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Introduction

Good afternoon, As my remarks will make clear, I am *not* an agricultural expert. I am, instead a transportation economist who deals regularly with the movement of agricultural and other dry-bulk commodities. Even, however, as a relative outsider, it seems clear that the agricultural community faces an abundance of both opportunities and challenges. Productivity or yield estimates for the coming decades indicate that the American farmer, more than ever, will be able to supply copious volumes of food to domestic markets and to the international community as a whole. On the other hand, many of us have heard compelling arguments that suggest that the ability of American agriculture to compete in international markets will depend heavily, not only on our ability to grow food, but also on our ability to efficiently move agricultural outputs from the field to export destinations. In short, if America is to retain or expand its place in world markets, it *must* simultaneously improve and expand its transportation infrastructure.

[1] While the research described herein was funded by the U.S. Army Corps of Engineers and performed by the Tennessee Valley Authority, the opinions and conclusions contained within these remarks do not necessarily reflect the position of either.

Arriving at this realization is the first and simplest step in the journey toward continued prosperity in the agricultural sector. Moving, beyond this initial awareness, however, toward an adequate assessment of transportation infrastructure capacity, future capacity needs, and the appropriate policy course is a tedious, even torturous, process that requires a great deal of input from a variety of academic and professional disciplines. Moreover, even when the best possible expertise and information are gathered together, uncertainties regarding the magnitude of expected demand and the actual cost of developing new capacity make reliable answers difficult to come by. In short, anyone who claims to *know* the correct answers is, more than likely, seeking only to further some narrow agenda and is not someone to be trusted. Having offered this warning, I'll spend the remainder of my time today discussing the issues that surround transportation capacity needs. Within this discussion, I'll provide an example of how I and my colleagues are attempting to develop information that will shed at least a little light on a few of theses issues, and finally, I will offer a few preliminary conclusions

Future Transport Capacity: Framing the Challenge

The first step in assessing available transportation capacity and determining the best possible way of providing for future transport infrastructure needs is to ask the right questions. The relevant queries actually fall into two broad groupings. The first area of interest revolves around whether or not there is sufficient competition and little enough baggage, so that we may reasonably expect freely operating transportation markets to provide us with the best available outcome. If there is effective competition within and between transport modes and if informational problems and environmental concerns are satisfied, then the need for aggresive public policy may be minimal. Alternatively, if relevant transport markets are marked by monopoly control or if externalities or other market failures are ignored, then the configuration of the transportation infrastructure that results from unfettered market interactions will almost certainly be undesirable and the public good will be ill-served by a hands-off policy.

I've studied the conditions that lead to effective transportation competition at length and have, likewise, worked to integrate environmental concerns into ongoing transport analysis, so that I am convinced that we are making progress in addressing this first set of issues. I am also firm in my belief that the level of transport competition and the determination of the appropriate public response are concerns that demand continual vigilance. This is not, however, the topic of my remarks today.

The second broad area of concern - the one that has motivated the research that I will describe momentarily - is defined by questions regarding the actual physical capacity of existing transportation infrastructures and inquiries regarding the incremental cost of expanding that capacity to meet growing transportation demands. In short, even if questions regarding the adequacy of competition are satisfied, can we build what we need at a cost that will allow us to compete in world markets or will the incremental cost of new capacity lead to increased transport rates and a diminished comparative advantage in world markets? It is a frightening question to ask, but one that demands an answer.

The Incremental Cost of Transportation Capacity

To understand the relationship between incremental capacity costs and currently observed transportation rates, we need only think back to our school days. A "C" student faced with a prospect of a "B" course grade is likely to be pleased with his accomplishment. This is true, in large part, because the inclusion of the incremental grade (course grade) into his overall GPA will produce a new and somewhat higher average. Alternatively, an "A" student who receives the same "B" is likely to be disappointed - not only because her performance was not up to usual levels, but also because the substandard incremental performance will pull *down* her aggregate GPA. Thus, we see that it is not just the cost of new capacity that matters, but the cost of that new capacity *relative* to the capacity costs already embodied in transportation rates that really matters. Still, the more cheaply we can place the additional infrastructure needed to accommodate growing demand, the more likely it is that the incremental cost will be less than currently embodied capacity costs, thereby resulting in declining transport rates.

The Upper Mississippi Basin and the Challenge of Measurement

How do we add new capacity as cheaply as possible and will the price tag be low enough? In a sense the U.S. Army Corps of Engineers' complex process for evaluating proposed navigation improvements amounts to an elaborate attempt to defensibly answer the first part of that question. The Corps assesses demand growth, then considers how that growth will impact barge operating costs and observed rates both with the proposed project and without it. In doing so the traditional assumption has been that traffic, diverted from the river, can be placed on the rail network either (1) without the addition of new railroad capacity or (2) with the addition of new capacity that can be brought on line without affecting railroad rates. Thus, the cheapest way of adding new transportation capacity (and, ultimately the criteria for judging the desirability of navigation projects) depends on whether the incremental cost of adding new navigation capacity is less than or greater than the average capacity cost already embodied in railroad (or trucking) rates.

In many settings the simplifying assumption of constant railroad capacity costs has a benign impact on the ultimate policy decision. Within the context of upper Mississippi River navigation, however, where hundreds of millions of tons of barge traffic could potentially be diverted onto the rail network each year, the assumption of constant railroad capacity costs is, at best, unnerving. Fortunately, the same Corps guidelines that impose the traditional assumption of constant railroad capacity costs also allow for an investigation of the matter if conditions are judged to warrant it. It was the Corps' conclusion that upper Mississippi navigation provides precisely the circumstances under which the validity of the traditional assumption regarding modal capacity must be investigated. The steps to be followed are quite easily enumerated -

- **Measure** the current capacity of the network of line-haul segments and terminals that constitute the nation's rail system.

- **Measure** the incremental capacity that would be needed on the various line-haul segments and at the various terminals if that network were to accommodate the traffic that currently moves on the upper reaches of the Mississippi River.

- **Measure** the least-cost method of producing that incremental railroad capacity.

The devil, of course is in the detail.

Measuring Railroad Capacity

Measuring current railroad capacity requires both a set of facilitating assumptions and a tremendous amount of data that describe the terminal facilities and line-haul route segments which, together, make up the nation's rail system. The most fundamental assumption is that the system - at some point in time - was optimally sized so that it precisely met the needs of shippers. For the purpose of our investigation, that period was judged to be 1994.[2] Accepting this assumption, the process of measuring capacity and determining the various means through which it can be expanded is relatively straight forward.

In order to measure and assess line-haul capacity, data from a variety of Geographic Information Systems (GIS) coverages were combined with data from other sources to build a set of link-specific information describing the physical characteristics of individual network segments. Next, records from the Surface Transportation Board's Carload Waybill Sample (CWS) were routed over the rail network in order to measure the volume of traffic passing over each network link. Finally, statistical models were developed that relate the observed volume of traffic over a particular route segment to the physical configuration and component quality of that segment. Not only do the models explain the relationship between components, configuration, and segment capacity, they provide a ready vehicle for identifying the various methods through which link capacity can be expanded.

Assessing terminal capacity provides an entirely different set of challenges. No two terminals are the same. Hence, the sort of cross-sectional analysis used to estimate line-haul link capacity is impossible in the case of terminal facilities. Consequently, it is necessary to undertake a painstaking investigation of every terminal at which it can be demonstrated that potential traffic diversions will add appreciable to traffic volumes. These individual analyses must include, but are not limited to: (1) an aggregate assessment of the additional traffic that will pass through the terminal in question; (2) an evaluation of the physical characteristics of the terminal location, including the identification of potential bottlenecks; (3) specific consideration of the individual

[2] 1994 was the watershed year in which historical rhetoric describing excess railroad capacity gave way to sporadic accounts of capacity constraints. Certainly, in advance of 1994 U.S. railroads were still in the process of "rationalizing" their route systems. Conversely, by 1995 most Class I carriers had expansion efforts at least in the planning stages. If there has been an equilibrium period in the past three decades, it very likely occurred in or around 1994.

railroads or combination of railroads that will be required to handle the additional traffic; (4) evaluation of the commodity mix of the additional traffic; and (5) the current potential capacities of both private and publicly owned transload facilities.

Diverting Traffic Onto the Rail Network

Once the rail network is characterized, the next task is to divert traffic from the waterway onto that rail system. Moreover, to ensure the validity of any conclusions it is critical that the diversions be as specific and as accurate as possible. In the case of the upper Mississippi study, this task was made considerably easier by rate and routing information developed as a part of the traditional shippers savings calculations. For each of the 1,331 water movements contained in the shipper savings sample, a rich set of detailed rail, rail/barge, and other land alternatives had already been identified. These alternatives include rate information, so that it is possible to identify the most likely alternative routing based on the economic criteria that would actually guide shipper decisions. It was ultimately assumed that navigation costs would increase to a level sufficient to drive all traffic from the river, so that the full 135 million tons of currently observed upper Mississippi traffic were placed onto the rail network.[3]

The Cost of Incremental Rail Capacity

Little is more frustrating for an engineer than to encounter an economist with questions about costs. In order to develop cost information that could be applied to broadly to a "typical" route segment, it was necessary to derive rule-of-thumb cost measures that are not influenced by the case-specific physical attributes that engineers typically employ to produce reliable cost estimates. We continually asked, "How much does it cost to add a mile of Centralized Traffic Control (CTC)," or "What is the cost of an additional 1,000 feet of siding." In response, our inquiries were met with questions regarding grade, soil characteristics, watersheds, and the like.

The final cost estimates used in the upper Mississippi analysis do distinguish between projects undertaken in urban versus rural settings and do discriminate between projects that utilize existing right-of-way and those that necessitate right-of-way acquisition. They even make a modest attempt to account for the regional topology that dictates the cost of establishing acceptable grades. Still, it is necessary to emphasize that these are generic cost estimates that should only be applied in circumstances where aggregation will help to mitigate the rule-of-thumb nature of their development.

Preliminary Results: The Upper Mississippi Basin

[3] The all-or-nothing diversions described above were developed specifically for this analysis and my vary substantially from the incremental traffic diversions predicted by the Corps in its traditional NED analysis.

The formal document that details the methodology and results of the upper Mississippi basin study is currently in its final development in route to internal review by the Corps of Engineers, so that it is not possible to discuss specific results, nor can I guarantee that even the general findings discussed today will survive without modification. Consequently, I would underscore once again that these are *my* preliminary conclusions based on *my* interpretation of the empirical results.

The traffic diversions developed for this analysis hold few surprises. Non-grain commodities were constrained to move over their original origin destination pairs, but these movements were allowed to select between an all land routing and a rail barge combination over the Port of St. Louis where such an alternative was deemed feasible. Export grain traffic was allowed one of four diversions that include: (1) the original origin destination pair over an all land routing; (2) a St. Louis rail/barge alternative to the original export destination; (3) an alternative all land routing to a Texas Gulf port; and (4) an alternative all land movement to the Pacific Northwest (PNW).

Of the non-grain traffic roughly one-half diverted to a an all land routing, while the remaining fifty percent diverted to a rail/barge alternative utilizing transload facilities in the St. Louis area.[4] A significant portion of export grain traffic from northwest Iowa, Northeast Nebraska and from Minnesota diverted to destinations in the PNW, while traffic from southern Nebraska, Kansas, and western Missouri diverted for export over the Texas Gulf. The remainder of the export grain traffic from eastern Iowa, eastern Missouri, and Illinois either diverted to an all land alternative to the original Gulf location or to the St. Louis rail/barge transload alternative.

The majority of affected export grain shipments originate at or near the Mississippi or Illinois Waterway. Moreover, the predicted diversion of all such traffic generally involves a railroad movement to St. Louis (if not beyond). Consequently, it is the line haul trackage between the grain gathering regions in eastern Iowa, northern Missouri, and central Illinois, along with the terminal facilities at St. Louis which pose the greatest capacity concerns

In order to assess the impact of the additional traffic on line-haul trackage a sample of 15 route segments representing 774 miles of trackage owned by the Burlington Northern-Santa Fe, Norfolk Southern, Union Pacific (including former CNW), and Canadian Pacific rail systems were analyzed. In all but two cases it was found that track capacity could be nearly doubled through signal improvements, siding extensions, or track component upgrades that would increase train speeds. Thus, it appears possible that each of the half-dozen or so routes between the affected grain loading areas and St. Louis could accommodate as much as an additional 10 million tons of revenue traffic each year without requiring the sort of track modifications that that would appreciably increase the cost of providing rail service.

Diverted traffic would impose additional demands on rail terminal facilities at Omaha, Council Bluffs, Lincoln, Kansas City, North Platte, Houston, and a variety of other locations. However, relative to the traffic that already moves over these points, the additional demands would be quite modest. Our analysis suggests that it is only the capacity of the terminal facilities in the St. Louis area that is of any real concern. The

[4] This includes facilities in Missouri at St. Louis, Jefferson Barracks, and St. Charles, as well as locations in Illinois at Cahokia, East St. Louis, Wood River, Hartford, Granite City, and Alton.

amount of additional rail traffic for the St. Louis area could be significant, amounting, perhaps, to an additional 50 or more unit trains per day. We have developed no information that suggests that Class I carriers would have little difficulty accommodating the additional traffic. However, experts familiar with the area have expressed concern regarding the ability of the two belt or transfer railroads to handle additional interchange or terminating traffic and there is specific concern regarding the capacity of the two railroad bridges spanning the Mississippi which handle the traffic that would necessarily pass between Illinois and Missouri.

Also, the significant amount of grain traffic that is estimated to divert to a rail/barge movement with a transload at St. Louis has raised questions regarding the capacity of the grain handling facilities there. Currently, these facilities handle an amount of grain that is roughly double the volume expected to divert to the rail barge alterntive, so that, all else equal, the projected diversions would imply a 50% increase in the magnitude of grain handling activities in the area. Without some alteration of the status quo, this could, in turn, mean a need for expanded grain handling capacity and the additional expense that would imply. It is our judgment, however, that the additional grain rail traffic destined for transload at St. Louis would, in fact, drive shipments that are currently trucked into the area to transload locations further to the south.[5] Thus, it appears likely that the additional rail traffic would simply replace extant truck traffic without appreciably increasing the total tonnage loaded to barge.

In summary, any policy alternative that significantly increases the costs of navigation on the upper reaches of the Mississippi River would simultaneously force an accelerated expansion of railroad capacity in the region directly above and including St. Louis. It is our judgment, however, that this capacity could be added through modifications to existing infrastructure that would not, by themselves, necessitate an increase in railroad rates. Thus, the Corps' traditional assumption, whereby, railroad capacity costs are assumed to be constant is valid in this instance.

Concluding Remarks

Rail industry advocates who blithely suggest that that Class I carriers currently possess all the capacity they need to accommodate any foreseeable volume of traffic are discredited by the variety of currently observable railroad efforts to expand system capacity both through line-haul trackage modifications and through the reconfiguration, expansion, or simple avoidance of terminal facilities.[6] There is very little question that, if current trends persist and projections are realized, ever greater expansions in rail capacity will be necessary. The more pertinent questions are whether there will be sufficient competition to produce the market signals needed to bring about the optimal levels of

[5] There is already evidence that Paducah is emerging as an alternative trnasload location for truck shipments bound for barge.

[6] Consider for example, Burlington Northern - Santa Fe's resurrection of the route across the Stampede Pass, UP triple tracking in the Powder River Basin, CSX plans to route traffic around Queensgate Yard in Cincinnati, or the myriad smaller projects evident throughout the United States.

new rail capacity and whether the incremental cost of that new capacity will increase or decrease the cost of providing railroad services.

The research I've described today was designed to provide some evidence regarding the latter of these two questions - at least with respect to the upper Mississippi River basin. Our goal was ambitious, our methods were novel, and our results are, by all means, tentative. Still, it appears, at least in this isolated setting, that those railroads that would be expected to accommodate traffic diverted away from the upper Mississippi River could do so through capacity-enhancing measures that would not add appreciably to railroad costs.

No one, however, should confuse this conclusion with an endorsement of any policy that would lead to such diversions. Quite to the contrary, it is my personal opinion and professional judgment that commercial inland navigation provides (and should continue to provide) a number of critical economic benefits. First, there are myriad movements of innumerable commodities for which barge transportation provides the least costly transport alternative. This is true even when the full rage of both private and public costs are taken into account. Thus, the economic savings that result from the utilization of barge transport represent a net welfare gain that would be lost to Americans if commercial navigation is left unsupported. Moreover, there is mounting evidence that the pollution abatement associated with barge transport may play a critical role in our ability to efficiently provide transportation and simultaneously attain ever more stringent air quality standards.[7] Finally, barge transport provides an important source of competition to rail carriers in a variety of transportation markets. Again, the ultimate desirability of market driven outcomes depends on the presence of effective competition. Without the disciplining presence of a waterborne alternative, we must seriously question whether unregulated competition can survive as an adequate alternative to a policy of more direct governmental oversight.

Thank you very much.

[7] While it has yet to be empirically demonstrated, we believe the pollution abatement advantages offered by commercial navigation will persist even in the wake of the recently announced emission standards for railroad locomotives.