AN EVALUATION OF CP RAIL'S PROPOSED BEAVER TUNNEL

by

TED JOHN FRIESEN

B. Comm. (Hon.), The University of Manitoba, 1973

A THESIS SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE (BUSINESS ADMINISTRATION)

in

THE FACULTY OF GRADUATE STUDIES
(Commerce and Business Administration)

We accept this thesis as conforming to the required standard

THE UNIVERSITY OF BRITISH COLUMBIA

May 1980

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Department of Business Administration

The University of British Columbia
2075 Wesbrook Place
Vancouver, Canada
V6T 1W5

Date June 30, 1980
Abstract

CP Rail is experiencing capacity constraints on its western mainline between Calgary, Alberta and Vancouver, B.C. The critical bottleneck has been identified as the Roger's Pass section, which is between Golden, B.C. and Revelstoke, B.C. CP Rail has examined several alternatives, and has concluded that this bottleneck can best be overcome by nineteen miles of double-tracking. This would require the construction of an eight-mile tunnel under Roger's Pass. CP Rail's financial evaluation of this project reveals an unacceptably low rate of return on capital invested.

This paper has two objectives, namely 1) to examine the potential conflict between the public desirability of the tunnel investment and the financial viability of the investment, and 2) regardless of the outcome of the first objective, to identify and analyze alternative methods of providing financial compensation to CP Rail so that it will proceed with the tunnel investment.

The analysis concludes that potential benefits brought on by the construction of the tunnel may make this project desirable from a public point of view, even if it is established that the tunnel is not financially viable to CP Rail. The analysis of the alternative methods of providing financial compensation point out that user pay financing alternatives are preferable from an economic viewpoint, but the analysis concludes that time constraints are such that public financing alternatives are optimal.
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CHAPTER 1 INTRODUCTION

Canada's first transcontinental railroad was completed in 1885, a scant sixty-one months after the signing of the original contract between the Canadian Pacific Railway and the Dominion government. The western link pierced a rugged barrier that had previously stymied the flow of goods between Vancouver and the rest of Canada. The Kicking Horse Pass in the Rocky Mountains, the Roger's Pass in the Selkirks, and the Fraser Canyon are but a few of the difficult sections of track.

By the time construction of the railway began in the mountains, CP Rail was experiencing severe shortages of working capital. The Railway's objective was to complete the track at the lowest possible cost in the least amount of time. The line provided all the capacity that was required in the late nineteenth century. In the early years, passengers, general merchandise, and agricultural commodities made up the bulk of the traffic. As the Railway's financial position improved, and traffic grew, modifications were undertaken to increase the capacity of the western mainline. The Spiral Tunnels on the western slope of the Kicking Horse Pass were completed in 1908. This reduced the grade from a high 4.4% to a more acceptable 2.2%. The Connaught Tunnel was constructed under Roger's Pass in 1915. This reduced the grade as well as eliminated a section of track that was in a dangerous avalanche zone.

Over the years, traffic continued to grow and various improvements enabled the line to handle the increased traffic. The introduction of diesel locomotives allowed heavier trains to
move. The length of sidings were increased to handle longer trains. Central Traffic Control led to fewer mainline delays and hence greater utilization of track and rolling stock. These engineering and technological advances have contributed to increasing the capacity of the western mainline.

In the past decade, bulk commodities such as coal, sulphur, and potash have become increasingly important to CP Rail. The mountain mainline is the conduit for these commodities to flow into the Port of Vancouver. Company forecasts indicate that CP Rail will reach sustainable capacity on its western link in the near future. The critical bottleneck has been identified as the Roger's Pass section, which is located between the cities of Golden and Revelstoke. Here the track climbs up the Beaver Valley (2.2% grade) to the mouth of the Connaught Tunnel. The steep westbound grade allows for the passage of only 15 westbound trains per day. CP Rail has examined its alternatives, and has concluded that double-tracking here will eliminate the bottleneck. Nineteen miles of track would be laid, with a maximum grade of 1%. Included in this project is a new eight-mile long tunnel under Roger's Pass. The expected cost of the project is $102 million (1978 $). CP Rail's financial evaluation of this project reveals an inadequate rate of return on monies invested.
1.1 Objectives

The first objective of this paper is to examine the potential conflict between the public desirability of the tunnel investment and the financial viability of the investment. CP Rail evaluates potential investments on a discounted cash flow basis, i.e., incremental cash outflows must be justified by incremental cash inflows (all on a discounted basis).

Is it possible, however, that the tunnel could be publicly desirable even though it is not financially viable? The tunnel is not viable financially because the Railway cannot collect adequate revenues, on the incremental traffic, through the pricing mechanism. But it is possible that the incremental traffic is willing to pay a greater amount than the Railway can collect. For example, if the incremental traffic was grain moving under the Crow's Nest rates, the Railway's prices are fixed by federal statute (below variable costs). It is likely that the shippers of the grain are willing to pay a greater charge. The difference between the price paid and the price that shippers are willing to pay is an economic benefit. Thus the tunnel could be economically desirable, while being financially unattractive to private investors. A second example relates to existing traffic. The tunnel may eliminate delays to the existing grain traffic moving under statutory rates. Or it may allow longer, more efficient trains to move over this line. These are economic benefits which the railway is unable to charge for.

This thesis estimates the economic but non-financial
benefits and contrasts the economic desirability of the tunnel from the Canadian economy perspective relative to the financial calculation of CP Rail.

Regardless of the outcome of the first objective, the second objective of this paper is to identify and analyze alternative methods of providing financial compensation to CP Rail so that they will proceed with the tunnel investment.

1.2 Outline Of Study

The second chapter documents the need for the proposed tunnel. A brief history of the line is followed by a discussion of the physical capacity problem.

A financial analysis is carried out in the third chapter. CP's criteria for investment are set out and applied to the proposed tunnel project.

The fourth chapter discusses how economic theory and financial criteria can diverge under certain investment conditions, e.g., decreasing cost investment such as the proposed Beaver tunnel project. This chapter argues that value-of-service pricing (widely utilized by railways) can satisfy both economic and financial criteria, i.e., if railways had complete pricing freedom the financial and economic analysis could be consistent with one another. However, there are important restrictions on CP's pricing. Chapter 5 examines these constraints. It has been Canadian government policy (reinforced by the National Transportation Act of 1967) that railways should enjoy pricing freedom. The railways have utilized price discrimination to
recover their constant costs. However, there is a restriction on their pricing freedom, namely the existence of the statutory grain rates. This has reduced the railways' ability to recover constant costs. Constant costs do not vary with output, and therefore cannot be charged to specific movement of goods.

The last two chapters deal specifically with the two stated objectives of this paper.
CHAPTER 2 A MAJOR BOTTLENECK

Over the next few years, traffic is forecast to increase on CP's already congested western mainline. This chapter will discuss the major capacity constraint problem which CP is facing on its western mainline between Calgary and Vancouver. Alternative solutions to this problem are outlined in this chapter. A brief history of the western mainline's difficult mountain section precedes the discussion of the capacity constraint problem.

2.1 The Early Years

The Canadian Pacific Railway Syndicate and the Dominion government signed a contract on October 21, 1880 which laid out the agreement for the construction of the transcontinental railway. The Canadian Pacific Railway Company was incorporated on February 16, 1881, just one day after Parliament had approved the terms of the contract.

One provision in the contract called for the route to go through the Yellowhead Pass. The government of Sir John A. Macdonald had chosen this Pass on the basis of Sanford Fleming's surveys. The CPR had a more southerly route in mind. It commissioned Major A. B. Rogers, an American engineer, to search for a pass through the mountain barriers. By the end of the 1881 surveying season, Rogers had decided that the Kicking Horse Pass would provide the route through the Rockies. The formidable granite walls and spires of the Selkirks were the last remaining
obstacle. If a pass could not be found, the railway would have to follow the 'Big Bend' of the Columbia River, which partially circumvents the Selkirks.

In 1883, Rogers located a relatively low level pass (4275 feet versus the 5337 foot crest of the Kicking Horse Pass) which today bears his name. The CPR applied to the government for permission to divert the route through this Pass. Sanford Fleming was dispatched to report on the efficacy of this route. His positive recommendation led to the government approval in the fall of 1883.

The route would, after Golden,

...parallel the Columbia, crossing it at Donald and running on to Beavermouth, where the Columbia is joined by the Beaver River. The line would then ascend the eastern slopes of the Selkirks to Roger's Pass (altitude 4,275 feet) by following the Beaver and its tributary, Bear Creek, and run down the western slope in the valley of the Illecillewaet River to the site of Revelstoke and a second crossing of the Columbia, which in the interval had made a great swing around the northern end of the Selkirks.!

The line was constructed through Roger's Pass in 1885, but not without protest. A book, outlining the folly of this route, surfaced in 1885. The anonymous author voiced strong objections.

I do not hesitate to say that this will be a
The Railway attempted to convince its passengers, and perhaps itself, that it had engineered a solution to the avalanche problem. Less than seven years after the completion of the mainline, the Company's description of the journey through the Pass matched the loftiness of the surrounding peaks.

The line here leaves the Beaver Valley and turns up Bear Creek along continuing grades of 116 feet to the mile. The principal difficulty in construction on this part of the line was occasioned by the torrents, many of them in splendid cascades, which come down through narrow gorges cut deeply into the steep slopes along which the railway creeps. The greatest of all these bridges crosses Stoney Creek - a noisy rill flowing in the bottom of a narrow, V-shaped channel, 295 feet below the rails - one of the loftiest railway bridges in the world. All of the difficulties of the railway from snow in the winter occur between Bear Creek and the summit on the east and for a similar distance on the west slope of the Selkirks,
and these have been completely overcome by
the construction, at vast expense, of sheds,
or more properly tunnels, of massive timber-
work.  

The Railway's reassuring prose was swept away, along with
its snowsheds, by thundering avalanches. In 1899, eight people
were killed in an avalanche which engulfed Roger's Pass station.
In 1910, sixty-two people died in a single avalanche. Instead of
diverting "round the River Columbia", the Railway undertook a
more direct approach—a tunnel. The five-mile long Connaught
Tunnel was completed in 1916. Originally, it was double-tracked,
but it was later switched to single-track in 1958, in order to
accommodate taller rolling stock.

The Canadian Pacific Railway has come a long way from the
brisk November day in 1885 when Donald Smith pounded in the last
spike. Smith's symbolic act had raised the capacity of the
western mainline from zero to some stated level. Initially, the
Railway had a surplus of mainline capacity. William Van Horne
predicted that "...three or four trains each way will carry all
the business to be done...".

Over the years, CP has increased its mainline capacity as
its traffic grew. Investments designed to increase capacity fall
into two categories: divisible and indivisible. Divisible
investments add to capacity in a continuous fashion. A portion
of a divisible investment will add to capacity, e.g., connecting
additional diesel units to a train will enable the train
capacity to be expanded. Some examples of divisible capacity
improvements include:
1. Longer and heavier trains (increased axle loading)
2. Longer sidings
3. Reducing the distance between passing places
4. Increasing the speed of operations
5. Unit trains
6. Increased locomotive power, including robot engines
7. Central traffic control

Indivisible investments increase capacity in a "lumpy" fashion, e.g. a 95% complete tunnel does not add to capacity, whereas the completed tunnel will. Examples of this type include the building of the Spiral Tunnels near Field, B.C., and the Connaught Tunnel under Roger's Pass. These investments decreased the grade with the result of allowing heavier trains to move equipped with the same engine power. Once the tunnels were in place, a quantum change in rail capacity was realized.
2.2 Capacity Problem

CP Rail is now beginning to experience bottlenecks on its western mainline. Given its traffic forecasts and present plant, the Railway will face capacity constraints in the early 1980's.

Defining capacity

The term capacity has a number of meanings. Transport Canada provides the following definition:

[Capacity is] the number of tons or the number of vehicles of various types which can pass through a transportation facility in a given period of time...

It is important to note that the concept of capacity is multi-dimensional; time is as crucial to the definition as quantities.

A distinction can be drawn between absolute capacity and sustainable capacity. Absolute capacity would mark the physical limits of traffic movement in a given period of time, given the existing plant. Sustainable capacity is that volume of traffic that can be sustained over an indefinite period of time, given the existing plant. This distinction is important. For example, a specific line of rail track may have a sustainable capacity of ten trains per day. By deferring maintenance, perhaps fifteen trains per day can move. This is absolute capacity. In the longer term, however, maintenance cannot be ignored. Therefore, in this example, if our given period of time is two years, it may be possible to run fifteen trains per day for, say, a year
before maintenance becomes critical. A relatively longer maintenance period would now be required than if maintenance was carried out every three months. The effective sustainable capacity is ten trains per day under either alternative. By deferring maintenance, the railway runs a higher risk of derailment, which would reduce its throughput.

The current capacity problem

Railway and government forecasts indicate that the western mainline is approaching sustainable capacity in the near future.

In 1975, Transport Canada issued a report on the state of freight transportation in Canada. Based on freight volume estimates developed by the Transportation Development Agency, the Report concludes that certain rail links will begin to experience capacity constraints in the coming decade. In particular, "...major freight capacity problems will occur on western rail links, particularly in the western mountain region..."7 the Report goes on to forecast the capacity of the Golden-Vancouver link as being 30 trains per day in both directions.8 (A CP source indicated that this could be halved to determine the number of trains moving in one direction).

A track profile of CP's western mainline is found in Figure 1, part a. Four steep westbound grades can be identified, namely the climb up to Stephen, Glacier, Clanwilliam, and Notch Hill. The westbound haulage capacity (of a 3000 horsepower diesel unit) associated with the western mainline is contained in Figure 1, part b. The four steep grades are the major
Figure 1

Track Profile and Westward Haulage Capacity from Dunmore (Medicine Hat) to Vancouver

C.P. Rail
Vancouver
11/22/78
CP Rail has embarked on grade revision projects at three locations, with the intention of reducing the westbound grades to a maximum grade of 1%. The double-tracking projects are taking place at Clanwilliam (4.5 miles), Notch Hill (11 miles), and Stephen (5.5 miles).

CP has identified its western mainline bottleneck as being that section of track between Stoney Creek and Glacier. The westward haulage capacity of a diesel unit is at its lowest point on the Glacier grade (Figure I). CP has estimated that the sustainable capacity of this section is fifteen westbound trains per day. The forecasts in Table I indicate that by 1982, given the present plant, the mainline would not have sufficient sustainable capacity to handle the projected traffic. As mentioned previously, the distinction between sustainable and absolute capacity is crucial. The mainline could handle more than fifteen westbound trains per day for some limited period of time. This paper is adopting CP's stated capacity level (fifteen trains) as being the sustainable capacity, which is then compared to net tonnes in Table II. The adoption of the figure of fifteen westbound trains per day is open to debate. An argument could be made that sustainable capacity is, say, 14 or 16 trains per day. The selection of a specific figure has significant implications, both as to the timing and financial viability, when evaluating any potential investment which would increase capacity. This will be discussed at greater length in the next chapter.

The traffic forecasts are another crucial area. This paper
## TABLE I

**Forecasted traffic-Westbound Trains**

**Present Plant**

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<tbody>
<tr>
<td><strong>Coal</strong></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td><strong>Grain</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potash</td>
<td>3.04</td>
<td>3.06</td>
<td>3.17</td>
<td>3.19</td>
<td>3.23</td>
<td>3.24</td>
<td>3.28</td>
</tr>
<tr>
<td>Sulpher</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canmore Coal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Passenger</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>General Merchandise</td>
<td>6.00</td>
<td>6.17</td>
<td>6.34</td>
<td>6.50</td>
<td>6.67</td>
<td>6.84</td>
<td>7.00</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>13.19</td>
<td>13.38</td>
<td>14.16</td>
<td>15.06</td>
<td>15.66</td>
<td>16.03</td>
<td>16.23</td>
</tr>
</tbody>
</table>

**Note:**
1. The coal and bulk (grain, potash, sulphur, and Canmore Coal) train requirements have been calculated from the net tonnage figures in Table II.
   a) It is estimated that each CP coal train will carry 9003 net tonnes (CP figure).
   b) The bulk requirements used the October, 1976 figures (see Table IV) as a base. These were modified downward, as the 1978 bulk tonnage forecast is slightly less than the 1976 forecast. Estimated that 3.15 trains per day would be required in 1979. The revised forecast, based on 1978 data, indicates that 3.04 trains will be required in 1979.

2. The passengers and general merchandise train requirements are drawn from the 1976 forecast (see Table IV).
**TABLE II**

Forecasted Westbound Commodity Tonneages

(Million net tonnes)

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<tbody>
<tr>
<td>Coal</td>
<td>10.36</td>
<td>10.36</td>
<td>12.00</td>
<td>14.36</td>
<td>15.63</td>
<td>16.27</td>
<td>16.27</td>
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<tr>
<td>Grain</td>
<td>4.55</td>
<td>4.55</td>
<td>4.64</td>
<td>4.73</td>
<td>4.73</td>
<td>4.82</td>
<td>4.82</td>
</tr>
<tr>
<td>Potash</td>
<td>1.14</td>
<td>1.18</td>
<td>1.27</td>
<td>1.32</td>
<td>1.41</td>
<td>1.45</td>
<td>1.54</td>
</tr>
<tr>
<td>Sulphur</td>
<td>1.73</td>
<td>1.73</td>
<td>1.82</td>
<td>1.73</td>
<td>1.73</td>
<td>1.63</td>
<td>1.63</td>
</tr>
<tr>
<td>General Merchandise</td>
<td>4.23</td>
<td>4.55</td>
<td>4.73</td>
<td>4.86</td>
<td>5.09</td>
<td>5.27</td>
<td>5.54</td>
</tr>
<tr>
<td></td>
<td>22.14</td>
<td>22.50</td>
<td>24.59</td>
<td>27.13</td>
<td>28.72</td>
<td>29.57</td>
<td>29.93</td>
</tr>
</tbody>
</table>

Source: CP Rail, January, 1978. These are the Company's most probable forecasts.
is utilizing CP's "most probable" forecasts. If their "minimum" forecasts turned out to be the actual traffic levels in future years, the Railway would not be facing a capacity problem until at least 1986, and probably much later than that (Table III).

It is evident that there is uncertainty regarding both traffic forecasts and the precise measure of sustainable capacity. However, in order to carry out a financial evaluation of this project, figures must be selected. Since both Transport Canada and CP Rail have set capacity at 15 westbound trains per day, it is not unreasonable to adopt this figure as sustainable capacity for the purposes of evaluation. Of course, more than 15 trains per day could move in the short-term, and this would have implications as to the timing of the project. Costing data relating to this short-term capacity increase are however, not available.

It is reasonable to use the "most probable" traffic forecasts for the major calculation. The effect of a range of traffic forecasts on the project evaluation will be ascertained in the following chapter.
TABLE III

Forecasted Westbound Commodity Traffic
(million of net tonnes)

Pessimistic forecast

|-------|-------|-------|-------|-------|-------|-------|-------|

TABLE IV

Forecasted traffic (westbound trains)

Present plant - most probable estimate

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</thead>
<tbody>
<tr>
<td>Coal</td>
<td>3.09</td>
<td>3.64</td>
<td>4.27</td>
<td>4.58</td>
<td>4.69</td>
<td>4.88</td>
<td>4.88</td>
</tr>
<tr>
<td>Bulk</td>
<td>3.15</td>
<td>3.17</td>
<td>3.29</td>
<td>3.39</td>
<td>3.47</td>
<td>3.57</td>
<td>3.65</td>
</tr>
<tr>
<td>Passenger</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
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</tr>
<tr>
<td>General Merchandise</td>
<td>6.00</td>
<td>6.17</td>
<td>6.34</td>
<td>6.50</td>
<td>6.67</td>
<td>6.84</td>
<td>7.00</td>
</tr>
<tr>
<td>TOTAL</td>
<td>13.24</td>
<td>13.98</td>
<td>14.90</td>
<td>15.47</td>
<td>15.82</td>
<td>16.29</td>
<td>16.53</td>
</tr>
</tbody>
</table>

Source: CP Rail, October 1976
2.3 Alternatives

A number of alternatives to increase mainline capacity are available to the Railway. These will be discussed under the subheadings of divisible and indivisible investments.

Divisible investments

The sustainable capacity of the bottleneck could be increased by means of divisible investments. Additional train sets (locomotives, robots, rolling stock, and cabooses) could be bought and inserted into the system. The result of this would be increased queuing times at the bottleneck, and hence increased transit times. This would adversely affect the quality of service offered by CP. Additional yard, sidings, and crews would be necessary under this scheme.

There is also the question of adding more locomotive power at the bottleneck, which would lead to greater speeds up the grade and/or longer trains. At the present time, up to thirteen locomotives are required to move trains up the Roger's hill. Four locomotives are located at the head end, four robots are placed in the middle of the train, and four to five "pushers" are added at the tail end. There are engineering problems associated with adding locomotives. The head end is restricted to 24 driving axles (six driving axles per locomotive) due to the drawbar-pull stress points. The first car has to endure the stress of pulling all the cars behind it. The possibility exists of adding robot units or tail end pushers. However, additional
units on the tail end can lead to unacceptable "buff" forces. This is essentially the reverse of drawbar stress. If the engineering difficulties could be overcome, the lengthening of trains would still mean lengthening the sidings, and this is a costly undertaking in the mountains.

CP can increase capacity by making divisible investments. However, these investments would lead to a lower quality of service to the customer, e.g., increased transit times. CP may feel that competitive forces will not allow an increase in rail transit times. Divisible investments would also result in increasing variable costs, which may rise faster than the profit CP makes on the additional traffic. (This will be delved into more fully in a later chapter).

Indivisible investments

A major indivisible investment could also increase capacity. One possibility would be the electrification of the mountain mainline. An electrified line has significant advantages over diesels when the line contains steep grades. The cost of implementing this solution—$300 million in 1975 dollars—is the major drawback to this alternative.

A second track could be constructed in order to reduce the grade and curvature for the westbound trains. The Connaught tunnel, completed in 1916, had reduced the grade to 2.2%. Double-tracking could reduce the grade to 1%. The Railway could achieve this in two alternative ways. The first possibility would be to increase the size of the present tunnel in order to
facilitate double-tracking. This tunnel had originally been double-tracked, but the introduction of higher rolling stock had forced the conversion to a single track in 1958. This alternative would require the construction of two spiral tunnels below the existing tunnel, due to the 1% grade requirements. The engineering difficulties, resulting traffic delays, and tight curvatures in the tunnels has lead to the rejection of this alternative.

The second alternative would include building a new eight-mile long tunnel under the Connaught tunnel. Eleven miles of new track would be built on the Beaver Valley approach. This would reduce the grade to 1% and reduce the maximum curvature to 6%. This is the alternative that CP has selected. The reduced grade and curvature associated with the nineteen miles of track would increase the mountain mainline capacity from the present fifteen trains per day to nineteen trains per day (westbound). The total cost of this project is estimated to be $102 million (1978).
Footnotes


4. Van Horne to Minister of Railways, May 19, 1884.

5. A.F. Joplin and P.J. Detmold, "Rail Capacity—Will there be sufficient?", Address to the Canadian Transportation Research Forum, Vancouver, June, 1976, p. 2.


9. "Economic Analysis Of Capital Spending Projects Required To Construct Second Main Track At Stephen, Beaver, Clanwilliam, And Notch Hill With Maximum One Per Cent Compensated Grade And 6% Curvature." (Vancouver: CP Rail, 1976), p. 11.


CHAPTER 3 FINANCIAL ANALYSIS

This chapter will present a financial analysis of the proposed Beaver tunnel investment. The previous chapter has introduced the uncertainty associated with a) quantifying sustainable capacity, and b) traffic forecasts. The first section of this chapter reviews the evaluation procedure utilized. The second section contains the financial analysis. The sensitivity of this analysis to changes in the traffic forecast and changes in capacity is examined in the Appendix.

3.1 CP Rail's Criteria For Investment

The most widely recommended method of evaluating proposed capital investments is discounted cash flow analysis. A capital investment will generate its benefits in future years. A firm wants to know whether the benefits generated over a number of years justify the expenditure of monies, which usually occur early in the time frame. Four points should be noted. First, the evaluation method is incremental, i.e. the firm is comparing incremental benefits to incremental costs. The incremental benefits include such items as savings brought on by the investment, and contribution margins (excess of revenue over variable costs) supplied by any additional production generated by the investment.

Second, since benefits accrue over a period of years, the time value of money is an important consideration. The future costs and benefits of a project must be discounted to base year
in order to reflect the time value. The analysis is concerned with cash flows and not accounting profits, as the non-cash expense of depreciation impacts accounting profits. This is not to say that depreciation is irrelevant to discounted cash flow analysis. In Canada, the Income Tax Act allows taxpayers to deduct a stated percentage of the asset every year for tax purposes. This deduction is called Capital Cost Allowance (CCA). As the CCA will reduce the taxpayer's income tax payable (a cash outflow) in any given year, it is a key consideration in determining net cash flows. A higher CCA rate will allow greater deductions in early years than would a lower rate, and hence defer taxes to later years. The time value of money means that a relatively higher CCA rate will be more favourable when utilizing discounted cash flow analysis.

Third, the discount rate should reflect the firm's marginal cost of capital. The cost of capital should be the "...the firm's weighted average cost of raising funds at the margin." If the discounted cash inflows exceed the discounted cash outflows, the return to the firm is greater than its marginal cost of capital. The investment is deemed to be beneficial to the firm, as the wealth of the owners has been increased. If discounted outflows are greater than the inflows, the firm is earning a lower return than its marginal cost of capital. On this basis, the investment cannot be justified.

Fourth, as the cash flows are accruing in the future, there is uncertainty associated with forecasting their magnitude.

CP Rail's criteria for investment conform to the above method. Its guidelines state:
When the investment of additional capital to serve an existing market segment is contemplated, after establishing that existing traffic is profitable, the new investment must be considered to be incremental and must be supported by the incremental savings or contributions which it generates.
3.2 Financial Evaluation

The financial analysis of the Beaver project has been performed internally by the Railway. Estimates of the costs and benefits have been completed. The discount rate selected was 12% (after-tax).³

Costs

The expenditure timetable together with the costs of the Beaver project are presented in Table V. These are CP's figures, developed from internal engineering data. The construction would stretch over a four-year period. The present value of the costs, based on a discount rate of 12%, are determined in Table VI.

Benefits

The benefits of the project are twofold, namely savings and contributions from additional traffic.

1. Savings

The investment would reduce the grade and curvature of the mainline in the Beaver Valley. This would lead to a reduced need for diesels, crews, fuel, and maintenance. The exact value of the savings associated with the tunnel was not obtainable from CP. However, it is known that the present value of the Beaver project costs is $73.8 million (Table VI). Company estimates also indicate that, given the current tax rates and capital cost allowances, the present value of the cash shortfall (based on the most probable traffic forecasts) required to earn a 12% rate of
<table>
<thead>
<tr>
<th>Year</th>
<th>Expenditure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1979</td>
<td>$500,000</td>
<td>engineering investigation and design approach</td>
</tr>
<tr>
<td></td>
<td>$1,100,000</td>
<td>to tunnel</td>
</tr>
<tr>
<td></td>
<td></td>
<td>engineering investigation and design for tunnel</td>
</tr>
<tr>
<td>1980</td>
<td>$660,000</td>
<td>land purchase</td>
</tr>
<tr>
<td></td>
<td>$8,340,000</td>
<td>grading and track for approach to tunnel</td>
</tr>
<tr>
<td></td>
<td>$24,000,000</td>
<td>tunnel construction</td>
</tr>
<tr>
<td>1981</td>
<td>$14,500,000</td>
<td>grading and track for approach to tunnel</td>
</tr>
<tr>
<td></td>
<td>$28,000,000</td>
<td>tunnel construction</td>
</tr>
<tr>
<td>1982</td>
<td>$900,000</td>
<td>signals, buildings, fences, etc</td>
</tr>
<tr>
<td></td>
<td>$13,908,000</td>
<td>grading and track for approach to tunnel</td>
</tr>
<tr>
<td></td>
<td></td>
<td>plus track in tunnel</td>
</tr>
<tr>
<td></td>
<td>$10,092,000</td>
<td>tunnel construction</td>
</tr>
</tbody>
</table>

TOTAL $102,000,000 - (undiscounted)

Source: CP Rail (March 1978 estimates)
TABLE VI

Beaver project

Forecasted capital costs (1978 constant $)

<table>
<thead>
<tr>
<th>Year</th>
<th>Forecasted Costs</th>
<th>Present Value @ 12%</th>
<th>Present Value @ 12%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1979</td>
<td>$1,600,000</td>
<td>$1,428,800</td>
<td></td>
</tr>
<tr>
<td>1980</td>
<td>$33,000,000</td>
<td>$26,301,000</td>
<td></td>
</tr>
<tr>
<td>1981</td>
<td>$42,500,000</td>
<td>$30,260,000</td>
<td></td>
</tr>
<tr>
<td>1982</td>
<td>$24,900,000</td>
<td>$15,836,400</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$102,000,000</td>
<td>$73,826,200</td>
<td></td>
</tr>
</tbody>
</table>
return (after tax) is $39.9 million. This calculation includes project costs and the associated tunnel savings.

2. Contributions from additional traffic

This paper's computation of the benefits differs from CP's, in that contributions from additional traffic are included here. The Bailway excludes the contribution from additional traffic in its evaluation. But an argument can be made for its inclusion. The investment would permit additional trains to move over CP's western mainline. Any revenues greater than variable cost--contribution margin--accruing from this additional traffic should be classified as a benefit derived from the investment, as the additional trains would not have moved if the investment was not made.

The sustained capacity of the present plant is fifteen westbound trains per day. Given the forecasted traffic mix in Table I, the Railway would reach sustainable capacity in 1982. If the investment is undertaken, mainline sustainable capacity would be increased by four trains per day. The contributions generated from the additional traffic are detailed in Tables VII and VIII. It is forecast that coal will provide the greatest portion of the incremental traffic. The inclusion of the contribution from additional traffic in the evaluation assumes that the additional coal would not move on CP's lines if the tunnel is not built, i.e., CP could not derive any portion of this contribution if an alternative route was selected. The contribution per ton of coal moved is derived from CP Rail. This is an after-tax contribution, based on expected coal rates, and
### TABLE VII

**Contributions from additional coal traffic**

#### A) Gross contributions

<table>
<thead>
<tr>
<th>Year</th>
<th>Additional coal moved (millions of tons)</th>
<th>Contribution per ton</th>
<th>Total Contribution (millions)</th>
<th>Discount Rate = .12</th>
<th>Present Value (millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1983</td>
<td>1.273</td>
<td>$2.22</td>
<td>$2.83</td>
<td>.567</td>
<td>$1.6</td>
</tr>
<tr>
<td>1984</td>
<td>1.909</td>
<td>2.22</td>
<td>4.24</td>
<td>4.45</td>
<td>18.9</td>
</tr>
<tr>
<td>2013</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**PRESENT VALUE OF CONTRIBUTIONS $20.5 million**

#### Less:

#### B) Train sets required

<table>
<thead>
<tr>
<th>Year</th>
<th>Required</th>
<th>Cost per set (Millions)</th>
<th>Total (Millions)</th>
<th>Discount Rate = .12</th>
<th>Present Value (Millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1983</td>
<td>1.5</td>
<td>$9.0</td>
<td>$13.5</td>
<td>.567</td>
<td>$7.65</td>
</tr>
<tr>
<td>1984</td>
<td>.5</td>
<td>9.0</td>
<td>4.5</td>
<td>.507</td>
<td>2.28</td>
</tr>
</tbody>
</table>

**PRESENT VALUE OF CONTRIBUTIONS (Gross contribution less train sets) $10.57 million**

Footnotes:

1. The base year for the present value contributions is 1978.
2. Assume that the tunnel is completed in 1982, and additional...
Footnotes - TABLE VII - continued

2. coal starts moving in 1983. It is assumed that sustainable capacity is reached in 1982, during which 14.4 million tonnes of coal are moved (see Table II). In 1983, with the tunnel completed, 15.6 million tonnes of coal move. It is assumed that the difference between 1982 and 1983 (1.3 million tonnes) would not have moved if the tunnel was not in place. The additional coal moved is therefore a benefit associated with the tunnel. The same rationale is applied to the coal traffic moving between the years 1984 and 2013 (1.9 million tonnes per year).

3. A CP source indicated that approximately 1.1 train sets are required for every additional million tonnes of coal that are to move. Approximately two additional train sets will be required to move the additional 1.9 million tonnes of coal beginning in 1984. 1.5 of that train sets are bought in 1983, as only 1.3 million tonnes (additional) will move, and the extra .5 of a train is added in 1984.

4. Cost per train set is $9.0 million (1978 $) - CP Source

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engines</td>
<td>$4.5 million</td>
</tr>
<tr>
<td>Rolling Stock</td>
<td>4.0</td>
</tr>
<tr>
<td>Miscellaneous &amp; Caboose</td>
<td>.5</td>
</tr>
<tr>
<td></td>
<td>$9.0 million</td>
</tr>
</tbody>
</table>
TABLE VIII

Negative Contribution from additional grain traffic

<table>
<thead>
<tr>
<th>Additional grain moved (millions of tonnes)</th>
<th>Loss per tonne</th>
<th>Total loss (millions)</th>
<th>Discount = .12</th>
<th>Present Value (millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1984</td>
<td>0.091</td>
<td>7.69</td>
<td>.699</td>
<td>.507</td>
</tr>
<tr>
<td>1985</td>
<td>0.091</td>
<td>7.69</td>
<td>.699</td>
<td>3.944</td>
</tr>
<tr>
<td>2013</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

PRESENT VALUE OF GRAIN LOSS $3.1

Footnotes:

1. This is the CP estimate of additional grain moved if the tunnel is built.

2. The loss per tonne is the variable cost (exclusive of subsidies) that Canadian Railways absorbed in 1977, as determined by Carl Gravely - Vancouver Express 15 January 1979.
does not include the costs of the additional train sets that would be needed to handle the greater amounts of coal traffic. The cost of the train sets has been obtained from CP sources. This cost is introduced into the cash flow analysis as the train sets become necessary (Table VII).

Any additional grain traffic that is generated would provide a negative benefit, as CP does not recover its variable costs of moving grain. The incremental loss is determined in Table VIII.

The complete financial analysis is presented in Table IX. The present value of the benefits derived from the proposed investment are considerably less than the present value of the costs. A cash shortfall of some $31 million is indicated. Given CP's desire to earn a 12% rate of return, it is apparent that CP is not enthusiastic about proceeding with this project at this time. The Appendix will examine the sensitivity of this finding to changing assumptions.
TABLE IX

Financial Analysis of Beaver tunnel
(millions of discounted $)

<table>
<thead>
<tr>
<th>Costs</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital costs (years 1-4) (^1)</td>
<td>$ 73.8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Benefits</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Savings</td>
<td>$ 33.9</td>
</tr>
<tr>
<td>Contributions from additional traffic</td>
<td></td>
</tr>
<tr>
<td>Coal (^2)</td>
<td>10.6</td>
</tr>
<tr>
<td>General Merchandise (^3)</td>
<td>1.0</td>
</tr>
<tr>
<td>Grain (loss) (^4)</td>
<td>(3.1)</td>
</tr>
</tbody>
</table>

Financial Shortfall  \(\$ 31.4\)

Footnotes:
1. TABLE VI
2. TABLE VII
3. Source: CP Rail
4. TABLE VIII
Footnotes


3. CP wants to earn 12%(after-tax) on prospective investments. The Snavely Report on the Costs of Transporting Grain set CP Rail's weighted average cost of funds at 20.8% before taxes and 11.31% after taxes.


5. CP included the contribution from additional traffic in its 1976 analysis, but clearly excluded it in their 1978 analysis, where it stated "...that none of the above calculations include any financial benefits generated by additional contributions from traffic which otherwise could not have moved account capacity restrictions", p.6. However, CP's "Guidelines for Developing the Economies of Major Spending Proposals" do mention contributions. See footnote 2 above.

6. Other bottlenecks would then become crucial. It must be noted that the western mainline is mostly single-tracked. Transport Canada states that "...based on the mix of traffic (unit trains, fast freights, slow freights, passenger trains) presently experienced, it can be expected that mainline rail links, single track with centralized traffic control, will have a capacity limitation of 30-40 trains in both directions." Transport Canada, op.cit., p.13. By halving the figures to obtain a single direction capacity, the numbers become 15-20 trains per day.

7. For example, CP might ship the incremental coal traffic to Prince Rupert via CN's line. If this was possible, CN and CP would split the contribution. However, this type of alternative is beyond the scope of this paper.
CHAPTER 4 ECONOMIC AND FINANCIAL CRITERIA

In a perfectly competitive, or first-best world, prices equal marginal costs and resources are allocated in their most efficient manner. A marginal cost pricing strategy can lead to financial deficits in decreasing cost industries. An indivisible or lumpy investment such as the Beaver tunnel can be a source of decreasing costs.

The first section of this chapter outlines the theory of marginal cost pricing, with an emphasis on its application to decreasing cost industries. It will be shown that this is a situation where economic and financial criteria diverge.

The second section explains that, given that the real world is imperfectly competitive, marginal cost pricing is not necessarily the optimal pricing strategy. Rather, value-of-service pricing can satisfy both economic and financial criteria.

4.1 Pricing In A First-best World

The concept of welfare

Microeconomic theory assumes that people derive utility from the consumption of goods. Utility is, in itself, not measurable. Consequently, interpersonal comparisons cannot be made, and it is thus impossible to set maximization of utility as a welfare objective.

The usual objective of welfare theory is the maximization
of net benefits to society. The benefit is the public's willingness to pay, and benefits can be measured by means of a demand curve. Costs can be thought of as benefits which must be foregone.

The economist's demand curve is a collection of points which relate the public's willingness to pay for a good for the various quantities offered. The area below a demand curve represents the worth of the goods to society. The worth is the relative willingness to pay, i.e., what the public is willing to forego in terms of alternative goods available.

At price $P_b$ in Figure 2, the quantity $Q_b$ is demanded. The triangle $APB$ is known as the consumer's surplus, which is the "...maximum sum of money a consumer would be willing to pay for a given amount of the good, less the amount he actually pays."\(^1\) The diagram shows that at price $P_b$, many consumers are able to buy at a price below the marginal value they attach to the good. The price charged is the consumers' marginal willingness to pay. If no market distortions or other externalities exist, the demand curve is the marginal benefit curve for society.

The marginal cost curve indicates what each additional increment of production will cost. Cost is defined to be the loss of benefit, or the opportunity foregone, that society incurs by producing that item of output. Assuming no externalities, the opportunity costs are the market price of the inputs.

Welfare economic theory desires to maximize net benefits to society. Under perfect competition, net benefits are maximized where $MB=MC$. This indicates that the marginal benefit to society

\(^1\) The definition of consumer's surplus is slightly different in the original text. It should be noted that the consumer is willing to pay more than the actual price they pay. The surplus is the difference between these two values. This is a common concept in microeconomics and helps in understanding consumer behavior and market equilibrium.
Figure 2

CONSUMERS' SURPLUS

[Graph showing the concept of consumers' surplus with a demand curve and corresponding calculations]
of the last item produced just equals the marginal benefit foregone (cost) by producing that item. The price must equal \( MB=MC \) if the benefits are to be maximized. To put it another way, "...the optimum of the general welfare corresponds to the sale of everything at marginal cost."\

Marginal cost pricing, decreasing costs, and financial deficits

Marginal cost pricing can lead to financial deficits under conditions of decreasing costs. The standard example is the "natural" monopoly, where economies of scale lead to decreasing average costs (Figure 3). First, the monopolist sets his price \( P_m \) such that \( MR=MC \). There is no financial deficit. Assuming the demand curve is the marginal benefit curve, the welfare maximizing solution sets \( P=MC \), at the point where the MC curve intersects the demand curve (or the marginal willingness to pay). This leads to price \( P_w \) and output \( Q_w \). Thus, the welfare maximizing solution has led to increased output and lower prices. Net benefits (the area under the marginal cost curve) have increased. However, average cost exceeds price, and a financial deficit results. The shaded rectangle ABEF denotes the magnitude of the financial deficit. A deficit can be avoided if the monopolist is allowed to set its price \( P_m \), or if a regulatory price \( P_r \) is imposed. But the deficit is avoided only at the detriment of welfare considerations. Output \( Q_r \) is produced under the regulatory solution. This is \( Q_w-Q_r \) less than would have been produced under the welfare maximizing solution.
Figure 3

Pricing and financial implications
for a Natural Monopoly

Source: Adapted from J. Hirshleifer, Price Theory and Applications: p.290
The welfare loss is the triangle between $Q_w$ and $Q_r$, bounded by the demand curve (marginal willingness to pay) and the MC curve (marginal cost of production). One can see that the absence of a regulatory solution would lead to an even greater welfare loss.

In Figure 3, the relationship between costs and output is a smooth continuous function. Indivisible investments can bring on decreasing average costs. In Figure 4, the plant sizes between A and E are not attainable because of the physical characteristics of the "lumpy" investment. The industry can produce beyond $Q_x$, with plant size A. This leads to sharply increasing marginal costs. An alternative is the undertaking of an indivisible investment in order to attain plant size B. (This assumes that the smaller increments to capacity do not exist). The long-run curves, LRMC and LRAC, are not continuous, as would be the case if an infinite number of SRMC and SRAC curves were possible. In this Figure, only two plant sizes are attainable. If the cost-input relationships $SRMC^1$ and $SRAC^1$ are given, the relationship to its right, $SRMC^2$ and $SRAC^2$, is attainable only by means of an indivisible expenditure. An example of such a "lumpy" investment would be a tunnel or a bridge. The completed tunnel will provide a step-like increase in capacity. Half a tunnel would have no effect on capacity.

When this investment is completed, i.e. plant size B has been attained, output to the right of $Q_x$ leads to lower average costs than what would have been the case if the investment had not been undertaken. In this way, the investment leads to decreasing average costs in the output range $Q_x$ to $Q_y$. 
Figure 4

Indivisible Investments

In Figure 4, assume that output is $Q_x$, with cost-output relationship $SRMC^1$ and $SRAC^1$. The industry is approaching capacity. Plant A can produce beyond output $Q_x$. Beyond this point, average and marginal costs rise rapidly. Given plant size A, the demand curve intersects the AC curve in a region of increasing costs. An indivisible investment is undertaken, leading to cost-output relationships $SRMC^2$ and $SRAC^2$. The average costs of plant A and B are equal at output $Q_x$. Given the plant size B, the demand curve intersects the AC cost curve in a region of decreasing costs. Setting $P=SMC$ anywhere in this range would lead to financial deficits.
4.2 Second-best World

In the real, or second-best world, imperfections exist in the marketplace. Marginal cost pricing may not lead to optimal resource allocation in any one industry due to violation of the marginal cost pricing rule in other sectors of the economy.

Value-of-service pricing

It has already been indicated that marginal cost pricing in a decreasing cost industry leads to a deficit. An alternative pricing strategy is value-of-service pricing (also known as price discrimination). Under value-of-service pricing, different consumers pay different prices. The demand curve in Figure 5 illustrates that certain buyers are willing to pay a higher price than P1, the intersection of the demand curve and the marginal cost curve. If a unique price P1 were established, the average cost would exceed average revenue, which would lead to a financial deficit. Price discrimination allows for the recovery of full costs by imposing higher prices on certain buyers. Jules Dupuit examined the pricing problem in an article written in 1849. A bridge served as an example. It connected a residential area with a factory. The workers were free to walk around the long way, and avoid the bridge. The toll of 5 centimes yielded 5000 francs per year, which was insufficient to cover average costs. Dupuit suggests a lower tariff for the workers. This could be achieved by dress distinction, a special pass, or by the time of day. He goes on to show how this tariff would yield
Figure 5

Price Discrimination

Price discrimination refers to a market practice whereby a single firm charges different prices to different buyers for the same product or service, or for different versions of the same product or service. This can occur in a variety of contexts, such as when a firm offers different prices to different customers depending on their willingness to pay, or when it offers different versions of the same product with different prices.

In the diagram, we see a graph with the x-axis labeled "Output" and the y-axis labeled "Price." The graph shows the relationship between price and quantity demanded. The curves labeled "AC" and "MC" represent the average and marginal cost curves, respectively. The demand curve is represented by "D." The graph illustrates how the firm sets different prices for different quantities of output, potentially maximizing profits by exploiting differences in consumer demand and willingness to pay.
revenue of approximately 8000 francs, which would be sufficient to recover average costs. The argument is then extended to railways and canals.

Dupuit was likely one of the earliest advocates of value-of-service pricing.

The (pricing) solution rests on the general principle that the price asked for should not be the cost of the service related to the producer, but a sum related to the importance which the consumer attaches to the service. Dupuit felt that goods or people should move as long as the variable costs are met. The minimum rate equals variable costs, while price discrimination is practiced on the beneficiaries who are willing to pay a higher rate in order to cover the financial deficit.

Value-of-service pricing has been advanced as an economically and financially acceptable solution in a second-best world. A perfectly-discriminating monopolist is, for example, economically efficient.

Since each buyer's marginal willingness to pay (demand price) is thus equal to the seller's Marginal Cost of production there is no social gain available for increasing or decreasing output. So the perfectly discriminating monopolist cannot be said to produce 'too little' or too 'much' from the point of view of economic efficiency.
The perfectly-discriminating monopolist does not exist in the real world. However, arguments have been made that value-of-service pricing is efficient in a second-best world. Baumol and Bradford state that marginal cost pricing will lead to deficits which must be overcome by taxation, and taxation will bring on distortions in the economy. Therefore, they argue that government revenue needs are a constraint in the quest for optimal resource allocation. Given that society is searching for a solution to this second-best problem, the authors advance the argument that the maximization of welfare will occur under a type of value-of-service pricing. Prices are determined by the elasticity of demand.

...the social welfare will be served most effectively not by setting prices equal or even proportional to MC, but by causing unequal deviations in which items with elastic demands are priced at levels close to their MC. The prices of items whose demands are inelastic diverge from their MC by relatively wider margins.

Value-of-service pricing is financially acceptable in the second-best world because it allows sellers to set their prices at a level equal to or above marginal costs, thereby reducing the consumers' surplus and eliminating the deficit which would have been brought on by the decreasing cost industry if a unique price equal to marginal cost had been set. It is important to note that traffic which can just pay its marginal cost does move under value-of-service pricing.
In summary, under first-best conditions, marginal cost pricing leads to optimal resource allocation and maximization of welfare to society. Under conditions of decreasing costs, marginal cost pricing will result in a financial deficit. This suggests that economic and financial criteria diverge.

Under conditions of second-best, however, value-of-service pricing overcomes the decreasing cost dilemma by eroding the consumers' surplus. An argument was presented which states that social welfare is maximized (under conditions of second-best) under a value-of-service pricing policy. The industry which practices value-of-service pricing can produce at the output where price equals marginal cost and still recover average costs.
Footnotes


This chapter will examine CP Rail's pricing strategy. A major pricing restriction that affects CP Rail is Statutory grain rates. These will be discussed in the second section of this chapter.

5.1 CP Rail's Pricing Strategy: Value-of-service

CP Rail has pursued a value-of-service pricing strategy since its inception. Under this pricing strategy, rates are set according to what the market will bear. The value-of-service pricing is common in the railroad industry.

The most familiar use of the value-of-service principle is found in railroad rate-making, where higher rates are charged for shipment of goods of higher value, the rate differentials being far higher than those which could be justified by any cost differential.

CP Rail fits the description of a third degree price discriminator, i.e. the buyers are segmented into groups which have different demand curves with different elasticities. The groups pay different prices, which entail varying contributions to the recovery of CP Rail's constant costs. Those groups having less elastic demand curves will make relatively larger contributions, as they have a greater ability to pay. However, a positive feature of this pricing strategy is that it allows
traffic to move that can barely afford to pay its variable costs. As long as the traffic pays a rate higher than its variable cost, it is making a contribution to CP Rail's constant costs.

Competition is a major force in determining the extent to which CP Rail can practice value-of-service pricing. Competition influences the buyers' elasticities, and competition from other transport carriers places an effective ceiling on CP Rail's prices.
5.2 CP Rail's Pricing Freedom

It is the policy of the Canadian government to grant a wide pricing latitude to Canadian railways. Of course, this was not always so. In the early twentieth century, the Board of Railway Commissioners was created in order that railway rates could be regulated. The federal Cabinet remained the final arbitrator.

Following World War Two, CP Rail applied to the (now) Board of Transport Commissioners for numerous rate increases to cover the costs of its post-war investments. The rate increases were large because the base on which the price increases could be made was shrinking. First, export grain moved at Statutory Rates. Second, trucking competition began to siphon off the Railway's high value, low bulk commodities. In 1958, the Diefenbaker government abrogated the railways' pricing freedom. It froze rail rates and introduced subsidization in lieu of freight rate increases.

In the following year, the MacPherson Commission was created to examine the whole question of freight rates. The Commission's report was a watershed for railway pricing in Canada. The Report of the Commission "...made the concept of competition the cornerstone of its new philosophy of rate regulation." The Commission noted the importance of value-of-service pricing, and of its acceptability to the Government.

Without the low rates a good deal of the bulk traffic would not have moved at all because transportation costs would have been too high in proportion to the value of the
commodity to make their shipment profitable—whereas the finished goods, because of their greater value, could and did move at higher rates. The railways thus obtained a volume of traffic which might not otherwise have come into being and they did so with the encouragement of the Federal Government which saw in the low-rate policy a further means of stimulating the development of primary production in Canada.*

The philosophy of the MacPherson Commission was embodied into the National Transportation Act of 1967. The legislators hoped to foster "...an economic, efficient, and adequate transportation system...", and competition was to be the foundation of this policy. In situations where it was in the public interest that railways should move traffic at non-compensatory rates, the federal government would provide a subsidy.

The Act was not the signal for total de-regulation. The Canadian Transport Commission was given the power to regulate railway rates if it was established that a rate(s) was prejudicial to the public interest (Section 23). The Act also prescribed that the minimum rate level should be variable cost, i.e. the rates must be compensatory.

The regulatory power of the C.T.C. With respect to railway rates has been used sparingly since 1967. On the whole, the National Transportation Act has
...brought about a large reduction in the regulation of railway pricing by the Canadian Transport Commission (formerly the Board of Transport Commissioners).

Restriction on CP Rail's pricing freedom

A major restriction on CP Rail's pricing freedom exists today. This restriction is commonly referred to as the Crow's Nest Rates, having been negotiated in an Agreement of the same name in 1897. The terms of the Agreement called for the C.P.R. to construct a railway from Lethbridge, Alberta to Nelson, B.C., via the Crow's Nest Pass. The C.P.R. would receive a cash subsidy of approximately $3.4 million from the Dominion government, and 3,755,733 acres of land from the British Columbia government. In return, the C.P.R. agreed to reduce its freight rates, in perpetuity, on grain and flour moving eastward to Port William.

At the time, the Agreement was attractive to both parties. The Railway received a cash subsidy and land grant for a line which provided access into the mineral-rich Kootenays. The Dominion government secured lower freight rates on grain, flour, and settlers' effects, fifty thousand coal-bearing acres to be chosen out of the provincial land grant, the right to regulate rates on all of the C.P.R.'s lines, and a concrete Canadian presence in an American-dominated region of southwest B.C.

The terms of the Agreement called for a rate reduction in
stages, with the final rate to become effective on September 1, 1899. These low rates only remained in effect until 1902, due to competitive pressures brought on by the Canadian Northern Railway. The Manitoba government had agreed to subsidize the latter railway's line as a quid pro quo for lower freight rates. The line was completed in 1902, and the C.P.R. lowered its rates from the Crow level in order to meet the competition.

This situation lasted until 1918, at which time the inflation brought on by the First World War led the government to suspend the Crow Rate. Declining grain prices on the world market brought grain rates down to the Crow level in 1922.

The suspension of the Agreement was lifted by the Mackenzie King government in 1924. The C.P.R. objected, and complied with the terms of the Agreement in the narrowest possible way. Only the 289 delivery points in existence at the time the Agreement was signed were allowed to use the rate. Points constructed after 1897 were charged a higher rate. This interpretation was upheld by the Supreme Court of Canada. That chain of events did not sit well with the King government, and it quickly moved to incorporate the Crow’s Nest Rates into the Railway Act. Thus, in 1925, the Crow’s Nest Rates became Statutory Rates.

In 1927, export grain moving to Pacific ports was made eligible for the Statutory Rates. The Port of Churchill was added later. In 1961, the Diefenbaker government included rapeseed in the list of grains eligible for the Statutory Rate.
The situation today

CP Rail receives 0.55 cents per tonne-mile for grain products that move under Statutory Rates. In the 1950's, it became apparent to CP that these rates were not compensatory, i.e. they did not cover the variable cost of moving the grain. However, the Prairie provinces did not agree. But it was not until 1975 that the federal government appointed the Snavely Commission to study the costs of transporting grain by rail in Canada. All interested and affected parties were encouraged to make submissions. The Commission then dealt methodically with each significant issue. The Report of the Snavely Commission justified CP Rail's position. Drawing on 1974 cost data, the Report indicated that CP Rail's revenue derived from Statutory Rates fell $54.1 million short of covering the variable cost of moving that grain.

Under the terms of the Railway Act, CP Rail cannot refuse to move export grain. This restriction on CP Rail's pricing freedom adversely affects its ability to recover constant costs. To put this another way, the Statutory Rates preclude the utilization of value-of-service pricing on the movement of export grain. Furthermore, it is possible that this pricing restriction can detrimentally affect the viability of potential investments, such as the Beaver tunnel. This possibility will be explored in the following chapter.
Footnotes


2. The Board of Transport Commissioners granted increases of 21% in 1946, 20% in 1949, 17% in 1951, 9% in 1952, 7% in 1953, and 11% in 1957.


5. Ibid, p. 150.

CHAPTER 6 POTENTIAL CONFLICT ASSOCIATED WITH THE BEAVER TUNNEL

This chapter will examine the potential conflict between the public desirability and the financial viability of the Beaver tunnel investment.

A financial analysis of the Beaver tunnel investment was undertaken in Chapter 3. It was clearly established that the proposed investment was not financially viable to CP Rail. This chapter will now turn to the question of the public desirability of the tunnel. This will be discussed under two headings: economic desirability and non-economic desirability.

To state the objective another way: do economic and non-economic factors exist which could lead to the project being desirable from a public point of view, even if the proposed investment is not financially viable to private investors?
6.1 Economic Desirability

Many of the economic benefits associated with the project have already been included in the financial analysis. Operating savings was one of the benefits. The tunnel would lead to a reduced need, and hence cost, for diesels, maintenance, fuel, and labour. Since costs can be considered to be opportunities foregone, reduced costs can be considered to be increased benefits. Resources are freed to flow elsewhere, while output has not diminished. The reduced cost may be passed on to the shippers in the form of lower freight rates, or it may increase CP Rail's profit and hence its return on investment. Lower freight rates would be an economic benefit accruing to shippers. CP Rail would pass benefits on to the shipper if competitive factors made it expedient to do so. In either case, the savings are a net benefit to Canada as a whole.

Another economic benefit is contributions from additional traffic that would not have moved if the tunnel was not built. The contribution margin (price less variable cost) which CP derives from the additional traffic has already been recognized as a benefit, and is included in the financial analysis above.

Based on the above benefits, the financial analysis has shown that the proposed tunnel investment is not financially viable. There are, however, additional economic benefits associated with this project that have not been included in the financial analysis. This section will introduce and quantify certain significant economic benefits, that are not exploitable by CP Rail, which may cause public desirability of the project.
to diverge from the financial viability.

A major constraint on CP Rail's ability to utilize price discrimination has been identified in Chapter 5. This constraint is Statutory grain rates. CP Rail moves a considerable amount of grain over its western mainline to the port of Vancouver. As this stretch of track has become more congested in recent years, the grain traffic has become subject to greater delays. There is a cost associated with these delays. The construction of the Beaver tunnel would ease congestion, lessen delay times, and hence reduce the grain car cycle time. CP Rail can presumably reap the benefits of lesser delays through price adjustments to its customers. As noted above, the rate on Statutory grain traffic cannot be altered. Therefore, with respect to Statutory grain traffic, the benefits of lesser delays accrue to the grain shippers.

The benefits accruing to the public from decreasing grain delays will be discussed under three headings; 1) reduced need for rolling stock, 2) reduced costs connected with grain shipment delays, and 3) contributions accruing to the grain producers from additional grain traffic that would not have moved if the tunnel was not built.

Reduced need for grain-related rolling stock

The construction of the tunnel would lead to a reduced need for rolling stock. This is an economic benefit and should be included in the overall economic analysis.

CP Rail did not include savings associated with grain-
related rolling stock in its financial analysis because it has not been purchasing grain-related rolling stock in recent years, and has no plans to purchase this type of rolling stock in the future as long as Statutory Rates remain in effect.\(^2\) Grain car shortages became the rule in the 1970's as the aging boxcar fleet diminished. The deteriorating situation forced the federal government to purchase grain hopper cars for the Canadian railways, paid for with public funds.\(^3\) In early 1979, the Canadian Wheat Board ordered a further 2000 hopper cars, at a cost of $82-$89 millions, to be paid for out of the Board's revenues.

Due to increasing volume and replacement considerations, additional purchases of grain hopper cars will have to be made in the coming decade. It is reasonable to assume that the cost of these cars will be borne by the federal government and/or the grain producers, as CP Rail has shown no inclination to purchase these cars due to the non-compensatory rates.

The construction of the Beaver tunnel would lead to a reduced car cycle period for CP Rail's grain traffic on its western mainline. A reduced car cycle period would translate into a reduced need for grain hopper cars.

The calculation of the present value of savings associated with a faster car cycle period are presented in Table X. The savings associated with a faster car cycle time are determined by estimating the potential savings in the grain car purchase program. Without the tunnel, it is assumed that 800 new hopper cars per year are required in the period 1983-1992. (It is estimated that 10,000 hopper cars will be required by Canadian
TABLE X

Economic benefit of reduced need for grain-related rolling stock
(Base year = 1978)
(Discount rate = .12)

If 800 hopper cars per year we need in the period 1983-1992, then the:

a) Economic benefit of 5 percent fewer cars
(.05) (800) ($43,000) = $1.72 million per year
Present value of savings (during 1983-1992) (d = .12)
$1.72 X 3.591 = $6.2 million
(t_{14-4})

b) Economic benefit of 10 percent fewer cars
Present value of savings (1983 - 1992, d = .12)
$1.72 X 3.591 = $12.4 million

Note: The capital costs of the hopper cars are $43,000 (1978 $)
railways in the next six years. If 50%, or 5000 cars, are needed by CP Rail, the average annual requirement is 833 cars.) If the construction of the tunnel is proceeded with, smaller number of cars are needed to maintain the same throughput. In 1974, for example, CP's average grain car cycle period was 28.5 days. It is not known how many fewer cars would be needed if the tunnel is built. Therefore, two percentages, 10% and 5%, were used in the calculations. Industry sources state that the grain car cycle time has been reduced to 17-18 days in 1979. If the Canadian railways are able to reduce the grain car cycle time by 35% in the last five years through various innovations, it is therefore not unreasonable to expect, that by removing the major bottleneck on its western mainline, CP Rail can reduce its grain car cycle period by a further 10%. The building of the tunnel would therefore generate an economic benefit to the general public and/or the grain producers. CP Rail cannot exploit any part of this economic benefit through its pricing practices due to the Statutory Rates.

Reduced costs connected with reduced grain shipment delays

Canada's grain transportation system has been deteriorating in recent years. The deterioration has lead to grain shipment delays on the West Coast, and the delays can be translated into costs. In the present and future time frames, the delays bring on demurrage charges, in the addition, the loss of goodwill undergone by our grain customers can lead to reduced grain sales.
There are many reasons for grain shipment delays, such as railway bottlenecks, railcar shortages, deteriorating branch line system, inadequate port facilities, labour disputes, and natural phenomena. Table XI presents a scenario which attempts to quantify the cost of the grain shipment delays connected with the Beaver bottleneck. First, it is assumed that construction of the tunnel will lead to a reduction of demurrage charges by 5% during the period 1983-2002, and that demurrage charges will average $10 million per year during this period.

Contributions accruing to grain producers from additional traffic that would not have moved if the tunnel was not built.

The construction of the Beaver tunnel and resultant greater capacity would allow additional grain traffic to move over the western mainline. The contribution (price less variable cost) derived by the farmers on this additional grain is an economic benefit. However, CP Rail would incur an additional loss as this export grain would move at a non-compensatory rate. The net benefit is arrived at by subtracting the incremental CP Rail cost from the grain producers' incremental benefit.

Two scenarios are presented in Table XII. The first scenario assumes that the completed Beaver tunnel allows an extra 500,000 tonnes of grain to move to Vancouver every year during the period 1983-2002. The second scenario doubles the incremental amount to 1 million tonnes per year. (It is assumed that producers derive a contribution margin of $17.55 per
TABLE XI

Economic benefits of reduced demurrage changes on ships

The average demurrage charge on the West Coast is taken to be $10 million per year during the period 1983 - 2002. If the beaver tunnel reduces the demmurage costs by 5%, then,

Present Value of benefits \( (d = .12) \)

\[
$10 \text{ million } (.05) \times 4.763 = $2.4 \text{ million}
\]

\[
(t_{24} - t_4)
\]
TABLE XII

Net benefit of incremental grain traffic
(Base year = 1978)

A) Scenario 1: It is assumed that an additional 500,000 tonnes of grain would to Vancouver over the CP mainline due to construction of the Beaver tunnel.

The present value of the benefits ($d = .12$) during the period 1983 - 2002 is:

\[ 500,000 \times (17.55 - 7.69) \times 4.763 = \$41.8 \text{ million} \]

The present value of CP Rail loss ($d = .12$) is:

\[ 500,000 \times (7.69) \times 4.763 = \$18.3 \text{ million} \]

The present value of the federal branchline subsidy is:

\[ 500,000 \times (2.78) \times 4.763 = \$6.6 \text{ million} \]

The present value of the net benefit to the public:

\[ \boxed{16.9 \text{ million}} \]

B) Scenario 2: An additional 1,000,000 tonnes of grain could move to Vancouver over the CP mainline due to construction of the Beaver tunnel.

The present value of the net benefits ($d = .12$) during the period 1983 - 2002 are:

\[ 1,000,000 \times (17.55 - (7.69 + 2.78)) \times 4.763 = \$33.7 \text{ million} \]
tonne, and that CP Rail loses $7.69 per tonne). The completed tunnel would easily facilitate the shipment of an extra million tonnes per year, as CP Rail has indicated that the jump in capacity provided by the tunnel would be in excess of ten million tonnes per year. The net benefit is some $17 million under the first scenario, and some $34 million under the second scenario.

This paper utilized the private sector discount rate in the computation of economic benefits. Some economists argue, however, that the private sector discount rate does not properly reflect society's view on resource allocations between present and future. This social time preference rate will be lower than the private sector rate. The Appendix II will re-evaluate the economic benefits utilizing a lower discount rate. Naturally, a lower discount rate will lead to a higher economic benefit present value, which implies that the proposed project is even more feasible. When the lower discount is applied, the economic benefits more than cover the financial shortfall, under both the less optimistic and more optimistic scenarios.
6.2 Non-economic Criteria

There are non-economic considerations which would make the Beaver project desirable from the public viewpoint even though it is not viable financially. This section will examine certain of the non-economic considerations.

Regional expansion

Regional expansion has long been a goal of the federal government. The justification of this goal stems from the belief that geography should not be the sole criterion in determining the economic well-being of Canadians. Hence transfer payments are made from the "have" provinces to the "have not" provinces. While it is conceptually easy to talk of "have" and "have not" provinces, each province will contain "have" and "have not" regions.

Canada's central government uses a variety of mechanisms to alleviate regional economic differences. It has established the Department of Regional Economic Expansion, for example, which has designated specific geographic regions to be eligible for grants to manufacturing enterprises.

The objective of these mechanisms is to bring about the redistribution of income and expand the industrial base of the West. Building the tunnel may fit in with the federal government's desire for regional expansion. As such, the subsidization of the capital costs of the tunnel may be a better cost-effective method of achieving this goal in the Prairies and
Kootenay regions than, for example, a negative income tax plan or DREE grants.

The use of transport subsidies to promote regional expansion has often been criticized on the grounds of economic efficiency, vis. resources flow to the subsidized mode that would otherwise be employed elsewhere. This is not an issue in this section, as it has been recognized that regional expansion is a non-economic goal of the government.

The subsidization of the Beaver tunnel would likely be seen as another handout to the CPR, but it is more than that. The Railway would benefit, as it would be realizing a 12% rate of return on its investment. But the subsidy would also be a covert subsidy to the workers, farmers, and corporations of the West, as additional western resources would move to export positions.

Desire for an "adequate" transport infrastructure

The desire for an "adequate" transport infrastructure is related to the goal of regional expansion, but differs in that it is more encompassing.

Defining "adequate" is an impossible chore, as "adequate" to the reader will likely differ from the writer's view of "adequate". For the purposes of this paper, an "adequate" transport infrastructure is one that can move all the traffic which can pay greater or equal to the marginal economic costs of moving that traffic.

The CP western mainline is one of the vital links in
Canada's transport infrastructure. It is especially efficient in the movement of bulk goods. In light of resource shortages and our increasingly competitive position in world markets, the demand for Canadian resources will be strong in the future. The resources must be able to move to ports if they are to be exported. Given that Transport Canada has forecast increasing congestion on our rail links, the federal government could justify a subsidy to CP Rail on two grounds: 1) the balance of payment argument and 2) diversification of risk.

The balance of payments argument is general, and proceeds like this: Our tourist and capital account deficits continue to grow. Canada's merchandise account has been in a surplus position during the past few years. Grain exports contribute approximately $3 billion per year to our merchandise account. But the merchandise surplus has not offset the other deficits. Therefore, it is recommended that Canada take steps to ensure that there are no unnecessary impediments in the growth of our merchandise surplus. A "less than adequate" rail infrastructure would be such an impediment.

The diversification of risk argument relates to the fragility of our mountain rail lines. The CP mainline terminates in Vancouver, while the CN mainline splits into two lines at Red Pass Junction, with one line terminating in Vancouver, and the other ending in Prince Rupert. All these lines are prone to closure from avalanches, slides, and floods. It could be federal policy to assist in the easing of bottlenecks on both the CP and CN lines so as to diversify the risk of an extended closure.
6.3 Summary

The first objective of this paper has been to examine the potential conflict between the public desirability and financial viability of the Beaver tunnel investment. The analysis carried out in this chapter has shown that there are economic benefits associated with the Beaver project that were not included in CP Rail's financial analysis. The economic benefits may make the project desirable from a public point of view. Table XIII summarizes the quantifiable criteria of the Beaver project which have been presented in this paper.

The public desirability of the project was explored from two viewpoints. The examination of the economic factors indicate that potential benefits to the public do exist if the tunnel is built. An attempt to quantify these benefits was undertaken in order to determine the relative magnitudes. The non-economic factors provided qualitative reinforcement to the argument supporting the desirability of the tunnel.

It is important to note that the potential benefits which would accrue to the public cannot be exploited by CP Rail through its current value-of-service pricing policy. Acceptance of this statement makes it possible to conclude that potential conflict may well exist, and that the Beaver project may well be financially viable if CP Rail's pricing freedom extended to the domain of export grain.

Given that the Beaver tunnel is not financially viable, and given that the constraint which impedes CP Rail's pricing freedom may affect the financial viability of the Beaver
TABLE XIII

Beaver Project Analysis
(Base year = 1978 discount rate - .12)

Financial Costs

Capital Costs (years 1-4) $73.8 million

Financial Benefits

Savings $33.9
Contribution from additional traffic
- Coal 10.6
- General Merchandise 1.0
- Grain 3.0

Financial shortfall $31.3 million

Economic benefits not available to CP Rail

<table>
<thead>
<tr>
<th>Less Optimistic</th>
<th>More optimistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hopper car savings</td>
<td></td>
</tr>
<tr>
<td>5% fewer cars</td>
<td>$6.2</td>
</tr>
<tr>
<td>10% fewer cars</td>
<td></td>
</tr>
<tr>
<td>Reduced demurrage charges</td>
<td>2.4</td>
</tr>
<tr>
<td>Incremental grain traffic</td>
<td></td>
</tr>
<tr>
<td>0.5 million tonnes</td>
<td>16.9</td>
</tr>
<tr>
<td>1.0 million tonnes</td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>$25.5 million $48.5 million</td>
</tr>
</tbody>
</table>
project, and given that qualitative arguments exist which reinforce the public desirability of the project, how can the federal government best provide financial assistance to enable CP to build this project? The final chapter will analyze the financing alternatives.
Footnotes

1. A CP Rail source stated that Statutory grain traffic accounts for 20%-25% of the tonne-miles on its western mainline.

2. CP Rail states: "The last boxcars suitable for carrying grain were purchased in the early 1950's., p.13, CP Rail booklet.

3. During the period 1973-1977, the federal government purchased 8000 hopper cars at an approximate cost of $284 millions.


5. During the 1977/78 crop year ending July 31, an average of roughly 25 vessels per day were waiting to be loaded on the West Coast.

6. For the period August 1, 1976 to October 31, 1978, the Canadian Wheat Board paid out a total of $21.9 million in demurrage charges system-wide.

7. Canada exported approximately 22 million tonnes of grain in the crop year 1977-1978. It is estimated that this figure must rise to 30 million tonnes by 1985 if Canada is to maintain our present market share.

8. The figure of $17.55 per tonne was determined by setting the contribution margin equal to 15% of the grain producers' realized price of $117 per tonne for #1 Canadian Western Red Spring. The figure of 15% is a conservative estimate. The grain producers' marginal cost of production on the incremental quantities of grain would be considerably less than on the initial production, as the land may well have remained in fallow without this production. Of course, this argument makes no allowance for the contribution margins that producers might have earned if they had switched to crops for domestic consumption/processing instead of producing the incremental quantities of export grain.

9. The figure of $7.69 per tonne was supplied by Carl Snavely, based on 1977 costs.
CHAPTER 7 FINANCING ALTERNATIVES

The previous chapter examined the hypothesis that the financial viability of the Beaver tunnel may diverge from the public interest. The financial evaluation determined that CP Rail cannot earn what it considers to be an adequate rate of return on this project. It was shown that an additional infusion of approximately $31 million would be required in order for the project to earn a 12% rate of return. It was further explained that restrictions on CP Rail's pricing freedom prohibit the Railway from exploiting certain economic benefits which would accrue to the grain producers if the tunnel was built.

This chapter will analyze several alternative methods of financing the shortfall. Each of the alternatives would require the impetus of the federal government, as it is the federal government which must transform the "public interest" into action.

The financing alternatives fall into two broad categories, namely public financing and user pay.
7.1 Public Financing

Public financing alternatives would involve a direct or indirect payment to CP Rail. Three options will be discussed: 1) subsidy, 2) accelerated capital cost allowance, and 3) income tax reduction.

Subsidy

Subsidies may be justified on a number of grounds, including promotion of regional development, national unity, and economic efficiency. It is the latter type which is of primary interest here. In a decreasing cost firm, subsidization can be justified on the basis of efficiency. The rationale behind this transfer is that the general welfare increase brought on by marginal cost pricing would more than offset the welfare decrease suffered by the taxpayers making up the subsidy. In Figure 6, setting \( P=SMC \) yields a consumer surplus of the triangle ABC. Full-cost pricing would lead to a loss of surplus GFCE. The tax-financed subsidy is justified because the additional surplus created by marginal cost pricing is greater than the amount of the subsidy HECB.

Two barriers stand in the way of acceptance of this line of reasoning. First, CP Rail's pricing on its marginal traffic is not necessarily at or near marginal cost. Second, the welfare gain brought on by the combination of subsidization and marginal cost pricing in one sector of the economy only holds if all sectors of the economy are pricing at marginal cost. In this
Figure 6

Economic justification for subsidies

case, the tax levied in other sectors of the economy to finance the subsidy may bring on a welfare loss in these sectors as large as the welfare gain in the subsidized sector. Also, it has been suggested that "... there is little need today for transport subsidies in Canada in order to meet economic efficiency criteria." The points above indicate that it would be difficult to justify the subsidy on grounds of economic efficiency. However, the government could use non-economic arguments such as regional development and national unity to justify payment of a subsidy.

In the case of the proposed tunnel, would the subsidy be a one-time contribution toward the capital costs, or would it be an on-going subsidy to finance operating deficits? The latter alternative would pose severe accounting difficulties in this case. A fixed subsidy toward construction costs has the advantage of no unforeseen escalation problems in future years, and the fact that the government knows exactly towards what project its money is being committed. A case in point is the Branch Line subsidy, which is designed to maintain and rehabilitate prairie branch lines. In retrospect, it is now clear that it is really a quid pro quo for losses suffered by the railways on the transport of export grain.

A disadvantage of the fixed subsidy is that it is a sunk cost on the part of the government, and the Railway may alter its pricing practices in the future after it has received the subsidy. It has been stated that an acceptable subsidy policy should include government control of the recipient's pricing policies and level of service. The provision implies greater
government regulation, whereas the National Transportation Act recently released CP Rail from much of its regulatory constraints.

On the whole, a direct subsidy is an unfavourable financing alternative for the reasons outlined above. In addition, the subsidy is a politically difficult course of action for the government to follow, as Canadian Pacific has been oft criticized in the past for receiving government handouts.

Accelerated capital cost allowance

The capital assets of a company generally depreciate over time. As well as simply wearing out, the assets are subject to economic obsolescence. The Income Tax Act allows taxpayers to deduct a stated percentage of the asset every year for tax purposes. This deduction is known as Capital Cost Allowance. There are a number of asset classes, reflecting the different characteristics of assets. Similar assets are grouped in one class.

Simply stated, the Capital Cost Allowance (CCA) reduces the taxpayer's income tax payable. It is thus a key consideration in determining net cash flows, and hence the efficacy of any particular investment. The CCA provides a tax shield. The present value of the tax shield is:

\[
PV \text{ of tax shield} = \frac{cdt}{(k+d)}
\]

c = capital investment

d = max. rate for CCA on declining balance basis
t=the firm’s marginal tax rate
k=discount rate³

Would accelerated CCA be useful to CP Rail financing of the shortfall? Two points should be noted. First, the Company must have the necessary taxable income in order to take advantage of the additional deduction. Second,

When tax rates are high, a growing firm will be able to finance a substantially larger fraction of its investment from retained profits under an accelerated depreciation plan than with normal depreciation allowances for tax purposes.⁴ CP Rail does have a sufficient taxable income to be able to utilize accelerated CCA. The taxable income of the Railway for the previous five years is found in Table XIV. With respect to the second point, CP Rail’s marginal tax rate of 46% is sufficiently high for the Company to reap the tax advantages of the accelerated CCA.

A financing scenario containing the effect of the accelerated CCA is presented in Table XV. In this example, the CCA rate for the tunnel only (excluding the track and approaches) is raised from 4% (the current rate in the Income Tax Act) to 50%. The net effect is very advantageous to CP, in that an additional $16.2 million is generated internally.

The entire financial shortfall of $31 million would not be covered by the 50% CCA. However, this measure could be part of a package, and therefore should not be dismissed out of hand.

There is ample precedent for accelerated CCA. For example,
### TABLE XIV

**CP Rail**

Net Income before tax  
(millions of dollars)

<table>
<thead>
<tr>
<th>Year</th>
<th>Income (millions of dollars)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1973</td>
<td>$ 73.2</td>
</tr>
<tr>
<td>1974</td>
<td>91.7</td>
</tr>
<tr>
<td>1975</td>
<td>65.5</td>
</tr>
<tr>
<td>1976</td>
<td>104.9</td>
</tr>
<tr>
<td>1977</td>
<td>114.6</td>
</tr>
<tr>
<td>1978 (estimate)</td>
<td>123.1</td>
</tr>
</tbody>
</table>
TABLE XV

Comparison of 50% CCA vis 4% CCA

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Present Value of tax shield = Cdt/ktd</td>
<td></td>
</tr>
<tr>
<td>Capital costs of tunnel only</td>
<td>$63.2 million</td>
</tr>
<tr>
<td>Present Value of taxshield -CCA = 4%</td>
<td></td>
</tr>
<tr>
<td>63.2 (( \cdot 04 \times .46 )) / (( .12 + .04 ))</td>
<td>$7.3 million</td>
</tr>
<tr>
<td>Present Value of Taxshield -CCA = 50%</td>
<td></td>
</tr>
<tr>
<td>63.2 (( \cdot 50 \times .46 )) / (( .12 + .50 ))</td>
<td>$23.5 million</td>
</tr>
<tr>
<td>The difference is:</td>
<td>$16.2 million</td>
</tr>
</tbody>
</table>
manufacturing equipment can today be written in a two year period, compared to its regular 20% (declining balance) maximum in the early 1970's. Certain specific asset classes, e.g. pollution controls and energy-efficient equipment, also qualify for a two year write-off. Another example relates to aircraft. In the mid-1970's, when airlines were experiencing financial difficulties, the maximum allowable CCA was raised from 25% to 40%. This special provision lapsed in May 1976.

Accelerated CCA is a very favourable financing alternative for both CP and the government. It is an acceptable fiscal practice employed many times in the past. It requires no cash outlay from the government, and CP gains only after making the investment. This alternative has the further advantage of being project-specific.

Income tax reduction

A reduction in CP Rail's marginal tax rate could help to finance the shortfall. The federal government could agree, for example, to an across-the-board income tax reduction of 5% during the period of construction (1980 to 1983). The present value of the reduction is determined to be $17 million in Table XVI.

Some precedent does exist for general income tax reductions. In 1973, the federal corporate income tax rate was lowered by 6% to 42% for manufacturing and processing industries. This fiscal measure was designed to stimulate Canada's manufacturing and processing sectors. While this tax
TABLE XVI

Effect of 5% reduction in incometax rate during period of tunnel construction (1980 - 1983)

Assuming a net income before tax of $125 million for the four year period 1980-1983, a 5% reduction in income tax rate would yeild a saving of $6.25 million.

The present value of the reduction is \( (d = .12) \)

\[
$6.25 \text{ million} \times 2.712 = $16.95
\]

\( (t_5 - t_2) \)
reduction may be an acceptable stimulus for an entire economic sector, it would be unacceptable to grant such concessions to a single company. Many other companies would feel that they should also be eligible for the same reduction. This differs from the CCA case where the fast write-offs apply to specific asset classes.
7.2 User Pay Alternatives

The first section of this chapter explored several public remedies which would ease and/or eliminate the prospective Beaver tunnel financial deficit. This section will examine a user-oriented remedy.

A restriction on CP Rail's pricing freedom prevents the Railway from capturing economic benefits which accrue to grain producers. It has already been established that grain moving under the Statutory Rates does not cover the variable costs of moving that grain. The Snavely Commission reported that, in 1974, the variable cost of transporting grain on CP's rail network was covered in the following proportions: 1) users-37.7%, 2) CP Rail-43.5%, and 3) federal government-18.8%.

Removal or modification of the Statutory Rates would have a positive effect on CP Rail's cash flows. Two sets of alternatives will be examined below. The first analysis will examine the incremental cash flows that would accrue to CP Rail as a result of an increase in the Statutory Rates. In this section, it is assumed that the amount of grain moved via CP's western mainline remains constant at the 1977 level. This alternative is plausible because it is reasonable to expect that CP Rail would apply part of the incremental revenue toward the tunnel deficit (and hence build the tunnel) if the government increased the Statutory Rates.

The second set of alternatives uses the same pricing scenarios as the first, but applies them only to the incremental grain that would not have moved if the tunnel was not built.
This set of alternatives conforms to the accepted rules of project evaluation, i.e., comparing incremental revenues to incremental costs. It is assumed that the tunnel would allow for the movement of an additional 500,000 tonnes of grain.

Increase Statutory Rates by a factor of four through a value-of-service policy.

Under this scenario, Statutory Rates are increased by a factor of four. It is assumed that the average length per train trip is the distance between Medicine Hat and Vancouver, which is 822 miles. In 1977, approximately 4.55 million tonnes of grain moved at Statutory Rates over CP Rail's western mainline. This is equivalent to 3.74 billion tonne-miles. The Statutory Rate yields 0.55 cents per tonne-mile. Quadrupling the rate would increase it to 2.2 cents per tonne-mile.

The factor of four is not out of line when a comparison is drawn between the Statutory Rate and the United States grain rate. Between Pincher Creek, Alberta and Vancouver, B.C., a distance of 748 miles, the Statutory Rate yields 0.99 cents per tonne. In 1977, the Burlington Northern levied a rate of 3.95 cents per tonne between Shelby, Montana and Seattle, Washington, a distance of 743 miles.

Table XVII shows that CP Rail would derive an additional $183 million on existing grain traffic and $30.9 million on incremental traffic.
TABLE XVII

Increase Statutory rates by a factor of four
(Base year = 1978, d = .12)

<table>
<thead>
<tr>
<th></th>
<th>Revenue at 0.55¢/tonne mile</th>
<th>Revenue at 2.2¢/tonne mile</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(0.55 X 3.74 billion tonne-miles)</td>
<td>(2.2 X 3.74 billion tonne-miles)</td>
</tr>
<tr>
<td></td>
<td>$20.57</td>
<td>82.28</td>
</tr>
<tr>
<td>Difference</td>
<td>61.71</td>
<td>9.04</td>
</tr>
<tr>
<td>Less Federal Branch Line Subsidy</td>
<td>23.3</td>
<td>2.56</td>
</tr>
<tr>
<td>Cash increase to CP Rail</td>
<td>$38.41</td>
<td>$6.48</td>
</tr>
</tbody>
</table>

Present Value of inflows 1983-2002 (d=.12)

<table>
<thead>
<tr>
<th></th>
<th>Present Value</th>
<th>1983-2002 (d=.12)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$38.41 (4.763)</td>
<td>$182.95 million</td>
<td></td>
</tr>
<tr>
<td>6.48 (4.763)</td>
<td>$30.86 million</td>
<td></td>
</tr>
</tbody>
</table>

\( \left( t_{24}-t_4 \right) \)
Cost-plus pricing policy

This pricing scenario takes into account input from the grain farmers. The United Grain Growers suggested that a grain rate be set by increasing the variable cost of grain movement by the ratio of rail revenues to the rail variable cost on other bulk commodities transported by rail in western Canada and sold on the world market. It was decided to use the ratio of two bulk commodities to arrive at a rate factor. In 1977, the weighted average of rail revenues to rail variable cost of coal and sulphur shipped in western Canada was 1.43. The variable cost of moving grain in 1977 was approximately $15.50 per tonne.

Table XVIII determines that the cost-plus pricing policy would net CP Rail an additional $334 million on existing traffic (1977 level), and $37 million on its incremental grain traffic.

Pricing at variable cost

The variable cost of CP Rail's grain movement was $15.50 per tonne in 1977. However, CP Rail received only $3.96 per tonne from the grain producers. The incremental revenue flowing to CP under a variable cost pricing system is presented in Table XIX. The existing grain traffic (1977 levels) would contribute an additional $190 million, while incremental grain traffic
TABLE XVIII
Cost-plus pricing policy
(Base year = 1978  \( d = .12 \))

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost-plus rate</td>
<td>$22.17 per tonne</td>
</tr>
<tr>
<td>Less Federal Branch Line Subsidy</td>
<td>$2.78</td>
</tr>
<tr>
<td>Cost-plus rate to users</td>
<td>$19.39 per tonne</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Existing grain traffic</th>
<th>Incremental grain (millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revenue-cost-plus rate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>((4.55 \text{ million tonnes} \times 19.39))</td>
<td>$88.2</td>
<td></td>
</tr>
<tr>
<td>((0.5 \text{ million tonnes} \times 19.39))</td>
<td>$9.7</td>
<td></td>
</tr>
</tbody>
</table>

| Less Revenue @ Statutory Rate                     |                        |                             |
| \((4.55 \text{ million tonnes} \times 3.96 \text{ tonnes})\) | 18.0                    |                             |
| \((0.5 \text{ million tonnes} \times 3.96 \text{ tonnes})\) | 2.0                     |                             |

| Incremental revenue                               | \$70.2             | \$7.7                       |

| Present Value of inflows 1983-2002                |                        |                             |
| \$70.2 \((4.763)\)                                | \$334.4             |                             |
| 7.7 \((4.763)\)                                  | \$36.7              |                             |
### TABLE XIX

**Variable Cost Pricing**

*(Base year = 1978, d = .12)*

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable cost of moving grain</td>
<td>$15.50 per tonne</td>
<td>Less: Statutory revenue</td>
<td>$3.96</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Branch-line subsidy</td>
<td>2.78</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Incremental revenue to CP</strong></td>
<td><strong>6.74</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Incremental revenue to CP</strong></td>
<td><strong>8.76 per tonne</strong></td>
</tr>
</tbody>
</table>

Existing grain traffic 

<table>
<thead>
<tr>
<th>Revenue</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>(4.55 million tonnes X 8.76)</td>
<td>$39.9</td>
</tr>
<tr>
<td>(0.5 million tonnes X 8.76)</td>
<td>$4.4</td>
</tr>
</tbody>
</table>

Incremental grain

Present Value of inflows 1983-2002

<table>
<thead>
<tr>
<th>Revenue</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>(39.0) (4.763)</td>
<td>$190.0 million</td>
</tr>
<tr>
<td>(4.4) (4.763)</td>
<td>$21.0 million</td>
</tr>
</tbody>
</table>
In summary, it is apparent that the user pay scenarios applied to grain would substantially increase CP Rail revenues. A small proportion of the incremental revenues associated with the existing grain traffic would cover the tunnel shortfall. The incremental revenue derived from the incremental grain traffic closely approximates the financial shortfall under the four times and cost-plus scenarios.
7.3 The Preferable Financing Alternative

The first section of this chapter dealt with certain public sector alternatives to financing the tunnel shortfall. The second section presented a number of user pay alternatives.

An argument was made in Chapter 6 that potential economic benefits may make the project publicly desirable. Yet these benefits cannot be captured by CP Rail due to pricing restrictions. Both public sector financing alternatives and user pay alternatives have been presented. Which is preferable?

From an economic viewpoint, the user pay alternatives are preferable. If the project is economically justified, it should be possible for CP to exploit the users' willingness to pay. This avoids possible distortions brought on by a tax in one sector to subsidize the tunnel. On the other hand, the government may feel that regional development/national unity considerations are best served by advancing public financing solutions and leaving Statutory Rates as is. It is even possible that the federal government could force CP Rail to build the tunnel without any financial compensation. The shareholders of CP Rail would then, in effect, absorb the shortfall. Given, however, the inattention paid to grain movement by CP Rail in the past two decades because of non-compensatory rates, it is unlikely that the government would resort to this alternative.

Given that demand for grain will be strong in the foreseeable future; given that Canadian grain exports are expected to rise from 22 million tonnes in the crop year 1977-78 to 30 million tonnes in 1985; given that the Roger's Pass
section is the critical bottleneck on CP's western mainline; and
given the long lead times associated with this project, every
effort should be made to get this project started as quickly as
possible. This must be reflected in the selection of a financing
alternative.

Keeping these factors in mind, it would appear that public
financing alternatives are preferable. The user pay alternatives
are sound, both from an economic and financial point of view.
But the modification of the Statutory Rates is a delicate
political question that is best viewed in the context of long-
term problems. Traffic forecasts indicate that the Roger's Pass
bottleneck is a critical capacity constraint in the short-term.

The public financing schemes discussed above have a common
characteristic: CP Rail receives a financial benefit in the form
of a cash payment or tax reduction. The subsidy is a cash
payment, and would be the most controversial in the eyes of the
public. The income tax reduction is a less visible benefit, as
the public does not see money flowing from the public coffers to
CP. Accelerated capital cost allowance is the least
controversial method, and has the added advantage of being very
project-specific.
Footnotes


2. Ibid, p.15.


Appendix I

Sensitivity Analysis

The financial evaluation utilizes CP's "most probable" traffic forecasts and a sustainable capacity figure that is open to debate. Adoption of different figures for traffic forecasts and/or sustainable capacity can dramatically affect the timing of the project.

Traffic forecasts

CP has produced "minimum" traffic forecasts (Table III). Under this scenario, only 20.17 million net tonnes would move in 1985. This could easily be handled by the present plant. The evaluation carried out in Chapter 3 showed that 27.13 million net tonnes could move in 1982 without additional rail capacity (Table II). If "minimum" traffic forecasts are used, it is apparent that the only substantial benefit of a tunnel would be the savings in equipment and operating costs associated with lower grades. Given "minimum" traffic forecasts, CP estimates the savings to be $27.1 millions. This is less than half of the discounted costs of the tunnel ($73.8 million). Any contributions from additional traffic would only be gained far into the future. Therefore, there will be a substantial timing delay before capacity constraints are such that the tunnel investment is needed.
CP has not produced "maximum traffic forecasts in its 1978 analysis. However, if one utilized traffic forecasts that were greater than the most probable forecasts, the sustainable capacity would be reached earlier, thereby calling for an increment to capacity. The level of savings would be substantially the same as under the most probable traffic forecasts, as the tunnel could not be completed any sooner than 1982, which is the same completion date as under the most probable forecasts.

The financial evaluations under minimum and maximum traffic forecasts appear in Table XX. The valuation of the benefits are rough estimates only. The purpose of this Figure is to illustrate the magnitude differentials of minimum and maximum forecasts.

Sustainable capacity

For the purposes of this paper, a figure of 15 trains (one-way) has been selected as a measure of sustainable capacity. Both CP and Transport Canada have adopted this figure. Given the most probable traffic forecasts, if sustainable capacity could be raised to 16 trains per day, the Railway would not encounter congestion problems until 1985 (Table I). However, if sustainable capacity was only 14 trains per day, congestion would become serious by the end of 1982. Starting construction in 1979 would lead to tunnel completion in the end of 1982. Thus, this lower sustainable capacity figure would call for a relatively earlier starting date.
TABLE XX

Financial Evaluation of the Beaver Project
under minimum and maximum forecasted traffic
(millions of discounted $)

<table>
<thead>
<tr>
<th></th>
<th>Minimum forecast</th>
<th>Maximum forecast</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Costs</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capital Costs</td>
<td>$73.8</td>
<td>$73.8</td>
</tr>
<tr>
<td><strong>Benefits</strong></td>
<td>$27.1¹</td>
<td>$35.0³</td>
</tr>
<tr>
<td><strong>Savings</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contributions from:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coal</td>
<td>1.1</td>
<td>.21</td>
</tr>
<tr>
<td>Gen. Mchse.</td>
<td>.1</td>
<td>2</td>
</tr>
<tr>
<td>Grain</td>
<td>(.3)</td>
<td>(5)</td>
</tr>
<tr>
<td></td>
<td>28.0</td>
<td>53.0</td>
</tr>
<tr>
<td>Present value of shortfall</td>
<td>$45.8</td>
<td>$20.8</td>
</tr>
</tbody>
</table>

Footnotes:

1. Source: CP Rail
2. The contributions are estimates based on available data.
3. It is assumed that the savings would be slightly higher under maximum forecasts than most probable, viz $35.0 million v. $33.9 million.
The financial evaluation under minimum and maximum sustainable capacity is presented in Table XXI. Here again the valuation of the benefits are estimated roughly. It should be noted, however, that the evaluation is sensitive with respect to a sustainable capacity figure. The minimum figure produces a coal contribution of $21 million, as compared to no coal contribution under the maximum figure.

It should be noted that none of the options explored above in the sensitivity analysis show the tunnel to be a financially viable project. The analysis has shown that the evaluation is sensitive to varying forecast and sustainable capacity figures, but the end result is the same: the tunnel is not financially viable.
### TABLE XXI

**Financial evaluations of the Beaver Project**

under minimum and maximum forecasted sustainable capacity

(millions)

<table>
<thead>
<tr>
<th></th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(14 trains per day)</td>
<td>(16 trains per day)</td>
</tr>
<tr>
<td><strong>Costs</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capital Costs</td>
<td>$73.8</td>
<td>$73.8</td>
</tr>
<tr>
<td><strong>Benefits</strong></td>
<td>$35.0</td>
<td>$27.1</td>
</tr>
<tr>
<td><strong>Savings</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cont'd from:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coal</td>
<td>21</td>
<td>0</td>
</tr>
<tr>
<td>Gen. Merch.</td>
<td>.5</td>
<td>.5</td>
</tr>
<tr>
<td>Grāin</td>
<td>(5)</td>
<td>53.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Present Value</td>
<td>($20.8)</td>
<td>($46.2)</td>
</tr>
</tbody>
</table>
Appendix II

Varying Discount Rates

The utilization of varying discount rates will significantly alter the present value of the economic benefits. The discount rate of 12% is the private sector discount rate which has been utilized throughout this paper. Assume that the discount rate of 8% more closely reflects the social time preference rate. The lower discount rate leads to significantly higher present values, as is shown in Table XXII.
### Table XXII

**Economic Benefits of the Beaver Project Under Varying Discount Rates**

(Base Year = 1978)

<table>
<thead>
<tr>
<th></th>
<th>Less Optimistic</th>
<th>More Optimistic</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Discount rate = 8%</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hopper car savings</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5% fewer cars</td>
<td>$8.5 million</td>
<td>$17.0 million</td>
</tr>
<tr>
<td>10% fewer cars</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reduced demurrage charges</td>
<td>3.6</td>
<td>3.6</td>
</tr>
<tr>
<td>Incremental grain traffic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.5 million tonnes</td>
<td>25.4</td>
<td>50.9</td>
</tr>
<tr>
<td>1.0 million tonnes</td>
<td>$37.5</td>
<td>$71.5</td>
</tr>
<tr>
<td><strong>2. Discount rate = 12%</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hopper car savings</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5% fewer cars</td>
<td>$6.2</td>
<td>$12.4</td>
</tr>
<tr>
<td>10% fewer cars</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reduced demurrage charges</td>
<td>2.4</td>
<td>2.4</td>
</tr>
<tr>
<td>Incremental grain traffic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.5 million tonnes</td>
<td>16.9</td>
<td>33.7</td>
</tr>
<tr>
<td>1.0 million tonnes</td>
<td>$25.5</td>
<td>$48.5</td>
</tr>
</tbody>
</table>
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