Evaluating the Competitive Effects of the Commodity Groups Originated by Class I Railroads in the United States

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A. Abstract:
Dynamic shift-share analysis reveals that national growth effects were positive while industrial mix, competitive, and allocation effects were negative. Results also show the time (technology) variable were significantly and positively related to the competitive effects for coal, chemical products, food products, nonmetallic products, petroleum products, metallic ores, and other products.

B. Background:

Railroads in the United States play a vital role in the economic well-being and structure of businesses in this country due to miles of the network that reaches these entities. Railroads in the United States operate in a highly competitive and complementary marketplace. For example, railroads serve as competitors to trucks and water carriers in many markets. They also provide complementary services to truck carriers by being part of intermodal transportation of agricultural and food products from various origins to destinations. By providing competitive and complementary services in the transportation system that serves this country, railroads are important to the continued success of businesses that are dependent on them for their economic livelihood. One of the types of railroads that serve the transportation infrastructure is Class I railroads. In 2007 Class I railroads were those carriers with operating revenues of at least $359.6 million (Association of American Railroads, 2009). Additional information on Class I railroads and other types of railroads serving shippers in the United States can found in the publication *Railroads and States-2007*, published by the Association of American Railroads.

One method of determining how the railroads have been able to successfully (or unsuccessfully) serve businesses is to evaluate the changes of specific commodity group originations by them over time. This evaluation will reflect the demand for transportation

services by shippers and, in turn, reflect the supply of transportation services provided by railroads to meet those demands.

C. Review of Literature:

Several studies have examined various industries, commodities and products using the static, dynamic shift, and multiple regression methods. The following highlight some of these studies: (Seyfried, 1996), (Mazzanti and Montini, 2009), (Allen et al, 2009), (Vicente et al, 1998), (Lee and Kim, 2009), (Knudsen, 2000), (Selting and Loveridge, 1990), (Estrada and Allen, 2004), (Biswaranjan and Rainey, 2006) , (Stephan and Levin, 2003), (Tu Suh Ping, 2005), (Kochanowski et al, 1989), (Wilson, 2000), (Selting and Loveridge, 1992), (Toh et al, 2004), (Mukherji and Siberman, 2009), and (Shaik et al, 2009). These studies provided background information for the current analysis. Some of these studies are reviewed below.

Seyfried used the dynamic shift-share analysis to examine the impact of national growth, industrial structure, and regional competitiveness on state growth. Among the sixteen states examined, the author found the industrial structure effect was positive in seven states, while the regional competitiveness effect was positive in eight states. The author also used a cross-sectional model of the sixteen states under study to estimate with the competitive position of each of the states being the dependent variable and taxes, wages, and education being the independent variables. Education and wages were found to have significant impacts in explaining state competitiveness, the former positive and the latter negative.

Knudsen presents and demonstrates the usefulness of two probabilistic forms of shift-share models. The author stated that these highly flexible variance partitioning methods

are but one example of the broader class of models used in the analysis of aggregate, tabular within planning, geography and regional science. Probabilistic shift-share also provides a major advance over traditional accounting-based methods because it allows the researcher to quantify and test hypotheses about changes in employment or value added by region or sector. Lee and Kim applied the shift-share analysis to decompose foreign direct investment (FDI) inflow into Korea for the period of 2003-2006. The authors find that Korea has been lagging behind the world average in absorbing inward foreign direct investment, recording negative aggregate industry mix effects and negative aggregate competitive effects as well. However, the results did show positive competitive effects for several industries including hotels and restaurants, finance, and storage and communications.

Shaik et al extended the stochastic frontier analysis to examine the market structure, conduct, and performance hypothesis for the U.S. trucking over the period 1994-2003. Results reveal that average haul, average load, debt-to-equity and market concentration were significant in the production function equation. Biswaranjan and Rainey conducted a shift-share analysis of 75 counties in the state of Arkansas for the period for the period 1980-2000. The purpose of the shift-share analysis by the authors was to determine the changing structure of the state's economy for aforementioned time period. Results reveal that a lack of comparative advantage for the major of the rural counties in the state. This lack of comparative advantage in these counties was due to the inability of the counties to attract jobs in manufacturing and professional sectors. Selting and Loveridge, 1992 states the shift-share analysis is a method of decomposing regional income or employment growth patterns into expected (share) and differential (shift) components. The authors

reveal that since its inception in the 1940s, over seventy academic contributions have criticized, defended, and extended the original concept. The authors, therefore, provide a summary of these contributions and research needs for the future are identified.

D. Objectives:

The general objective of this study is to examine the economic competitive positions of the commodity groups originated by Class I railroads in the United States by using secondary data from 1990 through 2007. Specific objectives are to:

1. Measure the performance changes of commodity groups originated by railroads and separate those changes into meaningful components; and
2. Develop a multiple regression model to explain why certain commodity groups originated by railroads are competitively advantaged (or disadvantaged)

E. Data and Methods:

Data to accomplish the objectives of the study will come from secondary sources including the *Statistical Abstract of the United States* published by U.S. Census Bureau, Washington, DC. Specifically **Objective One** will be accomplished by extending the original shift-share analysis of Esteban-Marquillas (1972) by using the dynamic shift-share analysis. The original Esteban-Marquillas (1972) shift-share analysis separates changes into four components: national growth , industry mix , competitive , and allocation effects (Lee and Kim, 2009). The dynamic shift share analysis will be used to separate changes in commodity groups originated by railroads into the aforementioned effects during the 1990-2007 periods. The national growth effect (**NGE**) is the amount that a commodity group's tonnage originated would have increased (or decreased) had it grown at the same rate as the nation's volume did. The industry mix effect (**IME**) is the

change attributable to differences in the initial industry makeup of the commodity groups relative to the nation (Coughlin and Pollard, 2001). The competitive effect (**CE**) reflects whether a commodity group has a competitive advantage or disadvantage in comparison to the nation (Coughlin and Pollard, 2001). The allocation effect (**AE**) is interpreted as a measure of the railroad industry's degree of specialization in those commodity groups in which they enjoy a competitive advantage. A positive value means the industry has the correct specialization (Ray, 1995). While the sign of the allocation component can be either positive or negative, four interpretations can be made, Table 1.

The national growth effects, industrial mix effects, competitive effects and the allocation effects are calculated annually and the results are summed over the study period. This approach is called the dynamic shift-share analysis (Sharma, 2008). According to Sharma, 2008, most shift-share applications have examined changes between the beginning and ending years of the time interval thereby failing to account for changes in the industrial mix. Therefore, the results obtained from this comparative static approach can be problematic if there are significant changes in the industrial structure over time. Thus, this problem can be eliminated by using the dynamic shift-share model. In this study, 2007 is the reference period or terminal year; whereas (1990-2006) are base years and all changes are measured with the 2007- year. The dynamic shift-share analyses were derived using Micro Soft Excel. The general form of the dynamic shift-share model and its components are found in the Appendix. The dynamic shift-share model does not provide an economic explanation about why certain commodity groups are competitively advantaged (or disadvantaged). Thus, **Objective Two** will be accomplished by using the general model hypothesized below:

$CE_{it} = \alpha + \beta_{it}$ Market Share $+\beta_{it}$ Concentration Ratio $+\beta_t$ RR Taxes + β_t GDP + β_t RR Total Compensation $+\beta_t$ RR Equipment Expenditures + β_t RR Net Investment Expenditures + β_t RR Ways-structures Expenditures + β_t Regional Trade Agreements + β_t Time + σ_{it} Residual Error

Table 6 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 regression equation was estimated for each commodity group by using Statistica 7, developed and licensed by StatSoft. The competitive effects 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 commodity groups originated by Class I railroads in a positive way. The market share variable also can be positive or negative. The market share variable is expected to be positive when products originated by carriers increase the efficiency of operations of the firms. 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 commodity by dividing the total tons of commodity *i* originated by Class I railroads by the total tons of all commodities originated by the carriers in time period *t*. This value is then converted to a percent by multiplying it by 100.

The market concentration of commodities originated by Class I railroad carriers is the percentage of market share captured by the largest four commodity groups originated

during the study period. The sign of the market concentration variable is expected to be positive. The sign on the tax variable is expected to be negative as taxes increase the cost of a firm's operating activities. All forms of taxes affect the total freight transportation cost, resulting in higher rates and prices for carriers, shippers and receivers of products (TMIP). Gross domestic product data were obtained from GPOAccess, 2009. The expected sign of the gross domestic product variable can be positive or negative. Expansion in the national economy, or the economy of any region, results in increases in overall demand for goods and services resulting a positive effect on commodities originated by Class I railroads. Alternatively, economic contractions in the economy may result in demand reductions and negative impacts on commodities originated by carriers. Overall economic condition is also indicative of the buying power of the population. The types and values of commodities produced and consumed usually reflect this economic condition (TMIP). The total compensation (wages and fringe benefits) variable for employees could positively or negatively impact the competitive effects of commodities originated by Class I railroads in the United States during the study period. When wages 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 total compensation 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 expected signs of the regional trade agreements, net investment expenditures, equipment expenditures,

and ways and structure expenditures are expected to be positively related to the competitive effects variable during the study period.

F. Results

As shown in Table 2, if the Class I railroads had originated tons of commodity groups at the same rate as the national growth of tons then they would have originated more than 4.1 billion tons of freight over the study period. Except the 2007-2006 time period, annual growth rate of tons of commodities originated by groups due to the national growth effect by Class I railroads was positive for each year during the study period. While the national growth effect was mostly positive, the industrial mix effect (except 2007-1990 period), competitive effect (except 2007-2005 and 2007-2006 periods), and allocation effect (except 2007-2004, 2007-2005, and 2007-2006 periods) was mostly negative. These results revealed that tons of commodities originated by Class I railroads declined by 357 million tons, 798 million tons, and almost 2.5 billion tons due to the industrial mix effect, competitive effect, and the allocation effect, respectively.

Summary of the allocation effects in Table 2 reveals the Class I railroads specialized in competitively disadvantaged commodities in all time periods except in 2007-2004, 2007-2005, and 2007-2006. In time period 2007-2004 the Class I railroads did not specialized in competitively disadvantaged commodity groups. However, in time periods 2007-2005 and 2007-2006 the carriers did specialize in competitively advantaged commodity groups.

Table 3 present the dynamic shift-share analyses by commodity groups. As shown in Table 3, most of the declines of tonnage originated by Class I railroads were due to large negative industrial mix, competitive and allocation effects in several industries, in

particular coal, other commodities, metallic ores, and chemicals, allied products. All these commodity groups had substantial lower growth rates relative to the base year 2007. However, the declines in these sectors were offset by the positive national growth effects in several commodities. These include coal resulting in an overall increase of 520 million tons of commodities originated by Class I railroads in the United States during the study period. Summary of the allocation effects in Table 3 reveals the Class I railroads specialized in competitively disadvantaged commodities including coal, farm products, chemicals, allied products, food and kindred products, and other commodities. The results of allocation effects also show the Class I railroads specialized in commodities that were competitively advantaged over the study period. These commodities were lumber and wood products, stone, clay and glass products, and metallic ores.

Table 4 presents the mean, minimum, maximum, and standard deviation values estimated by commodity groups and variables used in the econometric model. Parameter coefficients and the significant variables indicated by bold fonts in the multiple regression model estimated by commodity groups are found in Table 5.

Mean values presented in Table 4 by commodity groups show that coal had the highest market share value of almost 43%, followed by chemical products of almost 9%. These results, in general, indicate that coal were the dominant product originated by Class I railroads during the study period. Thus, managers and owners of Class I railroads should continue to provide the necessary logistical services to this commodity group.If possible, enhance the current services to the shippers of this product because this product has a large market share mean value relatively to other commodities during the study. On

an individual basis chemical products (almost 9%), farm products (almost 8.7%), nonmetallic products (7.2%), other commodities (almost 6.4%) and food products (almost 5.7%) had lower market shares than coal. These products in the aggregate accounted for 37% of the market share of the commodities originated by Class I railroads during the study. These results, in general, imply that these commodities provide a steady stream of tonnage to the carriers so they need to continue to enhance the services provided the shippers of these commodities to improve the efficiency of their operations.

Results on the relationships between the dependent variable competitive effect **(CE)** and the independent variables are shown in Table 5. Time variable with positive and significant signs indicates that with increased technology higher competitive effects are realized for most of the categories, except farm products. However, this exception was statistically insignificant. The size of the time variable was 8.980 (metallic ores) and 6.530 (other commodities) at the higher end, and 2.040 (coal) and 0.926 (chemical products) at the lower end. Expenditures on railroad equipment had mixed results but were positive and significant for coal. The positive sign indicates that more expenditures on railroad equipment than now would lead to higher competitive effects, and higher profits. This would allow the railroads to provide the most efficient and effective equipment available to serve their customers especially their coal customers.

Commodity groups with negative and significant signs for the 4-commodity concentration ratios were coal, farm products and other commodities. The significantly negative signs for these commodities indicate that with increased concentrations would lead to less competitiveness of these commodities, and less profits, earned by the Class I railroads if the concentration ratios are increased in the future. Net investment

expenditures by Class I railroads during the study period had mixed results. For example, coal had significantly negative sign while food products had a significantly positive sign. The significantly negative sign indicates that net investment expenditures would reduce the competitiveness of coal while the significantly positive sign would increase the competitiveness of food products originated by Class I railroads. Market share is significantly positive for food products. This result indicates that competitiveness for food products would increase if market share is increased for these commodities. Therefore, Class I railroads need to enhance their market share in this commodity sector to increase competitiveness.

The variable regional trade agreement is significantly positive for farm products. This result indicates the competitive effects of Class I railroads' originations of farm products have increased due to the implementations of regional trade agreements during the study period. As might be expected, taxes have a tendency to discourage the enhancement of competitiveness of various products by increasing the prices of products and services. Taxes were significantly negative for farm products and nonmetallic products thus reducing the competitive effects of these products. These results indicate that Class I railroads should lobby where possible to obtain tax credits or outright reductions or elimination of taxes that appreciably reduce the competitiveness of products they originate especially farm products and nonmetallic products.

The variable compensation was significantly and positively related to competitive effects of metallic ores originated by Class I railroads. This result indicates that when Class I railroads increased compensation for their employees for metallic ores competitive effects would increase. Ways and structure expenditures by Class I railroads

indicate that nonmetallic products are significantly and positively affected by these expenditures. They allow carriers to move on their ways and structures more effectively and efficiently thus having more satisfied customers especially those customers that ship nonmetallic ores. The gross domestic product variable was significantly negative for food products, petroleum products, metallic ores, and other products. These results indicate that gross domestic product had adverse effects on the competitive effects of these products during the study period.

G. Summary and Conclusions:

The dynamic shift share analysis and a multiple regression model using forward stepwise regression analysis were used to evaluate the competitive effects of commodities originated by Class I railroads in the United States for the period 1990-2007. The dynamic shift share analysis does not provide an economic explanation about why certain commodities originated by Class I railroads are competitively advantaged (or disadvantaged). This technique only provides broad descriptive factors that affect changes in commodities originated by Class I railroads. Therefore, a multiple regression model was developed to provide the economic explanations necessary for policy makers to make informed decisions about the competitiveness of products originated by Class I railroads during the study period.

The dynamic shift share analysis reveals that except for 2007-2006, annual growth rate of tons of commodities originated by groups due to the national growth effect by Class I railroads was positive for each year during the study. While the national growth effect was mostly positive, the industrial mix effects, competitive effects, and allocation effects were mostly negative. These results revealed that tons of commodities originated

by Class I railroads declined due to the industrial mix effect, competitive effect, and the allocation effect.

The dynamic shift-share analyses by commodity groups reveal that most of the declines in tonnage originated by Class I railroads during the study were due to large negative industrial mix, competitive and allocation effects in several industries. These industries included coal, other commodities, metallic ores, and chemicals and allied products. All these commodity groups had substantial lower growth rates relative to the base year 2007. The results imply, in general, that Class I railroads might want to look closely at the opportunities or challenges to reevaluate the structure of commodity mix they currently originate to improve their efficiency.

The relationship between the dependent variable competitive effects **(CE)** and the independent variables by commodity groups reveal that time, a technology variable, was significantly and positively related to competitive effects for coal, chemical products, food products, nonmetallic products, petroleum products, metallic ores, and other products. These results imply that with increased technology Class I railroads could be more competitive for these commodities during and beyond the study period.

Future analysis will extend beyond the study period (1990-2007) to account for the temporal effects of U.S. railroads. This extended time frame should provide insight into the temporal dynamics of Class I railroads in the United States. Also, the analysis will be extended by integrating a spatial error in the multiple regression models. Although these are future analyses that will enhance this study, the current analyses do offer insights into the diverse factors that affect the changes in the commodity groups originated by Class I railroads during the study.

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Table 1: Allocation effect interpretations

Sign of the Allocation Effect	Sign of the Competitive Effect	Interpretations
+	+	Specialized, competitive advantage
-	-	Specialized, competitive disadvantage
+	-	Not specialized, competitive disadvantage
-	+	Not specialized, competitive advantage

Source: *Webb, 1989.*

Table 2: Summary of Variables, Description and Expected Signs for Study Period

Dependent Variable	--
CE	--
Independent Variables	**Expected Signs (+/-)**
Market Share(%)=Each Commodity Group's Tons/Total Tons for All Commodity Groups X 100	Positive/Negative
4-Commodity Group Concentration Ratio(%)=Sum of Market Shares for Top 4 Commodity Groups in Each Time Period X 100	Positive
Rail Road (RR) Taxes (Mil. Dol.)	Negative
Gross Domestic Product ((GDP (Bill. Dol.))	Positive/Negative
Rail Road Total Compensation for Employees for Each Time Period (Mil. Dol.)	Positive/Negative
RR Net Investment Expenditures (Mil. Dol.)	Positive
RR Equipment Expenditures (Mil. Dol.)	Positive
RR Ways & Structures Expenditures (Mil. Dol.)	Positive
Regional Trade Agreements=1, If Implemented into Law in Study Period; 0 Otherwise	Positive
Time=Represents Technology Changes	Positive/Negative

Table 3: Summary of Dynamic Shift-Share Analysis, 1990-2007

TIME PERIOD	NGE (Mil. Tons)	IME (Mil. Tons)	CE (Mil. Tons)	AE (Mil. Tons)	TOTAL (Mil. Tons)
2007-1990	512	23	-139	-438	**-42**
2007-1991	396	-33	-87	-259	**17**
2007-1992	388	-38	-92	-260	**-2**
2007-1993	391	-40	-67	-209	**75**
2007-1994	355	-35	-58	-183	**79**

2007-1995	311	-31	-41	-177	**62**
2007-1996	272	-16	-61	-220	**-25**
2007-1997	291	-16	-41	-167	**67**
2007-1998	247	-21	-44	-113	**69**
2007-1999	197	-29	-40	-109	**19**
2007-2000	179	-26	-22	-129	**2**
2007-2001	178	-25	-33	-94	**26**
2007-2002	156	-21	-30	-73	**32**
2007-2003	131	-18	-25	-44	**44**
2007-2004	92	-17	-19	0	**56**
2007-2005	39	-8	1	26	**58**
2007-2006	-14	-6	0	3	**-17**
TOTAL	**4,121**	**-357**	**-798**	**-2,446**	**520**

Table 4: Summary of Dynamic Shift-Share Analysis by Commodity Groups, 1990-2007

Commodity Groups	**NGE (Mil. Tons)**	**IME (Mil. Tons)**	**CE (Mil. Tons)**	**AE (Mil. Tons)**	**TOTAL (Mil. Tons)**
Coal	1,723	259	-711	-1,003	270
Farm products	381	-211	-15	-153	5
Chemicals, allied products	372	40	-33	-332	49
Food and kindred products	295	-36	-16	-214	29
Nonmetallic minerals	238	-50	-10	-151	25
Transportation equipment	93	38	0	-109	20
Lumber and wood products	80	-76	0	6	11
Pulp, paper, allied products	107	88	-1	-179	12
Petroleum and coal products	111	54	-1	-144	17
Stone, clay, and glass products	93	-98	0	7	2
Metallic ores	134	-419	8	259	-18
Primary metal products	115	-83	0	-27	5
Waste and scrap materials	122	-50	0	-54	18
Machinery, exc. electrical	0	0	0	-1	-1
Fabricated metal products	0	0	0	-1	-2
Other Commodities	257	187	-19	-352	73
TOTAL	**4,121**	**-357**	**-798**	**-2,446**	**520**

Table 5: Descriptive Statistics of Variables by Commodity Groups

COMMODITY GROUPS AND VARIABLES	**N**	**Mean**	**Minimum**	**Maximum**	**Std. Dev.**
COAL					
CE	17	-41.82	-125	2	32.11
MARKETSHARE%	17	42.49	38.22	46	2.31
FARMPRODUCTS					
CE	17	-0.85	-2.26	0.5	0.70
MARKETSHARE%	17	8.67	7.37	10.7	1.20
CHEMICALPRODUCTS					
CE	17	-1.93	-4.44	0	1.12

MARKETSHARE%	17	8.94	8.43	9.7	0.34
FOODPRODUCTS					
CE	17	-0.96	-2.89	0.6	0.95
MARKETSHARE%	17	5.65	5.28	6.3	0.31
NONMETALLIC PRODUCTS					
CE	17	-0.54	-1.26	0.0	0.38
MARKETSHARE%	17	7.20	6.72	7.7	0.27
TRANSPORTATION EQUIPMENT					
CE	17	-0.40	-0.40	-0.4	0.00
MARKETSHARE%	17	2.03	1.59	2.2	0.21
LUMBERPRODUCTS					
CE	17	-0.18	-0.18	-0.2	0
MARKETSHARE%	17	3.3	2	3.7	0.36
PULPPAPER PRODUCTS					
CE	17	-0.43	-0.58	-0.4	0.04
MARKETSHARE%	17	2.33	2.32	2.5	0.05
PETROLEUM PRODUCTS					
CE	17	-0.26	-0.57	-0.2	0.08
MARKETSHARE%	17	2.67	2.46	2.8	0.16
STONE PRODUCTS					
CE	17	-0.04	-0.04	0	0
MARKETSHARE%	17	3.02	2	3.1	0.26
METALLIC ORES PRODUCTS					
CE	17	0.5	0.36	0.6	0.11
MARKETSHARE%	17	2.6	1.44	3.3	0.75
PRIMARY METAL PRODUCTS					
CE	17	-0.27	-0.27	-0.3	0
MARKETSHARE%	17	2.67	2.67	2.7	0
WASTE SCRAP PRODUCTS					
CE	17	-0.5	-0.5	-0.5	0
MARKETSHARE%	17	2.37	1.96	2.5	0.2
MACHINERY PRODUCTS					
CE	17	0	0	0	0
MARKETSHARE%	17	0.07	0.07	0.1	0
FABRICATED PRODUCTS					
CE	17	0	0	0	0
MARKETSHARE%	17	0	0	0	0
OTHER COMMODITIES					
CE	17	-1.31	-3.58	-0.3	0.79
MARKETSHARE%	17	6.37	5.26	6.8	0.46
CR-TOP 4(%)	17	67.47	65	70	1.28
RRTAXES(MIL.DOL)	17	4454.35	2649	6830	820.07
GDP (BIL.DOL)	17	8828.58	5735.4	12907.3	2259.28
RR COMPENSATION (MIL.DOL.)	17	9496.18	8654	11422	784.07
RRNETINVESTMENT(MIL.DOL)	17	76009.29	48126	112556	21795.98
RREQUIPMENT(MIL.DOL)	17	1522.82	874	2343	525.92
RRWAYSTRUCTURES (MIL.DOL.)	17	4126.53	2369	6982	1171.39
RTA:YES=1; 0=NO	17	0.29	0	1	0.47
TIME	17	9	1	17	5.05

Table 6: Forward Stepwise Regression Coefficients by Commodity Groups

Commodity Groups	Coal	Farm Products	Chemical Products	Food Products	Non-metallic	Pulp Products	Petroleum Products	Metallic Ores	Others
Intercept	408.580	31.570	-3.783	0.195	2.543	0.203	2.292	1.386	23.721
Time	**2.040**	-1.100	**0.926**	**2.640**	**3.72**	(---)	**5.890**	**8.980**	**6.530**
RR equipment	**0.208**	**-0.520**	(---)	(---)	**-0.41**	-0.330	(---)	-0.140	(---)
Cr-Top4	**-0.340**	**-0.600**	(---)	-0.09	-0.08	-0.300	-0.420	-0.050	**-0.410**
RR Net Investment	**-1.100**	(---)	(---)	**1.950**	-1.30	(---)	(---)	-2.60	(---)
Market Share	0.182	-0.450	(---)	**0.309**	(---)	(---)	(---)	0.531	-0.450
RTA	(---)	**0.782**	(---)	0.095	0.177	(---)	(---)	(---)	(---)
RR Taxes	(---)	**-1.10**	(---)	(---)	**-0.41**	(---)	(---)	-0.330	(---)
RR Compensation	(---)	-0.89	(---)	(---)	0.261	(---)	(---)	**1.510**	0.596
RR Ways & Structures	(---)	2.40	(---)	(---)	**0.997**	(---)	(---)	(---)	(---)
GDP	(---)	(---)	(---)	**-3.50**	-2.50	(---)	**-5.400**	**-7.900**	**-5.800**

Note: Values with bold font indicate significant at 0.05% level of significances. The symbol (---) indicates that the variables did not enter the specific commodity group's results.

Appendix: The Dynamic Shift Model and its Components

Equation 1: $CT_{it} = NGE_{it} + IME_{it} + CE_{it} + AE_{it;}$

Equation 2 $NGEit = T_{it}^{1990\text{-}2006} * \Delta N$

Equation 3: $IME_{it} = T_{it}^{1990\text{-}2006} * (\Delta N_i - \Delta N)$

Equation 4: $CE_{it} = [T_{\mathbf{t}}^{1990\text{-}2006} * (N_i^{1990\text{-}2006} / N^{1990\text{-}2006})] * (\Delta T_{it} - \Delta N_i)$

Equation 5: $AE_{it} = \{T_{it}^{1990\text{-}2006} - [T_t^{1990\text{-}2006} * (N_i^{1990\text{-}2006} / N^{1990\text{-}2006})]\} * (\Delta T_{it} - \Delta N_i)$

Equation 6: Value of Dynamic Shift-Share Results = Sum of $NGEit + IME_{it} + CE_{it} + AE_{it}$ over time periods and across commodity groups

CT_{it}: Change in tonnage originated of Commodity Group ***i*** in year ***t***

NGE_{it}: National Growth Effect of Commodity Group ***i*** in year ***t***;

IME_{it}: Industry Mix Effect of Commodity Group ***i*** in year ***t***;

CE_{it}: Competitive Effect of Commodity Group ***i*** in year ***t***;

AE_{it}: Allocation Effect of Commodity Group ***i*** in year ***t***; where:

$T_{it}^{1990\text{-}2006}$ 1990-2006 Commodity Group i tons in base time periods

$T_t^{1990\text{-}2006}$ 1990-2006 tons for all commodity groups in base year t;

ΔT_{it} Change in number of tons in Commodity Group *i* from 1990 to 2006;

ΔN Change in total tons of Commodity Groups from 1990 to 2007;

ΔN_i Change in total tons of commodity group *i* from1990 to 2007;

$N_i^{1990\text{-}2006}$ 1990-2006 tons of commodity group *i* originated;

$N^{1990\text{-}2006}$ 1990-2006 total tons of commodity groups originated;

i Types of Commodity Groups(Coal, Farm products, food products……other commodities)

t Time periods (Reference year or Terminal Year 2007 ; Base years 1990 to 2006)