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The Effect of User Charges on Barge Wheat Movements
on the Mississippi River System

by

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WHEAT--TRANSPORTATION

INTRODUCTION

Throughout American history, it has been the conscious policy of the Federal government to maintain a toll-free inland waterway system. Because the rationale behind the inception of this policy - the removal of impediments to economic development - is no longer of any real significance, the issue of user charges for inland waterways has been receiving a growing amount of support. Indeed, in 1977 a different bill calling for some form of tax on inland navigation to recover the costs of the system was passed by each House of Congress. Although no action will be taken until a compromise is effected, it is quite likely that some form of charge will be imposed.

The study reported here was conducted to provide information on the impacts of user charges. Concern has been expressed by the barge industry that waterway tolls will result in the elimination of commercial river navigation. Previous studies dealing with this issue (Bunker, Thayer) have indicated that barge movements are not likely to be seriously reduced by waterway tolls. However, prior work has been somewhat limited in geographic scope. This study analyzed the effect of user charges on barge movements of wheat throughout the entire Mississippi River System.^{1/} The choice of wheat was based on the fact that this commodity moves on nearly all segments of the system.^{2/}

Nature of the Charges

There are several methods by which user fees can be collected - fuel taxes, tolls, and lockage fees being typical examples. The method of application is of little consequence; what is important is whether they are imposed on a system-wide or segment specific basis - that is, whether the level of the toll over a particular segment is based on the cost of and traffic on that segment or the system as a whole. Since costs and traffic vary widely over

segments, the method used can make a significant difference for the level of the charge and hence its impact, at least for certain rivers. Thus, the effects of both uniform fees and segment specific tolls were examined. Further, since it is likely that any user charges actually imposed will be designed only to recover operation and maintenance (O & M) costs, this is the type of charge considered here.

For 100% O & M cost recovery, imposition of uniform user charges would increase barge rates by approximately 15 to 20 percent. Rates increases for specific charges would range from 10 to in excess of 400 percent, the latter occurring when a substantial portion of a movement involves a high cost river, such as the Missouri or the Arkansas.

Research Method

The analysis was conducted using a computer transshipment model. Three models were constructed, one each for hard red winter wheat, hard red spring wheat, and soft red winter wheat. Four transportation modes were incorporated: barge, rail, truck, and lake and ocean vessels. The models were constructed so that wheat could move either (1) directly from origin to destination by rail or truck or (2) by a combination move involving barge. Non-direct movements could involve two transshipment points. This formulation permitted the modeling of a typical wheat movement involving the barge mode: from producing region to river point via rail or truck, thence via barge to another river point, and finally via rail, truck, or vessel to point of final consumption. To reduce complexity, the models did not contain a storage component, and no capacity constraints were imposed at transshipment points. In most cases this would have been meaningless, since no other grains were involved in the study and each wheat variety was examined separately.

The Data

The models were based on 142 domestic regions and twelve world regions. The domestic regions were chosen on the basis of their importance in wheat production or consumption: world regions were selected by aggregating countries with roughly equal access to ocean vessels from U.S. ports. For all domestic regions, net wheat production (negative in the case of consuming regions) was calculated using 1970 production and consumption data obtained from USDA and state sources (1970 was chosen due to the availability of detailed variety-specific wheat milling data for that year). Livestock wheat use for each region was estimated by distributing the USDA estimate of total livestock consumption among regions based on numbers of grain consuming animal units. Data on U.S. wheat exports were used to determine consumption in foreign regions.

Transportation rate and cost data for the four modes mentioned above were required. All such information was put on a mid-1975 basis, even though wheat production and consumption were based on harvest year 1970-71. This was done because it was felt that transport rate and cost relationships should be as up to date as possible, and at the time the study was conducted 1975 was the latest year for which all required information was available.

For the barge mode, rates from industry tariffs were used in the analysis. To account for the fact that barge carriage of grain is for the most part unregulated and hence not subject to specific rates, Department of Transportation figures on the deviation of actual rates from published rates (based on a 1970 study) were used as adjustment factors. In most cases, actual 1975 (ex parte 315) rail rates were used in the models. Some rates considered less critical in the analysis were obtained using an estimating equation. It should be noted that rail transit privileges (which permit the storage

and/or processing of a shipment while en route, even though the rate is quoted from point of origin to point of destination) were ignored, due to the complexity that would have been introduced into the analysis. Grain trucking costs were estimated, using a procedure very similar to one developed in a previous study at Iowa State (Baumel). The major changes involved altering costs to reflect geographic differences (this was done based on information from the ICC), and an attempt to incorporate backhauls into the calculation of grain trucking costs (the Iowa State study assumed zero backhauls). Phone conversations with officials of grain firms provided information on backhaul rates for certain areas, and these were used to alter truck cost estimates. Ocean freight rates for grain were obtained from daily ship charters published in the Journal of Commerce. All 1975 charters were compiled, and average rates from major U.S. ports (which served as transshipment points in the models) to the world regions used in the study were calculated. The few rates for Great Lakes shipping that were required were provided by grain firms. Grain loading and unloading costs by mode and by region were obtained from USDA figures.

Information required for the imposition of user charges was based on waterway cost and traffic data obtained from the Department of Transportation. Per ton mile user charges were applied to relevant barge rates, based on the distances involved. Distance and cost data were input directly into the solution program, which calculated and applied user charges.

Empirical Results

The initial run of the models involved obtaining a "base solution", i.e., with 1975 transport rates and costs and no user charges. This solution provided both a benchmark against which to evaluate subsequent solutions involving the application of user charges and also a test of the model's ability

to replicate what actually occurred in 1970. Concerning the latter, the model performed reasonably satisfactorily, with a few exceptions, one or two of which were serious. Some of this can be explained by such factors as the exclusion of a storage component and the use of 1975 rates for 1970 movements. Some perhaps reflected inadequacies in the data used; others were caused by institutional factors not modeled. On balance, however, the base solution indicated that the models were adequate for the purpose at hand (for a detailed discussion see (Binkley)).

User Charge Impacts

In order to impose some order on the presentation, the discussion of user charge impacts on barge wheat movements will be arranged by destination area. The major such areas are as follows (with approximate percent of average 1970-75 total barge wheat shipments in parentheses: Tennessee River (17%), Ohio River (2%), Upper Mississippi (4%)^{4/}, Middle Mississippi (5%), Chicago area (4%), and Gulf ports (68%). Most of this wheat originates in four general areas: the Upper Great Plains, feeding into the Upper Mississippi; the Central Plains, feeding into the Missouri and Arkansas; the Central Midwest, feeding into the Middle Mississippi, the Illinois, and the Ohio; and areas along the Lower Mississippi.

I. Shipments to the Tennessee River Area

The analysis indicated that 100% cost recovery user charges are not likely to drastically reduce the quantity of wheat moving into the Tennessee River area, although some reductions are likely to occur and the origins of some shipments are likely to change. Major results are as follows: (1) uniform charges will probably cause little if any impact: perhaps movements arising on the Ohio River would be eliminated, but these are at present relatively minor; (2) specific charges might bring about a significant reduction in

some movements. In the analysis, direct rail shipments replaced barge movements for wheat destined for off-river points, and movements destined for river milling points (such as Chattanooga) which had arisen on the Missouri River (the primary source of such wheat at present) tended to switch to Mid and Upper Mississippi origins. This, of course, represents a serious consequence for shipping on the Missouri River.

II. Shipments to the Ohio River

In the base solutions, all barge wheat movements to the Ohio River area arose on the Missouri. These were for the most part unaffected by uniform charges; specific charges brought about either replacement by rail or by barge shipments from Upper Mississippi River origins. This again indicates that specific charges could have a devastating impact on Missouri River wheat movements. It also indicates that wheat movements from the Upper Mississippi to the Ohio (which actually exist but which did not appear in initial model solutions) are not likely to be responsive to user charges.

III. Shipments to the Upper and Middle Mississippi River Areas

Most wheat moving to points of consumption along the Mississippi is destined for on-river milling points located from Minneapolis to St. Louis. The majority of this wheat also originates at points along the Mississippi. The analysis indicated that neither type of charge is likely to affect these shipments, for no response occurred in the models. However, some wheat destined for this area arises from Missouri River origins, and, in the analysis, application of segment tolls eliminated such movements and caused them to be replaced by rail (uniform charges had no effect). Again, this resulted from the dramatic effect of segment tolls on Missouri River barge rates.

IV. Shipments to Chicago

For reasons discussed elsewhere (Binkley) (and related to a problem

presented in the next section), the results of the study pertaining to Chicago-bound barge shipments are somewhat difficult to interpret. However, review of the analysis indicated that the following are likely impacts of user charges on wheat movements to this area: (1) segment tolls recovering 100% of O & M costs will eliminate or drastically reduce movements from the Missouri River to the Chicago area: uniform charges might bring about a slight reduction over the same route; (2) movements from the Mid-Mississippi or Illinois Waterway would not be seriously affected by either type of charge, since in the models such movements were either not reduced by user charges or they replaced other movements and hence increased.

V. Shipments to the Gulf

The Gulf (including the extreme lower portions of the Mississippi River itself) is by far the most important destination area for barge wheat movements. Most of these shipments are for export elevators located along the Mississippi River south from Baton Rouge; a smaller amount is barged along the Intercoastal Waterway to points as distant as Texas ports. This large export wheat movement presented a rather serious modeling problem, having to do with the hard winter wheat model. The problem relates to the port area through which hard winter wheat is exported. In reality, most of this variety is shipped through Texas Gulf ports, to which the majority moves by rail. However, insofar as the costs used in the model are concerned, it is evidently cheaper for export shipments of hard red winter wheat from many producing areas to move through ports in the Lower Mississippi area. Thus, when the models were run, barge shipments from points on the Missouri and Arkansas Rivers greatly exceeded actual shipments from these areas. Part of this discrepancy can be attributed to the failure of such factors as rail transit privileges to be incorporated into the analysis. However, there is evidence

that it may also reflect disequilibrium factors in the grain handling system. For example, the throughput rate at elevators along the Louisiana Gulf is generally two to three times that at Texas ports. This suggests some sort of capacity constraints in the former vis-a-vis the latter. In any event, this situation renders interpretation of model results somewhat difficult.

An attempt was made to deal with this problem by running two versions of the hard winter wheat model, one constrained to export via Texas and one via Louisiana. Careful review of the results of the two formulations along with knowledge of factors affecting user charge impacts provided by the study, elicits the following conclusions concerning effects of 100% O & M cost recovery user charges on hard winter wheat movements: (1) Barge shipments to Texas ports (not significant at present) will in all likelihood be eliminated; (2) Segment tolls will probably eliminate all movements from the Missouri and Arkansas Rivers to the Gulf; (3) For the same area, uniform fees are likely to eliminate any movements involving wheat not produced near river points; (4) user charges will have a serious impact on attempts to further develop navigation on the Arkansas River - segment tolls would be disastrous for this effort.

The single most important barge wheat movement on the Mississippi System is that for hard spring wheat from the Minneapolis-St. Paul area to Louisiana Gulf ports. In the analysis, user charges (of either type) recovering 100% of O & M costs had no impact on this movement. It would seem that, given present alternatives, the barge mode at present possesses a significant comparative advantage over competing modes. However, when user charges were raised to higher levels (250-300% of O & M cost recovery),^{4/} a significant impact occurred, involving a shift of a large amount of export shipments from

Gulf ports to the port of Duluth. While such a diversion is unlikely given present transport rate structures, it does suggest that user charges could serve as a catalyst to bring about rather significant changes in transport patterns if other factors (such as key rail or ocean rates) changed appropriately.

There are two other areas from which significant Gulf-bound barge wheat movements originate. These are the Lower Mississippi area (from Cairo, Illinois, south) and from points in the Central Midwest, including areas along the Mid-Mississippi. The results of the analysis indicated no response by barge shipments arising at points along the Mid-or Lower Mississippi to charges at cost levels discussed here. However, barge shipments from Midwest points along the Ohio River were responsive: the general tendency was for such shipments to transfer to East Coast ports via rail direct when user charges were imposed. This is very likely to occur in reality, for there now exist favorable unit train grain rates from many points in Indiana and Illinois to the East Coast. This suggests that a similar response is possible for shipments now moving from Illinois River points to the Gulf. Little more can be said concerning movements from such points, however, since they never appeared in the analysis, although they exist in reality.

Conclusions

From the results of this study, several conclusions emerge. These can be asserted with a fair degree of confidence, although they strictly apply only to wheat:

- 1) Movements from points on the Mississippi River to other points on the Mississippi River (including export elevators on the Louisiana Gulf) will not be affected by user charges. Further, nearly all movements arising on the Mississippi and bound for points on other rivers are not likely to respond

significantly to charges. Mississippi River barge wheat traffic might actually increase as a result of diversion of present shipments from other rivers.

2) Segment tolls would drastically reduce barge wheat traffic on the Missouri and Arkansas Rivers. Should movements of other commodities respond in a similar fashion, there is little doubt that these rivers would be closed to navigation. Uniform charges would bring about a much smaller response, and would not be likely to lead to closing of these rivers. However, even these could have a serious impact in the sense of discouraging future traffic development. This is especially pertinent to the Arkansas.

3) It is probable that either type of charge would bring about a significant reduction in barge wheat traffic from the Central Midwest (e.g., from the Ohio and perhaps the Illinois Rivers) as export movements are shifted to rail for East Coast ports.

A further intuitively appealing result emerged from the analysis: the responsiveness to user charges was less ceteris paribus, the closer producing and consuming points were to navigable waterways and the higher were competing rail rates. This serves to illustrate an important point: the effect of user charges on barge movements is very much a function of the competitive environment in which barge firms operate. Thus, the ultimate effect will clearly depend upon the response (if any) by railroads. Should railroads view the imposition of user charges as an opportunity to raise revenues by raising or lowering their rates (depending upon their view of the elasticity of demand and supply for their services), the impact of user charges could be very different than indicated by the results of this analysis, since this study was conducted with rail rates constant.

Policy Considerations

The elimination of subsidies to the barge industry through the imposition of user charges should create a more economically efficient transportation system,^{5/} and this analysis indicates that this policy is not likely to destroy the industry. However, the results reported here point out some issues that should be considered in policy formation. Segment tolls (more efficient than uniform fees) are likely to have serious impacts on shippers in certain areas, and to inhibit development of traffic on already improved rivers, with possible significant implications for the location of economic activity. Any type of charges will affect existing rate relationships and traffic distribution between modes; thus the effects of user charges (including possible responses by other modes) should be viewed in a context of over-all transportation policy. Even if the only effect of user charges were to increase barge rates, the consequences of this should be considered. Charges of the magnitude examined here would increase the cost of (for example) North Dakota wheat in New Orleans by more than one dollar a ton, and this may have adverse impacts on farm income and the quantity of U.S. wheat exports.

One final comment is in order. If policy makers are wedded to the concept of insuring that the inland waterway system generate sufficient revenue to cover operating costs, user charges could have a much more significant impact than is reported here. If 100% cost recovery user charges are imposed and if these bring about any traffic reduction (as this analysis indicates they will), then on the "next round" charges will have to be raised. This is due to the fact that costs of operating the system are virtually independent of the volume of traffic. Thus, as traffic declines, that traffic remaining must pay a larger portion of operating costs. This would necessitate a higher per unit charge, which would probably cause a further traffic decline, and so on. Clearly, this effect would likely bring about a much larger response than that reported here, perhaps to the point of closing large portions of the system.

Footnotes

- 1/ The major components of this system are the Mississippi, the Ohio, the Illinois, the Missouri, the Tennessee and the Arkansas.
- 2/ Research using the same procedure as reported herein is currently being conducted at VPI to analyze the impact on movements of corn and soybeans.
- 3/ For present purposes, the Upper Mississippi is that portion north of the Illinois mouth, the Mid-Mississippi extends from the Illinois mouth to the mouth of the Ohio, with the balance being the Lower Mississippi.
- 4/ Although not reported here, the analysis involved studying the impacts of user charges ranging from 25 to 500 percent of O & M cost recovery. For details, see (Binkley).
- 5/ Theoretical considerations of marginal cost pricing are ignored here. For a discussion of this issue, see (Shabman).

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ABSTRACT

This paper reports on a linear programming transshipment analysis of the effect of user charges on Mississippi River System barge wheat shipments. The effect of charges depends upon how waterway costs are calculated and varies by geographic region. Some policy considerations are presented.

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