Report to The Treasury

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The Privatisation of New Zealand Rail

Part 2

Quantitative Cost Benefit Analysis

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Executive Summary

1. Executive Summary

In this study we estimate the social impact of privatisation by means of cost-benefit analysis. It includes assessing the performance of the privatised firm against counterfactual situations and examining economic efficiency at points in time as well as assessing the dynamic efficiency of investment.

The broad financial trends of the New Zealand rail business have evidenced increasing difficulty of competition with other modes of transport since the 1920s. From the early 1930s all sorts of mechanisms have been used to shore up the viability of New Zealand rail in the face of emerging competition. The de-regulation of all modes of transport in New Zealand in the early to mid 1980s forced rail to confront its situation. Historically, it was in its best position to perform well as a public enterprise business; for although it was not an SOE, the 1980s was a period when there was a sustained attempt to separate out political requirements and improve the commercial performance of public enterprise businesses.

Starting in the 1880s New Zealand rail has had five episodes of re-organisation to corporate-type forms under state ownership. In each case the rail business seems to have improved commercially but the improvement was not sustained. The data suggest that this was true as recently as the corporatisation of 1983. In 1988 the Board of the Railways Corporation committed to the preparation of rail for privatisation. From 1989 the focus was on the core rail business only. In 1993 the government sold rail. The economic empirical and theoretical literature on privatisation suggests that productivity will change from the time of managerial commitment to privatisation. The three counterfactuals used and the estimated welfare gain, as at 1997 under each are:

- The situation at the time the decision to privatise was made - $9.8b.,
- The situation at the date of privatisation - $0.9b., and
- The situation at the time of privatisation deteriorating to the state of the company when management committed to privatisation - $5.4b.

These indicate that welfare increased from the privatisation of rail. They reflect the remarkable improvement in productivity that took place from 1989. Between 1989 and 1995 the productivity from all inputs grew by 65%. It has grown at a slower rate since then.

Dynamic efficiency is a critical element of the performance of an economy. The dynamic economic efficiency of ownership forms is of particular interest. It is determined by appropriate investment decisions. Tranz Rail's investment has maintained its core-business capital assets and modernised them to reduce costs and to meet customer requirements. It has done this while rail's economic surplus has continued to be negative. The economic surplus generated by rail has improved dramatically since 1989, but we estimate that it has not turned positive in the period of our analysis. If competitive modes of transport are paying their full social costs, a negative economic surplus indicates that the outputs produced are valued by society less than the value society places on the inputs in other uses.

Throughout the 1980s New Zealand rail struggled to come to terms with its increasingly competitive environment. In this context, and given uncertainty about productivity of rail in private ownership, an entirely reasonable strategy for the owners of rail would have been to take time to improve productivity in order that a better assessment of the economic position of rail could be made. Taking stock at this point in time, it would seem that significant further productive gains, relative to other modes of transport, are required if all traditional rail services are to be economically sustainable into the future.

Taxpayers have been the major gainers from privatisation. They have not had to shore up rail's financial position since 1993 and have received some tax revenue. In 1997 prices the government made net-injections of approximately $1.1b between 1983 and 1993. Reflecting the economic surplus of rail, the private owners have not achieved returns in excess of a broad portfolio of other investments.

If relative prices of competing modes of transport do reflect social costs then economic surplus indicates welfare and public and private interests will coincide. It also means that the history of rail in New Zealand has been one of enormous taxpayer and social cost entailed in retaining rail as a state-owned enterprise. The record suggests that appropriate investment and dis-investment decisions are more likely now that rail is in private ownership.

Introduction and Review

2. Introduction and Review

The Treasury called for tenders for an empirical evaluation of the impact on the New Zealand economy of the privatisation of NZ Rail Limited, now Tranz Rail Ltd. The terms of reference were to:

- determine the nature and extent of the economic welfare gains and losses resulting from the privatisation
- identify which groups have gained or lost
- estimate the quantum of the gains or losses, and
- analyse in depth the decision and consequences of the privatisation

The aim of the review is to determine whether the privatisation of rail was in the public interest and to provide input to examinations of welfare changes associated with privatisation more broadly.

In conducting its evaluation, ISCR adopts the *ex post* cost benefit approach to appraisals while noting that standard cost-benefit analysis is conducted on an *ex ante* basis. The ISCR evaluation follows the broad guiding principles of the *Review of Methodologies for Estimating the Welfare Impacts of Corporatisation and Privatisation*, but not slavishly. In addition, the nature of the market (the extent of competition, for example) identified in part 1 of this study will be carefully taken into account in the design of the specific measures and techniques used in the cost-benefit calculations. Productivity is an important input to the explanation of cost-benefit findings.

The term "privatisation" has general use in a variety of contexts. For example, contracting out is at times referred to as privatisation. In this study privatisation is the act of transferring ownership of a company from the government to private individuals. For rail the act of privatisation was implemented some 5 years after the Board decided to prepare the company for privatisation.

2.1 Stage 1 Conclusions - Precis

Markets	As a result of deregulation overall freight and passenger market share steadily declined until 1993 when NZ Rail Ltd was sold to Tranz Rail Holdings. For a variety of reasons it is difficult to assess market share, however we estimate that between 1983 and 1993 about one half of Rail's long haul market share went to its competitors. The markets that rail operates in are directly competitive or have a vigorous competitive fringe.
Financial	Partly because of the market consequences but also due to very heavy investments in a number of projects, rail's financial performance was very poor. Revenues were halved and by 1989 large operating losses and accruing interest generated a debt of $1.2 billion that could not be sustained.
Restructuring	Restructuring during 1983 - 1989 entailed significant investment in both rolling stock and the rail network, and layoffs of rail staff. The restructuring continued after 1989, when it also included a dedicated focus on the core business of rail that required high quality management and sharp managerial incentives.
1989 Position	The position had reached a crisis point by 1989, • rail's market position had been drastically reduced by competition • rail had an uncompetitive cost structure and continued to make financial losses • rail seemed to not have in place a strategy and capability to succeed
Ownership	The Board of The Railways Corporation decided in 1988 that if New Zealand was to have a viable rail system the core rail business needed to be in private hands. In 1989 a plan to make this happen was put into place. From this time privatisation was the dominant motivating element for management.

Core Rail Business	Organisational, financial and cost restructuring in 1990 led to the creation of a core rail business, non-core activities were assigned to NZ Railways Corporation. However, rail's deteriorating performance in their product markets did not stabilise until 1993.
Privatisation	The sale of NZ Rail Limited to Tranz Rail for $400m in 1993 coincided with an improvement in both market share and financial performance. These improvements came from a successful marketing and performance enhancement strategy targeted at the long haul of bulk commodities and in the distribution of door-to-door goods.
Performance	Passenger services have shown a turnaround in demand volumes and financial performance, while operational efficiency has been improved significantly. This has been achieved through reducing costs, implementing service enhancing customer and operational systems as well as targeting technology investments.
Counterfactual	In the 110-year period prior to 1993, railways performance under five attempts at establishing corporate sorts of organisational forms did not succeed. In each case business performance improved but then deteriorated when it was re-departmentalised. If public ownership had continued past 1993, then, given management of rail since 1880 and the deregulation of all modes of transport since 1984, the counterfactual would be at best captured for the long term by rail's economic surplus in 1989/90 or in 1993 accompanied by deterioration over time.

Stage 1 Recommendations: It was recommended that the data and information available were of a very satisfactory quality for studies of this sort and that the Treasury should proceed with stage 2. It was further recommended that a segmented multiple output market approach for outputs be adopted to compliment the market analysis in stage 1. We note that no capital, productivity or economic surplus data had been evaluated prior to the commencement of Stage 2.

2.2 Counterfactual - As proposed

A counterfactual experience is required to assess the economic efficiency of the privatisation process. It is used for comparison with measured actual performance in order to assess the welfare change that is attributable to the change of ownership.

There are three broad sorts of counterfactual. The first entails comparison with other railway companies or entities. New Zealand railways is different from most other railways. It is smaller, reflecting market size. It has a narrow gauge with low capacity wagons and short trains. These characteristics render benchmark comparisons with best-practice railways in other countries, such as certain of those in North America, uninformative.

The second approach is to construct a New Zealand counterfactual with which the actual performance of New Zealand rail can be compared. The choice of a New Zealand counterfactual must be influenced by the factors peculiar to rail during the late 1980's, as well as the performance of companies owned by government. In reaching the counterfactual recommendation in stage 1, the following points were most influential:

- Although cost reductions and a degree of modernisation had been achieved, the status quo from 1989 would not have been a viable business.
- The investment in electronic customer systems and the development of yield management (focus on customer segments, and deliberately linking these segments' contributions to profit to efforts in the segments) had not reached maturity by 1992. It was almost certainly necessary for rail survival.
- The prospect of privatisation provided a (potentially rewarding) goal for management and brought a sharper focus on business and necessary developments forward in time.
- Given its markets, there is no reason at all why rail would have performed better under public ownership (Shleifer (1998)).
- The decision to privatise together with the accompanying (potential) incentives would of themselves stimulate performance changes (Beesley and Littlechild, 1992:38).

- The data of Orr (1981:25) suggest that the business performance (working expenses/gross earnings) of rail improved under corporate and board structures over other departmental organisations, but that the longest period that it maintained the more efficient performance was 6 years, and more often it was two years before performance began to deteriorate.
- When the decision to implement privatisation was finally taken by the government in late 1992 the distinct possibility of private sector run-down of the railways was of paramount concern.

There is no basis to establish the extent to which rail, without the incentive of privatisation, would have attained the performance level of 1993 and beyond, although the literature suggests that the ethos and performance of the companies changes significantly at the time management is committed to privatisation (Beesley and Littlechild (1992)). However, even if it attained the 1993 level of performance, the history of rail is that it would not maintain this level. These arguments were adduced in the Stage 1 report to suggest that two counterfactuals may be reasonable:

- Break even from 1993, or
- Deterioration to break even point from the 1993 position after, say, 4 years.

In addition, the economic efficiency of the decision in 1988 to embark on the privatisation course of action, as opposed to shutting down rail, should be evaluated. This would entail incorporation of any externalities from the shutdown of railways. Running down rail from 1988/89 is not used as a counterfactual, although it was a possibility of concern in 1988 and 1992.

In light of further work conducted in Stage 2, and for reasons that will become apparent, we propose now the counterfactuals for this study.

- The 1988/89 economic surplus, and
- The 1992/93 economic surplus
- The 1992/93 economic surplus deteriorating to that of 1988/89 in 1997.

The third category of counterfactual is to use the performance of New Zealand State Owned Enterprises (SOEs). The SOE model represents New Zealand's strongest attempt to set up

and manage state-owned businesses as business enterprises. It is recognised that comparison of rail's privatised performance with those of existing SOEs has the major problem that certain of the SOEs do not operate in contestable markets; and thus economic surplus comparisons will be confounded by a mixture of market power and organisational performance. Also, technological change varies enormously across SOEs, posing further difficulties of assessment. Nevertheless a study of SOEs provides an opportunity to get some information as to whether performance is maintained under the SOE structure.

An SOE study is underway and it may provide useful benchmarks for the performance of rail. The diversity of SOE's and the fact that the SOE study will not be of the depth of the rail investigation means that the study is of an experimental nature. It may be buttressed by benchmarking studies of the Australian Productivity Commission of Australian public enterprises.

Approach to Stage 2

3. Approach to Stage 2

The methodology of "cost benefit analysis" is more or less that which is described in the *Review of Methodologies for Estimating the Welfare Impacts of Corporatisation and Privatisation* (the Review). This analysis does however differ from the Review because of factors that are specific to rail, in particular the structure of the output markets. The Stage 1 analysis defined 7 "classes" of output (see section 4.2.2), none of which is a close substitute for the others. The 7 market segments fall into one of two market structures; either they are taken to be competitive or there exists a competitive fringe, as explained in the stage 1 report. In both these cases welfare will be indicated by the level of real economic profit, buttressed qualitatively by indicators of product variety where these are available.

A study of productivity will be conducted to gain a better appreciation of the sources of changes in welfare over time. Productivity gains directly effect cost reductions and these enter the welfare calculation. These will be estimated by subtracting the rate of growth in aggregate input from the rate of growth of output. The outputs will be aggregated using estimates of marginal costs and input aggregation will be by way of standard index methodology (see Diewert and Lawrence (1999)).

3.1 Approach to Welfare Calculation

The change in aggregate welfare due to privatisation will be estimated using the equation:

$$\Delta W = \lambda_{ds}\Delta S_d + \lambda_{fs}\Delta S_f + \lambda_g \Delta GR + \lambda_{d\pi}\Delta\pi_d + \lambda_{f\pi}\Delta\pi_f + \lambda_{dx}\Delta X_d$$

where Δ *is change due to privatisation,*
S *is consumers' surplus*
GR *is government net revenue*
π *is profits, generally taken to be the profits going to owners.*
X *is welfare associated with inputs*
d *is domestic ownership,*
f *is foreign ownership, and*
λ *denotes weights.*

In practice, the value of welfare change will be calculated at a particular date. It should be noted that there are some-what different formulae in the literature. This equation is broadly that of Galal et. al. (ch.2). We now consider the components in turn.

Consumer surplus: Our argument has been that because rail supplies largely intermediate goods, and goods for which there are close substitutes from other transport modes (even for passenger transport), any direct consumer benefits will be diffuse and virtually impossible to estimate (note that this applies to aggregate consumer benefits as well as to benefits as between consumer groups). Thus, we take rail markets to be competitive[1]. This implies that in measured terms $\Delta S_f = \Delta S_d = 0$ in the equation.

Nevertheless we expect that there are in fact some benefits to domestic consumers. The following illustrates potential, but unmeasurable, sources of consumer benefit.

- Product variety/quality: as intermediate goods arising from better (but unmeasurable) characteristics. In the only tangentially relevant theory reference we have uncovered, Anderson et. al. (1997) argue that if a government-owned firm maximises social welfare and product differentiation is valued by consumers, privatisation is efficient, and that this outcome is signalled by the price of the government firm's output being less than that of its competitors. Empirical assessment of differences in price between rail and other transport modes that reflected product quality would require the estimation of hedonic price indexes. This requires quantitative measures of service quality in these modes, but the data are not available.[2]

  For the welfare effects of product variety, the classic trade-off is between the (aggregate) fixed costs of the firms providing different (but related) products and the consumers' enjoyment of variety: less variety implies lower prices because of fewer firms and consequent lower fixed costs. In many models there is too much variety (i.e. fixed costs) because entering firms do not take account of other firms' profits (Carleton and Perloff (1994, 299)). Now suppose that Tranz Rail improved its product variety

[1] Note that an explanation for rail holding a share of a competitive market can be explained by increasing rail marginal cost, without resort to product variety.

[2] In Part 1 we noted that rail quality improved through faster trains (aided by welded tracks and more passing bays) much improved timeliness and loading and unloading times. These, and other changes, improved quality but there has been no measurement of service characteristics that, with data from other modes, would enable the product variety impact to be assessed.

without much changing its fixed costs, then there would be an increase in welfare. This is obvious if the products are new to the market, and may also be true if rail displaced trucking firms that had the same marginal cost of delivery and (small) fixed costs. This argument is introduced, rather than advocated. It would be mitigated if the fixed costs in trucking were small and perhaps related to warehousing rather than transport *per se* and if rail's services were not that different from the services of its competitors.

- Rail provides final goods in some areas of passenger transport, but we still assume no increase in consumer surplus here (eg: we assume that the fast ferry just breaks even, in competition with its opposition. To the extent that rail's competitors have higher costs, there will be a benefit to consumers of the presence of rail. This raises the question of whether the higher cost entrants have higher network access costs because of rail's ownership of the network. Any economies of scope may favour rail, but be an efficient comparative advantage.) We can rely upon the small share of passenger transport in Rail's revenue to neglect this aspect, and we note that existence of some alternative suppliers and the decline in the real price of ferry transport services is indicative of some competitive pressure.

- There may be externalities associated with rail as opposed to road transport. If these can be quantified these would contribute to ΔS_d. This is a difficult area where there is little hard information: but we explore this very briefly and approximately in Appendix 5. Where safety and environmental externalities are discussed the externalities of a "with and without rail" comparison will be quantitatively more important than a comparison where rail continues to exist and the volume of traffic is redistributed between rail and its competitors. We shall assume that subsidies for commuter services cover congestion externalities.

If there were measurable benefits to consumers we would suggest setting $\lambda_{fs} = 0$ and $\lambda_{ds} = 1$. Excluding consumer benefits enjoyed by foreign consumers is standard practice.

Producer surplus: Changes in producer's surplus broadly defined are:

$$\Delta PS = \Delta GR + \Delta \pi_d + \Delta \pi_f$$

where

$$\Delta GR = \Delta T - \Delta D$$

where T denotes tax revenue and D dividends[3]. Here we take government expenditure plans as given independently of privatisation. Asset sales will thus affect government's dividend income and taxes at the time of sales and in the future. If the firm's efficiency improves on privatisation or the price reflects more generous company tax in some other jurisdiction, the government's financial position will improve with the sale (Harrison and Grimes (1989) and Hogan (1990)). The taxation use of any improved financial position represents a useful benchmark of the opportunity cost of funds to the government. If (successful) privatisation were to stimulate an expenditure increase by government, then, on cost-benefit grounds, there must have existed an unrealised opportunity for government expenditure that had a social return exceeding this cost. Because the opportunity cost is not affected by a privatisation of the magnitude of NZ Rail Limited, it is difficult to see why there should be such an unrealised opportunity. If there was one, then, given the government's power to tax, it could be implemented in dependently of privatisation.

We do not include producers' surplus changes from firms other than rail: we consider that this is reasonable, given our assessment of market structure that concludes that close substitute modes of transport are very competitive. Nevertheless if, in any market where rail has some market power and cost reductions are shared with the customer then our procedure will under estimate welfare gains.

The role of the different weights is to differentiate between elements of producer's surplus. The magnitude of these weights cannot sensibly be addressed independently of the sale process. Our working hypothesis is that at the time of the sale there was considerable competition among a significant number of bidders. Supposing that the outcome was the maximum price that could be solicited for the company, it represents that *ex ante* valuation of the company by the bidder that values it the most [if the purchaser did not offer the highest bid, we presume that the other bids had contingent liabilities that reduced their bid below that of the purchaser]. In this competitive situation, the payment for the company will include:

1. efficiency improvements that are expected to be realised, and

[3] We shall treat subsidies as a negative dividend.

2. net revenue generating aspects that are peculiar to the purchaser, in particular it will include tax advantages that the purchaser possesses by virtue of its location (tax jurisdiction).

In consequence, the government will have received a lump sum payment that incorporates elements of these two items, and the flow of dividends to the owners wherever they are domiciled will simply be recompense for the payment made. In short, the changed profits, no matter where the owners are domiciled, should be included as welfare gains. In this circumstance the weights on the elements of PS should all equal 1, in particular, $\lambda_{d\pi} = \lambda_{g\pi} = 1$. We will impose these equalities, and describe the shareholding and flows of funds in a foreign/domestic classification (see 'Shareholding Structure % of Total' chart on page 68 of Part 1).[4]

The argument for a weight on GR that is greater than 1 (of the order of 1.2-1.3) is that it should reflect the marginal dead weight loss of taxation in New Zealand (see Diewert and Lawrence (1992)). Taking expenditure plans as given, the argument is that, no matter to what uses the extra revenue is applied (repayment of debt, or reducing an amount of increased tax required for increased expenditure), the extra revenue will reduce efficiency losses of taxation.

Note that because the purchase price may reflect a difference in purchaser-specific tax factors ΔGR may be more or less than that which is simply calculable under New Zealand tax law. In this event, the annualised ΔGR, $\Delta\pi_f$ and $\Delta\pi_d$ need not add up to the total pre-tax change in economic surplus generated by the privatisation of the firm.

Finally, the approach advocated here is based on *ex ante* speculation that is measured by the purchase price. The study of welfare change is *ex post*, however. The outcome may exceed or fall below expectations, and there are various problems with estimating the expected profits that formed the basis of the successful bid. The extent to which the actual profits are above or below expectations will depend on uncertain factors, for example, company performance, the business cycle, and various relative price changes. It could be argued that profits diverging from expectations should be assessed somehow, and if they do exist they should be included if owned domestically, and excluded if owned by foreigners. The difficulty of assessing

expected profits renders this approach completely impractical. The idiosyncratic factors that make a reasonable assessment impossible are one reason why a number of studies of privatisation are required to yield robust conclusions about the efficiency of the privatisation process..[5]

The final component of our welfare equation is ΔX. It will largely consist of changes in labour. Three issues are:

1. Reduced workforce: where voluntary redundancies have occurred, the redundancy payment is a lower bound on the amount of compensation that induces the employees to move to their next best occupation. The payment will include rent that employees earn in rail. The voluntary severance payment is at least the welfare reduction of employees. But where forced separation occurs the accompanying payment under-estimates the welfare loss. There is no way we know of to get a justifiable adjustment factor, particularly given that the voluntary redundancies largely took place prior to 1988, when privatisation became the motivating force. There are no records of the subsequent experience of staff who left rail, although we shall explore the extent to which they have been involved in contracting out. We can also look at the redundancy payments per-head over time, but the sorts of staff that left rail will also have changed over time. It might be noted that to the extent that some of these became unemployed the welfare efficiency loss of the concomitant taxation is likely to be very small (see Boles de Boer and Evans (1996) for the case of Telecom). We propose redundancy expenditures as indicators of lost welfare to redundant workers.

2. Staff may have gained or lost from privatisation.

   Some staff who gained may have left the organisation and these will be treated as described above. Others will remain in the organisation. The staff records do not allow us to study the changed salary structure of staff over time [they can be studied by company functional unit but not by task/personnel classification]. To the extent that staff are receiving rent, profits will be lower and thus these rents will be reflected in our

[4] As at June 1997 22.5% was held by Wisconsin Central Railroad, 19.2% by Fay Richwhite and nearly 50% by public in NZ and overseas. The balance was held by management and 2 private owners in NZ and US.
[5] While there have been many studies of privatisation (see Evans (1998) and McFetridge (1995)) there are no such studies in New Zealand. The study of Boles de Boer and Evans (1996) for NZ Telecommunications was concerned more with de-regulation than privatisation. However, reference to elements of this work will be made.

evaluation: all labour expenses will be included as a cost. Differentiating between rent and an employee's opportunity cost is very difficult. For example, as a practical matter employment contracts of senior staff are confidential to us. Employees' opportunity cost would have to include realisation of incentives for their management of the privatisation process. There is recent indicative information (Wolfram (1998)) provided by the growth in salaries of the 12 UK electricity supply authorities that were privatised in 1990.[6] It shows that CEO salaries grew rapidly towards CEO salaries of other comparable private sector companies and that there was minimal staff turnover. Because these were the CEOs of the government-owned companies for some years prior to privatisation, the study concludes that these persons did extract rent from privatisation. A key question remaining in the study, is why were the CEOs in the public sector prior to privatisation if they could obtain much higher private sector salaries? One explanation for the growth of CEO salaries for the same CEOs, is suggested by the result of Wolfram that the growth in salary was higher for those CEOs whose companies had a higher price cap: various explanations of which include that of regulatory capture. A second potential explanation is that because private (as opposed to public) sector companies have a more credible objective of profit maximisation they rely more on incentives than monitoring in their governance structures. Incentives typically entail payment schemes that mimic to some degree the prizes of tournaments (Lazear and Rosen (1981)). Under tournament theory one would expect private sector CEOs to be paid a lot more than their counterparts to provide strong incentives for those on the rungs below. Under this scenario, CEOs that manage the move from public to private would gain rents. However, these rents are in lieu of monitoring costs. All of the reduced monitoring costs may or may not show up in the profits of the firm, since under public ownership these costs may been met by the firm and the taxpayer by (via expenditures on government departments etc. that are involved in monitoring). Nevertheless, under this story the higher salaries of CEOs are legitimate resource costs and there is not a rationale for special treatment with respect to ΔX. The salary growth that is concomitant with the transition to private company provides very strong incentives for SOE service managers to develop their businesses, if privatisation is in prospect. The salary structure of employees is a matter of public and economic interest about which we will present what evidence we can.

[6] Evidence from other industries is discussed by Haskel and Szymanski (1994, ch.17).

There is an argument that an increase (decrease) in wages for the same work should be included as a benefit (cost) of privatisation because these represent rent transfers between the owners of the firm and employees and not real resource costs.[7] Because it would be impossible to assess jobs in this detail, and, typically, changed wages entail more than transfers, and data are limited, we have not sought to explore this argument.

3. Further components of X will include any activities of the railways that were shed as a result of the privatisation process. Most of these were quantitatively very small and had been shed by 1988. The training of apprentices that railways once carried out, and now does not, may have been an example while another example would include politically inspired idiosyncratic requests.[8] On the resource cost side, reduced cost because the apprentice activity (say) was shed, is a loss of welfare to the extent that the value of this activity exceeded its cost. If the (identical) activity was taken up by polytechnic training then there will be a welfare loss only to the extent that rail provided the service more efficiently. There may be a welfare loss (from taxation) and the redistribution of income if the polytechnic approach required individuals (or the state) to pay for their own tuition and living expenses, when the railway had done so. These sorts of activities make a negligible quantitative contribution to the cost-benefit analysis. The fact that they had been virtually eliminated by 1988 means that they have no role in the quantitative analysis.

Setting $\lambda_x = 1$ implies that we do not distinguish the welfare of economic agents as between their actions as consumers or providers of labour (ΔX will largely be determined by the changes to labour). This would be justified, for any individual, by the standard labour/leisure choice that results in the marginal rate of substitution being equal to the real wage, and across individuals, by arguing that, under current policy settings, the tax, social welfare, health and education systems are the mechanisms by which the appropriate trade-off between efficiency and equity is set.

[7] For example, if increased wages are simply a transfer there is no net cost/benefit and the cost has already appeared as an increased cost of production.
[8] The apprentice training programme ceased by 1988

3.2 Output Markets - Segmentation

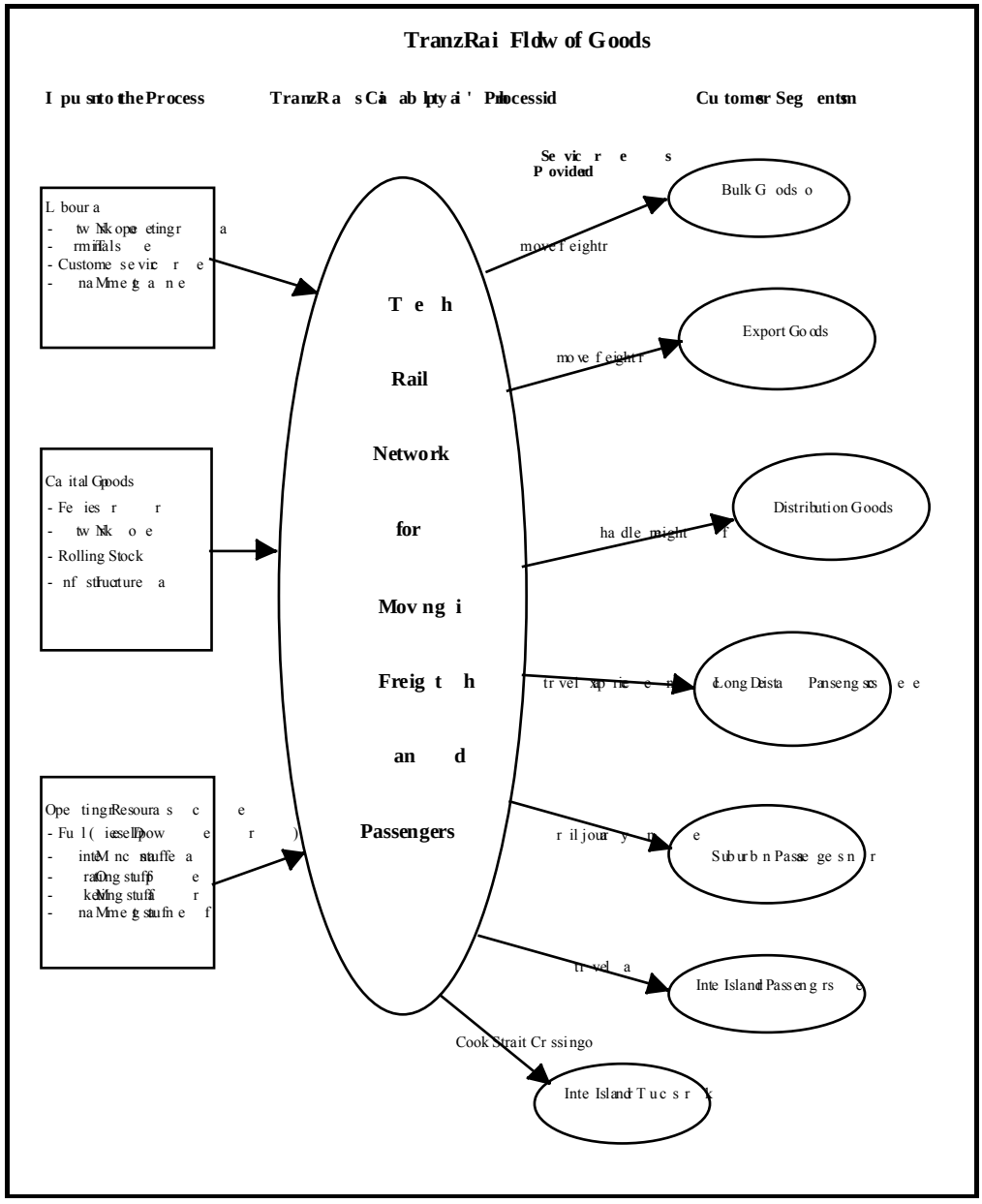
During the 1980's competitive pressure that differed by market segments – broadly freight and passenger - forced rail to focus on each of its output markets, with the aim of identifying what its advantages were by sub-segment and thereby how to maintain market share and develop profitability in each. This approach quickly revealed three freight and four passenger sub-segments. The freight segments were all long haul, as rail could not compete on short haul routes, while passenger markets covered long distance, suburban and InterIsland travel. The market segments are identified in Figure 1.

While each sub-segment is described by its own characteristics (handling requirements, distance/volume factors, length of haul etc.) the cost characteristics and financial performance of each segment also differs significantly. Tranz Rail has quite deliberately targeted specific segments for either growth in size and/or market share or profitability. For example the bulk goods segments are especially vulnerable to demand cycles for commodities and it has been diversified to some degree by Tranz Rail's more recent efforts to expand the size of their domestic door-to-door business which is less volatile but more competitive with trucks.

Because rail managed targeted specific market segments from the mid 1980's, data in one form or another are available to support the analysis. While various organisational restructurings resulted in changed managerial charts the core data that recorded inputs and outputs was (generally) collected independently of the organisation chart and assembled to meet the management structure of the day. This consistency over time enables the welfare calculations to be completed with confidence.

Figure 1.

Flow of Goods and Segmentation Structure



Data

4. Data

The data used in the welfare calculations are from the same sources as the data that NZ Rail Corporation, NZ Rail Limited and then Tranz Rail used for official reporting to shareowners and for internal management reporting. Further, the economic performance data used in the productivity and economic profit calculations is from the same data-bases and is easily aggregated to provide data by market segments freight and passengers.

There are two types of data used in the welfare analysis: measured performance data and estimates of economic costs from a model calibrated for internal use by Tranz Rail.

1. Empirical performance data; revenues, costs, output volumes and input volumes all come from rail data bases, especially financial (General Ledger) and operational (AMICUS) statistics. These data are [mostly] consistent over time at the freight/passenger segment level and are supplied to ISCR by Tranz Rail in that form. Data on sub-segments are not available prior to 1988 (for freight sub-segments) and 1994 (passenger sub-segments) as a series of internal business changes made consistent comparisons difficult before these times and aggregate data are used instead.

   Financial data are converted to constant 1997 dollars using Statistics New Zealand's output PPI index for each, except, labour costs for which Statistics New Zealand's wage-rate index is used, and InterIsland passengers where the CPI is used to convert revenues and prices. Overall, these data are considered to be of very good quality and, except for the sub-segments noted above, they are time consistent.

2. Estimates of economic cost, especially incremental costs by freight sub-segment and replacement capital costs, come from rail's economic cost models. These data are however derived from measured performance data as in 1. above, but are manipulated to yield economic cost estimates for freight using the cost models. The models are proprietary to Tranz Rail but they employ industry standard engineering/operational rules for charging freight capacity on the rail network and are founded on sound economic principles for assessing average incremental costs (AICs). The models were introduced by NZ Rail in 1989 and have been updated each year using costs of that year. For the period prior to 1989, incremental costs are estimated retrospectively by rolling the 1989

AIC's backwards by the actual cost changes experienced in the 1983-1988 period (more about this process is described in Appendix 2).

In the absence of specific passenger-service cost models, economic cost estimates for passenger sub-segments are derived from the detailed contribution analysis Tranz Rail routinely undertake for each of its business segments. This analysis captures the current costs of labour, materials and passenger specific capital assets in a way that allows them to be converted to estimates of average incremental costs. The potential for error in the cost estimates is largely confined to the area of assets and is thought to be small, in part, due to the low weighting of passenger outputs in aggregate output. Freight segments dominate the variable costs; accounting for 72% to 78% of the total variable costs for the period 1983 to 1997 with the balance made up of passenger and Cook Strait ferry costs.

After detailed review of the models and the data that they produce, we are satisfied that the estimates of economic costs are most adequate for this analysis. As a point of quality control the freight estimates were cross-checked against the detailed contribution analysis by segment that Tranz Rail introduced in 1994. While the results are not directly comparable, the two sets of data are in broad agreement. The main difference is evident in the capital costs where the contribution analysis uses accounting depreciation on the historical cost of assets and interest costs from the General Ledger of the accounts, while the cost models estimate capital employed at current replacement cost and calculate capital costs using the real weighted average cost of capital (WACC).

The following table lists our estimates of the economic costs expressed in constant 1997 dollars. Readers are referred to Appendices 1 and 2 for a detailed explanation of how costs are estimated, but briefly labour costs are the direct costs associated with the generation of outputs and specifically exclude labour used to build or put in place capital assets. Material costs are for those items that are purchased outside the firm for use in the productive process. They include materials, fuel and electricity, operating leases as well as ordinary overheads. Capital costs are the gross value of the replacement cost of capital stock annualised at the weighted average cost of capital.[9]

[9] The capital cost series is described in Appendix 2.

Rail is increasingly sourcing assets by way of finance and operating leases, examples of which include computers, some vehicles and rail berthing facilities. The lease costs are in effect the current cost of the capital items that would otherwise be purchased outright. Operating leases include both asset and operating costs (eg: people such as drivers) and are counted as material costs incurred in each year. Finance leases are applied to locomotives and wagons and the annual cost of the lease is recorded as material costs in rail's accounts. Because these assets appear in the replacement capital costs in this analysis and are charged each year at their weighted average cost of capital (WACC) value they are separated out of the cost of material inputs and included in capital. A summary of costs in constant 1997 prices is provided in Table 1.

Table 1 : NZ Rail Economic Costs - $m

	Labour	**Materials**	**Capital**	**Total Cost**
Mar-83	562.1	427.4	295.9	1285.4
1984	514.1	336.5	267.3	1117.9
1985	490.3	286.1	257.2	1033.6
1986	526.8	306.9	258.2	1092.0
1987	541.6	276.6	249.2	1067.4
1988	503.2	260.1	253.2	1016.4
June-89	429.7	304.8	232.1	966.6
1990	361.7	239.7	221.7	823.1
1991	280.1	242.1	204.7	726.9
1992	253.2	211.2	206.2	670.6
1993	238.3	193.2	164.5	596.0
1994	225.6	193.3	160.1	579.0
1995	215.3	216.8	160.7	592.9
1996	212.0	226.6	176.2	614.8
1997	202.4	233.1	185.0	620.6

Productivity

5. Productivity

In this section we measure the total factor productivity – sometimes termed x-efficiency - of the core business of New Zealand railways between 1983 and 1997. An increase in total factor productivity indicates the increase in output that can be achieved from the same level of inputs. For any level of output, it reduces costs. The increased output from the same quantity of inputs can arise from improved organisational efficiency or technical progress of various sorts. It is an important determining factor of social welfare in any market.

We adopt the standard approach of estimating total factor productivity growth in year t as $g[t] = g[q] - rsg[i]$ where $g[.]$ denotes rate of growth, q is output, rs is returns to scale and $g[i] = \alpha_1 g[m] + \alpha_2 g[l] + \alpha_3 g[k]$ is aggregate input growth constructed using the α_i, measured by cost shares;[10] and m, l, and k, respectively, are material input, labour and capital indices.[11] The growth in total factor productivity is measured as the difference between the growth in the indices of outputs and inputs adjusted for returns to scale. If scale economies exist rs will exceed one. We assume that that there are no scale economies, and thus that rs=1. Although Rail's economic model does have a separation of incremental and fixed cost that might suggest economies of scale, it is likely that this applies to the very short run decision making where capacity may be bid for by the different sections. The fact that in any of the market segments, rail has not obtained nearly 100% market share suggests that rail activities are subject to decreasing returns at some point over their operational range, particularly in the relatively large freight market. We report the productivity results as cumulative productivity indices.

It is likely that $g[t]$ will reflect more than simply organisational gains in x-efficiency. Inputs may embody technological advance. If this occurs but technological advance of the inputs is not measured then our index of productivity growth will reflect technological advance as well as organisational efficiencies.[12] Relatedly, to attribute productivity growth to organisational change requires that the output and input indices accurately represent output and input growth. For example, if the labour index that we calculate under measures (e.g. by mis-

[10] Aggregate input growth is calculated by means of a Divisia index.

[11] For a review and application of this approach see Kendrick (1973), and for an application to utilities see Denny, Fuss and Waverman (1979).

estimation of the growth in real wages) the labour input, it will positively influence measured total factor productivity growth. Finally, we recognise that $g[t]$ is a static concept in that it does not measure dynamic efficiency - which entails choosing the timing and amount of investment in the presence of adjustment costs, technological change and intertemporal market and organisational issues. However, the growth of output, inputs and $g[t]$ over time, together with information about investment will enable an assessment of dynamic efficiency.

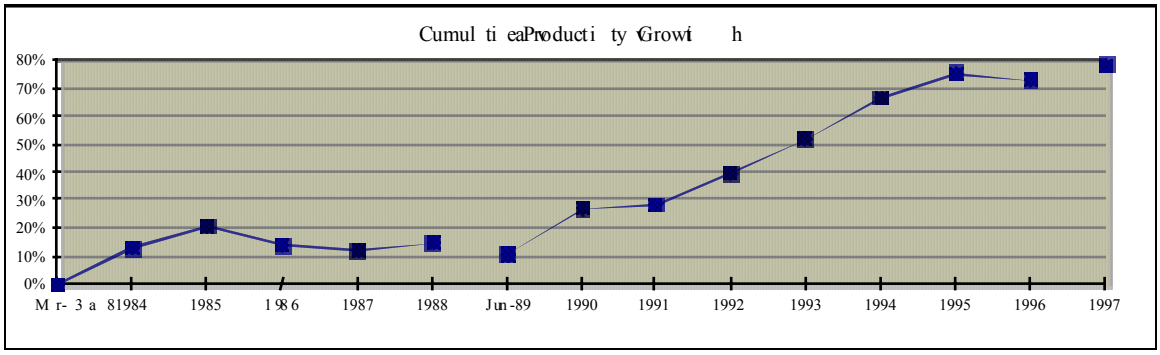
The productivity calculations should use the prices producers face (Diewert and Lawrence (1999)) even if this requires adjustments to data to account for tax wedges. Our firm-level data essentially values inputs at the prices paid and output at prices received. In terms of rail's profit, subsidies provided explicitly for passengers are more difficult. Until 1988 these were paid on a per-unit-of-output basis, but after this time as a negotiated lump sum. This complicates the creation of a price index for these outputs. Ideally output prices used in this analysis should include output-specific subsidies as prices, but negotiated lump-sum subsidies, even if averaged over passenger number and added to the passenger fare, very imperfectly represent the firm's marginal revenue from passengers. We return to this issue in the welfare calculations. For the productivity study it is appropriately handled because output is indicated by passenger numbers and total output includes them aggregated at their average incremental costs.

5.1 Productivity Changes

Total factor productivity is described in Figure 2 in cumulative form. In aggregate, the total factor productivity of the core railway business improved 79% in the period 1983 to 1997, at an average of nearly 6% per year. The majority of the improvement was to a considerable extent the result of a 61% reduction in input growth, which was shared between significant reductions in labour and capital.

12 See Norsworthy and Jang (1992) for discussion of the implication of quality changes for the measurement of productivity and for the estimation of quality adjusted indices.

Figure 2.



What is clear from these data is that there are two stages of change to rail productivity, the period to 1989 saw only a small improvement (aggregate of +10%) with declines in 1986, 1987 and 1989; while for the period 1989 to 1997 growth averaged over 7% per year and +68% in aggregate.

The productivity improvements that were gained following the establishment of the NZ Rail Corporation in 1983 were not sustained and performance deteriorated until privatisation was set as the goal in 1989. This is entirely in accord with Orr's (1981) conclusion that productivity will not be sustained under government ownership, even under corporation forms of governance. It is remarkable that productivity did not improve significantly between 1983 and 1989, given rail's genuine attempts to meet increasing competition by restructuring. One contributing factor to this was the decline in output over the period that more than offset improvements in productivity that appeared as cost reductions. As discussed, it coincided with a period of adjustment in all modes of transport under New Zealand's economy-wide de-regulation (Evans, Grimes, Wilkinson and Teece (1996)) and particularly road transport where distance limitations were lifted in 1983. However, it must be recognised that competition has been at least as vigorous in the period since 1989 as before, particularly with the expansion of the importation of used-vehicles, in both road and rail.

The turnaround in productivity of 1990 will reflect the fact that during the 1980s Rail Corporation entered property development as a partial response to the declining demand for the freight services. We estimate that the level of investment involved in this activity was not nearly sufficient to explain the poor productivity of the period. But this diversification activity will have diverted management's attention from commitment to the core business of rail. Furthermore, the investment in electrification during the period 1985-1989 – and in other core rail assets for that matter - may also have absorbed management time and thereby

created investment adjustment costs that appeared as poor productivity. The commitment to privatisation embodied management commitment to the core business of rail that is likely to have contributed to improved productivity.[13]

The higher productivity growth rate since 1989 has recently slowed considerably due to increasing levels of inputs (capital and materials) as opposed to the net input reductions of the early to mid 90's. Aggregate output declined on average, in the period to 1989 but has grown by nearly 4% per year since then.

While overall this 7% post-1989 growth of productivity is significant and compares to an average 9% improvement in the total factor productivity of Telecom NZ Ltd. in the period 1987 to 1993 (Boles de Boer and Evans (1996)), it should not be a surprising result given that, to arrest the market share losses to trucking and thereby simply survive, rail has had to increase its productivity and thereby reduce costs substantially.[14]

New Zealand rail was placed in a de-regulated environment well before it was privatised or the management planned privatisation. The disjuncture between privatisation and de-regulation is unusual (see McFetridge (1997)), but very useful in that it allow for separate conclusions about the effect of these two events to be proposed. We have pointed out that productivity of rail has grown at the rapid clip of 7% since 1989 when management firmly adopted the goal of privatisation. The effect of de-regulation on privately-held railroads is indicated by Friedlaender, Berndtard McCullough (1992) who report that total factor productivity in a wide cross section of US railroads grew at an annual rate of 3.5% during the 10 years following the railroad de-regulation of the Staggers Act of 1980.[15] If this in indicative of what is achievable by de-regulation in railways, the faster growth of New Zealand rail total factor productivity since 1989 is suggestive of the influence of privatisation. This performance may result from an element of catch-up since 1989. If so, it may be difficult to maintain this rate of productivity growth.

[13] Green and Vogelsang (1994, Ch4) suggest that commitment to privatisation is also likely to have contributed to the productivity improvement of British Airways before its sale.
[14] Guria (1988) reports that the real price of transport fell significantly when limitations on road transport were lifted in 1985. The Telecom result is likely to have benefited more from technological change than has that of rail.
[15] The regulation of the rail industry in the US will have emphasised different factors differently from the New Zealand situation, but regulation was of a common set of factors – tariff setting , entry restrictions and financial structure (for the USA see Freidlaender, Berndt and McCullough (1991, 98-99)).

5.2 Output Growth

The index of output volumes is constructed from the growth rates of the sub-segments of freight and passenger markets, as described in Table 2.

Table 2.

	Output Volumes - Growth Rates %					
	Freight	Suburban Passenger	Long-Dist Passengers	InterIsland[16] Passengers	InterIsland Trucks	Total
1983						
1984	0.0	6.2	6.8	0.0	-5.6	0.7
1985	-1.4	12.5	-11.2	0.0	33.6	-0.1
1986	-2.2	2.6	0.3	0.5	15.4	-1.2
1987	-4.6	-5.7	1.0	-4.9	29.0	-3.7
1988	0.4	-6.8	-40.8	0.5	6.8	-2.0
1989	-9.7	-7.2	0.0	-5.3	-2.2	-8.6
1990	3.9	-4.7	-39.6	12.2	18.5	2.1
1991	-12.5	-4.1	3.9	2.8	11.2	-9.5
1992	3.0	-6.0	16.9	6.3	2.5	3.3
1993	1.0	-6.0	6.5	12.1	-0.2	1.5
1994	13.4	-2.3	15.1	4.7	7.2	11.6
1995	12.9	1.0	-1.6	10.2	11.1	11.2
1996	1.8	3.9	2.3	-1.8	0.7	1.6
1997	7.5	4.7	4.2	3.8	6.4	6.8
Aggregate =						**+13.8%**

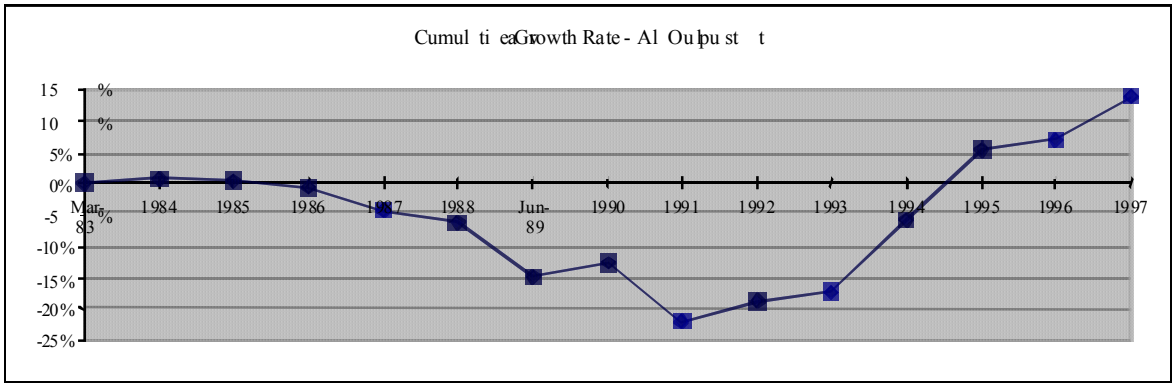
Note:

- Standard unit of freight volume is the NTK and is uniform across all freight sub-segments.
- Actual observations of long distance passenger numbers for 1988 and 1989 are not available and estimates have been used.
- Units for measuring InterIsland truck volumes changed in 1991 but data overlaps allow time consistent measurement.
- Growth rates of total output are calculated by weighting each segment volume by its marginal cost estimate. (see Denny, Fuss and Waverman (1979)). Because estimates of marginal costs for all segments are only available for 1995 to 1997, the marginal cost weighting by segment for this period are averaged and used in the previous periods.

Aggregate output growth in the 14 years to 1997 was only +14% but, as with total factor productivity, there were two very specific trends (see Figure 3). As a result of the decline in freight market share and passenger numbers, in the period 1983 - 1991, cumulative output

growth fell until 1991/92. Since then, output has grown. Unlike freight which contributed most to the overall trend, individual passenger sub-segments have experienced varied output growth with aggregate suburban passenger growth declining 12% over the period and long-distance falling 36%; largely as a result of the halving of passenger numbers in the 1987-1990 period. On the other hand the InterIslander service has shown positive output growth in both passengers and trucks with the latter in particular experiencing very strong growth. The changes in passenger numbers reflect competition in that sector as well. The importation of used Japanese vehicles starting in the late 1980s lowered car transportation costs and affected public transport ridership.

Figure 3.



5.3 Business Cycle

It could be anticipated that because rail outputs consist of substantial proportions of commodities its output performance (and hence productivity and economic profit) will be subject to business cycle influence. One way of testing this proposition is to examine rail-freight market performance during the early 1990's when the economy was in recession (1991 and 1992) and growing (1994 and 1995). In fact, rail's market share was independent of both market growth and GDP. Rail continued the trend of the 1980's and lost market share through to 1996 during which period the market overall was going through periods of high and low growth. Data from stage 1 of this project show that while Rail's share stabilised at about 14% as measured in NTK's in 1996, economic growth seemingly had little impact on its performance, as can be seen in Figure 4. This shows that road freight NTK's

[16] At the time these data were assembled no motor vehicle data were continuously available. We have learned that

grew throughout the period, rail's shrank initially then grew while GDP grew throughout. Certain of rail's large volume outputs (eg. coal) are largely for export. Exports fluctuate according to foreign market conditions that do not necessarily mimic New Zealand business cycles and this imparts some independence between rail output and fluctuations in New Zealand economic activity.

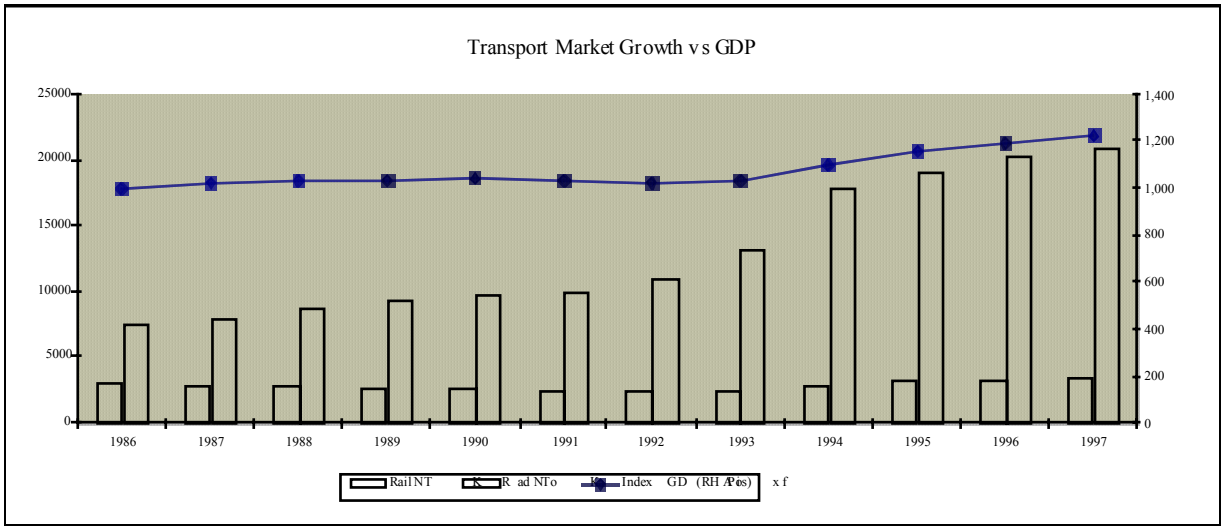
As a result of this analysis we do not make any business-cycle specific adjustments to our analysis.

5.4 Input Growth

Inputs are split into the three categories; labour, capital and materials.

Labour, formerly the biggest category of input by cost (40% in 1983, now 30% of total costs) has shown major changes. The basic measure of staff numbers has fallen from nearly 21,000 in 1983 to 4600 in 1997[17]. Aggregate growth of numbers employed has been -136% since 1983.

Figure 4.

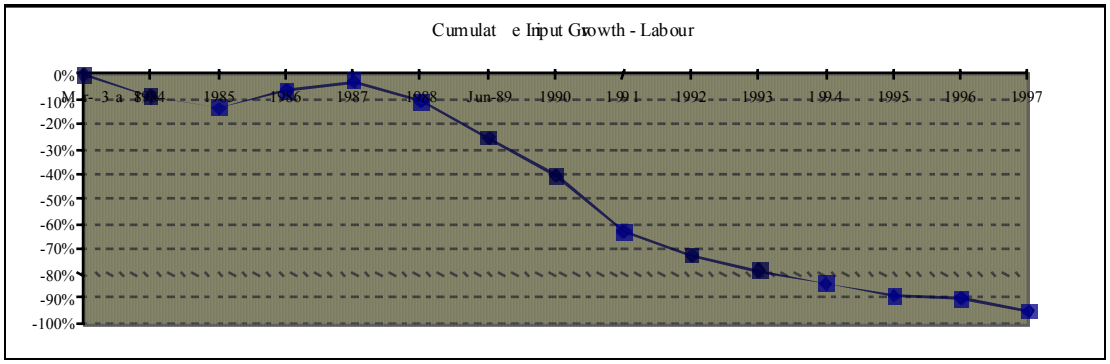


this dataset has recently been constructed. The output index is not sensitive to the inclusion of this series.

Contracting out of various tasks and activities has occurred especially in the 1990's. Anecdotal evidence suggests that a number of ex-rail employees are now providers of services to Tranz Rail, in the same way that former Telecom Corporation staff became service providers to that firm. From a total factor productivity point of view, contracting out to ex-staff will appear as declines in this category of input but will be counterbalanced by increases in aggregate material inputs.

Though the fall in labour costs began in 1988, the big changes to the rate of growth of labour inputs did not occur until 1989 when a 15% reduction was recorded and large (10% or more) reductions continued through to 1992 (see Figure 5). Although smaller in magnitude, the rate of growth has consistently been negative since then[18] .

Figure 5.



By way of comparison average employment in US railroads changed relatively little between the 1980-85 period where the average was 33,284 and 1986-90 when it changed to 26,574.[19] Closer to home, the Productivity Commission (1998) reports that the number of full-time equivalents employed by rail in Australia fell by 38% between 1991 and 1997.

For the subsequent welfare analysis we note the redundancy payments reported in Figure 6 relative to total labour cost. Prior to 1989 redundancies were voluntary, but from this time onwards they have been largely forced.

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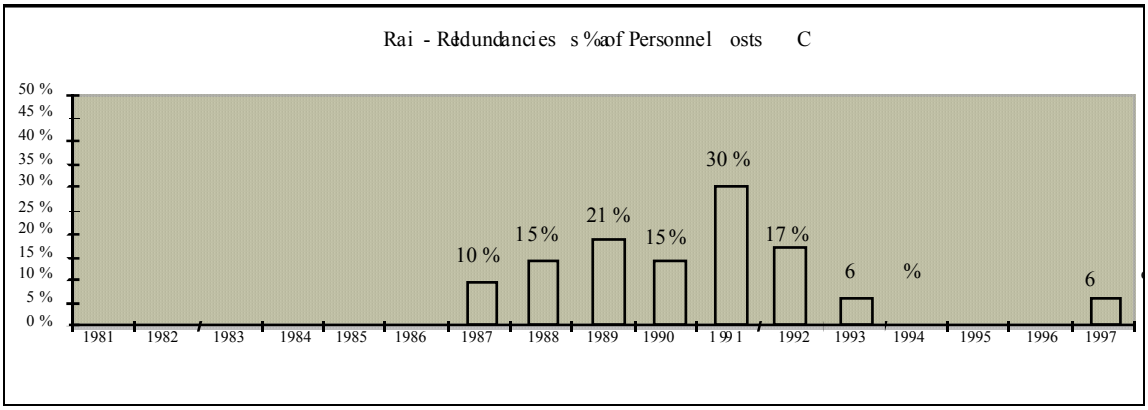
[17] Staff numbers represent full-time equivalent employed staff.

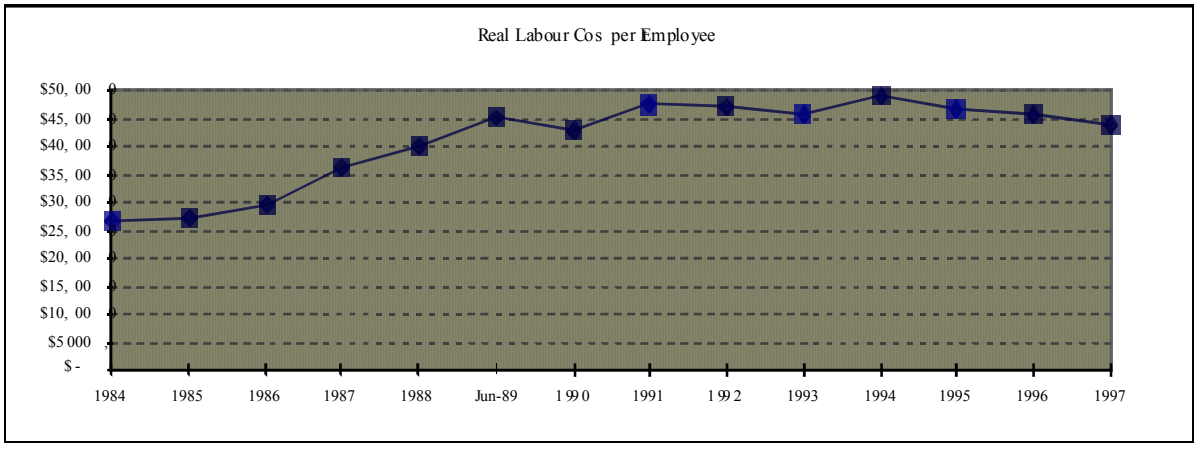
[18] Labour expenses result from labour employed directly in the productive process and therefore do not include labour that is used to build capital assets. They do not include redundancy payments. Detailed data by type of labour (engineers, drivers etc) is not available and this analysis therefore cannot estimate dis-aggregate changes to workforce "quality".

Figure 6.



The rate of growth of labour expenses, placed in 1997$ by way of Statistics New Zealand's Wage Rate Index, has also fallen though not by the same amount as staff numbers. The 94.5% fall in aggregate growth of expenditure has resulted in the average real cost per staff member rising from $27,000 in 1983 to over $48,000 in 1994 but falling since then (see Figure 7). The bulk of the rise was completed by 1989 and there has been little change since then. The increase between 1987 and 1989 will reflect the lower wage rates of persons made redundant as compared to the average wage. For example, guards were made redundant in this period and they did not draw high wages. Special-purpose public sector conditions of employment were eliminated by the end of 1988 for much of the company. It took longer to restructure the employment conditions of the Inter-Island ferries.

Figure 7.

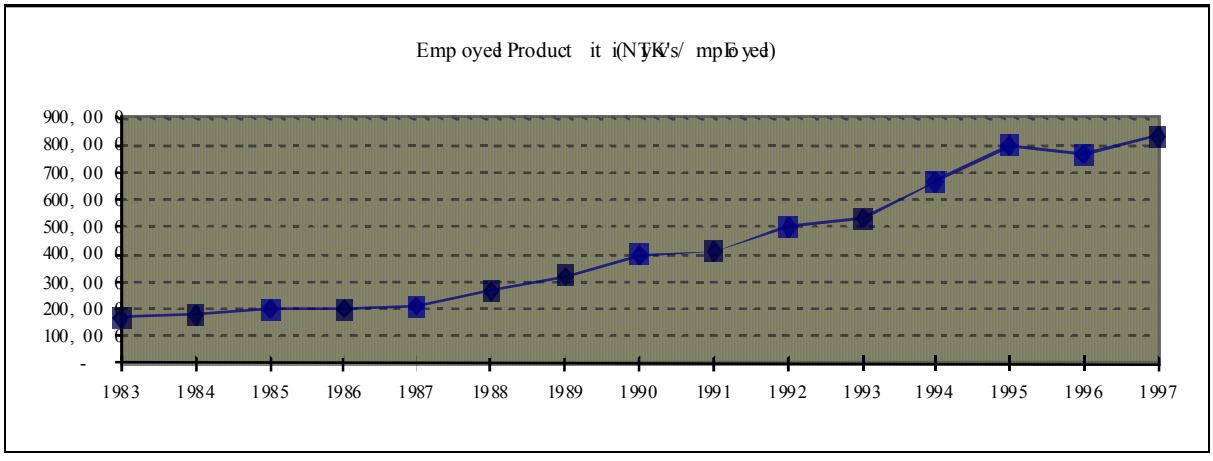


[19] Although US and Australian railroads differ to the extent that benchmark comparisons with NZ rail are not definitive, changes over time do provide some useful information.

Executives of Tranz Rail have indicated that there were no special managerial incentive contracts put in place in 1989, though there was Board discussion of these. However, the record of privatisation world-wide is that public sector managerial salaries approach those of the private sector upon privatisation (Wolfram (1998)), and this may have, for individual managers, provided the anticipation of personal pay-off from privatisation. In fact the situation did change in 1993: the new owners provided senior managers with private-sector employment packages with performance incentives that included performance bonuses and for a small number of managers, allocations of shares. In May 1996, the IPO prospectus reports that 4.71million shares were held by executive officers. This holding would have provided very strong incentives for the executives to improve the productivity of the company. Since the listing of the shares, senior managers have held contracts that incorporate options and potential bonuses. The higher executive packages at privatisation have not applied sufficiently widely to employees of the company to raise the real average wage since 1989.[20]

We conclude this review of labour by comparing the average labour productivity of New Zealand rail with other railways. In Figure 8 we ignore passengers and report NTK's per employee.

Figure 8.

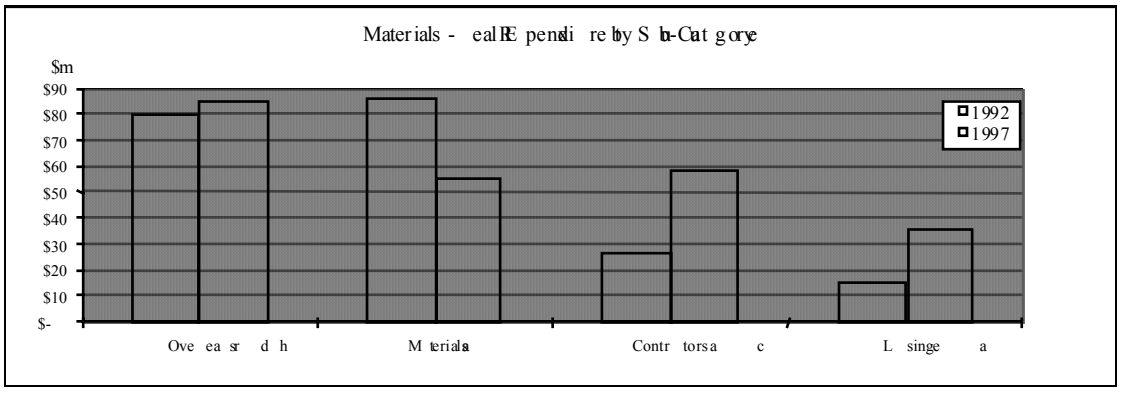


[20] The average wage does not include the value of stock and options.

These data reveal a substantial increase in labour productivity over that of US railways the average for which shifted from the 1981-85 average of 2,488 to that of 4,019 in 1985-90.[21] This confirms the relative total factor productivity comparison. For Australia the Productivity Commission reports that NTKS increased by 26%. When combined with the decline in labour the average labour productivity increased by 64% between 1991 and 1997, about half the increase of New Zealand rail over the same period.

Materials, the next largest category of input is made up of a number of different sub-categories (see Figure 9). Among these are basic materials: these include items that rail purchase to run the railway, in particular fuel and electricity, external contractors' services, lease and rental expenses and general (overhead) costs. While detailed data by these sub-categories are available from 1992, they are not available before then and it is not judged as consistent enough to allow analysis at that the sub-category level. Input growth rates are therefore analysed at the level of "total materials".

Figure 9.



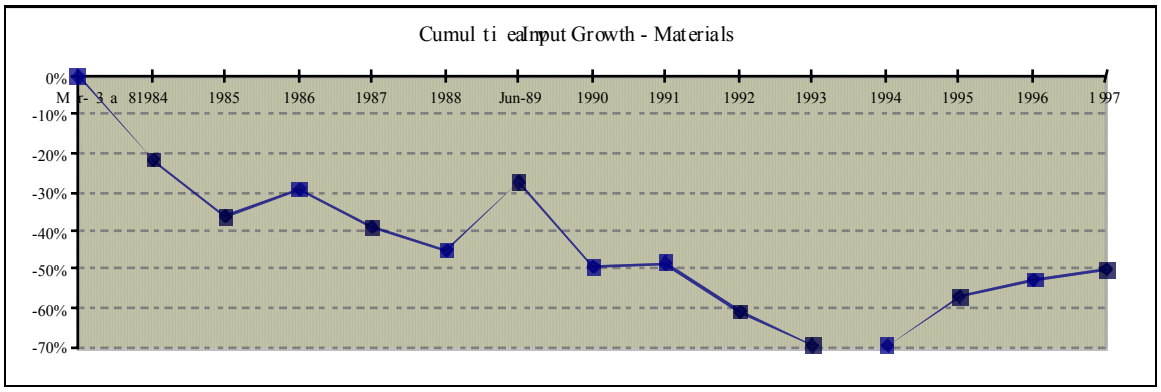
What is evident from the trend in these sub-category growth rates is that overheads (which make up nearly 40% of this category of input) have been stable in real terms, materials and fuel (23% of total) have declined since 1992, while the growth of both contractors (25% of total) and leasing (16% of total) has risen strongly since the early 1990's. While contracting out work has expanded since 1992, a major component of the growth of contracting will represent the expansion in trucking services that Tranz Rail has implemented since the mid-1990s. Since 1993, Tranz Rail have entered into a number of lease arrangements for various assets, especially locomotives and wagons (in 1997) and (in 1999) the new Cook Strait ferry.

[21] These are in revenue-ton-miles per employee.

Lease expenses increased in 1996/7 because of the inclusion of the leases of locomotives and wagons. To avoid double counting with capital inputs the annualised amount of this lease has been excluded from materials inputs in that year.[22]

As illustrated by Figure 10 overall aggregate material inputs have declined by more than 49% with two trends visible, a significant and steady decline in growth through to 1994 and an increase in growth in the 3 years since then.

Figure 10.



Capital inputs are made up of those capital assets that are required to be in place and allow Rail to operate its business of providing freight and passenger services to its customers. These assets have been allocated into 6 categories as follows.

[22] For our purposes the lease annual cost is capitalised, excluded from materials and included in capital. Rail use other assets under operating leases that are rightly material inputs but are not included in their fixed assets. This latter category includes the ferry berthing facilities in Wellington, various trucks and motor vehicles as well as computers and information technology assets. They appear in the materials category.

Table 3 : Classification of Assets

Asset Category	*Definition/Includes*
Right of Way	Access to the land that the rail tracks are laid on. (did not exist pre 1993)
Land	Freehold land owned by NZ Rail Ltd for yards, offices etc.
Buildings	All buildings, offices, workshops, stores etc.
Infrastructure etc	All track, permanent ways, roads, bridges, signals, electrification, communications etc.
Plant Equipment etc	Rolling stock, locos, motor vehicles, other plant, computes and office equipment, InterIsland facilities (excluding Wgton) and ferries.
Work in Progress	Assets in the process of being built.

Note that the assets do not include the land that the rail bed sits on. Because this land was retained in the previous NZ Rail Corp structure from 1990 onwards it is excluded from the core business capital throughout the analysis.

Measurement of the economic value of these capital assets has been confounded by two events. The first was the company restructuring and the consequent debt write off/capital restructuring that took place in 1990 and the second was the value attributed to the assets by the private owners in September 1993 and that is now entrenched in Tranz Rail's balance sheet.

Table 4 : 1989-90 Asset Split

Fixed Asset Split - NZ Rail Corporation to NZ Rail Ltd, 1989 - 1990.

NZRC 1989	NZRL 1990	NZRC 1990
All fixed assets	rail freight,	rail bed land,
for rail-freight,	rail passenger,	some IT, houses
passenger, ferry,	some IT, ferry,	property,
property, IT,	perm way/bridges,	advertising
rail-bed land,		Buses
permanent way/bridges,		
houses, advertising,		
Buses.		

There was a write-down of valuation as well as the re-allocation that took place in 1990. Prior to these events, NZ Rail Corporation had valued its assets using historical cost and depreciated them in a straight-line fashion using conservative asset lives. The capital restructuring that took place in 1990 was aimed at relieving rail of a large amount of debt that had been incurred through interest costs, operating losses in the 1980's and capital (mainly electrification) projects. As was noted in the stage 1 report the debt "write-off" was implemented in June 1990 by holding the debt in the old NZ Rail Corporation entity and creating NZ Rail Limited that held only those core freight and passenger assets needed for it to operate the core rail business. Of the $1.1b of fixed assets that existed on NZ Rail Corp books at June 1989 only $159m of fixed asset value was transferred to NZ Rail Ltd. The value of the fixed assets was written down with the bulk of the write down in rolling stock, electrification and permanent way formations while land, non-core assets and investment property were retained in NZ Rail Corp.

In 1993 the new owners allocated the total purchase price of NZ Rail Ltd[23] to the net assets, based upon an appraisal of the asset values. This process resulted in the creation of an asset called "Right of Way" which recognised the company's right to use the Crown owned land that the track was laid on and, in addition, the fixed assets were re-valued to $405.9m compared to the June 1993 value of $290m in NZ Rail's accounts. As a result of these events and actions the book values do not adequately represent estimates of the economic value of rail capital stock for any analysis of productivity or welfare.

The capital stock estimate used in the productivity analysis is the replacement value in constant dollars. It is the cost in $1997 to reproduce the rail freight and passenger network to meet the capacity requirements in each year of the analysis. This approach is preferred because it represents the current maximum value of the inputs used. If the replacement valuation is correct it will capture the impact on capital of the capacity changes necessary to meet market conditions as well as reflect the technology changes that are implemented for performance related reasons such as cost reduction or quality improvements. Appendix 2 describes in detail how the capital stock was estimated for this analysis.

Figure 11.

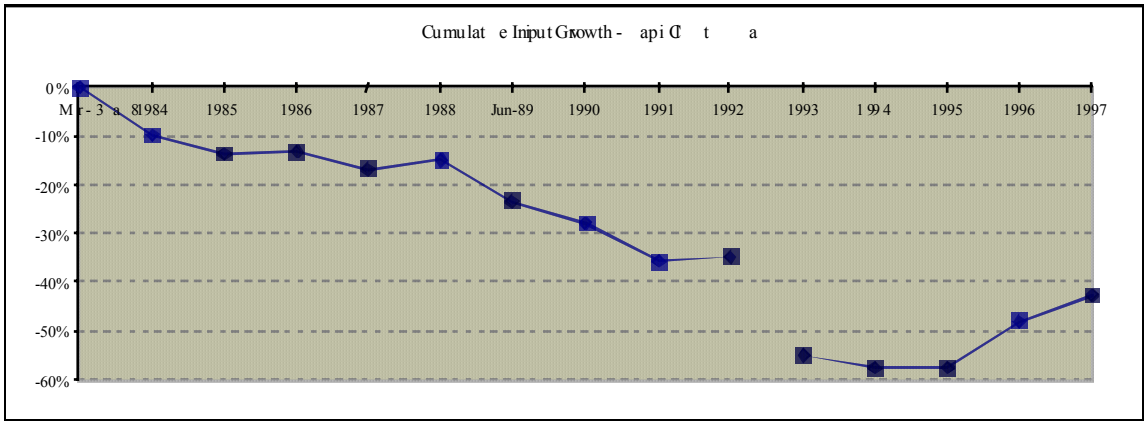


Figure 11 is the chart of cumulative growth of replacement capital for the core business only. The method of estimating capital pre 1989 inevitably includes investment that was in non-core assets but that spending is thought to have been small compared to investment in the core business and will therefore not feature in the capital growth reported here.[24]

While the book value of Rail assets climbed dramatically between 1983 and 1989, estimates of the replacement value declined in real terms through to 1991 as the network was refined to meet smaller volumes of freight and fewer passengers, and combined with better asset utilisation. Also, prices of elements of capital fell. The investments made in improving network performance, such as larger, faster trains made up of wider bodied wagons, appeared as reduced capital input particularly in the period 1988 to 1992.[25] The turn-around to a small growth in capital from 1992 and sustained growth from 1994 is noticeable. It consists of substantial investment in standard rail assets such as, locomotives and rolling stock.

5.5 Productivity growth contribution to welfare analysis

[23] While the full purchase price was $400m, $77.1m was applied to pay off bank debt and $332.9m was paid to the government for the shares.
[24] Capital expenditure in 1985 – 1989 included investment in electrification.
[25] In 1983 Rail had more than 26,000 wagons in service and over 500 shunting and mainline locomotives. Lower volumes of freight, faster trains and technology developments reduced these to 10,000 wagons and 280 locomotives in 1992.

Total factor productivity growth of the core business of New Zealand railways indicates the increased output from the same quantity of inputs that has arisen from improved organisational efficiency and technical progress of various sorts. Productivity indicates changes over time in the output attainable from a given set of employed inputs. It is an input to the welfare analysis of privatisation in that it is one explanation for welfare effects. It should be noted that no account has been taken in the measurement of productivity of factors such as subsidies, or employee severance costs. This reflects the fact that productivity analysis simply seeks to measure the change in (aggregate) inputs and outputs. The measurement of welfare requires taking account of the broader set of factors that enter cost benefit analysis.

The productivity advancement of rail will result in a lowering of the cost of operation of rail, and this is direct input to the welfare calculation. Under constant returns to scale the approximately 2% (7%) per annum productivity growth between 1983 and 1989 (1990 and 1997) would reduce costs at the rate of 2% (7%) per annum.[26] Thus, the considerable productivity growth that we have estimated will directly lead to cost reduction and hence welfare gains.

[26] See the appendix of Boles de Boer and Evans (1996).

Economic Profit by Segment

6. Economic Profit by Segment

As previously discussed (section 4.3.1 of stage 1 report) in a competitive market for intermediate goods, producers' surplus in the rail market is simply represented by the economic profit or surplus that is generated by rail. This is a key input to the welfare analysis. We describe the producer's economic surplus before proceeding to the complete analysis.

Here we seek to quantify the "economic profit" or surplus that rail was able to generate from each of its market segments over the period 1983 to 1997. By economic profit we mean the real economic surplus that remains after all costs are deducted from the real revenue stream. The calculation is carried out at segment and sub-segment level where possible, and aggregated as follows;

Figure 12.

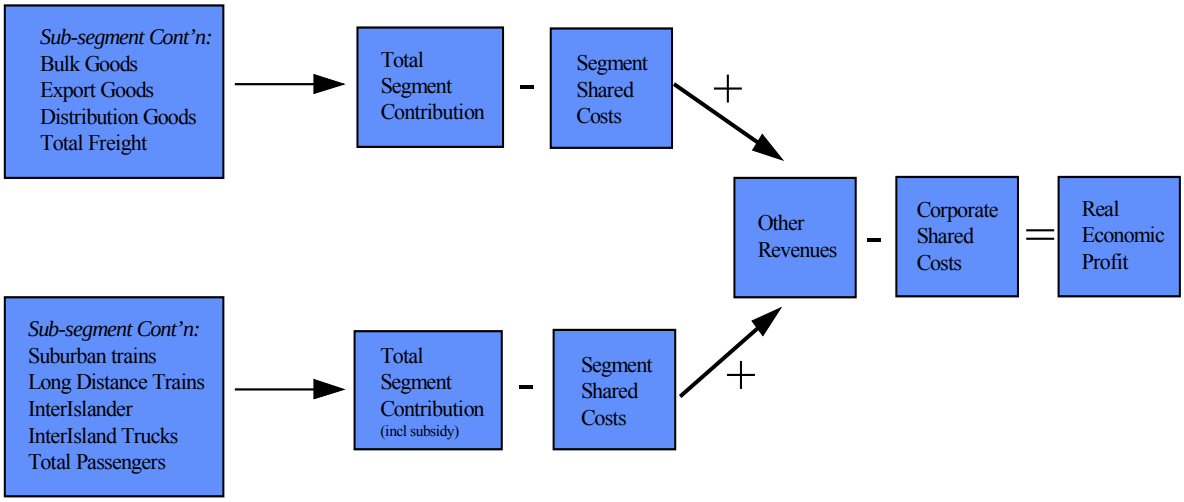


Figure 12 illustrates the feasible disaggregation of cost that is possible. Within each sub-segment box, contribution (revenue less variable cost) of each sector can be calculated. However, there are some costs that are attributable to Total Freight and Total Passengers but which cannot be assigned to individual elements of these categories. Those are termed 'Segment Shared' costs[27].

[27] A substantial portion of the individual segment shared costs are reported in the segment contribution analysis that TranzRail conducts internally however a number of asset types (IT for instance) are shared across both freight

The category of other-revenues includes the revenue from items that are not central to the core business of rail. These include telecommunications and property interests, for example. While other revenues only reached 10% of total revenue in any year, they have to be included because they utilise shared and corporate overhead costs.

Data sources for this analysis have been described earlier. They combine the performance data from financial and operational databases with the economic cost models of the freight and passenger networks. A number of minor issues were encountered and dealt with as follows.

1. Cost data for the period prior to 1990 includes those costs incurred by both the property and bus passenger businesses and in generating various minor "other" revenues (joint ventures, catering and the like). Because these costs cannot be simply eliminated from total shared/common costs the corresponding revenues are also included. It is recognised that the resulting economic profit (or loss) from these business areas will mean departures from core business results prior to 1990 compared to after that year (remember that the business was core rail only after 1990), however the small magnitude of these "other" revenues do not seriously influence the overall results of the analysis, as already mentioned.[28]

2. To recapitulate, total costs are not accounting costs from rail's accounts but are economic costs that are derived from the financial data as follows. Both labour and material cash costs are per the annual accounts but are net of capital works and are converted to constant 1997$. Leasing costs are not included in materials but the concomitant capital is included in the capital stock (as for the productivity analysis). Annualised capital costs are derived from estimates of capital employed in each year and an estimate of rail's cost of capital that is the WACC as described in Appendix 2. Accounting depreciation is included as a proxy for economic depreciation at the "corporate shared costs" level because it cannot be attributed to particular activities, but interest charges are removed from the sum of total rail costs.

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and passenger segments and cannot be attributed to a particular segment and thereby allow a true segment profit to be calculated.

[28] Their aggregate varies in size up to 10% of total revenue.

3. The model's estimates of incremental costs are used in this analysis. Deviations in actual from our estimates of variable costs (AIC's) are more likely in the 1980's when Rail did not have detailed economic models. The large economic losses that were incurred during this period are less sensitive to incremental cost estimates (which are simply used to determine contribution to profit by segment and sub-segment) than to the magnitude of the shared/common costs which had a larger impact on the big losses experienced in the 1980's (see Appendix 1 for a discussion of the calculation of shared costs).

We depict an economic surplus that includes passenger subsidies. While these subsidies are over and above market revenues they must be treated as revenue in the computation of producer's surplus. The presence of the subsidies led rail to make particular decisions and to incur costs that it would not have incurred without them. It is recognised that the welfare cost of the economic surplus should be adjusted for the fact that these originate from taxes, but this can be done in the GR term of the welfare calculation. To pressage this calculation, we note that if the subsidy covers an un-priced externality e.g. congestion – the subsidy-inclusive producer's surplus may reasonably accurately represent welfare without any tax adjustments. If there is no externality then it should appear in the net government revenue (GR) welfare term as well as economic profits and be adjusted for taxation and be subject to the cost-of-taxation multiplier. Our subsequent discussion refers to the subsidy-inclusive producer's surplus unless otherwise indicated, and we shall not adjust by the tax multiplier or include the subsidy in GR.[29]

The freight segment contribution changed from positive to negative in the mid 1980's simply because real unit freight revenue was falling at a faster rate than variable costs. As previously identified, rail did not really get to grips with its (largely fixed) cost structure until 1989 and 1991. In particular, this occurred when it had shed staff and concomitantly moved

[29] Note that if the passenger subsidies are unaffected by privatisation they will net out of the welfare calculation in any event.

as much cost as possible to be variable to volume.[30] These staff reductions are reflected in the trend of the economic profit from the freight business.

[30] In part, the switch to volume related expense was implemented by contracting out. In effect, this replaced long-term contracts with piece-rate contracts.

Table 5: Rail Producer's Surplus

(in 1997 $)

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	19
Freight Segment Contribution	52.2	50.0	38.7	(21.4)	(14.6)	(24.9)	(22.8)	(1.5)	(2.5)	6.1	11.3	30.7	73.8	80.8	67
Passenger Segment Contribution	(6.9)	(17.4)	(18.3)	(18.4)	(9.7)	(39.5)	(34.5)	(9.2)		17.9	29.9	38.3	41.6	51.5	46.5	56
Total Contribution	45.3	67.4	19.4	(39.7)	(24.3)	(64.3)	(57.3)	(10.7)		15.5	35.9	49.6	72.3	125.3	127.4	12
Segment Shared Costs*				Because this category of cost can only be partially i											
Other Revenues	83.9	93.5	88.9	109.7	89.3	146.6	123.1	130.1	99.1	68.9	62.1	65.7	68.5	58.1	55
Corporate Shared Costs	(639.8)	(641.6)	(624.6)	(652.6)	(652.8)	(645.8)	(567.6)	(428.1)	(353.8)	(343.9)	(236.1)	(203.0)	(254.0)	(263.5)	(26
Economic Profit (Including Subsidies)	(510.6)	(480.6)	(416.3)	(482.6)	(457.8)	(473.4)	(501.7)	(308.6)	(269.2)	(239.0)	(164.3)	(115.0)	(60.2)	(78.0)	(8
Excluding Subsidies	(597.4)	(552.6)	(474.5)	(540.5)	(516.6)	(526.3)	(521.7)	(328.6)	(289.2)	(259.4)	(185.4)	(133.5)	(82.1)	(99.8)	(1

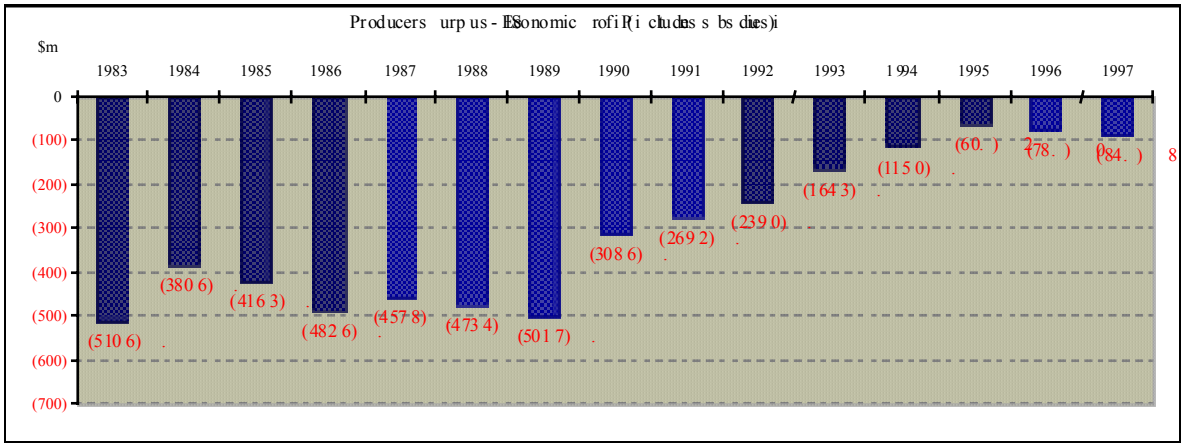
* See footnote 14 for an explanation of these costs and why they cannot be separated from corporate shared costs. Readers should also note that the annual capital cost (replacement value times WACC) is included in this calculation in two places. The portion of the capital that is peculiar to freight (locomotives, wagons etc) is counted in the freight segment contribution via the cost models. The same is true of passenger-activity capital. Those portions of the capital that cannot be counted in the segment analysis (less than 20% of the total capital) are included in corporate shared costs.

Two events led to improvement in contributions from both freight and passengers during 1991 – 1997. Firstly rail's costs were reduced by productivity growth. Secondly the declines in passenger volumes slowed (some segments even grew in volume

As noted Rail did not manage to make any serious reduction in the overall level of real costs until 1990 when they reduced staff numbers, cut materials costs and when the balance of "non-core" costs, such as property, were retained in the NZ Rail Corporation. This trend shows up in the level of shared costs in this analysis which remained between $500m and $600m in real terms until 1990 when they start to fall and dropped to a low of $203m in 1994. The slow decline of shared costs from 1990 suggests that the property cost component was small. The inclusion of other revenues [31]completes the picture and reveals the following trend in cumulative economic profit of rail.

Figure 13 reveals that the producer's surplus was negative at the start of the period and it has remained negative, with losses of more than $4.5b having accumulated over the full period.[32] It is noteworthy that the trend changed noticeably (ie: the losses became smaller) from 1988/89 when privatisation of the core business was planned. It is also noticeable that this pattern agrees closely with the time path of productivity improvement.

Figure 13.

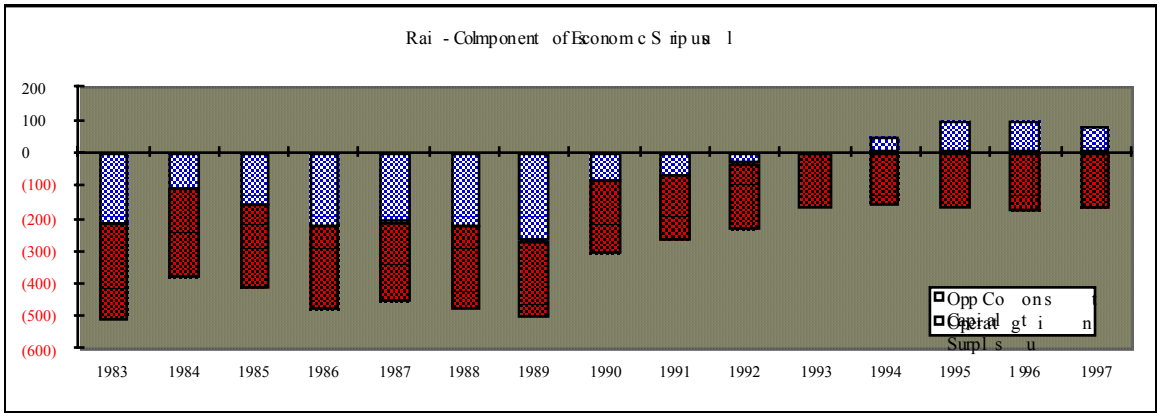


[31] Other revenues are made up of revenues identified in Rail accounts as "other" or property, as well as revenue from joint ventures, asset sales and investment income that is not generated from the market segments described here. Property income was the largest of the other revenue, growing to be $82m (constant 1997$) by 1989, after which it was retained in NZ Rail Corp. These various revenues have to be included in the analysis because the costs associated with them for the 1983 to 1989 period are included in shared costs and simply cannot be identified for exclusion.

[32] For a description of the economic surplus at a WACC of 8% see Appendix 4. It has the same broad features as Figure 13.

Figure 14 shows that the operating surplus of rail has been positive in recent years. However, this surplus does not take account of capital costs: these need to be included to evaluate rail's success in covering all the resource costs it incurs. Figure 13 shows that the inclusion of capital costs, at replacement value, results in a negative economic surplus.

Figure 14



Rail's economic performance will be studied more deeply in Section 8.

Owner Net Revenue - Government and Private

7. Owner Net Revenue - Government and Private

In this section we describe the financial effect of rail on its government and private owners.

7.1 Government

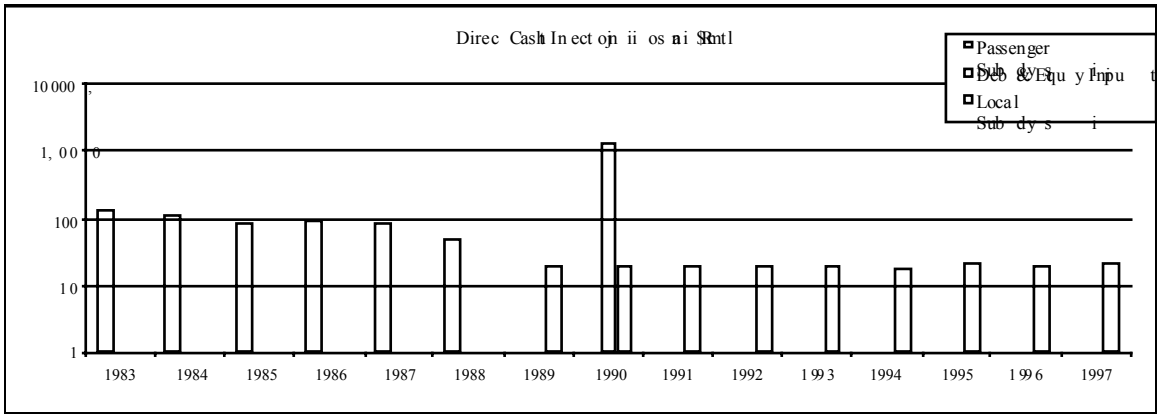
The government as owner could put cash into rail in ways that include direct cash subsidies for market services, equity inputs of various sorts, cash injections for special purposes (say a restructuring or to meet general losses). Equally it could remove cash from rail by way of company taxation, regular or special dividends, share repurchases or other one-off transactions (such as a sale).

The government had traditionally subsidised passenger services and this continued through to 1988. From this date passenger-service subsidies have been provided by local government. The position is described in Figure 15. For the purpose of the welfare analysis we will treat these subsidies as the purchase of passenger services by central government and then local government. This treatment does not differ between pre and post privatisation. To the extent that the subsidy is an efficient response to an externality problem it would not enter the welfare calculation of privatisation. It would, however, be an important component of any analysis of the public interest in closing down rail commuter passenger services.

Figure 15 provides a break down of the cash injections by government in rail. Direct cash inputs to rail were by way of passenger subsidies for both long distance and suburban rail services, take over of the 1990 debt plus injection of new equity and the ongoing subsidies from (local) government of suburban passenger services[33]. The totals are expressed in 1997$. It should be noted that the 1990 debt and equity input is net of the debt that existed in 1983 and therefore represents the net debt accumulated in the 1983 to 1990 period.

[33] Prior to 1989 passenger subsidies were calculated on a per head basis. Since that time they have been a negotiated block grant. They are reported in 1997 prices in Figure 15.

Figure 15.



The cumulative Government cash position in constant $ described in Figure 16 falls into three definite stages, the period to 1989 which was pre-privatisation, the period 1990-1993 when the sale occurred, and the period of private ownership to 1997.

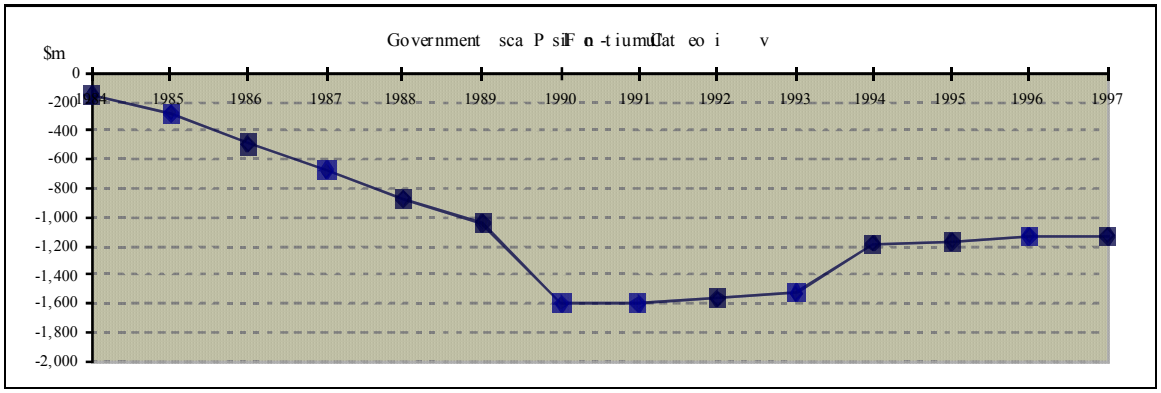
In the period to 1989, $1480m in constant 1997$ was provided to Rail, $450m was cash for passenger subsidies (which are counted as revenues in the analysis of economic profit and are therefore excluded from this review of cash injections) and the remainder was debt write off to that time, represented here by the losses on operations including investments on various projects plus interest on the accumulated debt. This cumulative representation of government investment in rail is an informative way of accounting for the total $1.2b of debt that the Government took over in 1990 and paid off, simply because the capital projects were funded by debt accumulated during the 1980's. Of this $1.2b, approximately $1.05b was a direct transfer from government. [34] It should also be noted that during this period the Government received no cash by way of tax, dividends or other special payments (see Figure 16). The government injections as they occurred are represented in Figure 15.

The period from 1990 to the sale transaction in 1993 saw a further $494m in 1997$ provided to rail. The net amount was made up of a $406m equity injection to cover other debts including capitalised interest, plus $160m of capital investment to account for the balance of the debt write off, as before. The Government, for the first time the period of our analysis,

[34] The records of NZ Rail Corporation since the restructuring of 1990 indicate that in 1996 the Corporation held $397m. in debt that fell due after 1999, and that the sales of property, buses etc had yielded approximately $140m. This to be balanced against the $1.2b debt.

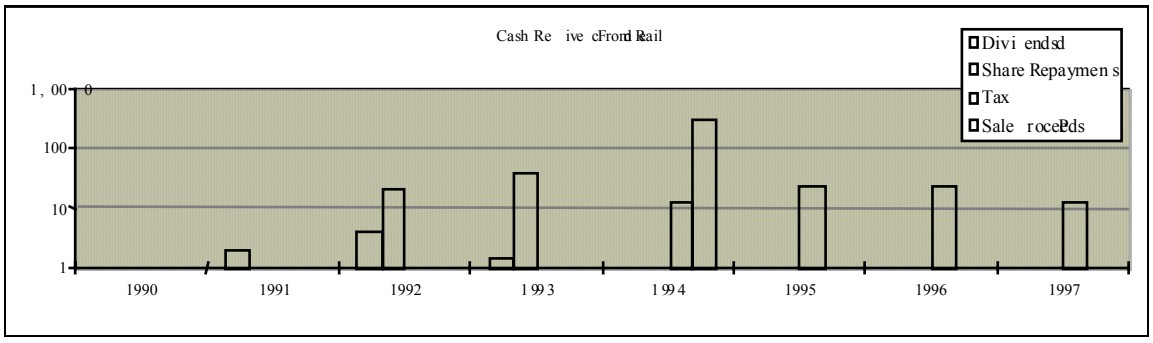
received dividend payments in 1992 and 93 as well as $60m nominal for redeemable preference shares that Rail issued.

Figure 16.



From the Government cash point of view a major turnaround occurred in 1990, after the commitment to privatisation and restructuring, and then again after 1993 when Rail was sold. Since 1990 there have been no cash injections. In 1993 (fiscal 1994) it received the proceeds of the sale and since then it has also received tax income (see Figure 17).

Figure 17.



Nevertheless, for the full 1984-1997 period the government invested $1120m in 1997$ more in rail than it received. As owners, the Government did not receive any cash from Rail until 1990 when it paid a small dividend on the redeemable preference shares, with the shares paid back in 1992 and 1993 prior to the privatisation. The Government received the proceeds ($400m) from the sale in the 1993/94 year along with the usual tax stream.

7.2 Private Owners

To 1997 the private owners' cash position fared little better than the Government, having spent $400m of nominal 1993$ to purchase the company, plus $342m of investment capital to 1997 while receiving only $23.2m in cash dividends.

Share ownership in private hands has changed since privatisation in 1993 as follows:

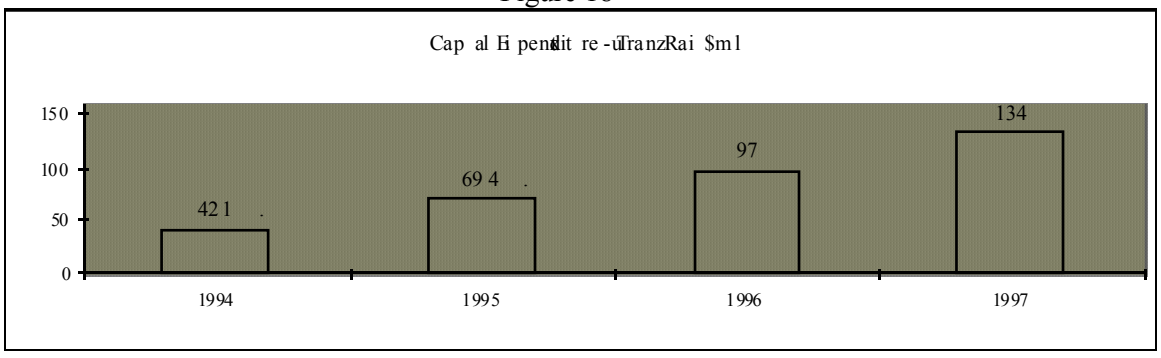
Year ending June	1994	1997
USA major owners	54%	28%
NZ major owners	37%	28%
Other	9%	---
Public owners	0%	44%

Dividends paid by Rail to its private owners has been limited to the following:

1993 to 1996	Nil
1997	$23.2m
1998	*$10.7m (year not included in analysis)*

The capital invested in rail by private owners is described in the following diagram.

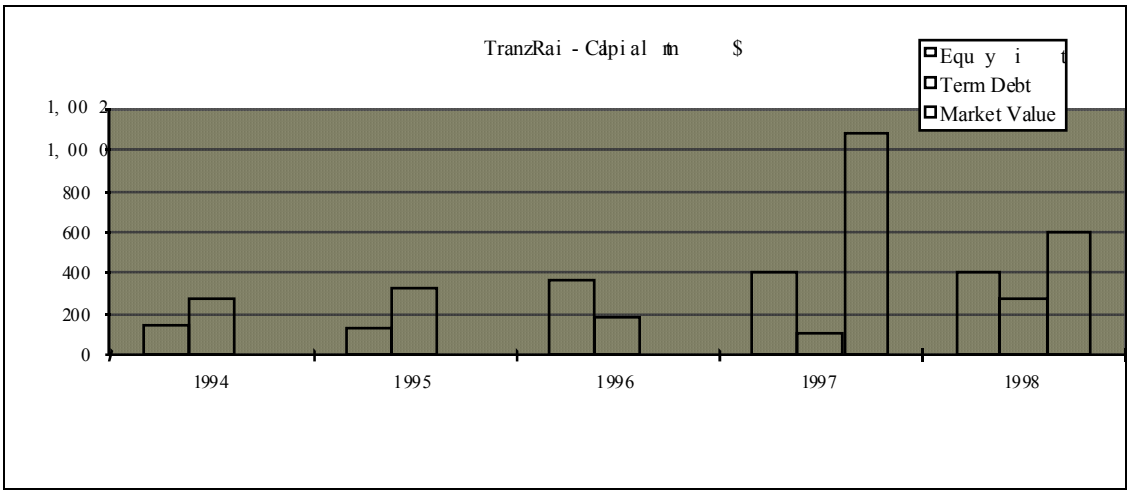
Figure 18



Much of the aggregate capital investment of $343.5 over the period has been financed from retained earnings. Debt has not increased commensurately with the level of investment (see Figure 19b).

Debt and equity levels in Tranz Rail are described in Figure 19a.

Figure 19a.



The following figure provides more detail about the company's valuation over time.

Figure 19b.

			Shares	Value $m	Debt	Total
Share Price IPO 6/1996	=	$6.88	126m	$957m	$162.3	$1119m
Share Price 6/1997	=	$8.50	126.7m	$1041m	$65.2	$1106m
Share Price 6/1998	=	$5.20	121m	$629m	$270	$899m
Share Price 6/1999	=	$3.20	121m	$387m	$278	$665

The change in the mix of debt and equity from 1995 to 1996 resulted from the sale of 27 million shares in Tranz Rail to public investors by way of a public offering. The IPO was over subscribed and by 1997, 44% of the company was owned by public investors around the world. The cash raised was used to pay off debt. The shareholding structure over time is shown in Figure 19c.

An indication of the return to private owners is provided by their *ex post* returns. The *ex post*, nominal, compound annual return on the investment of $400m provided by dividends plus the increment in market value is approximately 28% to 1997 and 11% to 1998. These are *ex post* returns and they will be subject to all the factors that enter the share market's

performance as a whole, as well as those of the company. Depending upon when shares have been realised, investors will have had an experience of varying profitability.

Figure 19c.
Shareholding Structure (% of total)

	Sept 93	June 94	June 95	June 96	June 97
Wisconsin Central	27.3	26.7	31.3	22.7	22.5
Fay Richwhite	31.8	31.1	28.2	20.4	19.2
Berkshire Assoc	27.3	26.7	25.2	18.3	5.4
Public/Other Co's	9.1	8.9	8.0	30.4	43.8
David Lloyd	4.6	4.4	4.0	2.9	2.9
Management	0	2.2	3.2	5.2	5.5
Staff/Directors	0	0	0	0	0.6
Total Share on Issue – m	114.7	121.8	95.1	126.8	127.6
Share Price				$6.88	$8.5

The Economic Position of Rail

8. The Economic Position of Rail

It is important to establish the position of rail as it has been in the past and as it is now. It is generally argued (see McFetridge (1997) and Schleifer (1998)), that privatisation strengthens incentives for dynamic efficiency as well as for productivity improvement. Dynamic efficiency is economic efficiency, or welfare, over time, that emanates from investment decisions and the adoption and adaptation of technological change. Evaluation of it must be carried out conjointly with estimates of the welfare consequences for a complete appraisal of privatisation. Changed welfare and dynamic efficiency taken together indicate the public interest in privatisation. In this section we provide the basis for this total evaluation.

We can summarise the key features of NZ Rail's performance as follows:

- There has been significant productivity growth especially since 1989. It dropped slightly in 1996.

- With capital valued at its replacement cost, rail has produced a negative economic surplus for each year since 1983. The productivity spurt of the 1990's has meant that this economic loss has been at its lowest in the mid – late 1990's. Following the path of productivity, economic surplus has grown, but waned in the last year or so, and has never been positive in our data.

- At the segment contribution level, revenue less directly avoidable capital and operating costs shows a surplus

A key conclusion is that rail's economic surplus has been negative throughout the period of our data. The fact that it is negative in 1997 means that our latest estimate of this surplus is negative. Whether or not 1997 is a good prediction of the future is a matter that would require knowledge of further internal productivity gains that are possible for rail. For the future economic surplus to become positive would require productivity gains relative to other modes of transport, not simply gains in the absolute level of productivity.[35]

[35] Because of New Zealand's unique characteristics, comparison with rail in other countries is fraught with difficulty. Nevertheless, we report that information on the Association of American Railroads suggests a picture of mixed performance since deregulation of 1980. Following a long period of restructuring, including

The negative economic surplus throughout the period of our data, including 1997, should be viewed in the context of Figure 20. This figure depicts (approximately) rail's financial performance since its inception in New Zealand. Apart from the pattern of revisions to its financial performance under episodes of corporatisation mentioned in Stage 1 of the report, the figure shows the deteriorating financial viability of rail since 1920.[36] Productivity has improved hugely since 1989, but it has not yet yielded a non-negative economic surplus on the replacement cost of its assets. Before examining the implications of this negativity we cursarially evaluate the robustness of this conclusion for 1997.[37]

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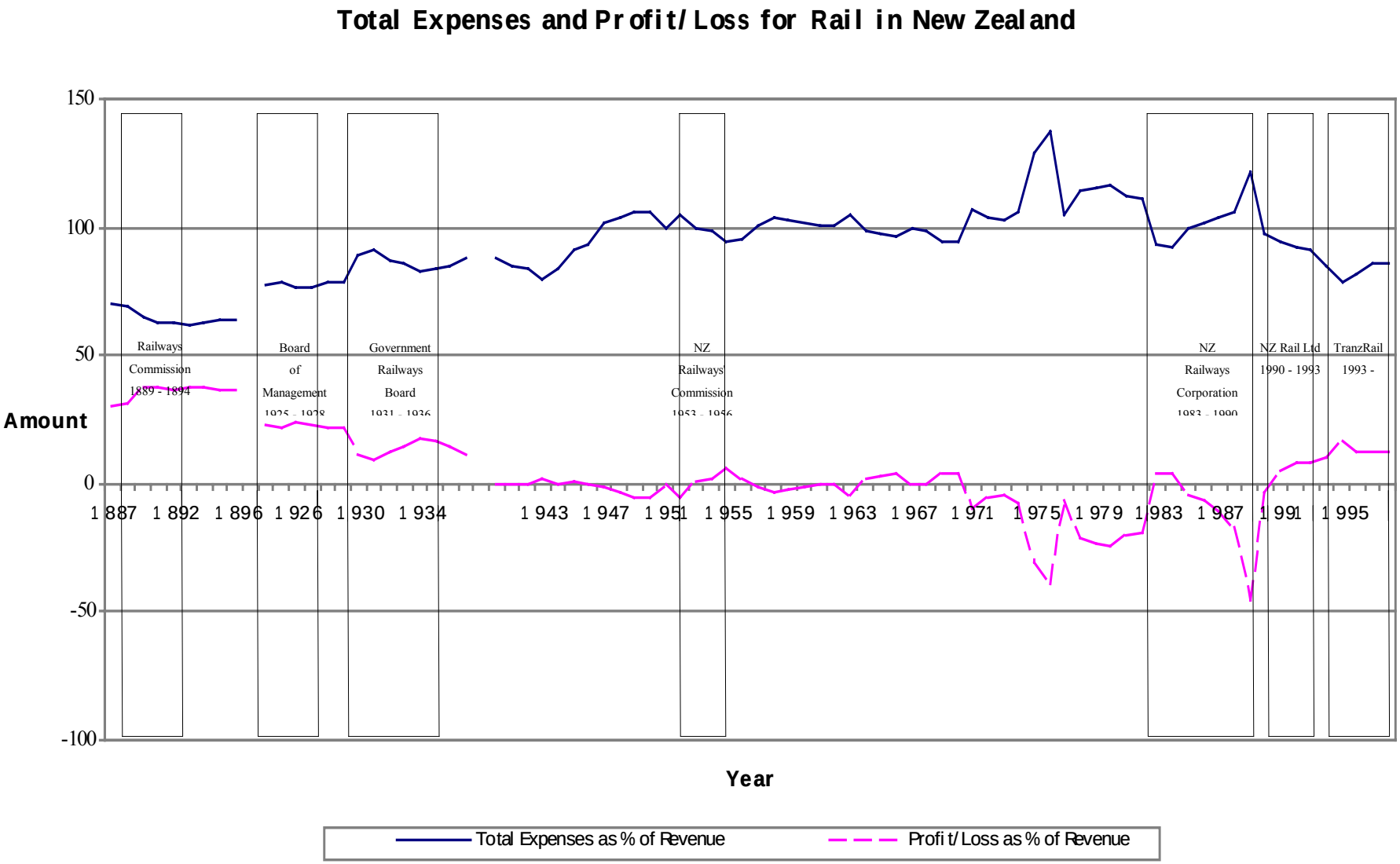
disinvestment, since 1996 there has been an upturn in volumes and in 1997 a small upturn in employment. But there seems to be no evidence that the railroads are generally meeting their cost of capital. The position is mixed because of factors such as major long distance haulage contracts that have resulted from environmental regulation changes that specify the use of low sulphur coal.

[36] For much of its existence Rail's financial viability has been propped up by restriction on competition from road (1934 – 1985), by forcing other trading enterprises to use rail (for the case of Postal Services see Smith (1997, Ch.1) and by subsidising their use of rail (eg. coal, Statistics New Zealand Yearbook (1981)).

[37] Figure A4.1 of Appendix 4 shows that if the cost of capital is left out, the operations surplus was negative until 1993.

Figure 20



(Source – Orr (1981))

The following is the 1997 economic surplus of rail calculated under different scenarios. Each presume that outputs, inputs and, unless otherwise specified, relative prices are maintained at their 1997 levels. Each therefore incorporate first round effects only in that output and input levels have not adjusted to changed relative prices. This is expected to only materially affect Cases 3 and 4 below where rail's share would be expected to expand: hence the economic surplus is understated in these cases. In all cases passenger subsidies are included and land on which the long-distance rail bed sits is excluded from capital.

1. Economic surplus in 1997 -$85m (12% WACC)
2. Economic surplus in 1997 -$54m (10% WACC)
3. Economic surplus in 1997 -$77m (fuel cost doubles, 12% WACC)[38]
4. Economic surplus in 1997 - $41.5m (road user charges double, 12% WACC[39]

Case 1 is repeated from our previous economic surplus calculation. In Case 2 we lower the WACC to the discount rate proposed by Treasury at the beginning of the 1980s for the evaluation of public sector projects. Case 3 is an estimate of Tranz Rail's surplus when the price of fuel is doubled, thereby increasing the cost of road transport relative to rail, and consequently allowing rail to raise its freight output prices and remain in the same competitive position with road freight transport. In Case 4 the effect of a doubling of road-user changes is reported. Finally, we note that, from the analysis of Appendix 4, including externalities other than congestion would not materially affect the key conclusion that the economic surplus is negative: congestion, we assume, is covered by the local passenger subsidies. Most of the welfare cost of externalities that rail ameliorates is incurred in urban areas, and hence it would only have implications for welfare if these rail services ceased.

The negative economic surplus persists under these various alternatives. We conclude this brief review of the negative economic surplus by noting that the costs of rail versus that of other modes of transport are critical for the level of rail's economic surplus. Because rail operates in competitive markets the prices it can charge for its services are set by the costs of alternative modes of transport (see Part 1). For the economic surplus to be a measure of rail's

[38] This scenario is included as an illustration of the impact of an external shock to the relativity of road and rail (the doubling of fuel costs say) on the competitive and economic position of Rail.

[39]The rail-price effect of doubling road user charges is based on Road Transport Association truck survey data. These data imply long distance truck road user charges of 12.3% of total costs. For NTK this is 1.24c. Thus based on rail's 1997 NTKs rail's economic surplus should improve by $43.5m because the increase is assumed to be reflected fully in transport prices.

contribution to welfare, it is essential that other modes are paying their full social costs. We have not investigated this issue except to explore the order of magnitude effect of changes in road user charges on rail's economic surplus.

Our calculation of rail producer surplus has used the replacement cost of assets and annualised them at the full opportunity cost of capital. The negative economic surplus suggests that the enterprise is not covering the maintenance and updating of its existing assets. If other transport modes are paying their social costs,, from an economic welfare perspective the negative economic surplus means that the value society places on rail's outputs has been for the last 14 years, less than society's valuation of its inputs. Taken at face value the cumulative loss in economic welfare is estimated to be $4.5b over the past 14 years.

If there is no prospect of a non-negative producer surplus for rail then, although productivity has improved hugely, there is no rationale for continuing to maintain and replace its assets. The options in this circumstance include selling up the business immediately and recovering the salvage value; or switching away from, perhaps traditional, rail activities that are not making a contribution, to those activities that are doing so. We do expect that the qualitative conclusions that rail has had difficulty meeting its replacement cost and therefore the present value of its economic surplus may be higher under restructured activities is reasonable. This conclusion can be checked by the market valuation of the company.

The present value of the company was;

$1.5b	-	replacement cost (Appendix 2: $1997)
$1.1b		1997 debt and equity (Figure 19b)
$0.9b	-	1998 debt and equity (Figure 19b)
$0.66b		1999 debt and equity (Figure 19b)
$0.4b	-	salvage value (Appendix 3: $1997)

Figure 19a shows that in 1997 the total of debt and equity was approximately $1.1b which is close to our estimate of the replacement value of the company ($1.5b). In 1998 debt plus equity fell to $0.9b. Despite considerable investment – a total of $231m in 1996 and 1997, the market value of the equity nearly halved in 1996-7. While the analysis would benefit from controlling for changes in the level of the sharemarket between years and for any IPO

effects, both these valuations suggest that the market is assessing rail as in prospect of not maintaining and growing the traditional core rail business, but restructuring aspects of this business.

Friedlaender, Berndt and McCullough (1992) report a very similar position for U.S. railroads for the decade following de-regulation in 1980. By 1990 the number of Class 1 railroads and railroad labour had been halved: route mileage had been reduced by almost a third. The companies' rates of return had increased dramatically, but not one railroad was consistently earning its cost of capital. The study suggests that activity divestment that had taken place in railroads to 1990, had a considerable distance to go before rail companies regularly earned a competitive return.

In 1988 and again in 1992 Government policy advisers were concerned about the possibility that rail would not be maintained. Our analysis indicates that, despite a huge increase in productivity, restructuring some traditional rail activities is a possibility. If current and past relative prices and passenger subsidies capture social costs even approximately, it will be dynamically efficient and enhance welfare if this takes place. We acknowledge that this assumes that other modes of transport are paying their full social costs and that there may be internal efficiencies to be gained from the rail business that may change this conclusion. Such efficiency gains must improve productivity relative to that of other modes of transport. For social costs of competing modes of transport to be properly accounted for requires that the infrastructure and other input of shipping and road transport, particularly, are priced at a level that covers their social costs.

Investment and disinvestment decisions under private ownership will be taken by management in concert with strategies approved by the board. In contrast to public ownership, it will be subject to the constraint of viability, monitoring and acceptance by the

debt and equity markets.[40] Providing other modes of transport are meeting their social costs, private and social investment criteria will coincide.

[40] Although there is some monitoring under public ownership it is much less intense and the monitors cannot instantaneously express their assessments in a way that quantitatively reveals them: eg. By selling shares or denying debt.

The Welfare Outcome of Privatisation

9. The Welfare Outcome of Privatisation

The method of welfare calculation has been set out in Section 3. In subsequent sections we have canvassed all inputs that are relevant to the calculation. In this section we impose the counterfactuals and assess privatisation.

In Section 3 we mentioned that what the government receives from privatisation may differ from the elements of the company's cash flow that goes to government because of various factors, including those related to different tax rules in different tax jurisdictions.

There is a second reason why this difference may occur. It is that the elements of welfare we want to use should of themselves be our best estimate of welfare components. In particular, we use our calculation of producer's surplus instead of accounting profit. Producer's surplus is an estimate of society's willingness to pay for rail output less society's valuation of resources used in producing this output. Accounting profits materially deviate from this by accounting conventions, including the treatment of capital. Our use of producer's surplus values all inputs at their opportunity cost and the method of valuing capital and including costs means that producer's surplus in each year is an estimate of the surplus that would continue over time if investment strategies, productivity and prices did not change over time: in this sense it is a static concept. The valuation of capital at its opportunity cost means that producer's surplus will not represent actual cash flows.[41] For this reason the actual cash flows to Government will not be represented by producer's surplus even when rail was owned by government.

It is not actual cash received or disbursed by government, adjusted for the cost of taxation, that indicates welfare changes emanating through the government from privatisation: rather, the governments financial position should be on an accrual basis. Because of government guarantee of NZ Rail Corporation debt until privatisation, the government could and did accumulate liability through the Corporation's accumulation of debt. In addition, given that some debt was supportable by the company, the extent of this liability is a matter of judgment. In fact, the 1990 cash injection (see Figure 14) is the government's action as shareholder, declaring in one lump sum an amount representing the accumulated deficits of

rail. We take the view that it is the government's accruing net position with respect to any SOE that is the appropriate entry to the welfare calculation.

For the counterfactual that is the situation of 1989, the government budget impact will be calculated for each year as (see GR_1 of Table 6)

GR=R-C

Where R consists of; dividend payments (to 1993), share repayments (to 1993), tax payments and the sale price: and C to 1993 consists of increments in rail debt each year and direct investments in rail by the government as owner (eg share purchase). This process presumes that the government equity in rail is zero in 1989 when the debt restructuring was implemented: government investment from 1989 and the performance of the company are presumed to create the equity realised in the sale price. It treats the period before 1989 as sunk and not relevant to the quantitative comparison.

In the counterfactual relating to 1993, history as represented by the government's equity interest in the firm must be taken account of in order to properly capture the accrual of equity that is represented by the sale proceeds. We do this by presuming that the company entered 1993 with equity valued at the share repayment of 1993 plus the equity component of the sale price.[42] This means that there was no accrual of equity for this counterfactual: the government simply received tax revenue after the sale (see GR_2 of Table 6).

We multiply the change in the government's position attributed to privatisation by 1.2 to account for the welfare cost of taxation, but we also report the welfare assessment without this cost-of-tax adjustment.

Because producer's surplus represents the sum available to service debt and equity we subtract from the producers surplus that is used in the welfare analysis any withdrawal by government as owner (see π_1 and π_2 of Table 6). The fact that we are not distinguishing

[41] This annualised cost is constructed on an *ex ante* basis and therefore producer's surplus is not that which is actually realised.
[42] On an accrual basis the government entered 1993 with an asset that was equity in New Zealand Rail.

between domestic and foreign owners means that we need not do this for the privatised company.

Table 6

Welfare $1997m

		1989	1990	1991	1992	1993	1994	1995	1996	1997
Government										
Pte. Owner	*GR1*	($163.10)	($564.80)	$1.95	$26.19	$43.01 [1]	$341.30 [1]	$24.64	$23.95	$12.57
Pte. Owner	*GR2*					$1.01	$13.00	$24.64	$23.95	$12.57
G. Owner	*GRcf1*	($163.10)	($163.10)	($163.10)	($163.10)	($163.10)	($163.10)	($163.10)	($163.10)	($163.10)
G. Owner	*GRcf2*					$1.01	$1.01	$1.01	$1.01	$1.01
	?GRcf1	$0.00	($401.70)	$165.05	$189.29	$206.11	$504.40	$187.74	$187.05	$175.67
	?GRcf2					$0.00	$11.98	$23.62	$22.93	$11.56
Economic Surplus	*s*	($501.72)	($308.57)	($269.20)	($239.00)	($164.34)	($114.97)	($60.15)	($77.97)	($84.79)
Pte. Owner	*s1*	($501.72)	($308.57)	($271.15)	($265.19)	($207.35)	($127.96)	($84.79)	($101.92)	($97.36)
Pte. Owner	*s2*					($165.35)	($127.96)	($84.79)	($101.92)	($97.36)
G. Owner	*scf1*	($501.72)	($501.72)	($501.72)	($501.72)	($501.72)	($501.72)	($501.72)	($501.72)	($501.72)
G. Owner	*scf2*					($164.34)	($164.34)	($164.34)	($164.34)	($164.34)
	?scf1	$0.00	$193.15	$230.57	$236.54	$294.37	$373.76	$416.94	$399.80	$404.36
	?scf2					($1.01)	$36.38	$79.55	$62.42	$66.98
Labour	*?X*	($89.00)	($54.00)	($83.00)	($44.00)	($15.00)	$0.00	$0.00	$0.00	($12.00)
Welfare [2]	*?Wcf1*	($89.00)	($342.89)	$345.64	$419.69	$526.70	$979.04	$642.22	$624.26	$603.17
	?Wcf2					($16.01)	$50.76	$107.90	$89.94	$68.85
Welfare in 1997 [3]	*?Wcf1*	($220.36)	($758.02)	$682.23	$739.63	$828.78	$1,375.47	$805.60	$699.17	$603.17
	?Wcf2					($25.20)	$71.31	$135.35	$100.73	$68.85

1. Includes payment of equity ($47m and $328.30m) to the government.
2. $1.2\Delta GRcf1 + \Delta\pi cf1 - \Delta X$
3. Compounded at 12%

Congestion externalities are accounted for with the inclusion of urban passenger subsidies as revenue to rail. Redundancy payments make up X.

The counterfactuals that we use as base cases are the situations in 1989, 1993 and 1993 deteriorating to the 1989 position after 1997. For each of these, the last year, 1997, will be treated as though the position is an equilibrium state that will persist to the forseeable future. Although trends could be forecast into the future, we have not done so. Such trends are a matter of conjecture and it is unlikely that the most recent economic-surplus trend of 1996-97 will persist.

To summarise the welfare analysis we present the calculated welfare values in 1997 of the privatisation act, assessed against the three counterfactuals.[43] These are:

1.	privatisation from 1989:	\$9.8b. (\$9.2b[44]., \$10.6b.[45])
2.	privatisation from 1993:	\$0.9b. (\$0.9b., \$1.0b.)
3.	privatisation from 1993 returning to 1989 performance from 1997:	\$5.4b. (\$5.1b., \$6.4b)

They give the increment in welfare evaluated at the one point in time, 1997.

They each indicate that welfare is higher because of privatisation. The gains reported under counterfactual 1 are substantial, but they are not out of line with the aggregate value of the producer's-surplus losses since 1983, since these are not compounded to 1997 and do not include a calculation as to future losses. It is the order of magnitude that would result from eliminating these losses: but the welfare calculation is affected by other factors.

From Figure 20, it is clear that the decision to privatise coincided with one of the worst measured financial performances in the history of rail. In contrast to the very poor performances of rail in the 1970s, however, the fact that rail in 1989 was in a de-regulated market meant that, unless transport was to be re-regulated, rail could not respond to its plight simply by raising prices or having market restrictions imposed. The large welfare gain

[43] For counterfactual 1 (2) these are calculated as the sum of the second-to-last (last) row of Table 6 plus the present value of the 1997 figure in the second-to last (last) row at a 12% discount rate. For counterfactual 3, the sum of the last row and the present value of the 1997 value in the second-to-last row is used.
[44] The first figure in brackets places no shadow price on taxation.
[45] The second figure in brackets uses a WACC of 10%, and discounts and compounds at this rate.

resulting from Counterfactual 1 reflects the very significant recovery that rail has made from its position in 1989.

The economic argument that welfare change from the date of commitment to privatisation will precede the privatisation act (Beesley and Littlechild (1992)), and the empirical findings of Weyman-Jones (1994) that productivity increased in the UK electricity distribution sector between the announcement and act of privatisation are in accord with our finding for Counterfactual 1. This counterfactual incorporates the "commitment to privatisation" effect and quantitatively it is most significant.

Counterfactual 2 may well describe the best possible scenario for government ownership, in that the counterfactual incorporates all the productivity gains to 1993 from vigorous restructuring and increased customer focus, and maintains that position. If this occurred, it would be the first time in the history of New Zealand rail that such gains were locked in. Counterfactual 3 represents the hypothesis of a cycle of productivity of corporatisations under government ownership and quantitatively a compromise between the other two.

The incidence of the benefits and costs of privatisation are also of interest. Because rail produces largely intermediate services, is in largely competitive markets and has maintained all its services, the main incidence effects lie with taxpayers and the firm owners. Taxpayers are the big direct gainers from this privatisation. Not since privatisation have taxpayers had to contribute to rail. In the past, transfers to rail from taxpayers have been very substantial. Between 1983 and 1993 the government actually invested approximately $1.8b (in $1997) for the return of the sale price and dividends and tax that reduced the net injection to $1.12b. Under the counterfactuals, injection of government funds would have been much higher. The actual incidence of this gain across the population will follow that of taxation under either existing rates if no change is made or under any new rates. The benefits to taxpayers of productivity gains induced by privatisation were presaged by Harrison and Grimes (1989) and Hogan (1990) who showed that providing firms were more productive in private hands the government's net income position would be improved by privatisation.

Employees of rail who have involuntarily retired from rail and have subsequently not found equivalently satisfying work have lost from the activity. A measure of their welfare loss is included in the welfare calculation, but the incidence of it has fallen on certain former employees. Those executives who were allocated shares at privatisation and who sold them before, or at the IPO are likely to have done well out of privatisation.

Finally, the return to private owners has been volatile and significantly different between 1994-97 and 1994–98. The nominal *ex post* return of the latter period is 11%. It means that the private owners have not earned the firm's cost of capital and hence have not gained from rail over ownership of investments in the market more generally. Although, *ex post* returns are very volatile and will differ, perhaps markedly, from year to year, this conclusion is in accord with the estimate of economic surpluses. The equity market seems to recognise the economic and financial position of rail.

Conclusions

10. Conclusions

Starting in the 1880s New Zealand rail has had five episodes of corporatisation under state ownership. Under these episodes the rail business seems to have improved commercially but the improvement was not sustained. The data suggest that this was true as recently as the corporatisation of 1983. New Zealand commentators have identified the inability of the business to be run independently of actual and potential political influence as a key feature of unsustained performance, and this is what the governance literature of modern economics would suggest.

Excepting the corporatisation episodes, the broad financial trends of the New Zealand rail business have evidenced increasing difficulty with competing with other modes of transport since the 1920s. From the early 1930s all sorts of mechanisms have been used to shore up the viability of New Zealand rail in the face of emerging competition. The de-regulation of all modes of transport in New Zealand in the early to mid 1980s forced rail to confront its situation. Historically, it was in its best position to perform well as a public enterprise business; for although it was not an SOE, the 1980s was a period when there was a sustained attempt to separate out political requirements and improve the commercial performance of public enterprise businesses.

Throughout the 1980s New Zealand rail struggled to come to terms with the increasingly competitive environment. Our productivity analysis suggests that total factor productivity growth was slow during this period, not least because of rail's falling share of its traditional outputs. The enormous societal cost of having shorn up New Zealand rail since the 1930s might be indicated by the accumulated producer's (surplus) loss of $4.10b in 1997$s over the 1983-93 period alone. This does not include the costs of indirect forms of assistance to New Zealand rail, including carriage restrictions applied to other public enterprises during the period.

The purpose of this study was to examine the effect on welfare of the privatisation of New Zealand rail. Because of the unique features of rail in New Zealand an appropriate counterfactual would seem most likely to be drawn from New Zealand experience, although

buttressed with observation of performance from other countries.[46] In 1988 a commitment to the privatisation of New Zealand rail was made by the Board of Directors and later the management of the company. Plans and actions from this date were designed to this end. They entailed focussing on the core rail business. The actual timing of the sale of the company was determined by the evolving commercial state of the company as well as political exigencies. Just prior to sale, the viability of rail was of real concern to government and its advisers, to the extent that the possible run-down of rail in private hands was a major element of a report commissioned by Treasury.

Non-viability had two implications. The first is that the highest bid for rail in the sales process may well have been above the salvage value but entail winding down key parts of rail. Secondly, providing the revenues and costs of rail reflected the full social benefits and costs of rail, winding down these parts would be economically efficient.

In 1989 the decision to commit to behaving as if rail was to be privatised had been taken, rail was performing poorly despite substantial investment since 1983.[47] We take as our counterfactuals to privatisation the state of rail in 1989, the state of rail in 1993 and the state of rail in 1993 declining, after 1997, to the situation of 1989. In Stage 1 of this study we proposed returning to zero profit from 1993, but, as we have shown, the economic surplus did not reach breakeven point in our data.

In many previous studies privatisation has been implemented at the same time as de-regulation. In the case of rail the major transport de-regulatory steps took place in the early-mid 1980s. Although adjustment to the more competitive environment may still be going on, the fact that privatisation is dated from 1989 at the earliest offers the opportunity to distinguish the effect of privatisation more sharply than if de-regulation and privatisation occurred simultaneously.

[46] The counterfactuals for the privatisation of rail will include relevant information from a study of New Zealand SOE's that is currently under way; when data are available.
[47] Some elements of this investment was not in rail's core business.

10.1 Counterfactual : 1989

The change in welfare resulting from the privatisation decision in 1993 we estimate to be $9.8b as of 1997. This result reflects a very significant recovery from the very poor performance of 1989. It is an outcome of productivity growth that we estimate reduced ongoing costs by the order of 68% over the 1989-1997 period. This growth has outstripped productivity growth in other public (Australia) and private (U.S.A.) railroads that we are aware of. It is significantly in advance of the productivity growth achieved in the 1983–88 period in New Zealand rail.

There was significant investment and restructuring during 1983-88 that included the development of certain non-core business activities. This is likely to have diluted management's focus on the core business, affected productivity adversely and the economic surplus of the 1989 counterfactual. The commitment to plan for privatisation in 1988 coincided with a decision to strip away all but the core rail business.[48]

10.2 Counterfactuals : 1993 and 1993 with deterioration

The position in 1993 was reached with rail as a public enterprise but with the commitment (by the Board and management) to privatisation in place. It most likely represents the position of best commercial performance attainable as a public enterprise. Without the privatisation incentives for managers that attend privatisation it is very difficult to maintain innovative productive performance.[49] For this reason and because of the hypothesis - suggested by the history of New Zealand rail - in that public enterprise improvements in productivity are not sustainable we consider the counterfactuals of 1993, and 1993 returning to the state of 1989 in 1997. The changes of welfare are:

1993:	$0.9b
1993 and deterioration to 1989 from 1997	$5.4b.

[48] Interestingly, Friedlaender, Berndt and McCullough (1991) report that the initial response of U.S. railroads to de-regulation was to diversify. They too returned to focus on the core rail business after their diversification experience.

as of 1997. Both sets of privatisation welfare gains are important. Based on our reading of the literature and on the history of New Zealand rail it would seem that the 1993 counterfactual would be the lower bound for welfare gains from privatisation. It is not just that it entails maintenance of the 1993 position in absolute terms, but the productivity of the position must be maintained against that of other modes of transport. Rail has not achieved this in its history of government ownership. These results will reflect productivity that continued to improve under privatisation, with the exception of 1996.

These quantitative results are based upon the evidence between 1983 and 1997. The negative economic surplus over this period renders problematical the sustainability of the counterfactual situations over time and the stability of the 1997 performance into the future. Mention has been made that it is unlikely that the 1989 situation would have persisted for a long period, and the same may be true of the 1993 counterfactual and 1997 performance. Nevertheless they are reasonable estimates for the period of our data.

The SOE model that was established under the 1986 SOE Act arguably represents New Zealand governments' best attempt at commitment to state-owned entities that perform to the standards of private firms. It is, however, new and untested. The study in-progress of certain of New Zealand's SOEs will provide information about their performance. It will be useful over time to compare these performances with New Zealand rail's performance as a public entity. The comparison of the counterfactual of SOE performs with that of rail in private ownership will provide additional information about privatisation.

The welfare assessments are a quantitative indication of the impact of privatisation on economic efficiency: and hence of economy-wide performance. They reflect the history of public enterprise that has no effective bankruptcy constraint and which has operated only with very substantial transfers from taxpayers. We calculate the economic loss, at replacement capital value, between 1983 and 1997 to be $4.5b, excluding measures designed to shore up rail that affected other industries. Taxpayers are major gainers from the privatisation because of the elimination of their commitment to funding rail losses under public ownership.

[49] This has been emphasised to us by certain SOE CEOs in the course of our SOE performance study.

The returns to the private owners depend on when that calculation is made, but indications are that they have not benefitted nearly to the extent of taxpayers: as of 1998 their *ex post* return was approximately 11% in nominal terms which is less than the *ex ante* cost of capital. Although the returns to different investors may have been quite different because of variation in the share price, since the inception of private ownership the compound return has not exceeded what could have been expected on average, from other investments.

10.3 Dynamic Efficiency

Dynamic efficiency is a critical element of the performance of an economy and the economic efficiency of ownership forms in particular. It is our assessment that Tranz Rail has been maintaining its core-business capital assets and modernising them to lower costs and to meet customer requirements. Indeed, investment in the last two years has been in core–long-distance freight capital goods as well as in the renewal of the InterIsland ferries. For these actions to be dynamically efficient requires that the economic surplus derived from them be positive, at least prospectively. The long-term trend for rail and our analysis both strongly suggest that this test of dynamic efficiency has not been met, either in public or yet in private ownership.

Given the long history of public ownership, privatisation might be assessed as an attempt to provide the ultimate test of the economic viability of rail. In this context, and given uncertainty about productivity of rail in private ownership, an entirely reasonable strategy would have been to take time to improve productivity in order that a better assessment of the economic position of rail could be made. Taking stock now, it would seem that further productive gains, relative to other modes of transport, are required if all traditional rail services are to be economically sustainable. In the event that these are not possible, and the relative prices of all modes of transport properly reflect social costs,[50] it would be in the public interest that some businesses of rail are restructured.

If relative prices of competing modes of transport do reflect social costs then public and private interests will coincide. Given these prices, the history of rail in New Zealand

[50] This would require that road and shipping transport infrastructure and other inputs are priced at a level that covers their full social cost.

suggests that there has been enormous government and social cost incurred in the past in retaining rail as a state-owned entity. The record suggests that appropriate investment and dis-investment decisions are more likely now that rail is in private ownership.

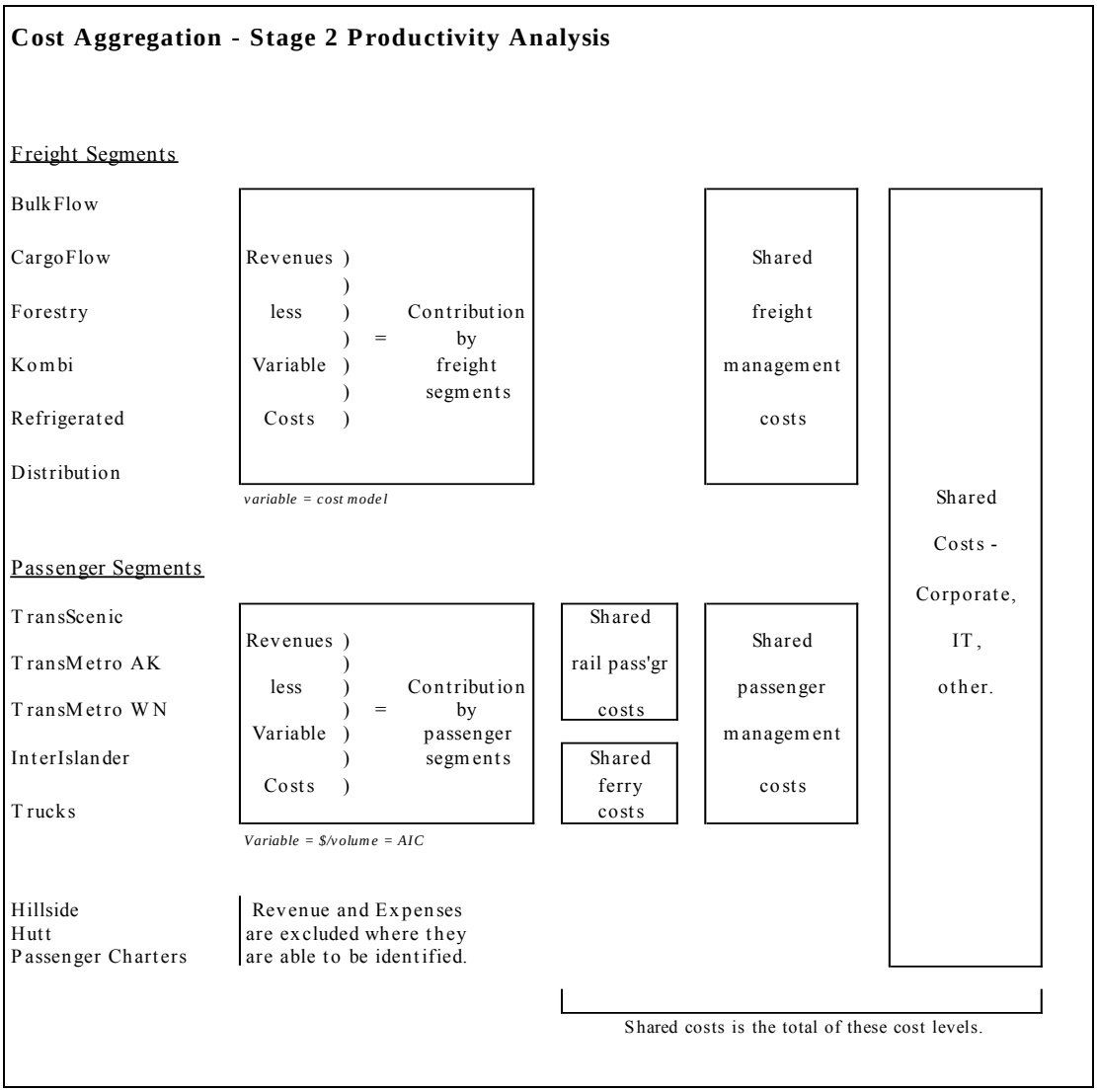
Appendices

Appendix 1 : The Cost Model

Estimates of Incremental Costs

As was noted earlier estimates of average incremental costs (AIC) for the rail freight system in its entirety are derived from Tranz Rail's cost models and we are satisfied that they adequately represent economic costs. It is important to understand the cost structure of the rail system, in particular which costs are variable to volume changes and which are shared or common. The following table describes the cost structure as used in this analysis and expands on the brief discussion that is in section 5.

Table A1.1



- The variable portion of the freight costs is calculated by the freight cost models. The models simply estimate by segment, the costs of providing the freight network to move the annual freight capacity in NTK's. The individual unit costs are averaged by their shares in total freight NTK's to give a "total" freight variable cost, which is subtracted from total freight revenue to show contribution (to shared costs) from freight segments.

- In the absence of passenger cost models, total passenger variable costs are converted to AIC by dividing the total variable cost by units of output. By deducting variable cost from revenues gives the contribution or economic profit for passenger segments.

- A number of shared costs are excluded from the analysis of economic profit by segment, fixed freight and passenger costs which are not volume sensitive, shared passenger management costs, corporate costs and the costs associated with the construction and maintenance activities at the workshops. These costs are summed to provide total are these your corporate shared cost shared costs that are included at the aggregate Tranz Rail level to calculate overall Rail profit.

- Also, as was noted earlier there are a number of miscellaneous revenue sources that are excluded from the segment analysis but are also included because their costs cannot be distinguished from the aggregate shared costs.

This approach was able to be used in the period 1990 to 1997 only; because economic costs by freight and passenger segments were not estimated prior to 1990. For the period 1983 to 1989 the 1990 estimates of cost were rolled back or adjusted each year using the average year on year cost change for actual costs. This is, the average variable costs in year x were changed in the proportion TC(t-x)/TC(t) where TC is total cost. This process should provide a reasonable estimate of segment costs simply because NZ Rail Corp were slow to respond to the changes in their markets prior to 1988, which meant cost levels were not significantly affected by technology and process changes, though the collapse in their market share meant that they had spare capacity in the network for much of the period. While this means that variable costs probably fell faster than our estimates indicate, this point is minor and is offset to a large degree by the lower network capacity used for the initial 1989/90 cost estimates.

Appendix 2 : Capital Stock and WACC

Estimation of Capital Stock - Replacement Value

This section describes the process used to estimate the gross replacement cost of the capital used by Tranz Rail to deliver its outputs. Replacement value is used as the maximum value of the resources tied up in the rail business, and in this analysis is expressed in constant 1997 $. The normal series has been deflated using the PPI for inputs, except where values are estimates (4,5 and 6 below).

- Tranz Rail's accounts do not have an accurate current record of the book value (where historical cost less depreciation = book value), with the best view of book value being back in 1983 prior to a series of events that confounded the view, e.g.:

    - North Island Main Trunk Electrification was added in the 1980's at a cost far above its economic value. (ref: Coopers & Lybrand 1989 review of this project)
    - Rolling stock values in the 1980's were way above replacement costs. (values were significantly reduced in 1990)
    - In 1990 book values were reset to market (cash generating) value.
    - In 1990 approx. $900m of asset values were written off.
    - In 1993 book values were arbitrarily reset by the new owners.
    - In 1993 a new RoW asset was added.

- The usual problem of estimating replacement capital values is overcome by using the RailCost average incremental cost model developed for NZ Rail by Travers Morgan/BCG in 1989. This model calculates the replacement value, and annual costs, of the freight system on a standalone basis. It uses engineering rules to size and scope the network and activity analysis to operate it. It uses annual capacity requirements and current costs to estimate network unit costs and then calculates financial performance by segment based on revenue/price decisions at that time. Replacement capital costs are reconciled by Tranz Rail to current book values and the model "run" is done each year 1990 to 1996. We do not make this adjustment.

- The gross capital value of the freight network is converted to an annual "charge" by recovering the cost of the assets over their economic lives. The average recovery rate in the model was 13.6% in 1996, though each type of asset has its own recovery rate. To reverse engineer a gross value, the annual capital charge is "marked up" by this rate to derive an aggregate capital value for the freight system.

- Standalone rail passenger assets were assessed by Tranz Rail for replacement value in 1993 and, on the basis that little change has occurred to passenger capital costs those figures are used in each of the years 1990 to 1997. Any investments in Tranz Scenic assets in recent years are thought to be minor quantitatively.

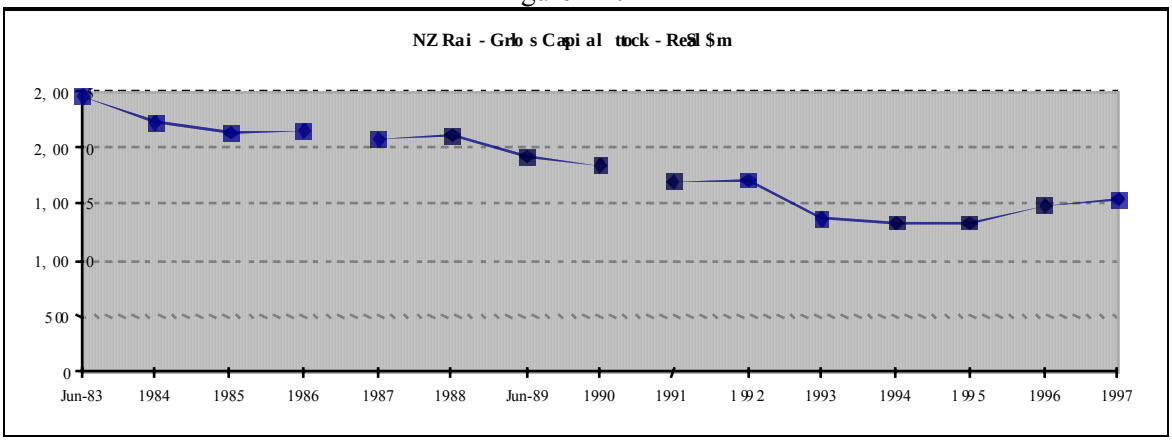
- Cook Strait ferries have been valued by Tranz Rail at their 1997 replacement cost of $390m. Examination of the capital goods index for the period 1990 to 1997 indicates that the cost of goods of this type have dropped only a minor amount through the period and the 1997 replacement cost is therefore used throughout.

- An amount of $150m has been added in each year to account for IT, motor vehicles, buildings, trucks and other assets needed and owned by Rail in the productive process. This is purely an estimate and is about 10% of the total replacement value of capital.

- Nominal replacement values for the period 1990 to 1997 are estimated using the following approach for the 1983 to 1989 period when there was no cost model. The 1990 gross "closing" capital is rolled back to the 1980s using the "closing value + depreciation - capex = opening value" calculation. The assumption here is that accounting depreciation rates in the 1980's were a fair representation of the economic lives of the assets. If this is not the case however, and verifying it is difficult, then the sensitivity to this assumption is very minor in the assessment of capital. Nominal values are then converted to constant 1997$ using the PPI for inputs.

By way of comparison, capital stock for Rail has been estimated by Professor Brian Philpott. His estimates give a gross capital stock of $2720m for 1983, expressed in 1997$. This compares closely with the $2450m of gross stock that we have estimated in this analysis. The Philpott analysis is made up of $2853m of building and construction (50% is land) and $1291m of plant and equipment. Right-of-way land is excluded in the model and is also excluded from the Philpott estimate. His most recent estimate was for 1987, at $1950m, which again is close to our 1987 figure of $2080m.

Figure A2.1



Estimation of the WACC

The weighted average cost of capital (WACC) is required in order to annualise the aggregate capital stock in the calculation of capital's contribution to productivity growth as well as the annual cost of the capital resource used in producing the economic surplus that we calculate for Rail. The WACC can be viewed as the appropriate hurdle for investment and thus it plays the same role as *ex ante* user costs (see Lawrence and Diewert (1999)) in productivity studies. We accept the argument that the WACC should be the same *ceteris paribus* for Rail as an SOE as a privatised firm (see Hathaway (1994)).

The key features of our Rail analysis for the WACC calculation are that the analysis is conducted in real terms, thus a real WACC is required; and the cash flows being discounted are pre-tax rather than post-tax.

Incorporating these features, the cost of equity capital is

$$r_e = r_f + \beta_e MRP$$

where r_f is the risk free rate of interest and *MRP* is the pre-tax market rate of return. The nominal WACC is then

$$WACCN = r_d(D/V) + r_e(E/V)$$

where r_d is the interest rate on debt and the value of debt (*D*) plus equity (*E*) equals the value of the company (*V*). We then subtract the expected rate of price increase from WACCN to obtain WACC.

We seek an expected real cost of capital for the entire period, rather than attempt to calculate a WACC for each period. Thus the components of the formulae are long term in nature. Our starting point for the calculation is the post-tax WACCN of the report of CS First Boston of July 1992. Upon adjusting back to a pre-tax basis (except the *MRP*) their estimate of pre-tax WACCN would be 14.7% to a close approximation.

The conversion to the real WACC requires subtracting from NWACC the appropriate rate of inflation. If rail's output and input prices were expected to grow at the same rate, this rate would be the appropriate rate at which to adjust NWACC. Nominal output prices hardly changed over the period of this study. According to the Statistics New Zealand wage rate index nominal wages grew over the period to the early 1990's but have changed little since that time: over the full period they averaged 3% annual growth. Their nominal transport capital prices index grew approximately 1.5% annually between 1989, when it was introduced, and 1997; but it has declined in the period since 1993. These price data suggest that nominal prices facing Rail either did not grow over the period of the analysis or grew to the early 1990s when they have changed little or declined. Where these prices are static WACC=NWACC. We adopt a very conservative position on the WACC and use 12% for all our analysis. This represents a considerable allowance for expected inflation and/or uncertainty about other components of the calculation.

Appendix 3 : Salvage Value

Estimation of Capital Stock - Salvage Value (1997)

This section describes the approach to estimating the salvage value of Rail assets. In the same way that current replacement value represents the maximum economic value of the assets, the Tranz Rail assets also have a minimum value that is represented by their scrap or net salvage value.

1. In 1989 Rail management commissioned an analysis of the net liquidation value of the core business, just prior to the 1990 restructure. The NLV report was prepared by Beca Carter as professional plant and building valuers with ferry valuations from marine surveyors, contractual obligations valued by Rail's lawyers while property and redundancy costs were internally assessed. Despite being prepared in a short space of time the exercise was a complete review of the rail business. The NLV was assessed as follows in 1989;

NZRC assets excluding ferries and land			$305m
Ferries			$ 20m
Land			$ 81m
Total			$406m
less:			
Assets :	those already sold	$135m	
	Capex committed	$ 61m	
Salvage value of assets			$210m
Liquidation costs		$112m	
Contract obligations		$ 95m	
Severance costs		$313m	
Net liquidation value			($310m)

2. When reporting to Treasury in 1992 advisors did not have the time to repeat the exercise but, in view of the structural changes to NZRL in 1990, they estimated the NLV to be at worst half the 1989 amount.

3. The 1989 asset valuation exercise cannot be sensibly updated without significant effort however because we need to provide a point estimate of the salvage value of the assets to establish the minimum capital of Tranz Rail in 1997, a salvage value for this year could be estimated as follows;

1989 Asset values	$305m
less: assets since sold & liquidation costs	$153m
plus: 30% of gross capex since 1989 + ferries	$246m
Total salvage value	$398m

Appendix 4 : Sensitivity of Economic Surplus to WACC

As discussed in Appendix 2., the estimation of WACC in real form is subject to some uncertainties. Our adopting 12% as a conservative estimate prompted sensitivity tests on Tranz Rail's economic profit as follows:

WACC	Cumulative Surplus 1983 - 1997	Economic Surplus in 1997
12%	$-4505m	$-85m
10%	$-3962m	$-54m
8%	$-3419m	$-23m

A lower bound of 8% is seen as a minimum. It is the weighted average of Tranz Rail's debt rate.

Appendix 5 : Externalities

In any welfare calculation, it is important to include external benefits and costs. These are the components of total social benefits and costs that are not accounted for by the private market. In our calculation, the crucial externalities to consider are related to (i) road safety, (ii) road congestion, and (iii) the environment. When a driver considers travelling an additional kilometre on a roadway, she does not take into account the accident risk that she imposes on other drivers, the additional time delays she causes for other drivers if the roadway is congested, and the additional environmental harm caused by emissions from her vehicle. Rail transport can reduce these external costs by diverting travel from roads. Rail has some externalities associated with it as well – primarily environmental externalities – so we need to consider the net effect of diverting travel from roads. We will consider the impacts from a scenario in which we have the status quo, a privatised Tranz Rail, versus no rail system at all. This provides an upper bound on an estimate of the externalities from privatisation.

Environmental externalities. Petrol-powered vehicles emit hydrocarbons (HCs), nitrogen oxides (NOx), and carbon monoxide (CO).[51] HCs and NOx react in the atmosphere, in the presence of heat and sunlight, to produce a variety of damaging oxidants, the most important being ground-level, or tropospheric, ozone (O_3). They also produce secondary carbon, a component of particulate matter (PM). Diesel-powered vehicles emit some PM directly and also emit sulfur oxides, primarily sulfur dioxide (SO_2) which contributes to particulate formation. NO_2, which is formed in the atmosphere from other NOx emissions, also contributes to particulates.

Evidence on ambient air pollution conditions in New Zealand is limited. The evidence that does exist suggests that ozone, CO, and particulates are problems in some urban locations at some times of the year. It is well-known, for example, that Christchurch has a fairly pronounced CO and particulate problem during the winter months and that vehicle emissions are a major contributor.[52] CO readings from monitors on busy roadways in Christchurch and Auckland are above acceptable levels – i.e., levels that the international community have designed to protect human health. The Ministry of Transport (1997) estimates that total CO emissions would need to fall by over 80% in those "hotspots" to obtain acceptable air pollution levels. Evidence on ozone is extremely limited but it is thought that some problem exists in some areas of Auckland during the warm summer months. Because of the strong winds it often experiences, Wellington probably does not have a CO or ozone problem, but the Hutt Valley experiences an occasional problem during the winter months and roadside particulate emissions in Wellington city could be a problem. Meteorological conditions suggest that Hamilton, Rotorua, and the Napier/Hastings area are also candidates for CO problems at certain times of the year. Again, more monitoring is needed.

Recent research on the health effects of various pollutants suggests that particulates are of the gravest concern, particularly those emissions less than 10 microns in diameter, PM_{10} (Schwartz, 1994). A recent study by Kenneth Small and Camilla Kazimi (1996) summarises evidence on the health benefits of reducing HC, NOx, and PM emissions from motor vehicles in the Los

[51] Vehicles running on leaded petrol also emit lead but with the gradual reduction of lead content and then the introduction of lead-free fuel, this problem has become less important.

[52] Burning of wood and coal in open fires is a more important contributor, accounting for 90% of particulate emissions – specifically PM_{10} – and 50% of CO emissions during the peak pollution events in the winter (Ministry of Transport, 1997).

Angeles area. These benefits are reduced mortality, in the case of PM emissions, and reduced morbidity from PM and ozone reductions. As explained above, HC and NOx emissions combine to form ozone, and PM results from direct emissions of particulates and also from HC, NOx, and SOx emissions. The Small and Kazimi study accounts for all of these effects.

We use the benefit numbers in the Small and Kazimi study, and we confine our results here to these *health* benefits. We ignore non-health benefits, because such estimates are more speculative. There are no studies of the health benefits of CO reductions so we ignore CO here (as do Small and Kazimi). We also ignore any direct benefits from reducing emissions of carcinogens such as benzene and 1,3-butadiene. Although the Ministry of Transport (1996a) presents some evidence on this, we do not have information about emissions of these pollutants from locomotive engines making it impossible to calculate a *net* external benefit number. We focus our attention on local air quality and ignore greenhouse gas emissions. Greenhouse gas emissions are a serious *global* problem, but we feel they should be ignored in our calculations since any change in New Zealand would have no discernible impact on global warming. Air emissions can settle on roads and run off into waterways, causing damages in the form of aesthetics, harm to aquatic life, and possible health effects. We present some evidence on the externalities associated with run-off from Ministry of Transport (1996a), but the estimate is very rough.

We assume that only emissions in urban areas impose a cost on society. This is an important assumption because it means that most emissions – those that take place in rural areas from either trucks or rail – impose no costs. In assessing the air pollution benefits of rail, we assume that all Tranz Metro passengers would travel by car if suburban rail were unavailable, and we assume that all freight would be moved by trucks if rail were not available.[53]

Table A5.1 below shows emissions from cars, heavy-duty diesel trucks, and diesel locomotives, in grams per gallon. Truck and locomotive engines are designed differently and thus have quite different emissions per unit of fuel consumption, despite the fact that both engines run on diesel. Locomotive engines drive electrical generators and the electrical generators produce the power to actually drive the locomotive down the tracks. Moreover, trucks and locomotives have different operating patterns to which their respective engines have to respond. Another point worth making is that these are emissions per unit of fuel, not emissions per tonne-kilometre. The Association of American Railroads reports that, on a tonne-kilometre basis, locomotives emit one-tenth the hydrocarbons and particulates of trucks and one-third the nitrogen oxides and carbon monoxide.

Table A5.1 - Emissions from Cars, Trucks, and Locomotives
(in grams/gallon)

	Cars	Heavy-duty trucks	Locomotives
Hydrocarbons	128.8	19.59	10.83
Nitrogen oxides	56.25	132.68	276.90
Particulates	1.21	24.87	6.89
Carbon monoxide	1167.25	81.70	27.46

Note: Car emissions from Ministry of Transport (1996a), Appendix F, converted to grams/gallon assuming an average fuel efficiency of 25 miles per gallon; heavy-duty truck emissions from U.S. EPA (1998), converted to grams/gallon assuming an average fuel efficiency of 6.18 miles per gallon (see Small and Kazimi, Table 4); locomotive emissions from U.S. EPA (1997).

[53] For cost reasons, coastal shipping is not a viable option for most items that currently move by rail.

Gross benefits from suburban passenger rail. We know the number of passenger trips each year on Tranz Metro. We assume that the average trip length is 10 kilometres to come up with an estimate of the annual kilometres diverted from roads. Using the Small and Kazimi benefit numbers (in U.S. dollars per tonne of emissions), we calculate the gross environmental benefits of suburban passenger rail as $3.0377 million (U.S.) in 1994 and $3.3084 million (U.S.) in 1997.

Gross benefits from freight services. To obtain the kilometres diverted from roads by rail, we assume that an average truck carries 20 tonnes and travels 300 kilometres. Combining that information with the actual tonnes moved by rail in 1994 and 1997, we obtain an estimate of the kilometres of travel that would have taken place by trucks in those years if there were no rail. We assume that 14% of that travel would be in urban areas.[54] Combining this with the Small and Kazimi benefit numbers and U.S. EPA (1998) estimates of truck emissions, we calculate a gross environmental benefit of $8.79 million (U.S.) in 1994 and $10.74 million (U.S.) in 1997.

Net benefits. To obtain the net air quality benefits of rail in the two years, we need to subtract the cost of emissions from locomotive engines in urban areas from the gross benefit estimates above. We again use the Small and Kazimi numbers, combined with fuel consumption figures from Tranz Rail for 1994 and 1997 and the locomotive engine emissions estimates from U.S. EPA reported in Table A1 above. Our estimates of the environmental cost of rail are $9.24 million (U.S.) in 1994 and $10.68 million (U.S.) in 1997.

This means that the net environmental benefits of rail in 1994 and 1997 were $2.59 million (U.S.) and $3.37 million (U.S.), respectively. Using a current exchange rate of $0.45(NZ)/$1(US), these benefits are $5.76 million and $7.49 million, in New Zealand dollar terms.

Additional benefits from reduced road run-off. Emissions from motor vehicles can settle onto roadways and eventually run off into waterways. This can cause damages from increased sedimentation and increases of metals and other toxic inorganic substances in bodies of water. There can also be problems specific to transport of certain materials such as livestock and hazardous substances. There are numerous studies looking at how air emissions can affect water quality, but no study of the benefits of reducing such impacts. The Ministry of Transport (1996a) relies on mitigation costs as a measure of these benefits and concludes that a best estimate is $0.3 cents/vehicle-kilometre. If we use this estimate with our estimate of kilometres diverted from urban roads by suburban passenger rail and rail freight, we get a gross benefit estimate for rail of $0.363 million in 1994 and $0.403 million in 1997 (in New Zealand dollars).[55]

We are unable to come up with a formal estimate of the damages to waterways from locomotive emissions, but we are reasonably certain that the damages are much lower than from road travel. The reason is that impacts are greatly mitigated if the run-off is conveyed through an area of land rather than a hard surface such as pavement. Ministry of Transport (1996a) reports from a U.S. Federal Highway Administration study that states that there are virtually no impacts if the run-off is conveyed through 60 metres of vegetation.

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[54] This estimate is rough and is based on numbers from the trucking association. Most rail hauling is long distance and thus rural, so if it took place on roads instead, most of it would still be in rural areas. This is the reason for the 14 percent figure.

[55] We continue to use urban travel rather than total travel because water quality impacts are minimal if daily traffic flows are low and the ratio of road area to catchment area is low (see Ministry of Transport, 1996).

If we assume that locomotive emissions cause damages to waterways that are approximately half of those from travel on roads, then our gross benefit numbers above are reduced by half to $0.182 million in 1994 and to $0.201 million in 1997. In fact, the rail-bed provides an effective filter as compared to the hard surface of roads.

Caveats. There are several reasons why are net benefit estimates for air quality should be viewed with caution. First, they include health benefits only; no effects on agricultural productivity, visibility, damage to buildings, aesthetics, etc., are included. Second, CO is omitted and this is an important pollutant in many locations in New Zealand. These facts mean that our estimates are likely to understate the true environmental externalities associated with both road and rail. On the other hand, the benefit numbers in the Small and Kazimi study are based on U.S. studies and in particular, based on studies of health effects in the Los Angeles area. Los Angeles has by far the worst air quality of any American city and surpasses anything in New Zealand by a wide margin. This may mean that our estimates overstate the environmental health externalities associated with road and rail. Finally, our estimates of how much travel would take place on roadways in urban areas in the absence of rail are very rough. We have no way of knowing exactly how much rail freight hauling currently takes place in urban areas, nor do we know exactly how many kilometres a Tranz Metro passenger would travel by car in the absence of rail. We have had to make informed guesses about these things.

In 1996, the Ministry of Transport conducted a large study of environmental externalities associated with transportation for the Land Transport Pricing Study. Estimates of externalities from air pollution were limited to health damages from particulates and carcinogenic hydrocarbons, benzene, benzo(a)pyrene, and formaldehyde; no estimates were generated for ozone or CO. We chose not to rely on the numbers in this study because we feel they underestimate the true externalities from motor vehicles. The estimates are based only on direct emissions of particulates and not the contribution to particulates from HCs and NOx, as explained above. And they include only excess mortality from particulates exposure and no morbidity effects. Moreover, the estimates exclude ozone costs.

Safety externalities. A comprehensive study of the social costs of road crashes in New Zealand was also part of the Land Transport Pricing Study (Ministry of Transport, 1996b). It estimates the medical costs, temporary loss of productive output, values of loss of life and permanent disability, property damage, and legal costs associated with accidents. The study takes the view that the external component of these social costs are minimal because they are internalised through ACC charges and road user charges. An appendix to the report takes a contrary view and estimates that 25% of total social costs are external costs – i.e., costs "suffered by road users not at fault (p. 96)." This yields a road safety externality estimate of $720 million per year. We believe that this is the appropriate view of externalities, not an ex post assessment after accounting for ACC. ACC necessarily covers the costs since these are, for the most part, real monetary costs (e.g., medical costs) that must be paid by someone and ACC is the mechanism in place for doing so. In addition, we want to know the external costs avoided by the use of rail, thus this estimate is appropriate for our purposes.

A total of 34.2 billion kilometres were travelled by all vehicles in 1995 (Ministry of Transport, 1996a). This yields a safety externality cost of $0.0211 per kilometre. Multiplying this cost by the estimated reduction in kilometres due to the presence of rail – and now using *all* rail kilometres, not simply those in urban areas – yields an external benefit from rail due to reduced vehicle crashes of $5.249 million in 1994 and $6.105 million in 1997.

Although there are safety issues associated with rail and costs from accidents involving trains, we do not feel that there are significant rail safety *externalities*. An externality occurs when

the actions of one party affect the well-being of another without those actions being taken into account by the first party. In the case of road safety, each individual driver does not consider the costs he imposes on other drivers in the form of increased risk of a crash when he takes to the road. However, an extra passenger on a train or an extra tonne of freight to be moved by rail does not impose any extra risk for other passengers or freight or, for that matter, pedestrians. The difference arises from the fact that each passenger or tonne is on the same train, not in an individual vehicle, as in the case of cars and trucks.

Furthermore, available evidence suggests that most rail-related accidents are the fault of other parties. The Association of American Railroads (1999) reports that 92% of the rail-related fatalities in the United States in 1996 involved either grade crossings or trespassers. These are primarily accidents whereby a pedestrian or motorist does not move out of the way of an oncoming train. On a kilometre basis, rail is far safer than roads.[56] Thus, we assume that our estimated external benefit numbers above are the *net* safety benefits from rail.

Congestion externalities. In the same way that a driver does not consider the accident risk that he imposes on others when he takes to the road, he also does not consider the increased congestion costs he imposes if he takes to the road in congested conditions. By adding to the number of vehicles on the road during peak periods, a given driver increases the waiting time of all other drivers.

Any congestion benefits provided by rail come primarily from suburban passenger rail. Many of these people are commuting to work and would be driving in their cars if the train were not available. Trucks, on the other hand, tend to avoid driving during peak periods, for the most part. Thus rail freight probably does not confer significant congestion benefits by diverting travel from trucks. In order to estimate the congestion benefits from rail, we would need to have several pieces of information that we do not have: an estimate of baseline congestion on Wellington and Auckland roadways; an estimate of the reduction in congestion from passengers who take rail; and an estimate of the average value of drivers' time spent waiting in traffic. Instead of undertaking this sizeable task, we have assumed that the subsidy provided to Tranz Rail by the regional councils is a reasonable estimate of these congestion externalities.

Externalities summary. We estimate that the total external benefit from rail in 1994 was $11.19 million and in 1997 was $13.80 million. Slightly more than half of the benefit in each year is due to environmental benefits, $5.94 million in 1994 and $7.69 million in 1997. These are estimates of the health benefits from improvements in local air quality due to reduced levels of particulates and ozone. The remaining external benefits come from reductions in vehicle crashes on roads. Trains are inherently safer in moving both people and goods and this is reflected in the large benefits, $5.25 million in 1994 and $6.11 million in 1997.

[56] The AAR reports that in 1995, four times as many people died in truck-related accidents as those involving railroads. In that year, 41 percent of all inter-city tonne-miles of freight was moved by rail versus 27 percent by trucks.

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