INCREASING CYCLING AS A COMMUTE MODE IN METRO VANCOUVER

by

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Abstract

This study investigates why some Metro Vancouver residents cycle to work more often than others using regression analysis of approximately 1600 surveys from the 2006 *Cycling in Cities* study. Regression results indicate cyclists tend to be male, have a university education, live in the City of Vancouver, have fewer vehicles per household, have household incomes between $60,000-$90,000 and live closer to their place of work. From these results the study evaluates a range of policies aimed at encouraging those not currently cycling to work to become cycling commuters. Policy options are assessed on the basis of cost, effectiveness, administrative feasibility, and public acceptability. This study recommends TransLink's Mayors' Council work to increase bike racks on buses, increase Bike and Ride facilities at transit stations, and introduce a vehicle levy.

Executive Summary

This study uses a policy analysis approach to explore options to increase cycling as a commute mode in Metro Vancouver. The primary source of information is TransLink's 2006 Cycling in Cities survey of 1660 residents across Metro Vancouver used to investigate why some Metro Vancouver residents cycle to work more often than others. Descriptive statistics and logistic regression are used to analyze survey data and provide. Six variables have a statistically significant relationship to the dependent variable including gender, education, number of vehicles per household, income, neighbourhood, and workplace distance. Further analysis suggests:

- Women are 60 per cent less likely than men to cycle to work.

- Those without university education are 36 per cent less likely than the university educated to be commuter cyclists.

- Those with household incomes between $60,000 and $90,000 were 64 per cent more likely than those with household incomes over $90,000 to cycle to work.

- Every additional vehicle per household decreases the likelihood of cycling to work by 58 per cent

- Those living outside the City of Vancouver are 48 per cent less likely than those living in the city to cycle to work.

- Every additional kilometre between a respondent's home and work decreases the likelihood of cycling by 5.5 per cent. Thus if a respondent lives ten kilometres away, they are 55 per cent less likely than those living 1 kilometre to cycle to work

- Age, employment, bicycles per household and having dependent children all failed to show a statistically significant relationship with cycling to work.

Building on these results and other research, the study proposes eight potential options to increase cycling levels in Metro Vancouver including: (1) A bike rental system; (2) Separate cycling lanes; (3) Allowing bicycles on the Skytrain at all times; (4) Increasing bike racks on buses; (5) Increasing Bike and Ride facilities at transit stations; (6) Introducing a parking site tax; (7) Introducing a commercial property tax incentive; and, (8) Introducing a vehicle levy on all

registered vehicles. Evaluated according to cost, effectiveness, administrative feasibility and public acceptability, policy analysis suggests adding more bike racks to buses, increasing Bike and Ride facilities at transit stations and introduce a vehicle levy are the policies best suited to increase commuter cycling in the region.

Dedication

To my mom and grandmother, for your unconditional love and support throughout my studies.

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1 Introduction and Policy Problem

In the last few years, Canadian governments, advocacy groups and public health organizations have all become more interested in cycling. For example, a new provincial Transportation Plan for British Columbia gives top priority to pedestrians, transit and cyclists citing numerous environmental and societal benefits of cycling including reduced traffic congestion, lower greenhouse gas emissions, increased public fitness and lower demand for parking (The Provincial Transit Plan 2008).

Although Metropolitan Vancouver leads other Canadian cities in terms of cycling as a commute mode, the region is far behind other international cities. For example, the 2006 Canadian Census found that 1.7 per cent of all Metro Vancouver residents' trips to work are by bicycle compared to 1.0 per cent of trips in Toronto and 1.6 per cent in Montreal. However, cycling accounts for 30 per cent of commuter traffic in the Netherlands and 20 per cent in Denmark (Pucher 2007). At a city level, Copenhagen has a commuter cycling level of 36 per cent and Amsterdam, 27 per cent (TransLink 2008). Clearly there is room for Vancouver to improve in this area.

Starting with the view that too few people cycle to and from work in Metro Vancouver, this study uses logistic regression analysis to examine what factors most influence an individual's decision to cycle to and from work. It then uses this analysis and other information to offer and evaluate a number of policy options by which Metro Vancouver levels can be increased. More specifically, the study investigates why some Metro Vancouver residents cycle to work more often than others using survey data collected from the Cycling in Cities study conducted in 2006 in Metro Vancouver, with policy recommendations are aimed at informing TransLink's Mayors'

Council decisions on this issue.[1] Section 2 discusses earlier research of cycling determinants and positions the current study within the broader context. Section 3 describes the methodologies used in the analysis, Section 4 results of a descriptive analysis of cyclists and cycling characteristics. Section 5 presents logistic regression results. After developing criteria by which to evaluate policy options in Section 6, policy options as to how to improve cycling in Metro Vancouver are presented in Section 7 with an evaluation of these options offered in Section 8. Section 9 makes final recommendations on how cycling levels can be increased in Metro Vancouver with conclusions and limitations offered in Section 10.

[1] Composed of 21 mayors of municipalities within Metro Vancouver, the Mayors' Council appoints the Board of Directors for TransLink and the Commissioner. In addition, it approves plans prepared by TransLink, including all transportation strategies and regional funding.

2   Background

This section explains the current place of cycling in Metro Vancouver. It outlines cycling in Vancouver and other cities and countries to situate where Vancouver sits in relation to other cities. This information is fundamental to understanding the potential Metro Vancouver has to increase commuter cycling levels and sets the stage for the study's methodology.

2.1   Cycling Around the World

The degree to which cycling occurs in a city is often estimated by calculating "mode share". Mode Share refers to the percentage share of a particular transportation mode (car, bus, bicycle etc.) in relation to other modes (Polzin 2005). Table 2.1 compares various cities, based on the bicycle mode shares of work trips.

Table 2.1: Bicycle Mode Shares of Work Trips (2006)

Country	City	Mode Share
Denmark	Copenhagen	36%
Germany	Berlin	10%
France	Paris	5%
Austria	Vienna	4.5%
Canada	Ottawa	2.1%
UK	London	1.8%
US	Denver	1.8%
Canada	**Vancouver**	**1.7%**
Canada	Montreal	1.6%
US	Portland	1.6%
Canada	Toronto	1.0%
Australia	Perth	1.0%
Australia	Brisbane	0.9%
US	Seattle	0.8%
Australia	Sydney	0.6%
US	Phoenix	0.6%
US	Los Angeles	0.6%
US	New York	0.6%

Source- Adapted from TransLink 2008b

As shown in Table 2.1, the highest bicycle mode share for trips to work occurs in European cities. In comparison to US and Australian cities, with the exception of Toronto, Canadian cities are, at or above the median score of 1.6 per cent. However, levels of cycling in Canadian cities are far lower than in many European countries. For example, Copenhagen is considered the "City of Cyclists" with 36 per cent of work and school trips made by bicycle (TransLink 2008). Ninety per cent of Copenhagen residents own a bicycle, and 58 per cent use their bicycle on a daily basis (Ibid.). In comparison, according to the 2006 Canadian Census, cycling accounted for only 1.7 per cent of Canadian work trips (Pucher 2005). Though Vancouver is among the top five Canadian census metropolitan areas in terms of resident workers who bicycled to work, steps could be taken to boost commuter cycling.

2.2   Cycling In Metro Vancouver

Metro Vancouver residents made 6.4 million daily commuting trips in 2004 (TransLink 2007a). Out of all trips, only 1.7 per cent were made by cycling whereas 77 per cent were by automobile (Ibid.). Table 2.2 below illustrates the mode share breakdown of daily work trips in Metro Vancouver in 2006. Only 33 per cent of Metro Vancouver residents use sustainable modes of transportation (public transit, passenger, walk, and bicycle). Cycling represents the lowest identified mode share, with private automobiles being the highest.

Table 2.2: Mode Share of Daily Work Trips in Metro Vancouver (2006)

Mode Share	%
Driver	67.3
Public Transportation	16.5
Passenger	7.1
Walk	6.3
Bicycle	1.7
Other	1.1

Source- TransLink 2008a

The Canadian Census indicates 1.7 per cent of commuters cycled to work in 1996, 1.9 per cent in 2001. However, in 2006, the proportion of commuting cyclists dropped back to of 1.7 per cent. "This stable regional mode share masks several underlying trends: 1) significant regional population increase; 2) increase in the average number of daily trips being made per person; 3) decreasing bicycle mode share in the auto-oriented parts of the region; and 4) increasing bicycle mode share in the City of Vancouver" (TransLink 2007a :9).

Table 2.3: Bicycle Mode Share of Daily Work Trips in Metro Vancouver

Area	1996	2006	Change in percentage points
UEL (including UBC)	11.0%	5.7%	-5.3
Vancouver	3.3%	3.6%	+0.3
North Vancouver City	1.7%	1.5%	-0.2
North Vancouver District	1.3%	1.4%	+0.1
West Vancouver	1.2%	1.4%	+0.2
Richmond	1.7%	1.3%	-0.4
Langley City	0.7%	1.2%	+0.5
Port Coquitlam	0.8%	1.0%	+0.2
Pitt Meadows	1.0%	0.8%	-0.2
Burnaby	1.0%	0.7%	-0.3
Delta	0.9%	0.7%	-0.2
Maple Ridge	1.1%	0.7%	-0.4
Langley Township	0.6%	0.6%	-
Coquitlam	0.7%	0.6%	-0.1
Port Moody	0.5%	0.5%	-
New Westminster	0.9%	0.5%	-0.4
Surrey	0.6%	0.4%	-0.2
White Rock	0.6%	0.4%	-0.2
Regional Average	**1.7%**	**1.7%**	**0**

Source: Adapted from 1996 and 2006 Census, Statistics Canada

Table 2.3 compares cycling levels of Metro Vancouver municipalities between 1996 and 2006. Cycling levels vary significantly by sub-area of the region (TransLink 2008a). Bicycle use is considerably higher in Vancouver and at UBC than elsewhere in the region, with cycling at 3.6 per cent and 5.7 per cent of all work trips respectively (Ibid.). Excluding Vancouver and UBC, the bicycle mode share of work trips in the rest of the region averages only 0.8 per cent (Ibid.). Cycling levels have decreased in many neighbourhoods. For example, commuter cycling rates in Richmond decreased by 0.4 per cent from 1996 to 2006 and the Maple Ridge cycling mode share decreased from 1.1 per cent to 0.7 percent. The University Endowment lands saw the largest decrease, 5.3 percentage points between 1996 and 2006. The City of Vancouver and Langley saw the largest increases with 0.3 and 0.5 percentage points respectively. All other municipalities stayed the same or saw moderate increases.

Although cycling as a commute mode appears stagnant in Metro Vancouver there is potential for significant growth. A common reason given for low cycling rates is destination distances. For example, individuals living within 7.5 kilometres of their work destination have been shown to have the most potential to begin cycling (see for example City of Vancouver 1999) with over 50 per cent of all commuter trips in Metro Vancouver being less than five kilometres (TransLink 2008a). In addition, most Metro Vancouver residents live between 1 and 7.5 kilometres from their work destination (Cycling in Cities 2007). A study conducted by TransLink and UBC found 60 per cent of Metro Vancouver residents own or have access to a bicycle and 30 per cent of Metro Vancouver residents cycle at least once a year (TransLink 2007). This indicates that a large share of Metro Vancouver residents are potential cyclists who could be persuaded to cycle.

2.3   Summary

Although Metro Vancouver is in the top five Canadian commuter cycling regions, much more needs to be done to achieve cycling levels comparable to those of European cities. To start, current and potential cyclists characteristics need to be determined and factors encouraging cycling must be examined. To explore pro-cycling policies, the study aims to identify, analyze and make recommendations on how to increase commuter cycling levels in Metro Vancouver. To do so, the next section looks at a TransLink survey of both cyclists and non-cyclists. The survey analyzes the commuting patterns of Metro Vancouver residents in order to determine why some and not others bicycle to work. Descriptive statistics identify significant factors in the decision to cycle and logistic regression is used to further signify each variable in multivariate statistical analysis.

3   Study Methodology

To better understand why some and not other residents cycle to work, this study uses logistic regression to analyze data from Cycling in Cities - a transportation survey of those Metro Vancouver residents owning or having access to a bicycle. Building on other studies comparing cyclist and non-cyclists, this study goes further by offering policy recommendations as to how non-cyclists might be persuaded to cycle to work. This section outlines Cycling in Cities study specifics and identifies possible cycling determinants. Hypotheses for the current study are developed from past literature and included in the final subsection. Descriptive statistics are presented in Section 4, with these variables further analyzed using in Section 5.

3.1   Data source

In 2006, TransLink and the University of British Columbia conducted the Cycling in Cities study, asking approximately 2200 randomly selected cyclists and non cyclists questions on topics such as demographics, household characteristics and factors considered to influence cycling behaviour. There first part of the study conducted three "waves" of telephone interviews over the course of a year, involving 2149 participants and including questions about transportation modes, demographic and household characteristics. Those contacted were only included in the sample if they owned or had access to a bicycle and had cycled at least once in the last year or would consider cycling in the future. The second part of the study asked respondents additional questions via a secure on-line web survey or by regular mail. Of the original 2149 participants, approximately 1700 completed the web survey.[2] Respondents were then asked a

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[2] This study does not include information from the web survey as the included questions do not address this study's main research question and including them substantially decreases the number of valid cases The web survey does include two safety variables inquiring about safety, injury and cycling experience,

series of questions regarding their commute patterns, demographic variables and household

characteristics. Though respondents were asked about their cycling habits for all trip purposes, of

interest to this particular study are individuals who commuted to work.

3.2   Dependent Variable

The dependent variable included in this study is the number of one-way trips made by

bicycle in an average week. Individuals were asked "From May to August 2006 in an average

week, how many one way trips did you make by any mode of transportation to and from work?"

Answers were gained from 1660 of 2200 total survey respondents. The included 1660

respondents were then asked "How many of these one-way trips you made to and from work in an

average week from May to August this year were by, driving by yourself/as a passenger/ by

bicycle/by transit/by walking or by other?" Not every respondent was asked all six questions. If

respondents had accounted for all one-way trips in the first two questions, it was assumed they

made zero trips by bicycle, by transit, by walking or by other. For example, if a respondent

indicated making 12 one-way trips in an average week, the next question would ask how many of

these trips were by driving alone. If they indicated that all 12 one-way trips were by driving

alone, the phone surveyor moved on to the next set of questions and it was assumed they made

zero trips by any other mode.

The dependent variable converts these calculations into "cycles to work" and "does not

cycle to work" with the regression analysis predicting those falling into the "cycles to work"

category. Looking at the factors and characteristics that make an individual more likely to cycle

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However, all three questions target respondents already cycling, rather than both cyclists and non-cyclists.
End-of-trip facilities variables are also included in the web survey, but not used in this current study due to
question format. These questions ask if a certain facility would increase the likelihood of cycling, but not
whether these facilities were currently available at their work destination. Though an attempt was made to
interpret the responses in a yes/no form, cross tabulation and regression analysis revealed this attempt was
unsuccessful.

help us determine how to move non-cyclists to cyclists and create policy recommendations that target non-cyclists. These independent variables are discussed below.

3.3   Determinants of Cycling

A great deal of research has been done on the various determinants of bicycle use as commute mode. Table 3.1 outlines many of these research findings, formatted here as 10 independent variables to use in the later regression analysis. Also included is a hypothesised relationship between each independent variable and whether or not work commuters cycle to work - the study's dependent variable. The final column includes the actual question from the Cycling in Cities survey.

Table 3.1: Variables, Hypothesized Relationship, Sources and Measures

Variable	Hypothesis	Authors	Cycling in Cities Survey Question
Demographics			
Gender	Male (+)	McClintock and Cleary 1996 and Parkin, Wardman and Page	Recorded from voice
Age	19-34 (+)	Moritz 1997, City of Vancouver 1999 and Sener, Eluru and Bhat 2008	To which of the following age categories do you belong?
Education	University (+)	City of Vancouver 1999, Xing, Handy, and Buehler 2008	What is the highest level of education you have completed?
Income	High Income (+)	See Dill and Voros, 2007 and Parkin *et al.*, 2008, Moritz 1997	Which of the following best describes your total household income before taxes for 2005?
Hours Employed	Fewer hours (+)	Moudon *et al.* (2005)	What is your present employment status?
Household Characteristics			
Vehicles per household	Fewer vehicles (+)	Dill and Voros 2007 and Sener, Eluru and Bhat 2008	Computed by dividing "How many motor vehicles are owned by members of your household?" by "Including yourself, how many people live in your household?
Bicycles per household	More bicycles (+)	Sener, Eluru and Bhat 2008	Computed by dividing "How many bicycles are owned by members of your household?" by "Including yourself, how many people live in your household?
Children	No Children (+)	Sener, Eluru and Bhat 2008 and Xing *et al.* 2008	Computed using "how many people live in your household?" And "How many of these individuals are 19 or over?"
Distance from Workplace	Close to work (+)	Pucher, Kamanoff, Schimek 1999, Pucher and Buehler 2006 and Parkin, Wardman, and Page 2007	Calculated by UBC PhD candidate Meghan Winters
Neighbourhood	City of Vancouver (+)	Statistics Canada 2006 and TransLink 2008	In which neighbourhood do you live?

As shown in Table 3.1, five independent variables test whether demographic

characteristics are associated with cycling to work including: gender, age, education, income and

employment. Studies on demographics of cyclists indicate more men cycle than women (see for

example McClintock and Cleary 1996, City of Vancouver 1999 and Parkin, Wardman and Page).

Age is also correlated with likelihood of cycling to work (See Moritz 1997, City of Vancouver 1999 and Sener, Eluru and Bhat 2008). Though education level has not been as widely tested, researchers (See for example City of Vancouver 1999, Xing, Handy, and Buehler 2008) link higher educational attainment to the propensity to cycle to work. Moudon *et al.* 2005 found individuals spending less time at work are more likely to cycle to work. It is often assumed that individuals in a lower income bracket are more likely to cycle than those in a higher income bracket. However, Dill and Voros (2007), Parkin *et al.* (2008) and Moritz (1997) indicated the opposite is actually true.

Five independent variables tests whether cycling to work is affected by certain household characteristics including: the number of vehicles per person per household, number of bicycles per person per household, whether children live in the household, the neighbourhood where the respondent lives and distance from workplace. Literature suggests (See Dill and Voros 2007, Pucher and Buehler 2006 and Sener, Eluru and Bhat 2008) an increased propensity to bicycle among individuals in households with fewer motorized vehicles. Similarly, studies (Sener, Eluru and Bhat 2008 and Xing *et al.* 2008) found that the frequency of bicycling decreases when children live in the household. It is hypothesized that if the respondent has children in his or her household, they are less likely to cycle.[3]

Access to a bicycle is positively associated with the likelihood of cycling. Studies (See Sener, Eluru and Bhat 2008) have also found a link between number of bicycles per household and likelihood of cycling. It is hypothesized that the more bicycles owned by the household, the more likely the respondent will be to cycle. Since this research looks at all sub-areas of the City of Vancouver, we must take into account the cycling levels in various neighbourhoods. Statistics

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[3] This variable was computed using two survey questions. Residents were asked. "Including yourself, how many people live in your household?" Residents were then asked. "How many of these members of your household are over 19 years old?" If respondents answered the same number for both questions, it was assumed that no children lived in the household. An odd number indicated there were individuals under the age of 19 living in the household.

(See Statistics Canada 2006 and TransLink 2008) have demonstrated that certain sub-areas of Metro Vancouver have higher levels of cycling. Therefore, it is hypothesized that residents of the City of Vancouver will be more likely to cycle than residents in other sub areas. One of the most significant determinants of cycling levels from literature is distance (See Pucher, Kamanoff, Schimek 1999, Pucher and Buehler 2006 and the City of Vancouver 1999, Parkin, Wardman, and Page 2007). Pucher, Komanoff, and Schimek 1999 assert that the low-density sprawl of most North American metropolitan areas, which increases average travel distances, is a main deterrent to increased cycling. It is hypothesized that the longer the average trip distance a commuter must travel, the less likely he or she will cycle.[4] Following these studies, fewer vehicles per household, more bicycles per household, not having children living in the household, living in the City of Vancouver and living close to your work destination are all hypothesised to be positively associated with cycling.

3.4 Summary

The preceding section outlined the survey specifics and examined research on cycling determinants. Hypotheses for the ten variables in the current study are developed from past literature and measures were given for each variable. The next section presents descriptive statistics of all variables and is used to identify statistically significant factors in cycling to work

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[4] UBC PhD student Meghan Winters commutes this variable by using respondent's responses to:

> Thinking of the trips you make by [INSERT MODE] to go to work what are the two cross-streets closest to the [INSERT TRIP PURPOSE] location and what is the municipality? IF NECESSARY Do you know the address of the [INSERT PURPOSE] location? IF NECESSARY Do you know the postal code of the [INSERT PURPOSE] location? IF NECESSARY Do you know the name of the building or major landmark nearby and the municipality?

Initial distances were then filtered into those reporting trips made to work by any mode. A special survey ID number was associated with each case and thus it was possible to match the coded distance with the correct survey. The length is the shortest distance on the road network.

4 Results I: Descriptive Statistics

This section presents descriptive statistics from the Cycling in Cities survey. It reviews and discusses the descriptive statistics and major findings. The descriptive statistics are used to identify significant factors in the decision to cycle. These variables are then employed in logistic regression to determine the probability a respondent who possesses certain characteristics will cycle to work. Table 4.1 presents the frequencies on all ten demographic and household variables.

4.1 Dependent Variable

As shown in Table 4,1, the dependent variable under study is the number of one-way trips made by bicycle to work. The initial sample of 2149 was reduced by screening non-workers out of the sample by asking "From May to August 2006 in an average week, how many one way trips did you make by any mode of transportation to and from work?" This screening left 1660 participants making trips to work. A random sample of this size produces a margin of error of approximately +/-2.5 per cent, 19 times out of 20.

These 1660 respondents were then asked "How many of these one-way trips you made to and from work in an average week from May to August this year were by….bicycle?" Categories are transformed into those who "cycled to work" (14 percent) (n=232) and those who "did not cycle to work" (86 percent) (n=1428). This result is surprising as the number of respondents indicating cycling at least once a week is higher than other studies indicate (See for example Pucher and Buehler 2006, TransLink 2008 and Canadian Census 2006). That 3.7 per cent cycle to work *every day* is substantially higher than statistics have indicated. For example, the 2006 Canadian Census indicated that only 1.7 per cent of trips made are by bicycle in Metro Vancouver. A possible explanation for this discrepancy is the Cycling in Cities survey filtering

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process that eliminates those who did not indicate access to a bike and have cycled at least once in the past year or would consider cycling in the future. Also, the 2006 Canadian Census question is more conservative, asking "How did the person usually get to work?" The wording of the question therefore makes it impossible to determine how many one-way trips the person made by bicycle. This eliminates people who may have cycled in an average week, but did not use it as their main mode of transportation.

Though the statistics differ slightly from values expected, this dependent variable supports the notion too few people cycle as a commute mode in Vancouver. Eighty-six per cent of individuals having access to a bike and have cycled at least once in the past year or have considered cycling do not cycle once in an average week. The following subsection explores what factors influence the decision to cycle.

4.2 Cyclists Demographics

Two groups of five independent variables are used to test why some and not other Metro Vancouver residents cycle to work. Household variables include, children living in household and neighbourhood. Demographic variables include, gender, age, education, employment, and income. Three other variables are included: bicycles per household, vehicles per household and distance with the median score provided.

Table 4.1: Demographic and Household Characteristic Variables Frequencies (N=1660)

Variable Type	Variable Name	Category	(N)	%	Median
Demographic	Gender	Female	708	42.7	
		Male	952	57.3	
	Age	19-34	397	24.2	
		34 or older	1243	75.8	
	Education	Less than University	871	52.4	
		University	790	47.6	
	Employment	Full time	1127	68.7	
		Not full time	513	31.3	
	Income	<$30 000	109	6.6	
		$30 000-60 000	289	17.6	
		$60 000 – 90 000	366	22.3	
		$90 000 and up	876	53.4	
Household Characteristics	Children	Yes	799	48.1	
		No	861	51.9	
	Neighbourhood	City of Vancouver	511	30.7	
		Other	1150	69.3	
	Bicycles per Household		1660		1
	Vehicles Per Household		1660		0.5
	Distance		1203		9.24
Dependent Variable		Do not Cycle	1428	86	
		Cycle	232	14	

Table 4.1 demonstrates more men responded to the survey than women (57.3 per cent and 42.7 per cent respectively). Since gender was recorded by the phone surveyor by assessing the respondent's voice, there were no missing cases. Initial responses to the question "to which of the following age categories do you belong?" were spread between six categories, with most respondents falling within the 25 to 54 categories. Three missing cases were re-coded into the median response, which was the 35 to 44 range. Based on studies that have found most cyclists are 34 and younger, the age variable was re-coded into two categories: 34 and below and over 35 and over. Table 4.1 demonstrates that about 24.2 per cent (n=397) of respondents were in the 34 and below category and the remaining 75.8 per cent (n=1243) were located in the above 34 category.

Other studies demonstrate individuals with a university education are more likely to cycle as a commute mode. Therefore, the education variable was re-coded into respondents with a university education and those without. As shown in the table above, 47.6 per cent (n= 790) of

respondents had a university education and 52.4 per cent (n=871) had less than university.

Respondents were also asked "what is your present employment status?" Studies have demonstrated that individuals who spend less time at work are more likely to cycle, as such employment status is re-coded into working full time or other, including part-time workers, self employed, unemployed, students and retired individuals. As demonstrated in the table above, 68.7 per cent (n=1127) worked full time hours and 31.3 per cent (n=513) worked less hours.

Literature is divided on the influence of income on likelihood of cycling. For the purpose of this study, income was put into four categories: below $30 000, $30 000- 60 000, $60 000-90 000 and $90 000 and up. Three hundred respondents replied to the question with "other", "do not know" or "refused". Cross tabs were run that included all missing cases in the median category ($90 000 and above) and without the missing cases. Both tests were insignificant and thus the decision was made to include the missing cases in the median category.

4.3 Household Demographics

This group of five independent variables tests whether cycling is affected by number of vehicles per household, number of bicycles per household, children living in the household, neighbourhood, and distance from workplace. Table 4.1 displays the frequencies of the household characteristics variables. The presence of children is hypothesized to have a negative effect on cycle use, due to the opportunity cost of time. If the respondents have children living in their household, they are less likely to cycle to work. Of the respondents, 48.1 per cent (n=799) had children while 51.9 per cent (n=861) did not have children living in their household.

As demonstrated in the background, statistics have shown that the City of Vancouver has a disproportionately high share of cyclists. To account for this, the neighbourhood variable is created and re-coded into the City of Vancouver and all other Metro Vancouver neighbourhoods. Of the respondents used in the survey, almost 31 per cent (n=511) lived in the City of Vancouver.

Number of vehicles per household was computed by dividing the question "How many motor vehicles are owned by members of your household?" by "Including yourself, how many people live in your household? This calculation allows us to control for number of household members. The decision was made not to recode the variable into discrete number of vehicles categories, but instead enter the variable (in number of vehicles per person per household) directly into the regression. The median number of vehicles is presented in Table 4.1. This demonstrates that Metro Vancouver residents have a median of 0.5 vehicles per person per household.

As noted while examining the dependent variable, access to a bicycle seems to have an effect on cycling levels. Number of bicycles per person per household was computed by dividing the question "How many bicycles are owned by members of your household?" by "Including yourself, how many people live in your household? This calculation allows us to control for number of household members. The decision was made not to recode the variable into discrete number of bicycle categories, but instead enter the variable (in number of bicycles per person per household) directly into the regression. The median is presented and demonstrates that one bicycle is the midpoint number of bicycles for Metro Vancouver residents.

The final household characteristic, distance, was originally computed using questions from the phone survey that asked respondents to think of their most frequent trips. The decision was made not to recode the variable into discrete distance categories, but instead enter the variable (in kilometres) directly into the regression. The median distance to work for Metro Vancouver residents is 9.24 kilometres. This indicates that a large amount of Metro Vancouver residents live approximately 10 kilometres away from their workplace.

4.4   Summary

This section examines descriptive statistics of each study variable. The probability that respondents who have or do not have a particular characteristic, with respect to each of these explanatory variables, will cycle to work is estimated using multivariate logistic regression in the following section.

5 Logistic Regression Analysis

This section explains the use of logistic regression to assess the impacts of all independent variables on levels of cycling as a commute mode. Results are used in Section 6 to inform policy options

5.1 Logistic Regression

This section performs multivariate logistic regression tests to estimate the probability that a Metro Vancouver resident cycles to work. Logistic regression determines the probability of a respondent possessing certain characteristics or behaves in a specific way falls into one of two categories. Logistic regression holds variables constant as it tests the significance of each independent variable and explains how much more likely a person with specific demographics or household characteristics is to cycle to work. To employ logistic regression in this analysis, respondents' scores on the dependent variable question (asking residents how many one-trips they made by bicycle in an average week) are categorized as "cycles to work" or "does not cycle to work". Those who said they made at least one trip by bicycle in an average week were put in the "cycles to work" category and all respondents that indicated they made zero trips were put into the "does not cycle to work" category. The Block-Enter method of multivariate logistic regression is used to estimate the probability that a Metro Vancouver resident with particular characteristics will fall into the "cycles to work" category.[5]

[5] Not all 1660 survey respondents included responses to all questions that measure explanatory variables. For missing cases in the demographic and household characteristics variables, cases are entered into the median category. Of concern was the income category, which had 300 missing cases. However, since income was not significant in the chi-square test, a decision was made to add all missing cases to the median category in order to not lose the data. Diagnostic tests on all independent variables reveal no problems of multicollinearity in the statistical model. Significance for variables is indicated at the 95 and 99 per cent confidence intervals.

5.2 Overall Fit of Statistical Models

Logistic regression is employed to demonstrate how well independent variables predict whether or not Metro Vancouver residents cycle to work. The Model incorporates all demographic and household characteristic variables from the last sections. The model includes 1195 of 1660 cases. The distance variable was not calculated for every respondent, eliminating approximately 300 cases. As shown in table 5.1, the model has a Nagelkerke pseudo-R^2 value of .179 and explains approximately 18 per cent of the variation in the dependent variable, correctly classifying 82.6 percent of included cases.   The predictive capacity of this model is quite weak, indicated by a Nagelkerke psuedo-R^2 value of .179. Still, the model has predictive value.

Table 5.1: Logistic Regression Results

Variable Type	Predictor	Reference	B	Exp (B)	Std Error	Sig
Demographic	Female	Male	**-0.902**	**0.406**	**0.179**	**
	Age 35+	Age 18-34	-0.155	0.856	0.176	
	No University	University	**-0.448**	**0.639**	**0.170**	**
	Did not work full-time	Worked full-time	0.034	1.035	0.190	
	Income					
		$90,000+	-			
	$60,000-90,000		**0.496**	**1.642**	**0.202**	*
	$30,000-60,000		0.133	1.142	0.222	
	<$30 000		-0.281	0.755	0.356	
Household Characteristics	# Vehicles		**-0.880**	**0.415**	**0.242**	**
	# Bicycles		0.036	1.037	0.019	
	Children	No Children	-0.011	0.989	0.179	*
	Outside Vancouver	In Vancouver	**-0.649**	**0.522**	**0.177**	**
	Distance		**-0.057**	**0.945**	**0.011**	**
N		1195				
Nagelkerke pseudo-R^2		18.2				
Percent classified correctly		82.6%				

Significant at *<.05, **<.001

5.3 Coefficients

Table 5.1 outlines the statistical model and odds ratios (Exp(B)) used to determine which variables are significant predictors of cycling to work.Six variables are significant at a 95 per cent confidence level or greater: Gender, education, number of vehicles per household, income, neighbourhood, and distance. More specifically, women are 60 per cent less likely than men to cycle to work, confirming our initial hypothesis. Respondents indicating they did not have a university education are 36 per cent less likely than respondents with a university education to be commuter cyclists, also supporting the earlier hypothesis. Those indicating their household income between $60,000 and $90, 000 were 64 per cent more likely than those with household incomes over $90, 000 to cycle to work, contradicting our original hypothesis.

Number of vehicles per person in a household had a significant effect on likelihood of cycling to work. Controlling for number of members per household, for every additional vehicle per household, respondent were 58 per cent less likely to cycle. This is consistent with previous research and confirms our original hypothesis. Respondents living outside the City of Vancouver are 48 per cent less likely to cycle to work also confirming our original hypothesis. For every kilometre away from his or her work destination a respondent is 5.5 per cent less likely to cycle. As a result, if a respondent lives ten kilometres away, they are 55 per cent less likely to cycle. This finding confirms our original hypothesis that distance is a main deterrent to cycling as a commute mode. Age, employment, bicycles per household and children all failed to show a statistically significant relationship with cycling to work.

5.4 Household Characteristics

Of household characteristics, three variables are significant at the 99 per cent confidence level or higher. Controlling for number of members per household, for every additional vehicle

per household, respondent are 58 per cent less likely to cycle. This is consistent with previous research and confirms our original hypothesis.

Living in the City of Vancouver as opposed to somewhere else in the Greater Vancouver Regional District is significant in the Model at the 99 per cent confidence level. As previously mentioned, the City of Vancouver has the highest cycling level in Metro Vancouver. Since approximately 500 of the respondents resided in the City, it was not surprising this was a significant factor since bicycle use is considerably higher in the City of Vancouver. In addition, some argue the high urban density of the City of Vancouver encourages cycling, as trip distances are likely shorter and more bikeable.

Distance is another significant variable in the model. For every kilometre a respondent is away from his or her work destination, the respondent is 5.5 per cent less likely to cycle. This is not surprising since literature indicates that distance is a main determinant of cycling to work. Pucher and Buehler (2005) assert that the low-density sprawl of most North American metropolitan areas, which increases average travel distances, is a main deterrent to increased cycling (Ibid.). An important aspect of distance is the cost of travel time. Surveys of the general commuting population indicate that three of the most important factors in choosing a commute mode are travel time, convenience and cost. Therefore, many potential cyclists do not choose to bicycle to work because of long commute distances and the consequent high travel times that bicycling would entail. Increases in average trip lengths resulted in a shift from bicycle to car use, and offset the positive effects of policies to promote cycling (Ibid.).

5.5   Analysis of Non-Significant Variables

Age, employment, number of bicycles per household and whether children lived in the household all failed to have statistically significant impacts on the dependent variable. Age is consistently found to be a factor in the decision to cycle. In general, the older the respondent, the

less likely they cycle. However, it was not found to be significant in our findings. This could be attributed to how the question was asked. It may have been more valuable if age was a scale variable; this would allow us to test whether increased age correlated with the likelihood of cycling to work. Number of bicycles per household was also not found to be significant. This result was surprising, since many studies have found that bicycle ownership is a predictor of bicycle use. . Another unexpected result was that children in the household did not have a significant relationship to cycling to work. Literature has demonstrated that children decrease the likelihood an adult will cycle to work. However, this question may have revealed more if respondents were asked how many children they had in their household.

5.6   Summary of Major Findings

In summary, regression analysis on the Cycling in Cities data reveals important information regarding cycling to work in Metro Vancouver. Gender, education, vehicles per household, income, neighbourhood and distance are all relevant to predicting whether or not individuals cycle as a commute mode. Men, respondents with a university education, households with fewer vehicles, households with incomes between $60, 000 and $90, 000, respondents that in the City of Vancouver and respondents that live closer to their work destination are more likely to cycle. All six significant variables are consistent with the findings of previous literature and statistics. The following sections use findings from the survey results and statistical analysis to develop and assess policy options to increase cycling as a commute mode.

6 Criteria and Measures

This section discusses the criteria and measures used to assess policy options to increase

the level of cycling as a commute mode in Metro Vancouver including: estimated cost,

effectiveness, administrative feasibility and public acceptability associated with implementing

each alternative. In the next section, each policy alternative is defined and evaluated relative to

the status quo. Table 6.1 defines the criteria, and the following sections further explain the

measures of each.

Table 6.1: Criteria and Measures for Assessment of Policy Options

Criterion	Definition	Data	Measure
Cost	Operating and Capital costs	$	1- High Cost (10+ Million over current budget) 2- Moderate Cost (5+ Million over current budget) 3- Low Cost (<$4 million over current budget)
Effectiveness	Increasing commuter cycling	Regression Results	0- Addresses 0 significant variables 1- Addresses 1 significant variables 2- Addresses 2 significant variables
Administrative Feasibility	Implementation ease	Interviews	1- Difficult 2- Moderate 3- Easy
Public Acceptability	Support in Metro Vancouver	Interviews	1- Low 2- Medium 3- High

6.1 Cost

Cost is an important criterion when examining any alternative. Cost refers to the

monetary cost to fund the proposed alternative and measured by pricing out the cost of the

proposed option as best as possible. A ranking from 1 to 3 is then given, with (1) representing

high costs (2) representing a moderate cost and (3) representing a low cost. Cost rankings are

assigned by comparing the cost of the proposed alternative to TransLink's current cycling budget. TransLink spent $4 million in capital projects related to cycling, and $260,000 in operating funds on cycling in 2005. A low (1) ranking is therefore assigned to options that would increase TransLink's spending on cycling by more than $10 million from the 2005 budget. A moderate (2) ranking is given to options that increase TransLink's budget by approximately $5 million, and a high (3) ranking for options that raise Translink's spending to a maximum of $4 million.

6.2   Effectiveness

Effectiveness refers to the extent to which the policy options increase levels of cycling as a commute mode. Efficiency is measured using regression findings from the analysis of the Cycling in Cities survey. Regression results indicate that gender, income, education, neighbourhood, number of vehicles per household, and distance are all significant factors in the decision to cycle. Of these variables, number of vehicles per household and distance can affect policy change, while the others indicate groups for which policy might be most effectively targeted. Since effectiveness is an important criterion to consider if the goal is to increase cycling, the decision was made to weight in more heavily than the other criteria. A ranking of (3) is given to policy alternative addressing any one of the two significant variables: reducing the number vehicles per household or reducing distance travelled. A ranking of (6) is given to options addressing both of the significant variables. If the option fails to address any of the variables, it is given a zero.

6.3   Administrative Feasibility

Administrative feasibility refers to the ease, relative to the status quo, with which the proposed alternative will be implemented and administered by TransLink and the municipalities involved in distribution. This is measured by examining whether proposed systems and programs exist or will need to be created to implement the options. In order to measure the administrative

feasibility, three interviews were conducted with four stakeholders. (1) Nancy Olewiler,

TransLink Board of Directors; (2) Cam Pearce, TransLink Marketing Research Specialist; and (3)

Mike Anderson and Jo Fung, City of Vancouver Greenways & Neighbourhood Transportation.

Respondents' rankings are based on their opinions and experiences in their roles, but in no way

reflect the position of their organization. After consultation with these stakeholders, ranking are

assigned to each alternative: (1) difficult (2) moderate and (3) easy. The stakeholders' rankings

are then averaged to get a score out of three.

6.4   Public Acceptability

The public acceptability criterion refers to the expected level of support among Metro

Vancouver residents to the given alternative. Public acceptability is calculated in a similar

manner to administrative feasibility. Three interviews were conducted with four stakeholders. (1)

Nancy Olewiler, TransLink Board of Directors; (2) Cam Pearce, TransLink Marketing Research

Specialist; and (3) Mike Anderson and Jo Fung City of Vancouver Greenways & Neighbourhood

Transportation. Stakeholders are consulted and asked to rank each of the policy options on a scale

from (1) low acceptability to (3) high acceptability. Rankings for public acceptability are

achieved by averaging rankings for each alternative provided by stakeholders from TransLink and

the City of Vancouver.

6.5   Summary

This section discussed the criteria and measures that will be used to assess the policy

options to increasing the level of cycling as a commute mode given in the next section. The

following section offers options for increasing cycling as a commute mode in Metro Vancouver.

The cost, effectiveness, public acceptability, and administrative feasibility associated with

implementing each alternative will all be examined.

7 Policy Options

This section proposes options to increase the overall level of cycling as a commute mode in Metro Vancouver. The policy options are initiatives that can be taken by TransLink and the municipalities and will be judged against relevant criteria in order to assess their overall viability in Metro Vancouver. Since the policy options involve TransLink and each Metro Vancouver municipality, recommendations will be made to the TransLink's Mayors' Council. The Mayor's Council has the authority to implement the proposed options better than TransLink or the municipalities can separately.

7.1 Alternative 1: Status Quo

The status quo is used as a base from which to compare and evaluate the other options. The status quo examines initiatives in place in 2005 when the Cycling in Cities survey was conducted. TransLink's bicycle program makes investments in bicycle- related facilities such as municipal bike route construction, special traffic signals, improved access to bridges, and improved integration of transit and bicycles. There are a number of components to TransLink's bicycle program, including:

- A regional cycling map.
- A bicycle locker rental program at 25 SkyTrain stations, West Coast Express stations, and transit exchanges throughout the region.
- All buses in TransLink's fleet are equipped with bicycle racks. Cyclists are also permitted to travel with their bicycles on SkyTrain and SeaBus, except in the peak direction during peak periods.
- Cycling route construction.
- Developing promotion and education initiatives, including cycling skills courses for students and adults and events such as Bike to Work Week and Month.

In 2005, TransLink invested $4 million in capital projects related to cycling, and $260,000 in operating funds for bicycle-related planning, research, education and promotion activities (Translink 2008a).

7.2   Alternative 2: Install Rental Bicycle System

The first proposed option is to install a rental bike system. Self-serve public bicycle systems have been successful in many Western European cities, such as Copenhagen and Barcelona. Public bike systems provide easy access to bicycles at stalls located across an urban area. Individuals can simply rent a bike from a docking station, ride it to their destination and then return it to another docking station. Public bike systems help bikes become an integral component of the wider public transportation system. TransLink is working with municipal partners to conduct a thorough investigation of the options (TransLink 2008d). The study will help determine whether to move forward with implementation of a public bicycle system in Metro Vancouver and "which administrative and financing models to pursue if the decision is made to proceed (TransLink 2008c)". This option would recommend TransLink and each municipality move forward with the plan and installs a public bike system.

7.3   Alternative 3: Separate Cycling Facilities

This alternative would have Metro Vancouver establishing a model similar to Copenhagen and making a large investment in cycling path infrastructure. Investing in higher quality infrastructure often increases cycling levels because of reduced risk of vehicle accidents with investments in cycling infrastructure increasing cycling mode shares (Becker 2008). Pucher and Buehler (2007) examined six cities in the Netherlands, Denmark, and Germany finding the most important approach to increasing cycling has been the provision of separate cycling facilities along heavily travelled roads and at intersections (Pucher and Buehler 2007). Metro

Vancouver's current attempt to separate bicycles from other vehicles has been demarcation of on-street bicycle-only lanes and shared bicycle-vehicle road lanes. Canadian cyclists are much more likely to be sharing the road with parked and moving cars than in European countries with high cycling levels (Ibid.).

7.4   Alternative 4:   Better Integration with Transit

The next proposed option is for TransLink to increase bicycle integration with transit. The low-density sprawl of Metro Vancouver increases average travel distances and makes cycling less feasible (Pucher 2007). Research indicates good coordination with transit can help resolve the difficulty of long trip distances. This includes three main options: allowing bicycles on the Skytrain at all times, additional bike racks on high use bus routes and additional Bike and Ride facilities at transit stations. Integration with transit will allow cyclist to use both bicycles and transit for their journey. The next sub-sections will examine each of these options.

7.4.1   Allowing bicycles on the Skytrain during peak hours

In Metro Vancouver, bicycles can be taken on the Sea Bus Ferries, buses and West Coast Express Trains at any time, but they are only allowed on the Skytrain at off-peak hours and on weekends (TransLink 2008a). This provides a barrier for commuter cyclists who must arrive at work during peak hours. This option would increase the capacity of bicycles on the Skytrain and allows them during all hours of operation. In order for bicycles on the Skytrain to be feasible, capacity issues would have to be dealt with. The Skytrain is a heavily used service and in order to accommodate bicycles, large changes (such as removing seats) would have to be done.

7.4.2   Additional bike racks on high use bus routes

This option increases capacity for bicycles on buses. Most buses are equipped with bike racks - though maximum two at one time. On bus routes that have high occupancy, this makes it

difficult for cyclist to secure a spot for their bicycle on the bike racks. Often cyclist will have to wait for another bus to arrive, without the guarantee it will accommodate their bike. This would see TransLink adding additional bike racks on to buses.

7.4.3   Additional Bike and Ride Facilities

This proposed option involves increasing Bike and Ride facilities at all transit stations. Both the West Coast Express and Sky Train provided bike racks at stations as well as over 400 bike lockers (located at some stations). This involves bicycle lockers that are available for commuters to rent and leave their bicycle at the transit station and take transit the rest of their journey. Currently, approximately 25 transit stations are equipped with Bike and Ride facilities. This option would see TransLink increasing these facilities to ensure Bike and Ride facilities are at all transit stations.

7.5   Alternative 5: Financial Incentive to Shift Mode

Such options restrict auto use by decreasing the availability of parking, increasing the cost of parking at work destinations and increasing taxation on vehicle ownership. The greater availability and lower cost of parking in most Canadian cities compared to many European cities has given the auto a comparative advantage. In addition, the low user-cost of autos is crucial in discouraging virtually all other modes. This includes low gasoline taxes, few road tolls, and free parking. At negligible marginal user costs, car use becomes a habit even for short trips that could be walked or cycled (Pucher 1995). This reduces the number of car-owners and increasing the tendency to use bicycles for many utilitarian trips (Pucher 1995).In order to increase cycling levels in Metro Vancouver, restrictions on automobiles could be implemented (TransLink 2008b). Since Metro Vancouver is such an automobile oriented city, TransLink could re-introduce the parking site tax, provide incentives to employers that convert parking spaces into bicycle storage

and introduce a vehicle levy. These measures represent charges to motor vehicle users based on their vehicle ownership. The following subsections review each option.

7.5.1 Parking Tax

The first proposed option under the umbrella of financial incentive to mode shift is to re-introduce a parking site tax for all non-residential parking sites. TransLink has the ability to tax parking based on the number of stalls within, or the size of, a parking area. The parking tax is payable by the affected property owners and is calculated by multiplying the parking tax rate by the taxable parking area (in square metres) of the parking site (TransLink 2008d). In 2005, Greater Vancouver Transportation Authority bylaws set the rate of the parking tax at $1.02 per square meter, or roughly $30.00 per parking stall. This option would see TransLink and the municipalities re-establish the parking site tax.

7.5.2 Property Tax Incentives

The second option in using financial incentives to mode share would be for municipalities to provide incentives (in the form of decreased tax) to employers that convert parking spaces into bicycle storage for employees. Conceptually, property taxes could be used to encourage developments that incorporate features supportive of commuter cycling, such as bike storage and end-of-trip facilities. This option would decrease availability of parking.

7.5.3 Vehicle Levy

The final financial incentive option would be to introduce a vehicle levy on all registered motor vehicles. This would consist of a $75 to $100 per year tax on all vehicles, creating a financial incentive to decrease number of vehicles per household. According to TransLink, an annual vehicle levy of $100 per year could raise $140 million a year (TransLink 2008b). This

option would have TransLink move ahead with the vehicle levy and use a portion of the money to fund other proposed options.

7.6 Summary

The preceding section outlined eight potential policy options for increasing cycling as a commute mode in Metro Vancouver. The next section will evaluate the options using the previously mentioned criteria.

8   Evaluation of Options

The following section outlines the rankings associated with each alternative as judged by previously discussed evaluation criteria. The following matrix compares the rankings of all nine options across each of the four evaluation criteria. Each option is evaluated based on cost, effectiveness, administrative ease, public acceptability and given a score out of 15.

Table 8.1: Comparative Rankings Matrix

Option	Cost	Effectiveness	Admin Ease	Public Acceptability	Total
Status Quo	Moderate	Distance: 0 # of Vehicles:0	NO=3 CP= 3 MA/JF= 3	NO=3 CP= 3 MA/JF= 3	
Score	3	0	3	3	**9**
Bike Rental System	High	Distance: 1 # of Vehicles:0	NO=1 CP= 2 MA/JF= 2	NO=2 CP= 2 MA/JF= 3	
Score	1	3	2	2.5	**8.5**
Separate Cycling Lanes	High	Distance: 1 # of Vehicles:0	NO=2 CP= 1 MA/JF= 1	NO=3 CP= 2 MA/JF= 2	
Score	1	3	1.5	2.5	**8**
Bikes on Skytrain	Moderate	Distance: 1 # of Vehicles: 0	NO=1 CP= 2 MA/JF= 1	NO=2 CP= 3 MA/JF= 2	
Score	2	3	1.5	2.5	**9**
More Bike Racks on Buses	Low	Distance: 1 # of Vehicles:0	NO=2 CP= 2 MA/JF= 1	NO=2 CP= 2 MA/JF= 2	
Score	3	3	1.5	2	**9.5**
Bike Park & Ride Facilities	Low	Distance: 1 # of Vehicles:0	NO=2 CP= 2 MA/JF= 3	NO=3 CP= 2 MA/JF= 3	
Score	3	3	2.5	2.5	**11**
Parking Site Tax	Moderate	Distance: 0 # of Vehicles:1	NO=2 CP= 2 MA/JF= 1	NO=1 CP= 2 MA/JF= 1	
Score	2	3	1.5	1.5	**8**
Commercial Property Tax Disincentives	Low	Distance: 0 # of Vehicles:1	NO=3 CP= 2 MA/JF= 1	NO=1 CP= 2 MA/JF= 1	
Score	2	3	2	1.5	**8.5**
Vehicle Levy	Low	Distance: 0 # of Vehicles:1	NO=3 CP= 2 MA/JF= 1	NO=1 CP= 2 MA/JF= 1	
Score	3	3	2	1.5	**9.5**

8.1 Status Quo

Making no changes to TransLink's existing cycling policy would mean maintaining current expenditure levels ($4 million in 2005), ranking low (3) on the cost criterion. In terms of effectiveness, the status quo ranks as (0) as the status quo does not address either of the two significant factors of cycling determined in regression analysis. Stakeholders ranked the status quo at easy (3) in terms of administrative feasibility, since the required systems, staff and programs currently exist and can be implemented with ease. Finally, status quo also ranks high

(3) on public acceptability. There seems to be support among Metro Vancouver residents for current cycling. Overall, this option receives 9/15.

8.2 Bicycle Rental System

Research indicates easy access to bicycles helps to increase cycling levels. TransLink is currently engaged in a feasibility study in order to assess whether it would work in Metro Vancouver. A public bike system would rank high (1) on the cost criterion. TransLink (2008) indicates two types of cost associated with the public bike system. This includes direct capital costs for procuring and installing the system (bicycles and terminals) and direct operating costs for running the system.

Direct capital costs are estimated at $18.5- $34.5 million (TransLink 2008c). Operating costs are estimated at $7-$12 million with an estimated $5-$9 million recovered in direct system revenues (Ibid.). User fees are projected to recover up to 70 per cent of operating costs so that the annual operating deficit would be $2-$4 million (Ibid.). Though annual operating costs would be moderate, initial implementation of the system would put this option into the high (1) cost category.

In terms of effectiveness, the public bike system ranks (3). Regression results indicate that distance is a significant factor in the decision to cycle. The convenience and ease of a public bike system would make longer trip distances easier, by having connecting modes of transportation. Interviewees ranked this option as moderate (2) on administrative feasibility. Implementing a complete new system will take a great deal of extra staffing and many additional systems would need to be implemented. A public bike system would also require considerable maintenance. Lastly, stakeholder interviews revealed that a public bicycle system would rank between medium and high (2.5) on public acceptability. Interviewees felt the public would most

likely support the system, as long as they do not have to bear the additional costs. This option receives a score of 8.5/15.

8.3   Separate Cycling Facilities

In many Western European cities, there is an emphasis on separate cycling facilities instead of on-road facilities (such as painted cycling lanes). It is argued these measures are safer and encourage people to cycle more. However, the costs associated with these measures are high. Therefore, separate cycling facilities ranks high (1) on cost. Jack Becker (2005) estimates that an additional $13 million is required to complete cycling routes identified in the 1999 Bicycle Plan. In addition, achieving cycling mode split comparable to the European leaders (in the 20 per cent cycling mode split range) could require a capital investment in the $100 to $220 million range ($186 to $408 per capita) (Becker 2005). In 2001, the City of Toronto published a bike plan. Its goal is to "guide the City in the development and implementation of new programs and facilities to encourage people to cycle, and environmentally, socially and economically sustainable." The City of Toronto has estimated the total capital cost for completing the bikeway network is estimated to be $66.8 million. This includes:

- The installation of 460 kilometres of new bicycle lanes ($11.6 million);
- The designation of 260 kilometres of signed routes ($1.5 million);
- The construction of 31 kilometres of off-road paths within road rights-of-way and boulevards ($14.3 million);
- The construction of 82 kilometres of off-road paths within utility corridors ($26.6 million);
- The construction of 15 kilometres of off-road paths within the City's parks system ($12.8 million).

Copenhagen has made a large investment in cycling infrastructure. Over a third of the City's road budget is spent on bicycle facilities (Ibid.). In terms of effectiveness, this option ranks as a (3). There is evidence that cycling infrastructure investments result in increases in cycling levels. Jack Becker of the VACC notes that recent studies suggest building infrastructure will aid

in increasing the modal share of cycling in Metro Vancouver. Regression results in Section 5 indicated that distance was a substantial deterrent to greater cycle use. Separate cycling facilities are often presented as a solution for dealing with distance. Separate cycling facilities help to connect roadways and makes longer commute modes shorter.

Stakeholders rank this option between moderate and difficult (1.5) on the administrative feasibility since very few separate cycling facilities currently exist. It would require a great deal of manpower to implement the new system. Finally, separate cycling facilities ranked between medium and high (2.5) on public acceptability. There appears to be wide public acceptability for separate cycling facilities. However, since there are a substantial higher number of auto users to cyclists, measures that would decrease road space would possibly see some resistance. This option receives an 8/15.

8.4   Allow Bikes on Skytrain

Currently, TransLink's cycling policy makes it difficult for commuter cyclists to cycle to work, since there are restrictions on bringing bicycles on the Skytrain and there is limited space for bringing bicycles on buses. The cost associated with increasing capacity for bicycles on the Skytrain is moderate (2). There would be initial costs involved to increase capacity for bicycles on the Skytrain. However, there would be few costs associated with the maintenance. In terms of effectiveness, this measure would receive a (3) since it would help resolve the distance issue. If Metro Vancouver residents knew they could take their bicycle on transit at anytime, it may increase the likelihood they would cycle to work. According to stakeholders, allowing bicycles on the Skytrain at any time would rank between difficult and moderate (1.5) in administrative feasibility. Currently, the Skytrain does not have the capacity to handle all regular users. At this time, it would be difficult to figure out how this could be accomplished. However, stakeholders did feel this option would be between medium and high (2.5) in terms of public acceptability. Overall, this option receives 9/15.

8.5 Additional Bike Racks on Buses

Currently, TransLink buses only have the capacity to hold two bikes per bus. This poses a problem on high occupancy routes. The cost of this proposed alternative ranks at a low cost (3). The Victoria Transport Policy Institute Bicycle estimates racks suitable for buses typically cost $500-1,000 (U.S. dollars) for a high-quality model that can carry two bicycles (Ibid.). Simple bicycle storage racks typically cost $50-100 per bike. It is difficult to precisely measure the effectiveness of this measure, but it would be expected to be a (3) since additional capacity for bikes on buses helps solve the distance problem and 67 per cent of Cycling in Cities respondents indicated they would cycle more if the bus racks carried bikes. In terms of administrative feasibility, stakeholder interviews ranked this between moderate and difficult (1.5). Most transit agencies that carry bikes on racks or in vehicles experience minimal problems once the programs are established, as indicated by the large number of transit agencies that have expanded this service (Ibid.). Finally, this option ranks medium (2) on public acceptability. Stakeholders noted that little resistance to such a measure would be expected. Overall, this measure scores 9.5/15.

8.6 Additional Bike and Ride Facilities

Increasing Bike and Ride facilities at transit stations allow cyclists to cycle for part of their journey and take transit for the rest of it. In terms of cost, this option would rank low (3). Replogle and Parcell (1992) estimated the cost of a Bike and Ride to be between $140 and 800 for installation and $0 to $30 per year for maintenance cost. If there are approximately 350 transit hubs, installing five bike and rides at each would cost approximately 1.5 million. Similar to the other integration with transit options, this measure would rank a (3) on effectiveness, since it helps resolve the distance deterrent. This option ranks between medium and high (2.5) on both administrative feasibility and public acceptability. Overall, this measure scores 11/15. This is the highest score for any of the options and the highest score for the integration with transit options.

8.7 Financial Incentive to Mode Shift

Various studies have found that Western European countries with high cycling levels have dramatically shifted their urban transport policies to curb car travel and promote cycling.

8.7.1 Parking Tax

In terms of cost, this option would rank moderate (2). When the parking tax was initially proposed in 2006, TransLink allocated $6 million for implementation of the parking site tax. In addition, TransLink estimated the cost at $3 million for expenses to manage the tax roll, fully implement the tax and administer the appeal process. This brings the total to approximately $9 million. Though this is over the threshold for a moderate cost, this option would also increase revenue to TransLink. It is assumed it would bring the cost into a moderate level. Based on regression results from Section 5, it is hypothesized that effectiveness would be a (3) since access to vehicle was consistently shown to be a significant determinant.

Administrative feasibility ranks as (1.5). Stakeholders maintained the biggest administrative issue would be the initial implementation and compliance issues. In terms of public acceptability, a parking tax would rank as moderate (1.5). Since such a large per cent of Metro Vancouver residents are automobile drivers, there most likely will not be wide support for this. It is noteworthy that public opinion polling conducted by TransLink in 2003 indicated broader public support for parking charges over gas taxes. Overall, this measure receives 8/15.

8.7.2 Property Tax Incentive

In terms of cost, this option ranks low (2). Since this measure is similar in implementation to the parking tax, it is estimated that about $9 million will be required to implement and manage the tax. Based on regression results from Section 5, it is hypothesized that effectiveness would be a (3). Vehicle ownership is a significant determinant of cycle use. This option takes away parking spaces at work destinations and promotes cycling. Stakeholder

interviews ranked the administrative ease as moderate (2). The biggest administrative issue would

be the initial implementation and evaluation issues. In terms of public acceptability, stakeholders

rank a parking tax between low and medium (1.5). Though this option does not directly affect car

users, they may see less parking and increased parking prices at their work destination. Since

such a large per cent of Metro Vancouver residents are automobile drivers, there most likely will

not be wide support for this. Overall, this measure receives 8.5/15.

8.7.3   Vehicle Levy

In terms of cost, this option would rank low (3) since this option is actually increasing

revenue. Based on regression results from Section 5, it is hypothesized that effectiveness would

be a (3). High vehicle ownership is a significant determinant of cycle use. It is hypothesized that

introducing this measure would reduce the number of vehicles. Administrative ease would rank as

moderate (2). The biggest administrative issue would be the initial implementation and evaluation

issues. In terms of public acceptability, a vehicle levy would rank as moderate (2). Overall, this

measure receives 9.5/15.

9 Recommendation

Based on the evaluation of policy options discussed in the preceding sub-sections, the TransLink Mayors' Council should consider the implementation of three policy options to increasing cycling as a commute mode in Metro Vancouver; increasing bicycle racks on buses, increase Bike Park and Ride facilities and introduce a vehicle levy on all registered vehicles. Each is explained below in more detail.

9.1 Bike Park and Ride Facilities

The first recommendation is to increase bike and ride facilities at Transit stations. Logistic regression results indicated that distance from work place was a significant deterrent to cycle use. Integration with Transit is often one solution to long trip distances. Based on the evaluation in the last section, Bike and Ride facilities seem to be the best and most feasible solution. Currently, TransLink is focusing on Bike and Ride facilities. However, TransLink needs to ensure these facilities are available to commuters at all transit stations. In comparison to the status quo, it is expected that this option would be more effective at increasing cycling levels in Metro Vancouver. Thus, it is recommended that TransLink implement this option.

9.2 Increase Capacity for Bicycles on Buses

The second recommendation is to increase the capacity for bicycles on buses, especially high occupancy routes. Logistic regression results indicated that distance from work place was a significant deterrent to cycle use. Integration with Transit is often one solution to long trip distances. By increasing the capacity for bicycles on buses, more commuter cyclists will be able to take their bicycles on transit. In comparison to the status quo, integration with transit appears to be more effective. Thus, it is recommended that TransLink adopt this option.

9.3   Vehicle Levy

The third recommendation is to introduce financial incentives to mode shift, specifically a vehicle levy on all registered vehicles. Logistic regression results indicate that respondents with more vehicles per household are less likely to cycle to work. These findings suggest that car restriction measures are needed to promote cycle use as a commute mode. In comparison to the status quo, introducing a vehicle levy would be more effective at increasing cycling levels. In addition, this measure takes a stronger stance against private automobile use than the status quo. It is recognized that to make a substantial change, additional measures that discourage car use will have to be implemented. Thus, it is recommended that TransLink and the municipalities introduce this measure.

9.4   Conclusion

In conclusion, survey results indicate that having a university education, living in the City of Vancouver, being male, having a household income between $60,000 and $90, 000, having less vehicles per household and living closer to your work destination all make you more likely to cycle as a commute mode. This study has identified three policy options to increase cycling as a commute mode in Metro Vancouver. These include: increasing bike racks on buses, increasing Bike and Ride facilities at transit stations and decreasing auto ownership through a vehicle levy. Adopting the recommended policy options would increase cycling level to work in Metro Vancouver.

Appendices

Appendix A

Table 10.1: Dependent Variable Frequencies

Times Cycled to Work	Frequency	Valid Percent
Zero	1428	76
1	10	1
2	45	4.6
3	3	0.3
4	26	2.6
5	9	0.9
6	31	3.2
7	2	0.2
8	37	3.8
9	4	0.5
10	61	6.3
12	2	0.2
15	2	0.2
20	2	0.2
Total	1660	100

Appendix B

Table 10.2: Cross-tabulations, Demographics

Query	Variable Name	% who Cycle to Work	% who Do Not Cycle to Work	(n)	% of Total
Recorded from voice**	*Gender* Female Male	8.8 17.9	91.2 82.1	708 952	42.7 57.3
To which of the following age categories do you belong?	*Age* 19-34 35 or older	16.0 13.0	84.0 87.0	545 1115	24.2 75.8
What is the highest level of education you have completed?**	*Education* Less than University University	10.8 17.5	89.2 82.5	871 789	52.4 47.6
What is your present employment status?*	*Employment* Full time Part time/Self employed	15.1 11.7	84.9 88.3	1132 529	68.7 31.3
Which of the following best describes your total household income before taxes for 2005?*	*Income* Below $30 000 $30 000- 60 000 $60 000-90 000 $90 000 and up	11.8 15.8 16.7 12.6	88.2 84.2 83.3 87.4	119 311 365 866	6.6 17.6 22.3 53.4

Pearson Chi-2 tests *Significant at < .05 , Significant **<.001

Table 10.3: Cross-tabulations, Household Characteristics

Query	Variable Name	% who Cycle to Work	% who Do Not Cycle to Work	(n)	% of Total
Including yourself, how many people live in your household?	*Children* Yes No	 14.1 13.8	 85.9 86.2	 799 861	 48.1 51.9
In which neighbourhood do you live?**	*Neighbourhood* City of Vancouver Other	 23.5 9.7	 76.5 23.5	 511 1149	30.7 69.3

Pearson Chi-2 tests *Significant at < .05 , Significant **<.001

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