PROCEEDINGS —

Twenty-fourth Annual Meeting

Volume XXIV • Number 1 1983

TRANSPORTATION RESEARCH FORUM

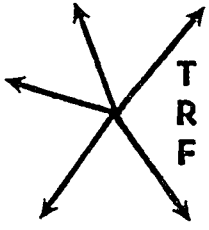
PROCEEDINGS —
Twenty-fourth Annual Meeting

Theme:

"Transportation Management, Policy and Technology"

November 2-5, 1983
Marriott Crystal City Hotel
Marriott Crystal Gateway Hotel
Arlington, VA

Volume XXIV • Number 1 1983



TRANSPORTATION RESEARCH FORUM

Impact of Waterway User Fees on Pacific Northwest Wheat Movement: Before and After Staggers Act

by Ken L. Casavant and Jeanne Mehringer**

INTRODUCTION

THE PACIFIC NORTHWEST wheat industry is a major contributor to total United States wheat production and exports. The large portion of PNW wheat that is exported (70-90 percent) makes the competitive position of PNW wheat in the world market critical for regional and national economies.

The healthy competitive position of PNW wheat in the international market is heavily dependent on the existing efficient transportation system, a system of truck, barge and rail. Competition between these modes has furnished the PNW with low transportation rates. However recent and potential changes in waterway policy regarding user fees may affect the competitive position of the PNW wheat industry.

It is obvious that user fees and a cost responsibility policy on inland waterways are and will be a phenomenon of the 1980's. However, the political process has not settled on the type of user fee to be imposed and the level of cost recovery to be attained. Underlying these questions is what portion of costs should be recovered from navigation and/or from agriculture.

The potential impact of these user fees alternatives is further complicated by the deregulatory environment of the Staggers Act. Although only a partial picture has been available (due to the economic recession, stable grain export sales, and large surpluses of both railcars and barges) an initial assessment of Staggers indicates a new innovative and rate reducing activity is underway, namely the introduction of multiple-car and unit train rates.[1] Such rates, prevalent in the PNW wheat industry since 1981, may well change the competitive structure of modes in the PNW. Little research has been done on this situation at this time.

This paper reports on a study of these policy variables and the impact of alternative user fee structures on the movement of wheat out of the Pacific Northwest, both prior to and following Staggers Act of 1980[2]. Specific objectives of the paper are to:

(1) identify the impact of user fees on truck-barge rates.

(2) identify the impact of these changed rates on wheat distribution patterns among modes and shippers' transportation bill, and

(3) compare these impacts with and without the availability of multiple car rates.

The study analyzed four user fee types: a fuel tax imposed on a uniform basis throughout the nation, a fuel tax imposed on a river segment specific basis, lockage fees, and ton-mile fees. Alternative levels of recovery of operation and maintenance fees analyzed were 100, 75, 50, and 25 percent.

RESEARCH METHOD AND DATA

A transportation model was used to minimize the cost of shipping wheat in the PNW for export. In the model, wheat was shipped from 66 supply regions in the PNW (Washington, Oregon, Montana, and Idaho) to the Portland area ports, the demand region, by the least cost transportation mode. Portland was used as the single demand region because since 1981 95% of wheat exported out of the PNW went through these ports. The alternative modes incorporated into the model included single and multiple unit rail, truck-barge and truck.

The mathematical model, quite traditional in use, included variables representing wheat production from each supply and the transportation rates from each supply area to Portland. The model minimized:

$$WTC = \sum_{i=1}^{66} \sum_{k=1}^{4} S_i T_{ik}$$

where WTC = wheat transportation cost
i = origin area
k = transportation mode
S_i = tons of wheat transported from origin area i

*Washington State University, Pullman, WA.

T_{ik} = transportatiton rate from origin area i to Portland by mode k

subject to: $D = \sum_{i=1}^{66} S_i$

where D = demand at Portland

Supply Areas

The supply areas and origin points within each supply represent the major wheat production areas in each state. The origin points within supply areas are centrally located shipping points with terminal facilities or country elevators with rail and highway access (for more detail see Casavant and Mehringer).

Wheat Production

The quantity of wheat transported from each origin point to Portland is the total wheat production from the corresponding supply area in 1980. This assumes that all wheat transported from the supply region is exported, based on the fact PNW wheat exports from these regions have been approximately equal to wheat production in recent years (Casavant and Mehringer).

Demand Regions

Pacific Northwest wheat is exported from Columbia River ports. The ports are located at Portland, Oregon, and Kalama, Longview and Vancouver, Washington.

Transportation Rates

Transportation rates include various handling charges and wheat inspection fees that are added to the modal charges. The wheat inspection fee varies by mode. The barge rate changes as user fees are imposed. All rates remain constant regardless of volume because the supply of transportation is assumed to be perfectly elastic in a given supply period.

Truck-Barge Rates

The total water transportation rate is the sum of the truck rate for shipping wheat from the origin point to the river terminal, a $3.33 per ton "put-through" charge at the river terminal, the actual barge rate to Portland and a 1.5 cent per ton wheat inspection fee.

Rail Rates

Both single unit and multiple unit rail rates were included in the model. A 17 cent per ton grain inspection fee is included in these rates. Individual models include the single unit rail rates and then the multiple car unit rates. In the areas where more than one type of multiple unit rate was available, the least cost option was used.

Truck Rate

The truck rate is the tariff charge to move wheat from an origin point to Portland. A Portland terminal put-through charge of $2 per ton and a 50 cent per ton wheat inspection fee was included in the truck rate.

User Fee Development

User fees were added to the truck-barge rate at rates to recover desired levels of Federal operation and maintenance expenditures. All increases in costs due to user fees were assumed to be passed on to shippers in the form of increased rates. It should be noted that examining the various cost recovery levels will indicate the impacts of used fees if only 75, 50, or 25 percent of the increased costs are passed on to shippers.

Fuel Fees

Estimation of the correct amount of fuel tax to generate desired cost recovery levels depends on the amount of fuel consumed. Results of previous research on energy intensities vary widely depending on the variables and assumptions used to estimate them.[3] An energy intensity estimate based on conditions similar to the Columbia-Snake Waterway was 270 BTU's per ton-mile and this was the estimate used in this study.

Uniform Fuel Tax

Uniform fuel taxes were developed in the following manner:

$$\text{Uniform fuel tax per gallon of} = \frac{\text{Annual total Federal navigation O \& M expenditures}}{\text{Annual total gallons of fuel consumed by navigation}}$$

where:

$$\text{Annual total gallons of fuel consumed by navigation} = \frac{\text{Annual collection of the waterways Trust Fund}}{\text{Annual fuel tax per gallon according to the tax table in PL95-502}}$$

Segment Specific Fuel Tax

Under a segment fuel tax the commercial traffic on a particular river segment would bear the operations and maintenance costs allocated to navigation for that river segment. The specific tax was calculated in the following manner:

$$\text{Segment fuel tax per gallon} = \frac{\text{Grain share of annual Columbia-Snake Waterway federal navigation O \& M expenditures}}{\text{gallons of fuel consumed}}$$

where:

$$\text{gallons of fuel consumed} = \text{gallons of fuel to move 1 ton to Portland from each pool} \times \text{annual total tons from each pool}$$

where:

$$\text{gallons of fuel to move 1 ton to Portland from each pool} = \frac{\text{River miles to Portland from each pool}}{500 \text{ miles}}$$

Lockage Fee

The Columbia-Snake Waterway has eight locks where a fee would be collected. A typical grain flotilla configuration on the Columbia-Snake Waterway consists of two 242 foot barges (3,000 ton capacity each), two 282 foot barges (3,500 ton capacity each) and a 110 foot tow boat. The calculations to allocate lockage costs per ton were as follows:

$$\text{Lockage fee from each pool} = \text{Average Lockage cost per ton} \times \text{Annual total tons from each pool} \times \text{Number of locks passed through to Portland}$$

where:

$$\text{Average lockage cost per ton} = \frac{\text{Average lockage cost per lock}}{\text{average size flotilla}}$$

where:

$$\text{Average lockage cost per lock} = \frac{\text{Annual grain O \& M per lock}}{\text{Sum of the annual tons through each lock}}$$

where:

$$\text{Annual grain O \& M per lock} = \frac{\text{Annual grain O \& M for each lock and dam}}{\text{Number of lockages through a dam}}$$

where:

$$\text{Number of lockages through a dam} = \frac{\text{Annual tons through each lock}}{\text{average tons in each lockage}}$$

Ton-mile Tax

A ton-mile tax imposes a tax on a ton of grain for each mile moved on the river. The calculations used the following procedure.

$$\text{Ton-mile fee from each pool} = \text{Dollars per ton-mile} \times \text{River miles to Portland from each pool}$$

where:

$$\text{Dollars per ton-mile} = \frac{\text{Annual Grain O \& M}}{\text{Total River ton miles}}$$

where:

$$\text{Total river ton miles} = \text{Sum of the ton-miles from each pool}$$

where:

$$\text{Ton-mile from each pool} = \text{annual tons of grain at each pool} \times \text{River miles to Portland from each pool}$$

Specification of Model Alternatives

Each model in this study reflects the application of the different user fee types and different cost recovery levels. Two base models are utilized. The first base model reflects the PNW wheat transportation system before multiple unit rail rates. The second base model does include these rates and serves to illustrate a competitive railroad rate and contemporary wheat marketing practices, and a rate presently quoted in the PNW. The structural formation of the model alternatives is shown in Figure 1.

User fees were added to base model one to form models three through

STRUCTURAL DIAGRAM OF THE ALTERNATIVE MODELS

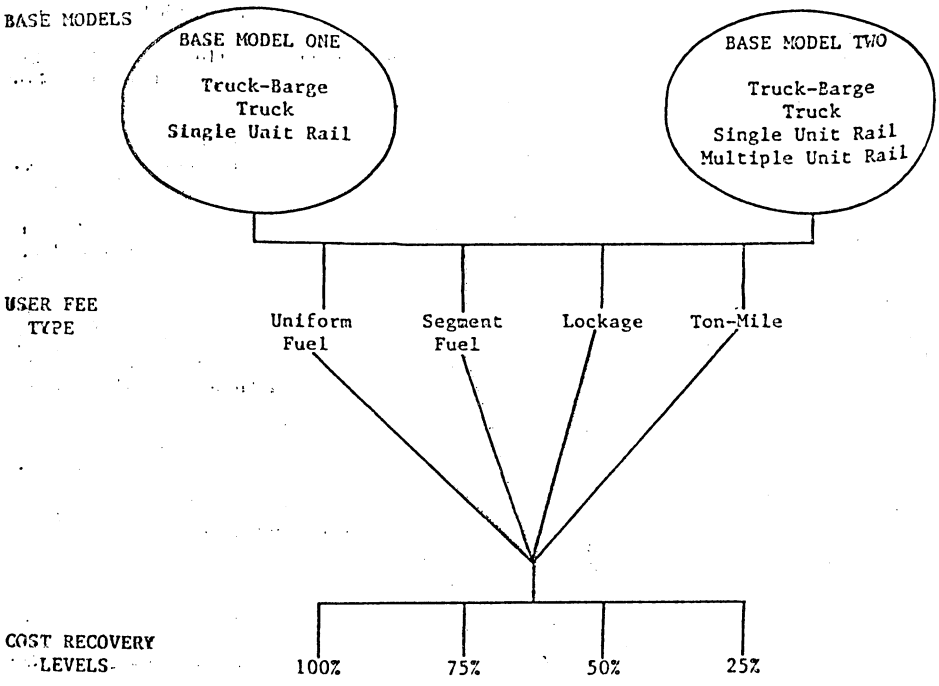


FIGURE 1

eighteen. Models nineteen through thirty-four were formed by adding the alternative user fees structure and levels to base model two. Each model is summarized in Table 1.

RESULTS

The four different types of user fees imposed different amounts of tax to each river pool at each cost recovery level. The segment specific fees were approximately twice the magnitude of the uniform fuel tax. This difference is illustrated in Figure 2 where the uniform fuel tax is compared to the segment specific tax. For example, the fuel tax from Lewiston, Idaho was 95 cents per ton when a full cost recovery segment specific user fee program was imposed but only 38 cents per ton under a full cost recover uniform fuel tax program.

Transportation Modal Market Share Shifts

Under single car rail rates market shares prior to imposition of user fees were rail — 42.9 percent, truck barge — 33.1 percent, and truck 23.9 percent (Table 2). All fees, except for a uniform fuel tax at the 25 percent cost recovery level, resulted in a slight decrease in the truck-barge market share. In most models 1 percent of PNW wheat shifted away from the truck-barge mode to rail when user fees were imposed. This 1 percent decrease in total wheat shipments was a 3 percent decrease in truck-barge share.

The uniform fuel tax had the smallest impact on the truck-barge industry, followed by segment specific and then lockage fees. The lockage fee at the 100 cost recovery level had the greatest impact on truck-barge market shares, decreasing the share 43 percent from their previous volume. The ton-mile fee had the second largest impact on water movements, with truck barge losing 36 percent of their volume to the railroads.

Inclusion of multiple car rates in the analysis, prior to imposition of user fees, diverted a considerable portion of the truck-barge, truck, and single car market shares to this new method of rail pricing. Multiple unit rail captured

TABLE 1

MODEL ALTERNATIVES

Model Number	Base Model	Use[1] None	Cost Recovery Level (Percent)
1	Single Car Rate	None	0
2	Multiple Rate	None	0
3	Single Car Rate	Uniform Fuel	100
4	Single Car Rate	Uniform Fuel	75
5	Single Car Rate	Uniform Fuel	50
6	Single Car Rate	Uniform Fuel	25
7	Single Car Rate	Segment Fuel	100
8	Single Car Rate	Segment Fuel	75
9	Single Car Rate	Segment Fuel	50
10	Single Car Rate	Segment Fuel	25
11	Single Car Rate	Lockage	100
12	Single Car Rate	Lockage	75
13	Single Car Rate	Lockage	50
14	Single Car Rate	Lockage	25
15	Single Car Rate	Ton-Mile	100
16	Single Car Rate	Ton-Mile	75
17	Single Car Rate	Ton-Mile	50
18	Single Car Rate	Ton-Mile	25
19	Multiple Car Rate	Uniform Fuel	100
20	Multiple Car Rate	Uniform Fuel	75
21	Multiple Car Rate	Uniform Fuel	50
22	Multiple Car Rate	Uniform Fuel	25
23	Multiple Car Rate	Segment Fuel	100
24	Multiple Car Rate	Segment Fuel	75
25	Multiple Car Rate	Segment Fuel	50
26	Multiple Car Rate	Segment Fuel	25
27	Multiple Car Rate	Lockage	100
28	Multiple Car Rate	Lockage	75
29	Multiple Car Rate	Lockage	50
30	Multiple Car Rate	Lockage	25
31	Multiple Car Rate	Ton-Mile	100
32	Multiple Car Rate	Ton-Mile	75
33	Multiple Car Rate	Ton-Mile	50
34	Multiple Car Rate	Ton-Mile	25

[1] Segment Fuel is identical to Segment-Specific Fuel.

58.3 percent of the total PNW wheat market share in base model two. When this market share was added to the 9.8 percent single unit rail share, rail had a total market share of 68.1 percent in base model two, up from 42.8 percent prior to availability of multiple unit rates.

Imposition of waterway user fees caused only 1 percent (6 percent of truck-barge share) of the total movement to shift from truck-barge to single car rail in all but one model (Table 3). The uniform fuel tax at the 25 percent cost recovery level caused no shifts at all.

Comparison of the impact of user fees on modal market share under single versus multiple unit rates yields some interesting insights (Tables 2 and 3). The market share for rail increased an additional 25.2 percent in addition to

Comparison of Segment-Specific Fuel Tax and Uniform Fuel Tax to Recover Shallow-Draft Operation and Maintenance Costs on the Columbia and Snake Waterway

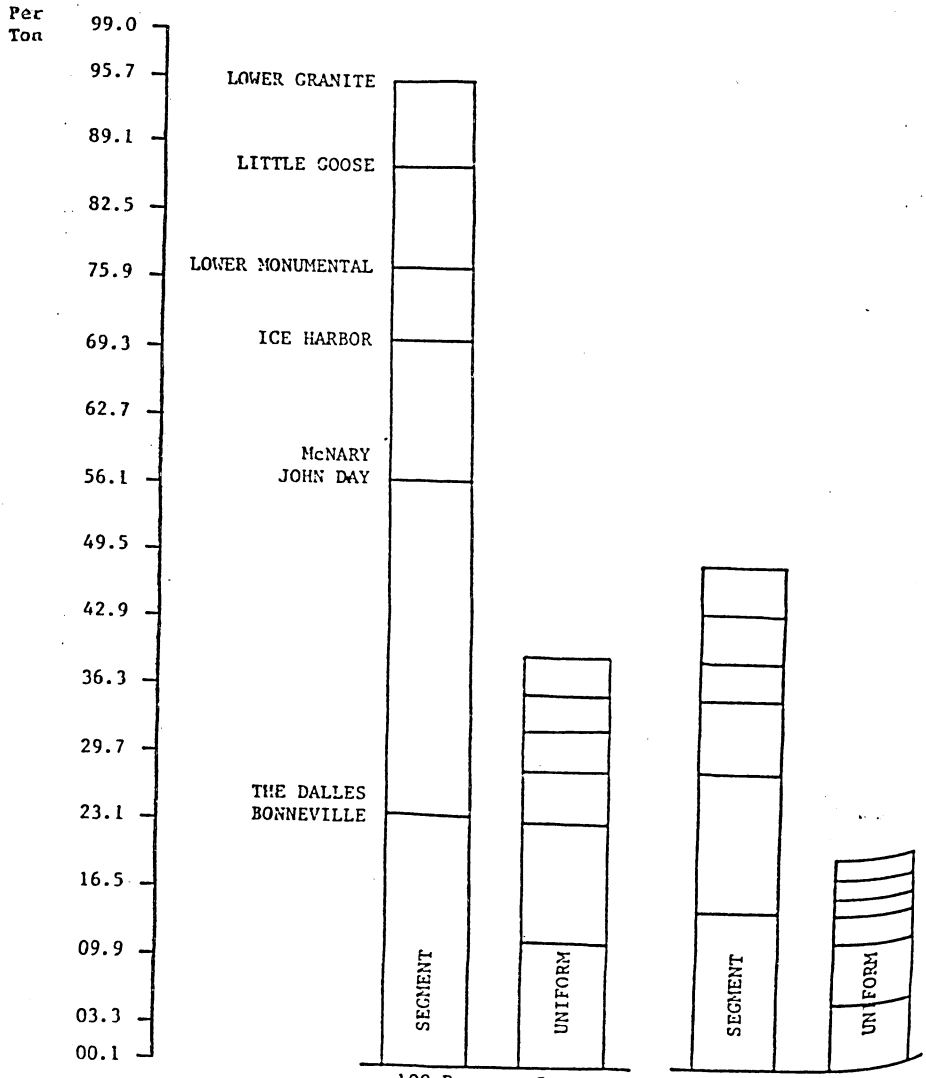


FIGURE 2

the single unit rail market share when multiple unit rates became available in the PNW. Rail captured 16.8 percent of the increased market share from truck-barge and 8.4 percent from truck. Interestingly, user fees had about the same impact, causing a 1 percent increase in rail market share in both cases. All of this change originated in Oregon origins (Casavant and Mehinger).

TABLE 2

PACIFIC NORTHWEST TRANSPORTATION MARKET SHARES, SINGLE UNIT RAIL MODELS (1, 3-18)

Fee Type	Cost Recovery Level	Model Number	Percent of Market Share		
			Single Rail	Truck-Barge	Truck
			%	%	%
Base Model One Uniform Fuel	0	1	42.9	33.1	23.9
	100	3	43.9	32.1	23.9
	75	4	43.9	32.1	23.9
	50	5	43.9	32.1	23.9
	25	6	42.9	33.1	23.9
Segment Fuel	100	7	43.9	24.2	31.8
	75	8	43.9	32.1	23.9
	50	9	43.9	32.1	23.9
	25	10	43.9	32.1	23.9
Lockage	100	11	46.9	18.9	34.1
	75	12	43.9	32.1	23.9
	50	13	43.9	32.1	23.9
	25	14	43.9	32.1	23.9
Ton-Mile	100	15	43.9	21.1	23.9
	75	16	43.9	32.1	23.9
	50	17	43.9	32.1	23.9
	25	18	43.9	32.1	23.9

Transportation Bill Changes

The transportation bill, simply the cost of transportation to PNW wheat shippers, is the sum of the quantity of wheat transported by a transportation mode multiplied by the rate of that mode.

The transportation bill, prior to user fees and when single unit rail rates were applied, was $225 million for the PNW. Imposition of alternative user fees increased this charge an additional 0.15 percent to 1.51 percent, from $341 thousand to $3.4 million over the initial $225 million (Table 4). The uniform fuel tax, at all cost recovery levels, increased the total transportation bill by a smaller amount than any of the three segment oriented user fees. At the full cost recovery level the transportation bill increased an additional $1.7 million. The 50 percent cost recovery level for the segment fuel, lockage and ton-mile fees had approximately the same effect as the full cost uniform fee.

The segment specific fees varied only slightly, under the single rail base model, in their impact on transportation charges at each cost recovery level. The lockage fee caused the greatest impact followed by the ton-mile fee and, finally the segment specific fuel tax.

Increased user fees had differing impacts on transportation charges in each state. Idaho had significantly larger increases in transportation charges than the other states. Montana and Washington had similar increases in transportation costs and followed Idaho in magnitude.

When multiple unit rail rates were available PNW wheat shippers paid $216 million before imposition of user fees. Introduction of multiple unit rates saved shippers almost $9 million. The transportation costs, even when user fees were applied at every cost recovery level with multiple rates were all below the single car model without user fees. The uniform fuel tax increased shipper's transportation bill $524 thousand, $395 thousand, $269 thousand, and $137 thousand at the 100, 75, 50, and 25 percent levels of cost recovery, respectively (Table 5).

Of the segment specific fees the ton-mile fee resulted in the largest increase in costs, followed by the fuel tax and the lockage fee. The latter two fees had equal percentage increases in the transportation charge to the shipper, ranging

TABLE 3

PACIFIC NORTHWEST TRANSPORTATION MARKET SHARES, MULTIPLE UNIT RAIL MODEL (2, 19-34)

Fee Type	Cost Recovery Level	Model Number	Percent of Market Share			
			Single Rail	Multiple Rail	Truck-Barge	Truck
	%		%	%	%	%
Base Model One	0	2	9.8	58.3	16.3	15.5
Uniform Fuel	100	19	10.8	58.3	15.3	15.5
	75	20	10.8	58.3	15.3	15.5
	50	21	10.8	58.3	15.3	15.5
	25	22	9.8	58.3	16.3	15.5
Segment Fuel	100	23	10.8	58.3	15.3	15.5
	75	24	10.8	58.3	15.3	15.5
	50	25	10.8	58.3	15.3	15.5
	25	26	10.8	58.3	15.3	15.5
Lockage	100	27	10.8	58.3	15.3	15.5
	75	28	10.8	58.3	15.3	15.5
	50	29	10.8	58.3	15.3	15.5
	25	30	10.8	58.3	15.3	15.5
Ton-Mile	100	31	10.8	58.3	15.3	15.5
	75	32	10.8	58.3	15.3	15.5
	50	34	10.8	58.3	15.3	15.5
	25	34	10.8	58.3	15.3	15.5

from $320 thousand at the 25 percent cost recovery level to $1.2 million at the 100 percent cost recovery.

Multiple unit rail rates caused significant decreases, 3.91 or $8.8 million, in the transportation bill (Tables 4 and 5). The impact of user fees on PNW wheat shippers was also reduced. The transport charge increases resulting from the imposition of user fees on the multiple unit rail model were at least two-thirds smaller than with the single unit rail situation.

Overall User Fee Ranking

The different user fees had various levels of impacts on the PNW and each state. A region would understandably desire that user fee that would minimize their additional transportation cost increase. The user fees listed in Table 6 were raked in order of desirability based on minimized transportation costs. The general rankings of these fees were similar although some differences do exist for each state.

The 25 percent cost recovery level uniform fuel tax was the most desired user fee for all states and the PNW. The 25 percent cost recovery level of the three segment specific fees was all more desireable than the uniform fuel tax at the 75 percent cost recovery level. The PNW as a whole was better off with a segment specific fuel tax and ton-mile at the 50 percent cost recovery level than a 100 percent cost recovery level uniform fuel tax. When multiple unit rail rates were available, the 50 percent cost recovery lockage fee in addition to the other segment specific user fees is also preferred to a 75 and 100 percent cost recovery level uniform fee. Oregon's rankings deviate most often from the other states ranking because a lockage fee was more often preferred over the other segment specific user fees.

SUMMARY AND CONCLUSIONS

The analytical model used in this study, and the institutional development of that model's structure allow some general conclusions to be drawn. First of all, the impact on shippers and modes from the imposition of user fees was not large. The imposition of user fees caused only slight decreases in truck-barge market shares and slight increases in transportation charges. The three segment user fees at the 100 percent cost recovery level were the only

TABLE 4

PACIFIC NORTHWEST TRANSPORTATION COSTS, SINGLE UNIT RAIL MODES (1, 3-18)

Fee Type	Model Number	Total Cost	Dollar Change From Base Model One	Percentage Change From Base Model One
		$	$	%
Base Model One				
0	1	225,661,856	0	0
Uniform Fuel				
100	3	227,406,208	1,744,352	0.77
75	4	226,667,824	1,044,868	0.45
50	5	226,336,080	674,224	0.30
25	6	226,003,056	341,200	0.15
Segment Fuel				
100	7	228,912,336	3,250,480	1.44
75	8	228,114,608	2,452,752	1.09
50	9	227,299,488	1,637,632	0.73
25	10	226,487,296	825,440	0.37
Lockage				
100	11	229,062,320	3,400,464	1.51
75	12	228,387,376	2,725,520	1.21
50	13	227,477,232	1,815,376	0.80
25	14	226,575,424	913,568	0.40
Ton-Mile				
100	15	229,060,128	3,398,272	1.51
75	16	228,271,664	2,609,808	1.16
50	17	227,405,744	1,743,888	0.77
25	18	226,538,048	876,192	0.39

fees which caused more than a 3 percent decrease of truck-barge traffic in the single unit rail modes. None of the user fees in the multiple unit rail models caused more than a 3 percent decrease of total truck-barge traffic.

Multiple unit rail pricing is the dominant transportation mechanism in the PNW and the total impact of this Staggers Act (allowed, if not induced), innovation far surpasses the impact of user fees. Introduction of multiple unit rail caused substantial changes in transportation market share distributions. Multiple unit rail captured at least 58 percent of the total market share.

The impact of user fees on the truck-barge industry was more severe when multiple unit rail rates were available, even if the magnitude was significantly less t of the multiple unit rail rates. Truck-barge market shares were reduced when multiple t unit rail became a transportation option. User fees decreased the truck-barge market share 1 percent of the total traffic share. This caused a 6 percent decline in truck-barge traffic instead of the 3 percent decline that resulted in the single unit rail models.

The uniform tax is generally preferred over the segment taxes and always preferred when both types of taxes are imposed at equal cost recovery levels. There is a trade-off between the combinations of user fee types and cost recovery levels. Some 75, 50, and 25 percent cost recovery level segment-specific user fees caused less impact than 100 and 75 percent cost recovery uniform fuel taxes. From a political viewpoint, shippers should be aware of the trade off between cost recovery levels and fee type.

The largest impact from user fees on shippers was in those areas where there were no modal market share shifts away from truck-barge. Shippers in these

TABLE 5

PACIFIC NORTHWEST TRANSPORTATION COSTS, MULTIPLE UNIT RAIL MODELS (2, 19-34)

Fee Type	Model Number	Total Cost	Dollar Change From Base Model One	Percentage Change From Base Model One
		$	$	%
Base Model Two				
0	2	216,844,832	0	0
Uniform Fuel				
100	19	217,369,232	524,400	0.24
75	20	217,240,672	395,840	0.18
50	21	217,112,976	268,144	0.12
25	22	216,982,096	137,264	0.06
Segment Fuel				
100	23	218,104,176	1,259,344	0.58
75	24	217,799,120	954,288	0.44
50	25	217,484,224	639,392	0.29
25	26	217,170,080	325,248	0.15
Lockage				
100	27	218,102,352	1,257,520	0.58
75	28	217,796,032	951,200	0.44
50	29	217,477,968	633,136	0.29
25	30	217,166,352	321,520	0.15
Ton-Mile				
100	31	218,200,304	1,355,472	0.63
75	32	217,864,352	1,019,520	0.47
50	33	217,528,400	683,568	0.32
25	34	217,191,104	346,272	0.16

areas absorbed all the user fees under the assumptions of this study. The increase in transportation charges associated with user fee imposition is modified by shippers having the ability to switch to lower cost alternative transportation modes. Thus, shippers' costs go up but not in the full magnitude of the user fee increase. As suggested earlier, multiple unit rail had more of an impact on transportation charges more than user fees did. These rail rates decreased transportation charges more than user fees increased transportation charges. The transportation charge in all the multiple unit rail models, even those with full cost recovery user fees, were less than the single unit model without user fees.

User fees had the least impact on Oregon. Redistribution of transportation market shares due to user fees occurs most often in Oregon. Transportation market share distributions in Idaho remained constant even after full cost recovery user fees were imposed. Idaho had the greatest impact from imposition of user fees. Shippers absorbed all the transportation rate increases from user fees because there were no reasonable alternatives available.

STUDY EVALUATION

To totally describe the wheat industry's movement of grain would require a complete dynamic transportation model of the PNW. The transportation model of the PNW in this study allocated traffic in a least cost manner, based on existing rates and assuming capacity and service to be similar among modes. A more complete model should contain more determining variables such as temporal constraints on modal and equipment capacity. This type of transportation model also excluded unobservable variables such as

TABLE 6

RANKING OF LEAST COST USER FEES BY FEE TYPE AND COST RECOVERY LEVEL FOR THE PNW, OREGON, IDAHO, MONTANA, AND WASHINGTON

	Rank	PNW		Oregon		Idaho		Montana		Washington	
Single Unit Rail Models	Most Desirable	Uniform Fuel	25	Uniform Fuel	25	Uniform Fuel	25	Uniform Fuel	25	Uniform Fuel	25
		Uniform Fuel	50	Lockage	25	Uniform Fuel	50	Uniform Fuel	50	Uniform Fuel	50
		Segment Fuel	25	Uniform Fuel	50	Segment Fuel	25	Segment Fuel	25	Segment Fuel	25
		Ton-Mile	25	Segment Fuel	25	Lockage	25	Ton-Mile	25	Ton-Mile	25
		Lockage	25	Ton-Mile	25	Ton-Mile	25	Lockage	25	Lockage	25
		Uniform Fuel	75	Uniform Fuel	75	Uniform Fuel	75	Uniform Fuel	75	Uniform Fuel	75
		Segment Fuel	50	Lockage	50	Segment Fuel	50	Uniform Fuel	100	Uniform Fuel	100
		Ton-Mile	50	Uniform Fuel	100	Lockage	50	Segment Fuel	50	Segment Fuel	50
		Uniform Fuel	100	Segment Fuel	50	Ton-Mile	50	Ton-Mile	50	Ton-Mile	50
		Lockage	50	Ton-Mile	50	Uniform Fuel	100	Lockage	50	Lockage	50
		Segment Fuel	75	Lockage	75	Segment Fuel	75	Segment Fuel	75	Segment Fuel	75
		Ton-Mile	75	Segment Fuel	75	Lockage	75	Ton-Mile	75	Ton-Mile	75
		Lockage	75	Lockage	100	Ton-Mile	75	Lockage	75	Lockage	75
		Segment Fuel	100	Ton-Mile	75	Segment Fuel	100	Segment Fuel	100	Segment Fuel	100
	Least Desirable	Ton-Mile	100	Segment Fuel	100	Lockage	100	Ton-Mile	100	Ton-Mile	100
		Lockage	100	Ton-Mile	100	Ton-Mile	100	Lockage	100	Lockage	100
Multible Unit Rail Models	Most Desirable	Uniform Fuel	25	Uniform Fuel	25	Uniform Fuel	25	Uniform Fuel	25	Uniform Fuel	25
		Uniform Fuel	50	Lockage	25	Univorm Fuel	50	Uniform Fuel	50	Uniform Fuel	50
		Lockage	25	Uniform Fuel	50	Lockage	25	Segment Fuel	25	Lockage	30
		Segment Fuel	25	Segment Fuel	25	Segment Fuel	25	Ton-Mile	25	Segment Fuel	25
		Ton-Mile	25	Ton-Mile	25	Ton-Mile	25	Lockage	30	Ton-Mile	25
		Uniform Fuel	75	Uniform Fuel	75	Uniform Fuel	75	Uniform Fuel	75	Uniform Fuel	75
		Uniform Fuel	100	Lockage	50	Uniform Fuel	100	Uniform Fuel	100	Uniform Fuel	100
		Lockage	50	Uniform	100	Lockage	50	Segment Fuel	50	Lockage	50
		Segment Fuel	50	Segment Fuel	50	Segment Fuel	50	Ton-Mile	50	Segment Fuel	50
		Ton-Mile	50	Ton-Mile	50	Ton-Mile	50	Lockage	50	Ton-Mile	50
		Lockage	75	Lockage	75	Lockage	75	Segment Fuel	75	Lockage	75
		Segment Fuel	75	Segment Fuel	75	Segment Fuel	75	Ton-Mile	75	Segment Fuel	75
		Ton-Mile	75	Lockage	100	Ton-Mile	75	Lockage	75	Ton-Mile	75
		Lockage	100	Ton-Mile	75	Lockage	100	Segment Fuel	100	Lockage	100
	Least Desirable	Segment Fuel	100	Segment Fuel	100	Segment Fuel	100	Ton-Mile	100	Segment Fuel	100
		Ton-Mile	100	Ton-Mile	100	Ton-Mile	100	Lockage	100	Ton-Mile	100

quality and time of service of alternative modes. Rates were used for this study rather than transportation costs. The rates were for one point in time and only reflect the structure of the transportation system at that time. Factors such as the volume of wheat moving at any given time or backhaul availability that influence the competitive structure of rates make this essentially a short-run study. The model could be taken a step further in that effects of user fees as an iterative process. As traffic leaves the river as a result of user fees, the federal expenditures on the waterway remain about the same. The smaller amount of traffic left on the waterway must pay higher user fees, causing even more traffic diversions from the waterway.

Further research could examine a broader transportation system by including waterway user fees on the commodities other than grain that move on the Columbia and Snake Waterway, and by considering highway user fees on trucks as well as deep-draft port fees. Finally, information on the competitive response of other modes to user fees would also enlighten the understanding of the PNW transportation structure.

FOOTNOTES

1 See **An Assessment of Impacts on Agriculture of the Staggers Act and Motor Carrier Act of 1980**, Office of Transportation, USDA, August 1982.

2 For a complete discussion, see Casavant, Ken L. and Jeanne Mehringer, **Impact of Alternative Levels and Structure of Waterway User Fees on Movement of Pacific Northwest Wheat**, manuscript submitted for publication as Experiment Station Bulletin, Washington State University.

3 Casavant, Ken L. and Mike Knighten, **Energy Impacts of Alternative Institutional and Policy Changes on the Pacific Northwest Wheat Transport System**. Ag. Econ. Series 81-2, Department of Agricultural Economics, Washington State University.