Traffic forecasting performance of PPP and toll roads

literature review

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International evidence 1

- Bain et al. (2002, 2003, 2004 and 2005),
- 104 international toll roads, bridges and tunnels
- ratio of actual traffic to forecast traffic
  - for first year of operation, average error 0.77 (actual 23% below forecast)
  - large variation (standard deviation 0.26)
  - no significant improvement after year one (0.77 to 0.80 between years 1 and 5)
  - inaccuracies larger for toll roads (0.76) than for non-toll roads (0.96)

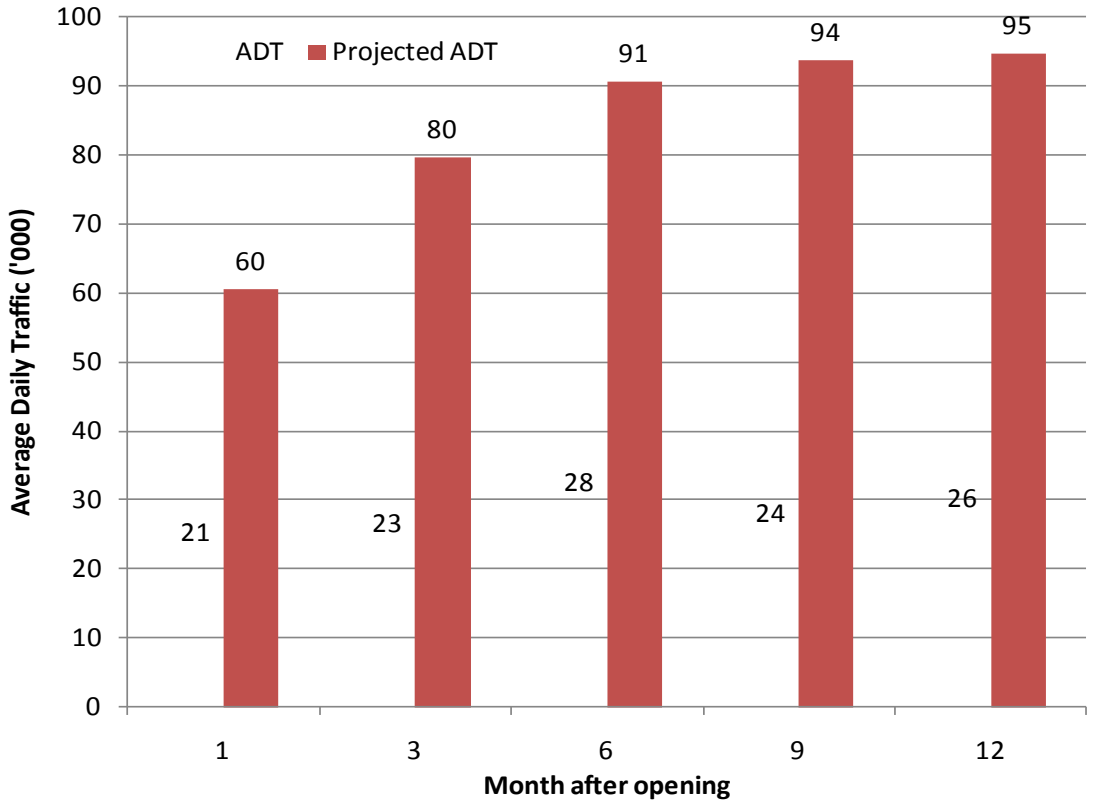
International evidence 2

- Flyvbjerg et al. (2005 and 2006)
- 183 road projects
- (actual minus forecast)/forecast x 100
  - forecasting error > ±20% for half the projects
  - forecasting error > ±40% for a quarter of the projects
  - no improvement in accuracy over the past 30 years

Australian evidence 1

- Hensher and Li (2010)
- 14 Australian toll roads (9 motorways, 3 tunnels, 2 bridges)
  - on average, actual 45% below forecast for first year of operation
  - for projects with data beyond first year of operation, forecasting errors became smaller over time
  - in some cases, actual was still 19% below forecast after 6 years of operation

Australian evidence 2: CLEM7



Source: RiverCity (2006)

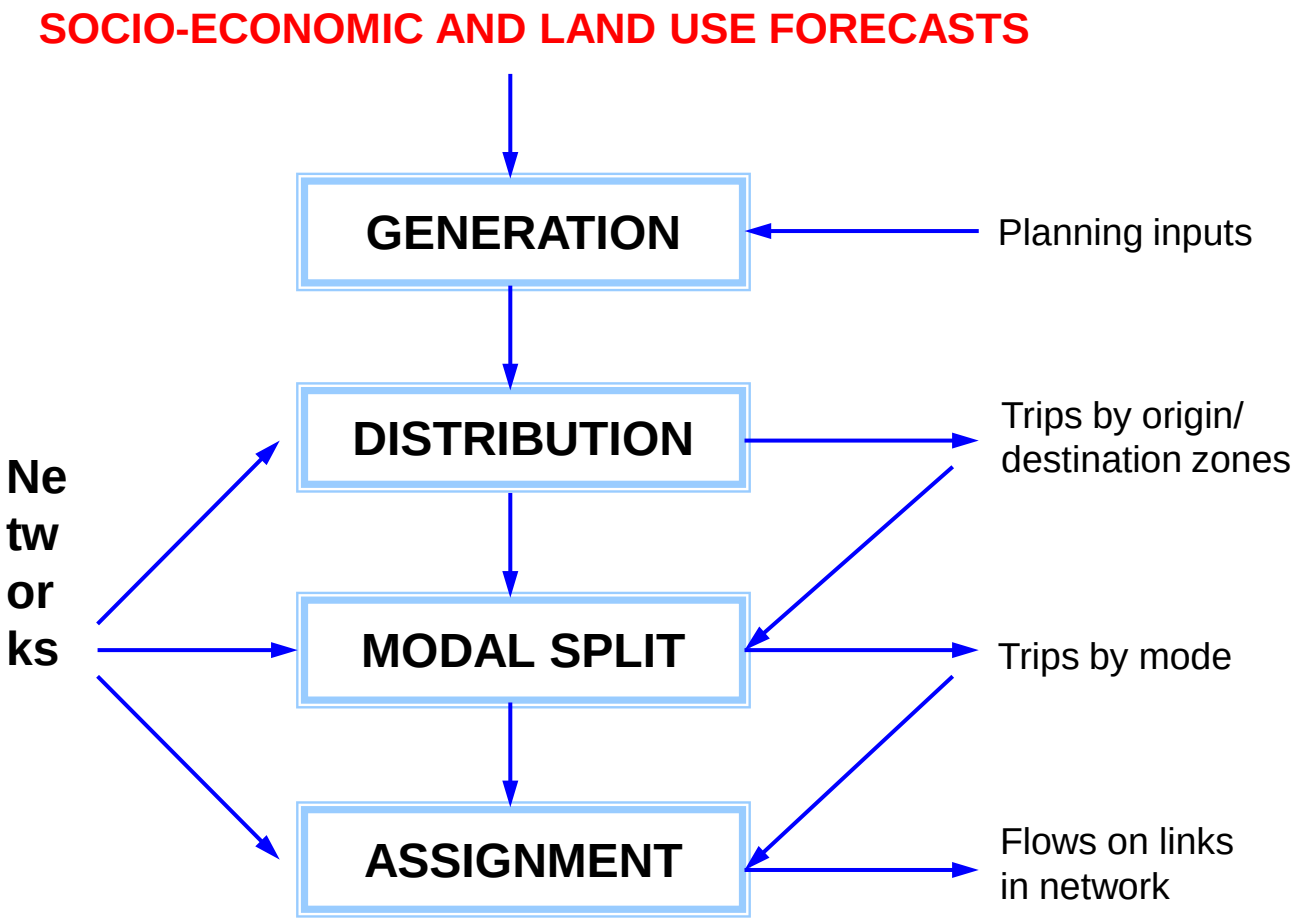
Actual Average Daily Traffic (ADT) versus projections for first year of operation
Note: The actual tolls changed during the period and were lower than assumed tolls for the projections.

Framework for considering the problem

- Technical
  - model adequacy
  - data limitations
  - uncertainty about assumptions
  - ramp-up risk

- Incentives
  - optimism bias
  - strategic misrepresentation

Four-step urban transport model



Source: adapted from BTE (1998)

Issues with four-step model 1

- ignores reductions in total trip numbers due to growing congestion across the whole network and rising fuel prices
- no time-of-day disaggregation
  - typical to model morning and/or afternoon peak and extrapolate using expansion factors over the day, week, month/season and year - ignores peak spreading and variations in traffic mix
- insufficient network detail
  - ‘rat-runs’ ignored

Issues with four-step model 2

- possible inappropriate speed-flow curves
- unable to account for tolls that vary with time-of-day
- truck and commercial traffic assumed to be a fixed proportion of the total
  - important market segment for toll road operators because they are charged more
- ignores trip chaining

Mitigation measures: models 1

- include feedback of higher travel costs (caused by rising congestion and fuel prices) to trip generation
- allow for time-of-day choice (peak spreading)
- model freight traffic explicitly
- more focus on model validation
- independent peer review of models

Mitigation measures: models 2

- use more advanced models
  - tour-based (trip chaining; allows for reorganisation of trips within a tour)
  - activity-based (predicts for individuals where and when specific activities (work, leisure, shopping) are conducted; allows adaptation to price variations in time and space)
  - dynamic traffic assignment (time-varying route choice behaviour)
  - but these require very detailed data, which historically has not been collected

Data limitations

- model calibration and validation
  - calibration: adjust parameters to represent observed base-year data
  - validation: compare backcast and/or forecast model results with observed data
  - inaccurate or outdated data will lead to errors

- lack of data on competing untolled alternative routes, existing and future

Data limitations: value of time

- usually assumed to be a single value for each trip purpose (non-work and work), which ignores the distribution of values
  - those willing to pay the toll come from the high end of the distribution
  - the distribution has a long right tail so the number of users willing to pay the toll could be fewer than would estimates assuming a normal distribution
- hypothetical bias in stated preference surveys to estimate willingness-to-pay for time savings

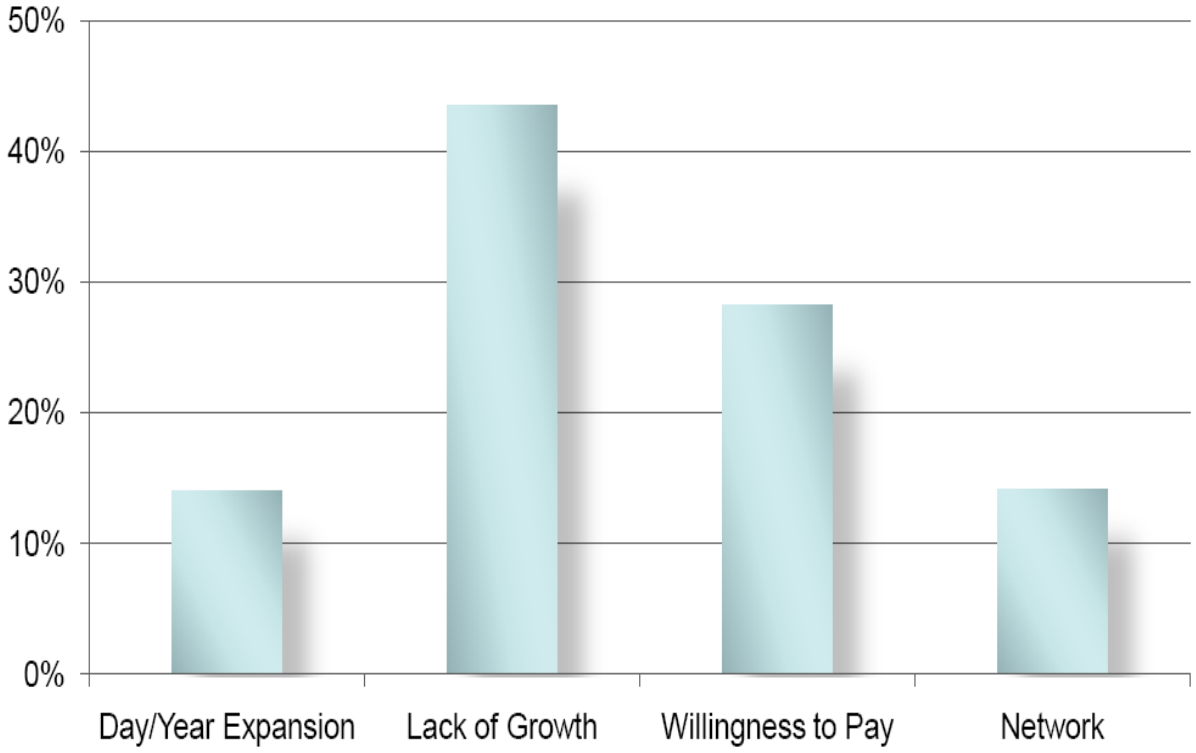
Mitigation measures: data

- more detailed traffic data
  - segmented by traveller characteristics, trip types, vehicle types, time of day
- improved data on the road network and vehicle speeds
- improved willingness-to-pay data on values of time and reliability

Uncertainty in input assumptions

- A large number of assumptions underlie traffic forecasts
  - socio-economic variables (population, employment, economic growth, land use)
- Issues
  - may not reflect market trends and so may not materialise
  - no consideration of short-term fluctuations

Factors affecting CLEM7 forecasts

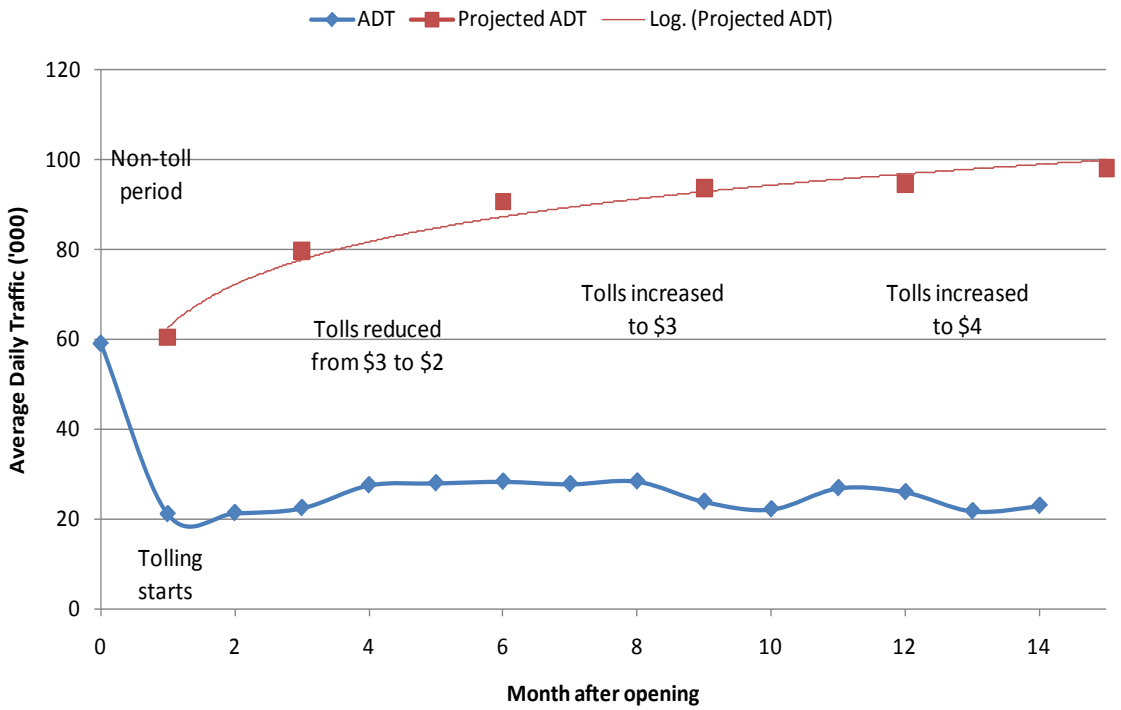


Source: RiverCity Motorway (2010)

Mitigation measures: assumptions

- independent expert review of population, employment, and land use assumptions
- sensitivity analysis of key input variables
- probabilistic modelling
  - assign probabilities to different scenarios and assumptions and then do Monte Carlo simulations

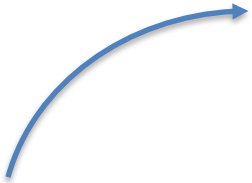
Actual versus assumed ramp-up pattern: CLEM7

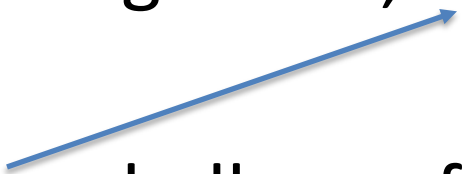


Source: RiverCity Motorway (2010)

Ramp-up risk

- The ramp-up period is important for financial viability
- it is the time when toll roads are most likely to default
- traditional shape concave
- experience suggests longer, more gradual, and closer to a straight line
- estimating shape and duration a challenge for modellers, particularly for greenfield projects





Mitigation measures: ramp-up risk

- stress test
  - explore worst-case scenarios
- probabilistic modelling
  - Monte Carlo simulations

Technical explanations alone are inadequate

- Flyvbjerg's argument:
- If technical explanations alone applied, one would expect
  - roughly symmetric distribution of inaccuracies (forecasts above and below actuals) and
  - improvement over time as sources of errors were identified and addressed
- but neither is the case.

Optimism bias: definition

- a systematic tendency for people to under-estimate the cost and over-estimate the benefit (or traffic)

- analyst's belief that a project will be successful affects study results, whether conscious or unconscious

Strategic misrepresentation: definition

- planned, systematic distortion or misstatement of fact, aiming to increase the likelihood of success for an event, say, gaining an approval for funding
- deliberate bias in which one purposefully skews results to serve institutional or private needs
  - can stem from political pressures within organisations.

Critical difference and similarity

- Optimism bias and strategic misrepresentation are both deception
  - but strategic misrepresentation is intentional
    - or to put it crudely, lying.

- Both have the same result: inaccurate forecasts and inflated benefit-cost ratios

UK context: majority of actors partial

Actors having no or little direct interest in avoiding cost overruns/optimism bias	Actors having a direct interest in avoiding cost overruns/optimism bias
Local transport authorities	Ministry of Finance
Local politicians	Department of Transport
Local economic interests	Partnerships UK
Local civil servants	
Consultancy companies	
Individual MPs	

Source: Flyvbjerg and COWI (2004)

Effect of bidding processes for PPPs

- Bidding competition encourages bidders to take more optimistic views of traffic forecasts and/or take on more risk to win the deal
  - heightened where there is a perception that the government will not allow the project to fail

Ways to inflate traffic and revenue projections

- Bain (2009) lists 21 ways, for example
  - flatter the asset
  - use upper ends of ranges for forecast socio-economic variables
  - hide high growth rates for the area affected by the project within broader averages
  - design and administer surveys to bias results
  - inflate expansion or annualisation factors
  - overstate the toll users are willing to pay
  - rely on speculative development.

Mitigation measures: optimism bias

- reference class forecasting
  - benchmarking forecasts against actual observations from a reference class of comparable situations
- optimism bias downpulls
  - analogue of ‘optimism bias uplifts’ to offset under-estimation of construction costs
  - downward adjustments based on past experience

Mitigation measures: strategic misrepresentation

- reference class forecasting again
- institutional change with a focus on transparency and accountability
  - professional and even criminal penalties for deceptive forecasts
  - forecasters sharing financial responsibility

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