Performance Term Three Traffic Forecasts

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1 Executive Summary

We were engaged by the British Columbia Ferry Commission to forecast the traffic of British Columbia Ferry Services Inc (BC Ferries) between fiscal year 2012/13 and fiscal year 2015/16.

Our forecast methods follow best practices in econometrics. We formed a hypothesis that traffic is a function of the cost of travel, which includes gasoline prices and BC Ferries' fares, and measures of economic activity, which include population, gross domestic project and household spending. We then specified the hypothesis in two different functional forms and employed two different least-squares regression models to: [1] establish a good fit with historical data; [2] estimate the elasticities of cost of travel and economic activities; then [3] use those elasticities with forecasts of those variables to forecast traffic.

The two models we employed were our model (the PTA model) and the COMPASS model, owned and operated by Transportation Economics and Management Services Inc (TEMS). The PTA model was used to generate estimates of the elasticities between: [1] BC Ferries' fares and BC Ferries' traffic; and [2] domestic spending or gross domestic product and BC Ferries' traffic. We used the COMPASS model, which BC Ferries used with success in 1997 and in 2007, to confirm the elasticities estimated by the PTA model.

These models, with their different functional forms and methods of incorporating historical data, produced elasticity estimates that are consistent with each other and, all together, confirm that BC Ferries' traffic can be reasonably estimated as a function of BC Ferries fares, population and economic activity. The exhibit below illustrates the consistency.

Exhibit 1–A: Estimates of Fare and Income Elasticities for Cars

	Major Routes		*Minor Routes*	
	Fares	*Income*	*Fares*	*Income*
COMPASS 1997, 1998	(0.5)	n/a	(0.3)	0.4 to 0.9
COMPASS 2007	(0.5)	0.8	(0.4)	0.9 to 1.1
COMPASS 2010	(0.6)	0.3 to 0.9	(0.3)	0.4
PTA 2010	(0.5)	0.7	(0.3)	0.7

Having confirmed that the elasticities estimated by the PTA model were consistent with the current and prior COMPASS model estimates and statistically significant, we used them to forecast traffic for each of the four traffic types in each route group. The traffic forecasts are presented below as quantity indices for each route group, calculated in accordance with British Columbia Ferry Commission Order 05-01:

Exhibit 1–B: Traffic with Economic Growth Forecasts of the BC Budget

Fiscal Year ending 31 March…	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*
Major	96	97	99	100	102	104
Route 3	100	102	103	105	106	108
Minor	96	98	99	100	102	103
Northern	81	81	81	81	81	81

These results use forecasts of the relevant economic variables from the British Columbia 2011/12 budget: trend growth of 4.6% per year in nominal GDP and trend growth of 2.8% per year in real domestic consumption.[1] These forecasts assume no change in BC Ferries' fares through the forecast period.

The runs of the PTA model that produced these forecasts exhibit sufficient robustness to accept the results within a 95% level of confidence with the exception of the forecasts for the four traffic types in Northern route group and for trucks on route 3. For those segments, the PTA model did not provide a sufficiently good fit to the historical data between 2001 and 2010 to reject the BC Ferries' hypothesis of no growth in traffic between 2012 and 2015.

To assess the consistency of these results, the COMPASS model was used to forecasts traffic with lower forecasts of the economic variables: about 2.6% in nominal GDP per year, which translates to negative real GDP per capita growth. The COMPASS model forecasts assumed no changes in BC Ferries' fares over the forecast period

Exhibit 1–C: Traffic with Low Economic Growth Forecasts

Annual Average Growth, 2010 to 2016	*Passenger*	*Vehicle*
Major	0.1%	0.1%
Route 3	0.2%	0.2%
Minor	0.1%	0.1%
Northern	(0.1%)	(0.1%)

The differences in the forecast values of the independent variables and the small differences in the elasticity estimates were able to account for the differences in the two forecast results, thus the COMPASS model affirmed the forecasts produced by the PTA model.

[1] British Columbia Ministry of Finance. *Budget and Fiscal Plan 2011/12-2013/14.* 15 February 2011.

2 BACKGROUND

The *Coastal Ferry Act* (R.S.B.C.) (the *Act*) requires the British Columbia Ferry Commissioner (the Commissioner) to establish a price cap for the ferry services provided by British Columbia Ferry Services Inc. (BC Ferries) over the successive performance periods of the *Coastal Ferry Services Contract* between BC Ferries and the Province of British Columbia. The upcoming performance period under that contract, the third period, commences on 1 April 2012 and ends on 31 March 2016.

The *Act* requires BC Ferries to give the Commissioner certain information relating to the current and upcoming performance periods. BC Ferries provided the information for the third performance period to the commissioner on 30 September 2010 in the document entitled *Performance Term Three Submission to the British Columbia Ferries Commissioner* (the submission). In that submission BC Ferries names several economic and social factors that may have impacts on their traffic then states: "…the individual or cumulative impacts these items may have on BC Ferries' future travel demand is uncertain." BC Ferries further explained this statement with the results of its econometric analyses, in which BC Ferries found that: "No variable, or combination of variables…provided a forecast with which (sic) BC Ferries has any degree of confidence." BC Ferries concluded that traffic would follow historical trends and "the resulting eight year average for both vehicle and passenger volumes would be 0.1% and -0.3% respectively" and proposed that the commissioner "use the current year forecast (2010/11) for each year of performance term three."

3 PURPOSE AND SCOPE

The purpose of this engagement is to produce forecasts for the Commissioner of the total vehicle traffic and total traffic that BC Ferries will carry between April 2012 and March 2016. The Commissioner may use these forecasts to set the price caps applicable under the Act to BC Ferries' services over the third performance terms.

Traffic is forecast for the four fiscal years ending on 31 March 2013, 2014, 2015 and 2016. BC Ferries' historical and forecast traffic on each of its routes are aggregated into the four route groups defined in the *Coastal Ferry Services Contract* and into the four revenue groups defined by the Commission.[2]

[2] British Columbia Ferry Commission Order 05-01. *Determination of the Calculation and Comparison of Average Ferry Fares and Price Caps*

Traffic is forecasted separately for each traffic segment $\mathbf{T}_{ij}$ where:

i Each of the four groups that were defined in 2008:

1. the “major routes” 1, 2 and 30;
2. route 3;
3. the “minor routes” 4, 5, 6, 7, 8, 9, 12 (since April 2008), 13 (since April 2008), 17, 18, 19, 20, 21, 22, 23, 24, 25 and 26;
4. the “Northern routes” 10, 11 and 40 (since April 2008).

j Each of the four revenue groups:

1. passengers;
2. cars (taken as under-height vehicles and motorcycles in this forecast);
3. buses; and
4. trucks (taken as over-height vehicles other than buses and drop trailers in this forecast).

Section 4 of the report describes the methods, the data and the assumptions that were used to generate the forecasts: the hypothesis of what influences the trip-making behaviour of BC Ferries’ customers; the independent variables and the functional forms employed in the models; and the historical data for dependent and independent variables. Section 5 of the report documents the elasticities estimated by the models applied to the historical data and the robustness of those estimates. Section 6 records the assumptions made about the independent variables over the forecast period and reports the forecasts produced by the models with those assumptions.

4 METHOD

Our approach follows generally accepted best practices for econometric analyses:[3]

1. Form a hypothesis that explains the trip-making decisions of BC Ferries' customers. In this first step, an econometrician identifies what factors BC Ferries' customers are reasonably believed to consider when deciding whether or not to take a trip. These factors can be validly drawn from other empirical studies of the factors known to influence traffic or from surveys of BC Ferries' customers. Factors that cannot be reasonably believed to influence the behaviour of BC Ferries' customers should not be included in the hypothesis.
2. Specify a functional form of a mathematical model that defines what the econometrician has reason to believe are the relationships between traffic, the dependent variable, and each of the independent variables that are named in the hypothesis. It is important that this model include all of the independent variables and only the independent variables named in the hypothesis. A simple mathematical form is preferred over a complex mathematical form. A log-linear form is most often applied in traffic studies as the regression coefficients are estimates of the elasticity between each independent variable and the dependent variable: traffic.
3. Test the functional form and the hypothesis that underlies it by fitting the best, linear unbiased (BLU) model of the functional form to historical data. When the specified functional form contains more than one independent variable, all of the independent variables should be tested simultaneously in a multivariate model that properly isolates the effects of each independent variable on traffic. Test the multivariate model with the simplest form of least squares regression that the hypothesis can accommodate.
4. Accept or reject the hypothesis by comparing the results to a null hypothesis, i.e. a hypothesis that none of the specified independent variables have any effect on traffic. If the multivariate model does not return coefficients that are, statistically, significantly different than those of a null hypothesis then the hypothesis should be rejected. If the returned coefficients are statistically different but the error term estimated by the model does not randomly follow a normal distribution then the hypothesis need not be rejected but the model must be identified as improperly specified.

[3] Koutsoyiannis, A. Theory of Econometrics, 2nd Ed. (1977) pp. 11-29 is one of many citations for best practices.

4.1 Hypothesis

We formed the hypothesis:

$$T_i = f(N_i, C_i, S_i, P_{Fi}, P_{Si}, L_i)$$

In which

T_i Volume of traffic, in route group i

N_i Number of households in the catchment area of route group i, for which the population in the catchment area can be used as a proxy.

This coefficient should be positive, i.e. increases in population should, *ceteris paribus*, result in increased traffic.

C_i Household consumption in the catchment area of route group i, for which household disposable income and savings rates, personal income or GDP can be used as proxies.

This coefficient should be positive, i.e. increases in consumer spending on all goods and services should, *ceteris paribus*, result in increased traffic.

S_i Number of seasonal homes in the catchment area of route group i.

This coefficient should be positive, i.e. increases in the number of seasonal homes should, *ceteris paribus*, result in increased traffic.

P_{Fi} Cost of travel on the routes in route group i, for which ferry fares, bus fares, reservation fees, exchange rates and the retail prices of gasoline and diesel fuel can be used as proxies.

This coefficient should be negative, i.e. increases in the costs of travel on BC Ferries' routes should, *ceteris paribus*, result in decreased traffic.

P_{Si} Cost of travel on substitute services offered in the catchment area of route group i, adjusted for differences in travel time using value of time estimates.

This coefficient should be positive, i.e. increases in the costs of substitute services should, *ceteris paribus*, result in increased traffic.

L_i Capacity of ferry services delivered on each route in route group i.

This coefficient should be positive, i.e. increases in capacity should, *ceteris paribus*, result in increased traffic.

This hypothesis is, *ex ante*, known to be improperly specified. It is missing variables for weather and for special events, which are known to have affected traffic in past years but cannot themselves be forecast over the performance term.

This hypothesis was used to specify the functional form between each independent and dependent variable.

We estimated the coefficients with two models: the PTA model, which estimates the elasticities of individual independent variables, and the COMPASS model, which estimates elasticities for the cost of travel (including ferry prices) and for a composite socio-economic variable. By employing two models, we increased our chances of proving or disproving the hypothesis: the COMPASS model, while proven to work in forecasting BC Ferries' traffic, does not estimate individual elasticities; the PTA model, while never before applied to BC Ferries' traffic, does estimate individual elasticities in a log-linear form.

1. *PTA Model*

   We specified the following model in a log-linear form:

   $$\log T_i = b_0 + b_1 \log N_i + b_2 \log C_i + b_3 \log S_i + b_4 \log P_{Fi} + b_5 \log P_{Si} + b_6 \log L_i$$

   This is the simplest and most intuitive functional form of the hypothesis but, with five independent variables and the restriction of a log-linear form, it suffered from limited degrees of freedom and did not provide the best fit as the results below indicate.

2. *COMPASS Model*

   The COMPASS model was calibrated for all of BC Ferries' routes in 1998 and its estimates were proven out between empirically between 1999 and 2003. BC Ferries used the COMPASS model again to estimate these elasticities on selected routes in 2007.

   To increase the degrees of freedom in the test of the hypothesis, we will apply the COMPASS model in the generalized form:

   $$\log T_i = b_0 + b_1 \log L_i + b_2 \log(\frac{P_{Fi}}{P_{Si}}) + b_3 \log(N_i C_i S_i)$$

   This model, owned and operated by Transportation Economics & Management Systems Inc. (TEMS) was calibrated for all BC Ferries routes in 1998 and again for selected routes in 2007. The COMPASS model can be used to estimate total demand, mode choice (foot versus vehicle) and route choice but will be used only to estimate total demand in this engagement. With its non-linear form, it also allows for own-price and cross-price elasticities to be properly estimated across a wide range of prices.

4.2 Data

The tests to prove the hypothesis are empirical in nature; they rely on large amounts of reliable data from historical records for the dependent variable and each of the independent variables. Where reliable data cannot be found, the model must be modified to accommodate the lack of them.

4.2.1 Historical Data: Traffic

BC Ferries provided data on the number of vehicles and passengers carried, broken out by month, by route and by fare code for the period April 1998 to March 2010 inclusive.

The data provided by sailing allowed for monthly totals to be adjusted, or normalized for, Easter weekend. Normalization refers to the process of identifying and removing systematic effects, and bringing the data into a common scale. These adjustments were required for the years in which some or all of the Easter weekend were in March instead of April. Easter weekend fell in the month of March in the years 2002, 2005 and 2008. The large volumes of traffic which occur over this weekend (specifically Monday & Friday) needed to be removed from the monthly totals in March and applied to the monthly totals in April. These changes were made by averaging the daily totals in Monday and Friday traffic patterns for vehicles and passengers in March (excluding the weekend of Easter). These day averages were then subtracted from the Easter Friday and Monday traffic totals to give the changes in travel which resulted from the Easter weekend holiday. Those differences in travel were added to April's monthly totals to reflect the normal traffic flow in the month of April when Easter occurs in this month.

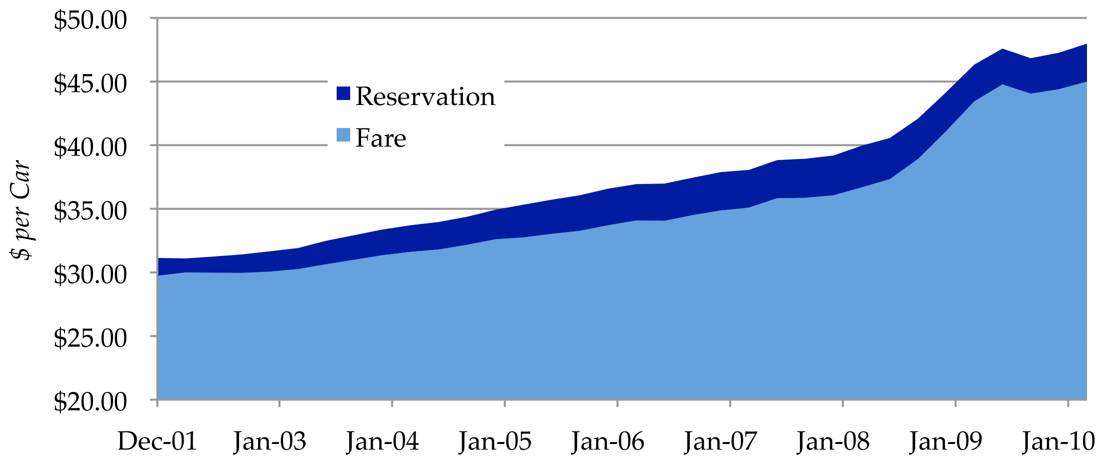
4.2.2 Historical Data: Independent Variables

Data were not available in sufficient quantity and quantity for the costs of substitute services or for the number of seasonal dwellings. The data for the other independent variables are described below.

4.2.2.1 BC Ferry Services Inc Fares

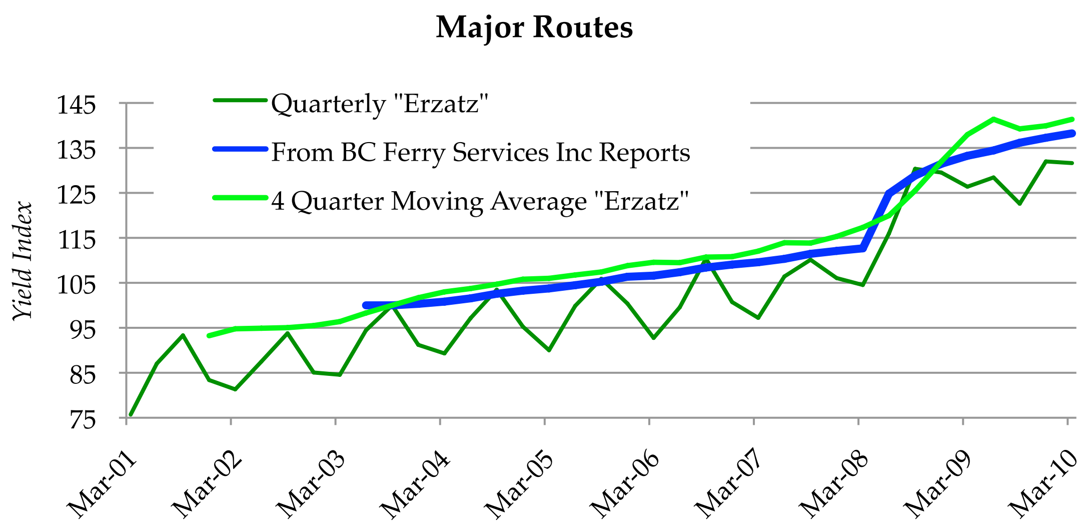
One of the two components of the cost of travel included in the PTA model is BC Ferries' fares. The fares and reservation fees charged by BC Ferries have increased significantly on most of its routes over the past decade. The example of cars on major routes is illustrated below.

Exhibit 4–A: Major Route Fare and Reservations Revenues per Car

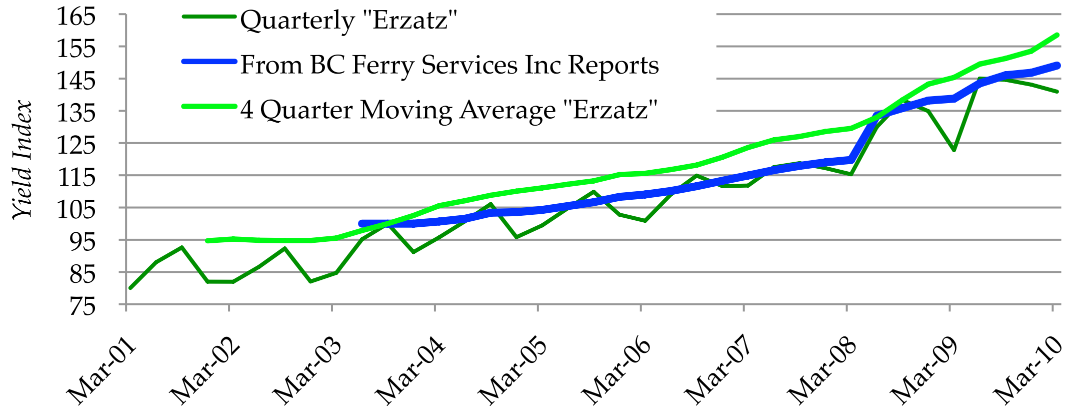


BC Ferries' fares over the historical period 1997 to 2010 vary by sailing. Rather than attempt to retrieve these detailed data and aggregate them into annual averages, we compiled a proxy for fares by route group and by traffic type from fare revenue and traffic data provided by BC Ferries. We then compared the values of this derived proxy, which we called an "ersatz" index to clearly differentiate it from the corresponding index estimated by BC Ferries to comply with the Commission's order 05-01, to that index.

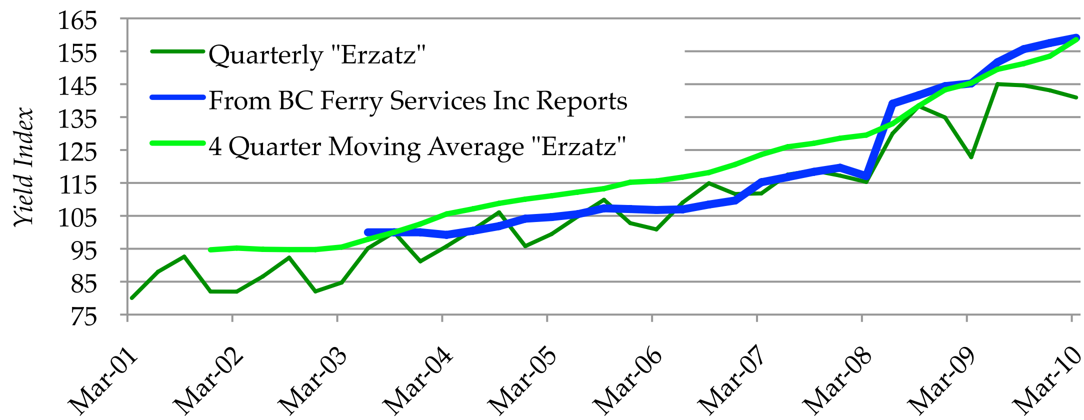
Exhibit 4–B: Comparison of 'Erzatz' Price Index to Actual Yield Index



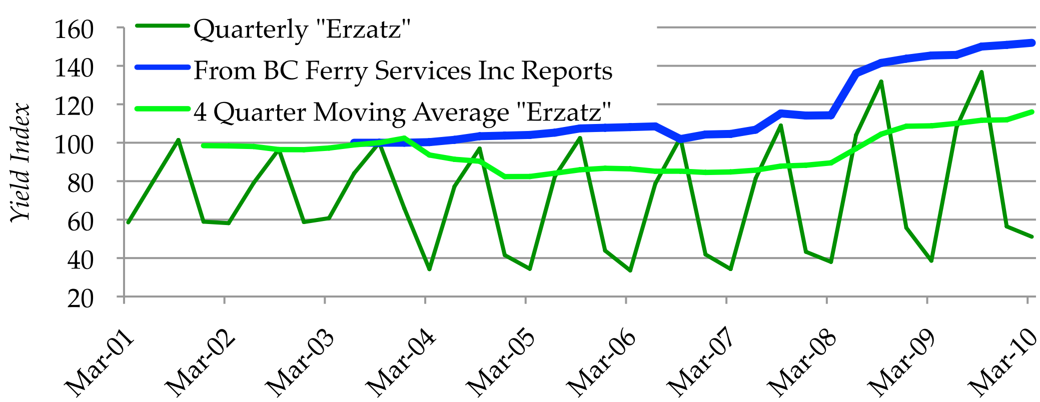
Route 3



Minor Routes



Northern Routes



In all but the Northern route group, the "ersatz" price index is a sufficient proxy for BC Ferries' fares.

To the price index for cars in the major route group, we added an adjustment for the expected cost of reservations. While reservations are not mandatory within that group and they are not regulated by the Commission, they form part of the expected cost of travel faced by BC Ferries' customers. Such a customer, expecting that for busy sailings he or she must purchase a reservation, will include the cost of that reservation in their decision-making as to whether or not to make a trip. We divided major route reservation revenues by the number of under-height vehicles carried as traffic to estimate the expected cost of a reservation: $1.58 per vehicle in September 2001 to a peak of $3.36 per vehicle in September 2009. These were added to the "ersatz" fares for major route cars to produce the data series shown in Exhibit 4–A above.

4.2.2.2 Retail Price of Motor Fuel

The other of the two components of the cost of travel included in the PTA model is the after-tax retail price of gasoline. We used the CANSIM series for monthly average retail prices for unleaded gasoline in Vancouver.[4]

4.2.2.3 Household Spending

Average annual consumer spending data are only available as a provincial average in the British Columbia Economic Accounts.[5] These data were adjusted for each of the regional districts in which BC Ferries operates by the ratio of personal income in that district to the provincial average of personal income.[6] The result is a measure of per capita domestic spending in chained 2002 dollars, i.e. adjusted for inflation, in each regional district.

4.2.2.4 Population

Population data for each regional district was interpolated by BC Stats between each census.[7]

The indices for these independent variables over the period of historical analysis are shown in exhibit below.

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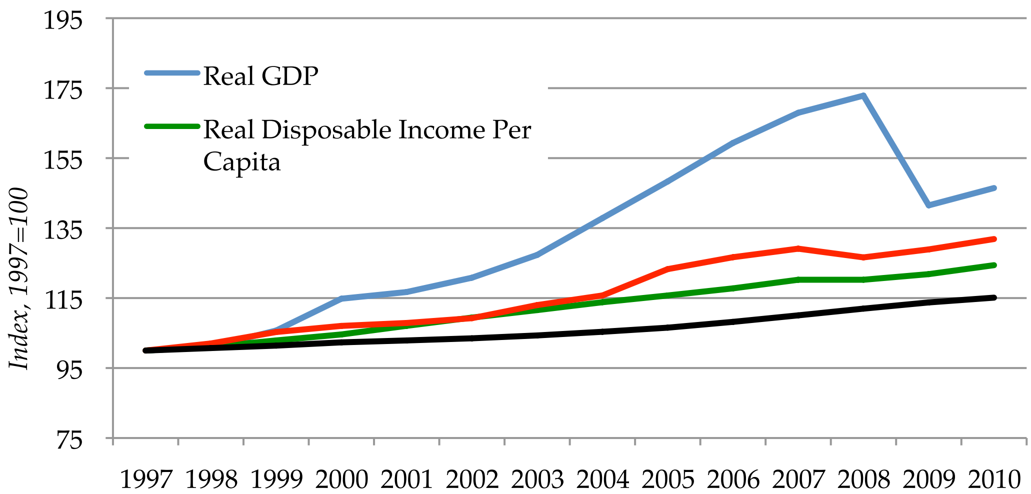
[4] Statistics Canada Table 326-0009: Average retail prices for gasoline and fuel oil, by urban centre.

[5] http://www.bcstats.gov.bc.ca/data/bus_stat/econ_stat.asp

[6] BC Stats: Taxation Statistics for each regional district in the Province. http://www.bcstats.gov.bc.ca/data/dd/income.asp

[7] BC Stats Census http://www.bcstats.gov.bc.ca/census.asp

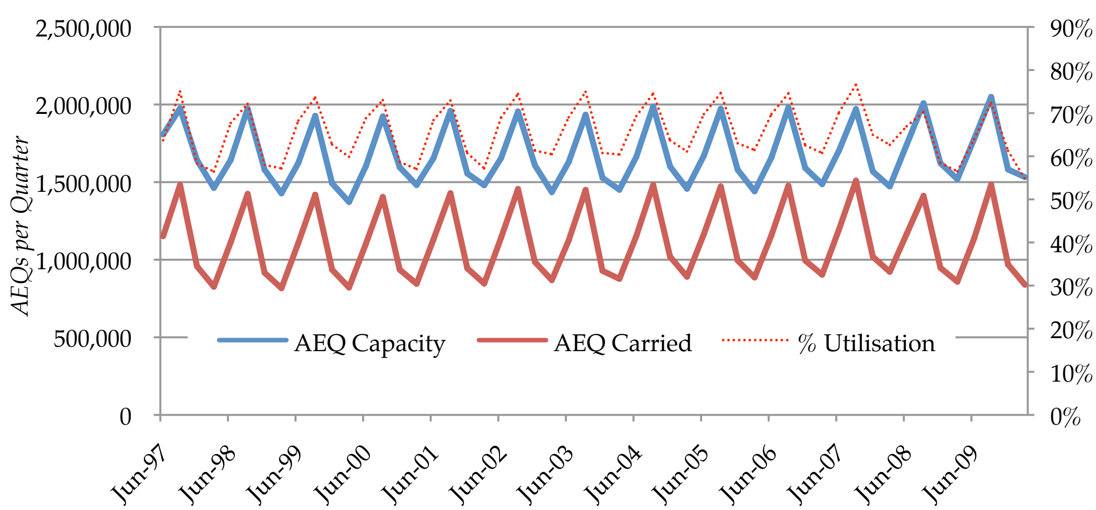
Exhibit 4–C: Indices of the Socio-economic Variables



4.2.2.5 Capacity of Ferry Services

BC Ferries provided the number of sailings and the total lift-off capacity, measured in auto-equivalent units (AEQs), for each month on each route from November 1993 to March 2010. These data were compared to total traffic in each route group, assuming that 1 bus = 3 AEQ and 1 truck = 4 AEQ. This comparison for the major routes is illustrated below.

Exhibit 4–D: Major Route Capacity Utilisation



Capacity, traffic and the combination of the two into a measure of utilisation all vary little from each other through their seasonal cycles. In statistical terms, traffic and capacity are highly collinear: the correlation between traffic and capacity is 0.97. This reflects what we know of BC Ferries' day-to-day management of capacity, particularly on major routes: the company responds to variations in traffic by adding or subtracting discretionary sailings from its schedule. As a result, the relationship between traffic and capacity violates one of the required assumptions of the classical linear regression model: that the independent variables be free from influence by the dependent variable.[8] Capacity must be excluded as an independent variable from the model.

4.3 Functional Form of the PTA Model

The data limitations described in subsection 4.2.2 above require that the PTA model for passengers, cars and buses be re-specified as:

$$\log\mathbf{T}_{ij} = b_0 + b_1\log\mathbf{P}_G + b_2\log\mathbf{F}_{ij} + b_3\log\mathbf{C}_i + b_4\log\mathbf{N}_i$$

and for trucks as:

$$\log\mathbf{T}_i = b_0 + b_1\log\mathbf{P}_G + b_2\log\mathbf{F}_i + b_3\log\mathbf{I} + b_4\log\mathbf{N}_i$$

In which

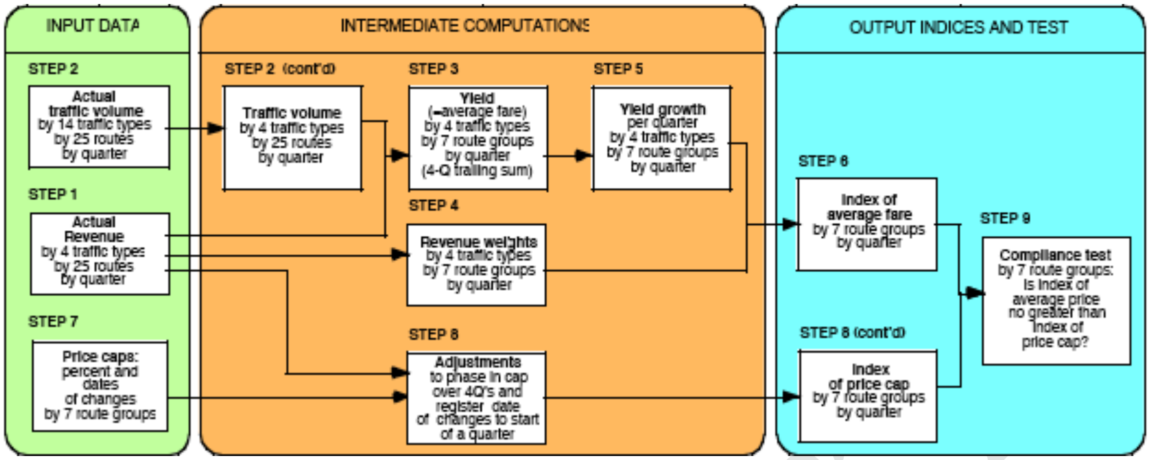
- T_{ij} Volume of traffic, in route group ***i*** and traffic type ***j***.
- N_i Number of households in the catchment area of route group ***i***, for which the population in the catchment area of route group ***i*** is used as a proxy.
- C_i Personal consumption in the catchment area of route group ***i***.
- I Provincial GDP.
- F_{ij} Average fare in route group ***i*** for traffic type ***j***. For major route cars, this includes the expected costs of reservations.
- P_G Retail price of unleaded gasoline in Vancouver.

4.4 Outputs

The PTA model and the COMPASS model each predict total volumes of foot and passenger traffic by route, which are then aggregated $\mathbf{T}_{ij}$ for each route group ***i*** and each revenue group ***j***. The Commission needs forecasts that can be used to regulate price caps in the nine-step process defined by the in BC Ferry Commission Order 05-01 and illustrated below:

[8] Cov($\mathbf{e}$,$\mathbf{X}_i$) = 0. There is no relationship between the error term ***e*** generated by the model and each independent variable X_i.

Exhibit 4–E: Steps in the Calculation of Price and Traffic Indices[9]



Those steps of this process that are relevant to the forecasts in this report are outlined below, along with a description as to how we incorporated the requirements into the forecast results.

Exhibit 4–F: Calculation of Price and Traffic Indices[10]

2	*Actual Traffic Volumes and Revenues*	BC Ferries records and reports actual traffic $\mathbf{T}_{ij}$ and actual revenues $\mathbf{R}_{ij}$. We forecasted annual total traffic by the four revenue-traffic types in each of the four route groups for the fiscal years 2013/14, 2014/15 and 2015/16.
3	*Yields by Traffic Type*	Calculate the yield for each route group and each traffic type: $$Y_{ij} = \frac{R_{ij}}{T_{ij}}$$ We estimated historical values independently and compared these estimates to the values reported to the Commission by BC Ferries by route group and by revenue traffic types, for the fiscal years 2003/04 to 2009/10 to ensure that "ersatz" price indices were sufficient. The yields for fiscal years 2013/14, 2014/15 and 2015/16 were not estimated but assumed to be unchanged form their values in 2010/11.

[9] British Columbia Ferry Commission Order 05-01. *Determination of the Calculation and Comparison of Average Ferry Fares and Price Caps*

[10] British Columbia Ferry Commission Order 05-01. *Determination of the Calculation and Comparison of Average Ferry Fares and Price Caps*

4	*Revenue Weights for Price Index*	Weights of each yield, $\mathbf{Y_{ij}}$, equal to the revenue share of each traffic type are needed to combine $\mathbf{Y_{ij}}$ into a single price index for each route $\boldsymbol{i}$. $$w_{ij} = \frac{R_{ij}}{\sum_{j=1}^{4} R_{ij}}$$ We estimated the revenue share of each revenue-traffic type in each route group through the years 2010/11 to 2015/16 using forecast traffic and the assumption that yields do not change.
5	*Growth Rates of Individual Yields*	Estimate the growth rate from period ***t-1*** to period ***t*** of the $\mathbf{Y_{ij}}$ for each route group and each traffic type: $$\Delta Y_{ij(t)} = \frac{Y_{ij(t)} - Y_{ij(t-1)}}{Y_{ij(t-1)}}$$ The yields for the fiscal years 2010/11 and 2011/12 are as estimated above. The growth rates for all individual yields for the fiscal years 2013/14, 2014/15 and 2015/16 were assumed to be zero.
6	*Direct Price Index*	First, compute the "weighted growth ratio" for each route group and each traffic type, $\mathbf{\Delta P_{ij}}$, from period ***t-1*** to period ***t*** for each by multiplying the growth rates of the individual yields from Step 5 by their revenue weights from Step 4: $$\Delta P_{ij(t)} = \Delta Y_{ij(t)} \left(\frac{R_{ij(t)}}{\sum_{j=1}^{4} R_{ij(t)}} \right)$$ For each route group, add the weighted growth ratios for the four traffic types into a sum that is the growth in price in that route group: $$\Delta P_{i(t)} = \sum_{j=1}^{4} \Delta P_{ij(t)}$$ Convert the price growth in each rate group into a "price index", setting the value of price index in quarter 4 of fiscal year 2002/03 as 100.
6a	*Quantity Index*	A quantity index for each route group, $\mathbf{\Delta Q_{i(t)}}$ is constructed by dividing total revenues by the price index. $$\Delta Q_{i(t)} = \frac{R_{i(t)}}{\Delta P_{i(t)}}$$ Convert $\mathbf{\Delta Q_{i(t)}}$ to an index by setting the value of the quantity index in quarter 4 of fiscal year 2002/03 as 100.

5 Estimates of Elasticities and Goodness of Fit

To test the hypothesis and to estimate the coefficients between each independent variable and traffic, the specified model was fit to BC Ferries' historical data from April 2001 to March 2010 with ordinary least-squares linear regression. The results are summarised below.

Exhibit 5–A: PTA Model Results When Fit to Historical Data

	Fare Elasticity Co-efficients					*Income or GDP Elasticity Co-efficients*					
	COMPASS Model			*PT&A Model*		*COMPASS Model Coefficients*			*PT&A Model*		*PT&A Model*
	1997	*2007*	*2010*	*Coefficient*	*T Statistic*	*1998*	*2007*	*2010*	*Coefficient*	*T Statistic*	*R^2*
Major Routes											
Passengers				(0.33)	(4.39)				0.1	1.02	0.70
Cars	(0.5)	(0.5)	(0.6)	(0.50)	1.02		0.8	0.3 to 0.9	0.7	6.38	0.83
Buses				(0.85)	(9.01)				0.1	0.61	0.94
Trucks				(0.46)	(4.75)				1.0	187.66	0.79
Route 3											
Passengers	(0.2)			(0.28)	(3.84)				0.5	4.28	0.76
Cars	(0.3)	(0.5)	(0.4)	(0.32)	(1.90)	0.4 to 0.9	0.7 to 1.3	0.4 to 0.9	0.5	4.34	0.88
Buses				(1.05)	(12.13)				0.1	0.87	0.90
Trucks				(0.44)	(5.67)				0.9	18.79	0.11
Minor Routes											
Passengers	(0.2)			(0.30)	(6.49)				0.4	3.84	0.73
Cars	(0.3)	(0.4)	(0.3)	(0.27)	(2.67)	0.4 to 0.9	0.9 to 1.1	0.4	0.7	5.39	0.69
Buses				(0.40)	(7.63)				0.0	0.00	0.89
Trucks				(0.29)	(4.52)				0.7	13.98	0.98
Northern Routes											
Passengers				(1.05)	(13.26)				0.6	4.33	0.45
Cars		(0.5)	(0.5)	(1.10)	(8.92)		0.6 to 1.5	0.4 to 0.7	1.2	7.09	0.53
Buses				(1.10)	(39.60)				0.4	3.96	0.59
Trucks				(0.60)	(6.35)				0.8	6.33	0.64

In this chart, the coefficients estimated by the PTA model are compared with the coefficients estimated by successive runs of the COMPASS model: in 1997 in 2007 and in 2010. The results are generally consistent which, given that the PTA and COMPASS models have different functional forms, lends credence to both models.

The significant exception, where the PTA and COMPASS models differ, is in the Northern route group: the price elasticities in the PTA model are significantly higher than in the COMPASS model. This is not surprising as Northern route fares have increased considerably over the last decade and the elasticities on a linear demand curve increase as we approach the upper end of the curve. The same demand curve should yield higher estimates of elasticity now than it did in 1997. While the difference may arise from nothing other than the fact that fares are significantly higher, the high elasticities estimated for the Northern route group by the PTA model should be met with some scepticism: the lower R^2 values in the Northern route group indicate that the PTA model is not a good fit on the Northern routes.

Another exception to the generally good fit of the PTA model to the historical data is the fit for trucks on route 3: the R^2 of 0.10 is so low that we rejected the hypothesis entirely and adopted BC Ferries' forecast of no growth for this traffic segment.

All of the instances in which the T-statistic for the estimated coefficient has an absolute value less than 2 are shaded in pink. When the T-statistic has an absolute value less than 2, we cannot assert with a 95% degree of confidence that the actual coefficient is different than zero, i.e. that independent variable in question has any significant impact on traffic when all other variables are held constant. These particular coefficients, while not statistically significant, are of the expected sign and contribute to high R^2 values for the PTA model in those regressions. For these reasons, they need not be rejected.

6 TRAFFIC FORECASTS

To produce forecasts over the 2012/13 to 2015/16 period, different forecasts of the independent variables were inserted into the PTA and COMPASS models to estimate traffic. The forecasts are reported in the executive summary of the report. Traffic forecasts, in units of traffic, for each of the four traffic types defined in Order 05-01 for each route group have been provided to the Commission in a spreadsheet.

The goodness of fit, the error term and the forecast for each of the four traffic types in each of the four route groups are illustrated in this section with graphs.

6.1 Forecasts of Independent Variables

The PTA model used the following estimates of growth rates to estimate the values of the independent variables in the years 2011/12 to 20015/16.

Fiscal Year ending 31 March…	*2012*	*2013*	*2014*	*2015*	*2016*
Population[11]	1.2%	1.2%	1.2%	1.2%	1.2%
BC GDP, Real[12]	1.8%	2.8%	2.8%	2.8%	2.8%
Disposal Income per Capita, Real[13]	1.6%	1.6%	1.6%	1.6%	1.6%
Retail Gasoline Prices, ¢/litre[14]	131	123	132	141	149

The PTA model assumed no increases in BC Ferries' fares over the forecast period.

The COMPASS model was run earlier than the publication date of the independent variables above, i.e. February 15, and so used different

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[11] BC Stats. *BC and Regional Population Projections*, PEOPLE 35 model, August 2010.

[12] BC Ministry of Finance. *Budget and Fiscal Plan 2011/12 – 2013/14*. Consensus forecast on 4 February 2011 of the Economic Forecast Council: Bank of Montreal, Royal Bank of Canada, Canadian Imperial Bank of Commerce, Toronto Dominion Bank, Scotiabank and IHS Global Insight.

[13] BC Ministry of Finance. *Budget and Fiscal Plan 2011/12 – 2013/14*. "The Ministry forecasts real consumption of goods and services to increase by 2.5 per cent in 2011, following an expected gain of 2.6 per cent in 2010. Improvement in real consumer spending is projected again in 2012, growing by 2.9 per cent, and then averaging 2.8 per cent growth annually in the medium-term."

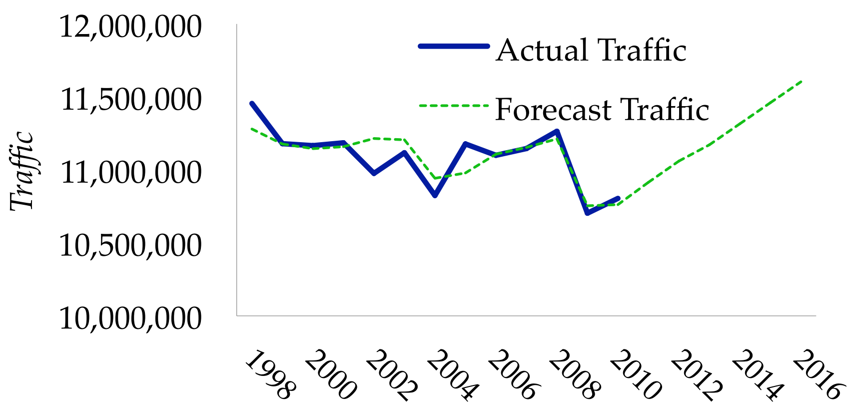
[14] U.S. Energy Information Administration. *2011 Annual Outlook* http://www.eia.doe.gov/oiaf/aeo/tablebrowser/#release=AEO2011&subject=0-AEO2011&table=12-AEO2011&region=0-0&cases=ref2011-d120810c

forecasts of the independent variables: growth rate of 2.6% in GDP per year, no fare increase and a 5% per year gas price increase.

6.2 Performance of the PTA Model with Annual Data

Sixteen separate runs of the PTA model were undertaken: one for each traffic type in each route group. For each of these runs, two graphs are presented below. The first shows the traffic forecast by the model and actual traffic. The fit of the model to historical data is illustrated by the green "forecast" line in prior years, as it compares to the blue "actual" line.

Exhibit 6–A: Model Results for Major Routes Passengers



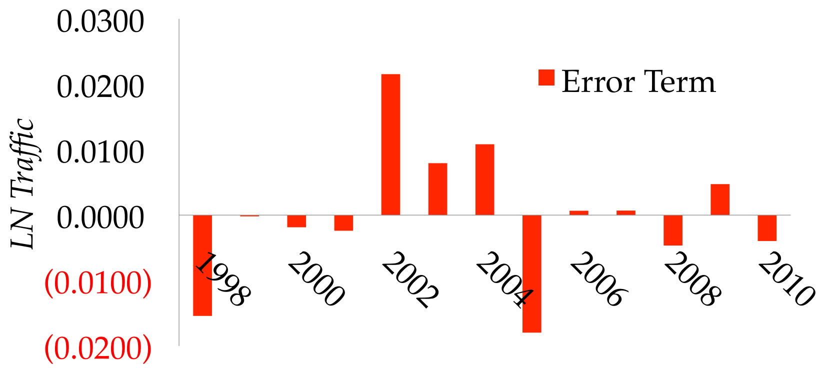
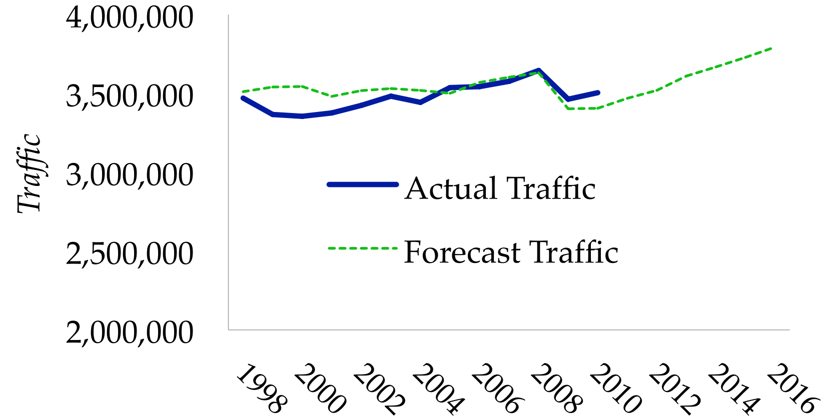


Exhibit 6–B: Model Results for Major Routes Cars



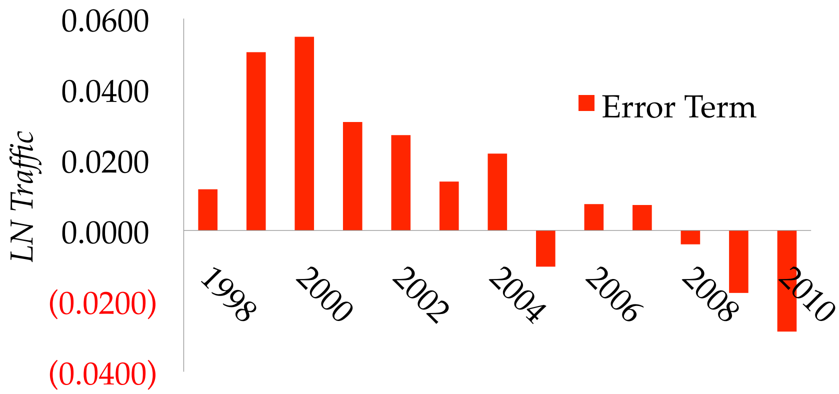
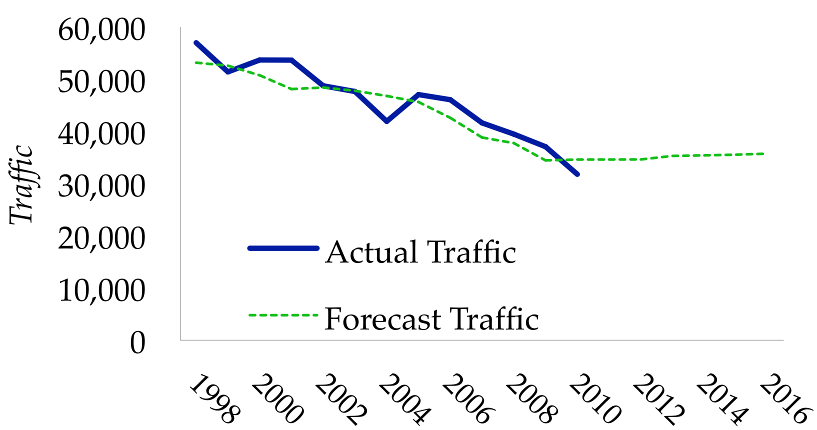
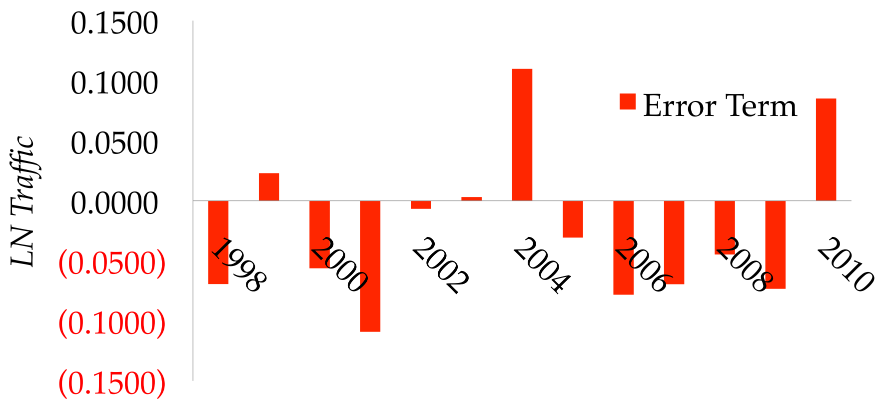


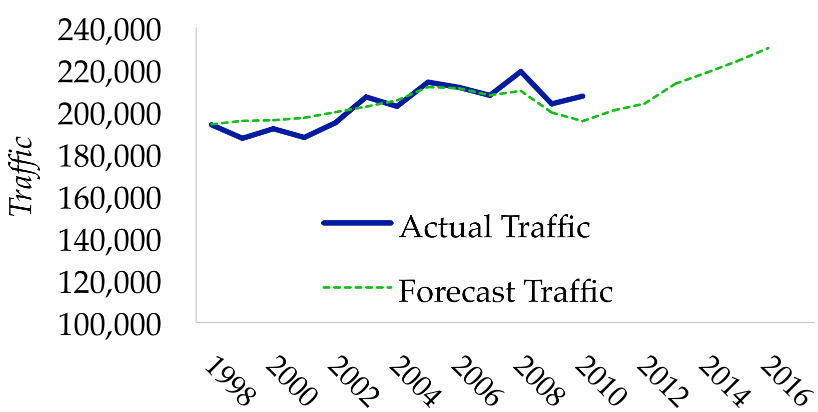
Exhibit 6–C: Model Results for Major Routes Buses





Bus traffic in all route groups is declining. The model results are not clear as to how much of the decline is due to increased fares for buses and how much is due to other factors. We have elected to stay with the forecast that the secular decline in bus traffic will continue. Off the major routes, buses are not a significant component of traffic.

Exhibit 6–D: Model Results for Major Routes Trucks



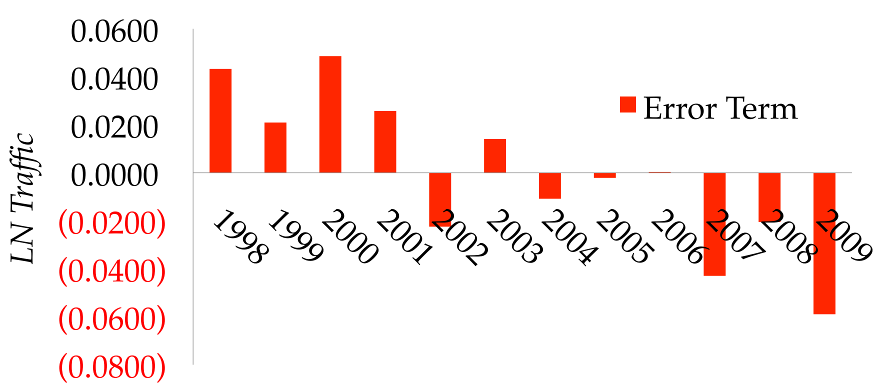
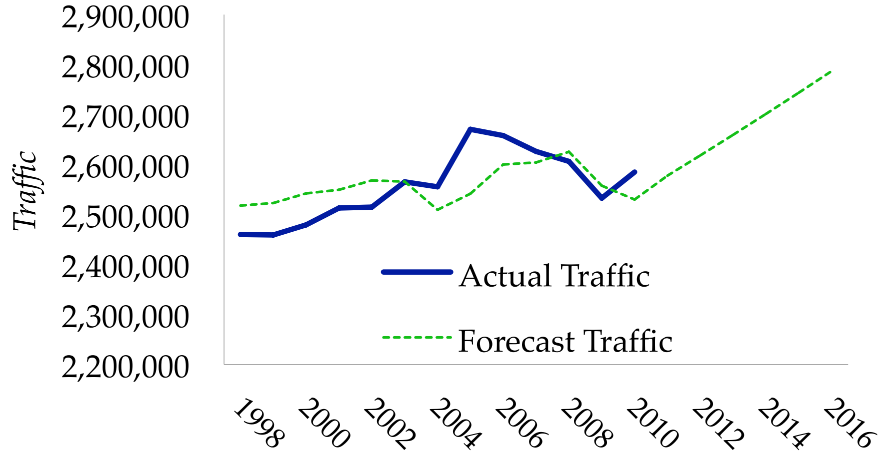


Exhibit 6–E: Model Results for Route 3 Passengers



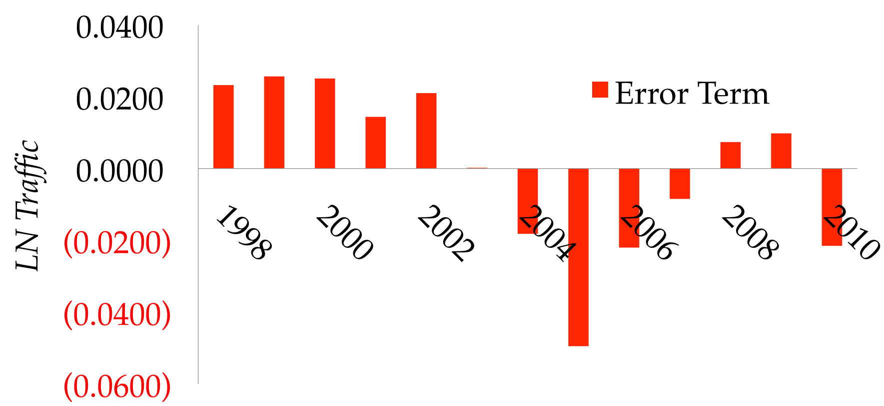
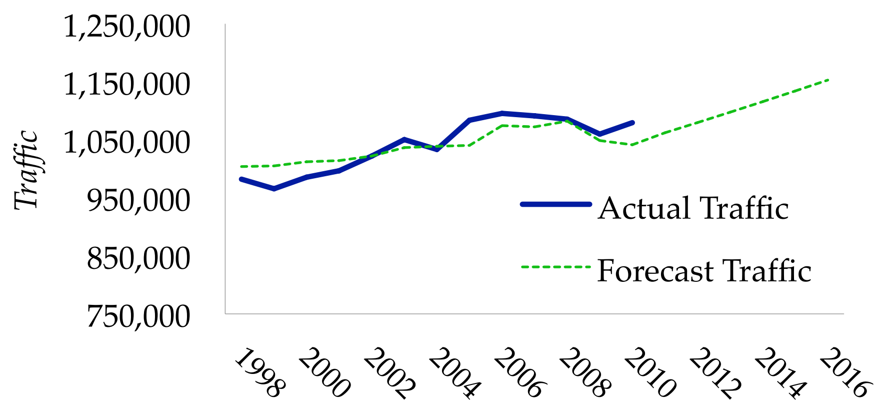


Exhibit 6–F: Model Results for Route 3 Cars



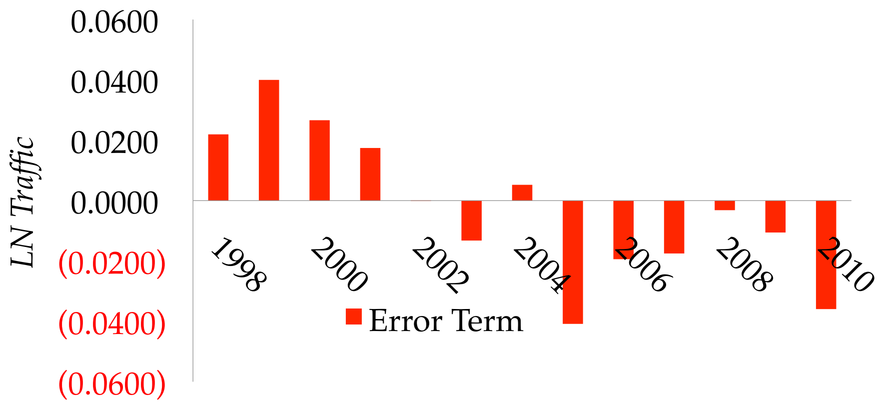
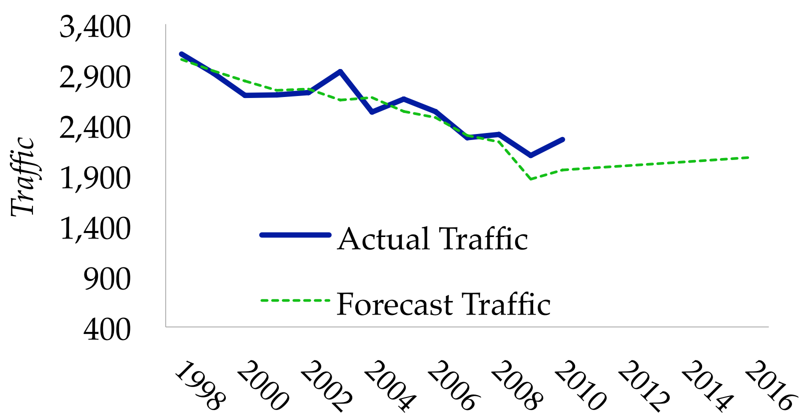


Exhibit 6–G: Model Results for Route 3 Buses



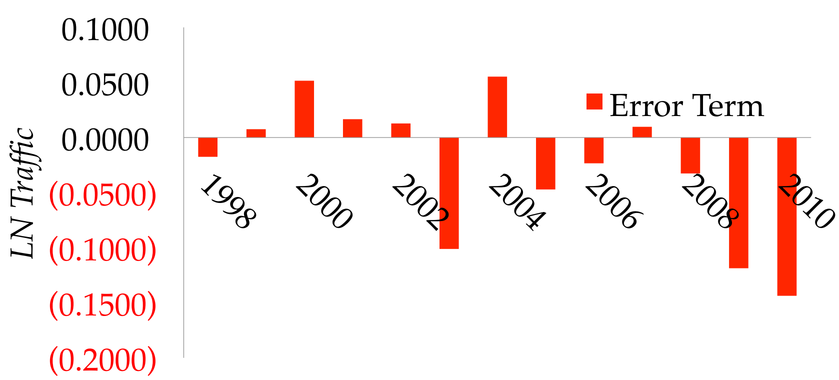
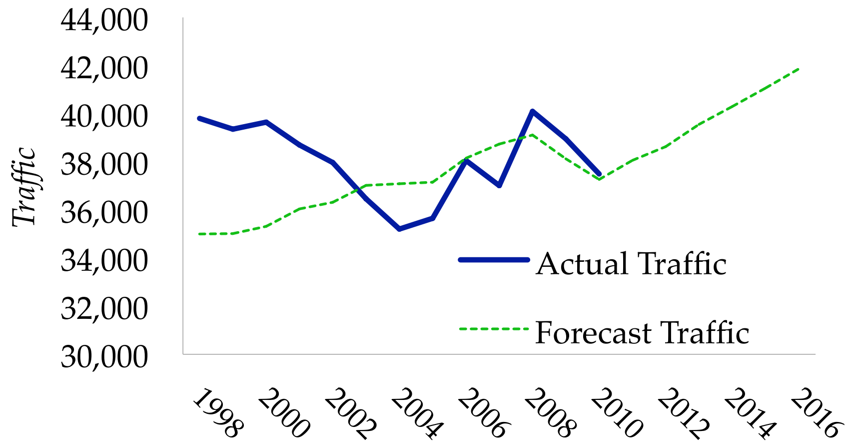


Exhibit 6–H: Model Results for Route 3 Trucks



Of the sixteen model runs presented in this section, the model for trucks on route 3 is the only one which failed to provide a good fit to the historical data. We rejected the hypothesis for this traffic segment and adopted the BC Ferries' hypothesis of no growth.

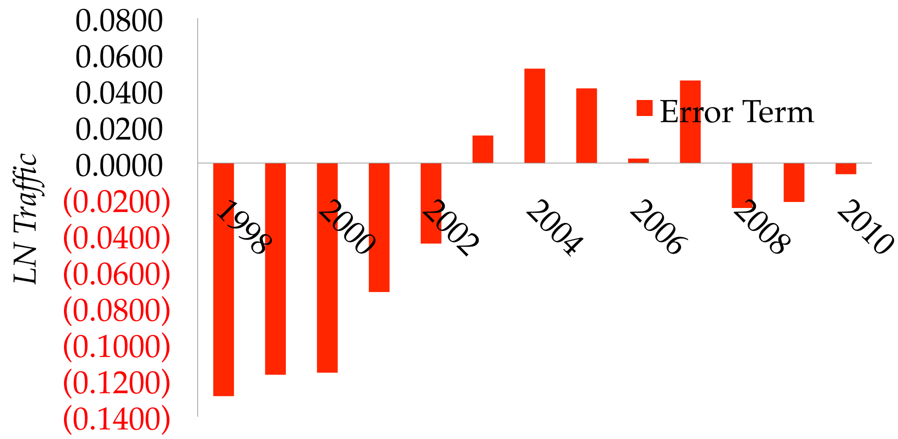
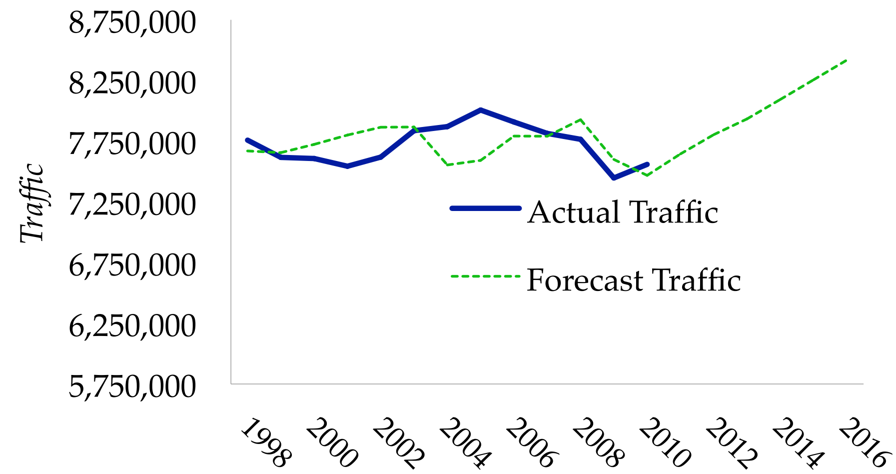
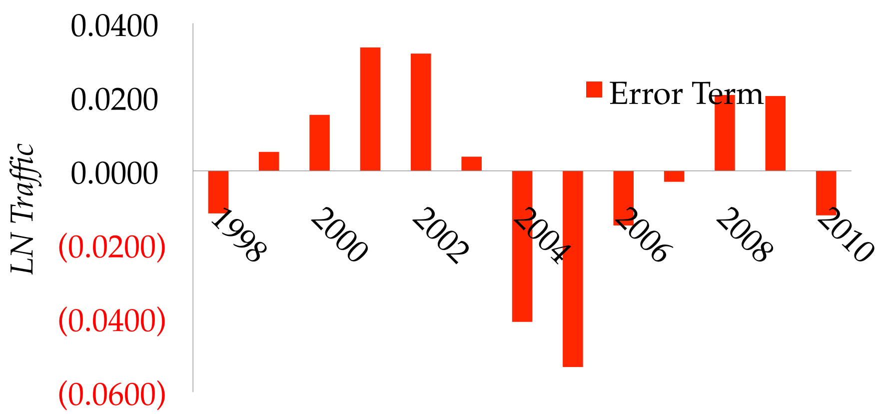


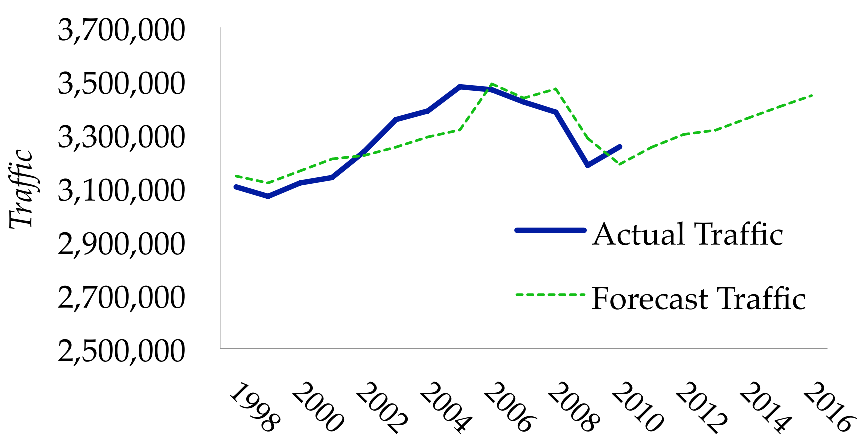
Exhibit 6–I: Model Results for Minor Passengers





Although the model is a good fit, with R^2 of 0.72, the sinusoidal pattern in the error term indicates heteroskedasticity due to a missing independent variable.

Exhibit 6–J: Model Results for Minor Cars



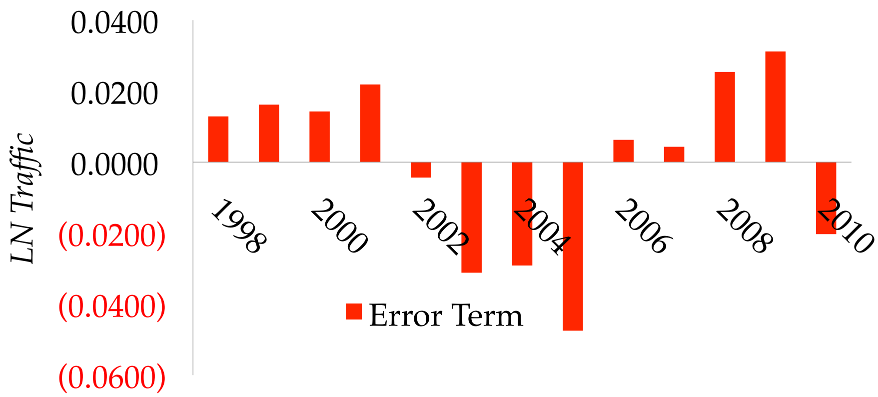
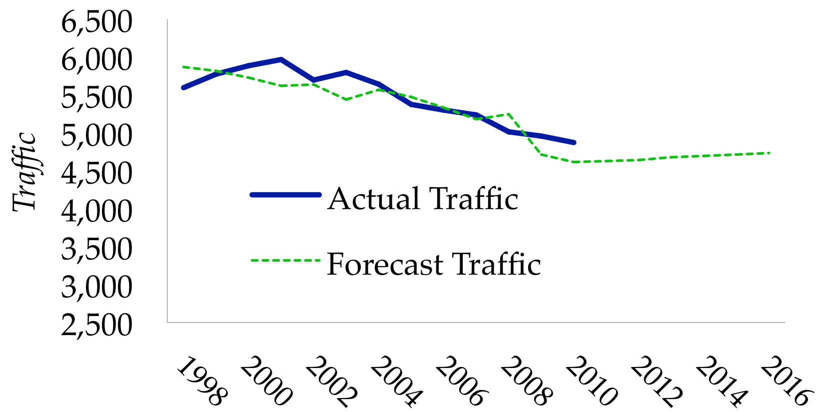


Exhibit 6–K: Model Results for Minor Buses



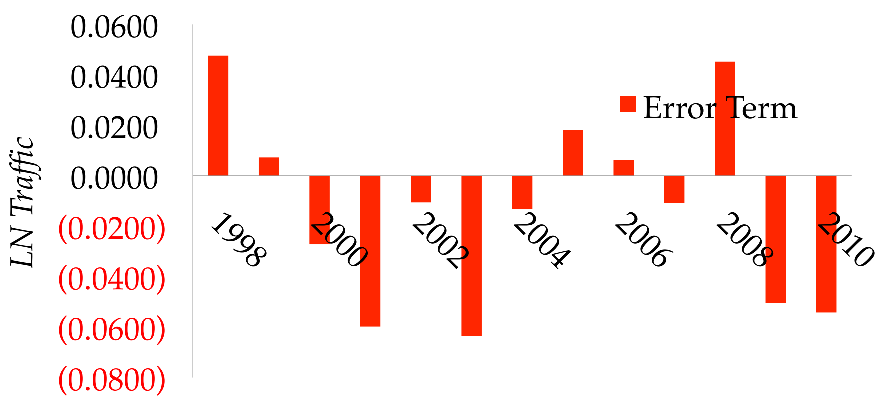
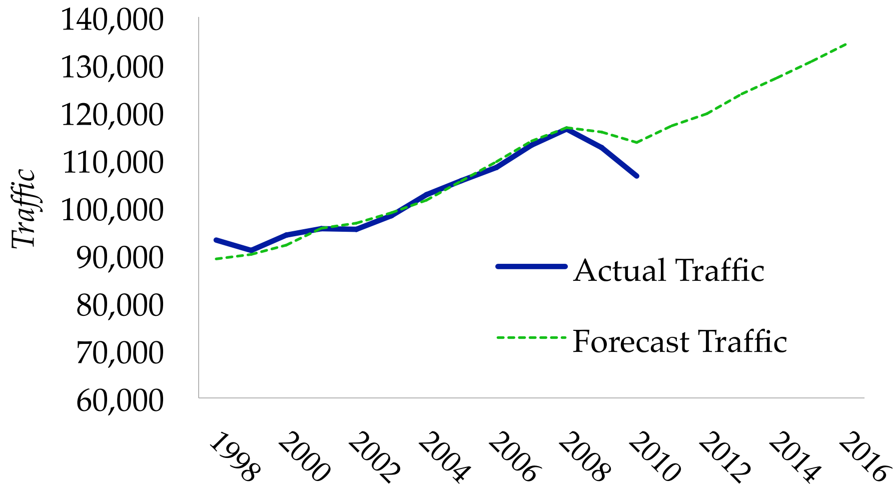


Exhibit 6–L: Model Results for Minor Trucks



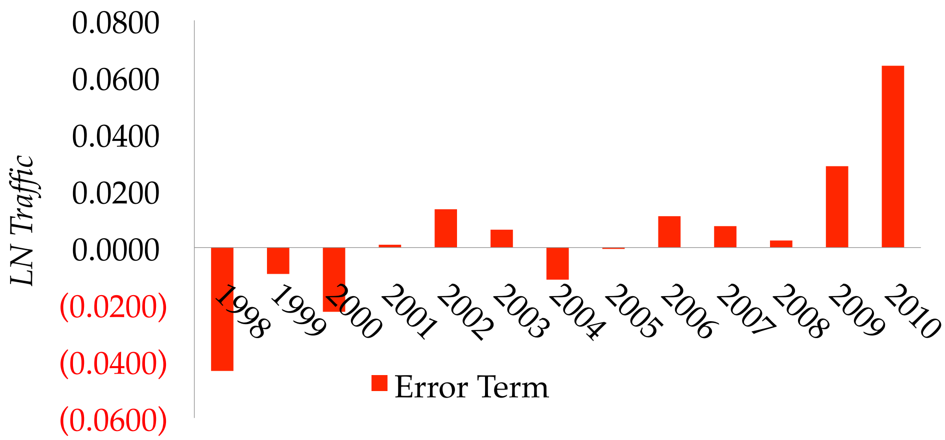
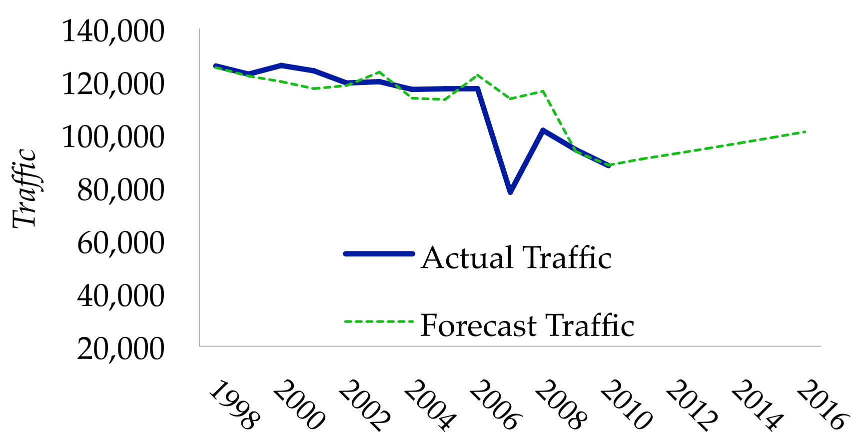
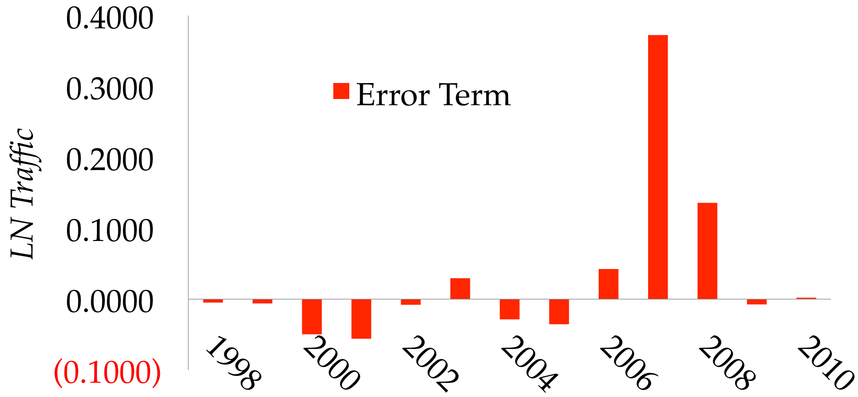


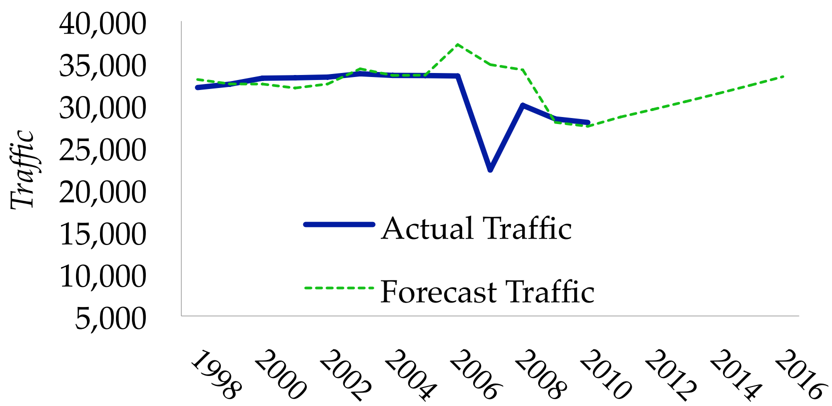
Exhibit 6–M: Model Results for Northern Passengers





Traffic on Northern routes will be flat in all categories except buses, which will continue to decline. Our models of Northern routes are not robust, given the discontinuity in FY 2007, and our overall forecast is no different than BCFS forecast - essentially, no growth.

Exhibit 6–N: Model Results for Northern Cars



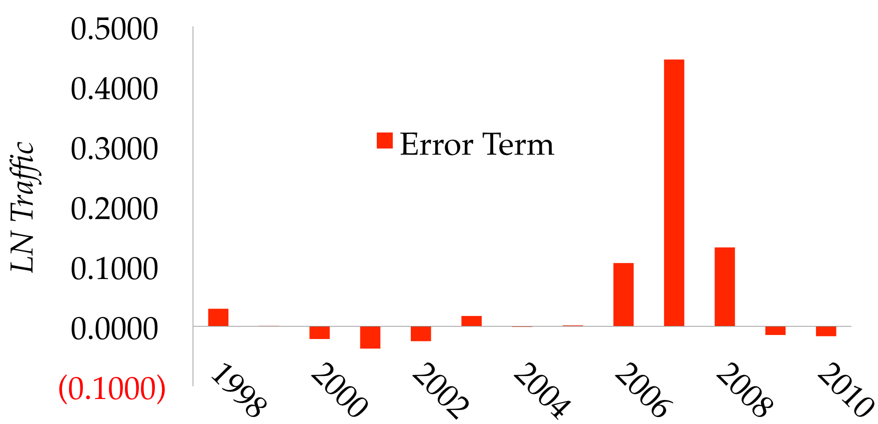
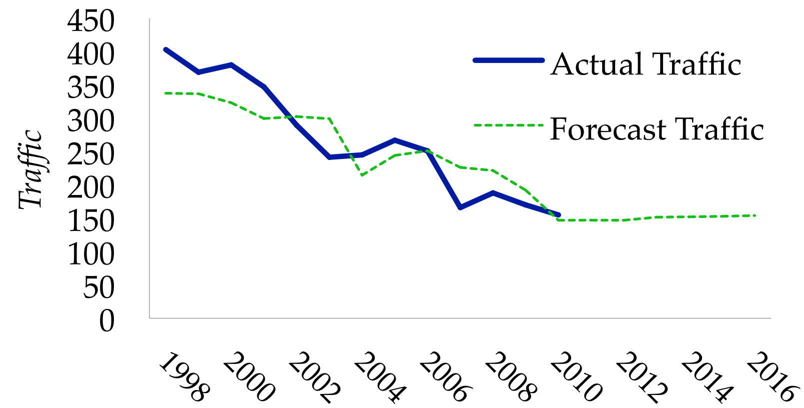


Exhibit 6–O: Model Results for Northern Buses



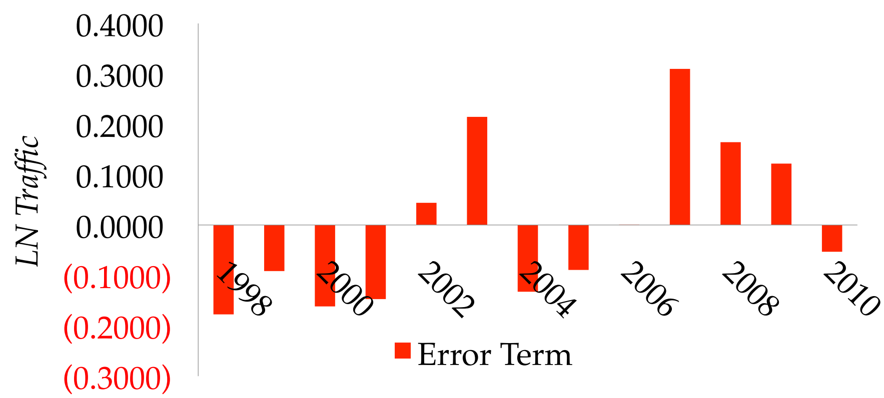
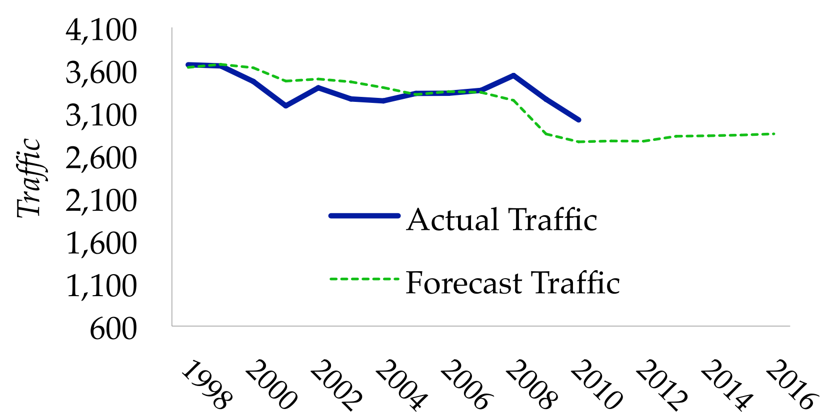
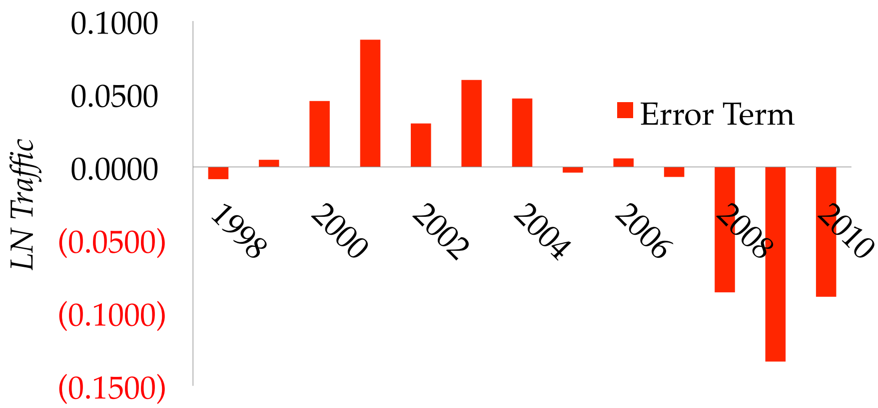


Exhibit 6–P: Model Results for Northern Trucks





The results for the COMPASS model are presented in a separate report from TEMS which has been delivered to the Commission.