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Modelling the Impact of a Freight Charge on Sydney Container Traffic

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All the views expressed in this paper are solely those of the authors.

Abstract

Increasing the use of rail to move export and import containers within Australia has been a policy challenge for some time. In Sydney, this issue is particularly poignant with Port Botany sitting right next to the country's largest airport and less than 10 kms from the CBD. Most of the Port's container movements are by road so further contributing to the already significant levels of road congestion on the M5 and across the local suburbs. Rail moved 317,000 containers (as measured by TEU) in 2009/10, the largest number ever moved at the Port but its market share was a modest 19 per cent, down from a high of 25 per cent at the beginning of the decade. In 2010/11 mode share fell further to 14 per cent.

This paper discusses the modelling of a charge on none rail containers as a possible policy solution. A Freight Infrastructure Charge (FIC) was proposed in the Brererton *FIAB Board* report (Freight Infrastructure Advisory Board) in 2005 and would be levied on import and export containers transported by road to and from the Port of Botany in Sydney. By raising the cost of using road relative to rail, a FIC could encourage more containers to be transported by rail. The revenue raised could be used to fund additional rail infrastructure thereby enabling rail to carry more freight.

This paper presents a model that was developed in 2006 to predict the impact of a FIC. The model disaggregated the catchment of Port Botany into 21 zones. For each zone, the share of import and export containers using road and rail was estimated. For rail, the share using each intermodal terminal was also determined. Tariff data was used to develop a cost function for moving containers by road and rail. The cost function was used in a two stage logistic choice model. The first stage of the model attempted to explain the variation in intermodal terminal share. The results were then fed into the second stage of the model which explained the variation in the rail-road share across the zones.

The estimated model was used to predict the impact of introducing a FIC set at various levels. To improve accuracy, the forecasting model pivoted off the base road and rail shares for each zone. The model also took into account the ability of rail to carry the additional traffic by calculating a set of inter-modal congestion costs. It was concluded that to achieve a target 40 per cent rail share in 2021, a FIC of $120 per TEU was needed.

Keywords: Freight Mode Share, Freight Infrastructure Charge

1. Introduction

In 2005, a Freight Infrastructure Charge (FIC) was proposed in the Brererton *FIAB Board* report (Freight Infrastructure Advisory Board) to be levied on containers transported by road to and from the Port of Botany in Sydney. By raising the cost of using road relative to rail, the aim of the FIC was to encourage more containers to be transported by rail. The revenue raised could be used to fund additional rail infrastructure thereby enabling rail to carry more freight. In this way, the FIC would help in raising the rail share of container movements to the target of 40% which was agreed in-principle at that time.

In 2005, Booz Allen Hamilton forecast that a FIC of $60 per TEU would achieve a 40% rail share which could reduce to $30 if combined with a relocation of container parks to western Sydney encouraging the movement of empty containers by rail, BAH (2005). A limitation of these forecasts was that they were based on an assumed elasticity of demand governing the sensitivity of road-rail share to tariff.

At the end of 2005, Douglas Economics was engaged by the NSW Department of Infrastructure, Planning and Natural Resources (DIPNR) to build a model based on observed data to estimate the FIC needed to achieve a 40% share, Douglas Economics (2006).

The model uses container growth forecasts for the Port of Botany and models road versus rail share for twenty one metropolitan and regional zones by taking account of travel time and costs. The FIC is then introduced as additional charge on road containers and the rail share re-forecast. For rail, the model assigns export and import containers to the existing and proposed intermodal terminals based on travel time and costs and takes account of terminal capacity in terms of a capacity charge.

This paper summarises the model that was developed and how it has been updated by the authors to take account changes in container movements, rail share and intermodal capacities.

2. Previous Work

In 2005, Booz Allen Hamilton was engaged by DIPNR NSW to estimate the level of FIC needed to achieve a 40% rail share, BAH (2005).

The BAH forecasts relied on an assumed mode share elasticity of -0.3 that governed the sensitivity of road-rail share to tariff for full containers. The elasticity was applied to the percentage increase in road transport costs resulting from levying a FIC. Therefore, if the road tariff was increased by 10%, road share would decrease by 3%. Half the elasticity that is -0.15 was applied to empty metropolitan containers and a zero elasticity was applied to containers transported outside the metropolitan area to/from regional NSW. In other words, regional containers were assumed to be unresponsive to a FIC.

BAH based the elasticity values on inter-capital freight movements along the eastern seaboard of Australia but made adjustments to the values to reflect the characteristics of shorter distance metropolitan – port container movements. The reader is referred to an Australian Productivity Commission report that provides a review of price elasticity estimates for road and rail freight for comparative purposes (Productivity Commission, 2006).

BAH used transport prices estimated by Sd+D (2005). Sd+D priced the transport of containers by road between Port Botany and six customer locations in metropolitan Sydney.

Rail prices (including pick-up and delivery and terminal charges) were also calculated for four inter modal terminals.

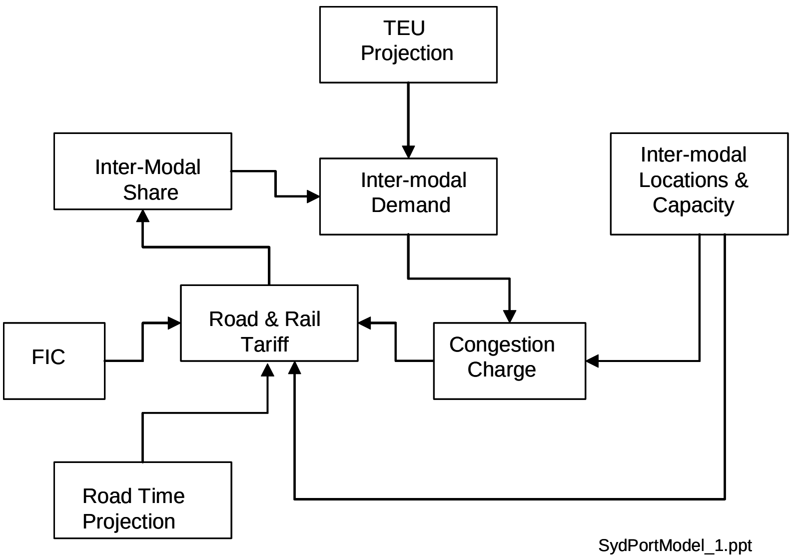
BAH estimated that a FIC of $60 would be required to achieve a 40% share. The FIC was forecast to generate annual revenue of $20-$50 million. BAH also forecast that additional inter-modal terminals would only have minimal impact on market share due to similar prices being levied across the terminals. However, a relocation of container parks to western Sydney was forecast to increase rail share for empty movements to the port and thereby lower the required FIC to $30.

2. Model Overview

At the end of 2005, Douglas Economics was engaged by DIPNR NSW to build a model based on observed data to estimate the FIC needed to achieve a 40% share.

The model had two components as shown in Figure 1: a growth model which projected container (TEU) demand and a inter-modal share model that forecast the share rail would achieve. In this regard, the demand model was pretty standard, there being several similar models developed to analyse passenger and freight demand. Two examples include a mode share freight model developed for the UK Strategic Rail Authority by Hawthorne and Brooker (2002) and a model of Australian inter-capital road-rail share by Mitchell (2010. Where the model offers a novel feature is in modelling terminal capacity through a congestion charge.

Figure 1: Model Overview



Forecasts were made for import and export containers to 21 study zones demarking the catchment area of Port Botany. Fourteen zones covered metropolitan Sydney and eight zones the regional catchment.

The projection of TEU demand was undertaken in a ‘top-down’ fashion. Import and export TEU projections for Port Botany were allocated to the study zones. Detailed forecasts were only undertaken for metropolitan zones. A simpler approach was used for regional zones.

Inter-modal share for metropolitan zones was based on the observed sensitivity of rail and road shares to tariff. A road tariff function was developed based on flag-fall and travel time components. The road time component was projected based on STM travel time forecasts. The rail tariff component was based on Sd+D estimates and the location of existing and proposed inter-modal terminals. The choice of inter-modal terminal was determined probabilistically (based on observed choices) and used to develop a composite tariff for each zone taking account the location of all available inter-modal terminals. The observed rail v road share was then related to the difference in tariff (composite rail – road throughout) to derive a modal share sensitivity tariff parameter.

The Freight infrastructure Charge (FIC) was added to the projected road throughout tariff. The change in inter-modal share was then forecast by reference to the estimated sensitivity parameters. Total Inter-modal demand was calculated by multiplying the inter-modal share by the TEU projection.

The model was constrained so that inter-modal demand did not exceed inter-modal capacity; this was done by calculating an implied congestion charge for each inter-modal terminal that ensured demand did not exceed capacity.

The model has several limitations. The model treats empty and full container movements the same because there was no data on the proportion of empty and full movements by zone. Movements of empty containers to and from empty container parks are not included since they do not involve Port Botany.

The model makes no allowance for 'leakage' to or from other ports such as Melbourne or Brisbane which might occur especially for movements to border regions such as Northwest and Monaro.

The model does not allow for a FIC to suppress economic activity and overall freight demand. The FIC pricing impacts would be offset, partially at least, by additional inter-modal terminal facilities (funded through the FIC). The extra capacity and additional locations would reduce the access and congestion costs of rail transport (thereby offsetting the increase in freight charges with the FIC).

The model assumes that industry would not relocate in response to the FIC and/or the additional inter-modal terminals.

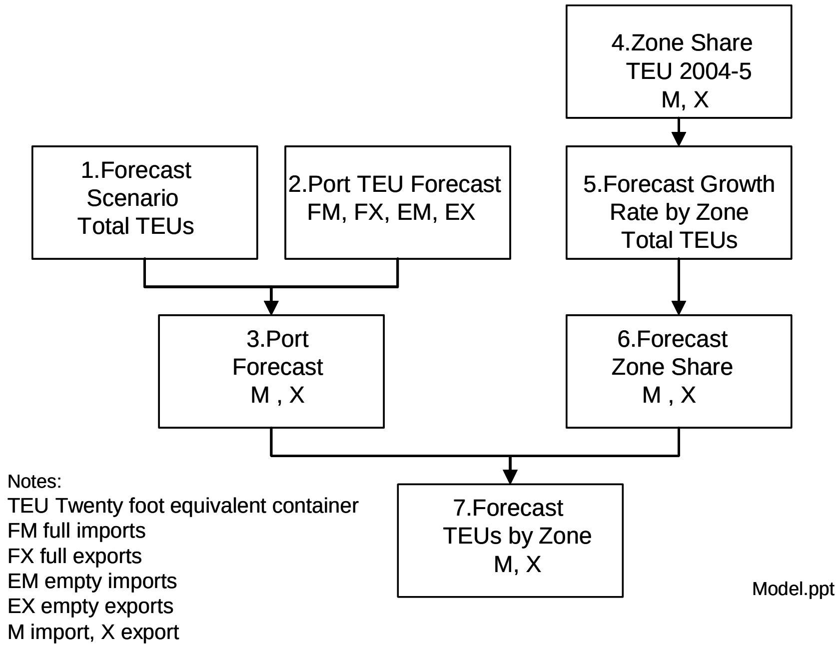
The FIC was assumed to apply throughout the day but it could be charged on only peak period container movements. Movements after 11pm and before 6am could be exempted or subject to a lower FIC.

3. Projecting Future Container Traffic

Container movements through Port of Botany have doubled over the decade 2001-2011. In terms of Twenty Foot Equivalent (TEU) units, container movements increased from 900,000 in 2001 to 1.8 million in 2011.

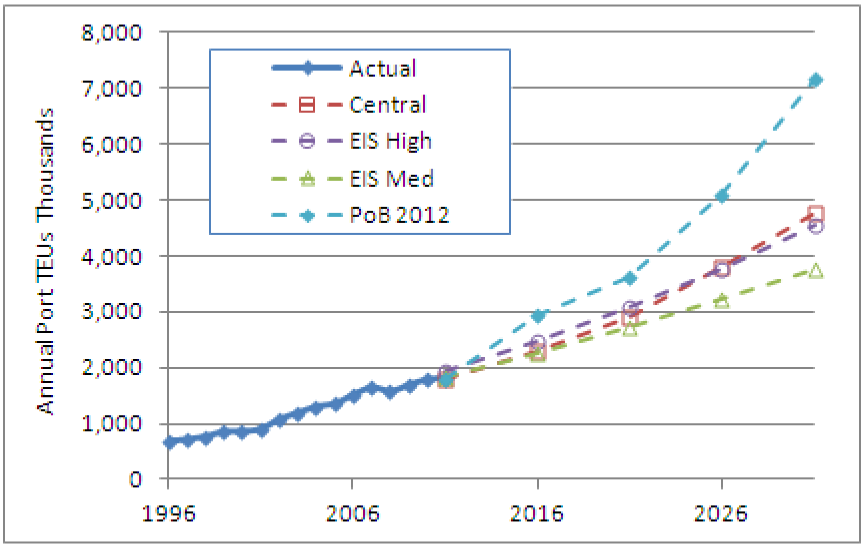
The demand projections were produced using a 'top – down' approach. An overall projection for the Port of Botany was combined with an import and export container projection to produce projections for import and export containers (full and empty). The catchment of Port Botany was divided into 21 zones and the zonal share of total imports and exports for 2004-5 was combined with the expected rate of growth in TEUs by zone to project future zone TEU shares. Finally, the forecast zone share was multiplied with the port TEU forecast to project import and export TEUs by zone.

Figure 2: Projecting Container Demand



The 2006 study considered three overall TEU projection scenarios which are graphed alongside historical trends in Figure 3. The central case projection was for 2.9 million TEUs to be moved into and out of Port Botany by 2021. The other two scenarios were developed as part of the Environmental Impact Statement for the development of Port Botany. The medium scenario forecast 2.7m TEUs and the high scenario forecast just over 3 million for 2021.

Figure 3: Growth in Port Botany Container Movements



Annual Container Imports & Exports through Port of Botany (000 TEUs p.a.)

	1996	2001	2006	2011	2016	2021	2026	2031
Actual	685	899	1,510	1,802				
Central				1,790	2,278	2,900	3,800	4,775
EIS High				1,928	2,456	3,081	3,081	3,748
EIS Med				1,842	2,259	2,730	2,730	3,211
PoB 2012					2,944	3,625	3,625	5,096

As can be seen, the three projections predict 2011 port movements reasonably closely with the central case scenario being within 1%.

A fourth projection is also shown in Figure 3. This is a projection by the Port of Botany made in 2011. This projection is far more aggressive than the earlier projections. For 2021, the Port projection is for 3.6 million TEUs which compares with 2.9 million.

The model was unable to discriminate between full and empty containers because of a lack of origin/destination data. The same FIC therefore applies equally to both types of movement and the same responsiveness to the FIC is implied. In 2005-6, approximately two full TEUs were imported for every one empty TEU through the Port of Botany with empty export containers correcting for the trade imbalance. The imbalance in full container movements resulted in higher numbers of empty export containers so that in 2005-6, there were 340,000 empty export TEUs compared to only 13,000 empty import TEUs. The net result was rough parity in import and export TEU container movements. Parity was forecast to continue so that in 2021, 1.45 million TEUs would be imported and 1.45 million exported.

The catchment of Port Botany was divided into 21 zones by the Department of Planning. Thirteen zones covered the metropolitan Sydney and were based on Sydney Council Areas. A further seven zones were aggregations of regional areas of NSW with one zone for Brisbane.

An estimate of the number of TEUs imported and exported by study zone was made for 2004-5. Metro zones accounted for 90% of TEUs with regional zones accounting for the remaining 10%. Regional zones had a higher share of exports (18%) than imports (3%). Around a fifth of TEUs moved a short distance by road for stuffing / un-stuffing. One quarter were transported to and from western Sydney with just under a fifth transported to the ‘South West’ and a tenth to the Inner West.

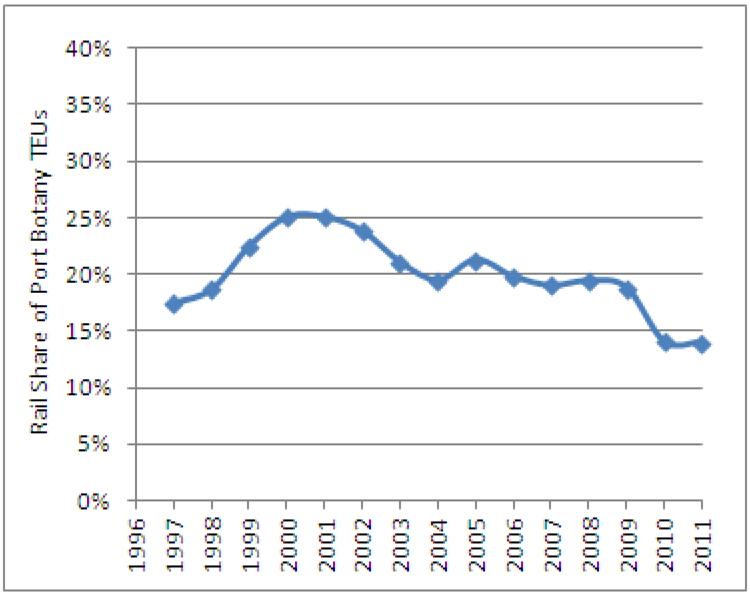
Forecasts were made of the likely port TEU share (import + export) for each metropolitan zone. Botany was forecast to decline in share to just over ten percent in 2021 with the industrial w and south west areas growing in importance.

The projected total TEU volumes through Port Botany in combination with forecast changes in share by study zone produced the forecast of import and export TEUs by zone. Most growth was forecast to occur in the metropolitan west. Lower growth was forecast for the remainder of metropolitan Sydney. Regional container movements were forecast to increase at a slightly lower rate than metropolitan Sydney.

4. Forecasting Rail Share

The impact of introducing a FIC to increase rail share to a target of 40% was modelled against a background of declining rail share as can be seen from Figure 5. After reaching 25% in 2000-01, rail share of TEU movements declined to just less than 20% in 2009 and then dropped to 14% in 2010-11 which coincided with the closure of the intermodal terminal at Camelia.

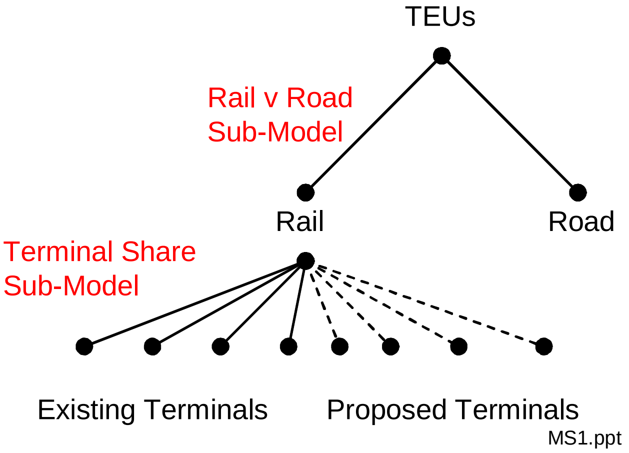
Figure 4: Growth in Port Botany Container Movements



Source: Port of Botany

Forecasting the future rail-road share with and without a FIC involved a two-step process as shown in Figure 4. First the share each rail intermodal terminal would achieve was estimated. This was based on the total inter-modal tariff (rail + road delivery). The predicted shares and the composite cost were then fed into the road v rail model which predicted the share rail would obtain of total TEUs. Separate forecasts were produced for import and export TEUs. Shares were forecast for each zone and then summed to get a total forecast.

Figure 5: Road – Rail Model



The TEU capacity of the rail inter-modal terminals was introduced as a constraint. For each inter-modal terminal, the forecast number of TEUs was not allowed to exceed the terminal capacity. The constraint was modelled by introducing an implicit congestion charge ($/TEU) for the inter-modal terminals – individually and collectively. The congestion charge raised the inter-modal tariff such that rail demand did not exceed inter-modal capacity.

At the time of the study (2006), there were four intermodal terminals at Yennora, Leightonfield; Camelia and Minto which collectively had a capacity of 200,000 TEUs per year.

For each study zone, an estimate was made of the proportion of import and export containers handled at each intermodal terminal. An estimate was also made for each zone of the total share achieved by rail of total import and export TEUs. The analysis highlighted a marked difference between metropolitan and regional zones. For metropolitan zones, 8% of import containers were moved by rail in 2005 and 17% of export containers whereas for regional zones, much higher rail shares of 31% for imports and 75% of exports were achieved.

Tariff data was used to determine a cost function for import and export containers. The function was based on an analysis of transporting 20’ and 40’ containers to destinations in six Statistical Local Authorities. The estimated tariffs were regressed against travel time (decimal hours) estimates output by the Sydney Travel Model (STM) which is a strategic transport model developed by the Transport Data Centre, NSW. The resulting tariff function for 20’ containers was $330 plus $80 per hour. The cost for 40’ containers was $418 ($88 more for than 20’) plus $88 per hour (10% more than for 20’ containers). A weighted tariff per TEU was then calculated based on the share of 20’ to 40’ containers. The model allowed for an increase in the share of 40’ containers from 20% in 2006 to 35% in 2025 which had the effect of gradually reducing the average tariff per TEU.

Future year road tariffs were assumed to increase in direct proportion to the travel time component of the tariff function. The STM was used to provide future road travel times.

The inter-modal tariff was expressed on a per TEU basis and comprised two components: the rail tariff for transport between the port and the rail terminal including terminal handling charges; and, the Road - Pickup / Delivery Charge.

The rail tariff for existing terminals was used to forecast the likely tariff for the proposed new terminals. In fact, the variation between existing terminals was not marked with tariffs ranging from around $370 at Camelia and Yennora to just over $400 per TEU at Leightonfield. Export TEUs were cheaper than import TEUs (possibly reflecting the proportion of empty containers). The tariff for the proposed terminals was assumed to be the same as Minto.

The pick up / delivery charge tariff was calculated using the travel time component of the road tariff function (factored for the 20’-40’ share) and terminal-zone travel time estimates.

The tariff functions were used in two statistical models estimated for metropolitan zones: an intermodal share model and a rail-road share model.

The inter-modal terminal model is shown in equation 3. Parameters were introduced to allow for the individual inter-modal terminals but were found to add little explanatory power. The final model therefore explained the share each inter-modal terminal would achieve purely in terms of the tariff function. The parameter which governed the sensitivity of share to differences in tariff was estimated at -0.04. A composite cost was then calculated over all rail inter-modal terminals (as shown in equation 2). This composite cost was used in the rail-road share model.

Separate import and export models were tried for the rail share model (equation 1) but did not improve estimation accuracy. An average tariff parameter was therefore estimated. The parameter estimate of -0.023 was half the size of the inter-modal parameter value reflecting lesser substitutability between rail and road than between inter-modal terminals.

$$\Pr(Rail) = \frac{\exp(\beta o + \beta T.CRT)}{\exp(\beta T.RoadTariff) + \exp(\beta o + \beta T.CRT)} \qquad (1)$$

$$CRT = \frac{1}{\alpha M}.\ln \sum_i \exp(\alpha M.IMTariff)_i \qquad (2)$$

$$\Pr(IM) = \frac{\exp(\alpha M.IMTariff)}{\sum \exp(\alpha M.IMTarif)} \qquad (3)$$

where:
Pr(Rail) = proportion of TEUs using rail (remainder use road)
CRT composite rail tariff
Pr(IM) proportion of rail TEUs using Inter-modal terminal i
αM = estimated sensitivity parameter of inter-modal share to inter-modal tariff
IMTariff = Inter-modal tariff per TEU
CRT = Composite Inter-modal tariff per TEU for all inter-modal terminals i
βo = alternative specific constant for rail
βT = sensitivity parameter for road v rail share with respect to tariff

Table 1: Estimation Intermodal & Rail-Road Share Models

Submodel	Beta	Estimate	STE	't'
Rail v Road	Tariff (βT)	-0.023	0.020	-1.2
"	Rail Constant (βo)	-1.682	0.636	-2.6
Intermodal Terminal	Intermodal Tariff (α M)	-0.04	0.014	-2.9

The estimated elasticity of metropolitan rail share with respect to the tariff difference (rail minus road) was -0.58 calculated using equation (4) at the average rail share (13%) and tariff difference ($29/TEU). The elasticity is nearly twice as high (ignoring sign) as the value of -0.3 assumed by Booz (op cit) for full containers.

$$\varepsilon = \beta T.\{1 - \Pr(Rl)\}.(IMTariff - RdTariff) \qquad (4)$$

The equation used to forecast rail share was specified incrementally rather than absolutely. In this way, errors in forecasting the base shares were removed. Equation 5 shows the incremental forecasting equation which by pivoting off the base road and rail shares made the rail constant parameter in Table 1 redundant.

$$\Pr(Rail)' = \frac{\exp(\beta T.\Delta CRT).\Pr(Rail)}{\exp(\beta T.\Delta RoadTariff + FIC).\Pr(Road) + \exp(\beta T.\Delta CRT).\Pr(Rail)} \qquad (5)$$

For regional zones, the rail share tariff sensitivity parameter was reduced in line with the increase in regional v average metropolitan tariff. The inter-modal terminal share sub-model was not required however since each regional zone was assumed to use terminals within that zone.

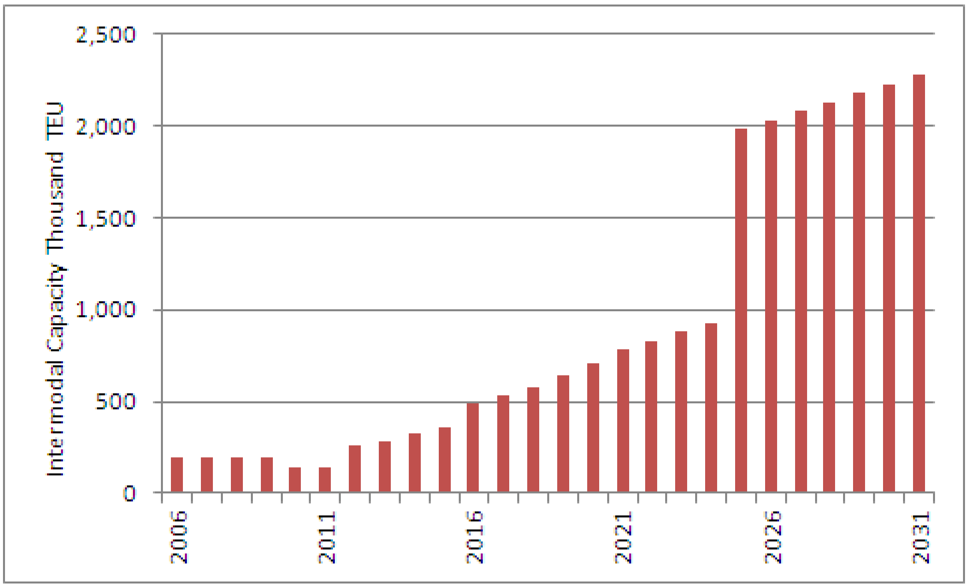
The ability of rail to capture higher shares in future will be limited by the capacity of the inter-modal terminals, both individually and collectively.

The model took account of proposed changes in Terminal capacity. These include the closure of the intermodal terminal at Camelia and modest future increases in capacity at Yennora and Minto. The most changes are new terminals proposed for Enfield, Moorebank and Eastern Creek. With these new terminals, total intermodal capacity will increase to 2 million TEU in 2026. Figure 6 shows the proposed increase in capacity.

The model took inter-modal capacity into account through a set of inter-modal congestion costs. The costs ensured inter-modal demand did not exceed inter-modal capacity. The capacity forecast equation is shown in equation 5. The congestion cost for an individual inter-modal terminal is the difference in the constrained and unconstrained log odds ratios multiplied by the reciprocal of the intermodal tariff parameter (-0.04) which expresses the constraint in dollars.

$$CongTariff_i = \left\{ \ln\left(\frac{\Pr(IMc)i}{1-\Pr(IMc)i} \right) - \ln\left(\frac{\Pr(IM)i}{1-\Pr(IM)i} \right) \right\} \cdot \left[\frac{1}{\beta T} \right] \quad (5)$$

Figure 6: Forecast Intermodal Capacity



The constrained terminal share was the maximum TEU capacity divided by the maximum TEUs over all inter-modal terminals. The congestion tariff for rail as a whole was similarly determined but was calculated in terms of the maximum rail share given total inter-modal capacity over all terminals.

Constraining capacity required an iterative approach since changing the tariff for one inter-modal terminal affected the demand for the other terminals.

To assess the impact of a FIC, repeated forecasts were undertaken which varied the charge from zero to $150 at $10 intervals. The FIC that achieved a 40% share was determined by linear interpolation. In situations where inter-modal capacity was insufficient to achieve a 40% share, the FIC charge was set at $160.

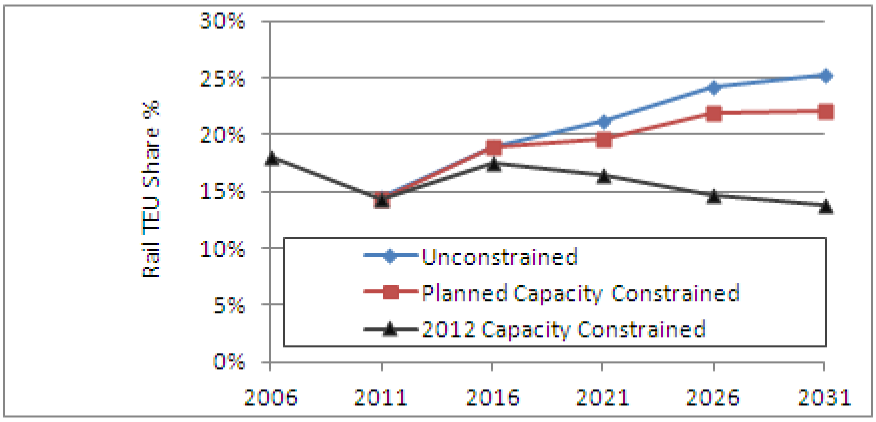
5. Model Forecasts

The model was used to project rail share without a FIC. Three projections were made: an unconstrained projection but with the new intermodal terminal locations included; a projection constrained by planned metropolitan intermodal terminal capacity and a projection with metropolitan intermodal terminal capacity kept at 2012 levels. Figure 7 presents the projections.

The projections reflected the change in distribution of import and export containers across the metropolitan and regional port catchment; the forecast increase in road travel times; and, for two of the projections, the impact of the three new intermodal metropolitan terminals which reduced road delivery times and increased capacity. The net result was a recovery in 'unconstrained' rail share from 14% in 2011 to 21% in 2021. Further modest growth was forecast to 2031 with rail share reaching 25%. With intermodal capacity kept at 2012 levels, rail share was only forecast to recover to 17.6% in 2016 after which it declined back to 13.8%.

With the proposed new intermodal terminals rail share was forecast to increase but at a slower pace than in the unconstrained forecast such that by 2031, rail share was 22% (3 percentage points less than with demand was constrained).

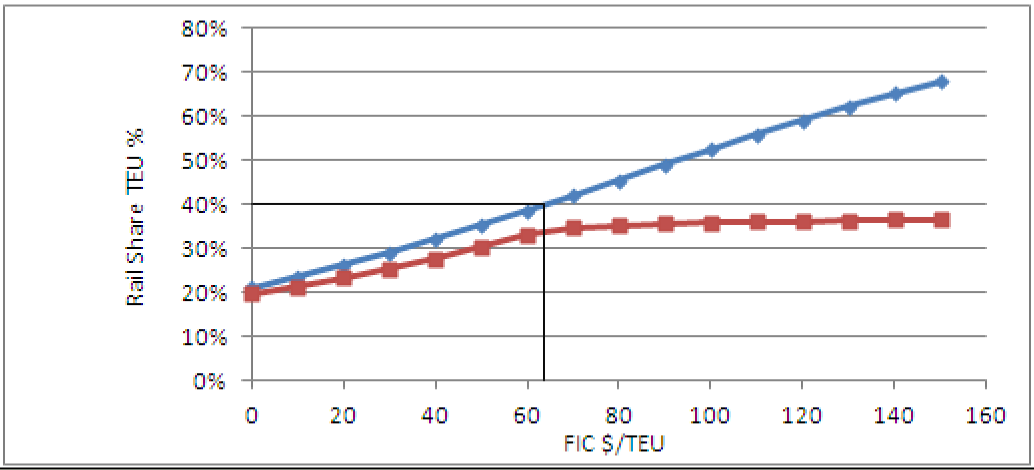
Figure 7: Base Case Rail Share (without FIC)



	2006	2011	2016	2021	2026	2031
Unconstrained	18.0%	14.5%	19.0%	21.2%	24.2%	25.3%
Terminal Constrained	18.0%	14.3%	18.9%	19.7%	21.9%	22.1%
2012 Capacity Constrained	18.0%	14.3%	17.6%	16.4%	14.7%	13.8%

Figure 8 shows the effect of a FIC on rail share in 2021. With rail demand unconstrained by terminal capacity, a FIC of $64 (June 2005 prices) would achieve a 40% share. At $64, the FIC would increase the average road tariff by 30%.

Figure 8: Forecast Impact of a FIC on Rail Share in 2021
FIC $/TEU June 2005 Prices



FIC $/TEU	0	20	40	60	80	100	120	140
UnConstrained	21%	26%	32%	39%	46%	52%	59%	65%
Constrained	20%	23%	28%	33%	35%	36%	36%	36%

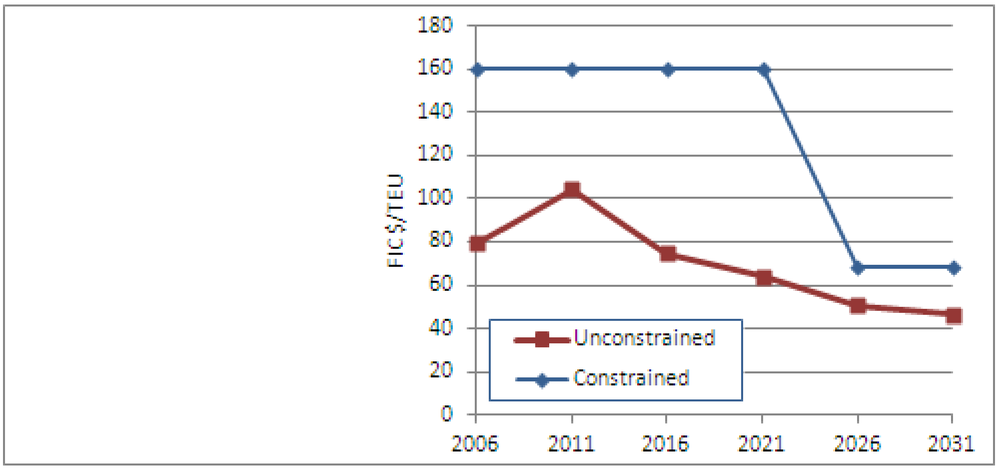
However inter-modal terminal capacity in the metropolitan area even with the proposed new intermodal terminals would only allow rail to achieve a 36% share (with a FIC under $160). Therefore a 40% share would be unachievable.

At $64, the level of FIC was close to the $60 estimated by BAH. However the BAH figure only applied to full containers moved within the metropolitan area. If it had been applied to regional containers, a lower FIC would have been forecast. Also if empty container movements to new intermodal terminals in western Sydney were included, BAH forecast the FIC would fall to $30.

Over time, the FIC required to achieve a 40% rail share was forecast to decline (ignoring inflation) as can be seen from Figure 9. If introduced in 2011, a FIC of $105 would have been required. For 2016, the FIC was forecast to decline to $75 and to $64 in 2021. By 2031, the FIC was forecast to decline to $46.

Figure 9: Projected FIC to Achieve Target 40% Rail Share

FIC $/TEU June 2005 Prices

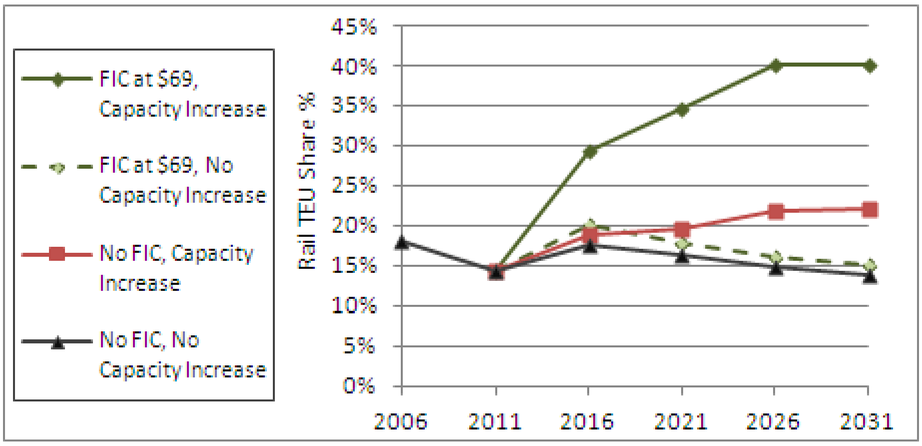


	2006	2011	2016	2021	2026	2031
FIC $/TEU Unconstrained	79	105	75	64	50	46
Rail Share % Unconstrained	40%	40%	40%	40%	40%	40%
FIC $/TEU Terminal Constrained	160	160	160	160	69	69
Rail Share % Terminal Constrained	23%	17%	31%	37%	40%	40%

However, when intermodal capacity was taken into account, a 40% share was forecast to be unachievable before 2026. Then, with increased terminal capacity, a 40% share was achievable with a $69 FIC.

Four rail share projections with and without a $69 FIC with and without additional terminal capacity is presented in Figure 10. Comparing the projections clearly shows the importance of additional terminal capacity. With a $69 FIC and proposed capacity increases, rail share is forecast to increase to 30% in 2016. However with no capacity increase (on 2012 levels), rail share would only reach 20.1% in 2016. This share is only 2.5 percentage points above the share of 17.6% forecast without a FIC. Thus, only when combined with the proposed new intermodal terminals does a FIC raise rail share significantly.

Figure 10: Projected Rail Share with $69 FIC
FIC $/TEU June 2005 Prices

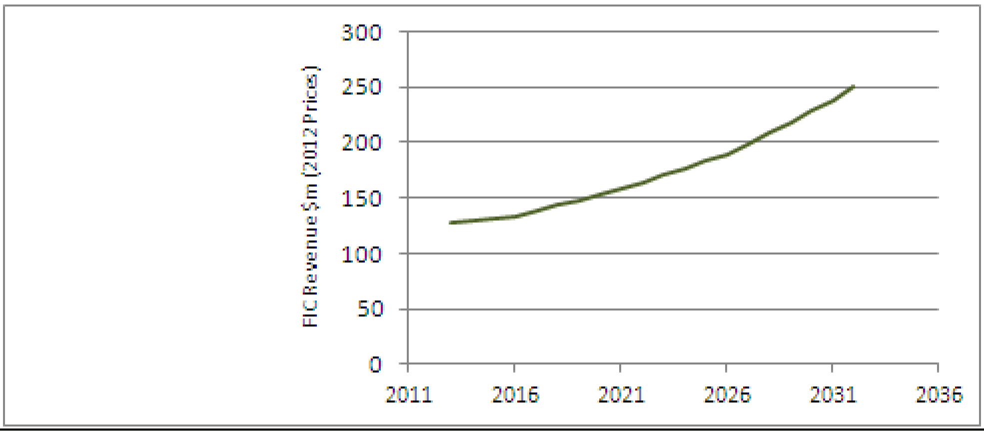


	2006	2011	2016	2021	2026	2031
FIC at $69, Capacity Increase	-	-	29.3%	34.6%	40.0%	40.0%
FIC at $69, No Capacity Increase	-	-	20.1%	17.8%	16.0%	15.1%
No FIC, Capacity Increase	-	-	18.9%	19.7%	21.9%	22.1%
No FIC, No Capacity Increase	18.0%	14.3%	17.6%	16.4%	14.7%	13.8%

The proposed financial purpose of the FIC revenue stream would be to fund intermodal terminal development. Figure 11 provides a projection of the revenue stream.

So far the estimated FICs have been expressed in June 2005 constant prices. Between June 2005 and March 2012, the consumer price index for Sydney rose 20%. Applying this factor to the $69 FIC raises the charge to $83. It this level of FIC was introduced on January 1st 2013, forecast first year revenue would be $128 million. Forecast revenue then rises to $157 million in 2021 and $250 million in 2032 (constant 2012 prices). Over the twenty year period, FIC revenue would total $3.5 billion (constant 2012 prices). If discounted at 7% per year to Jan 2013, the present value of the revenue stream would be worth $1.7 billion. These revenue streams can be compared against the costs of the additional intermodal terminal capacity.

Figure 11: Projected FIC Revenue with $83 FIC
FIC $/TEU March 2012 Prices



	2013	2016	2021	2026	2031	2032
FIC Revenue at $83/TEU 2012 Prices	128	134	157	189	237	250

6. Conclusions

This paper has modelled the ability of a Freight Infrastructure Charge (FIC) levied on road containers transported to and from the Port of Botany in Sydney to increase rail share.

The model used container growth forecasts for the Port of Botany and modelled road versus rail share using a logit model fitted to the observed modal shares and transport costs for twenty one metropolitan and regional travel zones. The estimated elasticity of rail share with respect to the difference in rail minus road tariff was -0.58.

The FIC was modelled as additional charge on road containers. The model then re-forecast the rail share for each zone. In this regard, the demand model was pretty standard. Where the study is considered to offer a new feature is in the modelling of terminal capacity through a set of 'congestion costs'.

In fact, intermodal capacity was found to be a major constraint on future rail share. Without new intermodal terminals, there would be insufficient capacity to achieve a 40% rail share even with a FIC levied on road containers.

Only with the proposed major increases in intermodal capacity was a FIC able to achieve the rail share target of 40%. The required FIC was forecast at $83 per TEU in 2012 prices. With this FIC, a 40% share would be achieved in 2026.

The aim of the revenue raised from the FIC levied on road containers would be to fund the proposed increase in intermodal terminals at existing and new locations. Set at $83, FIC first year revenue (2013) totalled $128 million and over 20 years, the revenue stream was be worth $1.7 billion in present value terms (7% discount rate and constant prices).

The model has limitations that could be relaxed by further work: empty and full container movements were treated the same because of a lack of origin/destination data; the model made no allowance for 'leakage' to or from other ports from a FIC or suppression in economic activity; industry location did not change in response to the FIC or the new inter-modal terminals and, the FIC was not varied by time of day.

Taking on board these limitations, the model is still considered to provide a useful starting point in modelling the impact of a freight infrastructure charge under capacity constraints.

References

Booz Allen Hamilton (2005) *"Freight Infrastructure Charge Modelling Assumptions and Results"*, report by Booz, Allen Hamilton to NSW DIPNR, June 2005.

Douglas Economics (2006) *"Freight Infrastructure Charge Modelling of Port Botany Containers"* report by Douglas Economics for the NSW DIPNR, June 2006.

Hawthorne J. and Brooker I (2002) *"A Rail Freight Forecasting Model for the Strategic Rail Authority"* European Transport Conference 2002.

Mitchell D. (2010) *"Australian Intercapital Freight Demand: An Econometric Analysis"* Australian Transport Research Forum, Canberra 2010.

Productivity Commission (2006) *"Road and Rail Freight Infrastructure Pricing Productivity Commission Inquiry Report"* Report No. 41, 22 December 2006 by the Australian Government Productivity Commission.

Sd+D (2005) *"Sydney Metro Modal Freight Pricing Study - Summary Report",* report by Strategic Design and Development for DIPNR, June 2005