*d1*	*0.18956*	*0.06831*	*2.72432*
R	*d2*	*-1.31161*	*2.34427*	*-0.55949*
T	*d3*	*1.68825*	*0.93748*	*1.80083*
$w_l * w_l$	*aa11*	*-1.34199*	*0.49541*	*-2.70883*
$w_l * w_f$	*aa12*	*-0.31585*	*0.09970*	*-3.16785*
$w_l * w_e$	*aa13*	*-0.09946*	*0.04148*	*-2.39751*
$w_l * w_m$	*aa14*	*-0.41863*	*0.07892*	*-5.30460*
$w_e * w_e$	*aa22*	*-0.15568*	*0.16328*	*-0.95345*
$w_e * w_f$	*aa23*	*-0.02617*	*0.02603*	*-1.00543*
$w_e * w_m$	*aa24*	*0.04945*	*0.04421*	*1.11841*
$w_f * w_f$	*aa33*	*2.19092*	*0.14280*	*15.34195*
$w_f * w_m$	*aa34*	*0.06798*	*0.02106*	*3.37162*
$w_m * w_m$	*aa44*	*1.06388*	*0.71993*	*1.47775*
$w_l * y_b$	*ab11*	*-0.05983*	*0.01797*	*-3.32892*
$w_l * y_v$	*ab12*	*0.01294*	*0.01151*	*1.12419*
$w_l * y_e$	*ab13*	*0.00116*	*0.02360*	*0.04927*
$w_e * y_b$	*ab21*	*0.01292*	*0.00963*	*1.34102*
$w_e * y_v$	*ab22*	*-0.04673*	*0.00623*	*-7.49934*
$w_e * y_e$	*ab23*	*0.04430*	*0.01278*	*3.46597*
$w_f * y_b$	*ab31*	*0.02469*	*0.00528*	*4.67559*
$w_f * y_v$	*ab32*	*0.01150*	*0.00337*	*3.41347*
$w_f * y_e$	*ab33*	*-0.08066*	*0.00677*	*-11.90334*
$w_m * y_b$	*ab41*	*0.12522*	*0.27846*	*0.44970*
$w_m * y_v$	*ab42*	*0.28747*	*0.16856*	*1.70539*
$w_m * y_e$	*ab43*	*-0.82167*	*0.28112*	*-2.92284*
$w_l * K$	*ad11*	*0.12725*	*0.02885*	*4.41054*
$w_e * K$	*ad21*	*0.03165*	*0.01546*	*2.04654*
$w_f * K$	*ad31*	*-0.09141*	*0.00845*	*-10.81106*
$w_m * K$	*ad41*	*0.36970*	*0.18351*	*2.01461*
$w_l * R$	*ad12*	*0.06394*	*0.03130*	*2.04239*
$w_e * R$	*ad22*	*-0.11489*	*0.01690*	*-6.79564*

w_f *R	*ad32*	*0.04749*	*0.00920*	*5.16010*
w_m *R	*ad42*	*-0.06918*	*0.29182*	*-0.23707*
w_l *T	*ad13*	*-0.06546*	*0.04738*	*-1.38146*
w_e *T	*ad23*	*0.00836*	*0.02241*	*0.37311*
w_f *T	*ad33*	*0.01844*	*0.01001*	*1.84277*
w_m *T	*ad34*	*0.25176*	*0.37777*	*-0.66642*
$y_b * y_b$	*bb11*	*-0.05392*	*0.09488*	*-0.56831*
$y_b * y_v$	*bb12*	*0.08227*	*0.08421*	*0.97689*
$y_b * y_e$	*bb13*	*-0.28296*	*0.13655*	*-2.07216*
$y_v * y_v$	*bb22*	*0.16245*	*0.06766*	*2.40076*
$y_v * y_e$	*bb23*	*-0.18546*	*0.12209*	*-1.51898*
$y_e * y_e$	*bb33*	*0.00833*	*0.23300*	*0.03577*
y_b *K	*bd11*	*0.13481*	*0.19733*	*0.68317*
y_v *K	*bd21*	*-0.14568*	*0.12345*	*-1.18006*
y_e *K	*bd31*	*0.29660*	*0.23734*	*1.24967*
y_b *R	*bd12*	*0.15150*	*0.22721*	*0.66678*
y_v *R	*bd22*	*0.00273*	*0.10114*	*0.02699*
y_e *R	*bd32*	*0.30837*	*0.23504*	*1.31199*
y_b *T	*bd13*	*-0.00794*	*0.06013*	*-0.13211*
y_v *T	*bd23*	*-0.01571*	*0.03911*	*-0.40179*
y_e *T	*bd33*	*0.12398*	*0.06887*	*-1.80003*
*K*K*	*dd11*	*-0.10014*	*0.39859*	*-0.25125*
*K*R*	*dd12*	*-0.18865*	*0.27484*	*-0.68638*
*K*T*	*dd13*	*-0.28647*	*0.14455*	*-1.98181*
*R*R*	*dd22*	*-0.24775*	*0.43403*	*-0.57082*
*R*T*	*dd23*	*0.15435*	*0.12351*	*1.24962*
*T*T*	*dd33*	*-0.10568*	*0.06252*	*-1.69022*

The R^2 for the variable cost equation is 0.99 and the Durbin Watson Statistic is 2.2. Most parameters that can directly interpreted have reasonable signs although there are some which have unexpected signs. The own- price share elasticities, i.e. *aa11, aa22, aa33, aa44* are expected to be positive. Coefficients *aa33* and *aa44* are both positive as expected. However *aa11* is negative, which is surprising . Also *aa22* is negative but not significant. The cross- price share elasticities are expected to be negative. The results show that they are negative with the exception of *aa24* and *aa34*. Both K and T appear to have significant explanatory power while R has little power. Overall the left hand variables are well explained.

A test of individual effects was perfomed. To perform this test, it is common to use the dummy variable estimator and the F-test based on the restricted and unrestricted sums of squares. An alternative test, which is much easier and requires only the restricted residuals was used. This is based on the Langrangean multiplier statistic (Breusch and Pagan, 1980), often referred to as the Breusch -Pagan Test in the literature. At the 5% significance level the hypothesis of no individual effects is rejected.

4.1 Marginal Costs

Using equation (8), marginal costs of hauling coal are projected and are displayed in Table 4.2. These MC are calculated at the mean of the data[11]. There are quite marked differences in marginal costs. ATSF appears to have the highest level of marginal cost. This could probably explain why coal as a percentage of total freight for ATSF is relatively small, i.e. 17.81%, compared to other railroads. As McCullough [1993] found, ATSF does have competitive marginal cost in the intermodal movements, which is its specialty. BN which is quite coal intensive, 55.15% in 1993, [AAR, 1993], does not seem to be very competitive compared to other railroads with smaller percentage of coal. ICG, which even though the percentage of coal is relatively large, so are of grain and chemicals, appears to have the smallest MC for coal. GTW, which specializes in auto transport, also appears to be competitive. This competitiveness may in part help explain an increase in the percentage of coal, which has almost doubled, from 17.45% in 1993 to 35.92% in 1997 [AAR, 1993,1997]. The next section presents the calculated market power indices.

4.2 Market Power Indices

Equation (3) was employed in calculating the market power indices, which are also presented in Table 4.2

Table 4.2

Mean Lerner Indices for each Railroad

Railroad	Mean Rate	MC*	L- Index
ATSF	1.5645	0.6593	0.5786
BN	2.5095	0.4543	0.8190
CNW	-	0.4931	-
CRC	2.6296	0.4284	0.8371
CSX	2.2771	0.2359	0.8964
DRGW	-	0.3452	-
GTW	-	0.2905	-
ICG	1.3842	0.2189	0.8419
KCS	-	0.3432	-
NSC	2.1532	0.2528	0.8826
SOO	-	0.5475	-
SP	0.7606	0.3676	0.5167
UPSYS	1.7930	0.3054	0.8297

* MC is calculated at the mean of the data

These are calculated as follows. For each railroad, the average rate was calculated. These average rates together with the MC of each railroad, calculated at the mean of the data, are then employed to obtain the Lerner Indices. These indices, ranging from an average of 0.5167 to 0.8964, are quite high. However as mentioned before, railroads have to cover they're fixed costs. The

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[11] An attempt was first made to estimate MC at each data point. The idea was to get yearly marginal costs for each railroad and for each coal move. The results of this exercise showed that these estimates are easily influenced by outliers and thus are likely to have large variances. This exercise was discarded and instead MC at the mean of data was calculated. This provides a more reliable measure of marginal costs.

Staggers Act considers rates in excess of 180% of variable costs[12] as constituting *prima facie* evidence of "market dominance". Even by this definition, on average, these indices are rather high, suggesting some amount of market power on the part of railroads.

It must be underscored again that these indices be interpreted within the shortcomings of the data. For example, ATSF and SP seem to have the lowest indices compared to other railroads. A close scrutiny of the data shows that we have relatively few observations on rates for these railroads. It is probable that these lower indices are due to the fact that we do not have enough observations for these railroads.

However, indices are quite high for railroads for which relatively more observations are available, e.g. CRC, CSX, etc. An index of 0.8964 for CSX appears to be the highest, followed by NSC with an index of 0.8826. In general, it is clear from this study that the market power indices for the U.S. railroads are quite high, a suggestion of prima *facie* evidence of non-competitive behavior.

5. Lessons for the SA

There are some very important lessons that SA can draw from the U.S. railroads experience with deregulation. These lessons are not confined only to the railroad industry, but to other regulated industries in SA.

5.1 Lessons for the SA Railroad

Goods and services worth billions of rands are traded each year, both within South Africa (SA) and within the Southern African Development Community (SADC). The rail industry is one of the most important player in the transportation of these goods. Transport costs comprise a significant portion of delivered prices of these goods and this has an important bearing on the welfare/economic empowerment, not only of SA but also on the whole Southern Africa region. The South African rail industry is undergoing somewhat controversial restructuring. Spoornet, the largest player in the rail industry, whose rail infrastructure represents some 80% of Africa's rail infrastructure, is being restructured. This restructuring of Spoornet is necessitated by its financial underperfomance, which has seen its market share reduced by road transportation (trucks). This market share reduction is a course for concern, as it is known that rail transportation possesses a comparative cost advantage over trucking, particularly over long distances. This should even be more serious in view of the continued escalating fuel prices.

We have seen in the case of US that deregulation did not bring about the level of competition it was envisioned to bring. Deregulation has not succeeded because it did not take into account the nature of the industry. Amongst other things, it did not address the entry conditions in the industry. The railroad industry is such that once a railroad has put in place its infrastructure it becomes difficult for any other firm to come and set up the same. In general, one consequence is that railroads tend to be monopolistic in the routes they operate.

The main lesson we learn therefore is that deregulation on its own is not enough to bring about competition in industry such as railroads. (Network industries). Thus if we are to restructure our rail industry we should do it in a manner that will increase the level of competition. One of the ways would be an introduction of the "competitive access" regime. That is, make rail tracks an "open access" resource. Explained differently, it means presenting investors in the rail industry

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[12] The variable costs used is of course different from the economic definition of marginal costs. In recent years however stand alone cost has been used to determine market dominance. Stand alone costs are costs that would occur, if the railroad dedicated its facilities to the shipments in question, and did not spread its overhead among other shipments. [Friedlaender, 1992].

with the same environment as trucks. Open up the rail tracks and allow for competitive access by private firms[13]. Surfice to mention that a separate company (probably a public company) can be created to the perform such functions. During the process the government cannot employ a hands off approach as we have seen in the US railroad industry. Effective regulation is necessary until we are sure that the level of competition is satisfactory.

5.2 Lessons for Other Industries

As mentioned before, these lessons also extends to other industries as well, particularly network industries like electricity and telecommunications. In the electricity industry the direction with respect to restructuring is not yet clear. However it seems that the proposal on the Table is to create some regional distributors. This kind of restructuring simply creates regional monopolies. The outcome will be the continuation of non-competitive behavior, which mostly manifest itself into high consumer prices. The "open access" regime could work in the distribution of electricity while generation can be opened up for new firms to enter.

In the telecommunication industry we are confronted with more or less the same situation. The Ministry is not sure whether to bring in one or more competitors in the industry or not. As we have seen in the U.S. rail industry, deregulation brought about sizable decrease in the number of firm operating and this increase their non-competitive behavior. The telecommunication industry will do better by encouraging entry into the industry. It is only when there are more firms compared to less that competition increases.

6. Conclusion and Direction for Future Research

This paper looked at the pricing behavior of U.S. rail firms. The finding was that there seems to be some non-competitive behavior on the part of U.S. railroads. Some lessons for SA were discussed. The main lesson was that restructuring/deregulation does not work well if it does not take into account the nature of the industry.

Future research clearly should focus on the SA industry, to see what behavior they exhibit with respect to pricing. Unfortunately this exercise will be hampered by unavailability of relevant data, something which the transport industry need to work on.

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[13] Clearly there will be problems with respect to maintenance and scheduling of trains in this regime. These type of questions are beyond the scope of this paper.

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