V. Economic Impacts

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INTRODUCTION

Objectives

The economic impact analysis section of this report examines the effect that development of coal slurry pipelines could have upon related areas of the economy. The most direct effect would be upon the railroad industry, its employees, suppliers, and customers. Many segments of the railroad industry have encountered financial difficulties in recent decades. The industry has tended to view the current emphasis on coal to be the Nation's primary fuel as an opportunity to regain a measure of financial stability, Coal's physical properties, the large quantities involved, and the long transportation distances without significant waterways for western coal favor railroads against their traditional competitors — barge and truck transportation. However, the primary railroad beneficiaries of the projected increase in coal transportation are certain western railroads that have on the average achieved better financial performance than most of the industry. Railroad industry employees will be directly affected by any development that reduces the industry's volume of business or forces it to modify its methods of operation. The principal supplier industries that would be affected are those that manufacture locomotives, freight cars, and track. Indirect effects would then be felt in the industries supplying the suppliers, principally steel manufacturers.

The railroad customers most likely to switch to pipeline are the large electric utilities that, by themselves or with a few others, can generate sufficient coal demand to achieve pipeline economies of scale. Some other shipments, including those of smaller utilities, farm products, stone and minerals, etc., will tend to encounter higher costs if their shipping charges must cover a larger fraction of the rail road's fixed costs as a result of a reduced rail business volume and downward pressure on some coal rates. Determination of the magnitude of the coal-related fixed cost was one of the principal goals of this study because its al location largely determines where the important economic impacts fall –regionally and by type of consumer— and the size of these impacts.

A second set of economic impacts can be grouped within the category of regional effects. Slurry pipelines consume large quantities of water, and, owing to the geographic location of coal, most of the pipelines originate in somewhat arid regions. Other water users in these regions, primarily agriculture, may be directly affected through any future water scarcity, The environmental implications of pipeline-related water shortages are discussed in chapter VI This chapter examines the economic implications of potential water shortages, Such shortages could affect not only the agricultural sector, but other sectors of regional economies as well, since water availability is an important factor in the location of some industrial activities. A second aspect of regional development to be examined is the payment of State and local taxes. Railroads have been a significant source of revenues in some States, and it is therefore important to appraise the net effect upon regional tax revenues of shifting some coal traffic from railroads to pipelines. A third regional aspect is that the benefits of pipelines may accrue to one area of the country, while the costs are borne in another region. A simple illustration of this possibility is as follows:

1, the projection of future coal movements in chapter IV identified Texas as the recipient of large volumes of coal;

2. if pipelines **are more economic for the Texas coal shipments, the consuming public** in Texas could receive lower rates for their electricity if pipelines are employed;
3. the railroads that lose these coal shipments may need to transfer some of their fixed costs onto other shippers;
4. other major shippers include those shipping grain and beef to the Midwest; thus
5. consumers in the Midwest (and East) may have to pay somewhat higher prices for food products.

It should be noted that this type of regional tradeoff occurs in nearly every regional transfer, e.g., oil and natural gas pipelines going from Texas to other parts of the country, This section attempts to quantify the magnitude of pipeline-related transfers.

The discussion thus far has focused upon the generally adverse impacts pipeline development will have upon the railroads and related industries. Pipelines are obviously a source of economic stimulus, and as such will generate their own set of economic benefits. It was the goal of this study to analyze the net economic impact of pipeline development (benefits minus costs), and to indicate where, and to what extent, each benefit and cost occurs. The principal economic benefit offered by pipelines is that they may more cheaply transport some large volume movements of coal from, for example, origins in the sparsely populated and lightly industrialized West to centers of population and industry in the Midwest, South, and Far West. Our Nation's fuel supply will be increasingly composed of coal, and a significant reduction in the cost of transport would therefore reduce the economic dislocations of a forced switching from oil and gas to coal, In addition, since pipelines are highly capital intensive, the investments associated with them could provide an important near-term economic stimulus to the economy in the form of materials purchases and construction labor employment in some localities.

The following discussion should be read with an understanding of the uncertainty associated with projecting present economic trends into the distant future. Major events could substantially violate the assumptions on which the analysis is based. One example would be a change **in the railroad regulatory environment, resulting from the Rail Revitalization and Regulatory Reform Act or related future legislation. Another example** would be any form of substantial public investment to aid the railroad industry.

Another significant uncertainty involves economies of scale associated with the extent of railroad service. Past experience is not a particularly useful guide for predicting railroad capital and operating cost relationships if the size of the industry is to be radically different from what it has been in recent history, The analysis presented here suggests that marginal costs decline as service expands. If marginal costs increase with expansion of coal unit train operation, the impacts of coal slurry pipeline development would probably be favorable both to the railroad industry and to the shippers of commodities other than coal by rail.

Methodology

The primary focus of the study was the rail road industry because, other than water resources and their allocation, nearly all other economic impacts have their origin within that industry. The central question is: "If railroads lose the revenues associated with a significant number of large-volume coal movements, how will they reallocate their fixed costs among the remaining shippers?" **In order to address this question, it was necessary to project both future revenues to the railroads from all commodities they transport, and the costs of transport as a function of traffic volume. It is not possible to evaluate the implications of railroads losing a large fraction of their coal revenues without knowing the nature of their remaining business volume. Projections of revenues were made** for 10 major railroad shipment categories and for an *all other* category over the 25-year period from 1975 to 2000.

Likewise, cost projections were made for the same period for three operating expenditure categories, for capital investment in rolling stock and way and structures, and for payroll, State, and local taxes. All projections were broken out into the three railroad regions (or districts)–Eastern, Southern, and Western–because the impacts of coal slurry pipelines are centered in the Western and Southern regions, even though the vast majority of rail road coal transportation is current I y located in the Eastern region.

The entire study was carried out in constant 1971 dollars. This is the base year for the input-output model employed to project national railroad revenues by commodity category between 1975 and 2000. Though 1971 dollars are used, a number of adjustments have been made to reflect real changes in the structure of prices since 1971, such as changing real wage rates and energy prices. As a result, though the study is in 1971 dollars, percentage relationships between major variables are those expected to pertain in the future.

A no-pipeline baseline and two pipeline-development scenarios were evaluated in order to assess the economic impacts associated with varying levels of market penetration by the coal slurry pipelines. The baseline, which served as a point of departure, assumes that no additional coal slurry pipelines will be built. The first pipeline seen a rio, termed the Lost Rail Tonnage scenario, assumes that pipelines will take over the coal-traffic Identified in table 9 of chapter IV. The second scenario, termed the Competitive Rate scenario, postulates that not only r-nay pipelines take over on certain routes, but also that the competitive market pressure of pipelines may force railroads to lower their rates on a set of additional routes. The latter scenario yields qualitatively similar results to the former and is therefore presented in Volume I I

Five cost/price alternatives were evaluated for the baseline **and the two pipeline** scenarios. These five alternatives reflect different assumptions regarding the ratesetting behavior of railroads and the Interstate Commerce Commission (ICC) as well as the relative fuel costs over the forecast periods. Alternative I assumes that the unit charges for railroad service in each region and commodity category will remain at their 1971 levels, and that the cost structure will basically retain its 1971 form, with adjustments for labor real wage and productivity changes. Alternative I I seeks to embody the effect of recent increases in the relative costs of fuel by introducing a one-time approximate doubling of relative fuel costs to simulate the effect of the 1973-74 energy crisis, and by increasing the relative price of fuel 1.5 percent more rapidly than general inflation for the years 1985 to 2000. Alternative III retains the fuel adjustment on the cost side, and assumes that rail revenues per ton-mile will continue to be reduced at their historic rate as a result of railroads passing forward productivity gains for competitive reasons. Alternative IV also retains the fuel cost adjustment, but assumes that revenues will bear a constant relationship to operating expenditures, determined by setting the operating expenditures-to-revenue ratio at 0.8. (A review of historical data indicated that the operating ratio has held reasonably constant near this value over the period 1969 -75.) Alternative V was developed only for the West. It retains the fuel cost adjustment, and changes revenues to satisfy the “Minimum Necessary Net Income” (MNNI) for railroad solvency and investment requirements.

The methodology employed is explained in detail in Volume I I of this report. Briefly, projections for national rail revenues were obtained by aggregating into 10 major categories and an “all other” group the more detailed output and transport by modal share forecasts from an input-output based transportation model. Regional shares of rail revenues from each commodity were projected by using equations obtained by regression analysis of historical data. The coal revenue forecasts were made separately in view of their importance to this

'A 4.8 million ton per year coal slurry pipeline is currently operational in Arizona, and a smaller pipeline is on standby in Ohio study. (For coal, the latest Department of Energy (DOE) forecasts of coal production were allocated to the railroad regions, the railroad shares of coal transport in each region were projected on the basis of historical trends and regional analyses, and the associated revenues were projected taking into account the ongoing shift to the more economic unit train coal shipments.) Operating cost expenditures in each region were projected for three expenditure categories by identifying, through regression analyses, the dependence of costs upon key operating variables, including miles operated, ton-miles, tons-per-car, and freight car miles. Investment requirements were projected by translating the commodity shipment projections into rolling stock and way and structures capital requirements, taking into account the productivity improvements now being made through substantial increases in tons-per-car loadings.

The five cost/price alternatives adapt the railroad revenue and cost projections to reflect different cost and pricing behavior by the railroads. The direct economic impact of coal slurry pipelines upon the railroad industry was established by determining, for each alternative, the differences in the railroad revenue and cost variables between the no-pipeline baseline and the two pipeline scenarios. The impact upon railroad employment was determined by translating the reduction in operating cost expenditures into equivalent hours of employment. The impact upon supplier industries was evaluated by determining the reductions in capital stock requirements associated with loss of the coal traffic. The impact upon payroll, State, and local taxes was determined by calculating the reduction in wages and in the tax base. Potential savings were determined by assessing the residual costs that would have been covered by coal revenues, and now must be allocated to other shippers. The transportation savings resulting from shippers switching to pipelines were determined by calculating the differential in the hypothetical costs established in the last chapter between the two modes and multiplying them by the shipment volumes. Other beneficial aspects of pipeline development were estimated by determining the employment and economic stimulus it could provide.

RAIL COST AND PRICE ALTERNATIVES

In order to assess the economic impact of coal-slurry pipeline development upon railroads, other shippers, other industrial sectors, and the public, it was necessary first to project what the future would be like in the absence of pipelines. Prediction of future railroad economic performance over the 25-year period in this study is an ambitious undertaking in itself. Nevertheless, since it is the difference in economic performance with and without pipelines that must be evaluated, the projection of a No-Pipeline Baseline was an essential analytic component of the present study. By constructing the baseline scenario and two pipeline scenarios within the same internally consistent analytic framework, potential bias associated with necessary analytic assumptions, such as assumed gross national product (GNP) growth rate, should be minimized.

Two other caveats must be borne in mind when reviewing the results of this study. First, as stated previously, the study was conducted using constant 1971 dollars. Thus, the revenue growth projections represent real growth, based upon estimated increases in product output by the railroad sector, e.g., ton-miles of commodities transported. Three alternative case studies were conducted regarding railroad pricing behavior. I n each, real rates were maintained at their 1971 level or reduced. However, reduction of real rates does not mean that railroads will be able to reduce their actual nominal or current dollar rates. The rates charged will be the real rates adjusted for the effect of inflation. The latter will probably be sufficiently large to result in an overall increase in railroad rates, expressed in current dollars. The second caveat is that analysis indicates that railroad economic performance will benefit from increases in coal and other commodity transportation revenues even in the presence of pipelines. Thus, the railroad revenue losses identified in the study as resulting from pipeline development are losses relative to the No-Pipeline Baseline. In other words, the railroads will not be able to achieve as high a level of coal transportation-related revenue gains if coal slurry pipelines are developed, but the railroads will probably nevertheless achieve a substantial revenue increase from overall traffic volume growth, In arriving at these results, this study assumes that real GNP will increase at 2.90 percent per year before 1985 and 2.95 percent from then until 2000, and it projects that rail revenue traffic will expand Slightly more slowly than GNP before 1985 and Slightly faster thereafter

Baseline revenue and cost projections for railroads, presented in the appendix to this volume, form the frame of reference for assessing the impact on the railroads, their shippers, and the consuming public of coal slurry pipeline development Five variations in the form of cost/price alternatives were evaluated in order to test the sensitivity of impact results to the underlying financial assumptions.

Alternative I—Constant Rate and Cost Structure

The study results presented in the appendix constitute Alternative I, This alternative postulates constant cents- per-ton-mile revenues (in 1971 dollars) over the forecast period, and operating costs that embody productivity and real wage changes only for labor. Projections for aggregate Class I railroad revenues under these conditions for the years 1980 to 2000 are presented in table A-2. The corresponding operating expenditure projections are presented in table **A-4. (See appendix.) These revenue and expenditure projections are now** shown together in table 10. Their differences, defined as Net Railway Operating Revenues (NET), are also identified in this table. The Net Railway Operating Revenues should not be considered a proxy for profits. In order to arrive at the Net Income for railroads, as reported to the Interstate Commerce Commission, it is necessary to subtract additional costs, such as taxes, interest payments, dividends, amortization and other fixed charges, net hire of equipment, and net joint-facility rents.

The ratio of operating costs to revenues, termed the operating ratio (OR), is frequently employed as an approximate measure of railroad financial performance. The operating ratios calculated from the data in table 10 are highest in the East, ranging from 0.69 in 1980 down to **0.56** in **2000,** and lowest in the South, ranging from 0.65 in 1980 to 0.53 in 2000. These projected operating ratios are considerably lower than historical values for railroads in this class, which averaged 0.806 over the period 1969-75. That is also true for the regional values, which over the 7-year historical period averaged 0.822 in the East, 0.755 in the South, and 0.783 in the West.

Several factors contribute to the low values projected for the rail road operating ratios. The revenue forecasts assumed that, except for coal, real revenues per ton-mile for each commodity will remain constant at the 1971 values.[2] In fact, historical data indicate that real revenues per ton-mile have been declining for railroads as operational economies are achieved and passed on to the shippers, A second factor affecting the OR results is that relative fuel prices have been held essentially constant over the forecast period, whereas they can be expected to increase faster than general inflation.[3] A third factor affecting the OR results is the selection of a logarithmic

[2] In the case of coal, real revenue per ton-mile declines as shipments shift to the more cost effective unit trains

[3] The study is done in constant 1971 dollars Thus, holding relative fuel prices "constant" enables them to increase at the same rate as general inflation

Table 10. Comparative Railroad Revenue and Operating Costs Projections-Alternative i

(Billions of 1971 dollars)

	1980	1985	1990	1995	2000
East					
Revenues	4.4	4.8	5.0	5.2	5.6
Operating costs	3.2	3.0	3.1	3.2	3.3
Net revenue	1.2	1.8	1.9	2.0	2.3
South					
Revenues	2.8	3.8	4.5	5.8	
Operating costs	1.9	2.1	2.5	3.0	3.6
Net revenue	0.9	1.7	2.0	2.8	3.6
west					
Revenues	7.1	8.8	10.4	12.4	15.0
Operating costs	4.9	5.4	6.3	7.3	8.6
Net revenue	2.2	3.4	4.1	5.1	6.4
U.S.A.[b]					
Revenues	14.4	17.3	19.9	23.4	27.8
Operating costs	10.1	10.5	11.9	13.5	15.5
Net revenue	4.3	6.8	8.0	9.9	12.3

[a]Not total costs. See text for definition. [b]Totals may not add due to rounding.

equation form to project operating expenditures. This functional form reflects achievement of constant economies of scale throughout the forecast period.

Alternative II—Fuel Cost Adjustment

The revenue projections for Alternative II remain the same as for Alternative 1. However, the operating expenditures were increased by an upward adjustment of relative fuel costs at a rate exceeding general inflation. The same fuel cost adjustment was made of Alternatives II to V. This was the only change made to the costing calculation for each of these alternatives. The comparison between railroad revenues and costs for Alternative I I is presented in table 11. Even with the increase in fuel prices, the operating ratios in Alternative 11, that is, 0.68 to 0.72, are significantly lower in 1980 than those prevailing historically. Declining rapidly to 2000, these ratios suggest that the economies of scale enjoyed because of increasing traffic volumes, assumed productivity gains, and constant cents-per-ton-mile revenues outweigh the impact of fuel cost adjustment.

Alternative III—Historical Rate Decline

The fuel cost adjustment is retained for this alternative and the revenues in each region are reduced at their historical rates of decline. The latter assumption reflects the apparent tendency of the rate structure to respond to productivity gains. Historically, the annual rates of tariff decline in each region have been: East, 0.02 percent; South, 1.0 percent; and West, 1.55 percent. The revenues projected on this basis, together with the fuel-adjusted costs, are presented in table 12 for Class I railroads. The revenue adjustment, combined with the fuel

Table 11. Comparative Railroad Revenue and Operating Cost[a] Projections—Alternative II

(Billions of 1971 dollars)

	1980	1985	1990	1995	2000
East					
Revenues	4.4	4.8	5.0	5.2	5.6
Operating costs	3.4	3.1	3.2	3.4	3.5
Net revenue	1.0	1.7	1.8	1.8	2.1
South					
Revenues	2.8	3.8	4.5	5,8	7.2
Operating costs	2.0	2.2	2.6	3.2	3.8
Net revenue	0.8	1.6	1.9	2.6	3.4
West					
Revenues	7.1	8.8	10.4	12.4	15.0
Operating costs	5.2	5.6	6.6	7.7	9.0
Net revenue	1.9	3.1	3.8	4.7	6.0
U.S.A.[b]					
Revenues	14.4	17.3	19.9	23.4	27.8
Operating costs..	10.5	10.9	12.5	14.3	16.4
Net revenue	3.9	6.4	7.4	9.1	11.4

[a]Not total costs. See text for definition. [b]Totals may not add due to rounding.

Table 12. Comparative Raiload Revenue and Operating Cost[a] Projections—Alternative III

(Billions of 1971 dollars)

	1980	1985	1990	1995	2000
East					
Revenues	4.2	4.5	4.7	4.9	5.3
Operating costs.	3.4	3.1	3.2	3.4	3.5
Net revenue	0.8	1.4	1.5	1.5	1.8
South					
Revenues	2.5	3.2	3.7	4.5	5.4
Operating costs.	2.0	2.2	2.6	3.2	3.8
Net revenue	0.5	1.0	1.1	1.3	1.6
west					
Revenues	6.1	7.0	7.7	8.6	9.8
Operating costs.	5.2	5.6	6.6	7.7	9.0
Net revenue	0.9	1.4	1.1	0.9	0.8
U.S.A.[b]					
Revenues	12.8	14.6	16.1	18.0	20.4
Operating costs.	10.5	10.9	12.5	14.3	16.4
Net revenue	2.3	3.7	3.6	3.7	4.0

[a]Not total costs. See text for definition. [b]Totals may not add due to rounding.

cost adjustment, substantially raises the operating ratios to between 0.76 and 0.82 in *1980,* but they again decline below the historic values in the outer years, implying that historic rates of revenue decline are not financially achievable for the remainder of the century.

Alternative IV—Constant Operating Ratio

In Alternative IV, revenues are calculated directly from the cost estimates by assuming that the operating ratio remains constant at 0.8. The operating cost estimates, which embody the fuel cost adjustment, are the same as for Alternatives II and II 1. These costs, the revenues calculated from them, and their NET are presented in table 13 for the Class I railroads over the period 1980 to 2000.

Alternative IV is conservative and will result in the lowest NET and railroad income projections among the first four alternatives except **in the West. It implies an even faster decline nationally** in cents-per-ton-mile than has prevailed historically. However regional differences emerge. The East and South can decline faster than historical trends, but the West will be unable to maintain its historic rate of decline under this alternative.

Alternative V—Minimum Necessary Net Income

By subtracting payroll, State, and local taxes from the Net Railway Operating Revenues identified in tables 10-13 for Alternatives I through IV, a better approximation was obtained for the income remaining to railroads. The resulting variable, termed Operating Income, is a pre-Federal-tax version of the Net Railway Operating Income reported to the ICC.[4] The

[4] Federal taxes were not explicitly estimated in this report because of their complexities with regard to deferments, credits, etc Federal taxes Imposed upon railroads appear to be approximately 25 percent at the margin, and to average somewhat less

Table 13. **Comparative Railroad Revenue and Operating Cost[a] Projections-Alternative IV**

(Billions of 1971 dollars)

	1980	1985	1990	1995	2000
East					
Revenues		3.9	4.0		4.4
Operating costs	3.4	3.1	3.2	3.4	3.5
Net revenue	0.8	0.8	0.8	0.8	0.9
South					
Revenues	2.5	2.7	3.3	4.0	4.8
Operating costs	2.0	2.2	2.6	3.2	3.8
Net revenue	0.5	0.5	0.7	0.8	1.0
West					
Revenues	6.4	7.0	8.2	9.6	11.3
Operating costs	5.2	5.6	6.6	7.7	9.0
Net revenue	1.2	1.4	1.6	1.9	2.3
U.S.A.[b]					
Revenues	13.1	13.6	15.6	17.8	20.5
Operating costs	10.5	10.9	12.5	14.3	16.4
Net revenue	2.6	2.7	3.1	3.5	4.1

[a]Not total costs. See text for definition. [b]Totals may not add due to rounding.

actual railroad discretionary income, Net Income, is less than Operating Income by the amount of Federal taxes, interest payments, dividends, amortization charges, other fixed charges, and other miscellaneous income deductions. Nevertheless, Operating Income values provide a useful first indication of the conditions under which railroads will encounter a cash-flow problem, The Operating Income results for Alternatives I through IV are given in table 14 for the southern and western railroad regions, between 1980 and 2000.

The Operating Income results shown in table 14 indicate marked differences between the four cost/price alternatives. The results suggest that the most likely cost/price behavior lies between the specified alternatives, which fall into two groups. Alternatives I and II lead to increasing prosperous railroad economic performance over the forecast period, while Alternatives I I I and IV lead to clearly unacceptable economic results. **In Alternatives I and 11, Operating Incomes** (in constant 1971 dollars) more than triple between 1980 and 2000 for both southern and western railroads. The fuel cost adjustment in Alternative **I I** slightly reduces the rate of Operating **Income** growth, but the maintenance of constant real rates per ton-mile in the face of the projected increases in commodity ton-miles provides an overwhelming upward thrust to revenues,

Viewed from another perspective, the favorable Operating Income results for Alternatives I and I I suggest that railroads will be able competitively to reduce their rates when necessary As discussed previously, rate reductions (in constant dollars) have been the historical pattern. Alternative III was evaluated to see whether these historical trends in rate reductions could be maintained. Clearly they cannot be, at least in the West. The western Operating Incomes decline sharply after 1985 and actually become negative in 2000. These results are based upon a continuation of the historical 1.55 percent annual decline in western rail tariffs. Thus, comparison of Alternatives I I and **I I I** indicates that in the absence of pipeline competition western **rail tariffs** (in constant dollars) could be reduced, but at a lesser rate than achieved historically. Alternative I I I also indicates that in the absence of pipelines the historical 1.0 percent annual decline in southern rail tariffs could be maintained

Alternative IV presents another view of the potential for reduction of railroad tariffs in response to the favorable Operating Income results for Alternatives I and 11. Alternative IV reduces tariffs in such a manner as to maintain the operating ratio at 0.8. The Operating Income results for the South hold constant under these conditions, but the values for western railroads decline continuously throughout the forecast period.

Since none of the first four cost/price alternatives seem to represent a likely behavior mode for railroads, a fifth alternative was evaluated. This alternative employed a bottom-up approach. Instead of determining the Operating Income results of a particular rate-setting approach. as in Alternatives I-IV, Alternative V determined a "Minimum Necessary Net Income" (MNNI) that the railroads must obtain in order to fulfill the minimal requisites of satisfactory financial performance. That is, if railroads are to maintain their functional capability, they must generate sufficient capital to finance necessary rolling stock and way and structures investments.

Computation of the MNNI to satisfy solvency and investment requirements is detailed in table 15. The minimum pretax railroad operating income average for the period 1969-72, converted into *1971* dollars, was employed as the Return-On-Capital Baseline,[5] The 1969-72 period was chosen because it was a time of reasonable, if not robust, health for the railroad industry. Hence, that period furnishes a more realistic goal for railroad operations than the more difficult recent years. Funding for new capital stock must be added to

[5] The Baseline is assumed **to** inc**l ude** funds **for** Federal taxes **at the** approximate **average rate of the 1969-72** period, i e , 20 percent Funds for net leasing over and above those for changes in capital stock are also contained in the Baseline

Table 14. Operating Income Projections for Southern and Western Railroads-Alternatives I to IV

(Millions of 1971 dollars)

	1980	1985	1990	1995	2000
Alternative I					
South					
Net railway operating revenues	$ 917	$1,652	$2,013	$2,746	$3,641
Payroll taxes	(183)	(267)	(256)	(491)	(669)
State and local taxes	(57)	(67)		(88)	(103)
Operating income	676	1,318	1,582	2,167	2,869
West					
Net railway operating revenues	2,209	3,330	4,100	5,044	6,416
Payroll taxes	(477)	(689)	(895)	(1,198)	(1,588)
State and local taxes	(192)	(208)	(225)		
Operating income	1,540	2,433	2,981	3,600	4,555
Alternatively					
South					
Net railway operating revenues		1,568	1,900	2,593	3,437
Payroll taxes	(183)	(267)	(356)	(491)	(669)
State and local taxes	(57)		(75)	(88)	(103)
Operating income	598	1,234	1,469	2,014	2,665
west					
Net railway operating revenues	1,998	3,147	3,814	4,665	5,928
Payroll taxes	(477)	(689)	(895)	(1,198)	(1,588)
State and local taxes	(192)	(208)	(225)	(246)	(273)
Operating income	1,329	2,250	2,694	3,221	4,067
Alternative III					
South					
Net railway operating revenues	522	997	1,047	1,313	1,586
Payroll taxes	(183)	(267)	(356)	(491)	(669)
State and local taxes	(54)	(61)	(66)	(75)	(84)
Operating income	285	669	625	747	833
West					
Net railway operating revenues	995	1,356	1,148	909	739
Payroll taxes	(477)	(689)	(895)	(1,198)	(1,588)
State and local taxes	(181)	(190)	(198)	(207)	(219)
Operating income	337	477	55	-496	-1,068
Alternatively					
South					
Net railway operating revenues	495	547	657	790	952
Payroll taxes	(183)	(267)	(356)	(491)	(669)
State and local taxes	(54)	(57)		(69)	(78)
Operating income	258	223	239	230	205
West					
Net railway operating revenues	1,288	1,401	1,649	1,929	2,260
Payroll taxes	(477)	(689)	(895)	(1,198)	(1,588)
State and local taxes	(184)	(190)	(203)	(217)	(235)
Operating income	627	522	551	514	437

Source: IR&T.

Table 15. Minimum Necessary Net Income for Southern and Western Railroads

(Millions of 1971 dollars)

	1985	1990	1995	2000
South				
Return-on-capital baseline.	**355**	**355**	**355**	**355**
Required changes in rate of return owing to:				
Coal-car rolling stock	*4*	8	11	
Noncoal-car rolling stock.	8		59	89
Locomotive rolling stock		22	22	*47*
Way and structures.	30	**45**	**58**	**73**
Minimum necessary net income	409	462	516	578
West				
Return-on-capital baseline.	689	689	689	689
Required changes in rate of return owing to				
Coal-car rolling stock	16	31	49	70
Noncoal-car rolling stock.	-50	“19	2	25
Locomotive rolling stock	-22	-12	-2	9
Way and structures..	105	155	198	246
Minimum necessary net income	738	844	936	1,039

Source: IR&T.

the minimum required to cover taxes and return on capital investment A 3 5 percent real return was assumed for new investment and existing capital stock Then, the minimum acceptable return given in table 15 was obtained by multiplying .035 times the change in capital stock calculated in the appendix. It must be emphasized that a real return of 3.5 percent is conservatively based on bond-market yields, and represents the absolute minimum required to stay afloat This level of net income may not be sufficient to cover adequate way and structures investments. Comparing the MNNI estimates in table 15 with the Operating Income projections for Alternatives I and IV confirms that the western railroads would be in serious trouble if the historical trends in either cents-per-ton-mile or operating ratio behaviors were to continue.

The necessary railroad revenues implied by the estimated MNNIs are identified in table 16 for western railroads in 1985 and 2000 The operating costs shown were previously given in table 11 and the payroll taxes were given in an earlier section on tax forecasts The State and local taxes were recomputed for table 16, to take into account changes in projected revenues. Comparing these minimum revenue requirements with the revenues projected for Alternatives I through IV again reveals that western railroads cannot maintain their historical rate of revenue decilnes, even in the absence of pipeline competition. In fact, in seems likely that the traditional 80 percent operating ratio may be too high to sustain the railroads in the future.

Table 16. Rail Revenues Necessary To Maintain Minimum Necessary Net Income on Western Railroads

(Millions of 1971 dollars)

	1985	2000
Operating costs	$5,641	$9,040
Payroll taxes.	688	1,587
State and local taxes.	179	226
Minimum necessary net income	738	1,039
Revenues	$7,246	$11,892

Source: IR&T.

PIPELINE IMPACT ANALYSIS

The results presented in the preceding section were for a baseline situation that assumes no pipeline development. Two pipeline scenarios were postulated in order to provide a context within which to evaluate the potential economic impacts of coal slurry pipeline development. The first scenario, termed the Lost Rail Tonnage scenario and presented here, assumed that railroads would lose five long-haul coal movements to pipelines. The five hypothetical markets of destination where pipelines may take over from railroads were discussed in chapter IV. They are Florida, Indiana, Kansas, Missouri, and Texas. A second scenario, termed the Competitive Rate scenario, assumed that not only would the coal movements of the first scenario be lost by railroads, but also that the threat of pipeline competition would force a reduction in rail rates along a number of additional routes.[6] The latter routes are assumed to be those over which coal flows identified in chapter IV amount to more than 5 million tons annually over distances greater than 500 miles. The results of the second scenario are qualitatively similar to the first and are presented in Volume II.

Lost Rail Tonnage

The hypothetical tonnages employed in this scenario are those identified in table 9 of chapter IV. The quantities are significant. The total tonnage associated with the five coal movements amounts to 11 percent of all tons originated in 1985 (including nonutility coal), and 17 percent of all tons originated by the year 2000. The effect is most striking in the West, where the selected movements represent 18 percent of western railroad shipment projections for 1985, and over 25 percent for 2000. Because the designated coal movements are long-haul shipments, their share of total ton-miles of coal is even larger than of tons originated. Nationally, the five movements represent 30 percent of all railroad coal ton-miles projected for 1985, and 38 percent for 2000, Again, the effect is greatest in the West because this region is characterized by an unusual number of long-haul, large-volume shipments that are susceptible to pipeline movement. The designated movements in the West account for 45 percent of the ton-miles of coal projected for railroads in the year 2000 under the No-Pipeline Baseline.

Operating Cost and Revenue Impacts

Railroad revenue losses associated with the Lost Tonnage coal movements were determined with help of the forecasting formula:[7]

$$\text{Revenues/Ton} = 113,7 + 0.382\ (\text{Distance})$$

where Revenues/Ton is in cents per ton, and Distance is in miles. Using this formula, the revenue loss for each route was computed as revenues/ton times total tons, It may be noted that this revenue-loss formula yields results comparable to published rate data. However, there is as yet little actual experience with unit trains for the volumes and distances considered in this study.

The operating costs for the Florida and Texas coal movements were obtained from the case study analysis, as described in chapter IV. The other three movements were judged to be between the cost of the Minnesota and Texas coal movements, for which case studies had been conducted. On this basis, the operating costs for these three shipments were estimated by a tonnage and mileage adjustment of a level of costs between those for Minnesota and Texas. The reduction in railroad operating costs as a result of the shipments lost to

[6]According to the *Dilemma of Freight Transport Regulation*, Ann F Friedlander, Brookings Institution, 1969, p 62, in situations where barge competition has posed a potential threat to railroads, the rate-per-ton charges for various rail moves, including coal, have been substantially reduced In two Instances, the rail rates per ton In the presence of barge competition were only about 60 percent of the rates prevailing in the absence of viable competition Unit train rates, however, contain less room for this sort ot reduction than do those of other types of rail shipment

[7]Derivation ot the formula is decribed in Volume II

Table 17. Lost Tonnage Impacts Upon Railroad Operating Costs

Destination	Coal supply region	Tonnage (millions)	Distance[a] (miles)	Ton-miles (millions)	Rail operating Costs[b] ($/ton)	cost reduction from lost tonnage (millions of 1971 dollars)
			1985			
Florida	So. Appalachian	16	857	13,712	3.98	63.7
Indiana	Central Western	27	1,430	24,310	3.36	57.1
Kansas	Central Western	No transfer in 1985				
Missouri	Central Western	14	1,235	17,290	2.90	52.2
Texas	Central Western	35	1,400	49,014	4.04	141.4
						314.4
			2000			
Florida	So. Appalachian	32	857	27,424	3.49	111.7
Indiana	Central Western	17	1,430	24,310	3.16	53.7
Kansas	Central Western	19	910	17,290	2.01	38.2
Missouri	Central Western	14	1,235	17,290	2.33	41.9
Texas	Central Western	125	1,400	174,795	3.75	465.0
						710.5

[a]Florida and Texas are based upon case study data, the other States calculate the distance at 1.3 times the straight line distance. [b]Not total costs. See text for definition.

Source: IR&T estimates based upon Teknekron and GRC data.

pipelines is given in table 17 for each route in the years 1985 and 2000. The largest effect occurs in the West in 2000, where a 6 5-percent reduction in operating cost is achieved, primarily due to the postulated loss of the Texas coal movement.

Having estimated the railroad revenue and operating cost reductions because of lost coal shipments, the changes in NET were determined The results are shown in table 18. These values indicate that the revenues lost by railroads for the selected routes substantially exceed the operating cost reductions that can be achieved. The results are the same for all the cost) price alternatives since the revenue and cost differentials between the scenario and baseline are exogenously determined for the specific routes involved.

Investment Impacts

Reductions in coal car and locomotive requirements are identified in table 19 for the tonnage losses to pipelines postulated in the Lost Rail Tonnage scenario. The rolling stock requirements for the Florida and Texas shipments were obtained from the case studies described in chapter IV. For the other three moves, it was assumed that coal cars would have a utilization rate of 75,000 miles per car per year and that 5 locomotives would be required for every 100 coal cars. As discussed in the appendix for the No-Pipeline Baseline, hop-

Table 18. Lost Tonnage Impacts Upon Net Railway Operating Revenues[a]

(Millions of 1971 dollars)

	1980	1985	1990	1995	2000
East. . .	0	-5.94	-5.97	-6.14	-6.25
South. .	0	-19.68	-32.76	-33.81	-53.32
West . .	0	-123.85	-352.58	-503.61	-628.30
U.S.A. .	0	-149.47	-391.31	-543.56	-687.87

[a]These values represent the difference between the Net Railway Operating Revenues for the Lost Rail Tonnage scenario and those for the No-Pipeline Baseline. There is no difference between the results for the five cost/price alternatives.

per cars and locomotive suppliers should have no difficulty in furnishing the necessary rolling stock in the absence of pipelines. Since the reduction in equipment requirements identified in table 19 would be only about 5 percent of the Baseline total, pipeline development should have little effect upon the supply situation for railroad rolling stock.

The investment reductions for rolling stock and way and structures associated with the scenario on railroad coal-tonnage losses are shown in table 20. The way and structures investment reductions for the Texas and Florida moves were derived from data presented in table A-6. (See appendix.) The values for the other three moves were obtained by a ton-mile adjustment of long-haul shipments total given in that same table. The Baseline way and structures investment requirements are shown in parentheses for purposes of comparison.

Table 19. Lost Tonnage Impact Upon Railroad Rolling Stock Requirements

(Reduction in vehicle requirements by route)

Category	Destination	1985	1990	1995	2000
Coal **hopper cars.**	**Florida**	2,975	3,958	3,958	5,846
	Indiana	3,137	3,137	3,137	3,137
	Kansas	0	0	2,305	2,305
	Missouri	2,964	2,964	2,964	2,964
	Texas	6,383	12,855	16,954	22,768
	Totals	15,549	22,914	29,318	37,038
Locomotives	**Florida**	196	257	257	379
	Indiana	157.	157	157	157
	Kansas	0	0	115	115
	Missouri	148	148	148	148
	Texas	315	629	839	1.126
	Totals	816	1,191	1,516	1,925

Source: IR&T.

Table 20. Lost Tonnage Impact Upon Railroad Investment Requirements

(Reduction in requirements for the Lost Rail Tonnage scenario relative to No-Pipeline Baseline)

(Millions of 1971 Dollars)

	1980-1985	1985-1990	1990-1995	1995-2000
Coal hopper cars per year (number)	**3,110**	**4,583**	**5,864**	**4,230**
Annual coal car investment	**40.4**	**59.6**	**76.2**	**55.0**
Locomotives per year (number).	**163**	**238**	**304**	**222**
Annual locomotive investment	**40.1**	**58.5**	**74.8**	**54.6**
Annual way and structures investment	**0/38[a]**			
(Baseline annual way and structures investment).	**(501)**	**(470)**	**(453)**	**(456)**
Total annual investment reduction.	**80.5/118.5**	**151.1**	**162.0**	**128.6**

[a] If pipelines are brought onstream along each route in 1985, the railroads may be unable to achieve any reduction in way and structures investment over the 1980-85 period. The possibility is indicated by the zero value shown in the table. If the pipelines come onstream in 1980, it was estimated that an average annual reduction of $19 million in way and structures investment could be achieved over the 1980-85 period.

[b] Baseline annual way and structures investment is provided for comparison.

Source: IR&T.

The ability of railroads to obtain the necessary financing for coal-related transportation investment has been occasionally questioned. Referring to the Baseline investment requirements discussed in the appendix and the reductions shown in table 20, a number of conclusions can be drawn regarding the critical 1975-85 time period. First, the identified railroad capital requirements are small compared to the demand for capital in the U.S. economy. Second, the investments are required of financially sound western and southern railroads that enjoy fairly easy access to capital markets. Third, the increase in investment for shipments that might go to pipelines is only 4 percent of overall railroad investment. Finally, at least the portion of the investment associated with hopper cars could be shifted to the shippers through leasing arrangements or shipper ownership of cars if the railroad should encounter difficulties in financing investments.

Another investment-related question regards the possibility of " u necessary" capital expenditures. If the bulk of the pipelines were not to come online before 1985, railroads might be forced to make substantial investments in order to provide unit train coal shipments prior to that date. It is unlikely they could recoup these investments. The problem is relatively minor for rolling stock investment, since most of this could be readily shifted to other uses. Track improvements and new track emplacements, however, are less likely to have alternative uses. If the strong assumption is made that rail roads provide full unit train service through 1985, then lose the Lost Rail Tonnage scenario shipments at that time, $270 million of sunk capital in way and structures would be lost. There are three possibilities as to how this problem would be handled in practice:

1. The railroads would simply not make these investments, and hence would provide only slower and more expensive service;
2. The railroads would make these investments but would be forced to charge very high rates to ensure their adequate amortization, or;
3. The railroads would have to absorb very high and unrecoverable capital costs to provide unit train service over the period in question.

The option that would be adopted is, in large part, a matter of regulatory policy.

Employment Impacts

The reductions in railroad employment in response to pipeline development along the five scenario routes are shown in table 21, These reductions correspond to 4.4 percent of the railroad employment that would exist in 2000 in the absence of pipelines. The railroad employment losses (relative to the Baseline) are greatest in the West, representing more than 6 percent of the potential railroad labor force for that region in 1995 and 2000. These railroad employment reductions are only partially offset by the direct employment increases associated with pipeline construction and operation, estimated at between 300 and 500 workers along each route,

The employment requirements identified above are for direct transportation operating employment by the railroads and pipelines. In addition, each transportation mode stimulates employment in equipment supplier and construction industries. These employment requirements vary with regard to the time period considered and the employment measure used. Because pipelines require greater construction expenditures, the total number of job position requirements (operating and other) of the two transport modes were found to shift over time. For the period 1980–90 job position requirements are greater for pipelines than for railroads. After 1990 railroads will generate more jobs than pipelines, but railroad requirements do not exceed the cumulative total for pipeline job requirements until 2000. In the long run, however, both direct and multiplier effects indicated that railroads would provide more jobs than pipelines because the former generate more spending and, in terms of

Table 21. Lost Tonnage Impact Upon Railroad Employment and Compensation by Route[a]

	Destination	1985	1990	1995	2000
Employment	**Florida**	**1,770**	**1,951**	**1,645**	**2,005**
	Indiana	**3,073**	**2,612**	**2,209**	**1,876**
	Kansas	**0**	**0**	**1,568**	**1,334**
	Missouri	**2,810**	**2,390**	**2,018**	**1,716**
	Texas	**4.369**	**7.127**	**8.092**	**9.012**
	Total	12,022	14,080	13,958	15,943
Baseline employment		**(362,520)**	**(361,950)**	**(362,660)**	**(365,660)**
Compensation (millions of 1971 dollars)	Florida	$29.68	$38.00	$ 37.23	$52.70
	Indiana	51.52	50.87	49.91	49.30
	Kansas	0	0	35.50	35.06
	Missouri	47.11	46,53	45.63	45.09
	Texas	73.23	138.78	183.12	236.76
	Total	$201.54	$274.18	$351.39	$418.91

[a]The employment and compensation numbers given in the table reflect the reduction in each variable for the Lost Rail Tonnage scenario relative to the No-Pipeline Baseline.
[b]The total No-pipeline Baseline employment estimates for each year are provided in parentheses for purposes of comparison.
Source: IR&T.

operating requirements, are more labor intensive.

As with investment needs, transition impacts are also an important consideration regarding employment requirements. The railroads might find themselves with a significant number of surplus employees if pipelines do not come online until 1985. It would be difficult to transfer these employees to other railroad jobs, since aggregate railroad employment was predicted to remain relatively constant in the post-1985 period. Pipeline implementation could therefore lead to layoffs and at least temporary unemployment of a maximum 12,800 railroad employees. The decreases in rail road wage compensation corresponding to the Lost Rail Tonnage employment reductions are also shown in table 21. The effect upon regional economics would be quite small. In fact, in line with the preceding discussion, pipeline labor compensation increases should offset the effect of the railroad compensation decreases up through the year 2000.

Operating Income Impacts

The reduction in railroad employee compensation given in table 21 was translated into a reduction in payroll taxes, in the manner described in the appendix. A similar computation was made for the State and local tax reductions resulting from the lost railroad coal shipments. These changes in railroad tax payments were then employed to evaluate the Operating Income for railroads under the conditions of the Lost Rail Tonnage scenario. The Operating Income results are presented in table 22 for the southern and western railroad regions over the period 1980 to 2000. The values become negative in the western region for Alternative III (historical rate decline) in 1990 through 2000, and decline steadily from an unacceptably low level to negative values for Alternative IV (constant operating ratio). Thus, neither of these rate behaviors could be sustained in the presence of the postulated level of pipeline market competition.

The railroads must at least obtain sufficient revenues to satisfy their MNNI requirements. This corresponds to Alternative V, as discussed for the Baseline. The MNNI revenues for western railroads in the case of the Lost Rail Tonnage scenario are shown in table 23. Comparing these results with those given in table 16

Table 22. Railroad Operating Income 1980-2000—Lost Tonnage Scenario

(Millions of 1971 dollars)

	1980	1985	1990	1995	2000
			Alternative I		
South					
Net railway operating revenues.	$ 917	$1,632	$1,980	$2,713	$3,588
Payroll taxes	(183)	(261)	(347)	(478)	(653)
State and local taxes.	(57)	(66)	(74)	(87)	(101)
Operating income	677	1,305	1,560	2,148	2,834
West					
Net railway operating revenues.	2,209	3,207	3,748	4,540	5,788
Payroll taxes	(477)	(652)	(839)	(1,1 14)	(1 ,479)
State and local taxes.	(192)	(204)	(217)	(234)	(258)
Operating income.	1,540	2,351	2,692	3,192	4,051
			Alternative!		
South					
Net railway operating revenues.	838	1,548	1,867	2,559	3,384
Payroll taxes	(183)	(261)	(347)	(478)	(653)
State and local taxes.	(57)	(66)	(74)	(87)	(101)
Operating income..	598	1,221	1,446	1,994	2,630
West					
Net railway operating revenues	1,998	3,023	3,462	4,162	5,300)
Payroll taxes	(477)	(652)	(839)	(1,114)	(1,479)
State and local taxes.	(192)	(204)	(217)	(234)	(258)
Operating income	1,329	2,167	2,406	2,814	3,563
			Alternative III		
South					
Net railway operating revenues.	522	977	1,015	1,279	1,533
Payroll taxes	(183)	(261)	(347)	(478)	(653)
State and local taxes.	(54)	(60)	(65)	(73)	(82)
Operating income.	285	656	603	728	798
West					
Net railway operating revenues.	995	1,232	795	406	111
Payroll taxes	(477)	(652)	(839)	(1,114)	(1,479)
State and local taxes.	(181)	(185)	(189)	(195)	(204)
Operating income.	337	395	–233	–903	–1,572
			Alternatively		
South					
Net railway operating revenues.	**495**	**528**	**624**	**757**	**899**
Payroll taxes	**(183)**	**(261)**	**(347)**	**(478)**	**(653)**
State and local taxes taxes	**(54)**	**(56)**	**(61)**	**(68)**	**(76)**
Operating income	**258**	**211**	**216**	**211**	**170**
West					
Net railway operating revenues.	1,288	1,277	1,297	1,386	1,632
Payroll taxes	(477)	(652)	(839)	(1,114)	(7,479)
State and local taxes.	(184)	(186)	(194)	(205)	(219)
Operating income.	$ 627	$ 439	$ 264	$ 67	–$ 66

Source: IR&T,

for the Baseline indicates that the expenditure reductions related to tonnage losses permit a maximum reduction in MNNI of **4.1 percent in 1985 and 6.4 percent** in 2000.

Table 23. Rail Revenues To Maintain Minimum Necessary Net Income on Western Railroads— Lost Tonnage Scenario

(Millions of 1971 dollars)

	1985	2000
Operating costs	$5,407	$8,452
Payroll taxes	652	1,479
State and local taxes	175	214
Minimum necessary net income	715	985
Revenues	$6,949	$11,130

Source: IR&T.

System Costs

Two effects must be distinguished in assessing the net economic impact of coal slurry pipeline development. These two effects are: 1) changes that result in net savings or costs to the overall economy, and 2) changes that affect prices or incomes by transferring money from one group to another without a net change in output of the overall economy. **In the case of coal slurry pipelines, the potential net savings to** the economy stem primarily from the labor, capital, and other resources that are released to uses other than coal transportation as a result of the shift from railroad shipments to pipelines. The relative transportation costs for the two alternative systems, with and without pipelines, constituted the basic measure of net savings.

Three additional considerations must be addressed in translating the transportation savings of pipelines into net savings to the economy. First, the total amount of coal transported may increase in response to the reduced transportation charges, and if rail rates charged other shippers increase as a result of the lost coal shipments, transportation of other commodities may correspondingly decrease. These potential shifts in commodity transport could add to, or detract from, the direct pipeline savings. Second, the full amount of the transportation savings are only applicable if resources can be successfully reallocated to other uses in the economy. For example, contained unemployment among railroad workers would imply that the labor resources could not be fully redirected. However, as noted earlier, pipelines offer greater near-term and lesser long-term employment than railroads. Third, the opportunity costs of water in alternative uses may have to be deducted. As discussed further on, these opportunity costs are relatively small if the pipeline water is drawn from what are currently the lowest value uses in the originating basins.

The reader should recall at this point that the pipeline markets and cost advantages on which this analysis is based are hypothetical. The purpose of this section is to illustrate how positive and negative impacts would be distributed if a pipeline industry as described in chapter IV were to develop.

Potential Savings

Utilities stand to benefit from reduced coal transportation charges, the extent of the benefit depending upon the rate differential achieved. Pipeline rates will be critically dependent upon three factors: regulating policy with respect to coal slurry pipelines;[8] competition between pipeline companies; and the relative bargaining power of the pipeline company and electric utility. Since there are several companies capable of building and operating coal slurry pipelines, and electric utilities themselves can invest in pipeline ventures, the ability of pipelines initially to charge rates significantly in excess of costs may be somewhat limited. In addition, the large shipment sizes necessary to achieve favorable pipeline economics mean that the electric utilities involved will tend to be quite large.

[8]Regulatory considerations are discussed in chapter **VI 1 of this report**

Customer size and financial leverage could further serve to restrict the possibilities for excessive pipeline rates. Reduced transportation rates could also increase the demand for coal in some areas, thereby benefiting the mining industry

The rate situation for railroads is more complicated than for pipelines. This study found, as others have, that railroads have historically been able to achieve significant economies of scale. These economies of scale have occasionally led to difficulties in setting railroad rates, This is true because as long as incremental, or marginal, costs' are declining, rates must exceed the incremental costs of each shipment if railroads are to cover effectively their total costs. The proper method of allocating these additional charges to specific rates has been the subject of regulatory debate for decades,

The actual savings to utilities as a result of a shift to pipelines therefore depend not upon differences in costs for the two modes, but upon differences in rates. The railroad rate and incremental railroad cost assumptions used embodied a significant difference between rail rate and incremental rail costs. The maximum savings to utilities would occur if pipeline rates equal led pipeline costs, due either to market or to regulatory forces. The maximum savings would then equal the difference between rail rates and pipeline cost. **In the Lost Rail Tonnage scenario this** would result in savings of $273 million a year in 1985, rising to $710 million a year by 2000. On the other hand, as noted above, pipeline rates may be significantly higher than pipeline costs. The minimum estimate of utility savings would therefore be calculated as the difference between rail rates and incremental rail costs. The estimated savings then would be $49 million a year in 1985, and rising to $416 million a year by 2000. The difference between these two utility savings estimates represent potential monopoly profit to pipelines,

The precedent-based nature of many railroad rates may not permit railroad rate reduction. The Interstate Commerce Commission [ICC) regulation of railroad rates becomes a factor at this point. The ICC attempts to approve rail rates in an internally consistent manner in part so that a customer making a shipment in one region of the country will be charged the same amount as a customer making a comparable shipment in the same region. As a result, the ICC may not approve lower rates where pipeline competition is arising. If the rate reduction were not allowed and the pipelines were able to capture that set of coal shipments, the effect upon the economy as a whole would be a transportation loss since a more expensive transportation mode would be employed along those routes.

Impact Upon Other Shippers

The transportation savings to utilities are directly related to downward adjustments in the rates charged for the coal shipments, whether the adjustment in rates are achieved by transferring shipments to pipelines or as the result of a competitive adjustment in railroad rates. Both adjustments cause a comparable reduction in railroad revenues. To the extent that the revenue losses exceed the corresponding reductions in railroad costs (including tax expenditures, etc.), railroads will suffer a net reduction in coal-transportation-related income. This income reduction can either be absorbed by the railroads, thereby adversely affecting their financial performance, or it can be passed on, in whole or in part, to other shippers. The amounts by which charges to other shippers must be increased in order to attain desired levels of railroad financial performance were determined for two situations. For Alternatives I-IV, revenues were increased by that amount necessary to restore the profits lost (calculated as the difference between railroad rates for coal and the costs of these shipments). **In Alternatives I and II no rate change was required as the profit from coal shipments was not necessary to the financial health of the railroads. For Alternatives III and IV, rate changes would be required in the West to restore an already precarious financial**

[9] Incremental, or marginal, costs are the change in total cost resulting from an additional unit of output or service

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status. For Alternative V, the rate increase required to maintain the MNNI was determined. In 1985, the rate increases required to restore pre-pipeline financial positions (for the Lost Rail Tonnage scenario) are from 0.7 to 0.9 percent by 1985 rising from 4 to 4.7 percent by 2000. If western railroads must also lower rates on some coal shipments to meet pipeline competition, the required rate increase for other shippers were estimated to be somewhat higher.

In order to put these potential rate increases into context, it should be noted that they do not represent increases over present rates. Rather they imply that rates would decline less than would occur in the absence of pipeline competition.

Net Savings

The preceding two subsections addressed the manner in which revenue losses and gains may be allocated among railroads, utilities, and other shippers. These allocations fall into the category of revenue transfers. The net savings to the economy are related to the difference in costs (not revenues) between the two shipment modes. Thus, the Lost Rail Tonnage scenario achieves net savings, since the pipelines are assumed to cost less along those routes for which shipment adjustments are made. Competitive pressures on rail rates, on the other hand, merely reallocate revenues without bringing about a net savings to the economy. The potential net savings associated with the pipeline costs and market shares assumed in chapter IV are given in table 24. The values shown are the cumulative savings for the periods 1985-2000, and 1985-2015 assuming that shipment levels remain at their 2000 level from 2000-2015. The aggregate net savings are in excess of $2.5 billion over the 30-year period. These figures are subject to the limitations and simplifying assumptions explained at the end of chapter IV.

Table 24 also shows the sensitivity of the net saving estimates to certain key economic assumptions. A significant fraction of the savings were attributable to assumed large shipments to Texas. **In order to gain insight** into the significance of the other four shipments,

Table 24. Sensitivity of Potential Net Savings From Hypothetical Coal Slurry Pipeline Development

(Discounted present value in billions of 1971 dollars[a])

		Sensitivity y Analysis		
Time **period**	Lost rail tonnage **scenario**[b]	Low Texas[c]	No way and structures **invest mental**	Significant railroad **economies of scale**[e]
1985-2000	1.6	1.2	1.2	0.63
1985-2015f	2.5	1.6	1.9	0.95

[a]1971 dollars can be converted into 1977 dollars by multiplying by 1.42. Future dollars are discounted to 1977 at 7.15 percent per year.

[b]The Lost Rai Tonnage scenario assumes that significant potential net savings can be achieved by substituting pipelines for railroads on selected routes. This sensitivity analysis was designed to evaluate the effect upon potential net savings of various economic assumptions favorable to railroads. As a result, these sensitivity analyses yield lower potential net savings than for the original scenario. This does not mean that the scenario represents the highest possible estimate. Additional pipeline construction would increase those savings as long as they were implemented in response to real cost advantages.

[c]The Low Texas case assumes no growth in Texas shipments after 1985.

[d]The No Way and Structures Investment case assumes that new track and upgrading expenditures attributable to those unit trains affected by pipeline competition are zero because of benefits elsewhere i n the rai l road system.

[e]The Significant Railroad Economies of Scale case assumes a scale factor of .87 for all operating expenditures and way and structures investment.

[f]The 1985-2000 alternative assumes that shipments Cent inue at the year 2000 levels f rom 2000 to 2015.

the net savings were calculated assuming no growth beyond 1985 for the Texas pipelines. The net savings remain substantial, being approximately 70 percent of the results with the full Texas shipments.

A more important economic assumption underlying the net savings estimates was the assumption that no changes occur with regard to systemwide costs. Two systemwide changes were examined through sensitivity analyses. First, the possibility was considered that way and structures investments for new track and track upgrading may either attract additional traffic or reduce costs for other shipments. A sensitivity analysis was conducted in order to test the potential importance of this issue. The extreme assumption was posed that all of the way and structures investment attributed to unit trains could, in fact, be assigned to other traffic requirements. On this basis, the way and structures investments for the coal unit train shipments of the Lost Rail Tonnage scenario were set to zero, Even with this extreme assumption, the net savings remain substantial Only one route (Kansas) actually changes sufficiently to return from pipeline to rail.

The analysis of the sensitivity of net savings to way and structures also has another implication which should be noted. In the section on Investment Impacts, a potential problem was raised that railroads might have to make way and structures investments which would then be worthless when pipelines came online. The fact that net savings are still high even in the absence of way and structures investments by railroads also implies that deductions of these transition costs would still leave substantial net savings.

A second way in which the incremental cost analysis may err is by failing to take into account systemwide economies of scale not readily apparent when analyzing a specific route These are in part dependent upon the systemwide total size. Economies of scale have two possible origins: large fixed costs accompanied by relatively constant costs for each additional shipment, or declining incremental costs for each additional shipment. The case of large fixed costs and constant incremental costs presents difficulties in cost allocation and ratesetting, but does not require a correction to the incremental cost-based net savings estimates given in table 24. The case of declining incremental costs does, however, require an adjustment to the incremental cost-based net savings estimates. Unfortunately, prior statistical cost studies, while strongly suggesting the presence of railroad economies of scale, do not permit differentiation between the two cases. For the purposes of a sensitivity test, it was assumed that declining incremental costs hold for all operating cost categories and for way and structures investments. The scale factor of 0.87 was used, i.e., cost increases 0,87 percent for every 1-percent increase in ton-miles. This extreme assumption considerably reduced the size of the net savings, but some net savings remain, as shown in table 24.

The net savings in table 24 were computed assuming that the total transportation system size does not change. That is, neither the total amount of coal transported nor the amount of other goods transported by both rail and pipeline change as a result of the implied changes in rates. **In fact, total goods transported does change with transportation rates. To the extent that utilities use** more coal with lower transportation rates, the resulting benefit to the mining industry from using coal rather than other fuels will increase the net savings attributable to pipelines. To the extent that railroads lose shipments when they attempt to increase rates to maintain necessary income, net savings will decrease. Whether net savings increase or decrease as a result of these two types of offsetting effects depends upon the relative responsiveness to rate changes of the different types of shipments. Current data does not permit a clear judgment as to the direction of this effect, but it would be unlikely to offset the total potential net savings identified in table 24.

Economic Impacts of Water Resource Allocation

The cost analysis described in chapter IV included the costs that pipelines will have to pay for water usage, such as pumping, transportation, and purchase price. These costs are part of the pipeline's operational expenditures. However, they may not reflect the full value of that water in alternative uses. This could happen because, unlike most other resources, water resources are not allocated through markets. Though details vary, water tends to be allocated in the form of water rights. These rights are frequently nontransferable, i.e., one must use the right or lose it, rather than being able to sell it. The problem in establishing water value in alternative uses is further complicated by the substantial subsidies often provided if the water source is a Federal resource project. As a result, the true societal value of water cannot be directly determined from the prices paid, but must be assessed through a comparative evaluation of the water's value in alternative uses. A variety of studies suggest the following ordering of water values in use: municipal water supply tends to have the highest value, industrial use varies by industry but tends to be lower in value than municipal use, and agricultural uses, with the exception of certain high value per-acre crops, such as fruits or vegetables, tend to have the lowest values.

The two principal potential industrial uses in the western coal region are coal gasification and coal mining. In order to appraise the value of water used for coal gasification, the net profits and flexibility of water used for such plants must be estimated. Since the feasibility of these plants in the West is somewhat uncertain, and the engineering details necessary for an analysis of flexibility in water use have not yet been developed, the value of water in this case cannot be quantified at this time. However, a maximum value can be estimated for water if it would otherwise be used for coal mining in the West. The environmental analysis described in chapter VI indicated that up to 331 million tons of coal would be foregone in 2000 if all the case study pipeline-related water were obtained from coal production. On the basis of the 1971 value of Wyoming coal, $4.I4 per ton, the resulting coal production loss would exceed $1.3 billion per year. Of course, only a small fraction of this value represents the opportunity costs associated with water usage. It also includes values for capital, labor, and other inputs that would be redirected into other uses. Nevertheless, the magnitude of the economic loss if coal production were affected by water withdrawals is such that even a small fraction of it would represent a major offset to the savings associated with coal slurry pipelines.

An estimate can also be made for the maximum possible value of water in the largest agricultural application, hay and alfalfa growing. The environmental analysis (see chapter VI) indicated that transporting 125 mill ion tons per year from eastern Wyoming by pipeline would require 69,500 acre-feet of water. If this water were otherwise to be used for hay and alfalfa acreage, 300,000 tons of potential annual hay production would be foregone. At a 1971 value of $26.00 per ton, the annual value of foregone hay production would be $7.8 million. This value includes the value of labor and other inputs. The actual value of the water is probably less than 20 percent of the total. The quantities of production in question are sufficiently small that they should not affect national food prices.

The estimated value of water in coal mining was found to be many times as great as in hay growing. The water would therefore be obtained from the latter usage if it were allocated by economic market conditions. However, water resources are allocated by nonmarket mechanisms in many regions, as discussed in chapter VII. As a result, the economic impact of water diversions by pipelines will be critically dependent upon the water resources policy in each region, and the economic impact will disappear if there is sufficient water to satisfy the needs of all potential users. The availability of water in the pipeline-origin region is discussed in chapter VI.