Grain Railroad Rates and Barge Rates in the Mississippi Waterway System

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1. Introduction

US grain is produced mostly in the Midwest and exported via the Pacific Northwest and the Gulf of Mexico (figure 1). Barges on the Mississippi River and railroads play fundamental roles in determining export competitiveness. Rail and barge transportation represented respectively 48% and 45% of the total volume of corn, soybeans and wheat exported over the period 2003-2007 (Marathon and Denicoff, 2011).

Concerns have been raised in the past about railroad market power (MacDonald 1987; Fuller and Shannumgub 1981; Mjllkovic 2001) while barges have always been perceived as a competitive market because new transportation companies can share the river. Despite some research on grain rail rates, little is known about the nature of market interactions between barge rates and rail rates in the Mississippi Waterway.

Because grains are often transported in more than one mode, competition and complementarity exist among these modes (figure 2). This paper analyzes the interactions between grain railroad rates (feeder–destination in the Mississippi waterway system - and nonfeeder lines) and barge rates in the Mississippi waterway system.

2. Objectives

We expect that:

H1: Mississippi barge rates should increase rates on nonfeeder rail lines as these may substitute.

H2: Mississippi barge rates should decrease rates on Mississippi feeder rail lines (e.g., the Des Moines to Quad Cities freight line) as these complement.

H3: Mississippi barge rates should increase rates on nearby parallel railroad lines by more than on more distant parallel rail lines (e.g., IL-LA vs. NE-TX), in light of greater substitution.

H4: Gulf Ocean freight rates should decrease barge rates on the Mississippi River as these complement.

H5: Pacific Ocean freight rates should increase barge rates on the Mississippi River.

H6: Mississippi River depth should decrease barge rates and increase rates on feeder lines because decreased costs and expanded capacity will be passed through.

H7: Mississippi River depth should decrease rates on parallel nonfeeder rail lines because prices on alternative routes must decline to retain traffic.

3. Methods

Using data from the Grain Transportation Report for 2002-2012, we have estimated 3SLS simultaneous equation models of barge and railroad rates for specific origin-destination and grains (figure 3).

Price-Price elasticities were estimated and various model specifications were regressed for robustness. This study uses river levels and railroad cost indexes as instrumental variables as they are largely if not entirely exogenous to the variables of interest. Railroad costs were obtained from the American Railroad Association. The Railroad Cost Recovery Index (RCR) is based on data from all US Class I railroads. Other grain transportation demand and supply shiftings are corn real exchange rate, diesel prices, crop specific agricultural year dummy variables, and seasonal dummies.

A representative model is as follows (all variables except dummies are in logs):

\[
\begin{align*}
\log_{\text{barga}} & = \beta_0 + \beta_1 \log_{\text{rail}} + \beta_2 \text{Water} + \beta_3 S + \beta_4 F + \beta_5 W + \beta_6 \text{RER} \\
& + \beta_7 \text{Gulf} + \beta_8 \text{PNW} + \beta_9 \text{Pacific} + \beta_{10} \text{Diesel} + \epsilon_{\text{barga}} \\
\log_{\text{rail}} & = \alpha_0 + \alpha_1 \log_{\text{gulf}} + \alpha_2 \text{ABF} + \alpha_3 S + \alpha_4 F + \alpha_5 W + \alpha_6 \text{RER} \\
& + \alpha_7 \text{Gulf} + \alpha_8 \text{PNW} + \alpha_9 \text{Pacific} + \alpha_{10} \text{Diesel} + \epsilon_{\text{rail}}
\end{align*}
\]

where \(\log_{\text{rail}}\) is the price of barge transportation from origin (\(\alpha_0\)); \(\log_{\text{gulf}}\) is the grain rail rate on corridor \(a\); Water is the Mississippi river level at Carlington, New Orleans; \(S\), \(F\), and \(\text{PNW}\) are seasonal dummies for summer, fall and winter; \(\text{RER}\) is the corn real exchange rate; \(\log_{\text{gulf}}\) and \(\log_{\text{PNW}}\) are Gulf and Pacific Northwest ocean rate, \(\text{RailRate}\) is a ratio of Gulf and PNW ocean rates, \(\text{RailRate}\) is the average price per gallon of No. 2 diesel fuel, ABR is the all-but-rail cost index, and \(F\) is a vector of agricultural crop year dummy variables. Unit roots test and stationarity tests provided sufficient evidence to assume that relevant variables could be assumed to be stationary or that level regressions of form (2)-(2) are appropriate.

4. Results and discussion

Not all data have been collected to address all hypotheses. Preliminary results support several of the hypotheses. In the case of corn, on the Minneapolis-PNW line, barge rates were found to have robust positive effects on rail rates as expected (elasticities between 0.53 and 0.65) due to their competitive nature. The elasticity with respect to barge rates in Illinois, is smaller for the IL-LA corn rail rate (-0.241) than for the NE-TX one. These results provide supporting evidence that distance from the origin to the water system affects the competition between barges and railroads.

In support of H2, the Des Moines, IA to Davenport, IA railroad rates complement barge rates (elasticity at least equal to -0.093). We also find that barge rates have an elastic reaction to railroad shuttle rates (1.2 to 1.6) and an inelastic reaction to unit rates (0.5 to 0.7) (table 1). The higher elasticity of barge rate to shuttle compared to unit rates is logical given shuttles are more export oriented than are unit trains. What is surprising is how elastic barge rate responses are to shuttle rates, showing that the barge market may have more market power than previously expected. A one-foot decrease in the water level at Carlington, New Orleans increases the barge rates by 5-7%.

Table 3 - 3SLS for Logs of Unit Railroad and Barge Rates Index of Corn

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\log_{\text{barga}})</td>
<td>0.648***</td>
<td>0.681***</td>
<td>0.724***</td>
<td>0.714***</td>
<td>0.743***</td>
<td></td>
</tr>
<tr>
<td>(\log_{\text{rail}})</td>
<td>-0.215**</td>
<td>-0.071***</td>
<td>-0.071***</td>
<td>-0.099***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(\text{summer})</td>
<td>0.014</td>
<td>0.069***</td>
<td>0.056***</td>
<td>0.055***</td>
<td>0.040***</td>
<td></td>
</tr>
<tr>
<td>(\text{fall})</td>
<td>0.362***</td>
<td>0.367***</td>
<td>0.338***</td>
<td>0.336***</td>
<td>0.337***</td>
<td></td>
</tr>
<tr>
<td>(\text{water})</td>
<td>0.162***</td>
<td>0.153***</td>
<td>0.126***</td>
<td>0.135***</td>
<td>0.195***</td>
<td></td>
</tr>
<tr>
<td>(\log_{\text{gulf}})</td>
<td>-0.115***</td>
<td>-0.135***</td>
<td>-0.104***</td>
<td>-0.126***</td>
<td>-0.194***</td>
<td></td>
</tr>
<tr>
<td>(\log_{\text{unit}})</td>
<td>-0.127***</td>
<td>-0.135***</td>
<td>-0.135***</td>
<td>-0.155***</td>
<td>-0.249***</td>
<td>-0.103***</td>
</tr>
<tr>
<td>(\log_{\text{gulf}})</td>
<td>-0.127***</td>
<td>-0.135***</td>
<td>-0.135***</td>
<td>-0.155***</td>
<td>-0.249***</td>
<td>-0.103***</td>
</tr>
<tr>
<td>(\log_{\text{unit}})</td>
<td>0.127***</td>
<td>0.135***</td>
<td>0.135***</td>
<td>0.155***</td>
<td>0.249***</td>
<td>0.103***</td>
</tr>
<tr>
<td>(\text{water})</td>
<td>0.138****</td>
<td>0.099***</td>
<td>0.097***</td>
<td>0.101***</td>
<td>0.082***</td>
<td>0.092***</td>
</tr>
</tbody>
</table>

All models have agricultural year dummy variables. Standardized beta coefficients * p < 0.10, ** p < 0.05, *** p < 0.01.

5. Conclusions

Crop production is expanding in the Upper Mississippi Waterway and these commodities or derived products will need transportation to access domestic and international markets. A variety of public policy issues surround transportation infrastructure in the area. Public funds are used to maintain locks and dams while river modifications have implications for flood control and for wildlife habitat. Carefully reasoned cost-benefit analyses of investments in transportation infrastructure and endeavors to regulate competition require an understanding of the nature of competition in transportation markets.

This paper provides evidence that rail and barge rates may behave as substitutes and complements according to their specific route. In the case of corn it was possible to identify for the first time in the literature the existence of complementarity between rail and barges in the rail line from Des Moines, IA to Davenport, IA.}

References:


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