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DEREGULATION AND CONTESTABILITY IN GRAIN TRANSPORT

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Abstract

In this paper, the effectiveness of deregulation in encouraging efficiency improvements in grain transport is questioned. In a deregulated system, rail freight prices will be based on road rates, but the structure of the industry implies that road transport cannot compete with rail in areas where they are most efficient.

A model of investment in rail network is presented and it is shown that economies of traffic density give rail monopoly power, which allow it to cross subsidise inefficient lightly trafficked operations. A privately owned rail company will invest in in socially optimal rail track, and make a profit. In contrast, a regulated monopoly which operates subject to break even constraint will over invest in rail track.

Introduction

In the late 1980's a Royal Commission was conducted into the handling, storage and transport of the Australian grain harvest, which looked at the effect of government regulation on the efficiency of the grain distribution system. Studies undertaken during the Royal Commission indicated that large cost savings would be realised in a more competitive environment (Royal Commission into Grain Storage, Handling and Transport 1988a). Savings in transport costs were a large component of the anticipated savings. Following the recommendations of the Royal Commission, Commonwealth and State Governments have taken measures to remove regulation in grain transport. In particular, the restrictions on road movement of grain have been removed, allowing more competition between the road and rail sectors.

In this paper, the effectiveness of deregulation in encouraging efficiency savings in grain transport is questioned. In particular, the optimal share of road and rail transport is examined from the perspective of economies of traffic density. A simple model is used to show how the rail industry has a spatial monopoly over the inner sector of any long haul journey. This means that "competitive" pricing polices adopted by the railway (where price is determined by the cost of alternative road transport for the entire journey) will result in cross-subsidisation and inefficient over-investment in rail infrastructure.

Other issues relating to road/rail competition and optimal transport infrastructure are also discussed. Results of a case study of some branch lines in Western Australia are presented. It is shown that inefficient branch lines will continue to be maintained under the "competitive" freight pricing structures adopted by the rail authority. The efficiency costs of this system are large but could be overcome with alternative institutional arrangements, such as privatisation of the grain rail freight industry.

Railway Pricing Issues

Most studies of grain distribution costs have been based on systems analysis which consider the first best grain paths from farms to the port, based upon resource costs. For example, studies conducted at the time of the Royal Commission compared the grain flows that would minimise resource costs with the grain flows that occurred when historical regulations were present (MacAulay, Batterham and Fisher (1988), Blyth, Noble and Mayers (1987)). This approach was also used by Brennan (1990), and Brindal and Dumas (1987) who recommended abandonment of certain branch lines in Western Australia. However, these approaches have failed to take into account the second best pricing practises adopted by the grain freight industry. Faced with incorrect price signals, farmers never make grain delivery decisions that are based on the resource cost of services, so the "first best" solutions predicted by most modelling work are unattainable.

Second best pricing problems arise because of the nature of costs in the railroad industry. Railroads represent a classic multi product natural monopoly, with large fixed costs, in particular the costs of maintaining the rail network, which are shared over a number of different rail services. Marginal cost pricing would lead to losses by the firm, and there is a vast literature on second best Ramsey pricing rules which enable natural monopolist to recover fixed costs, recouping a larger premium above marginal cost on services that have a more inelastic demand (eg. Sharkey 1982).

Baumol (1982) argued that a natural monopoly would provide socially optimal second best pricing rules provided the market was perfectly contestable. In a contestable market, excess profits are competed away by fly-by-night firms who can enter the industry, erode profits and leave costlessly. Baumol's efficiency conditions do not apply to railroads which have high sunk costs associated with rail line infrastructure. When there are high fixed costs, Faulhaber's (1975) cross-subsidy test for regulated monopolies is applicable. In a regulated monopoly, we can be sure that no cross-subsidy is evident provided that the price charged for any service covers the incremental costs of providing the service and is never higher than the "stand alone" cost of providing the service (Faulhaber 1975).

In a deregulated system, where restrictions on road movement of grain are removed, the competition provided by road places a limit on the price that can be charged by rail companies. Pricing practises based on competitive road rates had been adopted in several states even prior to deregulation (Royal Commission into Grain Storage 1988b).

At first glance, it might appear that a rail pricing policy based on road rating passes Faulhaber's classic stand alone test. This is because the operating cost of rail transport is always less than the operating cost of road transport[1]. No one on the rail line can complain about the pricing policy because the rail (equals road) price is always above train operating costs, and is never above the cost of the alternative mode (road). This was the approach recently taken in a recent study which concluded that all branch lines in Western Australia were viable (Department of Transport 1994). However, this view is based on the erroneous assumption that the fixed costs of rail infrastructure are joint costs that should be shared between users.

In the following, a model of optimal investment in rail infrastructure is presented. When the provision of rail track is viewed as a marginal investment decision, which must be made in the presence of an alternative transport mode, it is seen that fixed rail costs are not joint costs that should be shared across all users of the rail system. In these circumstances, Faulhaber's cross-subsidy test cannot reveal the inefficiencies associated with current pricing practises in the grain freight industry.

It is shown that there is an optimal length of service that should be provided by a rail sector, and if a road freight pricing policy is used, a private rail industry will always

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[1] In fact, on some branch lines train operating costs can be as high as road costs. However, the cost of operating trains over the entire long-haul journey to the port is always less than the cost of road transport.

operate at a profit. This is because economies of traffic density provide monopoly power to the rail industry. It also implies that a rail industry which operates subject to a break even constraint will over-invest in rail infrastructure, because inefficient lightly trafficked rail lines can be cross subsidised by the profits earned on the heavily trafficked lines.

Optimal Transport Infrastructure

In this simple example, it is assumed that there is a large sparsely populated producing region which produces a commodity which is exported through a single port. The model is designed to determine the optimal size of rail infrastructure and the optimal balance between the rail and road sectors.

The main purpose of this example is to demonstrate the economics of lightly trafficked transport segments, and some simplifying assumptions are made. It is assumed that the grain collection area is a rectangle, and the long haul freight task is carried along a line that passes down the middle of the region, from outlying areas to the port. The grain that is produced in the region is transported to this long haul line (which might be a rail track or a road).The amount of grain delivered from farms to any point on the track is described by a density a (t/km of track).

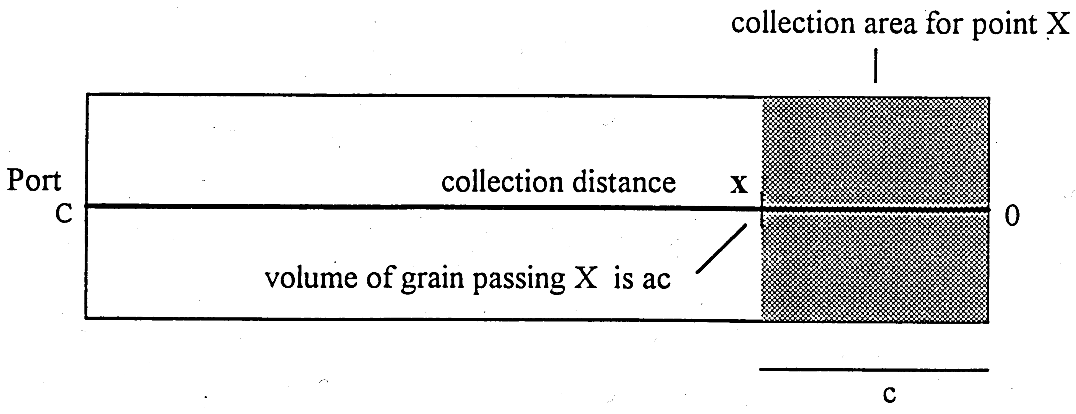

Figure 1: The Long Haul Task

The grain collection area has a total length C, as denoted in Figure 1. In order to describe the cumulative effect of traffic density, the collection length c is described with the farthest point in the region equal to zero, with the collection length increasing at sites situated at points closer to the port. This allows the volume of grain passing over any point on the collection line to be described by $a.c$. For example, in the figure the volume of grain passing through the point X will be the volume collected over the shaded area, equal to $a.c$. The total volume of grain arriving at the port is $a.C$. The variable cost of rail transport (per tonne kilometre) is denoted by t, and is always less than the cost of road transport, which is denoted by r[2].

The cost of transporting grain between two adjacent points on the line depend upon the volume of grain passing through the points, and the per unit (tkm) cost of transport. For example the cost of transport by train between two adjacent points can be described by:

(1) Var. Train Cost = volume x transport cost per tonne = $(a.c).t.\Delta c$

Rail is constructed from the port towards the hinterland. The volume of grain transported on the kilometre of rail that is joined to the port is a.C. As we increase the length of the rail track by extending it towards the hinterland, the traffic volume on the marginal unit of track declines, because the collection length decreases. In other words, less has been accumulated. Since rail track has high fixed costs but lowers the operating cost of transport, the marginal benefits of investing in rail track will decline traffic volume decreases.

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[2] In this simple example, the emphasis is on the economics of long hauls and constant average costs of transport are assumed. In fact, the higher fixed costs of train operations make short haul journeys relatively costly compared to road, and mean that road transport has a competitive fringe in areas close to the port.

The total costs of transport depend on the length of rail track (l), the operating costs of road and rail, fixed costs and the pattern of grain accumulation. Total costs are:

$$(2) \qquad \int_{0}^{C-l} r.a.cdc + \int_{C-l}^{C} t.a.cdc + F.l$$

We can determine the optimal length of track by differentiating the above with respect to l, subject to an additional non-negativity constraint.

The first order conditions give the following investment rules for rail track.

(3a) if $(r-t)a.C < F$ then l=0

This first condition shows that it is not worth building any rail track if the costs of track maintenance are higher than the marginal saving in operating cost achieved by substituting road for rail.

(3b) otherwise $l = C - \dfrac{F}{(r-t)a}$

If track maintenance costs are lower it is worth investing in track. The optimal length of track is inversely related to the ratio of fixed costs per kilometre and the saving in operating costs on the marginal unit of track. Moving from the outer region towards the port, there is a certain amount of haul that must be carried out by road, because the low cumulative density in this area does not justify the fixed costs of rail track. Beyond some minimum collection length (defined by the second right hand side term in Equation 3b), the volume of grain collected is high enough to justify the construction of rail track. A longer rail track will be built when the collection area is longer and when fixed costs of maintenance are low. Higher road costs relative to rail, and a higher density of production will also justify a longer rail track.

This representation of costs focuses the marginal cost of building rail track and can be further demonstrated in Figure 2. In this figure the cost of carrying out the transport task by road and by rail are compared, as a function of distance from the port. The rail cost line shows the marginal cost per kilometre of undertaking the transport task by rail. It is the *total transport cost per kilometre* that is imposed on the rail authority if it has the responsibility of providing that kilometre of service. It depends on the total volume of grain hauled over that kilometre, and is a declining function of distance from the port because traffic volume decreases. The road transport line shows the marginal cost per kilometre associated with using road transport. These lines are linear in this example because of the assumption that the density of grain production along the line is constant.

The trade off between road and rail can be seen in this diagram. Starting from the right hand side of the diagram and moving towards the port, per kilometre costs of transport increase because traffic volume increases. When traffic volumes are low, the per kilometre cost of rail is higher than the per kilometre cost of road because rail has high fixed costs. As we move closer to the port and accumulate more grain, the per kilometre cost of transport increases at a faster rate for road transport, because per tonne kilometre operating costs are higher. The optimal combination of road and rail transport can be seen from the figure, where rail is the cheaper option closer to the port where traffic volume is higher.

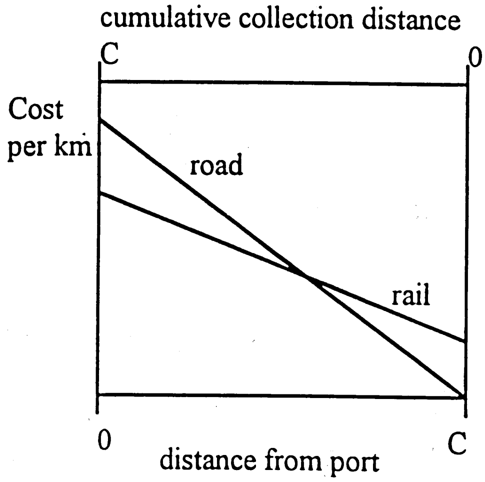

Figure 2: Marginal (per kilometre) Cost of Transport

Cost Recovery

The rail industry has an operating cost advantage over road for the area serviced by the rail line (t<r), but it must raise price above operating costs in order to recover fixed costs. The maximum price that the railway can charge is the cost of transporting the grain by road to the port. It is assumed that rail transport carries all the grain over the part of the journey where it is established, so the road cost line shown in Figure 2 describes the marginal revenue associated with providing an extra kilometre of rail service. The profit made by the railway is equal to the area between the marginal revenue and rail cost curves and can be seen on Figure 3. The profit maximising rail authority will choose the length of rail track l* which corresponds to the social cost minimising length. Positive profit occurs because of the cost advantage of rail, which allows prices to be set above operating costs.

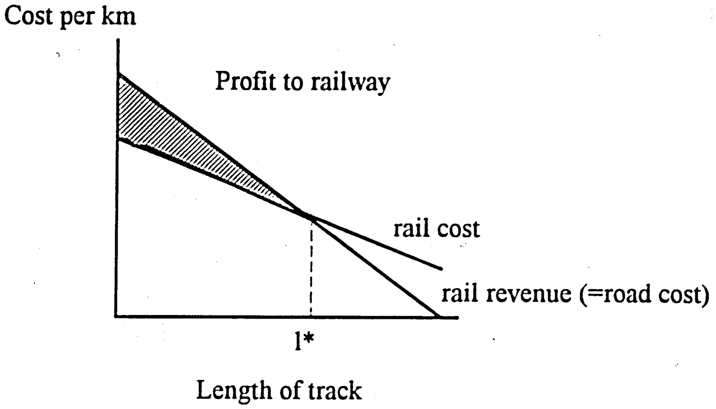

Figure 3: Optimal Track for a Profit Maximising Railway

The Regulated Monopoly

Government railways often operate with non-commercial objectives, for example "maintaining a level of service", which can involve disallowing the abandonment of uneconomic branch lines (Harris 1977). Thus, decisions about rail infrastructure are not subject to profit incentives, although regulated monopolies are usually required to satisfy a break even constraint.

From the revenue-cost diagram shown in Figure 4, it can be seen that the rail industry could expand its service beyond l* if it was only subject to a break even constraint. Profits made on earlier parts of the journey would cross subsidise the losses made on the lightly trafficked sections and allow the rail authority to compete with road where road was the most efficient alternative.

In this simple example, the rail length chosen by the break even firm will always be greater than the socially optimal length and can be described by:

$$(4) \qquad \text{Min}\ (C,\ 2C - \frac{2F}{(r-t).a})$$

Depending on the relative costs of road and rail, the rail authority could satisfy the entire transport demand, and operate at a profit (Figure 4a), or share some of the task with road and break even (Figure 4b, where l* is optimal track length).

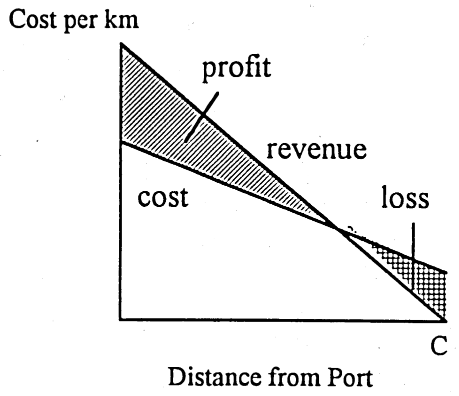

Figure 4a: Rail Monopoly supplies all transport requirements

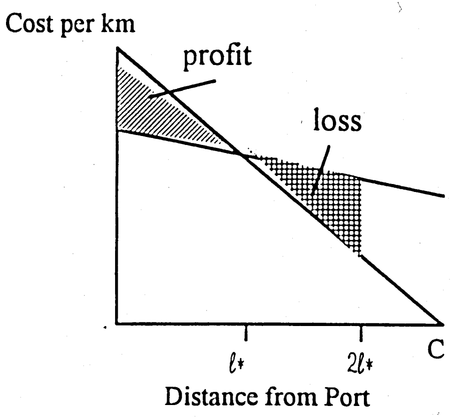

Figure 4b: Rail Monopoly shares task with road

Discussion

Joint Costs

In this analysis, it was shown how cost minimising investment decisions on rail track are made. Marginal investment decisions for a extra unit of rail track depend on traffic volume over that marginal unit. Rail is only constructed where it has a cost advantage, and all grain travelling over the region serviced by the rail line is hauled by rail. The volume of grain traffic passing any point on the track is independent of the existence of rail track beyond it (towards the hinterland). The same volume of grain would be flowing through any point on the track regardless of whether the grain was collected from more distant areas by road or rail. Thus the entire length of the rail track should not be considered as a joint cost, and grain originating from points closer to the port have no "responsibility" for the maintenance of track at more distant sites. This situation arises because of the presence of an alternative mode of transport, and implies that Faulhaber cross-subsidy test is not relevant.

The ability for the rail industry to cross subsidise its operations arises because of "spatial" monopoly power. It has a captive market for all grain going to the port because it provides the least cost option over the segment of the journey that is adjacent to the port. This means that it can always undercut the road freight industry over this section, and competitive (road based) pricing results in profits that can be used to subsidise inefficient sections. The structure of the industry allows the bundling of inefficient and efficient services and this protects the rail industry from competition in a deregulated environment. This point is illustrated further below, when a case study of the costs of low density branch lines in Western Australia are presented.

Competition from other Rail Companies

This analysis has focused on competition between road and rail. However, Quiggin and Fisher (1988) suggest that since the purchase of mobile capital stock associated with rail transport will have low sunk costs, the operation of rail transport services, given the rail network, is likely to be contestable. Thus in a deregulated system competition could be provided by neighbouring state rail authorities or by private transport companies who own their own rail fleets.

However, the extent to which alternative rail operators can compete with the state rail authority will depend largely on the policy used to price rail network services. If the incumbent rail companies retain ownership of the network, they will retain all price setting power, because of the price they set for rail network services. The limit on the price that can be charged for rail network services is the road rate less the cost of operating trains. Because of the high sunk costs of the rail network, the rival firms could not contest the rail network, and must pay the charge that the incumbent sets. It is possible that the incumbent will erode efficiency gains by raising the price of network services, or could even price rival firms out of the market.

Other Issues Affecting Rail Network Investment

In the simple model presented here, it was argued that the significant economies of density available to the rail industry result in a "spatial monopoly" which prohibits road transport from competing over sectors where it is more efficient. There are other factors which further complicate the rail/road competition issue. First, the rail network issue is really two dimensional, and involves a more complicated system of branched networks. While this would complicate the representation of optimal rail infrastructure decisions, it is clear that the cumulative effect of traffic density will still hold. Second, the costs of operating trains are also a function of traffic density, with trains on branch lines having higher operating costs than the trains on main lines (Brennan 1990). This aspect of economies of density has also been noted by Harris (1977) who found that two thirds of the economies of density were the result of operating cost savings. These factors make the analysis of the issue more complex, however the main point illustrated in the simple model still hold- ie. that the cumulative effect of grain collection results in a spatial monopoly and limits road competition.

An additional issue with road/rail competition and branch line closure is that some railways base their freight rates on radial distance, rather than road distance. Because the "as the crow flies" distance will always be less than the road distance, rail freight pricing should always have a competitive advantage over road transport. This can further mask the cost of operating branch line services and encourages the maintenance of inefficient low density rail lines. This is demonstrated below in the examination of the operation of two branch lines in WA.

Branch Line Abandonment in Western Australia

In this section, the results of a case study of two branch lines in Western Australia are presented. The branch lines feed into the standard gauge rail line at Merredin, which is 330km from the port and is situated on a standard gauge main line.

Costs Used in Analysis

The operating costs of transporting grain from each branch line site to Merredin was taken from Brennan (1990). In this study, the costs of rail transport specific to each site were calculated on the basis of estimates of train operating parameters such as train configuration and size, travelling speeds and train loading rates.

The Merredin to Port segment of the journey involves large trains which travel at high speeds, and train operating costs are only $6.25 per tonne for a 330km journey. This is much lower than the cost of road transport from Merredin to the port (about $20/t). Trains used on the branch line journey have higher operating costs because track characteristics limit train configuration and travelling speeds. Traffic on the branch lines is predominantly grain, and traffic density is low, ranging between 1000t/km and 1500t/km for the different branch lines. In contrast, traffic density on the Merredin to Port journey is higher because this main line carries other freight (it links interstate rail), and because of the cumulative effect of grain traffic which comes from other branch lines and directly from farms.

Road costs used in this analysis were also obtained from the same source, and include the cost of road damage. The issue of road- rail competition is complicated by the external cost of road damage, which implies that the social cost of road transport is not reflected in user charges. The prices set by the rail authority are based on financial costs of road transport, and this means that the monopoly power afforded to them is less than it would be if charges reflected the user cost of road transport. The problems of pricing for road damage are not addressed here, because the distortions created by road rate pricing by the rail sector far outweigh the distortions created by the external cost of road damage. This can be seen in Table 1.

The Benefits of Abandonment

The resource costs associated with continued operation of the two branch lines were compared with an alternative which involved road transport from branch line sites to Merredin. Regardless of how grain is transported to Merredin, it is carried by standard gauge trains to the port, so this analysis only compares the costs of getting the grain to Merredin. Results are shown in Table 1. It can be seen that after track maintenance costs are taken into account, the costs of operating the branch line service are about double that of the road transport option for both branch lines.

Table 1: Benefits of Branch Line Abandonment

	Branch Line	Road
Trayning Branch Line		
Operating $m	0.27	0.32
Road Damage $m		0.06
Track Maintenance $m	0.63	
Total Cost $m	0.89	0.38
Saving From Closure $m		0.52
Kondinin Branch Line		
Operating $m	1.33	1.12
Road Damage $m		0.28
Track Maintenance $m	1.21	
Total Cost $m	2.55	1.40
Saving From Closure $m		1.15

As illustrated in the theoretical model presented above, there is no market mechanism to encourage these efficiency savings to be realised. Transport charges are set equal to the road rate over the entire journey, and road is not competitive over the entire journey. Enormous profits made on the main line service help to subsidise the inefficient branch lines. Road transport operators could only compete for the segment of the journey where they have lower costs, if the price of branch line services were separated from the price of main line services to the port.

The competitiveness of road transport is undermined further by the radial rating system adopted by Westrail. Freight rates are set according to the radial distance from the port, which means that the freight rates are actually lower than the Merredin rate for some branch lines site. The "perceived" cost of abandoning the branch lines the extra cost that would be transferred to farmers (under the current pricing system) if branch line services were discontinued and grain was delivered by road to Merredin. The perceived cost is the cost of transporting by road to Merredin plus the change in the rail freight rate (the Merredin rate minus the branch line rate). It can be seen that in all cases market signals shows that branch line abandonment will increase costs, contrary to the analysis of resource costs presented in Table 2.

Table 2: Comparison of Freight Rates for Branch Line Sites and Merredin Rate

	Freight Rate	Difference	Road Cost to Merredin	Perceived Cost of Abandonment
Merredin to Port	19.52			
Sites (to Port)				
Trayning	18.17	-1.35	5.88	7.23
Kununoppin	18.92	-0.6	3.87	4.47
Nungarin	19.44	-0.08	2.95	3.03
Nukarni	19.56	0.04	2.42	2.38
Kondinin	18.59	-0.93	8.45	1.38
Bendering	18.75	-0.77	7.67	8.44
South Kumimin	18.91	-0.61	6.18	6.79
Narembeen	19.34	-0.18	4.94	5.12
Mt Walker	21.14	1.62	7.02	5.40
Wogarl	19.99	0.47	4.36	3.89
Muntadgin	20.25	0.73	3.84	3.11
Holleton	22.29	2.77	7.87	5.10
Koonadgin	20.25	0.73	3	2.27

Conclusion

The benefits of deregulation in encouraging cost savings in grain transport may be limited. This is because the rail industry has a captive monopoly over the part of the transport journey that is adjacent to the port. Even though road transport may be competitive at outlying fringes due to low traffic volumes, all grain must pass through the area over which rail has monopoly pricing power. The bundling of an efficient and inefficient services permits cross subsidisation and over investment in rail infrastructure.

Rail monopolies providing a transport service like the one illustrated in this paper should make a profit if they are operating efficiently. Break even constraints on regulated monopolies will mean that inefficient low density track will be maintained, resulting in deadweight losses. An example of two inefficient branch lines in Western Australia which cost twice as much as the alternative road transport was shown. Simple observation can also support this finding. The industry has been deregulated for five years, yet these branch lines continue to be maintained. There are no pricing signals in the current system to direct grain flow through the least cost combination of transport modes.

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