THE FATAL FLAW IN THE FINANCING OF PRIVATE ROAD INFRASTRUCTURE IN AUSTRALIA

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1. Introduction

Australian toll roads are usually financed by a combination of debt and equity, but there are two different ways in which this financial arrangement is utilised. The first one involves private equity partners who subscribe capital and in the second one the toll road project is listed on the Australian Stock Exchange (ASX), and tradable shares or trust units are issued. Examples of the first kind of arrangement are the Sydney Cross City Tunnel (CCT) and the Lane Cove Tunnel (LCT). Examples of the second kind include the M2 Motorway and Transurban City Link.

The listed entities have the advantage that the potential for insolvency can be covered up by a technique known as financial engineering, a method not available for the unlisted ones.

This paper analyses three financial models the CCT, LCT and M2 by the mathematical theory of probability in order to determine whether the cash flow is likely to be able to amortize debt by the end of the concession periods. Based on the matrices of financial data given in the models, the analysis shows that the probability of insolvency is generally very high even if the time value of money is ignored. If it is not ignored and appropriate discount rates are applied to the relevant financial quantities, the probability of insolvency is certain. These results have potentially serious consequences for long term investors such as superannuation funds with substantial equity positions.

Unless the government has guaranteed the project against failure, equity investors will lose heavily. The existence or otherwise of government guarantees is likely to be concealed by commercial-in-confidence arrangements involving matters of legal privilege. The timely release of these financial models, particularly before financial close, was prevented by such commercial-in-confidence arrangements. Experience with the Sydney Airport Railway strongly suggests that the existence of guarantees only surfaces when a project fails.

If there is no government guarantee, the equity invested in unlisted projects such as the CCT, LCT, will never be recovered. For listed projects, the loss may be more serious because of the Company/Trust arrangement and the fact that financial engineering of the project as described below is driving it further into debt. If the project fails, the Trust unit holders (who hold so-called “stapled stock”) may become liable for all losses including unpaid debt, because the “corporate veil of protection” applying to the limited liability company may not apply to the Trust. A court may rule that the so-called stapled security arrangement is a sham brought into being specially to create overall protection.

As mentioned above, each of the above projects has associated with it a Base Case Financial Model. These models are essentially financial concoctions, developed by a number of merchant banks, designed to facilitate a contract between the government and a private consortium. The model is intended to show that financial viability can be achieved provided certain traffic volumes and tolls produce the necessary revenue base so that debt can be serviced, equity investors paid their dividends, operating and maintenance expenses covered and the project debt repaid by the end of the concession period.

This paper demonstrates another common property of the projects: the traffic forecasts bear little or no relationship to those properly derivable from the interaction of transport and land use. They are invariably designed to maximize toll revenue even if this initiative means poor to impossible traffic conditions for road users. They are in effect work backs from some desired outcome for the project designed to encourage equity investment, particularly from institutions such as superannuation funds.

2. Financial solvency and return on investment

According to a substantial number of authorities (Sharma, 2001), the key determinant of solvency as discussed below is the financial ratio of cash flow to debt. Cash flow is recognised in accounting as having three components: cash flow from operating, investing and financing activities (Deegan, 1999). Operating activities are those that relate to the provision of services and for a toll road this segment of cash flow is naturally related to toll revenue and the relatively minor addition of interest earned from that revenue. We shall see that in one project examined below, namely that of the Lane Cove Tunnel, total cash flow in some years has been greatly increased in the model to enhance the overall value beyond that achievable from operations alone. But such creative accounting as will be shown has failed to disguise the true financial outcome.

The importance of cash flow as the key to solvency has been recognized for a long time (Heath and Rosenfeld, 1979):

"Solvency is a money or cash phenomenon. A solvent company is one with adequate cash to pay its debts; an insolvent company is one with inadequate cash. Evaluating solvency is basically a problem of evaluating the risk that a company will not be able to raise enough cash before its debts must be paid. Solvency analysis is not simply a matter of evaluating a company's so-called assets and liabilities".

As cash is required to service debt and repay it, it should be asked whether the lending institutions really accepted these models as a basis for lending a total amount of $1,882m for the Cross City, and Lane Cove Tunnels and the M2 Motorway, as examples. This matter will be pursued below.

One outstanding property common to all these models is the failure to take account of the time value of money. By failing to discount future cash flows, a false and misleading view of financial outcome is created.

The need for discounting is fundamental and has been clearly explained (Samuelson and Nordhaus, 1989):

"A positive interest rate means today's dollars will become more valuable in the future, hence future payments are worth less now, just as a distant building looks tiny."

The time value of money is particularly important in the case of long-term superannuation fund investments in these projects. But measures such as the internal rate of return (IRR) on equity investment, which does account for the time value of money can still mislead the investor as described below. It is particularly unfortunate that prospectuses for toll roads have been issued and officially approved that contain this misleading information. Have the issuers of these prospectus documents based on the Base Case Models misunderstood or misrepresented the financial outcome? This is another matter to be pursued in depth.

We shall now examine three of the above projects, the Cross City Tunnel, the Lane Cove Tunnel and the M2 Motorway in that order and evaluate the financial outcome. But first we shall look at financial solvency and evaluation by statistical methods.

3. Evaluation of financial solvency by the methods of mathematical statistics

The importance of statistical methods for organizing large amounts of data has been explained by Fisher (1950). These methods allow complex matrices of data produced by accountants to be reduced to relatively few parameters from which probabilistic information can be deduced. In the base case models examined in this paper, financial quantities can be considered as samples of continuous random variables, each of which has associated with it a mean value, standard deviation and standard error from which confidence limits, a probability density function and a probability distribution can be derived.

In determining the probability of solvency, there is need to consider the following seven variables defined as follows.

OP, the operating profit and **NPAT**, the net profit after tax,

E, the equity investment amount,

EQ, the pre-tax equity dividends paid to investors,

CF, the net cash flow equal to **(NPAT – EQ)**,

D, the project debt, which may be continuous, and the samples may be of unequal magnitude as the result of amortization.

CF/D, cash flow to debt, the key financial ratio.

Sometimes the financial statements in the model may show cash flows directly. but these results may well be the results of accounting manipulation or "creative accounting". Some models include taxation others do not.

Sharma (2001), in his review paper on the role of cash flows in predicting corporate failure has stated that:

"…no matter how sophisticated the statistical technique, if financial data is not adjusted for the effects of creative accounting, failure prediction models will produce erroneous results".

In response to this statement, it is accepted that creative accounting will generally result in an overstatement of the probability of solvency. However, statistical methods as used in this paper involve an averaging process. Probability density functions are distributed about the central tendency of the particular variable and are the result of including many samples thus tending to reduce the influence of any single or small number of creative artefacts introduced by accountants. Also, by the Central Limit Theorem of probability Lapin, 1978), it is unlikely that the approximately normal shape of the distribution function will be significantly altered by such influences.

Furthermore, in the case of toll roads, considerations of traffic engineering can produce other data that can be used in a general way to verify the tendency of a particular financial outcome.

For example, the operating profit (**OP**) and the net profit after tax (**NPAT**) contain the key element of toll revenue, which is a function of traffic volumes and tolls. Consideration of how these were derived has a critical bearing on the probabilities of solvency obtained by analysis.

4. Analysis of equity returns.

The ability to pay equity dividends to investors is a function of cash flow. There are a number of ways of expressing the return to investors from a toll road project. The simplest is the return on investment (**ROI**) and a more complicated way is the previously mentioned internal rate of return (**IRR**). Both these methods feature in this paper. **ROI** is defined as follows.

If $\sum \mathbf{EQ_i}$ is the cumulative gain over a period of $\mathbf{i = 1, T}$ years from an investment of cost **E** , then

$$\mathbf{ROI = 100.\left[(\textstyle\sum EQ_i - E) / E \right] / T\ (\%\ pa)} \qquad \mathbf{(1).}$$

For historical cash flows, $\sum \mathbf{EQ_i}$ is simply the sum of the annual dividends received by an investor. As discussed below, for future receipts the values of $\mathbf{EQ_i}$ have to be discounted in deriving **ROI.**

Internal rate of return (**IRR**), on the other hand, is an interest rate which makes the present value of the cash flows equal to the cost of the investment. For example if there are a number of dividends of amount $\mathbf{EQ_i}$ paid to an investor over a period i = 1, **T** years, then the present value of the **i** th dividend is a discounted amount $\mathbf{EQ_i / (1 + r)^i}$ where r is a rate to be determined. It is evaluated by equating the sum of the discounted dividends to the original equity investment **E**

$$\mathbf{E = \sum EQ_i / (1 + r)^i} \qquad \mathbf{(2)}$$

The solution of equation (2) for **r** yields the internal rate of return r = **IRR**. The solution can best be obtained empirically using a spread sheet computer, although the equation is capable of analytical solution by obtaining the relevant roots of a polynomial equation whose order increases with the number of years of investment.

In prospectuses for toll roads, such as Hills Motorway M2, Melbourne City Link and others, investor returns are expressed in terms of **IRR**. In this examination of the three toll roads, doubts are raised about its validity. These doubts are strengthened when one compares the numerical results of applying the simple, easily understood **ROI**, with the more complex **IRR**. The use of **IRR** in toll road financing has the capacity to mislead investors. For example, if the forecast **IRR** from an equity investment in a toll road project exceeds the rate of return on other investments, it would not be surprising if equity funds would flow preferentially in the direction of the toll road project. Thus there is an incentive for the toll road promoters to use this measure.

ROI is sometimes considered a simplified approximation for **IRR** (Aho and Virtanen, 1982). However for one period of investment, **ROI** and **IRR** are exactly the same as simple algebra shows. In this paper it is shown that the agreement diverges as the number of periods increase. Moreover, if the dividends used in the calculation of **ROI** are discounted, at the rate used for the project debt to take account of the time value of money, as is intrinsic to the definition of **IRR**, then in the examples given in this paper, **ROI** is always very significantly less than **IRR**.

This observation naturally leads to questions concerning the validity of **IRR** as a measure of equity return. Have superannuation funds therefore been misled by prospectuses using **IRR**? We shall therefore pay special attention to the equity outcomes of the three projects under review, namely , the Cross City Tunnel, the Lane Cove Tunnel and the M2 Motorway in that order.

5. The Sydney Cross City Tunnel

The material in this section is partly based on evidence presented by the author on 9 December 2005 to the Joint Select Committee on the Cross City Tunnel (Parliament of NSW).

The location of this project in relation to the other two roads is shown on the accompanying map in Figure 1. It is a four-lane tunnel of length 2.1 km with an east-west alignment and is not part of the orbital road network. .

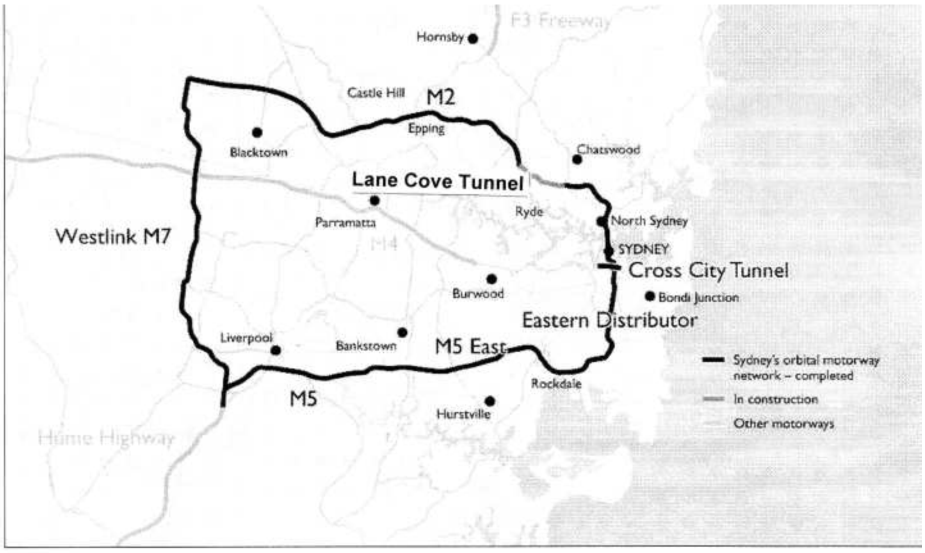

Figure 1. Map of the Sydney Toll Road Network

The debt and equity components of the project given in the model are listed in Table 1 below.

TABLE 1

Type of funding	Amount	Notes
Equity	\$347.00m	Three investors
Bank debt	\$443.00m	Senior Debt = \$119.137m
Total	\$790.00m	

It is evident from the model that the Deutsche Bank used an average interest rate of 8.7% per annum over most of the concession period in calculating the cost of debt servicing. This value appears to be concordant with a three year average for large business loans as specified by the Reserve Bank of Australia. However, it is difficult to accept that this interest rate will be maintained at such a level over the long 33 year concession period.

The project has a high level of risk as will be confirmed by probability analysis. Therefore a discount rate of 8.7% will cause an overestimation of the true present values of financial variables under examination. Nevertheless we proceed with this bias in favour of the project outcome.

As mentioned above, the use of mathematical statistics creates a conciseness of description for each financial variable and the relationship between them. In Table 2 below we summarise the essential statistical results in terms of their mean value and fiducial limits. The mean values allow a concise comparison to be made of the magnitude of the variables.

TABLE 2

Variable	**Mean value**	**-95% confidence limit**	**+95% confidence limit**
Total revenue	$ 90.1m	$ 82.52m	$ 97.7m
Net Profit After Tax	$ 41.75m	$ 34.52m	$ 49.0m
Equity Dividends	$ 42.42m	$ 37.0m	$ 47.0m
Net Cash Flow	$ 2.05m	-$ 1.3m	$ 5.4m
Senior Debt	$119.137m		
Cash Flow/Debt	0.017	-0.109	0.045

This above summary based on mean values and confidence limits is sufficient to show that if equity dividends are paid, the net cash flow is too small to pay other financial obligations. The table shows that 95% of normally distributed values of the ratio of cash flow to debt, either side of the mean, would be expected to lie between the confidence limits specified above. Thus the probability of a value of unity for the ratio is effectively zero. The extent of the financial futility of the Cross City Tunnel can be readily deduced from this result for two reasons. First, only the senior component of the debt is used in the calculation, and second, the cash flows are not discounted. We now examine the first mentioned financial variable, the toll revenue in Table 2. This component is a direct function of the traffic volumes and tolls. The traffic projections are not explicitly stated in the financial model.

In the Environmental Impact Statement for the CCT (Masson et al, 2000), projections derived from the interaction of land use and transport were reasonably consistent with the trends recorded by the RTA from actual screen line counts (SL6). Both these sets of projections bear no relationship whatever to the projections derived from using the toll revenue and tolls recorded in the financial model. To illustrate this derivation we show it in Table 3 for the half yearly period ended 31/12/35. Revenues in the model are given at six monthly intervals.

TABLE 3

Quantity	**Value**
Toll revenue (east flowing traffic) TRE	$ 57.002m
Toll revenue (west flowing traffic) TRW	$ 68.560m
Toll T (east and west)	$ 3.49
East traffic = TRE × 10^6 / (T x 182.5)	89 496 ADT
West traffic =TRW × 10^6 / (T x 182.5)	107 458 ADT
Total daily traffic in the period	197 044 vehicles/day

All results are displayed in Figure 2, from which it is observed that there is a very large difference between the EIS/RTA results and those of the model. Figure 2 further emphasises the dubious nature of the model traffic volumes. If they were realistic then future traffic conditions for road users during the AM 2 hour peak would range from inconvenient to flow breakdown over the concession period. (Austroads, 1988). The lane loadings in Figure 2 were evaluated by a process similar to that described below for the Lane Cove Tunnel. The average factor which converts AADT traffic volumes to AM 2-hour peak is 7.7, derived from hourly traffic volumes crossing screenline 6 according to RTA traffic volume data.

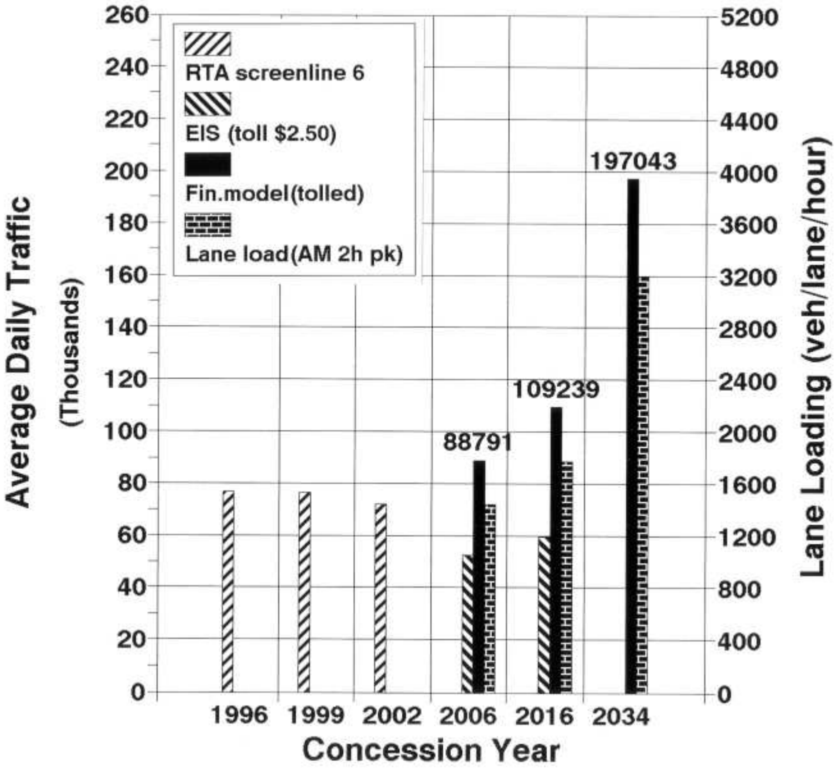

Figure 2. Comparison of traffic forecasts for the Cross City Tunnel

The results from the financial model would appear to be consistent with one key result required, namely to satisfy equity investors that their dividends can be paid. But this desideratum cannot be satisfied for the obvious reason that the traffic projections are essentially false and so the other demands on the toll revenue cannot be met.

5.1 A closer look at the equity component

The analysis of equity shows that the internal rate of return according to the model is **IRR** = 12.8% pa. A recalculation by the author shows that this value is grossly overstated. As it is in fact only 4.9% pa, the value in the model is either the result of creative accounting or an error. When the stream of equity dividends is discounted at a rate of 8.7% pa, the return on investment **ROI** = 3.1% pa. Whatever the true reason, the specification of investor return on equity should be treated with caution. Equity investors in this project would also have been misled by the specified value of **IRR** in relation to the debt interest rate (12.8% pa compared to 8.7% pa).

5.2 Concluding remarks on the Cross City Tunnel

Even if the model traffic projections were to be met, then there would be insufficient cash flow to amortize debt and pay equity dividends.

The fabrication of the traffic forecasts has another consequence: if equity dividends cannot be paid then the reason can be assigned to the lack of traffic. Such an assignment would clearly be false and misleading.

Overall, the project must be considered an exercise in financial futility. It is possible that Cross City Motorway (CCM) recognize this: CCM consists of the company Cross City Motorway Pty Ltd and the trust, Cross City Motorway Property Trust. If CCM were a single entity with limited liability, the profit and loss account for the company would determine the financial status. But the existence of the Trust which holds most of equity capital would mean that failure of the company might transfer the onus to the trust unit holders. What CCM may hope is that limited liability of the company might extend to the trust as well. On the other hand, a Court may find that the company/trust arrangement is a sham and order the lifting of the “corporate veil”. So far, to the author’s knowledge there has not been a legal test of this matter in Australia. Nevertheless, the risk for CCM remains.

There does not appear to be any compensating financial mechanism which would ensure a satisfactory equity return. At least for a listed entity, the lack of profit to pay dividends is compensated by increasing the long term debt using the methods of financial engineering to be described below.

6. The Lane Cove Tunnel (LCT)

The Lane Cove Tunnel is 3.4 km long and joins the M2 Motorway at its western end and the F1 freeway at its eastern end. The location of the LCT in the orbital road system is shown in Figure 1. The road capacity of the tunnel is determined by the minimum number of lanes in each direction. For east-flowing traffic the tunnel has in fact two lanes and for west-flowing traffic it has three lanes.

The equity/debt arrangement for the financing of the project is shown below in Table 4.

TABLE 4

Type of funding	Amount	Notes
Debt	$ 1128.0m	
Equity	$ 499.9m	Trust units held by the Lane Cove Tunnel Trust
Ordinary equity	$ 42.8m	Units held by the Lane Cove Tunnel Company Pty Ltd
Total funds	$1670.70m	

Out of this total amount, a net amount of $166.8m has apparently been withdrawn and placed in a number of reserve accounts. However, the reserves drawn down to augment the cash flow are deduced from the model to be $832.4m.

The cash flow is shown to be derived from toll revenue, interest payments on revenue cash flow and payments from reserves as mentioned above. But in the cash flow statements there are six extraordinary amounts that appear as outliers from the main cash flow trend. In the statistical analysis below the significance of these “debt financing” amounts can be seen diagrammatically. The values of debt are accepted as the residual amounts specified in the model that remain after amortization.

It will be noted from the table below that the undiscounted cash flow to debt ratio has only a 5% chance of equalling a value of 0.94. .But in any case, the discounted value of the ratio is nearly five times less likely to reach this value. What this result means is that irrespective of the attempt at creative accounting of the cash flows, involving the occasional injection of very large amounts of capital into the cash flow and the large overstatement of available reserves, the Lane Cove Tunnel project is potentially insolvent

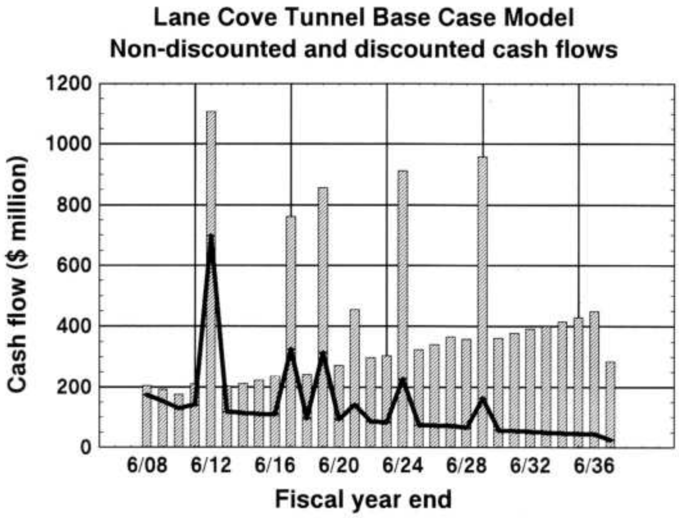

Figure 3. The time series of cash flows for the Lane Cove Tunnel showing anomalies due to debt financing, apparently an attempt to create the perception of solvency. The line graph shows the effect of discounting at 8% pa..

TABLE 5

Variable	Mean value	-95% confidence limit	+95% confidence limit
Debt	$957.6m	$832.8m	$1082.4m
Undiscounted cash flow	$405.2m	$317.6m	$492.75m
Discounted cash flow	$131.7m	$83.4m	$179.9m
Undiscounted CF/debt	0.65	0.36	0.94
Discounted CF/debt	0.14	0.10	0.19

The merchant bank that designed this financial model has another problem. The cash flow is substantially provided by toll revenue created by traffic volumes and tolls. Analysis given below casts serious doubts on the integrity of the traffic forecasts on the objective grounds of traffic engineering.

6.1 Analysis of traffic forecasts used in the Base Case Model

The Lane Cove Tunnel (LCT) closely follows the alignment of the Gore Hill Freeway. From the demographic viewpoint, commuters at present using the Gore Hill Freeway would be expected to use the Lane Cove Tunnel, and the traffic flow in the LCT during the AM peak period would follow the same patterns of hourly movement as observed along the freeway established after 9 years of operation.

Data taken from the RTA permanent recording station 33.205, located north of Northcote Street Willoughby has enabled the derivation of factors to obtain the AM peak two hour flows in both the easterly and westerly directions from the average annual daily traffic (AADT).

These factors are used to test the reliability of the traffic volumes specified in the LCT model, by calculating the lane loadings in the peak period and the corresponding level of service (Austroads, 1988) for motorists to which they correspond. Table 6 below gives the peak two hour flows as recorded during 11 March 2002, and the derivation of the conversion factors for each direction. The calculation of lane loading is as follows. The average two hour flow is AADT/CF. For a specific direction of traffic flow, the lane loading is the average flow over one hour in one lane. This value is (AADT/CFE)/4 for easterly flows and (AADT/CFW)/6 for westerly flows.

TABLE 6

Traffic direction	Time	Average weekday traffic counts	Average annual daily traffic (AADT) 2002
EAST	7 to 8 am	3991	
	8 to 9 am	3576	
	Total	7567	42 536
Conversion factor **CFE**	42 536 / 7567 = **5.6**		
WEST	7 to 9 am	2778	
	8 to 9 am	3102	
	Total	5880	43 296
Conversion factor **CFW**	43 296 / 5880 = **7.4**		

6.2. Application of the conversion factors to the analysis of the Lane Cove Tunnel traffic projections.

The lane loadings for the tunnel have been calculated using the traffic projections in the model and the AM peak factors in Table 6 above. The values of lane loading are then interpreted according to the Austroads classification for levels of service.

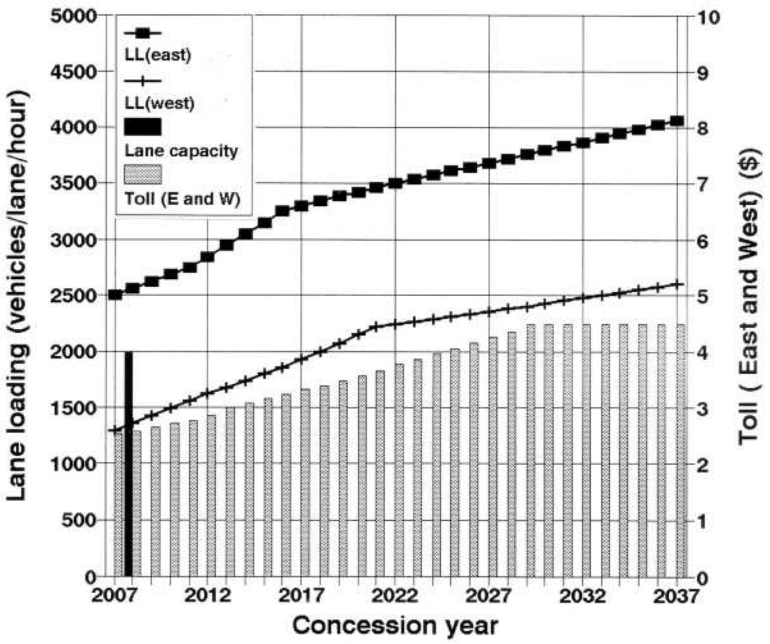

Figure 4. Traffic analysis for the Lane Cove Tunnel showing lane loadings and tolls. The results portray economic disutility: as the level of service deteriorates the cost of using the facility increases.

The graph in Figure 4 shows the entire series of loadings over a thirty year period. Sample values are given in Table 7. From the commencement of operation in 2007 all east flowing traffic, every week day would be subject to queuing, delays and flow breakdown corresponding to level of service F. West flowing traffic in the year 2012, will be subject to restriction in their freedom to manoeuvre within the traffic stream and select their speed. This level of service D corresponds to the limit of stable flow. Henceforth, the level of service deteriorates. This interpretation of level of service is appropriate for uninterrupted multi-lane roads carrying cars only. The presence of heavy vehicles and off ramps will cause even more deterioration in level of service.

TABLE 7

Concession year	**Traffic volume (AADT) (East)**	**Lane loading (east lanes) (v/l/h)**	**Traffic volume (AADT) (West)**	**Lane Loading (west lanes) (v/l/h)**
2012	63 840	2850	72 120	1624
2022	78 392	3500	99 606	2243
2037	90 966	4060	115 583	2603

Thus, in the morning peak period, particularly for east flowing traffic, the Lane Cove Tunnel will act as traffic impedance for most of the concession period, rather than as a means of rapid and easy access to the Sydney CBD. For west flowing traffic, due to the extra lane, level of service at least in the early years of the concession period is not as adverse.

Figure 4 also demonstrates the economic disutility of the Lane Cove Tunnel: the more the level of service deteriorates, the greater the financial cost in terms of toll paid and the greater the economic cost in terms of time savings foregone by motorists using the facility. Clearly, such a result means that toll revenue has been overstated as a major component of the cash flow statement and the probability of insolvency is even greater than the financial analysis has already indicated.

6.3 Equity investment outcome

We shall assume that equity dividends are paid out of the cash flow which should normally be used for repayment of debt. The equity position for investors is summarised below.

It will be noted, as was the case for the Cross City Tunnel, that the value of the internal rate of return I**RR** = 12.8% pa claimed in the model does not agree with the value **IRR** = 2.12% pa, obtained by calculation from the undiscounted equity dividends. Moreover, the value of **ROI** obtained from the discounted dividends is -2.2% pa, a loss on invested equity.

6.4 Concluding remarks on the Lane Cove Tunnel

Analysis of the Base Case Model using probability analysis shows that the project will not be able to generate sufficient cash flow to amortize debt and pay equity dividends. Certain features of the model designed to increase cash flow appear to be the result of creative accounting. The increase in toll revenue resulting from traffic forecasts is inconsistent with proper principles of traffic engineering. In terms of the conventional internal rate of return (**IRR**) measures, the return to investors is greatly overstated.

As is the case with the Cross City Tunnel, the Lane Cove Tunnel project consists of an operating company and a trust. The owners hope that in the event of insolvency, the “corporate veil of protection” applying to the limited liability company will also apply to the trust. If this tactic fails in a court action, unit holders in the trust may become liable.

The possibility of raising more capital is remote because there would be no basis for revaluation of the existing asset as is the case with a listed project such as the M2 Motorway and Transurban City Link.

7. The M2 Motorway

This toll road is shown in Figure 1, and runs from the end of the Lane Cove Tunnel to join what is now called the M7 motorway. It was the first of its type in Australia to be funded by debt and equity and its financial arrangement has become the prototype for others. The original debt of $280.291m in the model was increased to $311m in the M2 Prospectus. The original equity of $155m was also increased to $185m.

The financial model was prepared by the Macquarie Bank for the Hills Motorway Group which was granted a tolling concession for the motorway.

7.1 The derivation of the traffic forecasts

Although the M2 Motorway predated the Cross City Tunnel and Lane Cove Tunnel projects, its traffic projections were the result of a more sophisticated approach. In fact, the projections were based on a legitimate use of land/transport interaction using the EMME/2 model by the State Transport Study Group (STSG) of the RTA (The Hills Motorway Ltd, 1994).

However, it was apparently realized by the authors of the model that the forecast traffic and toll structure would not produce the revenue necessary to assure the large internal rate of return needed to encourage equity investment. The forecasts were manipulated as follows. The large diversions predicted by the EMME/2 model were ignored and replaced by a relatively smaller diversion derived from another Sydney toll road, the M4 in a completely different transport corridor with different land uses. This misuse of traffic/transport data gave a traffic volume of 91 902 vehicles per day but even with this volume the revenue of $42.8m was still short of the $110.3m demanded in the model. This requirement was achieved by a 75% increase in the toll applied to all cars proceeding east to the CBD.

Extrapolation of the traffic volumes at 2% per annum, forward from 2006 to 2042, and back to 1998 produced the series of forecasts used in the model and satisfied the internal rate of return. This work back from the required IRR was developed by Gutteridge Haskins and Davey (1993) who carried out the engineering design for the M2 Motorway.

One feature in common with the Cross City Tunnel and Lane Cove Tunnel was explained in the author’s earlier paper (Goldberg, 2005). The traffic forecasts correspond to increasingly poor levels of service as time progresses. Disutility on this road is no different from the others.

7.2 Evidence that the M2 Base Case Model is misleading

This section presents evidence additional to that of the traffic forecasts that the model is misleading. At the time of prospectus surveillance during 1994, the Australian Securities Commission (ASC, now ASIC) should have been aware of an alleged contravention of the Corporations Law. But instead of examining the model as a whole, it appeared to be concerned only with the traffic forecasts. In a letter to the author ASC, 1997), the criterion for an enforcement action was specified thus:

“It is necessary to prove that the forecast could not have been made on a reasonable basis at the time it was made”.

The evidence was available to the ASC that the forecasts and the model itself were not reasonable in a document known as the Equity Information Memorandum (The Hills Motorway Group, 1994), circulated confidentially to institutional investors, the targets for equity investment. It was from papers in that memorandum that the author was able to deduce how the traffic forecasts were derived.

The model did not become available until October 1999 when the project deed containing it was released by order of the NSW Parliament. The author referred to this matter in an earlier paper in which a partial analysis was published.

In this paper, consistent with the statistical treatment used for the other two toll roads, each financial quantity in the M2 Base Case Model is treated as a continuous random variable. and the specific values of each quantity are samples from which can be calculated the mean value, the standard deviation, the standard error. These parameters enable the fiducial limits of the variable to be calculated and a probability distribution derived for the ratio of cash flow to debt.

The outcome of this treatment is a concise view of the financial results which belong to the mathematics of finance rather than to accounting. Also, with parameter values calculated, probability methods can be applied to determine, for example, whether the model is a reliable guide to the solvency of the project. The statistical results are given concisely in the table below.

TABLE 8

Variable	Mean	-95% confidence limit	+95% confidence limit
Total revenue	\$246.73m	\$201.90m	\$283.56m
Operating profit	\$184.21m	\$146.54m	\$221.88m
Equity dividends	\$153.78m	\$124.85m	\$182.71m
Cash flow	\$30.43m	\$19.38m	\$41.48m
Debt (total)	\$280.291m		
Cash flow/debt	0.109	0.069	0.148

Based on these statistical results, it is easy to see that the cash flow available to discharge the debt is completely inadequate, because there is only a 5% chance that normally distributed values of the cash flow to debt ratio would be expected to lie outside the upper confidence limit. Yet the model runs an amortization profile for the debt in parallel with the main profit and loss account. In effect there are two sets of entries, each unrelated to the other. It needs to be asked why the Development Allowance Authority granted this potentially insolvent project, infrastructure borrowing privileges. What influence was used to gain acceptance for this fictional model? In addition, the M2 Prospectus based on the model was issued in 1994, but passed surveillance by the then Australian Securities Commission (ASC).

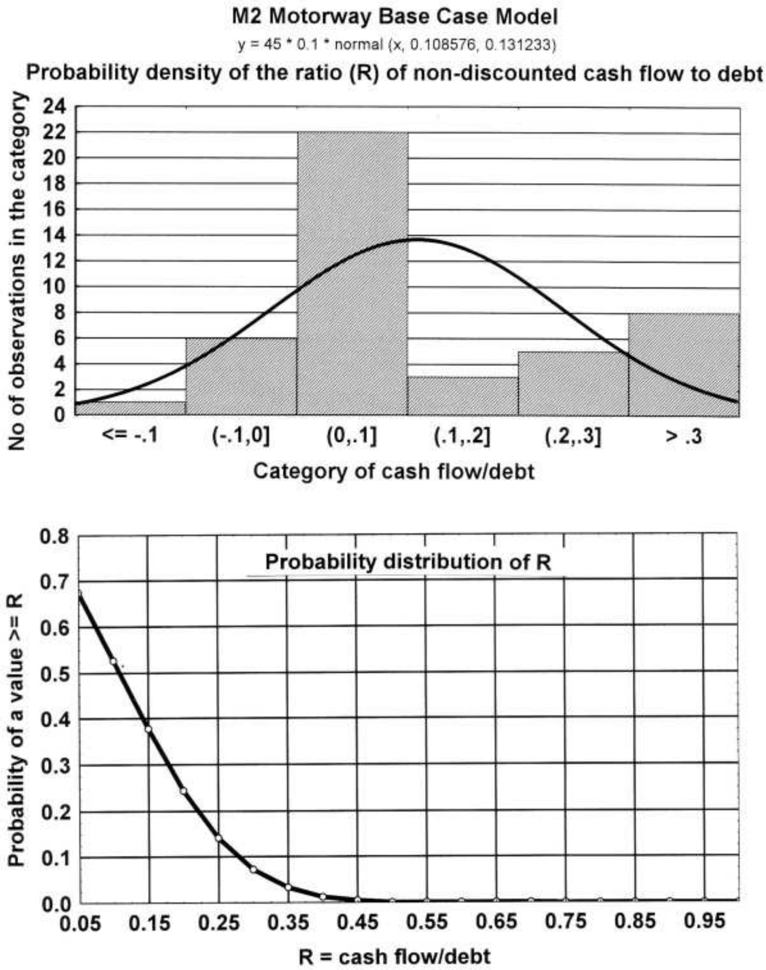

Figure 5. Probability analysis for the M2 Motorway showing the zero likelihood of debt amortization.

Figure 5 gives the results of a more detailed approach to the evaluation of probabilities. The graph above shows the histogram of values of the key financial ratio R of non-discounted cash flow to debt derived from data in the Macquarie Bank M2 Base Case Model. A normal shaped curve fitted to the histogram is the probability density distribution with mean value $\mu = 0.11$ and standard deviation $\sigma = 0.13$.

To calculate the probability distribution of R, the standard normal variable $Z = (R - \mu) / \sigma$ is evaluated. Tables of the normal distribution (Aczel, 1995) provide the probability P that any value of the standard normal variable will fall at or below Z. The probability that the variable will fall at or above Z is (1.0 – P).

The graph below shows the shape of the probability distribution for values of the variable R. It is again clear from this refined calculation that even with non-discounted cash flows the probability of amortizing the debt is zero.

This result is consistent with the fact that over eight years of actual operation, the debt is not being amortized. In fact it is actually increasing as discussed below in the context of financial engineering.

From the marketing viewpoint, investors like to see a high rate of return for their investment. If we calculate the internal rate of return (IRR) for the stream of equity dividends, we find that IRR= 20.6%pa. This very large value has been brought about by the large magnitude of the equity dividends themselves. But the reality for investors is adverse, because if one calculates return on investment (ROI), the value obtained is 3.4% pa. This value results from the initial discounting of each equity dividend at the mean rate of 12.6% pa which is the discount rate derived from the mean interest rate on debt in the model.

Whatever the financial outcome during actual operation, investors would have been misled into subscribing equity for what is essentially an ultimate financial failure. Yet, it should be realized that commercial viability of the project was required to obtain assistance from the Federal Government under the infrastructure bond scheme administered by the Development Allowance Authority. This scheme was explained in the author’s earlier paper. It allows substantial amounts of interest income to be added to the toll revenue. Either the Authority did not understand that the model was improper or some other influence was involved in the granting of this taxation break for a non-viable project.

7.3 The perception and the reality of toll road viability

What then is the mechanism which continues to create the perception of viability of these toll road schemes in the minds of investors?

The answer to this question lies partly in the practice of financial engineering which has been applied to this problem. There is now enough data over 8 years of operation to gain insights as to how this approach operates and also enable us to judge whether it will succeed.

7.4 The financial engineering of the M2 Motorway

The basic step in financial engineering is the revaluation of the asset well above the normally expected value of the plant, property and equipment (PPE). Valuation policies used by the NSW Roads and Traffic Authority (RTA, 1998), assign a value to a road equal to the cost of replacing it to its current condition, without improvements.

For the M2 Motorway, this value could be taken as the contract construction price, an amount of $435.77m, although the balance sheets of the Hills Motorway Group (HMG, 1999)) show the value of PPE as $401.2m at opening in 1997, probably reflecting some depreciation.

In 1999, the accounts of HMG recorded a large increase in value of the asset to $900m, said to have been derived from the work of the accounting firm KPMG which used a “discounted cash flow” method. KPMG originally derived a range of values from $1003.6m to $1021.9m, but the HMG directors settled for $900m. The methodology remains confidential to this day, but the following argument casts doubt on whether such a “discounted cash flow” method exists or is in fact a cover story. According to the NSW Treasury (2004) no such method of revaluation can be identified. Therefore, one must look elsewhere and one must look elsewhere for the likely basis of revaluation.

The existence of eight years of financial data (Aspect Huntley, 2006) has facilitated investigation by statistical correlation analysis. First, the correlation between market capitalization and plant property and equipment (PPE) is evaluated to test the hypothesis that market capitalization could be the probable basis of the revaluation. Market capitalization is determined by the average share price in a given year times the number of shares outstanding (185 000 000).

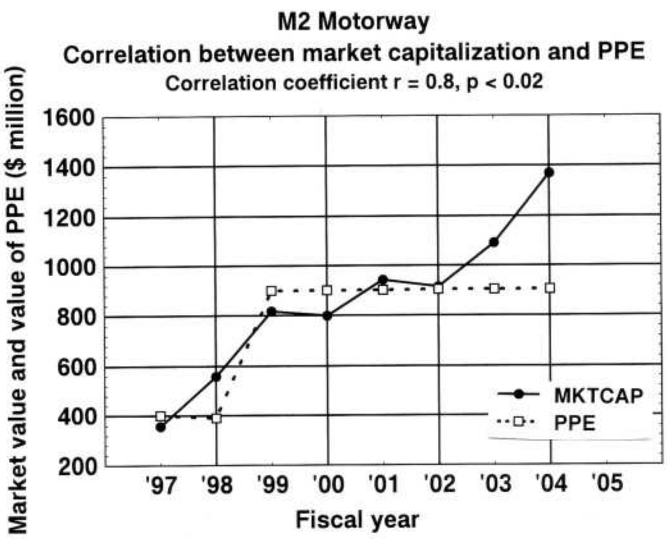

Figure 6. Correlation between market capitalization and plant, property and equipment (PPE) for the M2 Motorway.

Figure 6 shows that the correlation is significant (R = 0.8, $p < 0.02$). That is, the probability that such a correlation could have arisen by chance alone is less than 2%. This result suggests that revaluation of the M2 in 1999 was, in fact, based on market capitalization using an extrapolation of the share price.

7.5 Purpose of the revaluation in the context of financial engineering

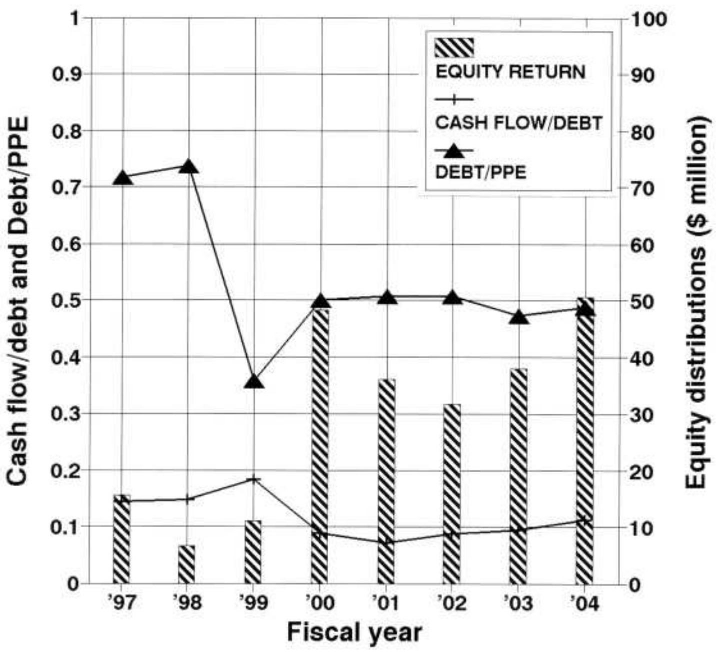

Figure 7. This diagram shows that financial engineering of the M2 is not a formula for financial solvency.

The greatly increased asset value enables more debt to be engaged. Figure 7 shows how the debt to asset ratio has been reduced. Such a result would tend to impress lenders with the financial soundness of the project. In the same figure it is shown that the equity distributions have increased in size but the cash flow to debt ratio has hardly improved.

An analysis of the Transurban Group accounts reveals a similar use of financial engineering. These findings will be published elsewhere.

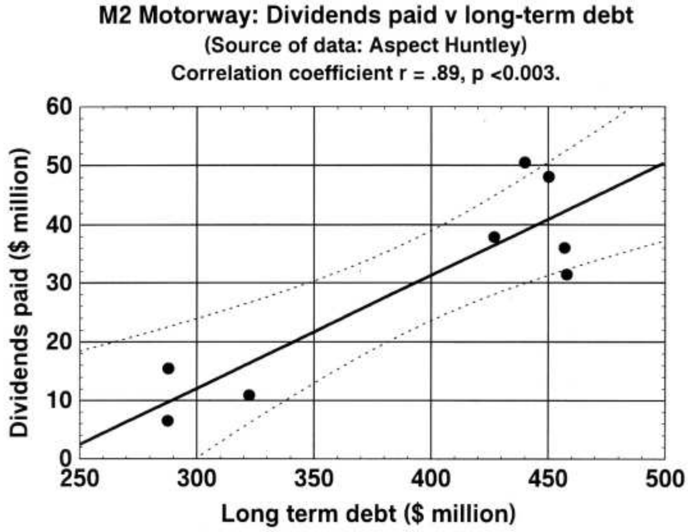

Figure 8. Showing that the value of the dividend payout is closely related to the long-term debt.

Figure 8 shows the correlation between the long term debt and dividends paid. It is highly significant and establishes the fact that one of the aims of the financial engineering is to increase the dividends so that the share price will rise as well, increasing the possibility of a further revaluation. But while this financial manipulation is proceeding, the cash flow to debt ratio is not improving at a rate which suggests financial viability in the long term.

The financial reality of this strategy should now be clear. Over eight years of operation, the average return on investment **(ROI)** is only 3.5% pa, whereas the average cost of capital is 11.8% pa. This example, based on data from the annual reports of the Hills Motorway Group[1], the owners and operators of the M2. emphasizes the adverse outcome of financial engineering for institutional investors such as superannuation funds.

On the other hand, in the financial year 2005, the Macquarie Bank received performance fees of $91.59m based on the increase in market capitalization value of its Macquarie Infrastructure Group to $3355m

7.6 Securitization

The repayment of debt is clearly on the minds of the toll road owners and operators as revealed by the recent release of a draft prospectus for the so-called Sydney Roads Group (Macquarie Infrastructure Group, 2006). This group consists of three existing toll roads, the M4, M5 and Eastern Distributor. The financial arrangements are similar to those of the M2. In February 2009, the debt of the M4, currently at about $57.6 m must be paid. The method of doing this is said to involve the use of reserves and a securitization arrangement (Alles, 1999) involving the M4 and M5. This means that future cash flow receivables and/or the asset value of the M5 is to be used as collateral for a new financial structure for refinancing. It should be noted that the M5 has a debt of $515m which has to be repaid or refinanced by June 2010. But in the final prospectus, serious doubts have now been raised about the ability to repay the debt or refinance it on favourable terms (MIG, 2006).

[1] Hills Motorway Group was taken over by Transurban in the first half of 2005. The deterioration in its financial position has now been subsumed.

8. Concluding remarks

The financial models for three toll roads in the Sydney region have been analysed in detail, using the methods of mathematical statistics to derive probable values for the key financial ratio, cash flow/debt that determines solvency or the lack of it. The models, which are part of the contract documents or project deeds, are shown to lack integrity, as do the prospectuses based on them

The data in the financial models attempt to portray the best possible outcome for the consortiums promoting the projects using for example, unrealistic traffic projections, and creative accounting. Despite this attempt the probability of financial failure has been shown to be 100% in every case, in the sense that cash flow will be insufficient to amortize debt. Not only do the models specify unattainable rates of return to investors but the true financial position of the projects is being masked by financial engineering leading to increased debt out of which equity dividends are being paid. Such an approach is unlikely to be sustainable, but may nevertheless lead institutional investors and others to erroneously believe in the long term outcome portrayed by the promoters.

Recent statements about the use of securitization as a means of debt amortization are unconvincing. In the event of corporate collapse, and in the absence of government guarantees, the trust/company structure of these projects will be used to claim limited liability for the entire structure. But such a claim may be rejected by a court, leaving investors liable.

The lack of action by the Australian Securities and Investments Commission may have been the result of a failure to understand the models and their implication, but it has led to a proliferation of similar schemes throughout Australia. This approach to financing road infrastructure is not a financially or economically responsible one.

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APPENDIX

Summary of numerical differences between internal rate of return (IRR) and return on investment (ROI) for different projects.

Project	Time Period	IRR	ROI	Notes
M2 Motorway	8 years (1997-2004)	4.7% pa	3.5% pa	Historical data
Transurban	4 years (2002-2005)	1.9% pa	1.6% pa	Historical data
M2 Motorway	45 years	20.6% pa	3.5% pa	Model data
Cross City Tunnel	33 years	12.8% pa	3.1% pa	Model data
Lane Cove Tunnel	33 years	12.8%	-2.2% pa	Model data