

THE IMPACT OF HOURS OF SERVICE CHANGES TO MOTOR CARRIER PROFITABILITY AND PRODUCTIVITY

INTRODUCTION

With the major change to the Federal Motor Carrier Administration (FMCSA) Hours of Service rule (HOS) announced in late 2011, there have been several studies regarding highway safety and the health of truck drivers but relatively little research on the impact on profitability of firms. The Regulatory Impact Analysis (FMCSA, 2010) includes an estimate of the cost of reduced productivity at the macro level but not at the firm level. The estimates used to calculate reduced productivity were also called into question in a paper prepared for the American Trucking Association (Edgeworth Economics, 2011). The last major change to HOS was in 2003 and went into effect in 2004. This 2003 HOS reduced the total allowable on duty time by one hour and increased the allowable driving time by one hour; however, the real maximum driving time in 24 hours was effectively reduced from 16 to 14 with the requirement of 2 additional hours off duty. Before the final 2011 HOS were publicized, there were options to decrease the maximum driving time by 1-2 hours and to decrease the maximum on-duty time. The final 2011 HOS did not make any changes to the maximum driving time but the FMCSA retained the option to make further adjustments as more studies on the impact become available. Furthermore, the new rules will have minimal impact on the maximum on-duty time for many carriers and with long detention times. While the maximum on-duty time is technically reduced with the addition of a mandatory 30 minute break in addition to the 10 hours off duty per day, the definition of on-duty time will no longer include time in the truck waiting to be loaded or unloaded. Looking at the impacts of the previous change to HOS should give a good indication of the impact to carriers if maximum driving time is further reduced in the future.

This paper investigates the actual impact of the last major change to the HOS on profitability and productivity of publicly traded motor carriers. Quarterly data from 1997-2010 for 14 publicly traded motor carriers was used. To see the impact on profitability, Operating Ratio (OR) and Return on Assets (ROA) were dependent variables in two separate models. The variable of interest was a dummy variable with a value of one for the time periods after the change to HOS (2004-2010). To see the impact on productivity, a similar model was tested with sales per employee as the dependent variable. Results of the estimations indicate that the 2004 HOS led to an increase in both productivity and OR, or costs as a percentage of sales, and no significant change to ROA.

HISTORY OF HOS RULES

HOS rules were first proposed by the ICC in 1936 and went into effect in July of 1938. These rules allowed for 15 hours on-duty and 12 hours of work which could all be driving or could include other tasks such as loading, unloading, and completing paperwork. Drivers were also required to have at least 9 hours off duty each day. A limit of 60 hours on-duty in 7 days or 70 hours on-duty in 8 days was also instated. These rules resulted in protests from both organized labor and some motor carriers, so in early 1939 revised rules went into effect. These new rules reduced the required off duty time to 8 hours per day and implemented a 10 hour driving limit

per day (eliminating the work limit). The next change came in 1962 when, for unexplained reasons, the ICC changed the rule to allow for a maximum driving time of 10 hours and on duty time of 15 hours (this could be extended to 16 hours with breaks) after 8 hours off duty (no longer making these daily limits). This effectively allowed drivers up to 16 hours of driving time per day (FMCSA, 2000).

With the exception of minor changes to the rule as part of the Motor Carrier Act of 1984 the HOS remained unchanged until 2003. With the ICC Termination Act of 1995, jurisdiction for HOS was given to the Federal Highway Administration (FHWA). The FHWA was asked by Congress to re-examine HOS with a focus on public safety and driver health. An advanced notice of proposed rulemaking was issued in 1996, but no further action was taken. In 2000 jurisdiction was transferred to the Federal Motor Carrier Safety Administration (FMCSA) and a notice of proposed rulemaking was issued. In 2003 The FMCSA issued a final rule in 2003, which went into effect in January 2004. The 2003 HOS decreased maximum on-duty time to 14 hours (including any breaks), increased maximum driving time to 11 hours per day, and increased off duty time to 10 hours. Furthermore, the 34 hour restart was added, which allows a driver to reset the 7 or 8 day time limit effectively adding up to 17 hours to a driver's work week (Jones, 2007).

Table 1: Summary of HOS rules

HOS	Driving Time per Cycle	Driving Time per Day	On Duty Window per Cycle	On Duty Time Per Day	Required Off Duty Time	7 (8) day limit	Max. Avg. Driving in 7 Days	34-hour Restart	Required Breaks
1938	12	12	15	15	9	60 (70)	60	No	No
1939	10	10	15	16	8	60 (70)	60	No	No
1962	10	16	15	16	8	60 (70)	60	No	No
2003	11	14	14	14	10	60 (70)	82	Yes	No
2011	11	14	14	14	10	60 (70)	70	Limited	Yes

The first lawsuit following the 2003 HOS was filed before the rule even went into effect but despite courts vacating the rule, Congress granting relief from court rulings, and more lawsuits being filed, the 2003 HOS has remained virtually unchanged. The only change was mandating that 8 of the 10 hours of duty for drivers operating with a sleeper berth be taken consecutively (Jones, 2007).

As part of a settlement between FMCSA and several safety groups, the proposed 2011 HOS rules were released in December 2010, and the final rule was released in December 2011. The compliance date for the on-duty time definition and oil field exemption is February 27, 2012, and all other provisions have a compliance date of July 1, 2013. These new rules maintain a

maximum 11 hours of driving time but require a 30 minute break after 8 hours of driving. The maximum on-duty time remains at 14 hours but is effectively reduced to 13.5 with the required break. Changes to the 34 hour restart will require that it include 2 periods between 1 a.m. and 5 a.m. and can only be used once every 7 days. Finally, the definition of on-duty time has been modified to not include any time resting in a parked vehicle (this could include detention time) or up to two hours in a passenger seat of a moving vehicle following 8 hours in the sleeper berth (FMCSA, 2011). Table 1 summarizes the HOS rules from 1938 – 2011.

ECONOMETRIC MODEL

For this study, two models were developed to see the impact of the 2003 HOS regulation on motor carrier profitability as measured by operating ratio (OR) and return on assets (ROA). A third model was developed to look at the impact on productivity as measured by sales per employee (SPE). All three models used the same independent variables. The variable of interest, PHOS, is a dummy variable indicating whether an observation was taken after the 2003 HOS regulations, which went into effect in January of 2004. The impact of this regulation is difficult to predict in advance because depending on the practices of a particular firm, the maximum driving time per day would have either been increased by 1 hour or decreased by 2 hours and on-duty time was decreased by 1 or 2 hours. In addition to the HOS regulation that went into effect in 2004, two other types of regulations, Ultra Low Sulfur Diesel (ULSD) requirements and stricter emissions standards, likely had impacts on motor carrier revenues and profitability and went into effect between 2004 and 2010.

ULSD was phased in between 2006 and 2010 with all 2007 and newer vehicles required to only run on ULSD. This change had an impact on the price of diesel and on the price of tractors which had to be modified in order to run with the lower lubricity of ULSD. To incorporate additional operating cost from this change into the model, the percentage change in average diesel price from the previous quarter or change in diesel price (CDP) was used as an independent variable. The average diesel price may not be the same for all carriers, but the percent increase or decrease should be similar for all carriers operating in all different parts of the country.

Stricter emissions standards were implemented for 2004 and newer vehicles and then even stricter emissions standards were implemented for 2007 and newer vehicles and phased in through 2010. Because of the way the laws were written, there were modest increases in new vehicle prices in 2004 and 2007 followed by large increases in 2010. To incorporate this information into the model, the average percent change in new tractor price (CTP) was included as an independent variable. While it would be preferable to obtain the actual price per tractor from each carrier, that information was not available, however, tractors are sold in a competitive environment, so the average price increase or decrease should be correlated with each individual carrier's cost of equipment.

To control for general economic conditions, the percentage change in (Gross Domestic Product) GDP for services was included in the model as well as a dummy variable for any quarter that had a month classified as recession (REC). To control for the different business environments less than truckload and truckload carriers operate in and the different business environments between unionized and non-unionized carriers, dummy variables were included for less than truckload carriers (LTL) and unionized carriers (UC). Finally dummy variables were included for the four quarters of the year. Manufacturing shipments were considered as an independent variable, but that measure was highly correlated with the quarter of the year (Q₁-Q₄), and a better fit to the data was obtained by using Q₁-Q₄.

Putting these variables together resulted in the following three specific equations to be estimated:

$$OR = \beta_1 PHOS + \beta_2 CTP + \beta_3 CDP + \beta_4 CGDP + \beta_5 REC + \beta_6 LTL + \beta_7 UC + \sum_i \beta_{Qi} Q_i + \varepsilon \quad 1$$

$$ROA = \beta_1 PHOS + \beta_2 CTP + \beta_3 CDP + \beta_4 CGDP + \beta_5 REC + \beta_6 LTL + \beta_7 UC + \sum_i \beta_{Qi} Q_i + \varepsilon \quad 2$$

$$SPE = \beta_1 PHOS + \beta_2 CTP + \beta_3 CDP + \beta_4 CGDP + \beta_5 REC + \beta_6 LTL + \beta_7 UC + \sum_i \beta_{Qi} Q_i + \varepsilon \quad 3$$

DATA

For this analysis, quarterly data for 14 out of 17 publicly traded motor carriers with data available from 1997-2010 was used, resulting in 56 observations per carrier and a total of 784 observations. The years 1997-2010 were chosen, so there would be an even number of observations on each side of the 2003 HOS rules. Landstar was excluded because it is a non-asset based carrier, and therefore, operates in a somewhat different business environment. UPS Freight and FedEx Freight were also excluded because their SEC filings don't separate out the LTL portion of their business from the express, small package, and other portions of their business. Table 2 lists the 14 carriers included in the sample as well as whether they were less than truckload (LTL) carriers or unionized (UC). For purposes of the analysis, any carrier with a significant portion of their business coming from LTL business was considered LTL because they would have to make the significant capital investment in terminals required of LTL carriers.

Table 2: Carriers Included in Sample

Company Name	LTL	Union
Arkansas Best Corporation	Y	Y
Celadon Group, Inc.	N	N
Con-way, Inc.	Y	N
Covenant Transportation Group, Inc.	N	N
Frozen Food Express Industries, Inc.	Y	N
Heartland Express, Inc.	N	N
J B Hunt, LLC.	N	N
Knight Transportation, Inc.	N	N
Marten Transport, LTD.	N	N
Old Dominion Freight Line, Inc.	Y	N
PAM Transportation Systems, Inc.	N	N
USA Truck, Inc.	N	N
Werner Enterprises, Inc.	N	N
YRC Worldwide, Inc.	Y	Y

The financial data for the carriers (total sales, cost of goods sold, total assets, total equity, and number of employees) came from Standard and Poor's Compustat North America. From this data, operating ratio (OR), return on assets (ROA), return, and sales per employee per quarter in thousands of dollars (SPE) were calculated. The average tractor price was obtained from Paccar Truck's SEC filings, in which they list the revenue from truck sales and units sold. The average tractor price was calculated from this and then adjusted for inflation using the Producer Price Index (PPI) for heavy trucks obtained from the Bureau of Labor Statistics (BLS). Average diesel price was obtained from the U.S. Energy Information Administration (EIA), and it was also adjusted for inflation using the PPI, and the CDP was then calculated. GDPD was obtained from the Bureau of Economic Analysis (BEA). Data on recessions was obtained from the National Bureau of Economic Research (NBER). Table 3 lists the variables used in the analysis as well as some descriptive statistics. Dummy variables are included to show what percentage of time or carriers fall into which categories.

Table 3: Descriptive Statistics of Variables

Variable	Mean	Std. Dev.	Min	Max
OR	86.31	7.31	65.24	119.44
ROA	4.44	7.80	-69.32	18.24
SPE	29.89	7.21	11.82	56.50
CTP	0.13	2.85	-7.30	12.44
CDP	1.43	9.48	-32.24	24.00
CGDP	2.34	1.77	-2.30	6.20
PHOS	0.50	0.50	0.00	1.00
LTL	0.36	0.48	0.00	1.00
UC	0.14	0.35	0.00	1.00
REC	0.20	0.40	0.00	1.00

ANALYSIS AND RESULTS

The final three models were estimated using SHAZAM econometric software with the POOL command. This is a generalized least squares (GLS) estimator that assumes and corrects for heteroskedasticity and autocorrelation within cross sections, different values of rho for each cross section, and correlation between error terms from different cross sections. Initial testing performed by SHAZAM (Whistler et al., 20011) indicated that these assumptions were justified.

The results of the analysis are summarized in Table 4. The first R^2 reported in Table 3 is based on the residuals from the Best Linear Unbiased Predictor (BLUP), which uses the coefficients on the untransformed variables to predict but then adjusts that prediction using the residual from the previous period multiplied by rho for the particular firm in question. The second R^2 reported is based on a method described by Buse as an appropriate R^2 to use for GLS estimation (1973). These goodness of fit measures show that Equations 1 and 3 were most effective for prediction and equation 2 explained little of the variance in return on equity.

The most interesting result of equation 1 was that the operating ratio for the firms in question actually increased after the 2003 HOS, indicating that many of the carriers may have seen a net decrease in drive time per day. This result is after accounting for tractor and diesel prices, economic growth, and recessions. The other results of equation 1 were much as expected: an increase in equipment or fuel prices leads to a higher OR, an increase in GDP leads to a lower OR, a recession leads to a higher OR, and LTL carriers and unionized carriers experience higher costs than TL or non-unionized carriers.

Table 4: Results of Estimation

Independent Variable	Estimated Coefficient (p-value)		
	Equation 1	Equation 2	Equation 3
PHOS	0.807 (0.027)	-0.806 (0.249)	2.770 (0.000)
CTP	0.043 (0.026)	-0.024 (0.627)	0.046 (0.143)
CDP	0.024 (0.000)	-0.004 (0.808)	0.059 (0.000)
CGDP	-0.208 (0.006)	0.418 (0.017)	-0.024 (0.841)
REC	0.807 (0.003)	-1.682 (0.008)	0.724 (0.093)
LTL	2.828 (0.010)	1.320 (0.089)	4.106 (0.007)
UC	7.153 (0.000)	-3.403 (0.017)	4.849 (0.001)
P	0.896	0.417	0.863
use	0.312	0.113	0.228

Equation 2 reveals that the 2003 HOS changes, tractor prices, and diesel prices have no significant impact on ROA; however, the sign of the estimated coefficient is negative, consistent with the results of equation 1. It seems that any higher expenses revealed in equation 1 are able to be accounted for by reducing assets, reducing administrative expenses, or increasing some other revenue stream. Furthermore, equation 2 shows that large LTL carriers may be able to actually achieve a higher ROA than TL carriers (the sign is positive but only significant at the 0.10 level). Other things confirmed by equation 2 are that a growing economy allows for higher ROA, a recession is associated with a lower ROA, and union carriers tend to have a lower ROA than non-union carriers.

Rather than financial performance, equation 3 deals with productivity, and the results are much as expected because longer driving time per day should lead to the same work being accomplished with fewer employees. Sales per employee increased after the 2003 HOS regulatory change. Tractor price increases have no significant impact on SPE. Diesel price increases have a slight impact on SPE likely due to the increase in revenues from higher fuel surcharges. GDP changes seem to have no impact on productivity, but it may be higher during a recession (significant at the 0.10 level). Finally, LTL and unionized carriers tend to have higher sales per employee, most likely because of the higher prices charged to customers which must

not be enough to cover additional expenses because equation 1 reveals a higher OR for LTL than for TL carriers and a higher OR for unionized carriers than for non-unionized carriers.

CONCLUSION

The results of this study indicate that despite the fact that motor carriers were able to increase their sales per employee after the 2003 HOS regulations, they were unable to improve or even maintain their operating ratios. However, they were able maintain profitability as measured by ROA, possibly due to a reduced need for capital investments in tractors and terminals resulting from this increased productivity.

These results further indicate that motor carriers should not be overly concerned about a loss of profitability resulted from any forthcoming reductions in maximum driving hours per day. While this will not happen in the immediate future, it could still be an issue despite the fact that the final 2011 HOS rule includes no reduction maximum driving time and effectively lengthened the maximum on duty time or driving window for many carriers with the relaxed definition of on-duty time. The final rule states that if new research comes out showing improved health of drivers or safety of the general public from a reduction in maximum driving time, the rule could be modified (FMCSA, 2011). If this does occur, carriers could expect a change in productivity and operating ratio but should be able to maintain their return on assets if the same pattern is followed.

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