VFT

The Economics of the VERY FAST TRAIN

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THE ECONOMICS OF THE VFT

THE LINKAGES BETWEEN THE STUDIES AND THEIR MAIN FINDINGS

In thinking about the VFT project, it is appropriate to regard the VFT as akin to an invention that permits the attainment of what previously had been impossible. The "new product" offered by the VFT is the movement of people and goods in the Sydney-Melbourne corridor at a speed of 350 kilometres per hour without leaving the ground. This product can be made available at prices for passengers that are two-thirds to one-half of the comparable air fare and, for freight, at rates that are competitive with road transport.

Like the commercial application of all new products, the VFT involves a step into the unknown. Unlike most other projects, however, the minimum scale investment to establish the VFT as a viable commercial operation - the creation of a new rail link between Sydney and Melbourne via Canberra - immediately places the VFT among the largest investment projects ever undertaken in Australia. Certainly, the VFT is the largest investment project under consideration in Australia at present.

The VFT would expand Australia's total stock of capital invested in the transport sector by some 8%. While it is clearly of significance nationally, the effect of the VFT on transport operations in the Sydney-Melbourne corridor would be dramatic.

Given Australia's foreign debt problem and the desirability of Australia trading its way out of debt (rather than stabilising debt by suppressing Australians' living standards), a large investment project that reinvigorates a substantial portion of Australia's jaded transport infrastructure is potentially a step in the right direction. Whether it is, in fact, a step in the right direction depends on whether the benefits of the project to the nation outweigh the costs.

The VFT commissioned two studies using different methods of analysis to answer the question: Is the VFT project in Australia's national interest? The two studies are:

- the Cost Benefit Study of the VFT, prepared by Access Economics; and
- the study of the Economic Impact of the VFT, prepared by the Centre for Regional Economic Analysis (CREA) at the University of Tasmania.

The two studies approach the same question - the net benefits of the VFT from the point of view of the nation - from different directions. The Access Economics study employs cost benefit analysis as its main analytical tool, whereas the CREA study answers the question using the ORANI general equilibrium model of the Australian economy, and its regional sub-model, ORES.

While there is a focus that is common to both studies, the two studies also provide separate insights into the economics of the VFT.

In one sense the Cost Benefit Study is narrower than the Economic Impact Study. The Cost Benefit Study focusses on changes caused by the VFT in the markets for passenger and freight services. It does not model the interaction between these changes and the rest of the economy in terms of regional and industry effects. Those effects are captured in the economy wide model used in the Economic Impact Study.

In another sense the Cost Benefit Study is broader than the Economic Impact Study The Cost Benefit Study includes estimates of the costs and benefits that are external to the VFT Project sponsors, such as road accident cost savings and noise pollution impacts. Those external costs and benefits are not included in the Economic Impact Study.

The Cost Benefit Study devotes considerable space to examining the crucial issues of:

- forecasts of the size of the market for passengers and freight in the absence of the VFT;
- describing the models used to identify the characteristics of alternative modes of transport and the characteristics of travellers that explain the shares of the market held by existing transport modes in the corridor;
- using the demand models to forecast the share of the market likely to be captured by the VFT;
- forecasting the effect of the VFT in expanding the size of the market through induced travel;
- estimating the consumer benefits to those who travel on the VFT;
- the costs of the VFT in terms of costs of construction, the costs of capital equipment and operating costs.

The results of the investigation of these issues provide much of the data that is essential to both studies. The Economic Impact Study uses the economy-wide modelling capability of the ORANI model to determine which industry sectors of the economy would supply the resources used by the VFT during the construction and operating phases of the project, the relative impacts of the VFT on each State and the impact of the project on various economic outcomes for Australia as a whole, such as aggregate investment, consumption, the CPI, balance of trade, and so on.

An important feature of both studies is that forecasts of the impact of the VFT are prepared subject to the constraint of a fixed supply of labour resources. In practice a project the size of the VFT would be more than likely to utilise some labour that was unemployed, especially if VFT construction commenced at a time when economic activity was depressed.

As a general proposition, however, the level of employment in the economy is assumed to be determined by demographic factors and the level of real wages, rather than by particular projects such as the VFT. So far as the level of employment is concerned, therefore, both studies have been prepared on the basis that the VFT is a "zero sum game". (The VFT improves the efficiency in the use of employment and capital - see below.) That means the labour and other resources that are supplied by some industries - and thereby boost the size of those industries relative to the 'no VFT' situation - must be drawn from other industries because of the constraint that total employment is unchanged as a result of the VFT. Similarly, if activity in some States is stimulated by the VFT, then activity in other States must contract to provide the resources that are used in the construction and operating phases of the VFT.

In interpreting the Economic Impact Study results, therefore, it is important to recognise that a "contraction" or "expansion" in the output of an industry or a State is *relative to the no VFT situation*. In reality the economy as a whole is most likely to be growing in the years ahead and so will each State and even most industries. The estimated impact of the VFT provides an indication of its relative effect at the margin. It is not intended to be a guide to the likely future strength or weakness of regions or sectors.

The sectoral and regional impacts of the VFT depend on which areas of the economy ultimately provide the resources used by the VFT. For example, the impact on industries will differ according to whether the extra investment in the VFT comes about by way of reductions in consumption or investment, and if consumption, whether private or public. The Economic Impact Study models impacts under three alternative assumptions: the resources used by the VFT are provided by a reduction in public consumption, an equi-proportional reduction in private and public consumption and a decline in the balance of trade. The actual source of the resources used by the VFT would depend on the setting of economic policies at the time.

If both studies were designed such that the VFT, by assumption, has no impact on employment and, at least through that channel, no impact on the nation's output, how can they shed light on the question of whether it is in Australia's national interest to proceed with the VFT? The welfare gains from the VFT derive from the greater efficiency of the VFT compared with the 'no VFT' situation. This efficiency gain allows the economy to produce more output with the same amount of inputs. Essentially, the VFT is in the nation's interest if it can deliver travel and freight services at prices that displace alternative modes of transport and cater to demands that presently are not being met - and in the process use less of the nation's resources.

The Cost Benefit Study and the Economic Impact Study both encapsulate the net benefits of the VFT project in a single measure - the net present value (NPV) of the Project. The NPV measures the "lump sum" value of the stream of benefits and costs of the Project that stretch out into the future.

The methodology of the Cost Benefit Study is to measure separately each of the costs and benefits of the VFT. Thus, the size and time profile of the costs of construction and capital equipment costs (which are incurred early in the life of the project), the operating costs and the revenues are all traced out and brought back to a "lump sum" equivalent by discounting future costs and benefits.

The Economic Impact Study measures the economic benefits of the VFT in terms of the effect of the VFT on total consumption in Australia in future years. If the project enables an increase in consumption compared with the 'no VFT' situation, then that increase is assumed to measure the improvement in Australians' living standards or welfare.

Both studies find that the VFT has a major net positive impact on the welfare of Australians. The Cost Benefit Study found that the NPV of the project is $11.8 billion[1] using a discount rate of 7% real. The Economic Impact Study found that the VFT would improve the welfare of Australians by an amount equivalent to a one-off boost in aggregate private and public consumption of between 2.5% and 4.5% in 1990. Over the last decade total public and private consumption has grown at an annual average rate of 3.2%. The impact of the VFT, therefore, is equivalent to a "free gift" of around a year's growth in consumption.

Another overall measure of the value of the project to the nation is the internal rate of return (IRR). The IRR is the rate of interest used to discount future costs and benefits back into 'lump sum' equivalents that reduces the NPV of the project to zero.

A major finding of the Cost Benefit Study is that the VFT has an IRR of 16.1% in real terms (that is, after excluding the inflation component in nominal interest rates).[2]

The bottom line of both studies is that, based on the data provided to Access Economics and CREA and after allowing for risk, the expected rate of return from the VFT compares favourably with alternative investment opportunities. In this fundamental sense, therefore, the studies conclude that *it is* in Australia's national interest to proceed with the VFT project.

THE COST BENEFIT STUDY

The purpose of this study is to assess and weigh the benefits and costs of the VFT project *from the viewpoint of the community as a whole.* These include benefits and costs that the project confers or imposes on the community, such as saving of lives due to road accidents or noise pollution, but which are not reflected in revenue or cost to the Project sponsors.[3] These are known as external benefits and costs.

By virtue of its size and nature, the VFT is likely to have significant effects beyond the financial returns to the Project sponsors. While it is impossible to value all costs and benefits, including all environmental costs and benefits of the project, the cost benefit analysis provides a rigorous framework for balanced analysis of the impacts of the Project on the community as a whole.

VFT Capabilities

Speed has been the key to the renaissance of rail in the post Second World War period. The Japanese Shinkansen was the first high speed rail system to be established (in 1964), with initial average operating speeds of 210 kilometres per

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1 Unless otherwise indicated, value figures are expressed in terms of June 1990 dollars.

2 Unless otherwise specified, the IRR is expressed in real terms throughout this report.

3 The term Project sponsors refers to the current Joint Venture undertaking the Feasibility study, the group of companies that ultimately will sponsor the construction and operation of the project and, more generally, to investors in the project. The key distinguishing feature of Project sponsors is that they have a direct financial interest in the VFT.

hour, since increased to 270 kilometres per hour. The French TGV operates routinely at 300 kilometres per hour, has run extensive trials at speeds between 300-500 kilometres per hour and has attained a record speed of 515 kilometres per hour.

The VFT project got underway in 1986 when the Project sponsors (Elders, Kumagai and TNT - later joined by BHP) initiated a Pre-Feasibility study - the Feasibility study is now in progress - of a proposal conceived by CSIRO for a fast passenger train service (with some freight capabilities) between Sydney and Melbourne, via Canberra. The VFT would run on dedicated (double) tracks on a right-of-way about 55 metres wide on average. It would draw its power from the existing electricity grid, which would be fed to the locomotives by overhead wiring.

The construction period is expected to be five years. The total capital costs of the project are expected to be $6.5 billion or $7.5 billion, respectively, depending on whether the inland or coastal route is chosen.

The VFT will have an operating speed of 350 kilometres per hour. Non-stop trips between Sydney (Central Station), and Melbourne (Spencer Street Station), would be completed in three hours. Each VFT passenger train would have about 400 seats.

Each VFT freight car could carry about 40 tonnes of freight (compared with an average semi-trailer payload capacity of about 15 tonnes). VFT freight cars have the same aerodynamic shape as passenger cars and either would form a mixed passenger/freight train (operating generally at off-peak times) or a dedicated freight train.

The Sydney-Melbourne Corridor

The VFT would operate in the largest passenger and freight corridor in the country. Nonetheless, publicly available data on car passenger movements in the corridor do not provide a sufficiently firm basis for modelling likely demand for the VFT.

Two routes are under consideration - an inland route via Albury and a coastal route via Gippsland. Both routes are shorter than the existing railway between Sydney and Melbourne (960 kilometres), with the inland route (856 kilometres) about 20 kilometres shorter than the coastal route (876 kilometres). The populations served by the two routes are very similar.

Two important differences between the routes are that the inland route is already well served by road, air and rail links, compared with the coastal route; and the potential for holiday travel appears considerably greater on the coastal than the inland route because of access from the coastal route to the New South Wales snowfields and the coastline of south-east Australia.

The Approach to Data Gathering

The Project sponsors commissioned the Macquarie Transport Group (MTG) to conduct two major surveys to gather the necessary data for forecasting purposes:

(i) an *intercept survey* of those travelling in the corridor by existing mode - air, coach, rail and car - between 18 November and 6 December 1987 which involved interviews with over 30,000 travellers and sought information on their trip at the time of the survey to estimate the number of origin-destination trips by each mode and purpose. It also collected data on the socio-economic profile of the travelling market; and

(ii) a *face-to-face survey* of over 2,000 travellers and non-travellers covering travel (if any) in the previous year in the case of residents and, in the case of tourists, trips during their present visit over the period mid-December 1987 to March 1988. The face-to-face survey provided a measure of the incidence of non-travel and the extent of repeated travel. It included questions about travel preferences including preferences for the VFT on the basis of various time and cost characteristics of journeys on alternative modes. This is known as the stated preference data.

The face-to-face survey also included effective interviews with international tourists undertaken at Sydney and Melbourne airports.

The data collected from the intercept survey suggested there were 26.7 million one-way trips of greater than 70 kilometres in the corridor in 1987. Of these, an annual level of 21.9 million trips were regarded as relevant to the VFT, equivalent to 9.2 million one-way Sydney-Melbourne trips (Syd-Mels). This represented 1.3 Syd-Mels for every resident in the corridor (comprised of 3.1 trips per person per annum of average length 368 kilometres).

Projecting Market Growth

The intercept and face-to-face surveys provide a benchmark estimate of the size of the market in 1987. The VFT would be expected to commence operation in 1996-97. It is necessary, therefore, to project forward to 1996-97 the estimated size of the market in the absence of the VFT.

The Project sponsors commissioned Cambridge Systems Incorporated and the Hague Consulting Group (CSI-Hague), JARTS and Sofrerail[4] to undertake the demand modelling for the VFT Feasibility Study. The CSI-Hague model produced the lowest level of projected demand of the three groups and was adopted by the VFT for the purposes of estimating revenue and for further analysis. The size of the passenger market in 1995 was predicted on the basis of equations for the three main segments of the market - business, visiting friends and relatives (VFR) and 'other' travel. The 21.9 million trips in 1987 is projected to grow to 28.4 million in 1995.

The projection of growth of about 2.2% per annum in the operating phase of the project is one of the key economic assumptions employed in this study.

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4 JARTS and Sofrerail are the consulting subsidiaries of the Japanese and French railways, respectively.

Modelling Travel Behaviour

The modelling of travel behaviour was undertaken jointly by CSI-Hague, using the data collected by the Macquarie Transport Group. The objective of the modelling exercise was to quantify the relationship between the likelihood of a person travelling on a particular mode and:

- the characteristics of that mode, especially its cost and speed; and
- the characteristics of the person travelling, such as income, ownership of a car, age, number in party etc.

Having captured the major determinants of travel behaviour in the model, the model was then used to predict the response of travellers to a new form of transport with the characteristics of the VFT.

The modelling approach followed by CSI-Hague was to:

- use the intercept data to model the modal split in the Sydney-Melbourne corridor in the absence of the VFT, i.e. between car, plane, coach or rail;

- use the face-to-face data to model the diversion from each of the existing modes to the VFT; and

- use the face-to-face data to estimate the amount of induced travel on the VFT.

It is evident from the estimated time and cost coefficients that car travellers (both business and non-business) are the least responsive to VFT time or cost changes. As might be expected, air business travellers are most sensitive to VFT time changes, while diversion from coach and air is most sensitive to VFT cost changes. Estimated values of time inferred from the time and cost coefficients range from $5.71 per hour for rail travellers, up to $41.55 per hour for air business travellers.

The estimates of latent demand are based on the stated intentions data from the face-to-face survey. Latent demand is demand for travel in the corridor that the population would like to exercise but for which none of the current modes offers an acceptable journey. Hague used the difference between the estimates of the average number of generated trips by those with latent demand and those with no latent demand as a measure of the extent of latent demand, which was attributed to the proportion of respondents reporting such demand.

Forecasts of Passenger Demand

The demand model was used to develop a realistic approximation for the revenue maximising station-by-station VFT fare structure. At $130 and $100 the Sydney-Melbourne and Canberra-Melbourne revenue maximising VFT fares, respectively, represented 63.7% and 62.5% of the respective air fares.

It should be emphasised that these figures do not represent actual VFT fares. The detailed VFT fare structure remains to be established prior to the commencement of operations. The structure is likely to include premium, economy and discount fares. Prior to commencement of operations more data will be collected by the Project sponsors (a second wave of survey data and modelling is in train at present). Also, relative prices between modes will be affected by changes in costs; for example, oil prices impact significantly on the projections.

On the basis of the revenue maximising fare structures, the demand model predicts 5.95 million Syd-Mels (11.36 million trips) on the VFT in 1995 on the coastal route and 5.83 million Syd-Mels (9.51 million trips) on the inland route. In terms of Syd-Mels the model predicts that the VFT will divert around 24% of projected car travel in the corridor in 1995, between 45% and 50% of air and bus travel, and up to 60% of train travel. Induced demand represents 33% (coastal route) to 35% (inland route) of total forecast usage of the VFT.

The passenger ridership forecast by the demand model on the basis of the VFT fare structures implies total VFT passenger fare revenue of $957 million in 1995 on the coastal route and $897 million in 1995 on the inland route.

Because diverted demand is forecast to be relatively insensitive to changes in relative prices (diverted demand is inelastic), forecast revenue responds sluggishly to reasonably major differences in projected fare relativities among modes.

Passenger revenues form part of the returns to the VFT Project sponsors and, as such, are included among the benefits of the Project. Using a discount rate of 7% real, the net present value of the stream of revenue is estimated to be $14.5 billion for the coastal route and $13.0 billion for the inland route.

The Concept of Consumer Surplus

The VFT would introduce new travel opportunities that would substantially lower travel costs for some travellers and travel time for others. Potential travellers would also attach value to a VFT trip because it reduces waiting time, the greater certainty regarding time of arrival, more convenient departure times and the ability to use time more productively on the VFT than on other modes. The value that travellers attach to the VFT is measured by their willingness to pay.

Willingness to pay lies at the heart of the concept of consumer surplus. In 1920 Alfred Marshall defined consumer surplus as: "...the excess of the price which the consumer would be willing to pay rather than go without the thing, over that which he actually does pay..."[5]

The VFT (economy) fare between any station pair is the same for each (economy) passenger (similarly, for premier and discount passengers). However, the value attached to the trip by each passenger would vary according to a host of factors specific to each passenger, such as the value of time for that passenger, the convenience of the VFT schedule for that passenger, the proximity of the passenger's origin/destination to the relevant stations.

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5 Marshall, A. (1920) "Principles of Economics", Eighth Edition, MacMillan, London.

An individual would only choose to travel on the VFT if the value placed on the journey is at least equal to the VFT fare. However, there is no reason why the individual's valuation of the journey would not exceed the VFT fare. In fact, for most passengers the savings in time by travelling on the VFT and the values attributed to other VFT characteristics would exceed the VFT fare. These consumer benefits - the consumer surplus - represent an important component of any cost -benefit analysis.

The demand model was used to measure the willingness of consumers to pay for ridership of the VFT at any given VFT fare and so to derive an estimate of the consumer surplus.

> For the base case cost benefit calculations, the estimated consumer surplus is equal to about 50% of VFT revenue. On the coastal route the net present value of consumer surplus was estimated at $6.9 billion using a 7% real discount rate. The comparable estimate on the inland route was $6.1 billion.

Freight Markets Available to the VFT

While passenger revenues would be the dominant source of VFT income, freight revenue should represent a significant supplementary form of income. In a study for the VFT, McLennan Magasanik Associates estimate that total corridor freight traffic with Sydney and Melbourne as origin and destination is over 6 m tonnes.

Major corridor freight markets the VFT might penetrate could amount to over $650 million by 1996, of which the line haul component would comprise $350-$400 million. If the VFT line haul rate for higher volume freight is competitive with road and rail ($40 tonne), the VFT might capture over $300 million in freight revenue in 1996. At $50 per tonne, the VFT might only capture half as much revenue.

> The cost benefit analysis makes the conservative assumption that the VFT would earn freight revenue of about $64 million in 1998. This revenue stream has a net present value of $0.8 billion using a 7% real discount rate. Freight revenue is assumed to be the same on both routes.

Estimates of the External Benefits

Reduced Airport Congestion Costs

Information supplied by the Civil Aviation Authority for a typical week suggests that, on average, each plane into Mascot is delayed 9.72 minutes on arrival and departure (double that - almost 20 minutes - for transit passengers); the Tullamarine delay is less, at 3.55 minutes on average for both arrival and departure. Baseline projections suggest that the advent of the VFT would cut back the number of air trips in the corridor by 9.8%. That is assumed to lead to a saving of about 10% a year in the cost of delay at Mascot and Tullamarine, estimated to be about $18 million in 1996-97 (were the VFT fully operational in that year).

> The net present value of this benefit is estimated to be $133 million using a 7% real discount rate.

Public Rail Subsidies and Airport Infrastructure Savings

The VFT would confer an external benefit to the extent that it reduced distortions or inefficiencies elsewhere in the economy. To the extent that the VFT diverts traffic away from subsidised public rail it would provide a resource saving to Australia. The forecast diversion of more than half of public rail passengers to the VFT is a benefit which has not been quantified but should be noted in conjunction with the results of this study. The VFT is assumed to divert freight from road rather than rail traffic. There is no firm evidence regarding inefficient pricing of airport services to enable an estimate of benefits from possible reductions in that distortion due to diversion of airline traffic to the VFT.

Road Maintenance Savings

The diversion of freight from road transport is another example of diversion from a transport mode that is not efficiently priced. Because road user charges for heavy trucks do not reflect the damage trucks cause to the roads, the diversion of freight transported in trucks is an external benefit.

> The estimated net present value of this benefit is $181 million using a 7% real discount rate.

Accident Cost Savings

One effect of the reduced road traffic volumes as a result of the VFT would be a reduction in the number of road traffic accidents. The relative importance of the various components of the cost of road accidents vary considerably according to injury severity level. On average, vehicle damage is the single largest cost component, representing almost 30% of total costs. Other accident generated activities accounted for a further 20% of total costs. The other half of total costs were represented by the loss to the victim of 30% and pain and suffering (20%).

> Savings in road accident costs attributable to the VFT in a given year are estimated to be around $60 million, with a net present value of $590 million using a 7% real discount rate.

Reduced Atmospheric Pollution and the 'Greenhouse Effect'

The advent of the VFT project would affect the total amount of atmospheric pollution produced by the various modes of transport in south-east Australia. In so doing, it also would have an impact on the 'greenhouse effect'.

The introduction of the VFT would:

- reduce the number of trips in the corridor by car, air, bus and rail, reducing atmospheric emissions by these modes; but

- cause an increase in the generation of electricity (to power the VFT itself), which would contribute to emissions.

In order to produce a net saving to air pollution, the VFT must transport both diverted and induced VFT demand for less than the pollution produced by existing modes. The underlying reason for the benefit (of a reduction in atmospheric pollution through 'greenhouse emissions') is that the VFT would be a much more energy efficient mode than either car or air travel. The VFT (a very efficient energy user) runs off electricity (which is - not very efficiently - produced from a combination of black and brown coal, natural gas and hydropower).

Using a real discount rate of 7%, the net present value of the saving in atmospheric pollution from the operation of the VFT (and associated diversion from other modes of travel or freight) is estimated to be about $106 million.

Firebreak

It has been argued that the VFT would contribute a benefit to the wider community through its ability to help both contain and fight fires in 'wilderness areas', for example, because it provides improved access to remote areas.

However, others have argued that the frequency of fires 'would probably increase', for example, due to accidents during the construction of the route.

Given that there are arguments both ways, no allowance has been made in this study (for either a net benefit or a net cost).

The Costs of the Project

The largest costs of the VFT, from the viewpoint of both the nation and the Project sponsors, are the costs of construction, the costs of acquiring the capital equipment and the construction costs. These costs must be subtracted from projected revenue to determine the profitability of the VFT (or producer surplus) - one of the important overall benefits from the Project.

Construction Costs

The main components of construction costs are as follows:

	Coastal ($m)	**Inland ($m)**
Land acquisition	265	262
Route and facilities		
• Sydney metropolitan	448	448
• Dandenong or Tullamarine/Glenfield	2951	2536
• Melbourne metropolitan	1006	615
• Trackwork	933	895
• Power supply - overhead wiring	589	525
	6192	5281

Costs of Capital Equipment

The major items of capital equipment are the rolling stock ($960 million on the coastal route and $870 million on the inland route) and train control and communications ($318 million on either route). Including an allowance for contingencies, total spending on capital equipment is estimated to be $1278 million on the coastal route and $1186 million on the inland route.

Operating Costs

Operating costs include maintenance of rolling stock and the fixed works, wages, energy costs, advertising, insurance and catering. Operating costs in 1998 are estimated to total $324 million on the coastal route and $306 million on the inland route.

Estimates of the External Costs

Impact of Noise

The cost estimates already include some allowance for noise abatement measures. Also there are offsets to VFT noise due to diversion to the VFT and resulting reduced noise from aircraft, trucks and cars.

> The estimated net present value of the saving in noise pollution from roads and aircraft is about $60 million using a 7% real discount rate. In the absence of a detailed study of VFT noise, the arbitrary assumption was adopted for purposes of the analysis that the cost due to VFT noise is double the benefit from reduced road and aircraft traffic noise.

Costs of Containing the Environmental Impact of Construction

Besides the resources used in construction, the construction of the VFT track also would involve costs to the wider Australian community - over and above those arising from the ordinary operation of the VFT itself once the track was built. For example:

(1) *Erosion and water quality*

The VFT has indicated that it would plan for appropriate water supply sources; and would prepare environmental management control plans to ensure that amelioration measures are undertaken effectively. The VFT also has indicated its intention to adopt appropriate measures to reduce erosion from relevant sites; and to ensure construction camps are provided with appropriate water supply and waste disposal facilities.

(2) *Access*

The VFT has indicated construction activities would be arranged so as to minimise disturbance to adjoining areas by:

- ensuring haulage of cut and fill materials would be within the 'right of way' (ROW) where possible;
- importing of railway infrastructure by the ROW where possible; and
- establishing construction camp sites in areas removed from existing settlements.

(3) *Weed control and revegetation*

The VFT has indicated that it would plan for weed control: measures intended include washing down and other hygiene procedures for earth moving equipment.

In particular, the Project sponsors have noted their intention to undertake progressive revegetation of cleared/exposed areas with native species.

Overall cost assessment: In an internal memorandum, the VFT notes " ... the measures outlined are incorporated in the capital cost estimates". Some of the costs to the wider community of the VFT construction would be borne by the Project sponsors (rather than the community). However, as a practical matter, not all of these 'external' costs of construction can be removed.

Given the uncertainty surrounding the magnitude of the wider costs of construction, and the difficulty of attaching a valuation to any such costs, this study does not attempt an estimate of such costs to the Australian community. Rather, it is a (negative) factor to be noted in conjunction with the results of this study.

Mine Subsidence

The proposed route for the VFT crosses over current and potential coal mining sites. If and when mining occurs, the land above that mined area will subside, affecting the integrity of the track.

An estimate of the loss to the nation has been obtained by estimating the loss to revenue accruing to the Project sponsors were the VFT forced to run more slowly. A run of the demand model suggested that, were the VFT to run 30 minutes slower, there would be an (annual) loss to revenue of a little under $50 million a year. The estimate assumes an average delay of about 5 minutes.

Using a 7% real discount rate, the net present value of this cost is $157 million.

Community Severance Costs

The type of problems which can arise in **rural areas** mainly involve the fragmentation of (mainly dairy) farms. The Project sponsors have made cost allowances for overpasses and underpasses and the like.

With the possible exception of Canberra, neither proposed VFT route (inland or coastal) goes close to any rural towns or cities (and the Canberra station could be outside built up areas).

Problems of 'community severance' costs which can arise in **urban areas** are limited by the fact that the VFT would use existing rail or road corridors. That is, a degree of 'severance' already exists, and the operation of the VFT appears unlikely to materially add to those costs.

Given the uncertainty surrounding the magnitude of community severance costs, and the difficulty of attaching a valuation to any such costs, this study does not attempt an estimate of such costs to the Australian community. Rather, it is a (negative) factor to be noted in conjunction with the results of this study.

Other Environmental Costs: The 'Wilderness' Issue

Concern has been expressed that the net impact of the VFT project on the environment along the coastal route would be a marked cost, no matter what measures are taken by the Project sponsors to abate the problem.

The 'wilderness' question is an issue relevant to the route comparison because the environmental groups' concern lies chiefly (though not solely) with the coastal route.

There are obvious issues - and disputes - regarding the extent and importance of any residual environmental impacts. Putting those to one side, the difficulty in incorporating environmental costs such as these into the cost benefit study arises because there are few well-defined markets for 'the environment'. That makes it hard to estimate how much Australians value those parts of the East Gippsland 'wilderness' which would be affected by the VFT.

Environmental costs are often incorporated into a cost benefit analysis by first valuing everything else (that is, getting a net present value of the net benefits of the VFT, ignoring the question of any potential 'residual effect on wilderness'). That net benefit is then one measure of what environmental costs must exceed if they are to rule out the project on cost benefit grounds - a decision 'hurdle' cast in terms of Australia's social well-being.

The Cost Benefit Calculus

The Base Case

The estimates of the costs and benefits to the nation of the VFT project are spread over different time periods, with the construction and train acquisition costs occurring in the initial five years of the project and operating costs, revenues and most external costs and benefits spread over the assumed remaining thirty-five years of the life of the project.

The cost benefit calculations bring all these different estimates together and compare the various streams of costs and benefits stretching out into the future on a consistent basis. They do so by measuring the time path of the net benefits of the project in terms of what the nation would be willing to pay today in terms of a "lump sum" to acquire that stream of net benefits. This is known as the net present value of the project and the result is partly dependent on the rate used to discount net benefits expected to accrue in the future to their lump sum equivalent.

In assessing the base case, it is important to recall that generally the base case estimate of individual costs and benefits are based on assumptions that deliberately have tended to understate benefits and overstate costs.

The base case (for the coastal route) has been prepared on the basis of the following main assumptions:

- the base case station-by-station fare structure involving a $130 Sydney-Melbourne fare;
- 'base' passenger revenue in 1998 of $1475 million;
- 'base' passenger trips equivalent to 6.75 million Syd-Mels (including allowance of 0.4 million Syd-Mels for snow traffic) in 1998;
- diversion to the VFT of 24% of car travel, 46% of air travel, 49% of coach travel and 60% of rail travel;
- freight of 1.5 million tonnes in 1998, yielding revenue of $64 million;
- consumer benefits equal to about half of passenger revenue;
- growth in passenger numbers of 2.2% per annum and growth in freight volumes of 2% per annum;
- commencement of construction in 1992, with construction spread over five years, costing $6.2 billion;
- acquisition of 30 train sets and other capital equipment expenditure involving total capital equipment expenditure of $1278 million;
- operating costs in 1998 of $324 million;
- commencement of operations on the Sydney-Canberra sector on 1 January 1997 and of the Canberra-Melbourne sector on 1 July 1997;
- an assumed 40 year operating life for the project; and
- an assumed residual value for the project at the end of its life of zero.

On the basis of these assumptions, the base case results using real discount rates of 4%, 7% and 10% are as follows:

	REAL DISCOUNT RATE		
	4%	7%	10%
NPV (billion)[a]			
Passenger revenue	26.5	14.5	8.8
Freight Revenue	1.4	0.8	0.5
Consumer surplus	12.6	6.9	4.2
Construction costs	-6.1	-5.6	-5.2
Cost of trains	-1.5	-1.1	-0.9
Operating (and working capital costs)	-7.8	-4.4	-2.7
NPV before externalities	**25.0**	**11.1**	**4.7**
Airport congestion	0.2	0.1	0.1
Road maintenance costs	0.3	0.2	0.1
Accident cost savings	1.0	0.6	0.4
Atmospheric pollution	0.2	0.1	0.1
Mine subsidence	-0.3	-0.2	-0.1
Noise pollution	-0.1	-0.1	-
EXTERNALITIES	**1.4**	**0.8**	**0.5**
TOTAL NPV	**26.4**	**11.8**	**5.2**
B/C ratio before externalities	**2.6**	**2.0**	**1.5**
Benefit Cost Ratio	**2.7**	**2.1**	**1.6**
Real IRR before externalities (%)	**15.5**	**15.5**	**15.5**
REAL INTERNAL RATE OF RETURN (%)	**16.1**	**16.1**	**16.1**

(a) Subcomponents may not add to totals due to rounding.

The estimated IRR of 16% is the measure of the real economic rate of return to the nation (compared with the financial rate of return to the Project sponsors) of investing in the VFT.

Sensitivity Analysis

The following table shows estimates of the sensitivity of the base case to variations in VFT passenger revenue:

	Real IRR (%)	NPV[a] ($ billion)	Benefit Cost Ratio
Base case	16.1	11.8	2.1
Passenger revenue and consumer benefits			
+10%	17.4	13.9	2.2
-10%	14.8	9.8	1.9
Consumer benefits			
+40%	17.8	14.6	2.3
+20%	16.9	13.2	2.2
-20%	15.2	10.5	1.9
-40%	14.3	9.1	1.8
Slower growth (2%)	15.9	11.3	2.0
Faster growth (2.5%)	16.4	12.7	2.1
Pessimistic[a]	13.2	7.3	1.6
Optimistic[b]	18.8	17.0	2.5

(a) Based on real discount rate of 7%.
(b) Revenue -10%; Consumer benefits -40%; growth 2.0% p.a.
(c) Revenue +10%; Consumer benefits +40%; growth 2.5% p.a.

The estimated rate of return is relatively most sensitive to changes in passenger revenue (and proportionate changes in consumer benefits). *Clearly, however, the estimates are robust with respect to major adverse changes in some of the key determinants on the benefits side of the project.*

As noted earlier, the assumptions adopted in arriving at the base case have tended to be conservative. The "optimistic" case (passenger revenue 10% above the base case, consumer benefits up by 40% and higher growth) produces a rate of return of 18.8% and an NPV of $17.0 billion.

In addition to uncertainty about the demand side of the project, there are risks attached to the achievement of the construction timetable and budget. Similarly, operating costs may differ from those adopted in the base case. Sensitivities to fluctuations in costs are shown in the following table:

	Real IRR (%)	NPV[a] ($ billion)	Benefit Cost Ratio
Base case	16.1	11.8	2.1
Construction costs			
+10%	15.1	11.3	2.0
-10%	17.2	12.4	2.2
Operating costs			
+10%	15.7	10.5	1.8
-10%	16.4	12.6	2.2
Construction delay of one year	14.7	10.8	2.0

(a) Based on real discount rate of 7%.

Again, it is evident that even in the event of a 10% blowout in construction costs, the rate of return to the project is still around 15%, with an NPV of around $11.3 billion. The estimates of construction costs include a contingency allowance of about 15%. The increase in construction costs shown in the above table would be on top of full utilisation of the contingency allowance. If construction costs came in 10% below the base case estimates, the rate of return rises to 17.2%.

The rate of return drops to 14.7% for a one year delay in construction. This was modelled as $500 million of expenditure in the fourth and fifth years of construction slipping into a sixth year, with passenger and freight revenue being delayed for a year.

Route Comparison

Those external costs and benefits for which estimates have been derived are expected to be similar for the two routes. The comparison of the costs and benefits of the two routes shown in the following table is, therefore, confined to costs and benefits before externalities.

	Coastal	Inland
Net Present Value ($ billion)[a]		
Passenger revenue	14.5	13.0
Freight revenue	0.8	0.8
Consumer surplus	6.9	6.1
Cost of construction	-5.6	-4.8
Cost of trains	-1.1	-1.0
Operating costs	-4.4	-4.2
Total NPV	11.1	9.9
Internal Rate of Return (%)	15.5	15.8
Benefit cost ratio	2.0	2.0

(a) Based on real discount rate of 7%.

The net present value of the coastal route is higher than the inland route essentially because it is a larger project. The striking feature of the route comparison is, on the available evidence, the similarity in the internal rate of return expected to be derived from both routes. The inland route enjoys a margin of 0.3 percentage points above the coastal route. That is, the saving in construction and other costs on the inland route more than offsets the forecast higher revenue on the coastal route.

'Quantifying' the VFT's Environmental Impact

The basic conclusion of the Cost Benefit Study is that - for all those factors which can be quantified - the VFT offers a benefit to Australia with a net present value of about $11.8 billion (estimated using a real discount rate of 7%).

One issue then arising is whether allowance for those factors which cannot be quantified would be enough to tip the scales against the VFT project.

Among these unquantified items is the residual environmental effects on 'wilderness' value in East Gippsland to the Australian community.

Importantly, too, the latter cost is relevant to the route choice.

There are two ways of answering that question.

The ***first way*** simply asks 'Are the potential residual environmental effects on wilderness areas to the Australian community worth more or less than $11.8 billion?'

The ***second way*** would suggest several different ways of posing the question, depending on the extent to which wilderness values grow over time:

- If wilderness values do not grow over time, a net quantified benefit of $11.8 billion can be recast as the question: 'Would Australians be willing to pay $775 million each and every year - beginning in 1992 and continuing indefinitely - if that could ensure the VFT and its disruption to the 'wilderness environment' of East Gippsland did not proceed?'

- If wilderness values grow over time then the net present value of those values is higher than if they do not grow and the annual payment in perpetuity required to tip the decision against the VFT is smaller. For example, if wilderness values grow over time at the same rate as demand for the VFT is projected to grow, the annual amount is $522 million; and if wilderness values grow over time at twice the rate demand for the VFT is projected to grow (that is, at 4.4% a year), the annual amount is $290 million, continuing indefinitely.

The catch, of course, is that there is no objective measure of the rate at which the 'value of wilderness' will grow in the years ahead. All that can be said is that the greater the relative price shift in favour of wilderness, the less Australians would have to be willing to pay before the VFT could be ruled out.

If:

- it is considered that the chief 'unquantified item' is the residual environmental effects on wilderness areas; and
- these are mainly (or solely) in East Gippsland;

then

- similar calculations can provide measures of the 'hurdle' for the VFT coastal route to clear relative to the inland route.

Specifically, assuming the rate of return on the inland and coastal routes were similar and given a gap in net present values between the coastal and inland routes of $1.2 billion (in favour of the coastal route):

- 'Would Australians be willing to make a 'once and for all' payment of $1.2 billion if that could ensure the VFT did not proceed along the coastal route - so avoiding disruption to the 'wilderness environment' of East Gippsland?'

That figure is rather smaller than those applicable to the project as a whole. Clearly, in terms of ranking, the first step is to apply this type of analysis to the route choice and then to the VFT project as a whole.

Does the VFT Clear the Hurdle?

The Department of Finance[6] suggests that a real discount rate of 'at least 10%' be used in evaluating public sector investments - the VFT's real IRR of 16.1% clearly passes that hurdle. The Industry Commission[7] recently set a slightly easier hurdle of an 8% real rate of return (again easily surpassed by the VFT's 16.1%).

But the Department of Finance and the Industry Commission - as well as the Treasury Department[8] - would not recommend fixed 'hurdle rates' for any project to exceed. Rather, in line with the Capital Asset Pricing Model[9], those bodies would suggest the need for the VFT to better a rate made up of two components:

- a 'risk free' rate (taken as the long term government bond rate); plus

- an allowance for the riskiness of the VFT project multiplied by the average rate that businesses earn over and above the 'risk free' rate.

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6 'The Choice of Discount Rate for Evaluating Public Sector Investment Projects', Dept of Finance, Canberra, November 1987, at page 54.

7 'Measuring the Performance of Selected Government Business Enterprises', Canberra, August 1990, at page 1.

8 Treasury Economic Paper No. 14, 'Financial Monitoring of Government Business Enterprises: An Economic Framework', AGPS, Canberra, October 1990.

9 Discussed in many finance theory texts. One such is R. Brealey and S. Myers, *Principles of Corporate Finance*, third edition, McGraw-Hill, 1988.

If the VFT project carried *no risk at all*, the IRR required of it would be the long term government bond rate (currently trading between 13% and 14%, or 6-7% real). The gap between the real bond rate and the IRR for the VFT - about 10 percentage points - is the potential return to the nation from investing in the VFT. Is that enough?

The Treasury paper notes the existence of a range of estimates of the amount by which market returns exceed the risk free rate. It quotes two results in particular - a premium of 2 percentage points, and one of 8 percentage points. If the average premium is 5 percentage points, returns to the VFT would have to be twice as sensitive to the business cycle before the nation should rule out investment in the VFT. This appears unlikely given that the highest sensitivity, among the estimates shown in the Treasury paper, is 1.15 (for US airlines).

On that basis, the IRR estimated in this study for the VFT exceeds the hurdle rates of return that have been put forward in official circles as appropriate for investment projects.

ECONOMIC IMPACT STUDY

Construction of the VFT is forecast to have average annual costs over the five years from 1993 to 1997 of between $1.2 billion and $1.4 billion depending on the route chosen. Annual expenditures of this order are between about 0.33% and 0.38% of GDP. Although construction of the VFT would be a very large project, at the macroeconomic level its effects would be quite small.

On taking account of alternative possible uses for the resources absorbed in VFT construction, the impact of the VFT on GDP over the period 1993 to 1997 is likely to be no more than 0.1 per cent different from its level in the absence of the VFT.

As noted earlier, the negligible impact on GDP effectively reflects the assumption that the project has no effect on total employment in the economy. Any benefits derived in practice from higher employment levels due to the VFT would be in addition to the benefits measured using the ORANI model.

At the sectoral level the VFT will add about 2% to the output of the construction industries during a typical year of its construction phase. The effects on other industries depend heavily on which sectors of the economy are assumed to provide the resources used by the VFT. For example, if the resources used by the VFT are provided via foreign capital inflow, then, for the period of construction, there will be an appreciation of Australia's real exchange rate, that is, a deterioration in Australia's international competitiveness. Through this mechanism resources would be released from the traded goods sectors to make possible the construction of the VFT. This would reduce the size of export-oriented sectors such as mining and agriculture and import-competing sectors, such as textiles, clothing and footwear below the levels of activity that would exist in the absence of the VFT. Whether these industries are, in fact, growing or contracting in the 1990s will depend on factors other than the VFT which have a far more important bearing on Australia's export and import competing industries. These factors include commodity prices, the value of the $A, domestic costs and so on.

If the resources used by the VFT are made available via a reduction in domestic expenditure, then the adverse effects are likely to be concentrated in the non-trade-oriented service industries.

At the regional level, VFT construction would draw resources out of the non-VFT States into New South Wales and Victoria. GSP in the non-VFT States could be reduced during the construction of the VFT by between 0.2 and 0.8 per cent.

With the coastal route, the gain in activity for Victoria is likely to be 0.25 and 0.50 per cent of its GSP. The projected gains for Victoria are much lower (and can even be negative) with the inland route. This is because construction expenditures on the inland route are much less heavily concentrated in Victoria than is the case for the coastal route.

For New South Wales the gain in GSP during a typical year of the construction phase is likely to be between 0.25% and 0.4% of GSP if the inland route is chosen. If the coastal route is chosen the gains for New South Wales are likely to be smaller, between 0.05% and 0.25% of GSP in a typical year.

By 1998 it is expected that the VFT would be operational with sales of about $1 billion and a gross operating surplus of almost $0.6 billion. Sales are expected to increase to $1.2 billion by 2002 with a gross operating surplus of nearly $0.8 billion.

The existence of a fully operational VFT would raise gross domestic product by between 0.10% and 0.17%. Much of this increase in GDP would be concentrated in the passenger transport sector. The VFT is expected to increase travel in the Sydney and Melbourne corridor by almost 20 per cent, with only about half of this increase replacing travel in other corridors.

Most other sectors of the economy would be slightly smaller with the VFT in place than they would be without it. This reflects a diversion of expenditure to consumption of VFT services and away from other products. However, some industries would be larger. For example, VFT would be a heavy user of electricity. Thus the electricity industry would expand as a result of VFT operations. Trade-exposed industries also may be expanded by the VFT's operations. If the VFT's construction is financed by foreign loans, then during the operational phase Australia would need a more competitive economy (lower real exchange rate) with greater activity in trade-exposed industries to generate the trade surplus required to make the loan repayments.

Much of the expenditure diversion to the VFT would be at the expense of industries in Victoria and NSW. Because the VFT would be less labour intensive than the modes of transport it replaces (e.g. air, rail, car and coach), employment and GSP in NSW and Victoria are likely to be lowered by an operational VFT. Labour released in the VFT States is likely to flow to the non-VFT States. Consequently, the economies of the non-VFT States are likely to be expanded by an operational VFT.

The public sector borrowing requirement is projected to improve as a result of the construction phase of the VFT project - by amounts ranging from $2.3 billion to $0.6 billion, depending on the ultimate source of the resources used by the

VFT. The effects on the PSBR from the VFT operating phase are expected to be considerably smaller - $0.23 billion in either direction.

The VFT is likely to have an overall positive effect on economic welfare equivalent to that which would occur if there were an increase in public and private consumption in 1990 of between 2.5 and 4.5 per cent, with consumption in years beyond 1990 being unaffected.

The increase in economic welfare is derived mainly from an increase in consumer surplus. Most of the consumer surplus would accrue to residents of New South Wales and Victoria. Thus, although these States are likely to suffer a small contraction in their economic activity during the operating phase, the overall welfare of their residents is likely to be increased by the operating phase of the VFT.