Determinants of Profitability Performance: An Analysis of Class I Railroads in the United States

Albert J. Allen
205 Howell Hall
Dept of Agricultural Economics
Mississippi State University
Mississippi State, MS-39762
Phone: (662) 325 2883; Fax: (662) 325 -8777
E-mail: allen@agecon.msstate.edu

Saleem Shaik
504 Barry Hall
Dept. of Agribusiness and Applied Economics
North Dakota State University
Fargo, ND 58108
Phone: (701) 231 7459; Fax (701) 231 7400
Email: Saleem.Shaik@ndsu.edu

Albert E. Myles
202 Howell Hall
Dept of Agricultural Economics
Mississippi State University
Mississippi State, MS 39762
Phone: (662) 325-2044; Fax: (662) 325-8777
Email: myles@agecon.msstate.edu

Osei-Agyeman Yeboah
Dept of Agribusiness, Applied Economics & Agriscience Education
N.C. A&T State University
A-25 C.H. Moore Agricultural Research Station
1601 E. Market St. Greensboro, NC 27411
Phone: (336) 334 7056; Fax: (336) 334 7658
E-mail: oyeboah@ncat.edu

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The purpose of this study was to estimate the impact of internal and external variables on the net profit margins of Class I railroads for the period 1996-2009. Parameter coefficients show that market concentration had a significant and negative impact on the net profit margins of the carriers.

B. Background:

The profitability of Class 1 railroads in the United States is important because profit is the essential prerequisite to a competitive and complementary transportation system that provides for the economically efficient movement of agricultural and food products from origins to destinations in an ever increasingly globally competitive marketing system. Profitability is not merely a result, but also a necessity for the economically successful and effective movement of agricultural and food products in this marketplace in which these carriers operate. Thus, the basic aim of ownership/management of Class 1 railroads is to achieve a profit, as the essential requirement for hauling any commodity or products to markets. In the overall U. S. transportation market, the profitability of Class 1 railroads as a group and individually is essential for the economically efficient operation of the country's economy because these carriers provide complementary as well as competing services to certain destined markets. For example, Class 1 railroads serve as competitors to trucks and water carriers in many markets. They also provide complementary services to truck carriers by being part of an intermodal transportation system that move agricultural and food products from various origins to destinations. By providing competitive and complementary services in the transportation system that serves this

country, Class 1 railroads are important to the continued success of the agribusinesses that are dependent on them for their economic livelihood.

In 2007 Class 1 railroads were those carriers with operating revenues of at least $359.6 million. Also, this group of carriers operated 67% of the miles in the U.S., employed almost 90% of the workers in the railroad industry, and generated over 93% of the freight revenues in that year. Therefore, it is important that the profitability performance of these carriers in the United States be evaluated.

The empirical results generated from this analysis will provide decision makers with a quantitative measures to evaluate the determinants that affect the profitability of Class I railroad carriers in the United States. This in turn, would allow managers, owners, and outside investors to be better informed about the factors that affect the profitability of the carriers and how stakeholders may use these determinants to allocate their resources so that the carriers in this sector could become more profitable when alternatives are available to them.

C. Review of Literature:

Several studies have examined various industries, commodities and products using profitability measures and multiple regression methods. The following highlight some of these studies: (McDonald, 1999), (Kambhampati and Parikh, 2003), (Ganesan, 2001), (Ahmed and Khababa, 1999), (Joshua Abor, 2008), (Devinaga Rasiah, 2010), (Grimes and Barkan, 2006), (Todani, 2001), (Kim and Lovell, 2009), (Vachal and Bitzan, 2000) and (Zingales, 1998). These studies provided background information for the current analysis. Some of these studies are reviewed below.

McDonald study provided new evidence on the determinants of the profitability of Australian manufacturing firms by analyzing a unique firm-level data set of firm performance over the period 1984-1993. The panel nature of the data permitted the author to estimate the dynamic profitability models over the business cycle, to test both the persistence and cyclically of firm profitability. Econometric results suggest that lagged profitability is a significant determinant of current profit margins, and that industry concentration is positively related to firm profit margins. Also, profit margins are found to be procyclical in concentrated industries but counter-cyclical in less concentrated industries.

The paper by Kambhampati and Parikh analyzed the effects of increased trade exposure on the profitability of firms in Indian industry. The authors revealed that while trade reforms are often expected to decrease profit margins as firms struggle to compete in international markets, there is the possibility that increased competition may improve firm efficiency and provide a positive impetus to firm profitability. The authors indicated that their paper is different from many others in this area because it considered both possibilities. The authors developed an efficiency index to directly analyze the impact of changing efficiency levels on firm profit margins. Results indicated that liberalization significantly influenced profit margins. Results from this analysis further indicated that liberalization main effect was through the impact that it had on the other firm variables: market shares, advertising, R&D and exports-all that changed after 1991. The authors of the paper indicated that neither capital nor managerial capabilities (as proxied by remuneration) were particularly effective in increasing profit margins.

The paper by Ganesan examined the determinant of profitability of Public Sector Banks in India by an empirical estimation of profit function model which showed that interest cost, interest income, other income, deposits per bank, credit to total assets, proportion of priority sector advances and interest income loss were the significant determinants of profits and profitability of Indian Public Sector Banks. Also, the average establishment cost positively contributed to the profitability but adversely affected the net profit of the Indian Public Sector Banks.

The study by Ahmed and Khababa assessed the financial performance (profitability) of commercial banks in Saudi Arabia. The authors employed a regression model to test the effect of business risk, concentration and market size on the profitability of the bank measured in terms of return on assets (ROA) and return on equity (ROE), and earnings per share (EPS). The authors used both time series and pooled time series data for their analyses. The empirical results generated from the three models showed that business risk and the bank size were the main variables which determined banks' profitability. However, the authors revealed to readers that the short time series and the availability of data were the main limitations of the study. Therefore, readers should use the results of this analysis with caution. The authors used the time period 1987-1992.

The study by Abor compared the capital structures of publicly quoted firms, large unquoted firms, and small and medium enterprises (SMEs) in Ghana. The author used a panel regression model and examined the determinants of capital structure decisions among the three sample groups. The results show that quoted and large unquoted firms exhibited significantly higher debt ratios than did SMEs. The results did not show significant difference between the capital structures of publicly quoted firms and large unquoted firms. The results reveal that short-term debt constitutes a relatively high proportion of total debt of all the sample groups of firms. The

regression results indicate that age of the firm, size of the firm, asset structure, profitability, risk and managerial ownership of the firms are important in influencing the capital structure decisions of Ghanaian firms.

The purpose of the review article by Rasiah was to identify the determinants of profitability of commercial banks. The determinants of profitability and theories used in the review by the author are those frequently described in conventional banking studies and literature. The author divided the profitability determinants into two main categories, namely the internal determinants and the external determinants. The internal determinants included management controllable factors such as liquidity, investment in securities, investments in subsidiaries, loans, non-performing loans, and overhead expenditure. Other determinants such as savings, current account deposits, fixed deposits, total capital and capital reserves, and money supply also play a major role in influencing the profitability of commercial banks. The external determinants include those factors which are beyond the control of management of these institutions such as interest rates, inflation rates, market growth and market share.

The objective of the research by Grimes and Barkan was to investigate the cost-effectiveness of renewal-based maintenance strategies using high-level financial data from Class I railway industry sources. The results indicate that maintenance strategies that place more weight on renewal result in lower unit maintenance costs, at least within a specified observable range. The results imply that if railroads constrain renewal maintenance to reduce overall capital expenditures, increasing maintenance expenses will more than offset temporary reductions in capital spending. Furthermore, the authors revealed that the cost-effectiveness of emphasizing one method over the other has not been analyzed using empirical data.

Todani's paper analyzed 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 were estimated. From the estimated model, marginal cost of hauling coal was determined. Together with the rate/price data from the CTRDB, market power indices were computed. These market power indices were 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 were discussed. These lessons are important not only to the rail industry in South Africa but also to other industries undergoing restructuring.

Kim and Lovell examined how productivity changes and price changes have contributed to short-run profit change in the railroad industry. Using an unbalanced panel of US Class I railroads for the period 1996–2003, a short-run profit change decomposition model was used to attribute inter-temporal profit change to its causal factors. The authors found that productivity improvements and an increased scale of production contributed to increases in profit, and that variation in operating efficiency had a mixed impact on profit. Also the authors found that relative changes in rail rates and variable input prices exerted downward pressure on profits.

The study by Vachal and Bitzan performed a Delphi survey of grain market experts to assess the future availability and quality of rail services for the agricultural sector. The survey produces several results of future expectations, including (1) further consolidation of the rail and elevator industries, (2) increasing prominence of the HAL cars in grain service, (3) an increase in rail rates from 1 to 4 percent annually over the next decade, (4)

expanded use of shuttle/efficiency rail programs for major grains, (5) an increased use of market-based car ordering systems, (6) growth of the short line rail network, and (7) small market-scale, but large volume, increases in the share of grain marketed via container.

Zingales determined the impact that the capital market imperfections had on the natural selection of the most efficient firms by estimating the effect of the pre-deregulation level of leverage on the survival of trucking firms after the Carter deregulation. Results show that highly leveraged carriers were less likely to survive the deregulation shock, even after controlling for various measures of efficiency. The author revealed that this effect is stronger in the imperfectly competitive segment of the motor carrier industry. The results of the study also showed that high debt seemed to affect survival by curtailing investments and reducing the price per mile that a carrier can afford to charge its customers after deregulation.

D. Objectives:

The general of objective of this study is to assess the determinants of the profitability performance of Class 1 railroads in the United States for the period 1996-2009. The specific objectives are to:

(1) Discover the determinants that affect the profitability of Class 1 railroads in the United States; and (2) Develop an econometric model to explain which determinants statistically affect the profitability of Class 1 railroads during the study period, 1996-2009.

E. Data and Methods:

To accomplish **Specific Objective 1** of this study, an extensive review of literature was conducted. Based on the literature review, profitability can be evaluated by internal and external determinants. Internal determinants of profitability performance can be defined as factors that are influenced by management decisions. The quality of the employees, leverage, and investment levels can be considered internal factors. External determinants include all factors that are beyond the direct control of a carrier's management such as GDP and inflation. However, the management can anticipate changes in the external environment and try to position its company to take advantage of anticipated developments.

Specific Objective 2 was accomplished by developing an econometric model to statistically measure the effects of several variables on the profitability of the firms measured in terms of net profit margin. The basic premise underlying this research is that firm's financial and operating performance data can be used as representative indicators of the determinants that constitute the essence of profitability. Therefore, each variable included in this analysis are represented by a financial and/or operating statistic. The general hypothesized pooled, one-way fixed effect and one-way random effect econometric model is shown below:

Pooled $$NPM_{it} = \alpha + \beta_1 X_{1,it} + \beta_2 X_{2,it} + \beta_t \text{trend} + \varepsilon_{it}$$

Fixed $$NPM_{it} = \alpha + \beta_{1it} X_{1it} + \beta_{2t} X_{2t} + \beta_t \text{trend} + \mu_i Dummies + \varepsilon_{it}$$

Random $$NPM_{it} = \alpha + \beta_{1it} X_{1it} + \beta_{2t} X_{2t} + \beta_t \text{trend} + u_i + \varepsilon_{it}$$

where NPM_{it} is the net profit margin for firm i in time period t; X_{1it} is internal variables for firm i in time period t, X_{2t} is the external variables for time period t that affects all

firms, *trend* represents the years 1996-2009, α is the constant, β and μ_i are coefficients of the variables and dummies variables, and u_i is the firm or cross section random error ε_{it} is the error term. For this analysis the net profit margin is calculated by dividing the net income by total operating revenues and multiplying the resulting value by 100 to convert to a percent (Transportation Technical Services, 2000). Data needed to accomplish the objective of this study came from the electronic copies of Class I Railroad Annual Reports (Form R-I) published by the Surface Transportation Board (STB) and other secondary sources.

Table 1 summarizes the variables used in the analysis, the description of each variable and the expected signs in the regression analysis for the study period. The pooled regression equation was estimated for the overall Class I railroad industry using SAS. The net profit margin equation includes time which represents technology changes over the study period. The sign on this variable can be positive or negative as technology advances may not affect all Class I railroads as a group or individually in a positive way. The market share variable also can be positive or negative. The market share variable is expected to be positive when carriers increase the efficiency of their operations. Thus, reducing cost and increasing profitability of the carriers. Alternatively, the variable could be negative when there are too many commodities competing for the same amount of limited resources available for the shippers interested in moving commodities on the Class I railroads' ways and structures. This could adversely impact the carriers by increasing costs, reducing reliability of services, and increasing prices. The market share is computed for each railroad by dividing the total operating revenues by the total

revenues of all the carriers in time period *t*. This value is then converted to a percent by multiplying it by 100.

The market concentration of Class I railroad carriers is the percentage of market share captured by the largest four railroad carriers during the study period. The sign of the market concentration variable is expected to be positive. The total number of employees could positively or negatively impact the net profit margins of Class I railroads in the United States during the study period. When the number of employees are increased to enhance competitiveness of particular employees hired or retained by Class I railroads, this could have a positive impact on the carriers' bottom line. Thus, the increase in the cost of adding more employees to the rolls of Class I railroads is more than offset by increases in productivity and efficiency. If labor costs are increasing at a higher rate than productivity and efficiency, these costs are likely to reduce the rate of employment by Class I railroads and increase the workload on those employees who are employed by the carriers.

The variable debt/equity is calculated by dividing total liabilities by net stockholders equity and multiplying the resulting value by 100 to convert to percent. The debt-equity ratio is a leverage ratio that compares a company's total liabilities to its total shareholders' equity. This is a measurement of how much suppliers, lenders, creditors and obligors have committed to the company versus what the shareholders have committed (Roth, 2010). This value could negatively or positively impact the net profit margins of Class I railroads in the United States. For example, high percent will likely have a negative impact on net profit margin while a low percent will likely have a positive impact on the net profit margins.

F. Results:

The results of this analysis are shown in Tables 2-6. Table 2 presents mean, standard deviation, minimum and maximum values of the variables used in the pooled analysis. Table 3 presents parameter estimates for the pooled analysis. Table 4 presents the result of the analysis based on individual carriers rather than on the industry as a whole. This analysis might show that the independent variables used in the pool analysis for the Class I industry as a whole might significantly impact individual carriers differently.

Results reveal that the mean value of the net profit margin is almost 9.70% which indicates that overall the Class I railroads are fairly efficient in providing services to their customer, Table 2. The net profit margin ranges from a low of -20.43% to a high of over 24.1% during the study period. Mean employees for the industry was 21,667 with a minimum range of 1,703 to a maximum range of 53,157. This result indicates that there was large difference in employment by the industry. Mean value of the debt/equity ratio was almost 176% which means that this high percent might have a negative impact on the industry. This value ranged from a negative value of 2848 to a positive value of 2511 for the industry.

Table 3 presents the pooled parameter estimates for Class I railroads in the United States. Results reveal that the market concentration and time variables had significantly negative and positive impacts on net profit margin, respectively. The significantly negative value of the market concentration variable indicates that an increase in concentration would have a negative impact on the net profit margins of the Class I industry in the United States. The positive and significant signs for the time variable indicate that technology has had a positive impact on the net profit margins for the Class I

railroads as a whole. This result implies further that the industry needs to invest in more technological advances to increase their net profit margins.

Table 4 presents information on the results by individual railroads. The results reveal that the debt/equity had a significant and negative impact on the net profit margins for the CSX and the Norfolk Southern railroad companies. These results imply that these railroad companies need to reduce their debt/equity ratios to increase their net profit margins. Results further reveal that employees had a significant and negative impact on the net profit margin for the Norfolk Southern Railroad Company. This result implies that the employee variable with the negative and significant sign indicates with less employees or more productive employees, an increase in net profit margin might be realized for the carrier.

Table 5 presents information on the results for the one-way fixed effects model. The results reveal that the debt/equity had a significant and negative impact on the net profit margins. These results imply that these railroad companies need to reduce their debt/equity ratios to increase their net profit margins. Results further reveal that employees had a significant and negative impact on the net profit margin. This result implies that the employee variable with the negative and significant sign indicates with less employees or more productive employees, an increase in net profit margin might be realized for the carrier. The firm dummies reveal statistical difference across CSX, Grand Trunk Corporation and Norfolk Southern firms.

Table 6 presents the one-way random effect panel model for Class I railroads in the United States. Results reveal that the market concentration and time variables had significantly negative and positive impacts on net profit margin, respectively. The

significantly negative value of the market concentration variable indicates that an increase in concentration would have a negative impact on the net profit margins of the Class I industry in the United States. The positive and significant signs for the time variable indicate that technology has had a positive impact on the net profit margins for the Class I railroads as a whole. This result implies further that the industry needs to invest in more technological advances to increase their net profit margins.

G. Summary and Conclusions:

The general of objective of this study was to evaluate the determinants of the profitability performance of Class 1 railroads in the United States for the period 1996-2009. To accomplish the general objective of this study an econometric model was developed to estimate the impact of a set of variables on the net profit margin for Class I railroads as a whole and individually.

Parameter coefficients show that market concentration had a significant and negative impact on the net profit margin for the Class I railroad industry during the study period. This result implies that Class I railroads need to reduce their market concentration to increase their net profit margins. Also, results show that time, which represents changes in technology, was significant and positive. This result implies that the net profit margins for Class I railroads in the United States have been positively impacted by technological enhancements.

Parameter coefficients on individual railroads show that debt/equity had a negative and significant impact on the net profit margins for the carriers CSX and Norfolk Southern. This result implies that these carriers need to reduce their debt/equity ratios to increase their net profit margins. Also, parameter coefficients show that employees had a

negative and significant impact on the net profit margin for the Norfolk Southern Railroad company. This result implies that the carrier needs to reduce its current labor force or increase the efficiency of its current employees or both to improve its net profit margin.

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Table 1. Description of Variables used in Study

Dependent Variable	--
Net Profit Margin	--
Independent Variables	**Expected Signs (+/-)**
Market Share	Positive/Negative
4-Firm Concentration Ratio	Positive
Debt/Equity	Positive/Negative
Employees	Positive/Negative
Time	Positive/Negative

Table 2. Simple Statistics

Variable	N	Mean	Std Dev	Sum	Minimum	Maximum	Label
NPM	104	9.6826	6.2833	1007	-20.43	24.14042	Net Profit Margin
EMPL	104	21677	18413	2E+06	1703	53157	Employees
DTE	104	175.85	447.75	18289	-2848	2511	Debt/Equity
MC	104	92.19	2.9402	9588	82.233	94.39813	Market Concentration
MS	104	13.361	11.471	1390	0.9769	33.25437	Market Share

Table 3.Pooled Parameter Estimates

Variable	DF	Estimate	Standard Error	t Value	Pr > |t|	Label
Intercept	1	-566.2	319	-1.78	0.079	Intercept
EMPL	1	-1E-04	0.0002	-0.65	0.5203	Employees
DTE	1	-5E-04	0.0014	-0.37	0.7128	Debt/Equity
MC	1	**-0.48**	0.2283	-2.1	0.038	Market Concentration
MS	1	0.2342	0.3148	0.74	0.4586	Market Share
Time	1	**0.3096**	0.1627	1.9	0.06	Time

Note: Values with bold font indicate significant at 0.05 % level of significances.

Table 4.Parameter Estimates by Individual Firms

Variable Estimates/Firm	BN-SF RR	CSX RR	G T RR	NS RR	KCS RR	Soo Line RR	UP RR
Intercept	-24.40	76.25	-113.60	81.81	112.24	223.08	26.82
Employees	.910	-.15	.394	**-.52**	-.23	-.48	.093
Debt/Equity	.128	**-.59**	.26	**-.63**	-.39	.608	-2.6
Market Concentration	.243	-.27	.421	-.24	-.33	-.99	.482
Market Share	.031	-.21	-.81	.129	.065	-.40	-.53
Time	.694	.107	.566	.324	.671	-.58	-2.2

Note: Values with bold font indicate significant at 0.05 % level of significances.

Table 5.Parameter Estimates by One-way fixed effect panel model

Parameter Estimates						
Variable	**DF**	**Estimate**	**Standard Error**	**t Value**	**Pr > |t|**	**Label**
CS2	1	**-13.109**	6.2633	-2.09	0.0391	CSX
CS3	1	**-27.8347**	14.083	-1.98	0.0511	GRAND TRUNK CORPORATION
CS4	1	-21.1031	14.652	-1.44	0.1532	KANSAS CITY SOUTHERN
CS5	1	**-32.4329**	14.58	-2.22	0.0286	NORFOLK SOUTHERN
CS6	1	-10.7822	6.8926	-1.56	0.1212	SOO
CS7	1	**-26.0027**	14.566	-1.79	0.0776	UNION PACIFIC
Intercept	1	**-811.931**	300.8	-2.7	0.0083	Intercept
EMPL	1	-0.00033	0.0003	-1.07	0.2857	EMPL
DTE	1	-0.00121	0.0013	-0.91	0.3652	DTE
MC	1	**-0.43647**	0.2106	-2.07	0.0411	MC
MS	1	-0.44418	0.4022	-1.1	0.2724	MS
Time	1	**0.445202**	0.1535	2.9	0.0047	Time

Note: Values with bold font indicate significant at 0.05 % level of significances.

Table 6.Parameter Estimates by One-way random effect panel model

Parameter Estimates						
Variable	**DF**	**Estimate**	**Standard Error**	**t Value**	**Pr > |t|**	**Label**
Intercept	1	**-725.511**	301	-2.41	0.0178	Intercept
EMPL	1	-1.43E-06	0.0002	-0.01	0.9949	EMPL
DTE	1	-0.00119	0.0013	-0.91	0.367	DTE
MC	1	**-0.45706**	0.2124	-2.15	0.0339	MC
MS	1	-0.03886	0.3551	-0.11	0.9131	MS
Time	1	**0.388743**	0.1534	2.53	0.0129	Time

Note: Values with bold font indicate significant at 0.05 % level of significances.