U.S. Federal Regulations and Motor Carrier Profitability

Ahren Johnston
North Carolina Agricultural & Technical State University, ajohnston@ncat.edu

Follow this and additional works at: https://digitalcommons.wayne.edu/jotm

Part of the Operations and Supply Chain Management Commons

Recommended Citation
Johnston, Ahren (2019) "U.S. Federal Regulations and Motor Carrier Profitability," Journal of Transportation Management: Vol. 30: Iss. 1, Article 3.
DOI: 10.22237/jotm/1561953780
Available at: https://digitalcommons.wayne.edu/jotm/vol30/iss1/3

This Article is brought to you for free and open access by the Open Access Journals at DigitalCommons@WayneState. It has been accepted for inclusion in Journal of Transportation Management by an authorized editor of DigitalCommons@WayneState.
US FEDERAL REGULATIONS AND MOTOR CARRIER PROFITABILITY

Ahren Johnston
North Carolina Agricultural & Technical State University

ABSTRACT
This study explores the impact of recent federal regulations, such as Comprehensive Safety Analysis (CSA) 2010, Hours of Service Changes, Environmental Regulations, and electronic logbooks on motor carrier profitability. Quarterly data from 2004 – 2015 from U.S. publicly traded motor carriers is used to estimate the temporal trends on various financial ratios after controlling for general economic and carrier specific characteristics. Results of the analysis reveal that motor carrier profitability was declining between 2004 and 2009 but has been improving since that time.

INTRODUCTION
The Federal Motor Carrier Safety Administration (FMCSA) fully implemented its new Comprehensive Safety Analysis (CSA) 2010 in the fourth quarter of 2010, and many carriers and industry experts were concerned that it would lead to the exit of many drivers from the industry. Many carriers voiced this concern in their 2010 Annual Reports. J.B. Hunt Transport Service, Inc. said “. . . CSA 2010 could have a material adverse effect on the ability to obtain qualified drivers” (2011a). Werner Enterprises said, “This may limit our ability to attract and retain qualified drivers” (2011a). Arkansas Best Corporation said, “CSA regulations could potentially result in a loss of business to other carriers, driver shortages, increased costs for qualified drivers, and driver and/or business suspension for noncompliance” (2011a) thus indicating that they were concerned about a driver shortage and a potential reduction in profitability. Old Dominion Freight Lines held a similar view and said that, “The implementation of FMCSA's Compliance, Safety, Accountability initiative (“CSA”) could adversely impact our ability to hire qualified drivers, meet our growth projections and maintain our customer relationships, each of which could adversely impact our results of operations” (2011a).

In addition to CSA 2010, carriers expressed concerns about new hours of service rules that had been proposed, and about Electronic On-Board Recorder (EOBR) requirements, which the FMCSA was discussing. During the timeframe of this study, new emissions standards for heavy trucks, ultra-low sulfur diesel requirements, and fuel efficiency standards were added to the Federal Registry. These various changes likely impacted costs and profitability in some way, but it is difficult to separate the effects of any individual changes from the effect of the other changes.

While the original motivation of this study was to investigate the relationship between two specific regulatory changes, the plethora of regulatory changes that have taken place in the time frame of this study make it difficult, if not impossible, to determine the specific impact of CSA2010 and hours of service changes. Therefore, the primary motivations of this study are (1) to determine if changes in motor carrier profitability after these specific regulations were large enough to be statistically significant despite the confounding factors introduced into the regulatory environment during the time-frame in question and (2) to see the temporal changes that have occurred in motor carrier profitability as these regulatory changes have been announced and implemented.

SUMMARY OF REGULATORY CHANGES
CSA 2010
CSA 2010 (known as both “Comprehensive Safety Analysis” and “Compliance, Safety, and Accountability”) was intended to provide a means to assess how well commercial motor vehicle
carriers and drivers complied with safety rules and to better intervene with those who are not complying. CSA replaced the previous compliance review program and SafeStat, an earlier program designed to monitor and evaluate the safety of motor carriers. CSA was tested in nine states between 2008 and 2009 and was initiated nationally in December 2010. The three components of CSA are: measurement, evaluation, and intervention.

Measurement and evaluation come in the form of a Safety Measurement System (SMS) which gives carriers a score on seven criteria using an algorithm that controls for the number and severity of violations and size of the fleet. Of these seven criteria, five are publicly available on the CSA website. These scores are then used to identify carriers for early intervention (Harrison et al., 2012). As the FMCSA refines their methodology for calculating these SMS scores, historical SMS scores are retroactively calculated after each update. The five publicly available measures are: unsafe driving, hours of service, vehicle maintenance, controlled substance/alcohol, and driver fitness. Two additional scores are calculated and used by the FMCSA and made available to the carriers. These are: crash indicator and hazardous materials compliance.

Although many industry analysts, industry organizations, and carriers predicted increases in driver shortages following the implementation of CSA 2010, these additional driver shortages did not seem to happen based on number of employees (Harrison et al., 2012). However, the lack of a driver shortage does not mean that carrier costs were not impacted by the rule. There may have been additional costs associated with compliance and inspections, but these may have been offset by fewer accidents and incidents as carriers try to proactively maintain low (better) scores.

**Hours of Service**

After remaining unchanged since 1962, hours or service rules were changed in 2003, and these changes went into effect in January 2004. These rules increased the allowable drive time per cycle and off duty time per cycle but decreased the maximum driving time per day. Possibly the biggest change of this rule was the addition of the 34-hour restart provision, which led to an increase in maximum driving hours per week. This provision allows for a driver who has reached his/her weekly maximum driving time to “reset the clock” upon completing 34 consecutive hours off duty. Following lengthy legal battles questioning the motivation and impact of these changes, new hours of service regulations were announced in 2011 and went into effect in July of 2013. This new rule changed the maximum average hours per week a driver could theoretically achieve by placing restrictions on the 34-hour restart rule. It could only be used once per seven day period and had to include two time periods between 1:00 am and 5:00 am. This restriction increased the effective reset period to 45 hours or more depending on the driving habits of an individual driver. A second change required a 30-minute break after 8 hours of driving and could have potentially limited driving hours by 30 minutes per day, or this break could have been incorporated into the split sleeper berth allowance (Johnston, 2013). In December 2014 Congress suspended the 34-hour restart restrictions pending the submission of the CMV Driver Restart Study to Congress (FMCSA, 2016). This report was made available to Congress in March 2017, and it was determined that the restrictions to the 34-hour restart would remain suspended (FMCSA, 2017). This effectively made the new rules identical to the 2004 rules in terms of maximum driving hours per day and week with the additional restriction of a 30-minute break after 8 hours of driving.

A difficulty with determining the impact of this most recent change is that many carriers may have adhered to the 2011 rule even though a major portion was not being enforced because it was unclear when the CMV Driver Restart Study would be made available to Congress and what the results of the study would show. These changes could have impacted the productivity of drivers and increased costs and reduced profitability for carriers; however, if the presumptive goal of the rules to increase alertness of drivers was achieved, costs could have been reduced through fewer accidents and incidents. Contradictory to this
proposition, fatalities, injuries and property only crashes have been on an upward trend since 2009 or 2010. This is evident in Figure 1 which uses data from Trends Tables 4, 7, and 10 in *Large Truck and Bus Crash Facts 2015* available from the FMCSA (2017b).

**Electronic Logging Devices (ELD)**

Another area of concern for carriers in their 2010 Annual Reports was the possible requirement on ELDs. In April 2010, a final rule with a June 2012 compliance date set standards and incentives for the use of Electronic On-Board Recorders (EOBRs) and requirements for the use by carriers with serious hours of service non-compliance. However, the final rule applicable to all carriers was published in the Federal Register on December 16, 2015 and required ELDs of all carriers (with a few exceptions) by December 18, 2017. Many carriers had voluntarily installed EOBR and other Automatic Onboard Recording Devices (AOBR) in advance of the rule and will have until December 16, 2019 to replace these with ELDs. Further exceptions include drivers of driveaway-towaway operations delivering the vehicle they are driving, drivers of pre-2000 model year vehicles, and drivers required to keep a Record of Duty Status (RODS) or logbook not more than 8 out of 30 days (FMCSA, 2016a). Although this rule was not in effect during the period of this study, many motor vehicle operations began investing in AOBRs as early as 2009 when the rule was on the horizon (Heartland Express Inc., 2011; Knight Transportation, 2011; Werner Enterprises, 2011). In a conversation with an executive of a large refrigerated carrier in 2010, it was explained that with EOBRs the carrier was less likely to be audited, and if an audit did occur, it would be less costly to provide the required data. Further complicating the impact of this rule on carriers is that carriers have had between two and four years to invest in ELD’s, and it is difficult to determine when they will actually make the investment.

**Emissions**

Much more restrictive emissions standards were phased in from 2007-2010 (EPA, 2016c). These standards reduced the amount of Non-Methane Hydrocarbons and Nitrous Oxides by 90%. These standards were required for 50% of engines for model years 2007-2009 and 100% of engines for 2010 model year trucks. There were significant increases in the price of new and used trucks in 2010 as these changes went into effect. An estimate of average tractor price was included in the model to account for this increase, but that does not necessarily coincide with when a carrier buys a new truck or if they buy a used truck.

![Figure 1: Injury, Fatality, and Property Only Damage Crash Rates Per 100 Million Vehicle Miles Traveled Indexed on 2004 Values](image-url)
Ultra-Low Sulfur Diesel
In conjunction with the new emissions standards, the requirement for Ultra Low Sulfur Diesel was phased in between 2006-2010 (EPA, 2016b) with the allowable limit going from 500ppm down to 15ppm. This change could have impacted the price of diesel fuel, but it is difficult to say if changes are the result of the new regulation or due to other market conditions.

Fuel Efficiency
Finally, standards related to fuel economy for combination vehicles required a 20% increase in fuel economy between model years 2014-2018, and a further increase of 2.5% per year between model years 2021-2027 (EPA, 2016a). These standards likely increased the price of new tractors but also reduced the cost of operations with better fuel economy.

SAMPLE CHARACTERISTICS AND DATA SOURCES
The primary data source for this study is the (10-k) and quarterly (8-k) reports of the publicly traded motor carriers in the United States (ArcBest Corporation, 2004a-2015a, ArcBest Corporation, 2004b-2015b, Celadon Group Inc., 2004a-2015a, Celadon Group Inc., 2004b-2015b, Con-Way Inc., 2004a-2015a, Con-Way Inc., 2004b-2015b, Covenant Transportation Group Inc., 2004a-2015a, Covenant Transportation Group Inc., 2004b-2015b, Heartland Express Inc., 2004a-2015a, Heartland Express Inc., 2004b-2015b, J.B. Hunt Transport Services Inc., 2004a-2015a, J.B. Hunt Transport Services Inc., 2004b-2015b, Knight Transportation Inc., 2004a-2015a, Knight Transportation Inc., 2004b-2015b, Marten Transport Ltd., 2004a-2015a, Marten Transport Ltd., 2004b-2015b, Old Dominion Freight Line Inc., 2004a-2015a, Old Dominion Freight Line Inc., 2004b-2015b, P.A.M. Transportation Services Inc., 2004a-2015a, P.A.M. Transportation Services Inc., 2004b-2015b, USA Truck Inc., 2004a-2015a, USA Truck Inc., 2004b-2015b, Werner Enterprises Inc., 2004a-2015a, Werner Enterprises Inc., 2004b-2015b, YRC Worldwide Inc., 2004a-2015a, YRC Worldwide Inc., 2004b-2015b). The sample included all the publicly traded motor carriers that were in business from the first quarter of 2004 through the second quarter of 2015. The second quarter of 2015 was selected as the final date because initial tests on the data revealed that a balanced panel of data would be optimal for the estimation. XPO Logistics purchased Con-Way and stopped filing reports with the SEC after June 2015, so using the second quarter of 2015 as the final date rather than the second quarter of 2016 allowed for the inclusion of Con-Way. The inclusion of Con-Way allowed for 598 total quarterly observations on 13 carriers over 46 quarters, and the exclusion of Con-Way would have allowed for a total of 600 total quarterly observations on 12 carriers over 50 quarters. This decision was made in order to maximize the sampled carriers but likely had little impact on the results. The only excluded publicly traded carrier, Frozen Foods Express, was purchased by a privately held company in June 2013 and was excluded from the sample. Frozen Foods Express was also the only refrigerated carrier in the potential sample and likely had significantly different operating characteristics than the other, primarily dry van carriers. Total annual revenue of PACCAR divided by number of units sold was obtained from the annual reports of PACCAR (2004a-2015a, 2004b-2015b), a company controlling between 21% and 29% of the heavy truck market between 2004 and 2015, and used as an estimate of new tractor price.

Information on the implicit price deflator and the growth of the services sector of gross domestic product came from the Bureau of Economic Analysis (2016a). Information on the national average diesel price came from the US Energy Information Administration (2016). Finally, information on when the US economy was in a recession was obtained from the National Bureau of Economic Research (2016a).

The companies included in the sample of quarterly observations are listed in Table 1, and descriptive statistics of the variables included in estimation are shown in Table 2.
As can be seen in Table 2, there is a significant variation in all the variables to be included in the model, and the time span of the study included difficult times for motor carriers. It further reveals that 31% of the sample were LTL carriers and 69% were predominately truckload carriers; 15% of the sample were unionized carriers; 15% of the observations were from a recession although the services sector only contracted in 8.7% of those quarters; 41% of the observations came after the implementation of CSA2010; and only 13% and 4% of the observations came from times when the hours of service regulations were changed. The 2013 change added the requirement of a break for every 8 hours of driving, which could be incorporated into the split sleeper berth allowance for some carriers, a different definition of on-duty time, and restrictions to the 34-hour restart provision.

**HYPOTHESES** Due to the large number of regulatory and economic changes that occurred during the time of the study that are difficult or impossible to isolate, the following hypotheses are based on the working assumption that carriers’ performance has suffered over time. This has been the generally accepted view in the trade press and amongst industry leaders. These hypotheses do not try to assign specific causes but state that the combined effect of all regulatory changes has been a decrease in financial performance.

- **Hypothesis 1:** The Operating Ratio of motor carriers has increased (worsened) over time.
- **Hypothesis 2:** Return on Assets of motor carriers has decreased over time.
- **Hypothesis 3:** Return on Equity of motor carriers has decreased over time.
- **Hypothesis 4:** Net Profit of motor carriers has decreased over time.
- **Hypothesis 5:** Sales per Employee of motor carriers have decreased over time.

The secondary hypotheses of this study are that after the implementation of CSA 2010 and HOS guidelines and rules, specifically, changed the financial performance of motor carriers in a negative way. The specific hypotheses are that:

- **Hypothesis 1a:** Operating Ratio of motor carriers increased (worsened) after CSA 2010.
- **Hypothesis 1b:** Operating Ratio of motor carriers increased (worsened) after HOS changes.
- **Hypothesis 2a:** Return on Assets for motor carriers declined after CSA 2010.
- **Hypothesis 2b:** Return on Assets for motor carriers declined after HOS changes.
Hypothesis 3a: Return on Equity for motor carriers declined after CSA 2010.

Hypothesis 3b: Return on Equity for motor carriers declined after HOS changes.

Hypothesis 4a: Net Profit for motor carriers declined after CSA 2010.

Hypothesis 4b: Net Profit for motor carriers declined after HOS changes.

Hypothesis 5a: Sales per Employee for motor carriers declined after CSA 2010.

Hypothesis 5b: Sales per Employee for motor carriers declined after HOS changes.

---

TABLE 2
DESCRIPTIVE STATISTICS OF VARIABLES

| Measure                | Mean  | Standard Deviation | Minimum | Maximum |
|------------------------|-------|--------------------|---------|---------|
| Operating Ratio        | 93.7  | 7.8                | 60.2    | 152.1   |
| Return on Assets       | 1.1%  | 2.2%               | -17.3%  | 4.5%    |
| Return on Equity*      | 2.6%  | 4.2%               | -33.5%  | 15.8%   |
| Net Income             | 3.3%  | 5.9%               | -33.5%  | 17.3%   |
| Sales per Employee     | $41,185 | $9,581             | $19,137 | $76,672 |
| Diesel Price           | $3.10 | $0.62              | $1.80   | $4.24   |
| Tractor Price (S000s)  | $101.52 | $9.21              | $86.03  | $118.58 |
| GDP Growth             | 1.7%  | 2.5%               | -8.2%   | 5.0%    |
| Less than Truckload    | 0.31  | 0.46               | 0       | 1       |
| Union Carrier          | 0.15  | 0.36               | 0       | 1       |
| Recession              | 0.15  | 0.35               | 0       | 1       |
| CSA 2010               | 0.41  | 0.49               | 0       | 1       |
| HOS 2013               | 0.13  | 0.34               | 0       | 1       |
| HOS 2015\(^1\)         | 0.04  | 0.20               | 0       | 1       |

*ROE had only 552 observations rather than 598 because YRC Worldwide was excluded due to 25 quarters with negative stockholders’ equity.

\(^1\)HOS 2015 indicates that the restrictions to the 34-hour restart were suspended beginning in January 2015 and continuing into the future.

---

STATISTICAL MODEL

Equations
To test hypotheses 1-5 and to account for the impact of multiple regulatory changes, equations 1-5 were estimated using linear regression with variables for year and year\(^2\) included to test for temporal trends. This allowed for observation of the trends in costs from year to year after accounting for recessions, the growth of the economy and various other factors. Initial testing of the data revealed that curvilinear trends would provide the best fit. Initial testing revealed that costs and financial results were significantly different in quarter 2 than for all other quarters due to the seasonality of the motor carrier industry, so a dummy variable for Q2 was included in the final models.
OR = \alpha + \beta_1 \text{LTL} + \beta_2 \text{UC} + \beta_3 \text{REC} + \beta_4 \text{DP} + \beta_5 \text{TP} + \beta_6 \text{GDP} + \beta_7 \text{Q2} + \text{YEAR} + \text{YEAR}^2 + \varepsilon_{it} \tag{1}

\text{ROA} = \alpha + \beta_1 \text{LTL} + \beta_2 \text{UC} + \beta_3 \text{REC} + \beta_4 \text{DP} + \beta_5 \text{TP} + \beta_6 \text{GDP} + \beta_7 \text{Q2} + \text{YEAR} + \text{YEAR}^2 + \varepsilon_{it} \tag{2}

\text{ROE} = \alpha + \beta_1 \text{LTL} + \beta_2 \text{UC} + \beta_3 \text{REC} + \beta_4 \text{DP} + \beta_5 \text{TP} + \beta_6 \text{GDP} + \beta_7 \text{Q2} + \text{YEAR} + \text{YEAR}^2 + \varepsilon_{it} \tag{3}

\text{NI} = \alpha + \beta_1 \text{LTL} + \beta_2 \text{UC} + \beta_3 \text{REC} + \beta_4 \text{DP} + \beta_5 \text{TP} + \beta_6 \text{GDP} + \beta_7 \text{Q2} + \text{YEAR} + \text{YEAR}^2 + \varepsilon_{it} \tag{4}

\text{SPE} = \alpha + \beta_1 \text{LTL} + \beta_2 \text{UC} + \beta_3 \text{REC} + \beta_4 \text{DP} + \beta_5 \text{TP} + \beta_6 \text{GDP} + \beta_7 \text{Q2} + \text{YEAR} + \text{YEAR}^2 + \varepsilon_{it} \tag{5}

Where:

- OR = operating ratio = Operating Expenses/Operating Revenue
- ROA = return on assets = Net Income/Total Assets
- ROE = return on equity = Net Income/Total Stockholder Equity
- NI = net income = Net Income/Operating Revenue
- SPE = sales per employee = Operating Revenue/Number of Employees
- LTL = 1 for less than truckload carriers, 0 otherwise
- UC = 1 for union carriers, 0 otherwise
- REC = 1 for a recession, 0 otherwise
- DP = national average diesel price, adjusted for inflation
- TP = national average tractor price, adjusted for inflation
- GDP = gross domestic product growth
- Q2 = 1 for the second quarter, 0 otherwise
- YEAR = the year of the observation (1-14)

For an even clearer picture of what has happened with the financial performance of these carriers for the last 14 years, equations 6-10 were estimated using a dummy variable for each year of observation.

\text{ROA} = \beta_1 \text{LTL} + \beta_2 \text{UC} + \beta_3 \text{REC} + \beta_4 \text{DP} + \beta_5 \text{TP} + \beta_6 \text{GDP} + \beta_7 \text{Q2} + \sum_{i=2004}^{2015} \beta_{7i} Y_i + \varepsilon_{it} \tag{7}

\text{ROE} = \beta_1 \text{LTL} + \beta_2 \text{UC} + \beta_3 \text{REC} + \beta_4 \text{DP} + \beta_5 \text{TP} + \beta_6 \text{GDP} + \beta_7 \text{Q2} + \sum_{i=2004}^{2015} \beta_{7i} Y_i + \varepsilon_{it} \tag{8}

\text{NI} = \beta_1 \text{LTL} + \beta_2 \text{UC} + \beta_3 \text{REC} + \beta_4 \text{DP} + \beta_5 \text{TP} + \beta_6 \text{GDP} + \beta_7 \text{Q2} + \sum_{i=2004}^{2015} \beta_{7i} Y_i + \varepsilon_{it} \tag{9}

\text{SPE} = \beta_1 \text{LTL} + \beta_2 \text{UC} + \beta_3 \text{REC} + \beta_4 \text{DP} + \beta_5 \text{TP} + \beta_6 \text{GDP} + \beta_7 \text{Q2} + \sum_{i=2004}^{2015} \beta_{7i} Y_i + \varepsilon_{it} \tag{10}
Equations 11-15 were then developed to test hypotheses 1-5 and 1a-5a. Dummy variables were used to capture the implementation of CSA 2010 and the two successive changes to HOS regulations.

\[
OR = \alpha + \beta_1 LTL + \beta_2 UC + \beta_3 REC + \beta_4 DP + \beta_5 TP + \beta_6 GDP + \beta_7 Q2 + \beta_8 CSA + \beta_9 H2 + \beta_{10} H3 + \varepsilon_{it} \tag{11}
\]

\[
ROA = \alpha + \beta_1 LTL + \beta_2 UC + \beta_3 REC + \beta_4 DP + \beta_5 TP + \beta_6 GDP + \beta_7 Q2 + \beta_8 CSA + \beta_9 H2 + \beta_{10} H3 + \varepsilon_{it} \tag{12}
\]

\[
ROE = \alpha + \beta_1 LTL + \beta_2 UC + \beta_3 REC + \beta_4 DP + \beta_5 TP + \beta_6 GDP + \beta_7 Q2 + \beta_8 CSA + \beta_9 H2 + \beta_{10} H3 + \varepsilon_{it} \tag{13}
\]

\[
NI = \alpha + \beta_1 LTL + \beta_2 UC + \beta_3 REC + \beta_4 DP + \beta_5 TP + \beta_6 GDP + \beta_7 Q2 + \beta_8 CSA + \beta_9 H2 + \beta_{10} H3 + \varepsilon_{it} \tag{14}
\]

\[
SPE = \alpha + \beta_1 LTL + \beta_2 UC + \beta_3 REC + \beta_4 DP + \beta_5 TP + \beta_6 GDP + \beta_7 Q2 + \beta_8 CSA + \beta_9 H2 + \beta_{10} H3 + \varepsilon_{it} \tag{15}
\]

Where:
CSA = 1 after the implementation of CSA 2010 in the fourth quarter of 2010, 0 before
H2 = 1 for Q3 2013 – Q4 2014 (34-hour restart restrictions were in effect), 0 otherwise
H3 = 1 for Q1 - Q2 2015 (34-hour restart restrictions were abandoned), 0 otherwise

**Estimation and Results**
The models listed above were tested using the POOL command in SHAZAM econometric software. This technique allows for random effects from the specific carriers. Initial tests in SHAZAM indicated that the model should allow for cross-section heteroscedasticity, cross section correlation, and correct for auto correlation. The inclusion of these assumptions requires a balanced panel of data, so the time of analysis went through third quarter 2015 and Frozen Foods Express was excluded from the sample. Equations 11-15 include dummy variables for the implementation of CSA 2010 and the two changes to hours of service requirements. This methodology requires the assumption that the implementation dates were when carriers saw an impact from these regulatory changes. The problem with this assumption is that carriers knew in advance of the implementation that CSA 2010 would “go live” in the fourth quarter of 2010, so it is possible they changed their operating procedures in advance of this date in order to improve their scores on the seven criteria. Furthermore, carriers likely changed their operating procedures for the hours of service regulations that went into effect in 2013 but may have changed them any time in the two years between the announcement and the implementation date. In regards to the decision by FMCSA not to enforce the 34-hour restart restrictions, it is likely that many carriers were waiting to see the outcome of the study being prepared for Congress and made no changes to their operating procedures i.e. continued to use the restrictions on the 34-hour restart. This
would have been simpler than changing operating procedures twice in rapid succession when it was unclear if or when the 34-hour restart restrictions would be enforced.

In an effort to avoid the restrictive assumption of a strict cut-off date, account for the many other regulatory changes discussed in the summary of regulatory changes, and test hypotheses 1b-5b; equations 1-5 were used to estimate a curvilinear trend over time for each of the dependent variables. To provide a more complete picture of the changes to the dependent variables over time, equations 6-10 were estimated and included dummy variables for each year other than 2004. The coefficients associated with these dummy variables will show the changes to the various dependent variables (OR, ROA, etc.) after controlling for the economy, the type of carrier and the price of fuel and equipment.

Results of the estimation are shown in Tables 3-8 and results of Equations 1-10 are shown graphically in Figures 2-6. Common to all estimation results are the impacts of the control variables on the financial performance of carriers. The following was found:

- LTL carriers had better financial performance than TL carriers with a lower (better) operating ratio, higher return on assets, higher return on equity, higher net income and higher sales per employee.
- Unionized carriers had worse financial performance than non-unionized carriers with a higher operating ratio, lower return on assets, lower (but non-significant) return on equity, lower net income, and lower sales per employee.
- As one would expect, recessions hurt the financial performance of carriers resulting in higher operating ratios, lower returns on assets, lower returns on equity, lower net incomes, and lower sales per employee.
- Surprisingly, diesel price seems to have little or no impact on financial performance, but this may be the result of the fuel surcharge, that almost all carriers use to recover additional costs associated with fluctuating fuel costs, offsetting any additional costs. Higher diesel prices were associated with higher returns on equity and higher sales per employee.
- As expected, increases in tractor prices were associated with worse financial performance: higher operating ratio, lower return on assets and equity, lower net income and lower sales per employee.
- Increases in gross domestic product growth (GDP) also helped the financial performance of carriers, and their performance was better during the second quarter of each year as compared to the first, third and fourth. Both of these factors were associated with lower operating ratio, higher returns on assets and equity, higher net income levels, and higher sales per employee.

Surprisingly, Table 3 reveals that none of the specific regulatory changes tested had a statistically significant impact on Operating Ratio (OR) (Equation 11), so Hypotheses 1a and 1b (Operating Ratio worsened) are rejected. Based on the coefficients of YEAR and YEAR^2 in Equation 1 the second derivative of this function with respect to YEAR is negative, so this is a concave function with a maximum value at YEAR = 7.59 (between 2010 and 2011). This maximum is based on finding the inflection point of the function where the first derivative with respect to YEAR equals zero. This leads to the rejection of Hypothesis 1 because OR was increasing but has been decreasing since the implementation of CSA 2010 and has continued to decrease with the changes to hours of service regulations. Equation 6 reveals that between 2006 and 2015 OR was higher than in 2004, but it has been declining since a peak in 2011. Figure 2 shows the percentage increase in OR over a 2004 base after accounting for the control variables. The OR trend line was about 11% higher in 2010 and 2011, but that has declined to about 6% higher in
2015 than in 2004. Because OR represents costs as a percent of revenue, these higher values represent worse financial performance on this measure. However, as carriers adjust to regulatory changes their performance seems to be returning to earlier levels.

Table 4 reveals that Return on Assets (ROA) has been worse for carriers since the implementation of CSA 2010 (Equation 12), so Hypothesis 2a (CSA 2010 worsened ROA) is not rejected, but Hypothesis 2b (HOS changes worsened ROA) is rejected, indicating that the HOS regulatory changes did not impact ROA. Based on the coefficients of YEAR and YEAR$^2$ in Equation 2, the second derivative of this function with respect to YEAR is positive, so this is a convex function with a minimum value at YEAR = 8 (2011). This minimum is based on finding the inflection point of the function where the first derivative with respect to YEAR equals zero. This leads to the rejection of Hypothesis 2 because ROA was decreasing but has been increasing since the implementation of CSA 2010 and has continued to increase with the changes to hours of service regulations. Equation 7 reveals that between 2007 and 2014 ROA was lower than in 2004, but it has been increasing since its lowest point in 2011. Figure 3 shows the percentage decrease in ROA over a 2004 base after accounting for the control variables. The ROA trend line was about 45% lower in 2011 but has increased to about 24% lower in 2015 than in 2004; however,
this difference is not statistically significant. Carriers have had worse performance on this measure since 2006, but as they adjust to regulatory changes their performance seems to be returning to earlier levels.

Table 5 reveals that Return on Equity (ROE) was not impacted by the implementation of CSA 2010 or the HOS regulatory changes (Equation 13), so Hypotheses 3a and 3b (ROE worsened are rejected. Based on the coefficients of YEAR and YEAR$^2$ in Equation 3, the second derivative of this function with respect to YEAR is positive, so this is a convex function with a minimum value at YEAR = 6.9 (between 2009 and 2010). This minimum is based on finding the inflection point of the function where the first derivative with respect to YEAR equals zero. This leads to the rejection of Hypothesis 3 because ROE was decreasing but has been increasing since the implementation of CSA 2010 and has continued to increase with the changes to hours of service regulations. Equation 8 reveals that between 2008 and 2009 ROE was lower than in 2004, but it has been increasing since its lowest point in 2010. Figure 4 shows the percentage decrease in ROE over a 2004 base after accounting for the control variables. The ROE trend line was 64 and 65% lower in 2009 and 2011, but has increased to 17% lower in 2015 than in 2004; however, this difference is not statistically significant. Carriers have had worse performance on this measure since 2004, but as they adjust to regulatory changes their performance seems to be returning to earlier levels. One additional thing to note in regards to ROE is that YRC Worldwide, the worst performing carrier of the sample, was omitted from these estimations related to ROE due to a negative stockholder equity for over half of the sample period. The exclusion of this carrier could have potentially, but not necessarily, skewed the results with the random effects model.

Table 6 reveals that Net Income (NI) has been worse for carriers since the implementation of CSA 2010 (Equation 14), so Hypothesis 4a (CSA 2010 worsened NI) is not rejected, but Hypothesis 4b (HOS changes worsened NI) is rejected, indicating that the HOS regulatory changes did not impact Net Income. Based on the coefficients of YEAR and YEAR$^2$ in Equation 4, the second derivative of this function with respect to YEAR is positive, so this is a convex function with a minimum value at YEAR = 7.19 (between 2010 and 2011). This minimum is based on finding the inflection point of the function where the first derivative with respect to YEAR equals zero. This leads to the rejection of Hypothesis 4 because Net Income was decreasing
### TABLE 4
RESULTS OF ROA ESTIMATION

| Equation 2 | Equation 7 | Equation 12 |
|------------|------------|-------------|
| Buse (1973) R²: 0.2745 | Buse (1973) R²: 0.3148 | Buse (1973) R²: 0.2602 |
| **Variable Name/ Estimate Coefficient (p-value)** | **Variable Name/ Estimate Coefficient (p-value)** | **Variable Name/ Estimate Coefficient (p-value)** |
| LTL | 0.0092 (0.042) | LTL | 0.0094 (0.043) | 2007 | -0.0146 (0.030) | LTL | 0.0087 (0.020) |
| UC | -0.0257 (0.000) | UC | -0.0261 (0.000) | 2008 | -0.0240 (0.001) | UC | -0.0259 (0.000) |
| REC | -0.0150 (0.000) | REC | -0.0138 (0.000) | 2009 | -0.0224 (0.004) | REC | -0.0159 (0.000) |
| DP | 0.0012 (0.580) | DP | 0.0027 (0.297) | 2010 | -0.0133 (0.086) | DP | -0.0008 (0.717) |
| TP | -0.0004 (0.012) | TP | -0.0005 (0.004) | 2011 | -0.0218 (0.003) | TP | -0.0006 (0.000) |
| GDP | 0.0008 (0.004) | GDP | 0.0006 (0.105) | 2012 | -0.0274 (0.000) | GDP | 0.0008 (0.005) |
| Q2 | 0.0046 (0.000) | Q2 | 0.0047 (0.000) | 2013 | -0.0219 (0.002) | Q2 | 0.0050 (0.000) |
| α | 0.0581 (0.000) | α | 0.0580 (0.002) | 2014 | -0.0134 (0.081) | α | 0.0532 (0.003) |
| YEAR | -0.0080 (0.001) | 2005 | 0.0003 (0.955) | 2015 | -0.0115 (0.138) | CSA | -0.0070 (0.070) |
| YEAR² | 0.0005 (0.005) | 2006 | -0.0063 (0.289) | | | HOS2 | 0.0044 (0.314) |

### FIGURE 3
ANNUAL CHANGES (% OF ‘04 BASE) TO ROA (EQ.7) AND CURVILINEAR TREND (EQ.12)
### TABLE 5
RESULTS OF ROE ESTIMATION

| Equation 3 | Equation 8 | Equation 13 |
|------------|------------|-------------|
| Buse (1973) $R^2$: 0.1883 | Buse (1973) $R^2$: 0.2432 | Buse (1973) $R^2$: 0.1800 |
| Variable Name/Estimate Coefficient (p-value) | | |
| LTL | 0.0274 (0.046) | LTL | 0.0276 (0.030) | 2007 | -0.0005 (0.972) | LTL | 0.0271 (0.046) |
| UC | -0.0084 (0.536) | UC | -0.0083 (0.514) | 2008 | -0.0287 (0.048) | UC | -0.0083 (0.550) |
| REC | -0.0178 (0.016) | REC | -0.0144 (0.034) | 2009 | -0.0320 (0.043) | REC | -0.0207 (0.005) |
| DP | 0.0126 (0.005) | DP | 0.0149 (0.004) | 2010 | -0.0110 (0.485) | DP | 0.0109 (0.024) |
| TP | -0.0007 (0.029) | TP | -0.0006 (0.084) | 2011 | -0.0196 (0.194) | TP | -0.0010 (0.005) |
| GDP | 0.0017 (0.002) | GDP | 0.0014 (0.046) | 2012 | -0.0142 (0.347) | GDP | 0.0017 (0.003) |
| Q2 | 0.0085 (0.000) | Q2 | 0.0082 (0.000) | 2013 | -0.0147 (0.317) | Q2 | 0.0092 (0.000) |
| $\alpha$ | 0.0514 (0.150) | $\alpha$ | 0.0150 (0.691) | 2014 | -0.0006 (0.969) | $\alpha$ | 0.0583 (0.149) |
| YEAR | -0.0107 (0.052) | 2005 | 0.0142 (0.126) | 2015 | 0.0094 (0.561) | CSA | -0.0072 (0.467) |
| YEAR$^2$ | 0.0008 (0.060) | 2006 | 0.0098 (0.420) | | HOS2 | 0.0081 (0.424) |

### FIGURE 4
ANNUAL CHANGES (% OF ‘04 BASE) TO ROE (EQ.8) AND CURVILINEAR TREND (EQ.13)
but has been increasing since the implementation of CSA 2010 and has continued to increase with the changes to hours of service regulations. Equation 9 reveals that between 2007 and 2013 Net Income was significantly lower than in 2004, but it has been increasing since its lowest point in 2010 and 2011. Figure 5 shows the percentage decrease in ROA over a 2004 base after accounting for the control variables. The Net Income trend line was 41% lower in 2010 and 2011, but has increased to 20% lower in 2015 than in 2004; however, this difference is not statistically significant. Carriers have had worse performance on this measure since 2007, but as they adjust to regulatory changes their performance seems to be returning to earlier levels.

Table 7 reveals that Sales per Employee (SPE) was not impacted by the implementation of CSA 2010 or the HOS regulatory changes (Equation 15), so Hypotheses 5a and 5b (Sales per Employee worsened) are rejected. Based on the coefficients of YEAR and YEAR$^2$ in Equation 5, the second derivative of this function with respect to YEAR is positive, so this is a convex function with a minimum value at YEAR = 7.79 (between 2010 and 2011). This minimum is based on finding the inflection point of the function where the first derivative with respect to YEAR equals zero; however, the coefficients associated with YEAE and YEAR$^2$ were statistically non-significant. This leads to the rejection of Hypothesis 5. Equation 10 reveals that SPE was significantly lower than in 2004 only in the year 2006, and it has been generally increasing since its lowest point. Figure 6 shows the percentage decrease in SPE over a 2004 base after accounting for the control variables. SPE was about 5% lower in 2011 and has increased to about 3% lower in 2015 than in 2004; however, this difference is not statistically significant. Carriers have had fairly consistent performance on this measure with a statistically significant decrease only in 2006.

**CONCLUSION**

The results of this study suggest that, despite the concerns carriers’ expressed in their annual reports, CSA 2010, hours of service changes, and electronic logging devices have all been threats that the large publicly traded motor carriers have been able to deal with effectively while going through a massive recession. This is a very important finding and counter to what most observers inside and outside of the motor carriers thought would be the case. In essence, it seems that these carriers saw some beneficial impacts from the regulations, and/or were able to drive other efficiency gains despite these regulations.

However, large publicly and privately held motor carriers represent a small portion of motor carriers and a relatively small portion of motor carrier revenues. An interesting direction for future research would be to see how these changes impacted smaller carriers. This study also excluded bankrupt carriers because none of the publicly traded motor carriers underwent bankruptcy during the time frame of this study; however, many small and medium sized carriers went bankrupt during the “great recession” (and YRCW would have gone bankrupt were it a smaller carrier). This would be another interesting factor to incorporate into future studies if one were able to attain the appropriate data.

The overall result of all the estimations is that the financial performance of carriers, as measured by operating ratio, return on assets, return on equity, and net income, declined after the implementation of the HOS changes that went into effect in 2004 but has been improving since the recession and the implementation of the 2011 changes to HOS regulations. This is most clearly illustrated by the results of Equations 1-10 which show a statistically significant curvilinear trend and annual differences over 2004 values. These results are shown graphically in Figures 2-5. These results indicate that despite all the regulatory changes that have gone into effect or will be going into effect between 2004 and 2023 and the difficulty motor carriers have had trying to increase prices (Wilson, 2014), they have been able to adjust to the changes and improve their financial performance. An alternative
### TABLE 6
RESULTS OF NI ESTIMATION

|        | Equation 4 |        | Equation 9 |        | Equation 14 |        |
|--------|------------|--------|------------|--------|------------|--------|
|        | Buse (1973) R²: 0.2942 |        | Buse (1973) R²: 0.3397 |        | Buse (1973) R²: 0.2717 |        |
| Variable Name/Estimate Coefficient (p-value) |        |        | Variable Name/Estimate Coefficient (p-value) |        | Variable Name/Estimate Coefficient (p-value) |        |
| LTL    | 0.0200     | (0.068) | LTL        | 0.0192  | (0.066)     | 2007   | -0.0248  | (0.080) | LTL    | 0.0200  | (0.042) |
| UC     | -0.0567    | (0.000) | UC         | -0.0574 | (0.000)     | 2008   | -0.0462  | (0.003) | UC     | -0.0567 | (0.000) |
| REC    | -0.0336    | (0.000) | REC        | -0.0307 | (0.000)     | 2009   | -0.0528  | (0.001) | REC    | -0.0366 | (0.000) |
| DP     | 0.0045     | (0.358) | DP         | 0.0065  | (0.275)     | 2010   | -0.0301  | (0.061) | DP     | 0.0002  | (0.969) |
| TP     | -0.0011    | (0.004) | TP         | -0.0012 | (0.006)     | 2011   | -0.0453  | (0.004) | TP     | -0.0017 | (0.000) |
| GDP    | 0.0019     | (0.003) | GDP        | 0.0015  | (0.049)     | 2012   | -0.0537  | (0.001) | GDP    | 0.0021  | (0.003) |
| Q2     | 0.0110     | (0.000) | Q2         | 0.0110  | (0.000)     | 2013   | -0.0410  | (0.007) | Q2     | 0.0120  | (0.000) |
| α      | 0.1419     | (0.000) | α          | 0.1238  | (0.004)     | 2014   | -0.0222  | (0.162) | α      | 0.1679  | (0.000) |
| YEAR   | -0.0187    | (0.001) | YEAR       | 0.0035  | (0.734)     | 2015   | -0.0140  | (0.382) | YEAR   | -0.0169 | (0.060) |
| YEAR²  | 0.0013     | (0.002) |            |         |             |        |         |        | HOS2   | 0.0098  | (0.335) |
|        |            |         |            |         |             |        |         |        | HOS3   | 0.0144  | (0.317) |

### FIGURE 5
ANNUAL CHANGES (% OF '04 BASE) TO NI (EQ.9) AND CURVILINEAR TREND (EQ.14)
### TABLE 7
RESULTS OF SPE ESTIMATION

| Variable Name/Estimate Coefficient (p-value) | Equation 5 Buse R²: 0.4453 | Equation 10 Buse R²: 0.4676 | Equation 15 Buse R²: 0.4651 |
|--------------------------------------------|-----------------------------|-----------------------------|-----------------------------|
| LTL | 3,784.70 (0.189) | LTL | 3,788.60 (0.238) | 2007 | -970.77 (0.463) | LTL | 3,773.10 (0.009) |
| UC | -5,150.50 (0.075) | UC | -4,781.70 (0.143) | 2008 | -1,473.60 (0.323) | UC | -9,750.40 (0.000) |
| REC | -1,365.50 (0.055) | REC | -1,303.70 (0.054) | 2009 | -656.36 (0.677) | REC | -1,595.90 (0.038) |
| DP | 4,999.70 (0.000) | DP | 5,096.70 (0.000) | 2010 | -724.15 (0.654) | DP | 4,776.20 (0.000) |
| TP | -125.89 (0.000) | TP | -181.30 (0.000) | 2011 | -2,311.90 (0.140) | TP | -150.77 (0.000) |
| GDP | 119.64 (0.043) | GDP | 145.19 (0.038) | 2012 | -1,815.40 (0.252) | GDP | 131.52 (0.040) |
| Q2 | 827.93 (0.000) | Q2 | 824.74 (0.000) | 2013 | -2,453.80 (0.115) | Q2 | 940.80 (0.000) |
| α | 41,522.00 (0.000) | α | 45,523.00 (0.000) | 2014 | -744.18 (0.657) | α | 43,111.00 (0.000) |
| YEAR | -763.87 (0.156) | YEAR | -994.98 (0.262) | 2005 | -1,141.00 (0.512) | CSA | -1,365.70 (0.148) |
| YEAR² | 49.00 (0.226) | YEAR² | -2,250.90 (0.051) | | | HOS2 | 1,130.60 (0.270) |
| | | | | | | HOS3 | 317.80 (0.826) |

### FIGURE 6
ANNUAL CHANGES (% OF ‘04 BASE) TO SPE (EQ.10) AND CURVILINEAR TREND (EQ.15)
explanation is that one of the regulatory changes since 2009 has somehow led to an improvement in the financial performance of motor carriers. It is certainly conceivable that electronic logbooks or more fuel-efficient tractors could lead to better efficiency. Emissions regulations likely increased costs with no benefit to profitability, but hours of service changes could have potentially led to more productive drivers who were better rested. These possibilities are beyond the scope of this study but could provide direction for future research.

REFERENCES

ArcBest Corporation (2004a-2015a), “Annual Report on Form 10-k,” https://www.sec.gov/edgar (accessed October 2016).

ArcBest Corporation (2004b-2015b), “Quarterly Report on Form 10-q,” https://www.sec.gov/edgar (accessed October 2016).

Bureau of Economic Analysis (2016a), “Table 1.1.9. Implicit Price Deflators for Economic Analysis,” https://www.bea.gov (accessed October 2016).

Bureau of Economic Analysis (2016b), “Table 1.1.1. Percent Change from Preceding Period in Real Gross Domestic Product,” https://www.bea.gov (accessed October 2016).

Buse, A. (1973), “Goodness of Fit in Generalized Least Squares Estimation,” American Statistician, 27 (3): 106-108.

Celadon Group Inc. (2004a-2015a), “Annual Report on Form 10-k,” https://www.sec.gov/edgar (accessed October 2016).

Celadon Group Inc. (2004b-2015b), “Quarterly Report on Form 10-q,” https://www.sec.gov/edgar (accessed October 2016).

Con-Way Inc. (2004a-2015a), “Annual Report on Form 10-k”, https://www.sec.gov/edgar, ((accessed October 2016).).

Con-Way Inc. (2004b-2015b), “Quarterly Report on Form 10-q,” https://www.sec.gov/edgar (accessed October 2016).

Covenant Transportation Group Inc. (2004a-2015a), “Annual Report on Form 10-k,” https://www.sec.gov/edgar (accessed October 2016).

Covenant Transportation Group Inc. (2004b-2015b), “Quarterly Report on Form 10-q,” https://www.sec.gov/edgar (accessed October 2016).

Environmental Protection Agency (2016a), “EPA and DOT Finalize Greenhouse Gas and Fuel Efficiency Standards for Heavy-Duty Trucks,” https://www.epa.gov/newsreleases (accessed January 2017).

Environmental Protection Agency (2016b), “Highway and Non-road, Locomotive, and Marine (NRLM) Diesel Fuel Sulfur Standards,” https://www.epa.gov/emission-standards-reference-guide (accessed January 2017).

Environmental Protection Agency (2016c), “Heavy-Duty Highway Compression-Ignition Engines and Urban Buses: Exhaust Emission Standards,” https://www.epa.gov/emission-standards-reference-guide (accessed January 2017).

Federal Motor Carrier Safety Administration (2016b), “Compliance Safety Accountability,” https://csa.fmcsa.dot.gov/about/ (accessed October 2016).

Federal Motor Carrier Safety Administration (2016a), “Electronic Logging Devices,” https://www.fmcsa.dot.gov/hours-service/elds/electronic-logging-devices (accessed October 2016).
Federal Motor Carrier Safety Administration (2015), “Hours of Service,” https://www.fmcsa.dot.gov/regulations/hours-of-service (accessed October 2016).

Federal Motor Carrier Safety Administration (2017a), “Hours of Service,” https://www.fmcsa.dot.gov/regulations/hours-of-service (accessed March 2017).

Federal Motor Carrier Safety Administration (2017b), “Large Truck and Bus Crash Facts 2015,” https://www.fmcsa.dot.gov/safety/data-and-statistics/large-truck-and-bus-crash-facts-2015 (accessed September 2017).

Heartland Express Inc. (2004a-2015a), “Annual Report on Form 10-k,” https://www.sec.gov/edgar (accessed October 2016).

Heartland Express Inc. (2004b-2015b), “Quarterly Report on Form 10-q,” https://www.sec.gov/edgar (accessed October 2016).

J.B. Hunt Transport Services Inc. (2004a-2015a), “Annual Report on Form 10-k,” https://www.sec.gov/edgar (accessed October 2016).

J.B. Hunt Transport Services Inc. (2004b-2015b), “Quarterly Report on Form 10-q,” https://www.sec.gov/edgar (accessed October 2016).

Johnston, A. (2013), “US Motor Carrier Hours of Service Regulations: Their Impact On Carrier Profitability and Productivity,” Journal of Transportation Management, 24 (1): 3-36.

Harrison, H.D., Keim, C., Pacurar, I. (2012), Labor Market Impacts of Compliance, Safety and Accountability (CSA) On The Trucking Industry: Supply and Demand Issues For The Future.

Knight Transportation Inc. (2004a-2015a), “Annual Report on Form 10-k,” https://www.sec.gov/edgar (accessed October 2016).

 Knight Transportation Inc. (2004b-2015b), “Quarterly Report on Form 10-q,” https://www.sec.gov/edgar (accessed October 2016).

National Bureau of Economic Research (2016), “US Business Cycles Expansions and Contractions,” http://www.nber.org/cycles/cyclesmain.html (accessed October 2016).

Marten Transport Ltd. (2004a-2015a), “Annual Report on Form 10-k,” https://www.sec.gov/edgar (accessed October 2016).

Marten Transport Ltd. (2004b-2015b), “Quarterly Report on Form 10-q,” https://www.sec.gov/edgar (accessed October 2016).

Old Dominion Freight Line Inc. (2004a-2015a), “Annual Report on Form 10-k,” https://www.sec.gov/edgar (accessed October 2016).

Old Dominion Freight Line Inc. (2004b-2015b), “Quarterly Report on Form 10-q,” https://www.sec.gov/edgar (accessed October 2016).

PACCAR Inc. (2004a-2015a), “Annual Report on Form 10-k,” https://www.sec.gov/edgar (accessed October 2016).

PACCAR Inc. (2004b-2015b), “Quarterly Report on Form 10-q,” https://www.sec.gov/edgar (accessed October 2016).

P.A.M. Transportation Services Inc. (2004a-2015a), “Annual Report on Form 10-k,” https://www.sec.gov/edgar (accessed October 2016).

P.A.M. Transportation Services Inc. (2004b-2015b), “Quarterly Report on Form 10-q,” https://www.sec.gov/edgar (accessed October 2016).
US Energy Information Administration (2016), “US No. 2 Diesel Retail Prices,” http://www.eia.gov (accessed October 2016).

USA Truck Inc. (2004a-2015a), “Annual Report on Form 10-k,” https://www.sec.gov/edgar (accessed October 2016).

USA Truck Inc. (2004b-2015b), “Quarterly Report on Form 10-q,” https://www.sec.gov/edgar (accessed October 2016).

Werner Enterprises Inc. (2004a-2015a), “Annual Report on Form 10-k,” https://www.sec.gov/edgar (accessed October 2016).

Werner Enterprises Inc. (2004b-2015b), “Quarterly Report on Form 10-q,” https://www.sec.gov/edgar (accessed October 2016).

Wilson, R. (2014), 25th Annual ‘State of Logistics Report, Council of Supply Chain Management Professionals. Chicago, IL.

YRC Worldwide Inc. (2004a-2015a), “Annual Report on Form 10-k,” https://www.sec.gov/edgar (accessed October 2016).

YRC Worldwide Inc. (2004b-2015b), “Quarterly Report on Form 10-q,” https://www.sec.gov/edgar (accessed October 2016).

BIographies

Ahren Johnston is an Associate Professor in the Department of Marketing and Supply Chain Management in the College of Business and Economics at North Carolina Agricultural & Technical State University in Greensboro, North Carolina. Previously he was an Assistant Professor at Missouri State University. His research primarily focuses on transportation, and he has numerous publications in journals such as The Journal of Transportation Management, Transportation Research Part E, and the International Journal of Logistics Management and Operations Management Research. E-Mail: ajohnston@ncat.edu