Zenith Model of Victoria

Technical Note 4
Non-Home Based Trip Productions

Zenith Version: 2.0.0

VEITCH LISTER CONSULTING PTY LTD

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Zenith Model of Victoria

Technical Note 4: Non-Home Based Trip Productions

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1 Introduction

The Zenith travel model of Victoria is one of a family of models developed by Veitch Lister Consulting (VLC) for transport planning in Australian cities and regions.

This document is one in a series of technical notes that collectively describe the Zenith Model of Victoria.

1.1 Related Documents

This technical note is the fourth of eleven. The other technical notes are:

- Working Paper 1: Model Validation Framework and Data Sources
- Working Paper 2: Review of VISTA07
- Working Paper 3: Home Based Trip Production Model
- Working Paper 4: Non-Home Based Trip Production Model
- Working Paper 5: Household Segmentation & Travel Market Segmentation Models
- Working Paper 6: Period Allocation and Vehicle Occupancy Models
- Working Paper 7: Mode Choice Model
- Working Paper 8: Destination Choice and Trip Attraction Model
- Working Paper 9: Overall Model Validation
- Working Paper 10: Backcasting and Sensitivity Testing
- Working Paper 11: Reference Case Model Assumptions

1.2 Aim and Scope of This Document

The primary focus of this document relates to the first step in the four-step travel modelling process: *trip generation*, but with a focus on trip productions for non-home based trip purposes. Trip productions for home based purposes are discussed in Working Paper 3, while trip attractions will be developed as part of destination choice (Technical Note 8).

The remainder of this document is structured as follows:

- Section 2 describes the sources of data which have been used to develop, estimate, calibrate and validate the model,
- Section 3 describes the scope of the model,
- Section 4 describes the methodology,
- Section 5 describes the results of the recalibrated model, and
- Section 6 describes the correction factors which have been included to account for under-reporting in VISTA.

2 Data Sources

Three key data sources have contributed to the recalibration of the Non-Home Based Trip Production module:

- Victorian Integrated Survey of Travel and Activity 2007 (VISTA07) – Version 1.3
- ABS Census Data (Population and Journey To Work Data)
- Primary, Secondary and Tertiary enrolments

Secondary data sources used to validate VISTA include:

- Screenline Traffic Counts
- 2009 Rail OD survey
- 2008 Tram OD survey
- Bus ticket validations

VISTA07

The VISTA07 survey was the primary source of information regarding travel behaviour. The survey was used to estimate model parameters, and to validate the resulting model at various levels of spatial aggregation.

The VISTA07 sample comprises 43,822 people, from 17,715 households. In total there are 128,744 reported trips, a very healthy sample from which to estimate a strategic travel model.

Not all of the survey responses are usable for our purposes. In the case of non-home based trip productions, trips which have an origin or destination outside of the Zenith model area (specifically, in Shepparton and the LaTrobe Valley), and travel made on weekends and during school and public holidays do not form part of the estimation sample. In addition, the sample was necessarily restricted to the set of fully responding households. That leaves a sample of 7,228 households (42% of the total sample). From these households, we have a total of 17,263 non-home based trips with which to calibrate and validate the model, which is a healthy sample.

2006 ABS Census

2006 ABS Census Data was used to construct the explanatory variables which have been used within the Zenith model. Key variables have included:

- Number of households
- Employment by Industry Category

Enrolments

VLC maintains databases of school and tertiary enrolments, as input to its base year models. Enrolment data is sourced from:

- Department of Education and Early Childhood Development (DEECD),
- The Association of Independent Schools of Victoria (AISV),
- The Catholic Education Office Melbourne (CEOM), and
- University personnel and websites

3 Model Scope

This chapter describes the scope of the Zenith Trip Generation model in terms of:

- The set of trip purposes,
- The set of land use variables included within the model, and which can act as predictors of non-home based trip making,
- The definition of the "modelled day",
- The spatial boundary of the model.

3.1 Trip Purposes

The Trip Generation model separately estimates travel for a wide range of distinct trip purposes.

At the time of writing, VLC is not proposing to modify the set of trip purposes currently employed by the Zenith model. The set of trip purposes may be reviewed at a later date.

The Zenith model includes trip purposes relating to:

- Travel made by residents
- Travel made by overseas visitors, Australian visitors and persons living outside the region
- Commercial vehicles (freight)

This note will concern itself only with the first item: *travel made by residents*, as the VISTA07 survey only includes travel made by residents.

Travel made by overseas visitors, Australian visitors and commercial vehicle traffic may be reviewed at a later date.

The resident trip purposes in the Zenith model are:

<u>Home Based</u>

- Home based work (white collar)
- Home based work (blue collar)
- Home based education (primary)
- Home based education (secondary)
- Home based education (tertiary)
- Home based shopping / personal business [Home based shopping]
- Home based recreation / social [Home based recreation]
- Home based serve passenger / other [Home based other]

<u>Non-home based</u>

- Work based work
- Work based shopping
- Work based other
- Shopping based shopping
- Shopping based other
- Other non-home based

The scope of this note is confined to the non-home based trip purposes.

3.2 Land Use Variables

The Zenith model uses a range of land use variables as predictors of non-home based travel. The variables which can typically affect the rate of non-home based travel are:

Measures of population

- Count of Households

Education based measures of activity

- Primary school enrolments
- Secondary school enrolments
- Tertiary enrolments

Employment based measures of activity

- Total employment

Employment by the following industry categories (ANZSIC 1993):

- Agriculture
- Manufacturing
- Mining
- Electricity, gas and water
- Construction
- Communications
- Wholesaling
- Retailing
- Transport and storage
- Finance & business
- Public administration
- Community services
- Recreation and personal services

This list is consistent with the previous Zenith model; the list may be reviewed at a later date. In particular, we may move to ANZSIC 2006 categories, or groupings thereof.

3.3 Definition of the Modelled Day

The Zenith Trip Generation model predicts daily travel for an average weekday during school term time, and excluding public holidays.

3.4 Geographic Scope of the Model

The geographic coverage of the model is shown in Figure 1 below. The model includes all of Melbourne, Geelong, Ballarat and Bendigo. The Zenith Non-Home Based Trip Production model has been constrained to predicting travel within these areas.

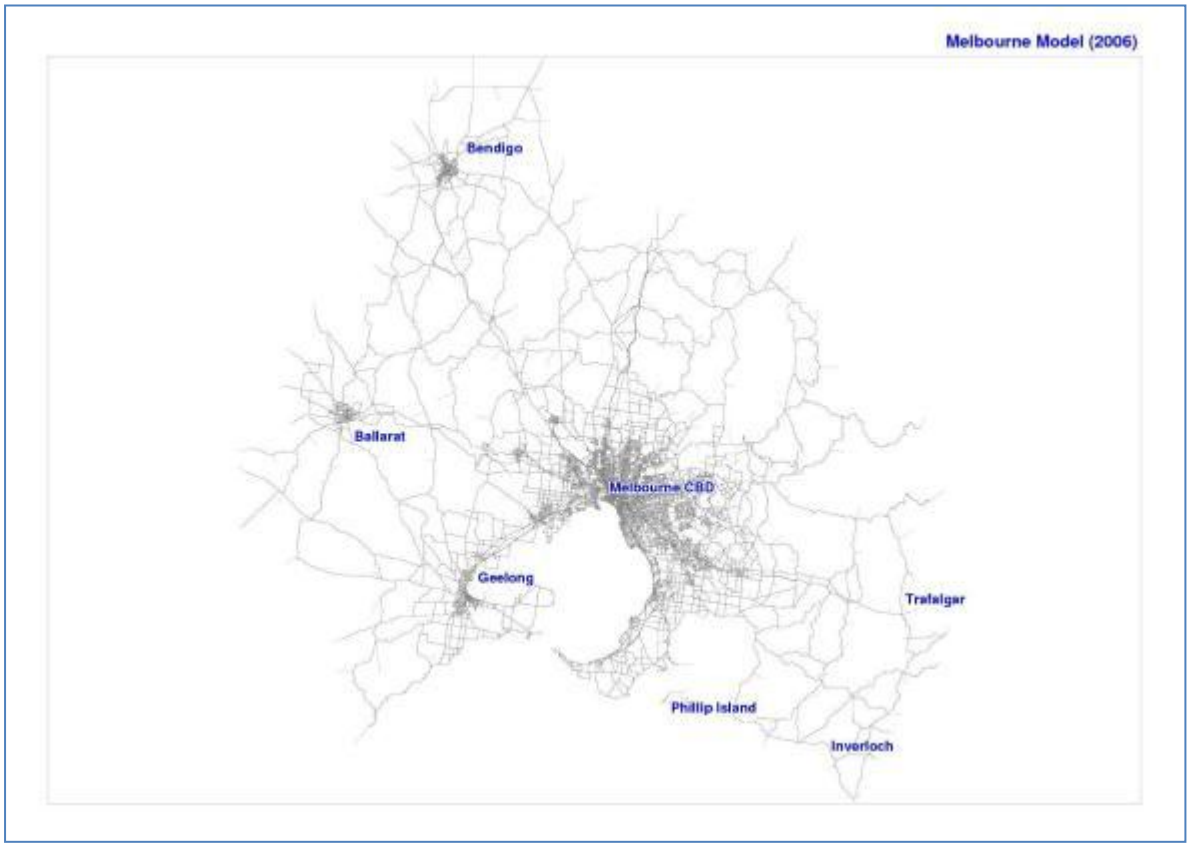


Figure 1- The Geographic Coverage of the Zenith Model

4 Methodology

4.1 Model Form

The Zenith Trip Production model for non-home based trip purposes is a linear model where the dependant (predicted) variable is the number of trips produced in a travel zone, and where the independent (explanatory) variables are a range of land use measures associated with the travel zone.

For example, in the case of Shopping Based Shopping, the following variables were found to have significant parameter values:

Parameter	Re-estimated-DZ PARAMETER ESTIMATE	T-STATISTIC	P-VALUE	STANDARD ERROR
HOUSEHOLDS	0.190	14.431	0.000	0.013
EMP - Community Services	0.178	5.514	0.000	0.032
EMP - Public Administration	0.144	2.296	0.022	0.063
EMP - Recreation & Personal Services	0.529	7.420	0.000	0.071
EMP - Retailing	1.084	20.228	0.000	0.054

To calculate the Shopping Based Shopping trips produced in a travel zone, we multiply the parameter estimate for each variable by the value taken by that variable for the travel zone.

For example, consider a travel zone with the following attributes:

- 500 households
- 20 community services jobs
- 50 public administration jobs
- 10 recreation and personal services jobs, and
- 80 retail jobs

The Shopping Based Shopping trips produced by this travel zone would be equal to:

$$Trips(SBS) = (0.19 \times 500) + (0.178 \times 20) + (0.144 \times 50) + (0.529 \times 10) + (1.084 \times 80)$$

$$Trips(SBS) = 197.77$$

This process is repeated for all travel zones, and for all of the six non-home based trip purposes.

4.2 Estimation Procedures

As described in Section 4.1, the non-home based trip production model is estimated by regressing the number of non-home based trips (for a given purpose) against the land use variables described in Section 3.2.

The trips in the VISTA07 survey have been expanded so that they are reflective of the resident population as it existed in 2006. Roughly, if the survey is a 1% sample, then the average expansion factor will be 100.

There are many parts of the study area for which no non-home based travel has been reported in VISTA07 (due to sample size). Given this, some care must be taken in deciding at what level of spatial disaggregation to run the regression. If the areas are too small, there will be a large number of zeroes,

and an increased risk of outliers distorting the regression. If the areas are too large, there will be a limited number of data points, and the regression may fail to identify the land use variables which really influence non-home based trip rates.

Another consideration is the accuracy of the land use data input to the regression. Employment data is released by the ABS at the level of JTW Destination Zones, and subsequently broken down by VLC to its small area zoning system (which can be aggregated to both CCDs and Destination Zones). The data at the level of Destination Zones is likely to be more accurate than VLC's breakdown at the small area level.

Given these considerations, VLC has tested a number of different levels of spatial disaggregation, including Census Collector District, JTW Destination Zone, Suburb, Post Code, and SLA, as well as a number of VLC's travel zone systems including its small areas (9282 zones), and our balanced travel zone system (3407 zones).

JTW Destination Zones have ultimately been chosen as the spatial basis for our regressions. The prime motivation is that they are the most disaggregate level for which we have ABS Census place of work data.

4.3 Model Validation Criteria

The DOT has provided a draft copy of their document: "*Guidelines for Strategic Transport Model Development: Calibration, Reasonableness Checks, Validation and Sensitivity Testing, Sept 2010.*" In that document, the recommended criteria for model calibration and validation criteria for Trip Generation are summarised as follows:

Check	Segmentation	Desired Criteria
Compare total modelled trips to VISTA	Total Melbourne	± 5%
	LGA	± 10%
	Trip Purpose	± 10%
	LGA and Trip Purpose	± 15%
Apply trip production model to VISTA responses	Household	$R^2 \geq 0.85$

Table 1 – DOT Trip Generation Validation Criteria

NOTE: These criteria are still being developed by DOT and are subject to review.

At this stage, VLC believes that the proposed criteria should be adjusted, and as such, we haven't explicitly used the desired criteria thresholds to validate the model. We hope to discuss this with DOT in the near future.

Our reasoning is as follows:

- With VISTA only capturing a small sample of total people, the VISTA trip rates cannot be assumed to be correct. This is particularly the case as the level of disaggregation increases (eg. trip purpose / LGA). For example, the average sample size for each LGA is 213 households. Collectively, this sample results in the production of around 100 non-home based trips in each LGA for each of the non-home based trip purposes. However, the sample of non-home based trips is not uniform across LGAs; the Melbourne LGA produces an average of 360 trips per trip

purpose, while Frankston averages only 80. As a result, the level of confidence we attach to the survey data will vary by LGA, meaning that model validation criteria based on a fixed percentage difference may be impractical.

- Confidence intervals provide a way to consistently measure the uncertainty associated with survey results, and thus provide a fair benchmark against which to evaluate the performance of the model. For example, for the Melbourne LGA, 466 Work Based Work trips are reported in the usable portion of the VISTA07 sample. Expansion of these trips results in 53,500 trips, which is an estimate of the total Work Based Work trips produced in the Melbourne LGA by all residents of the study area. However, we cannot be certain of this number; but we can be 95% confident that the true number of trips lies between 42,000 and 65,000. In this document, 95% confidence intervals have been provided wherever the model and survey have been compared.

Confidence intervals may form the basis of an adjusted set of criteria in the future.

5 Results

5.1 Overview of Non-Home Based Travel

This section provides an overview of non-home based travel, providing some context for the later analyses.

In the VISTA07 survey, non-home based trips make up 26% of all trips.

The breakdown of these trips by the Zenith non-home based trip purposes is presented in Figure 2 below. Work based travel (WB*) accounts for 40% of non-home based travel; shopping based travel (SB*) accounts for 46%, while other non-home based travel accounts for the remaining 14%.

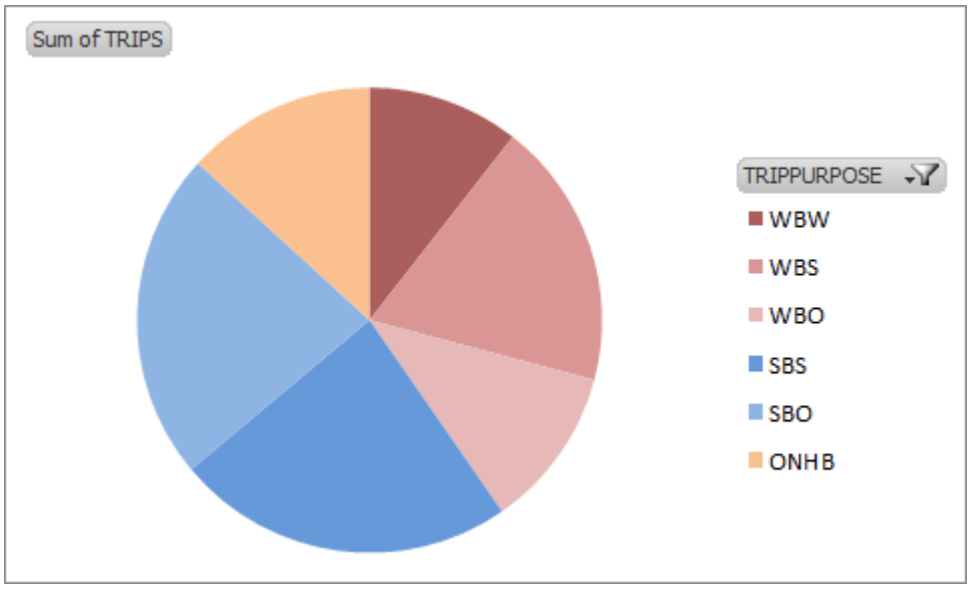


Figure 2 - Breakdown of Non-Home Based Travel by Trip Purpose

In total, there are 17,263 surveyed non-home based trips from which to calibrate and validate the model. The sample size for each purpose is shown in Table 2 below.

	Sum of TRIPS
WBW	1,824
WBS	3,204
WBO	1,937
SBS	4,069
SBO	3,947
ONHB	2,281
Grand Total	17,263

Table 2 - VISTA07 Surveyed Trips by Purpose

The demographic breakdown of non-home based travel is presented in Figure 3 below. White collar workers make nearly half of all non-home based trips, with the remainder fairly evenly split between the other categories.

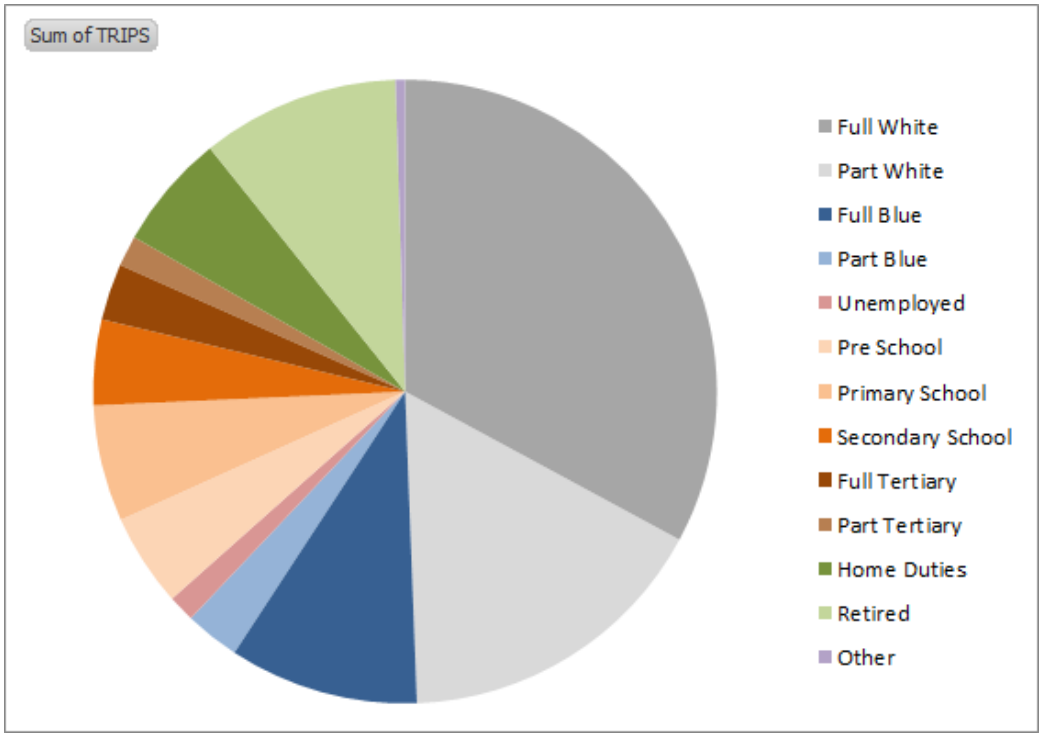


Figure 3 - The Breakdown of Non-Home Based Trips by Main Activity Group

The trip rate for non-home based travel by Main Activity group is presented in Figure 4 below. Part time white collar workers have the highest trip rate, at 1.36 trips per day. In general, those engaged in activities part time (part time white collar, blue collar and tertiary education) have higher non-home based trip rates than their full time counterparts. Those engaged in home duties also have a high trip rate.

A likely explanation is that these people are more likely to be engaged in multiple activities, which they combine during tours away from the home.

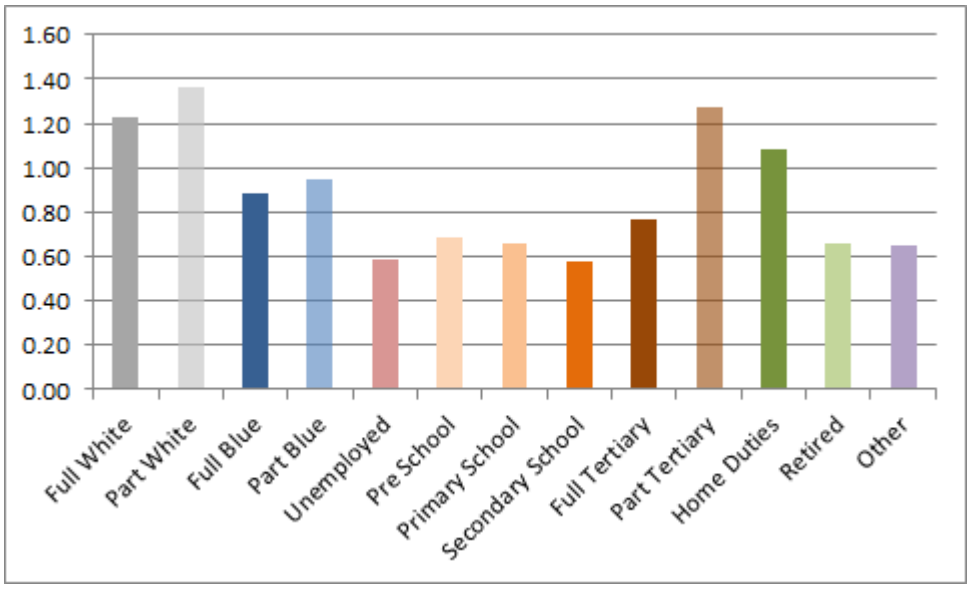


Figure 4 - Trip Rates for Non-Home Based Trips by Main Activity Group

5.2 Work Based Work

5.2.1 Travel Market

This section provides a high level analysis of the market for *Work Based Work* trips, which we will refer to as WBW.

The breakdown of WBW trips according to the Zenith person classification is seen in Figure 5 below.

65% of WBW trips are made by white collar workers, with most of the remainder made up by blue collar workers. Dependants aged 18-64 do make a small number of work based work trips; these are tertiary students who also undertake part time work.

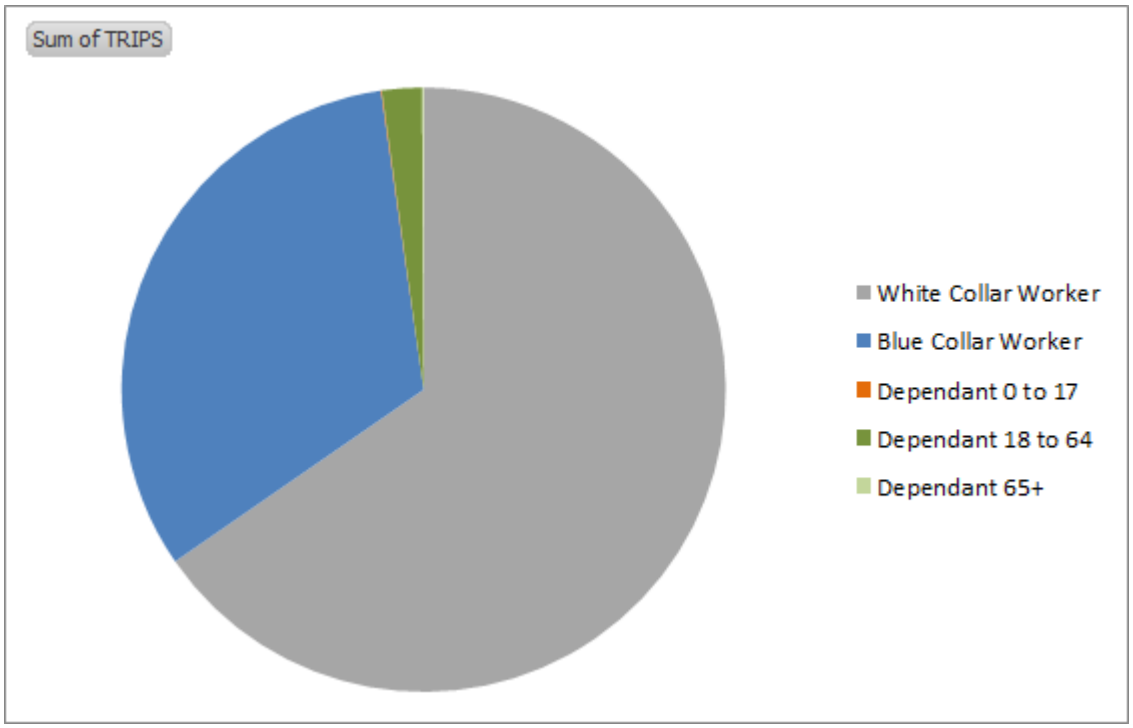


Figure 5 -The Breakdown of Work Based Work Trips by Zenith Person Types

A further breakdown is provided in Figure 6 below, which shows that WBW trips are dominated by full time workers.

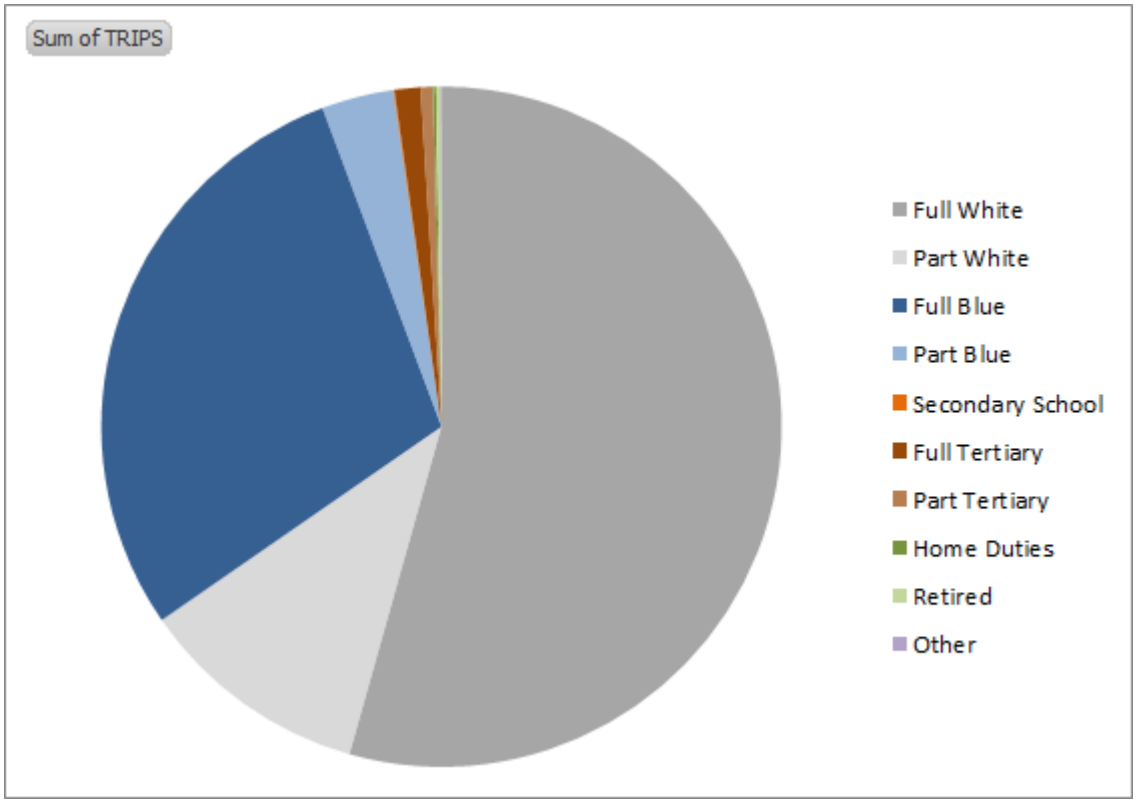


Figure 6 - The Breakdown of Work Based Work Trips by Main Activity Group

While white collar workers make the majority of WBW trips, blue collar workers have a higher trip rate. This is illustrated in Figure 7 below, which shows that blue collar workers make an average of 0.24 WBW trips per day, with white collar workers averaging 0.18.

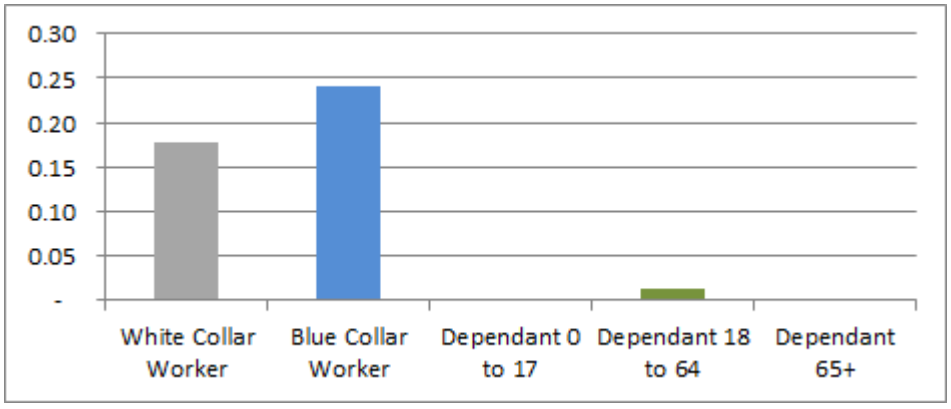


Figure 7 - Trip Rates for Work Based Work by Zenith Person Types

Part and full time workers also exhibit very different trip rates, as shown in Figure 8 below. The trip rates for full time workers are over double those of part time workers. Obviously, full time workers go to work more often, and thus it follows that they will have more opportunities to make WBW trips.

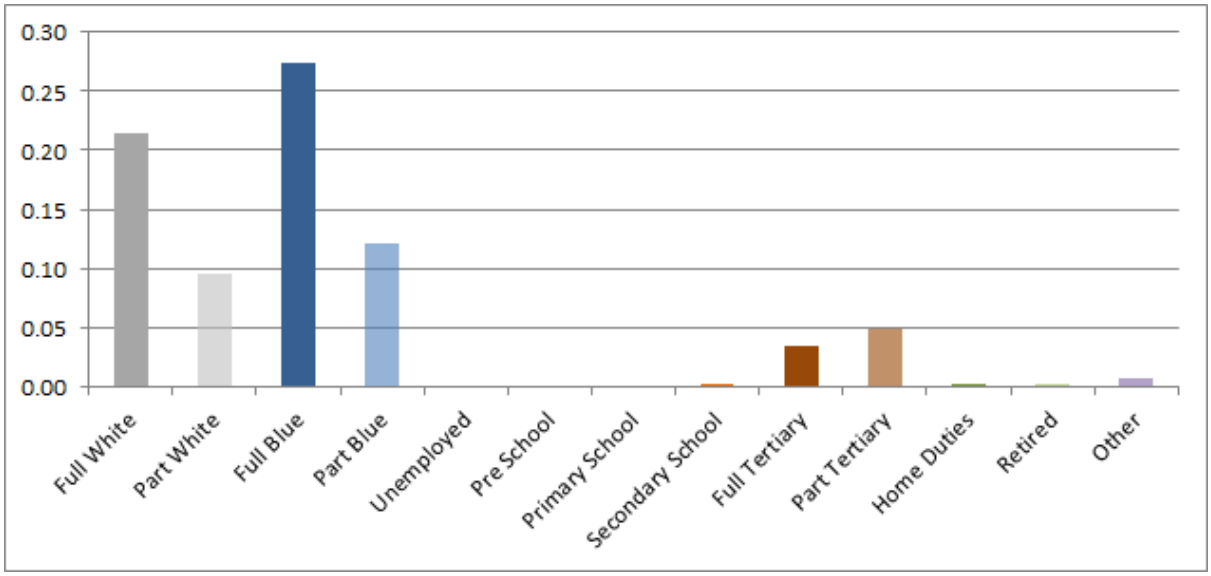


Figure 8 - Trip Rates for Work Based Work by Main Activity Group

5.2.2 Model Estimation

The Trip Production model for Work Based Work has been re-estimated, with the resulting model parameters presented in Table 3. The parameter estimates have also been compared in Figure 9, with grey bars indicating industries dominated by white collar workers (>70%), with the remaining industries coloured blue, indicating their higher proportion of blue collar workers (>30%).

Parameter	Re-estimated-DZ PARAMETER ESTIMATE	T-STATISTIC	P-VALUE	STANDARD ERROR
HOUSEHOLDS	0.041	5.896	0.000	0.007
EMP - Agriculture	0.620	2.156	0.032	0.288
EMP - Community Services	0.046	2.695	0.007	0.017
EMP - Construction	0.141	1.621	0.108	0.087
EMP - Electricity Gas & Water	0.644	4.078	0.000	0.158
EMP - Finance & Business	0.136	10.009	0.000	0.014
EMP - Manufacturing	0.039	1.785	0.075	0.022
EMP - Public Administration	0.258	8.701	0.000	0.030
EMP - Recreation & Personal Services	0.252	6.820	0.000	0.037
EMP - Retailing	0.057	2.335	0.020	0.024
EMP - Transport & Storage	0.259	10.024	0.000	0.026
EMP - Wholesaling	0.159	2.484	0.013	0.064
ENROLMENTS - Secondary	0.018	1.255	0.210	0.015
ENROLMENTS - Tertiary	0.009	1.829	0.069	0.005

Table 3 - Model Parameters for Work Based Work

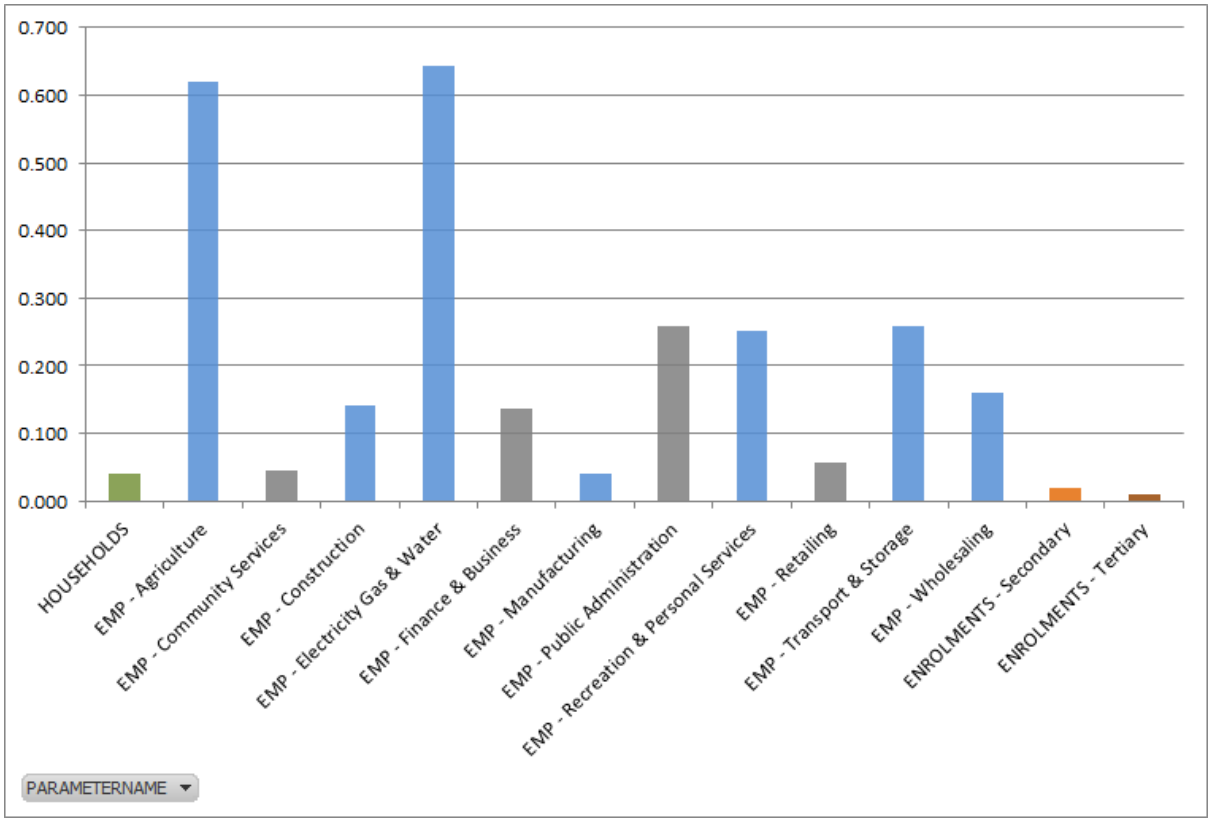


Figure 9 - Model Parameters for Work Based Work

The calculation of WBW trips for a travel zone is performed by multiplying the parameter estimate for each variable by the value of the variable for the travel zone, and then summing.

For example, if a zone comprises 100 Finance & Business jobs (parameter estimate: 0.136), and 200 Public Administration jobs (parameter estimate 0.258), the calculation would be as follows:

$$Trips(WBW) = 100 \times 0.136 + 200 \times 0.258$$

$$Trips(WBW) = 65.2$$

Unsurprisingly, the scale of employment in a travel zone has the largest bearing on the production of WBW trips. Certain industry types do generate more trips than others; the Agriculture and Electricity, Gas & Water industries have the highest parameters, at around 0.6, while public administration, recreation and personal services, and transport and storage each generate around 0.25 trips. Construction, Finance & Business, and Wholesaling jobs each generate around 0.15.

5.2.3 Model Validation

The re-estimated model has been applied to the study area of the VISTA07 survey, with predicted and actual trips compared at various levels of spatial aggregation.

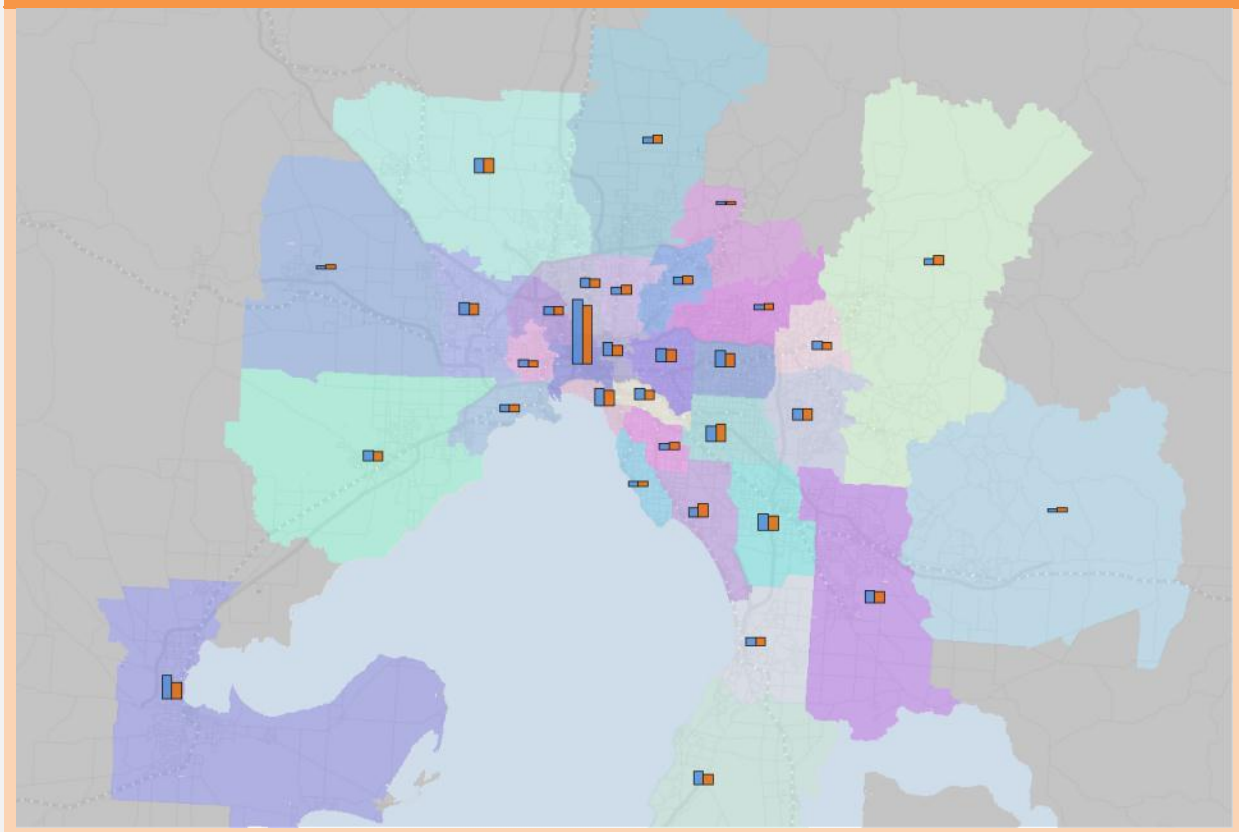
Referring to the LGA analysis (Figure 10 and Table 4 below), it can be observed that:

- The Melbourne LGA is by the far the greatest producer of WBW trips, commensurate with its high job density.
- Generally, the inner and middle south-east suburbs are significant producers of WBW trips.
- The Zenith model's predictions generally concord with the surveyed estimates, despite the significant uncertainty associated with the surveyed estimate of trips for each LGA (as illustrated by the error bars, which indicate a 95% confidence interval on the true average number of WBW trips for each LGA).
- An R-Squared of 0.95 is achieved across all LGAs (0.68 if the Melbourne LGA is removed, as shown in the inset). In 32 of the 34 LGAs, the model's prediction falls within the 95% confidence interval.

Referring to the Concentric Region analysis (Figure 11 and Table 5 below), it can be observed that:

- The model's predictions generally match the survey for each region. There is a reasonable likelihood that the model is slightly under-predicting trips in the inner city, and in Geelong, though in both cases, the modelled estimate falls within a 95% confidence interval.
- Under-prediction of WBW trips in the inner city might be related to the high density of employment found there, and the opportunities this provides for business to business interactions. Also, many businesses who locate in the central city are likely to do so because of their need to be close to their clients. The inclusion of an accessibility variable may correct for this, and may be considered at a later date.

Trips by LGA
Work Based Work | Re-estimated Zenith Model



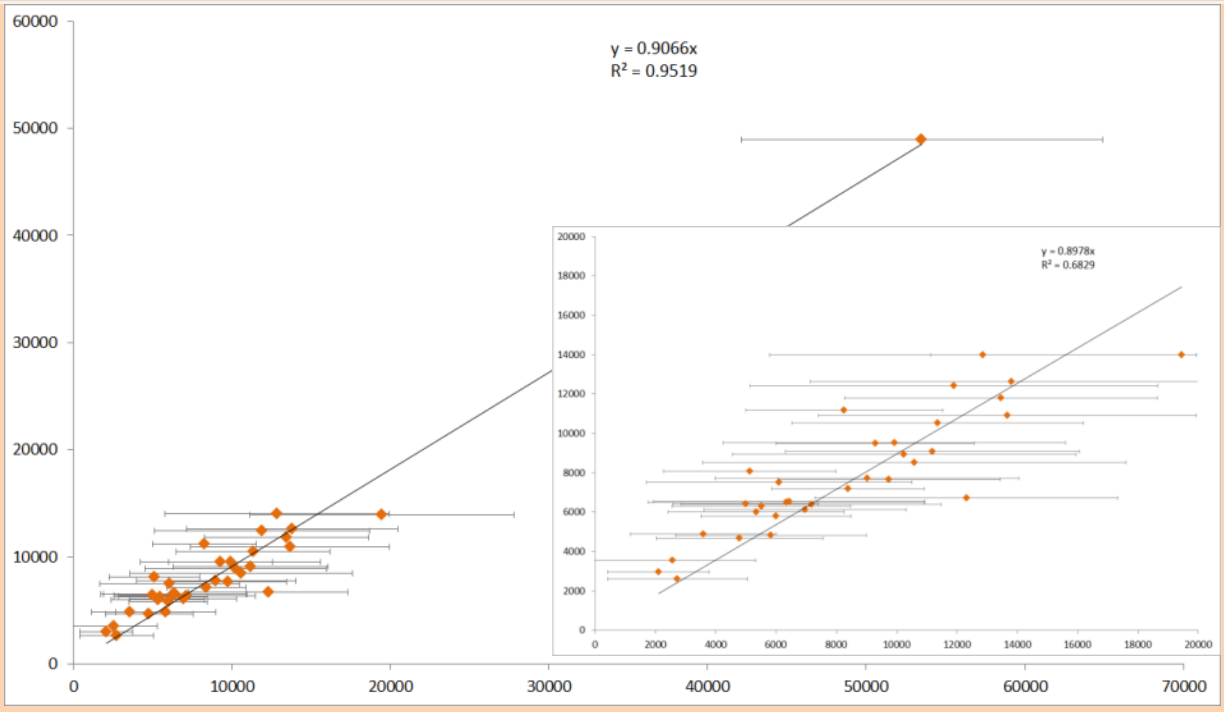


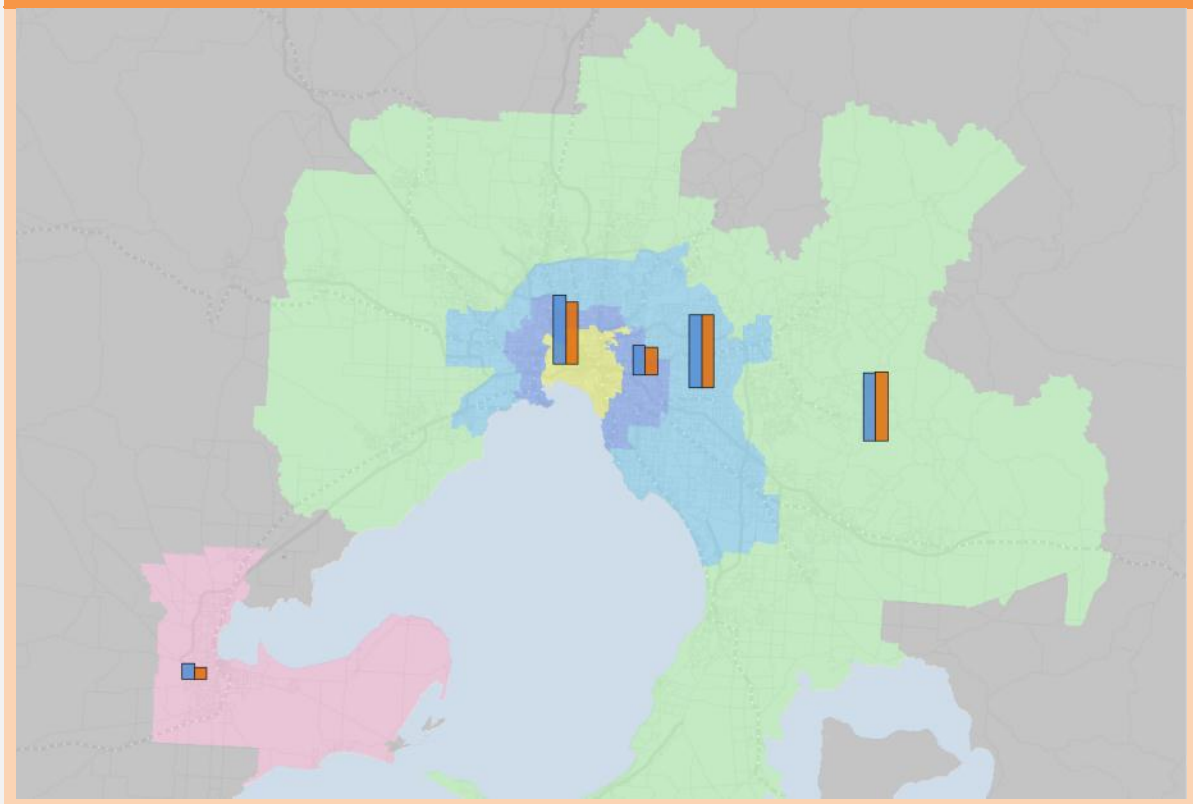
Figure 10 - Comparison of Modelled and Surveyed Trips for Work Based Work, By LGA

Sum of TRIPS	VISTA07	Re-estimated-DZ	% Diff	95% C.I.	Unweighted trips in VISTA07 Sample
Ballarat (C)	12,315	6,731	-45%	± 41%	366
Banyule (C)	5,510	6,295	14%	± 54%	62
Bayside (C)	4,794	4,692	-2%	± 58%	35
Boroondara (C)	11,358	10,538	-7%	± 43%	97
Brimbank (C)	10,246	8,927	-13%	± 56%	61
Cardinia (S)	2,563	3,572	39%	± 108%	16
Casey (C)	9,926	9,520	-4%	± 57%	48
Darebin (C)	6,100	7,530	23%	± 72%	54
Frankston (C)	6,345	6,522	3%	± 72%	45
Glen Eira (C)	5,336	6,016	13%	± 55%	44
Greater Bendigo (C)	8,398	7,183	-14%	± 30%	213
Greater Dandenong (C)	13,459	11,790	-12%	± 39%	90
Greater Geelong (C)	19,448	13,979	-28%	± 43%	228
Hobsons Bay (C)	5,996	5,810	-3%	± 41%	67
Hume (C)	11,901	12,423	4%	± 57%	61
Kingston (C)	8,256	11,187	35%	± 40%	63
Knox (C)	9,286	9,500	2%	± 35%	74
Manningham (C)	3,583	4,878	36%	± 68%	35
Maribyrnong (C)	5,834	4,828	-17%	± 54%	56
Maroondah (C)	6,969	6,131	-12%	± 48%	51
Melbourne (C)	53,494	48,968	-8%	± 21%	466
Melton (S)	2,097	2,981	42%	± 80%	15
Monash (C)	12,863	14,001	9%	± 55%	98
Moonee Valley (C)	6,440	6,541	2%	± 70%	40
Moreland (C)	7,167	6,386	-11%	± 60%	55
Mornington Peninsula (S)	10,582	8,512	-20%	± 66%	79
Nillumbik (S)	2,731	2,619	-4%	± 85%	18
Port Phillip (C)	13,809	12,624	-9%	± 48%	113
Stonnington (C)	9,746	7,673	-21%	± 38%	86
Whitehorse (C)	13,671	10,917	-20%	± 46%	96
Whittlesea (C)	4,991	6,419	29%	± 48%	47
Wyndham (C)	9,018	7,726	-14%	± 56%	58
Yarra (C)	11,191	9,086	-19%	± 44%	78
Yarra Ranges (S)	5,125	8,086	58%	± 56%	38
Grand Total	330,546	310,593	-6%		3,053

Table 4 - Modelled and Surveyed Trips for Work Based Work, by LGA

Trips by Concentric Region

Work Based Work | Re-estimated Zenith Model



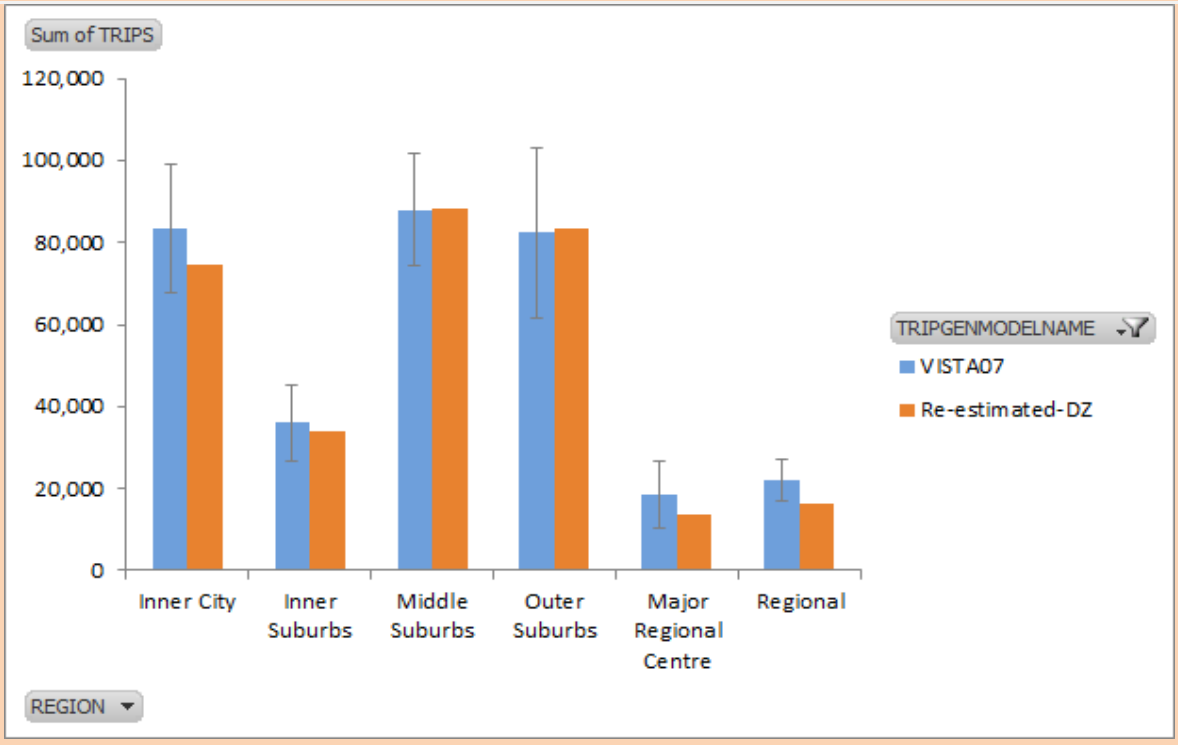


Figure 11 - Modelled and Surveyed Trips for Work Based Work, by Concentric Region

Sum of TRIPS	VISTA07	Re-estimated-DZ	% Diff	95% C.I.	Unweighted trips in VISTA07 Sample
Inner City	83,549	74,751	-11%	± 19%	705
Inner Suburbs	36,056	34,082	-5%	± 26%	317
Middle Suburbs	87,927	88,508	1%	± 16%	674
Outer Suburbs	82,393	83,594	1%	± 25%	544
Major Regional Centre	18,625	13,495	-28%	± 44%	221
Regional	21,996	16,163	-27%	± 23%	592
Grand Total	330,546	310,593	-6%		3,053

Table 5 - Modelled and Surveyed Trips for Work Based Work, by Concentric Region

5.3 Work Based Shopping

5.3.1 Travel Market

This section provides a high level analysis of the market for *Work Based Shopping* trips, which we will refer to as WBS.

WBS trips occur when an individual who has been working goes shopping (or vice versa). Irrespective of the direction of the trip (work to shopping, or shopping to work), the trip is referred to as a WBS trip, with the work end referred to as the "Production" end of the trip, and the shopping end referred to as the "Attraction" end. As such, trips can occur from production to attraction, and in reverse from attraction to production (often with contrasting temporal distributions).

The Trip Production model for WBS (which is the subject of this paper) aims to predict the number of WBS trips which have their *production end* in each travel zone.

So, a trip from work (in Travel Zone A) to shopping (in Travel Zone B) *and back* will result in two WBS productions in Travel Zone A. This is because Travel Zone A is the production end (ie. the work end) of both the outward and return trips.

As such, our model will predict:

> Work **TO** Shopping Trips **originating** in Zone A
>
> **+**
>
> Shopping **TO** Work Trips **destined** for Zone A

The breakdown of WBS trips according to the Zenith person classification is seen in Figure 12 below.

79% of WBS trips are made by white collar workers; blue collar workers comprise 17%, while dependants (students who work part time) make up the remaining 4%.

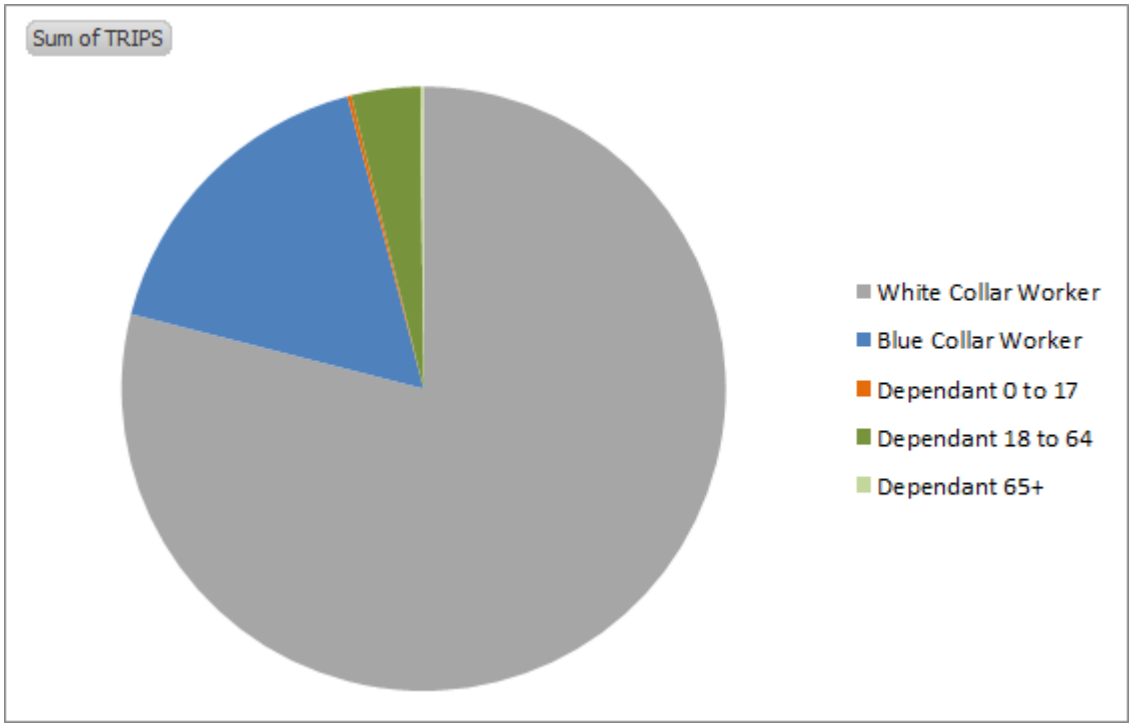


Figure 12 -The Breakdown of Work Based Shopping Trips by Zenith Person Types

A further breakdown is provided in Figure 13 below, which indicates the full time workers are the primary source of WBS trips, accounting for 80% of trips.

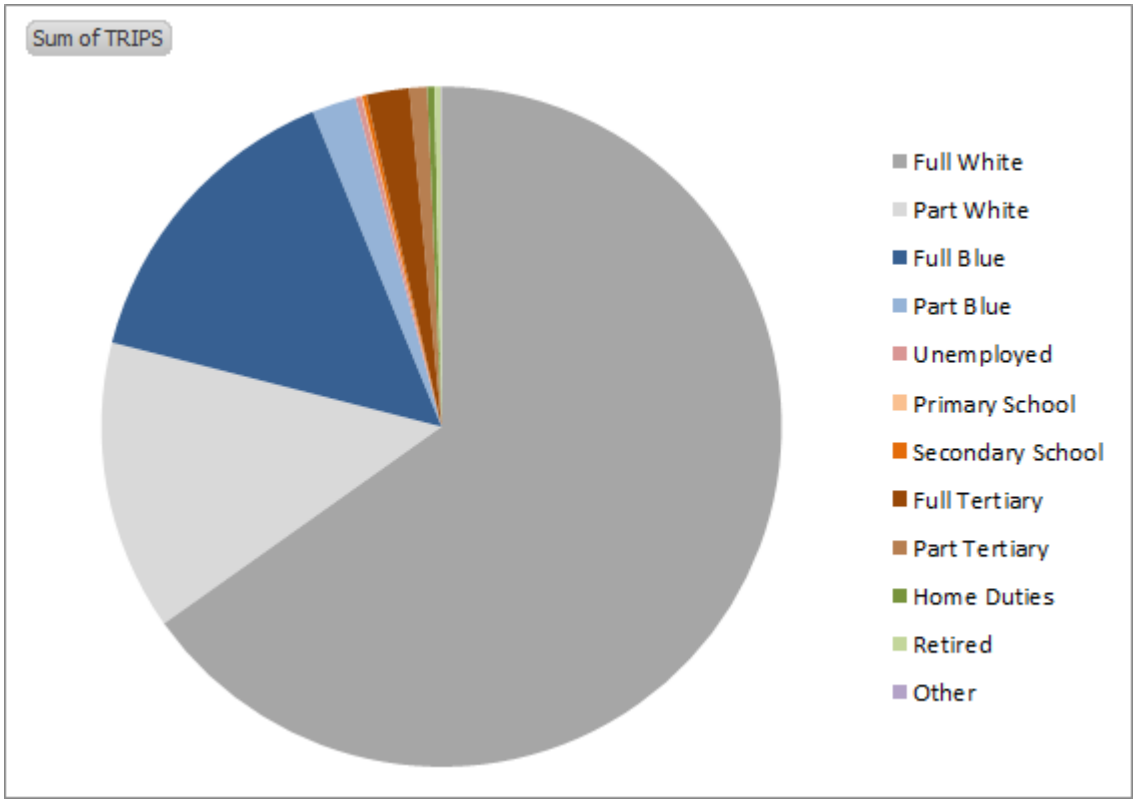


Figure 13 - The Breakdown of Work Based Shopping Trips by Main Activity Group

The high proportion of trips made by white collar workers is partly due to the higher proportion of white collar workers in the population (70%), and partly due to the average white collar worker having a higher trip rate for WBS trips. As shown in Figure 14 below, white collar workers have an average trip rate of 0.38, compared with 0.22 for blue collar workers. It seems that white collar workers are more likely to combine work with shopping.

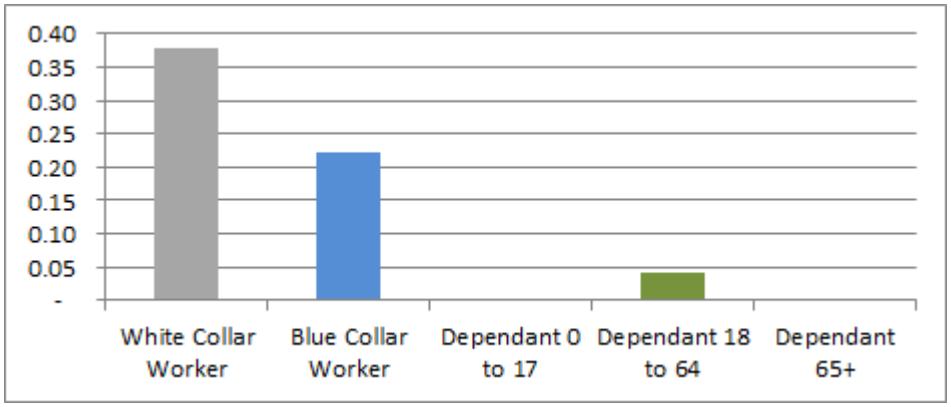


Figure 14 - Trip Rates for Work Based Shopping by Zenith Person Types

Figure 15 below further disaggregates these trip rates by Main Activity group. As with WBW, full time workers have a trip rate roughly double that of part time workers. This is probably a direct result of full time workers being at work more often, and having more opportunities to combine work and shopping.

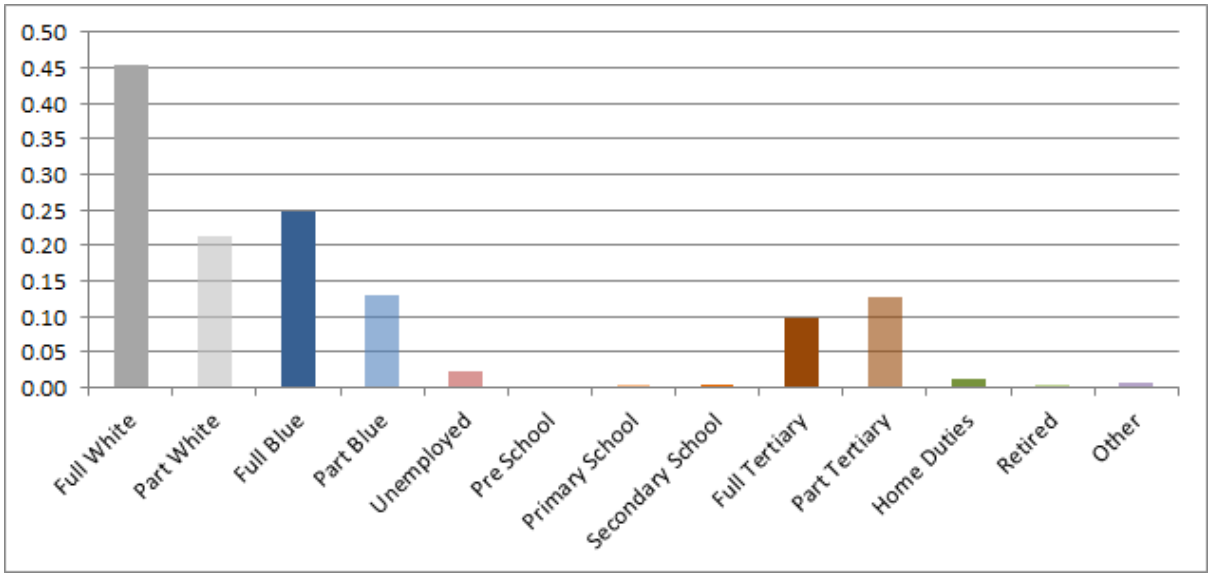


Figure 15 - Trip Rates for Work Based Shopping by Main Activity Group

5.3.2 Model Estimation

The Trip Production model for Work Based Shopping has been re-estimated, with the resulting model parameters presented in Table 6 below. The parameter estimates have then been compared in Figure 16.

Parameter	Re-estimated-DZ PARAMETER ESTIMATE	T-STATISTIC	P-VALUE	STANDARD ERROR
EMP - Agriculture	0.127	0.170	0.865	0.743
EMP - Communications	0.212	1.328	0.185	0.160
EMP - Community Services	0.261	7.152	0.000	0.036
EMP - Finance & Business	0.972	26.904	0.000	0.036
EMP - Manufacturing	0.105	1.916	0.057	0.055
EMP - Public Administration	1.582	19.230	0.000	0.082
EMP - Recreation & Personal Services	0.157	1.863	0.065	0.084
EMP - Wholesaling	0.666	4.410	0.000	0.151

Table 6 - Model Parameters for Work Based Shopping

Businesses in the Finance & Business and Public Administration industries are by far the largest producers of Work Based Shopping trips. The high incidence of such businesses in the inner city is probably not a coincidence, with inner city workers having many opportunities to buy lunch within walking distance, or buy something on the way to or from the train station. Together, Finance & Business and Public Administration make up 48% of jobs in the Melbourne (C) LGA.

The large parameter for wholesaling jobs is interesting, and may be worthy of some investigation at a later date.

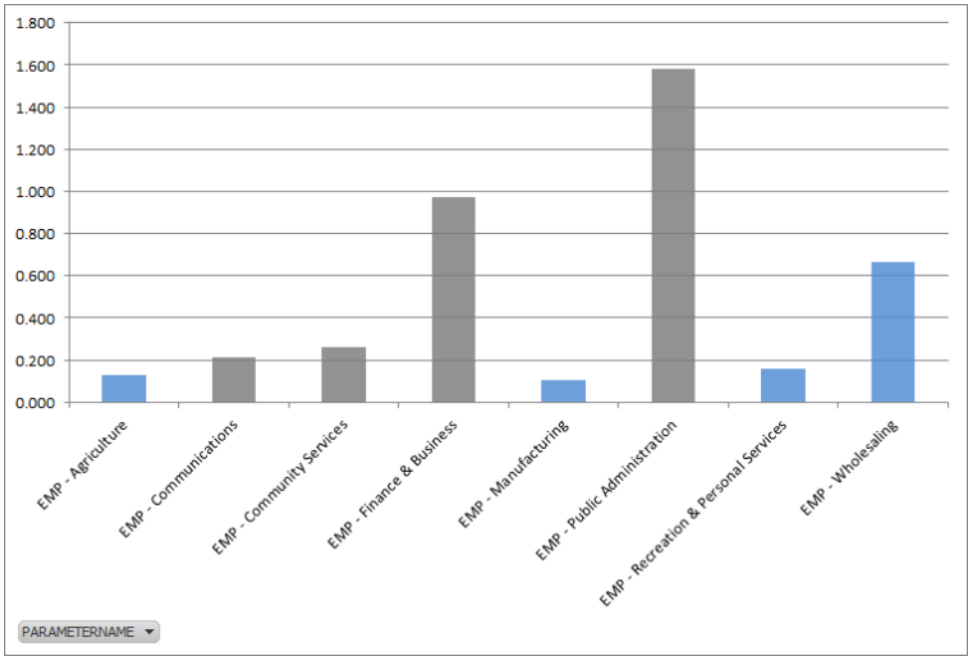


Figure 16 - Model Parameters for Work Based Shopping

5.3.3 Model Validation

The re-estimated model has been applied to the study area of the VISTA07 survey, with predicted and actual trips compared at various levels of spatial aggregation.

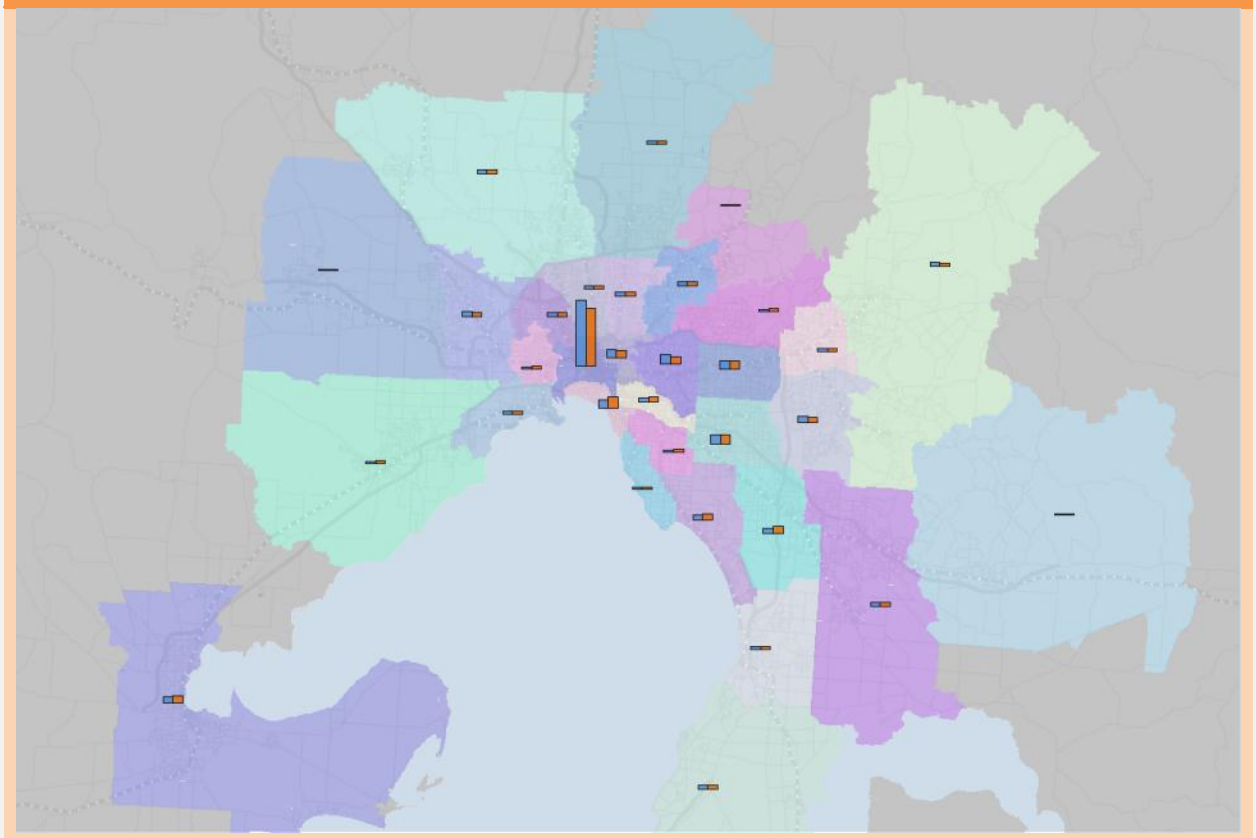
Referring to the LGA analysis (Figure 17 and Table 7), it can be observed that:

- The Melbourne LGA is by the far the greatest producer of WBS trips. The Melbourne LGA produces 32% of all WBS trips within the VISTA study area, even though it contains only 17% of jobs. It is evident that inner city workers make more than their fair share of WBS trips, which is consistent with the industry types which were found to be the main predictors of WBS trips in the previous section (Finance & Business, and Public Administration).
- It is possible that locating in the inner city (or perhaps simply in locations accessible to shops) is a greater determinant of WBS trip making than the industry in which one is employed. It is likely that workers in the CBD generally make more WBS trips, irrespective of their industry of employment. If this is the case, then we would expect the model to under-predict the WBS trip making of inner city workers in these industries, and conversely over-predict elsewhere (as the parameters by industry will be averaged across the entire study area). This theory is supported by the model's under-prediction of trips in the Melbourne LGA by 12%. The role of accessibility to shops may be worth exploring at a later date.
- Generally there is excellent concordance between the surveyed and modelled estimates of WBS trips for each LGA, with an R-Squared of 0.98. Admittedly, this high R-Squared is largely related to the Melbourne LGA falling close to the regression line. If the Melbourne LGA is removed, an R-Squared of 0.87 is achieved.

Referring to the Concentric Region analysis (Figure 18 and Table 8), it can be observed that:

- The model's predictions generally match the survey for each region, with differences falling well within the 95% confidence interval for the true average of trips for each region (except for Regional areas, where the model over-predicts by 20%).
- As with the LGA analysis, the model slightly under-predicts trips from the inner city.

Trips by LGA
Work Based Shopping | Re-estimated Zenith Model



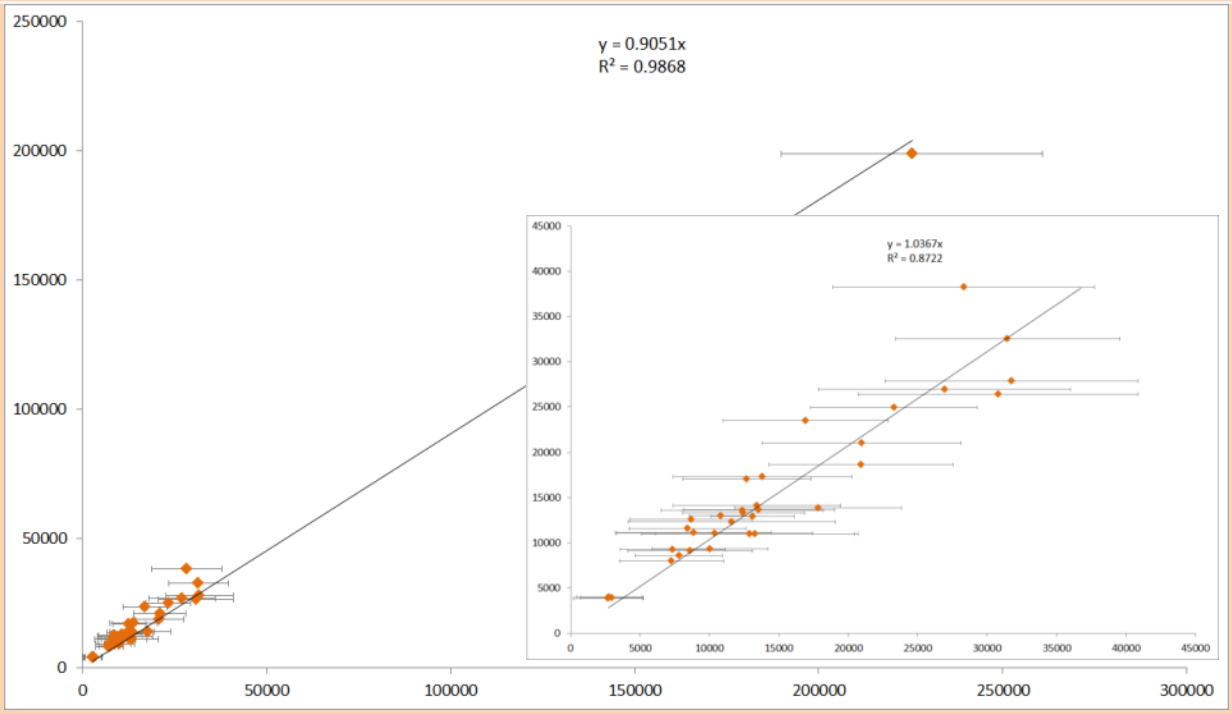


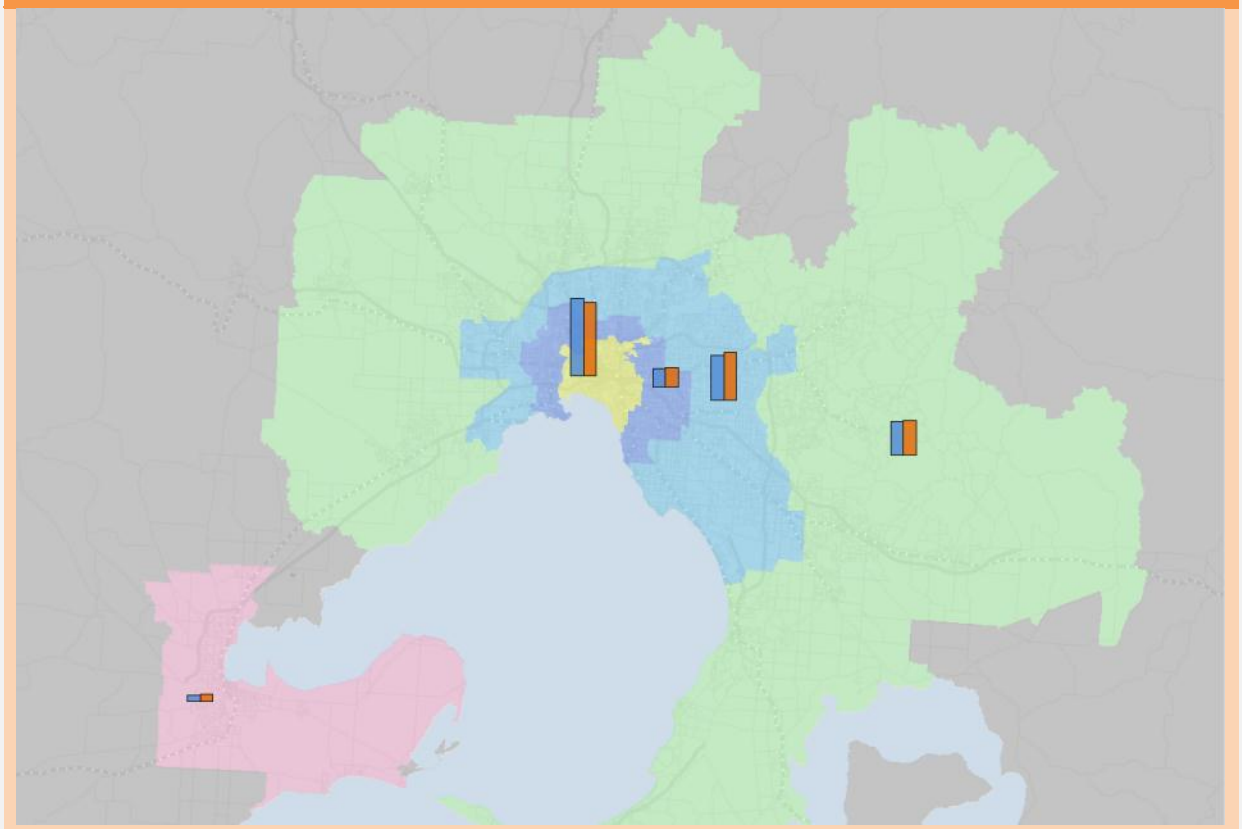
Figure 17 -Comparison of Modelled and Surveyed Trips for Work Based Shopping, By LGA

Sum of TRIPS	VISTA07	Re-estimated-DZ	% Diff	95% C.I.	Unweighted trips in VISTA07 Sample
Ballarat (C)	10,824	13,019	20%	± 21%	172
Banyule (C)	12,436	13,341	7%	± 35%	52
Bayside (C)	7,359	9,240	26%	± 52%	30
Boroondara (C)	31,754	27,857	-12%	± 29%	104
Brimbank (C)	17,822	13,867	-22%	± 34%	54
Cardinia (S)	2,714	3,901	44%	± 93%	5
Casey (C)	11,576	12,312	6%	± 64%	34
Darebin (C)	13,406	14,153	6%	± 45%	49
Frankston (C)	8,846	11,128	26%	± 64%	28
Glen Eira (C)	8,424	11,561	37%	± 50%	32
Greater Bendigo (C)	13,120	12,932	-1%	± 23%	168
Greater Dandenong (C)	16,915	23,528	39%	± 35%	58
Greater Geelong (C)	23,297	24,969	7%	± 26%	156
Hobsons Bay (C)	7,798	8,627	11%	± 40%	33
Hume (C)	13,823	17,320	25%	± 47%	50
Kingston (C)	20,967	21,015	0%	± 34%	69
Knox (C)	20,905	18,651	-11%	± 32%	77
Manningham (C)	7,255	7,975	10%	± 52%	26
Maribyrnong (C)	8,598	9,136	6%	± 52%	35
Maroondah (C)	12,888	11,013	-15%	± 60%	46
Melbourne (C)	225,343	198,720	-12%	± 16%	762
Melton (S)	2,759	4,040	46%	± 86%	14
Monash (C)	31,470	32,557	3%	± 26%	119
Moonee Valley (C)	12,363	13,577	10%	± 47%	42
Moreland (C)	10,371	11,068	7%	± 68%	32
Mornington Peninsula (S)	13,548	13,630	1%	± 40%	55
Nillumbik (S)	2,975	3,943	33%	± 77%	11
Port Phillip (C)	28,315	38,275	35%	± 33%	107
Stonnington (C)	12,681	17,049	34%	± 36%	54
Whitehorse (C)	26,952	26,955	0%	± 34%	99
Whittlesea (C)	10,039	9,333	-7%	± 42%	40
Wyndham (C)	8,687	12,561	45%	± 51%	31
Yarra (C)	30,785	26,419	-14%	± 33%	107
Yarra Ranges (S)	13,266	11,021	-17%	± 54%	35
Grand Total	**700,283**	**704,696**	**1%**		**2,786**

Table 7 - Modelled and Surveyed Trips for Work Based Shopping, by LGA

Trips by Concentric Region

Work Based Shopping | Re-estimated Zenith Model



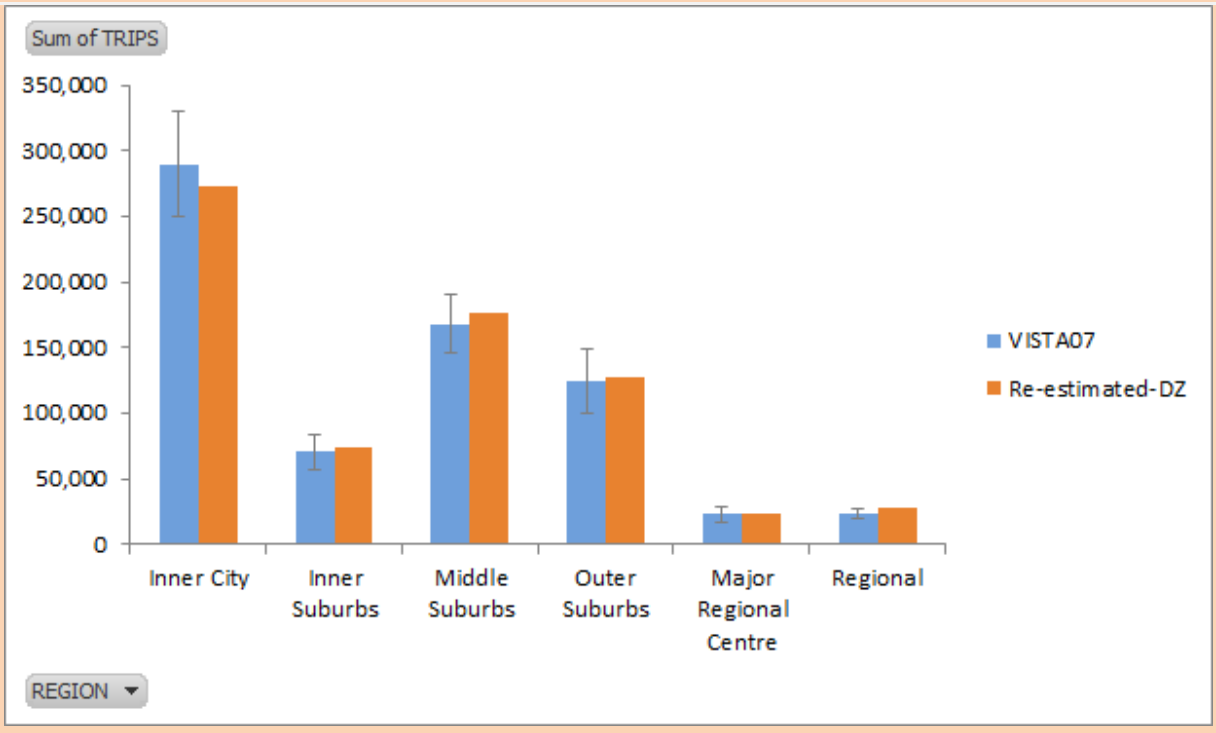


Figure 18 - Modelled and Surveyed Trips for Work Based Shopping, by Concentric Region

Sum of TRIPS	VISTA07	Re-estimated-DZ	% Diff	95% C.I.	Unweighted trips in VISTA07 Sample
Inner City	289,608	273,053	-6%	± 14%	1,001
Inner Suburbs	70,669	74,397	5%	± 19%	246
Middle Suburbs	168,290	177,306	5%	± 13%	613
Outer Suburbs	124,476	127,360	2%	± 19%	430
Major Regional Centre	23,297	23,743	2%	± 26%	156
Regional	23,944	28,837	20%	± 16%	340
Grand Total	700,283	704,696	1%		2,786

Table 8 - Modelled and Surveyed Trips for Work Based Shopping, by Concentric Region

5.4 Work Based Other

5.4.1 Travel Market

This section provides a high level analysis of the market for *Work Based Other* trips, which we will refer to as WBO.

WBO trips occur when an individual who has been working makes a trip for the purpose of recreation, education, picking up or dropping someone off, or accompanying someone (collectively referred to as "other"). Irrespective of the direction of the trip (work to other, or other to work), the trip is referred to as a WBO trip, with the work end referred to as the "Production" end of the trip, and the "other" end referred to as the "Attraction" end. As such, trips can occur from production to attraction, and in reverse from attraction to production.

The focus of the WBO Trip Production model is to predict the number of WBO trips which have their production end in a travel zone.

As such, for a given Travel Zone, A, the model will predict:

> Work **TO** Other Trips **originating** in Zone A
>
> **+**
>
> Other **TO** Work Trips **destined** for Zone A

The breakdown of WBO trips according to the Zenith person classification is seen in Figure 19 below. As with WBO trips, white collar workers are responsible for the bulk (80%) of trips.

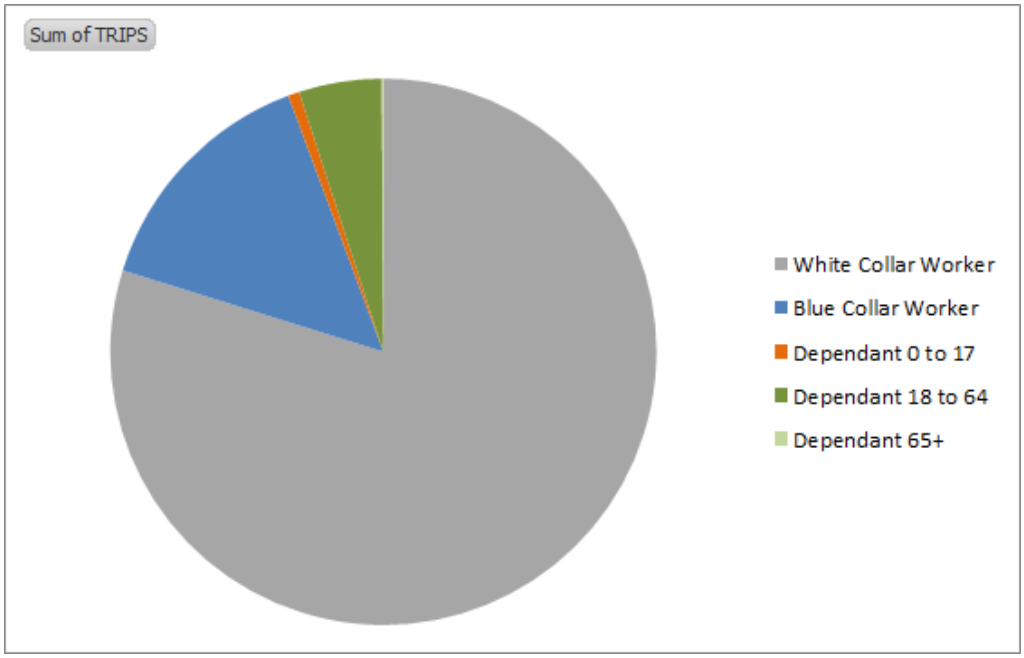


Figure 19 -The Breakdown of Work Based Other Trips by Zenith Person Types

However, unlike WBS, part time workers (particularly white collar part time) make up a significant share of trips (30%), as shown in Figure 20 below.

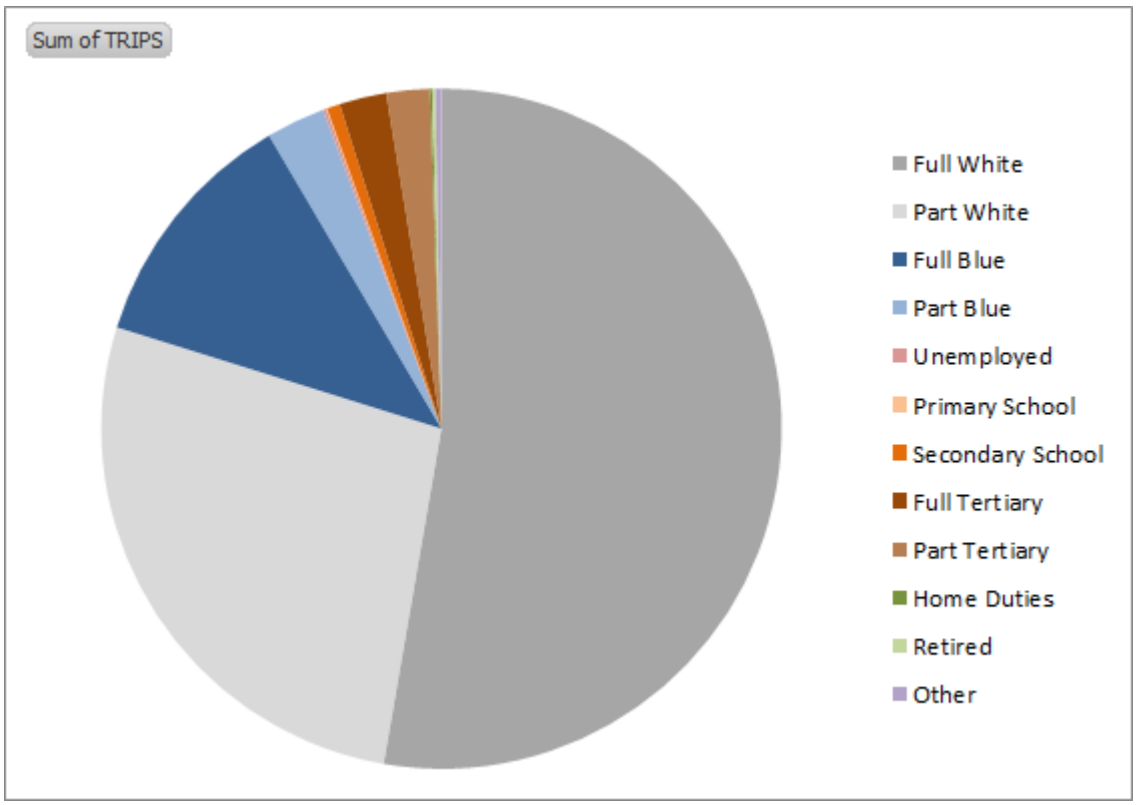


Figure 20 - The Breakdown of Work Based Other Trips by Main Activity Group

In Figure 21, below, we see that white collar workers have a significantly higher trip rate for WBO trips, almost double that of blue collar workers.

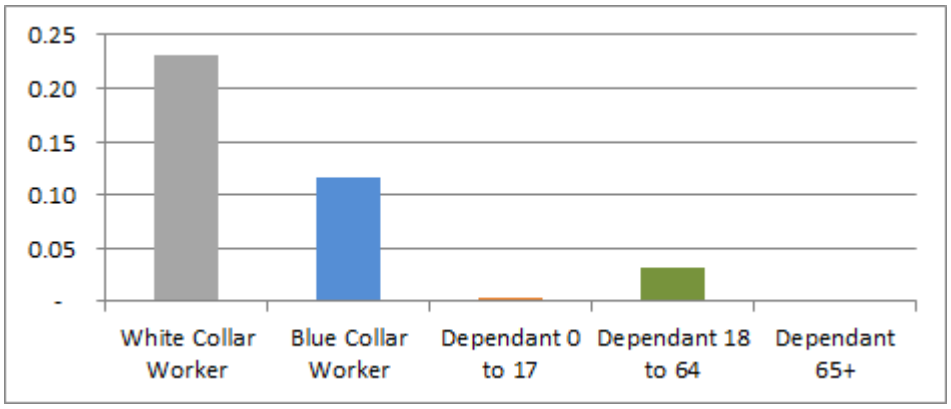


Figure 21 - Trip Rates for Work Based Other by Zenith Person Types

Interestingly, however, part time white collar workers have a higher trip rate than their full time counterparts, despite the fact that they work less often, and thus have fewer opportunities to make work based trips. It is also interesting to note the high trip rate for part time tertiary students. In Non-Home Based travel, education is grouped into "other"; as such, trips between education and work are defined as WBO trips. These trips are presumably common for part time tertiary students.

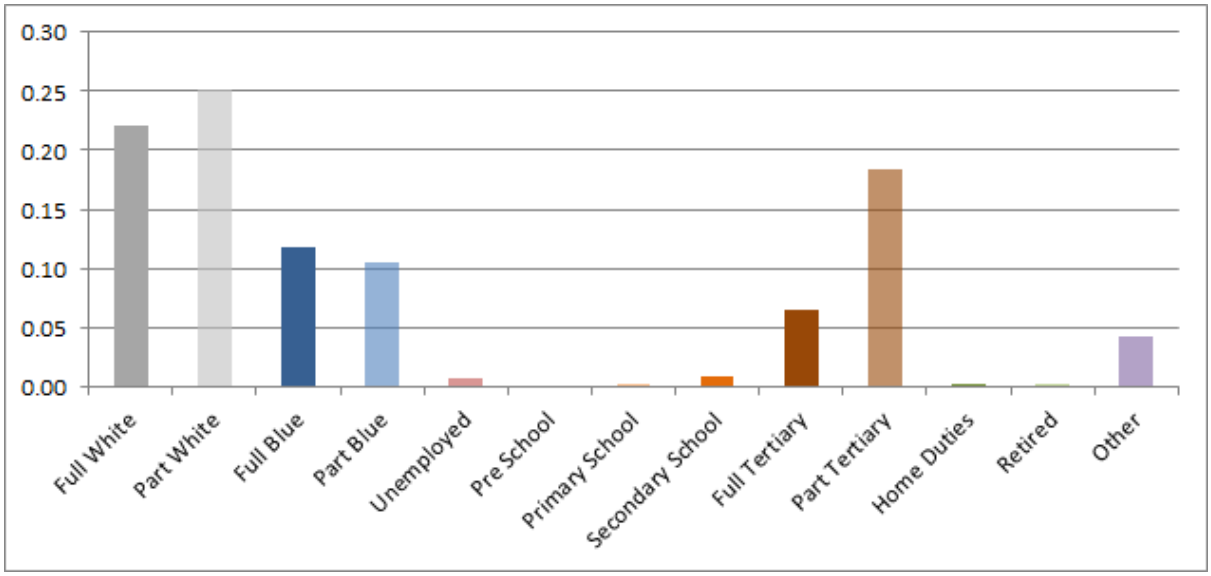


Figure 22 - Trip Rates for Work Based Other by Main Activity Group

5.4.2 Model Estimation

The Trip Production model for WBO trips has been re-estimated, with the resulting model parameters presented in Table 9 below. The parameter estimates are then compared in Figure 23.

Parameter	Re-estimated-DZ PARAMETER ESTIMATE	T-STATISTIC	P-VALUE	STANDARD ERROR
EMP - Communications	0.119	1.217	0.224	0.098
EMP - Community Services	0.198	7.494	0.000	0.026
EMP - Construction	0.623	5.285	0.000	0.118
EMP - Electricity Gas & Water	0.153	0.613	0.540	0.250
EMP - Finance & Business	0.183	8.385	0.000	0.022
EMP - Public Administration	0.344	6.767	0.000	0.051
EMP - Retailing	0.184	5.136	0.000	0.036
EMP - Transport & Storage	0.119	2.910	0.004	0.041
EMP - Wholesaling	0.496	5.728	0.000	0.087
ENROLMENTS - Secondary	0.038	1.700	0.091	0.022
ENROLMENTS - Tertiary	0.040	4.940	0.000	0.008

Table 9 - Model Parameters for Work Based Other

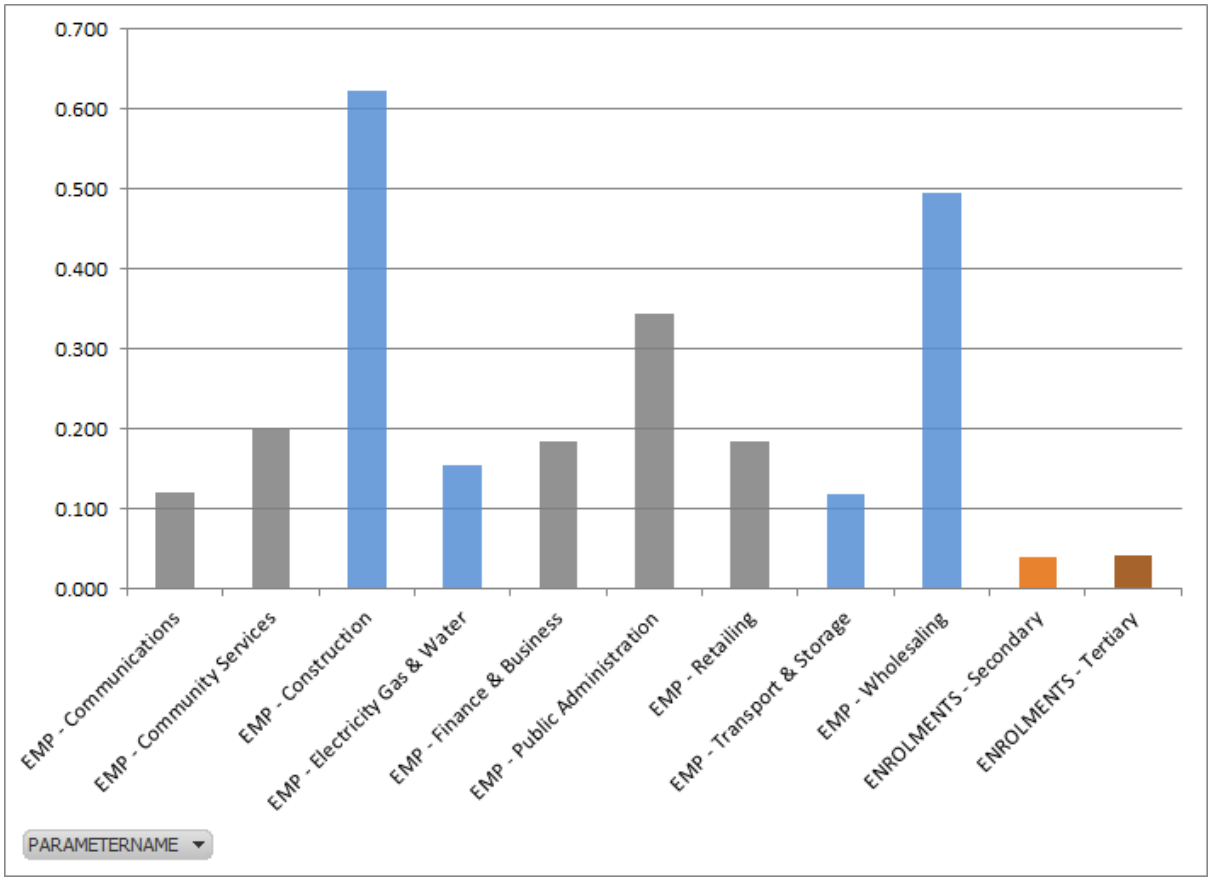


Figure 23 - Model Parameters for Work Based Other

A wide range of industries have been found to be significant producers of WBO trips; notably, Construction, Wholesaling and Public Administration have the highest trip rates.

I don't have a ready explanation for these trip parameters; thoughts are welcome! I have explored whether these industries have a higher proportion of part time workers (given the higher trip rate for part time workers), but perhaps unsurprisingly, these industries have some of the highest average hours worked per week (based on ABS Census – Hours Worked by Industry for Melbourne), suggesting low incidence of part time work.

Given our current lack of understanding, it is entirely possible that these estimated parameters are an artefact of a small survey sample, the effect of outliers, or our non-inclusion one or more key variables which influence the production of WBO trips.

Given this, we must give careful attention to the ability of the model to replicate the survey results, which will be explored in the model validation section which follows.

5.4.3 Model Validation

The re-estimated model has been applied to the study area of the VISTA07 survey, with predicted and actual trips compared at various levels of spatial aggregation.

Referring to the LGA analysis (Figure 24 and Table 10), it can be observed that:

- As with WBW and WBS, the Melbourne LGA is the largest producer of WBO trips, comprising 16% of all trips. This proportion is significantly less than that observed for WBS (32%), but equal to the proportion observed for WBW.
- The Monash LGA is the second largest producer (8% of trips), which can be explained in terms of students (of Monash University) finding employment in the Monash area. Trips between the university and work would be defined as WBO trips (though the trips are *produced* at the places of work, rather than the university; the trips would be *attracted* to the university). Given that proximity to a university does not factor into our model, it is unsurprising that the model under-predicts WBO trips for the Monash LGA, by 34% (falling outside the 95% confidence interval). Inclusion of a variable which measures accessibility to "other" activities (including education) might be considered at a later date.
- The WBO model is less able to replicate the survey than was the case in WBW and WBS. An R-Squared of 0.92 is achieved, though this is distorted by the model's correct prediction for the Melbourne LGA. Excluding the Melbourne LGA, an R-Squared of 0.58 is achieved, with 4 of the 34 LGAs falling outside of the 95% confidence bounds.

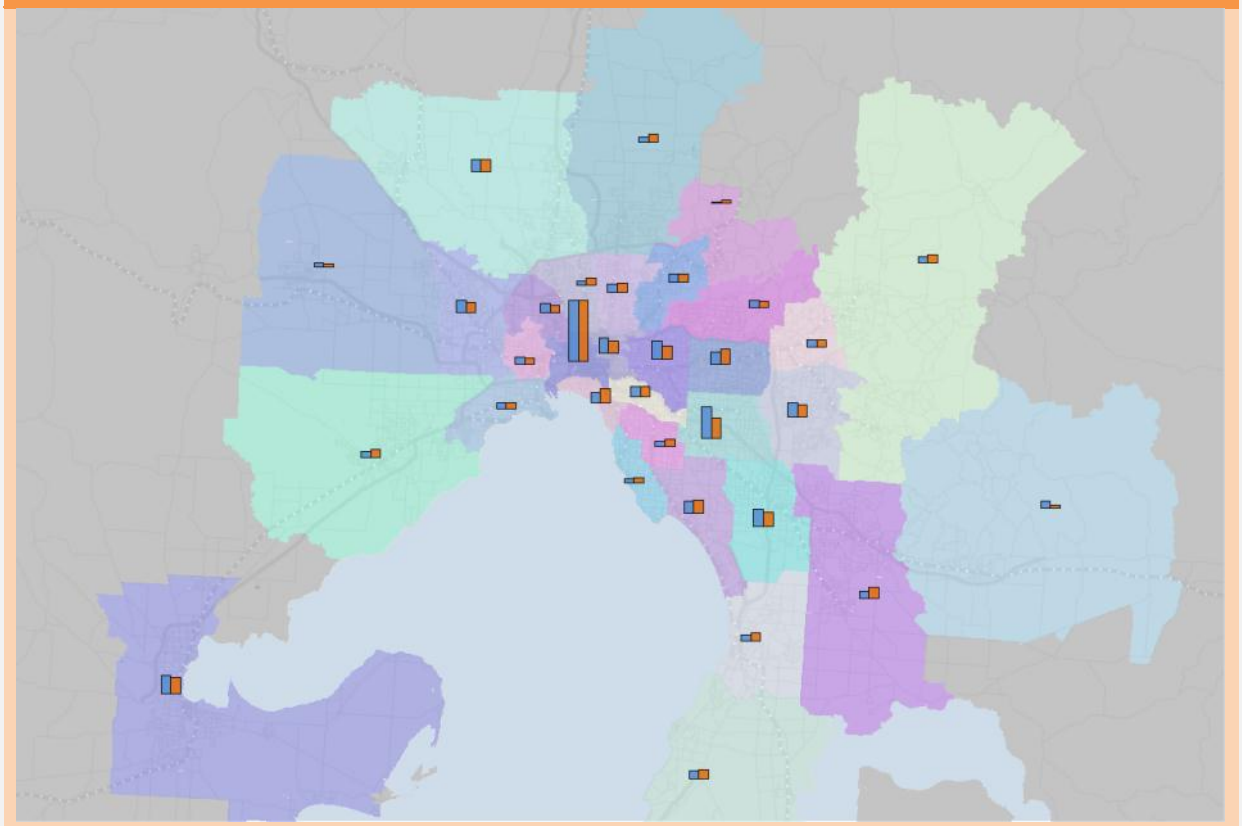
Referring to the Concentric Region analysis (Figure 25 and Table 11), it can be observed that:

- The model accurately replicates the overall surveyed trips for the inner city and inner suburbs, but under-predicts the middle suburbs (containing the Monash LGA, as discussed above), and over-predicts the outer suburbs.

Our lack of understanding of the model parameters for WBO, combined with the validation analysis presented above suggests that:

- The model can be relied upon to produce roughly the right amount of WBO trips, and in roughly the right areas.
- It may, however, fail to correctly predict the sensitivity of WBO trip making in response to changes in the composition of industry types, or the spatial distribution of "other" activities.
- Given that WBO trips only account for 3% of total resident travel, this is considered a minor issue which could be explored at a later date.

Trips by LGA
Work Based Other | Re-estimated Zenith Model



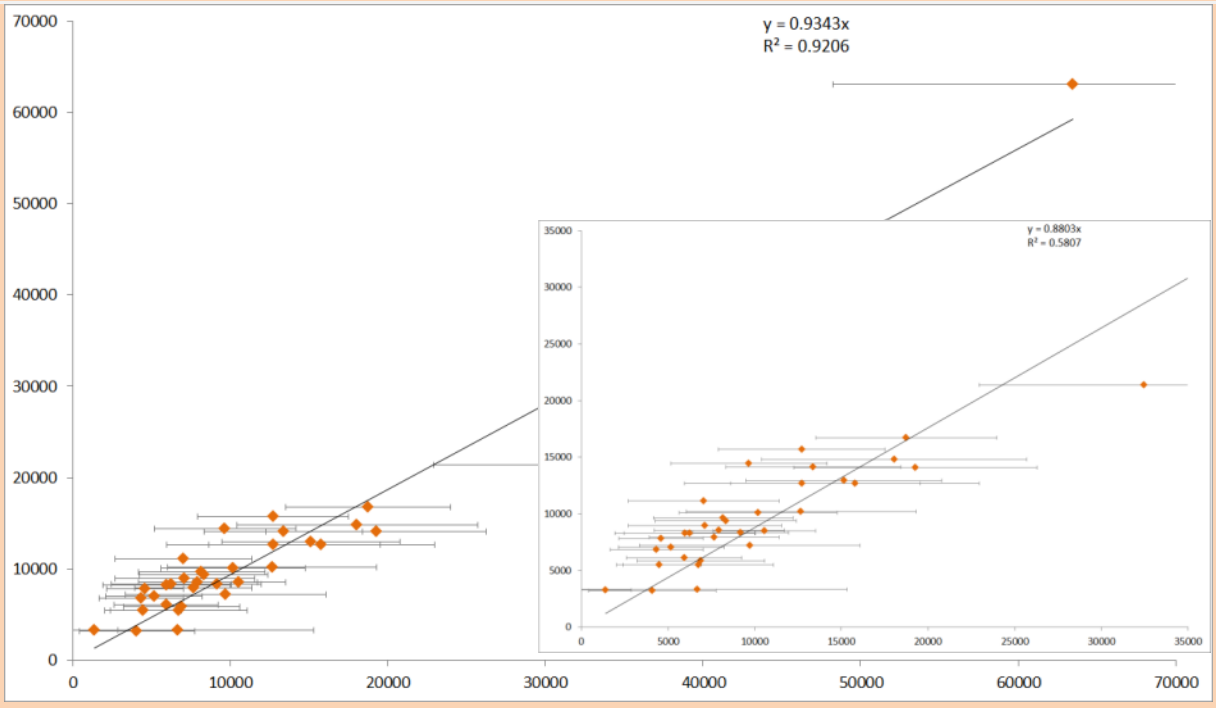


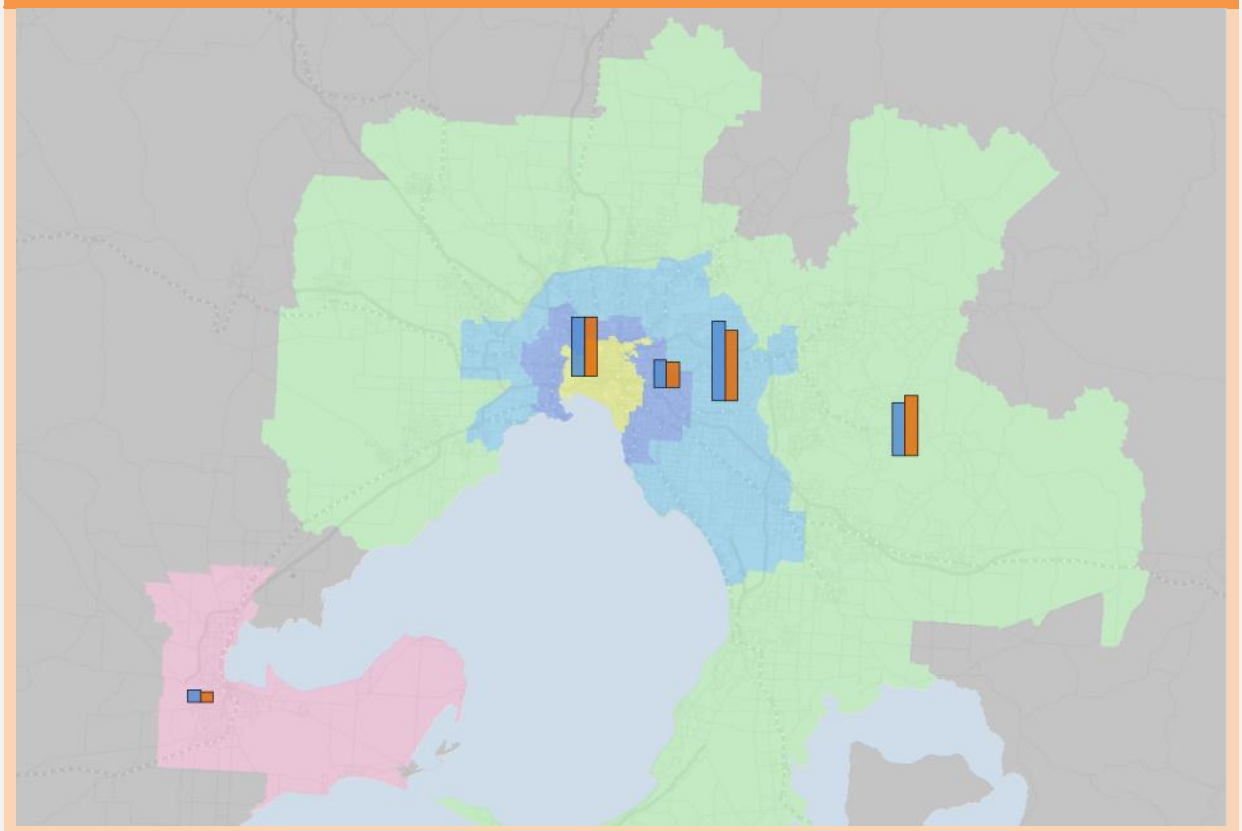
Figure 24 - Modelled and Surveyed Trips for Work Based Other, by LGA

Sum of TRIPS	VISTA07	Re-estimated-DZ	% Diff	95% C.I.	Unweighted trips in VISTA07 Sample
Ballarat (C)	9,189	8,366	-9%	± 30%	138
Banyule (C)	7,950	8,549	8%	± 47%	34
Bayside (C)	4,485	5,492	22%	± 55%	18
Boroondara (C)	19,265	14,102	-27%	± 36%	77
Brimbank (C)	12,672	10,211	-19%	± 52%	40
Cardinia (S)	6,694	3,316	-50%	± 129%	7
Casey (C)	7,049	11,120	58%	± 62%	20
Darebin (C)	8,183	9,652	18%	± 49%	32
Frankston (C)	5,972	8,272	39%	± 68%	20
Glen Eira (C)	5,181	7,033	36%	± 59%	22
Greater Bendigo (C)	10,559	8,513	-19%	± 28%	111
Greater Dandenong (C)	18,049	14,804	-18%	± 42%	58
Greater Geelong (C)	18,747	16,748	-11%	± 28%	113
Hobsons Bay (C)	5,931	6,100	3%	± 56%	28
Hume (C)	12,741	12,687	0%	± 53%	42
Kingston (C)	13,380	14,149	6%	± 38%	48
Knox (C)	15,146	12,961	-14%	± 37%	46
Manningham (C)	6,749	5,483	-19%	± 64%	27
Maribyrnong (C)	6,902	5,851	-15%	± 53%	25
Maroondah (C)	7,658	7,920	3%	± 49%	25
Melbourne (C)	63,465	63,079	-1%	± 24%	241
Melton (S)	4,087	3,210	-21%	± 90%	15
Monash (C)	32,476	21,373	-34%	± 29%	113
Moonee Valley (C)	9,709	7,204	-26%	± 66%	26
Moreland (C)	4,336	6,820	57%	± 62%	16
Mornington Peninsula (S)	8,331	9,395	13%	± 49%	29
Nillumbik (S)	1,394	3,275	135%	± 106%	6
Port Phillip (C)	9,670	14,423	49%	± 46%	38
Stonnington (C)	10,188	10,126	-1%	± 45%	36
Whitehorse (C)	12,713	15,707	24%	± 38%	52
Whittlesea (C)	4,607	7,827	70%	± 53%	19
Wyndham (C)	7,120	8,971	26%	± 62%	25
Yarra (C)	15,779	12,693	-20%	± 45%	51
Yarra Ranges (S)	6,259	8,304	33%	± 60%	22
Grand Total	**392,634**	**383,738**	**-2%**		**1,620**

Table 10 - Modelled and Surveyed Trips for Work Based Other, by LGA

Trips by Concentric Region

Work Based Other | Re-estimated Zenith Model



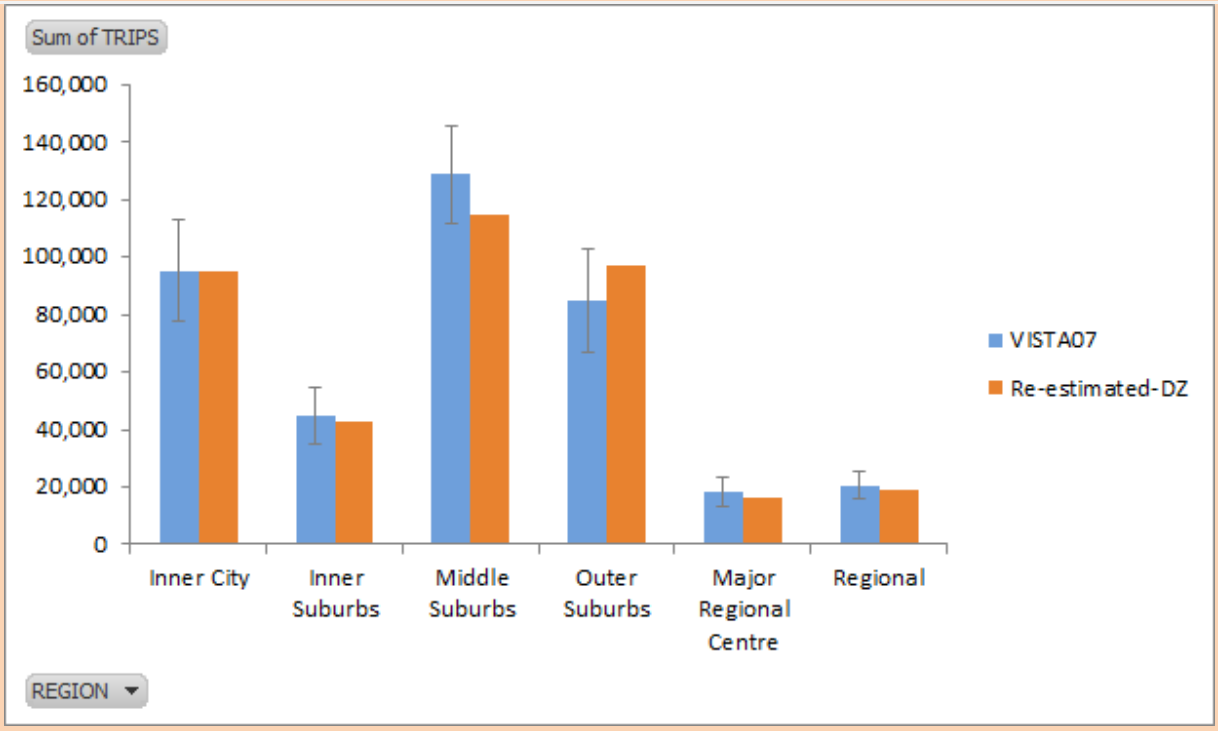


Figure 25 - Modelled and Surveyed Trips for Work Based Other, by Concentric Region

Sum of TRIPS	VISTA07	Re-estimated-DZ	% Diff	95% C.I.	Unweighted trips in VISTA07 Sample
Inner City	95,099	94,816	0%	± 19%	350
Inner Suburbs	44,799	42,666	-5%	± 22%	164
Middle Suburbs	128,693	114,355	-11%	± 13%	470
Outer Suburbs	85,002	96,891	14%	± 21%	272
Major Regional Centre	18,436	16,355	-11%	± 28%	111
Regional	20,606	18,656	-9%	± 22%	253
Grand Total	392,634	383,738	-2%		1,620

Table 11 - Modelled and Surveyed Trips for Work Based Other, by Concentric Region

5.5 Shopping Based Shopping

5.5.1 Travel Market

This section provides a high level analysis of the market for *Shopping Based Shopping* trips, which we will refer to as SBS.

SBS trips occur when someone shops at one location and then travels to shop at another.

The breakdown of WBS trips according to the Zenith person classification is seen in Figure 26 below.

White collar workers are responsible for the largest number of SBS trips, making up 35% of all trips. However, unlike the work based purposes, dependants make up a significant portion of the SBS market, accounting for over half of all trips.

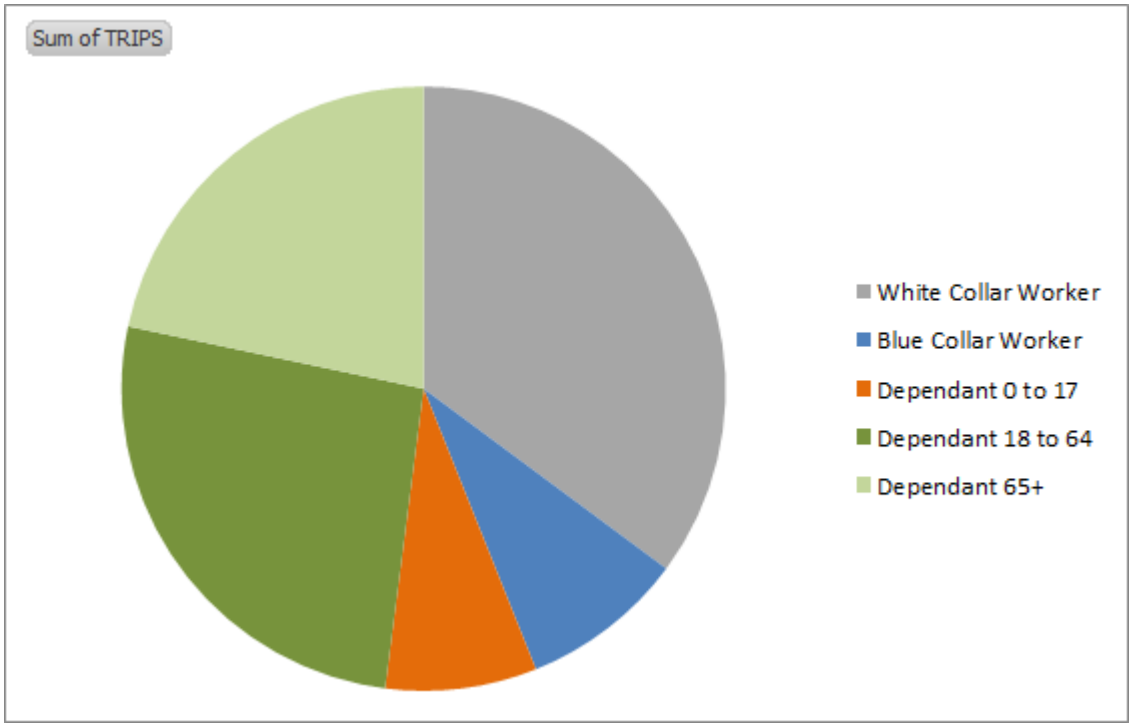


Figure 26 -The Breakdown of Shopping Based Shopping Trips by Zenith Person Types

By further disaggregating these person types by Main Activity group (Figure 27 below), we can see that retirees are responsible for a large share (29%) of SBS trips. It is also notable that part time white collar workers make as many SBS trips as full time workers, despite full time workers outnumbering part time workers by over two-to-one.

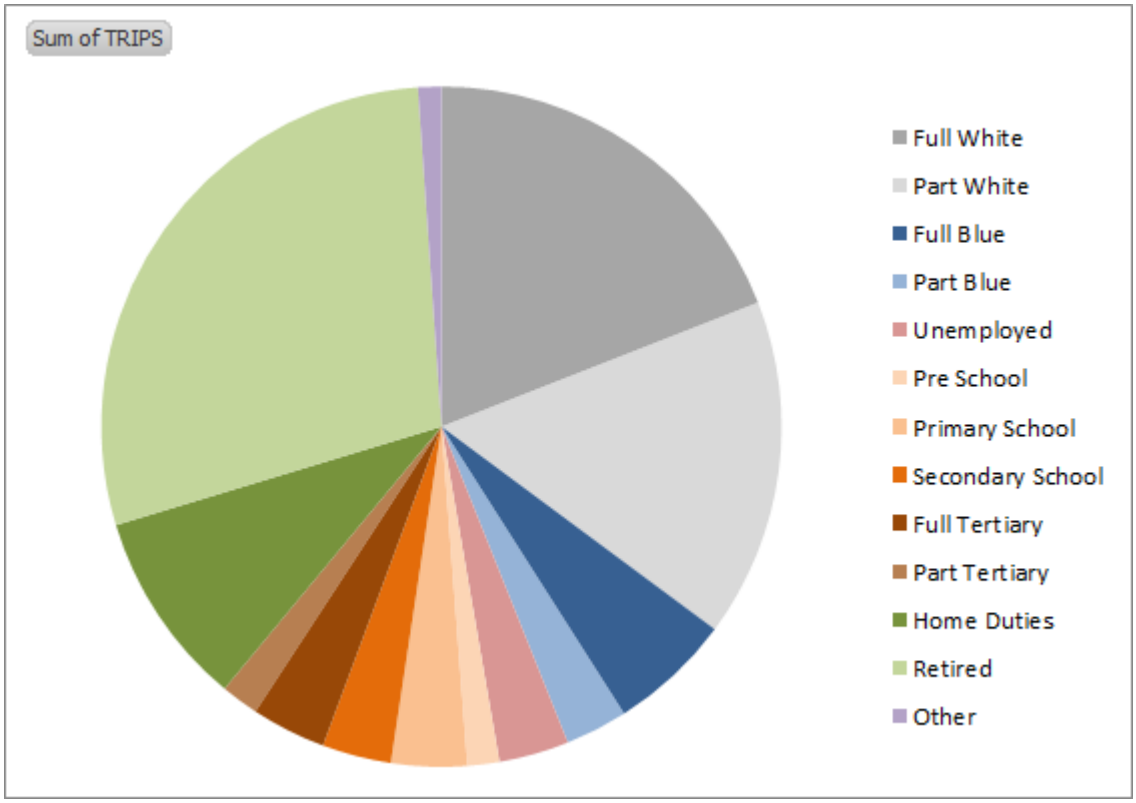


Figure 27 - The Breakdown of Shopping Based Shopping Trips by Main Activity Group

Figure 28 below presents the SBS trip rates for each of the Zenith person types. It is evident that dependants - particularly adult dependants – are much more likely to make SBS trips, with an average trip rate of around 0.36 – 0.40. White and blue collar workers average only 0.21 and 0.15 trips per day respectively, while dependants aged 0-17 average only 0.08.

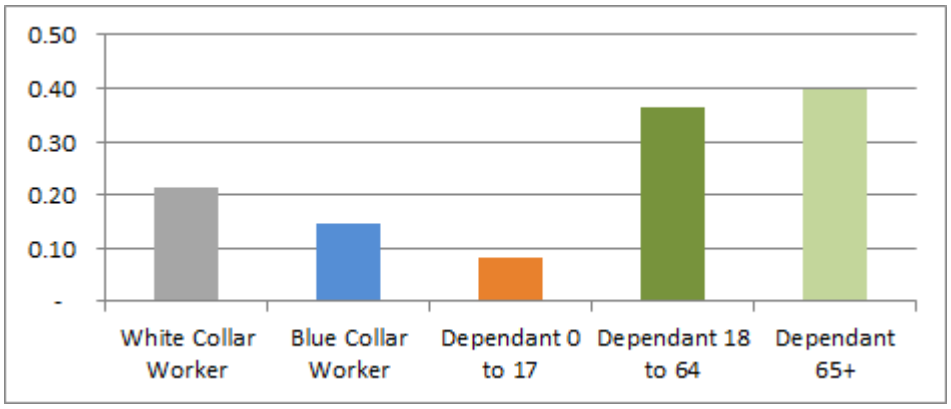


Figure 28 - Trip Rates for Shopping Based Shopping by Zenith Person Types

There is heterogeneity within these groups, however, as illustrated in Figure 29 below. As expected, retirees, and those engaged in home duties are most likely to undertake SBS trips. It is also interesting to note the large difference between part and full time workers, and part and full time tertiary students. Part time workers are nearly twice as likely to undertake a SBS trip, relative to their full time counterparts. Likewise, the trip rate for part time tertiary students is 55% larger than full time students.

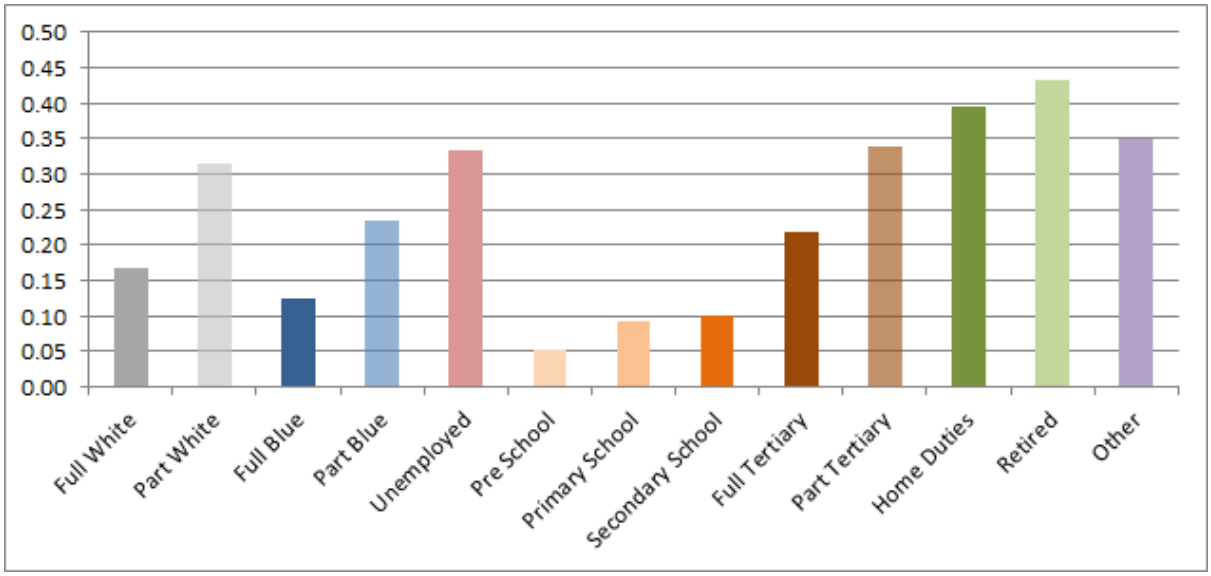


Figure 29 - Trip Rates for Shopping Based Shopping by Main Activity Group

5.5.2 Model Estimation

The Trip Production model for SBS has been re-estimated, with the resulting model parameters presented in Table 12 below. The model parameters are then compared in Figure 30.

Parameter	Re-estimated-DZ PARAMETER ESTIMATE	T-STATISTIC	P-VALUE	STANDARD ERROR
HOUSEHOLDS	0.190	14.431	0.000	0.013
EMP - Community Services	0.178	5.514	0.000	0.032
EMP - Public Administration	0.144	2.296	0.022	0.063
EMP - Recreation & Personal Services	0.529	7.420	0.000	0.071
EMP - Retailing	1.084	20.228	0.000	0.054

Table 12 - Model Parameters for Shopping Based Shopping

Referring to Figure 30, it can be observed that retail employment is the key predictor of SBS trips. Places with high levels of retail employment will be more likely to produce SBS trips. On average, each retail job will generate 1.084 SBS trips.

Recreational & Personal Services jobs also have a strong influence on SBS trips, generating 0.529 trips per job; public administration, community services, and households also generate a small number of trips.

The inclusion of households as a variable may indicate that SBS trips are more likely to occur in suburban regions than employment centres. This might be worthy of further exploration at a later date.

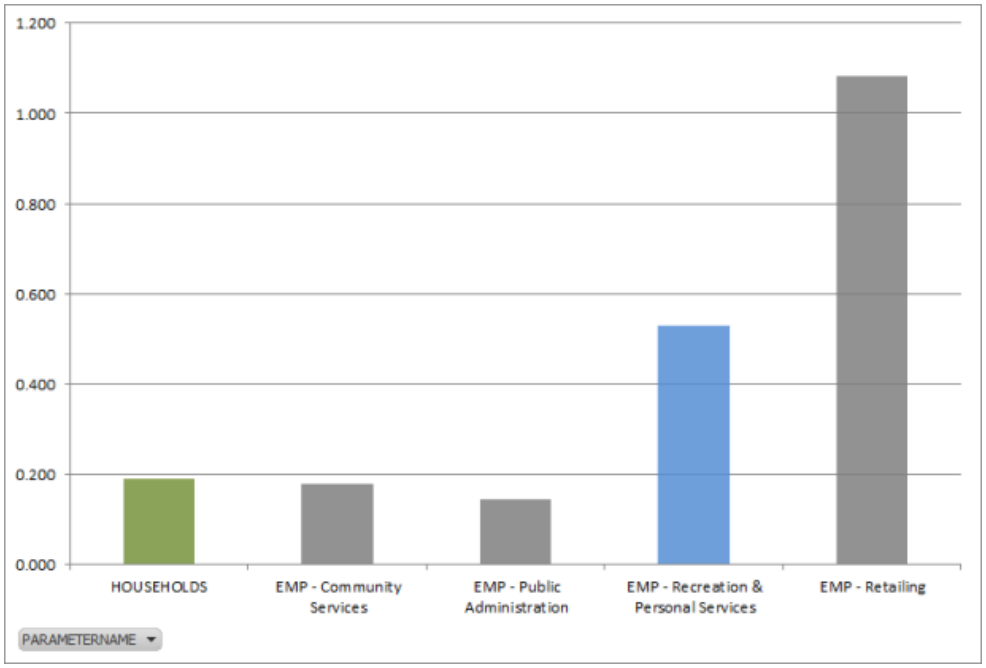


Figure 30 - Model Parameters for Shopping Based Shopping

5.5.3 Model Validation

The re-estimated model has been applied to the study area of the VISTA07 survey, with predicted and actual trips compared at various levels of spatial aggregation.

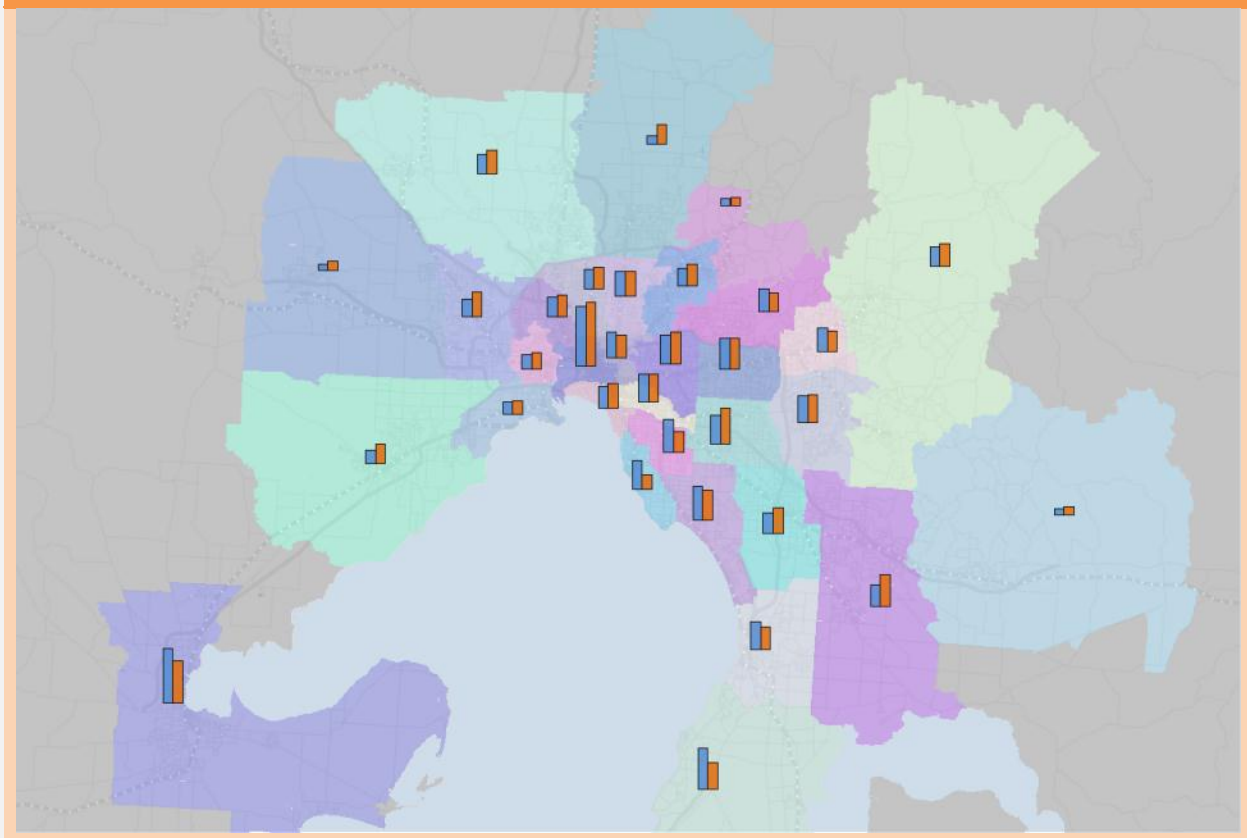
Referring to the LGA analysis (Figure 31 and Table 13), it can be observed that:

- Compared with the work based purposes, SBS are much more evenly spread across Melbourne. Though the Melbourne LGA is still the largest producer of trips, its role is less significant, making up only 7% of total trips, as compared with 17+% for the work based purposes,
- Generally, the inner LGAs, and LGAs in the east and south-east are the largest producer of SBS trips,
- Generally, the model does a reasonable job of replicating the survey estimates, with an R-Squared of 0.60.
- There are, however, a number of areas where the model could improve:
  - The model is generally slightly high in the western and outer northern suburbs
  - The model is low in the LGAs which hug the south-eastern coastline (down to the Mornington Peninsular). The LGAs of Bayside, Glen Eira, and the Mornington Pensinsular are particularly low, with Kingston and Frankston slightly low. The explanation is likely to be found in the socio-economic characteristics of those areas. Generally speaking, the coastal LGAs will comprise an above average proportion of retirees (who have been shown to have the highest SBS trip rates). In Glen Eira and Bayside, income may also play a role; we might postulate income has a positive influence on SBS trips (though we have not investigated this as yet). Generally speaking, the coastal strip is also a significant attractor for day trippers (from Melbourne), who might undertake recreational shopping (again, not investigated as yet). This may be worth exploring at a later date.
  - The role of "high streets" in SBS travel has not yet been explored, but it is likely that they have a greater influence on SBS trip rates than can be explained through their levels of retail employment.

Referring to the Concentric Region analysis (Figure 32 and Table 14), it can be observed that:

- The model and survey are generally in agreement, though the model has a tendency to under-predict SBS trips in the Major Regional Centre (Geelong), and the Regional areas (Bendigo and Ballarat). It is likely that the compact nature of these areas (relative to the sprawl of Melbourne) makes shop-hopping easier. It may be worth exploring this at a later date.

Trips by LGA
Shopping Based Shopping | Re-estimated Zenith Model



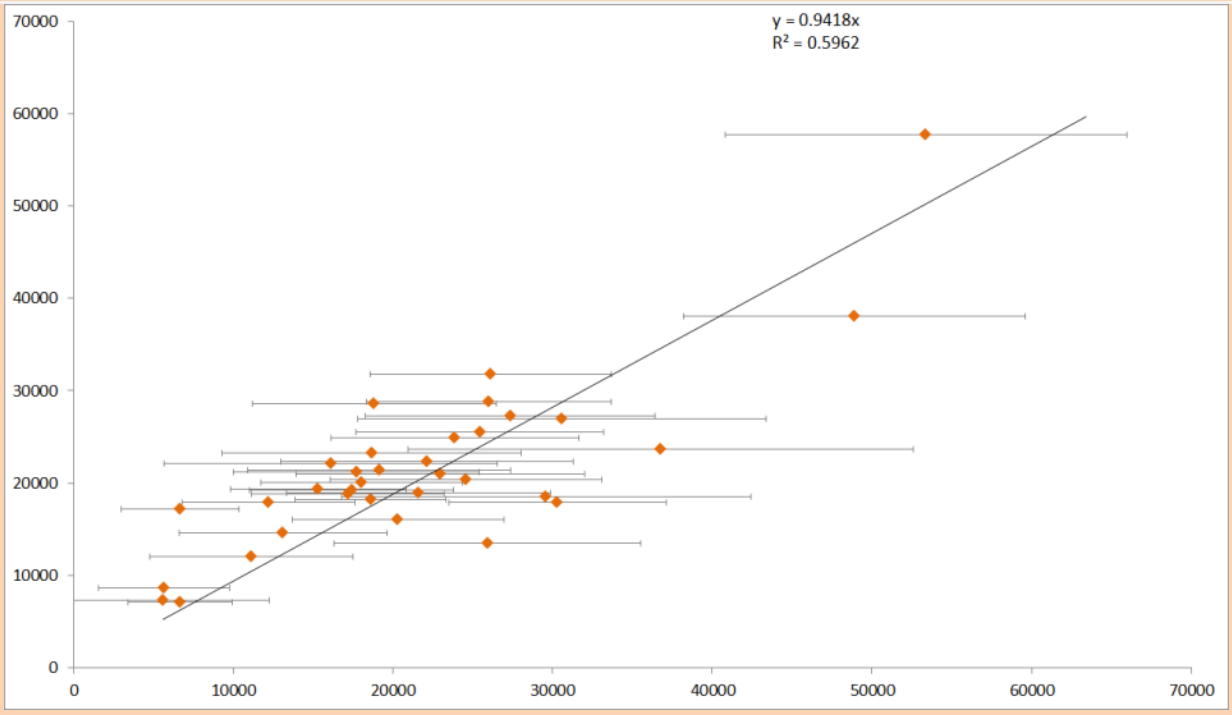
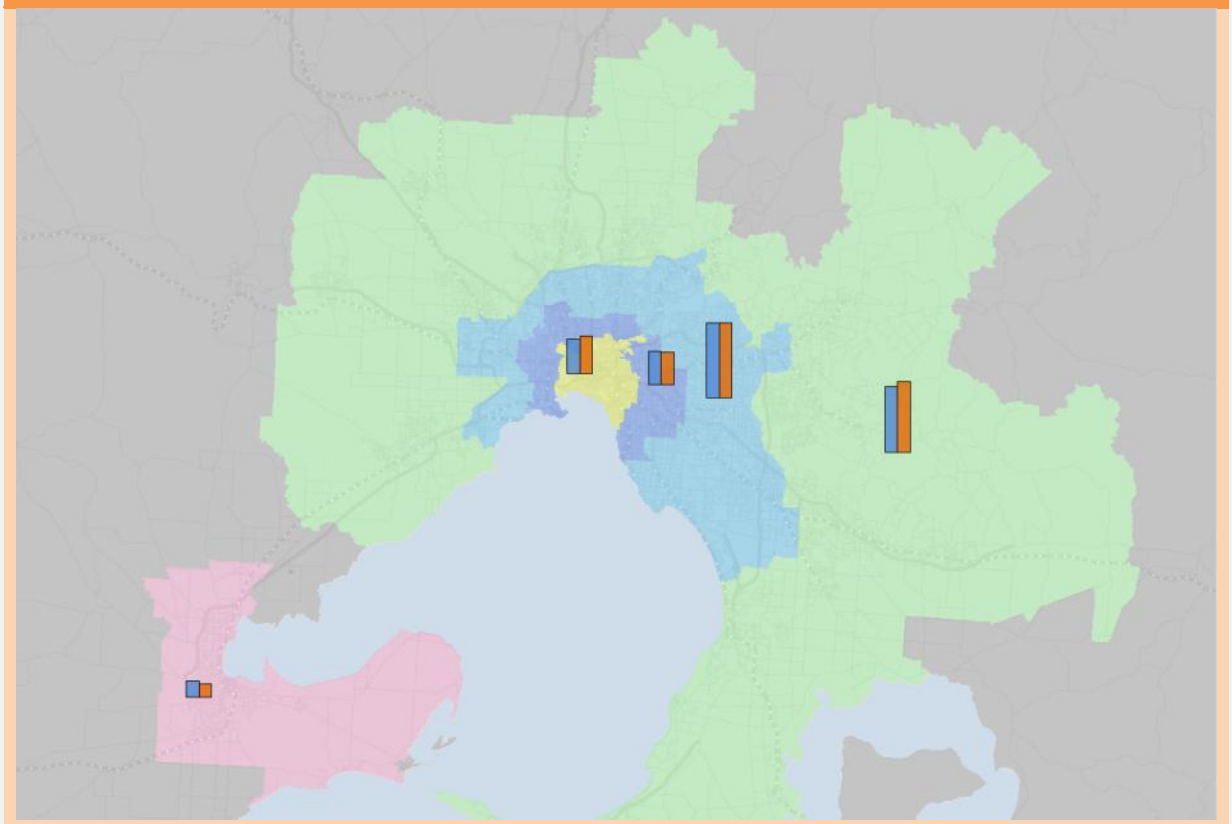


Figure 31 - Modelled and Surveyed Trips for Shopping Based Shopping, by LGA

Sum of TRIPS	VISTA07	Re-estimated-DZ	% Diff	95% C.I.	Unweighted trips in VISTA07 Sample
Ballarat (C)	30,309	17,941	-41%	± 23%	667
Banyule (C)	15,316	19,327	26%	± 36%	113
Bayside (C)	25,922	13,430	-48%	± 37%	162
Boroondara (C)	26,014	28,839	11%	± 29%	160
Brimbank (C)	16,103	22,160	38%	± 65%	58
Cardinia (S)	5,587	7,351	32%	± 120%	11
Casey (C)	18,819	28,613	52%	± 41%	83
Darebin (C)	22,135	22,334	1%	± 41%	139
Frankston (C)	24,581	20,387	-17%	± 35%	150
Glen Eira (C)	29,585	18,559	-37%	± 43%	144
Greater Bendigo (C)	18,609	18,204	-2%	± 25%	368
Greater Dandenong (C)	18,669	23,285	25%	± 50%	99
Greater Geelong (C)	48,894	38,104	-22%	± 22%	544
Hobsons Bay (C)	11,159	12,082	8%	± 57%	56
Hume (C)	17,733	21,208	20%	± 43%	80
Kingston (C)	30,577	26,950	-12%	± 42%	173
Knox (C)	23,888	24,872	4%	± 33%	156
Manningham (C)	20,315	16,049	-21%	± 33%	160
Maribyrnong (C)	13,125	14,646	12%	± 50%	65
Maroondah (C)	21,588	18,900	-12%	± 38%	159
Melbourne (C)	53,389	57,699	8%	± 24%	336
Melton (S)	5,683	8,681	53%	± 72%	28
Monash (C)	26,119	31,814	22%	± 29%	176
Moonee Valley (C)	17,192	18,782	9%	± 35%	103
Moreland (C)	17,432	19,220	10%	± 37%	109
Mornington Peninsula (S)	36,762	23,704	-36%	± 43%	198
Nillumbik (S)	6,677	7,142	7%	± 49%	44
Port Phillip (C)	19,146	21,394	12%	± 43%	98
Stonnington (C)	25,453	25,475	0%	± 30%	145
Whitehorse (C)	27,363	27,234	0%	± 33%	210
Whittlesea (C)	6,683	17,143	157%	± 55%	44
Wyndham (C)	12,210	17,919	47%	± 44%	80
Yarra (C)	22,986	20,971	-9%	± 39%	132
Yarra Ranges (S)	18,042	20,074	11%	± 35%	104
Grand Total	734,066	730,494	0%		5,354

Table 13 - Modelled and Surveyed Trips for Shopping Based Shopping, by LGA

Trips by Concentric Region
Shopping Based Shopping | Re-estimated Zenith Model



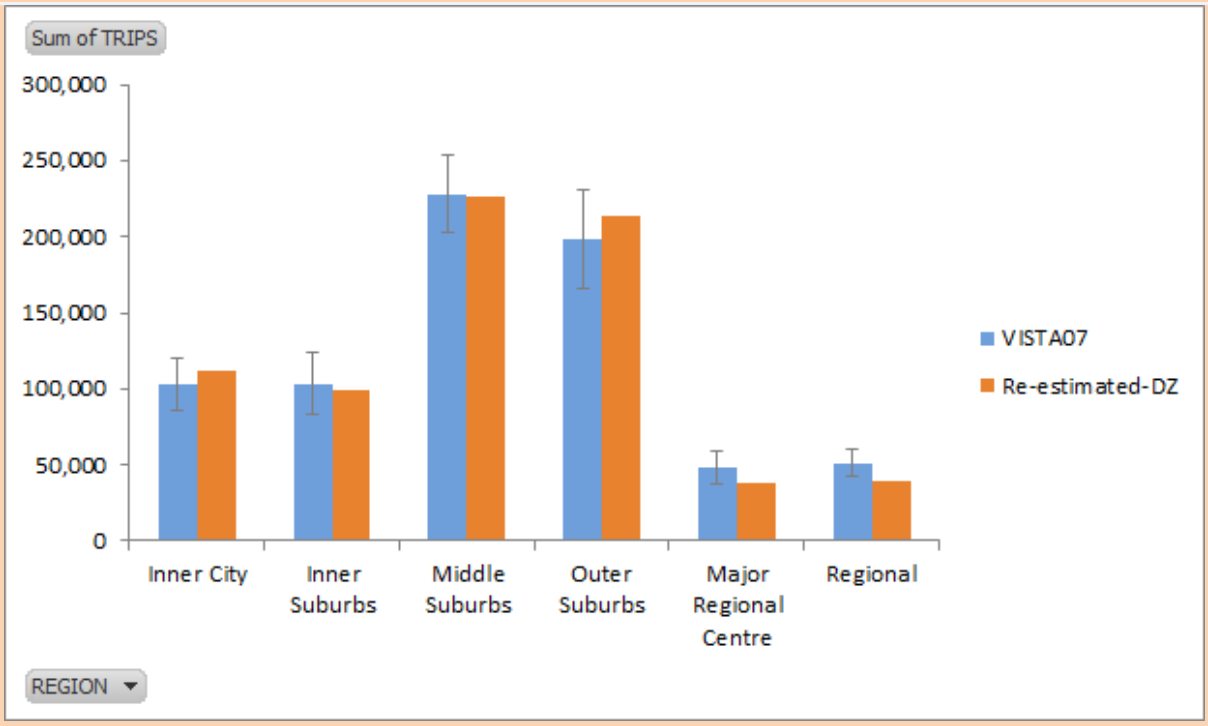


Figure 32 - Modelled and Surveyed Trips for Shopping Based Shopping, by Concentric Region

Sum of TRIPS	VISTA07	Re-estimated-DZ	% Diff	95% C.I.	Unweighted trips in VISTA07 Sample
Inner City	103,219	112,350	9%	± 17%	609
Inner Suburbs	103,590	99,550	-4%	± 19%	615
Middle Suburbs	228,216	226,680	-1%	± 11%	1,444
Outer Suburbs	198,783	214,188	8%	± 16%	1,097
Major Regional Centre	48,798	37,698	-23%	± 22%	542
Regional	51,460	40,027	-22%	± 17%	1,047
Grand Total	734,066	730,494	0%		5,354

Table 14 - Modelled and Surveyed Trips for Shopping Based Shopping, by Concentric Region

5.6 Shopping Based Other

5.6.1 Travel Market

This section provides a high level analysis of the market for *Shopping Based Other* trips, which we will refer to as SBO.

SBO trips occur when an individual who has been shopping makes a trip for the purpose of recreation, education, picking up or dropping someone off, or accompanying someone (collectively referred to as "other"). Irrespective of the direction of the trip (shopping to other, or other to shopping), the trip is referred to as a SBO trip, with the shopping end referred to as the "Production" end of the trip, and the "other" end referred to as the "Attraction" end. As such, trips can occur from production to attraction, and in reverse from attraction to production.

The focus of the SBO Trip Production model is to predict the number of SBO trips which have their *production* end in a travel zone.

As such, for a given Travel Zone, A, the model will predict:

Shopping **TO** Other Trips **originating** in Zone A

+

Other **TO** Shopping Trips **destined** for Zone A

The breakdown of SBO trips according to the Zenith person classification is seen in Figure 33 below. Dependants are the largest makers of SBO trips, with dependants aged 0-17 and 18-64 accounting for just over half of all trips. Dependants 0-17 play a far greater role than they have in previous purposes. This is due to education, recreation and accompanying someone being part of "other".

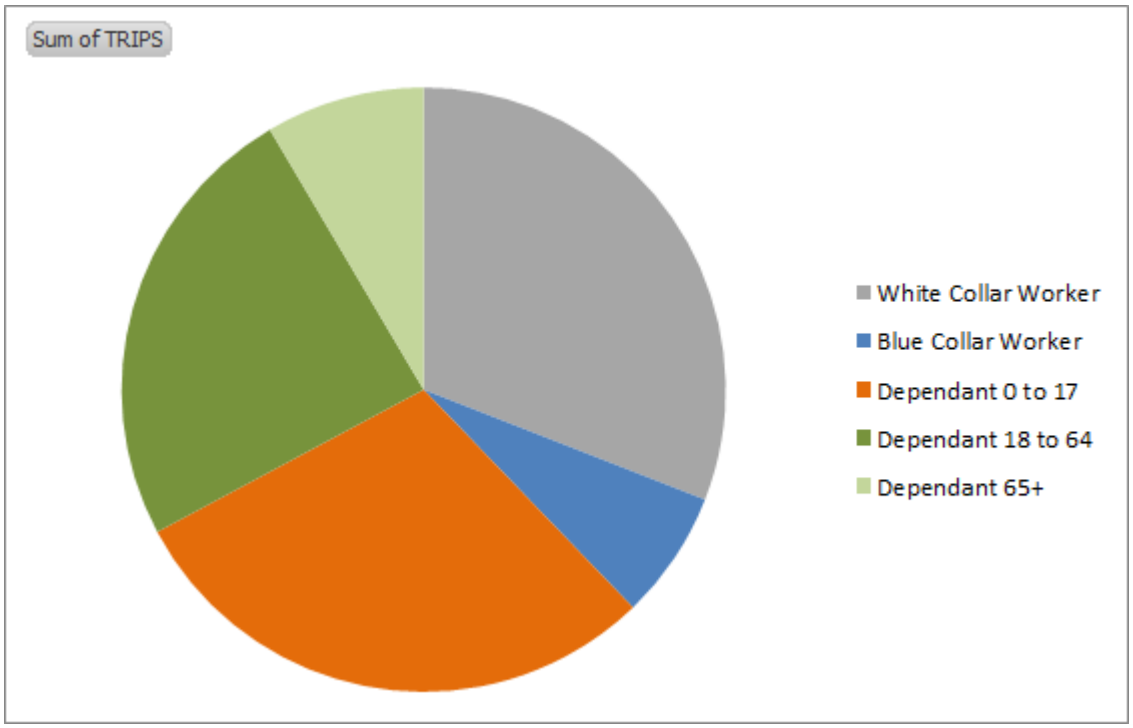


Figure 33 -The Breakdown of Shopping Based Other Trips by Zenith Person Types

Further disaggregation of the SBO market by Main Activity group reveals that primary school and pre-school (not yet at school) children make up a significant part of the market (22%). These children are most likely accompanying their parents as they drop in at the shops on the way to or from school (shopping to/from education). Their parents (most likely identified as home duties or part time work) will also be recorded as making a SBO trip (shopping to/from picking up or dropping someone off).

Tertiary students travelling between their place of study and the shops will also be recorded as a SBO trip; retirees travelling between the shops and recreational activities will also be included.

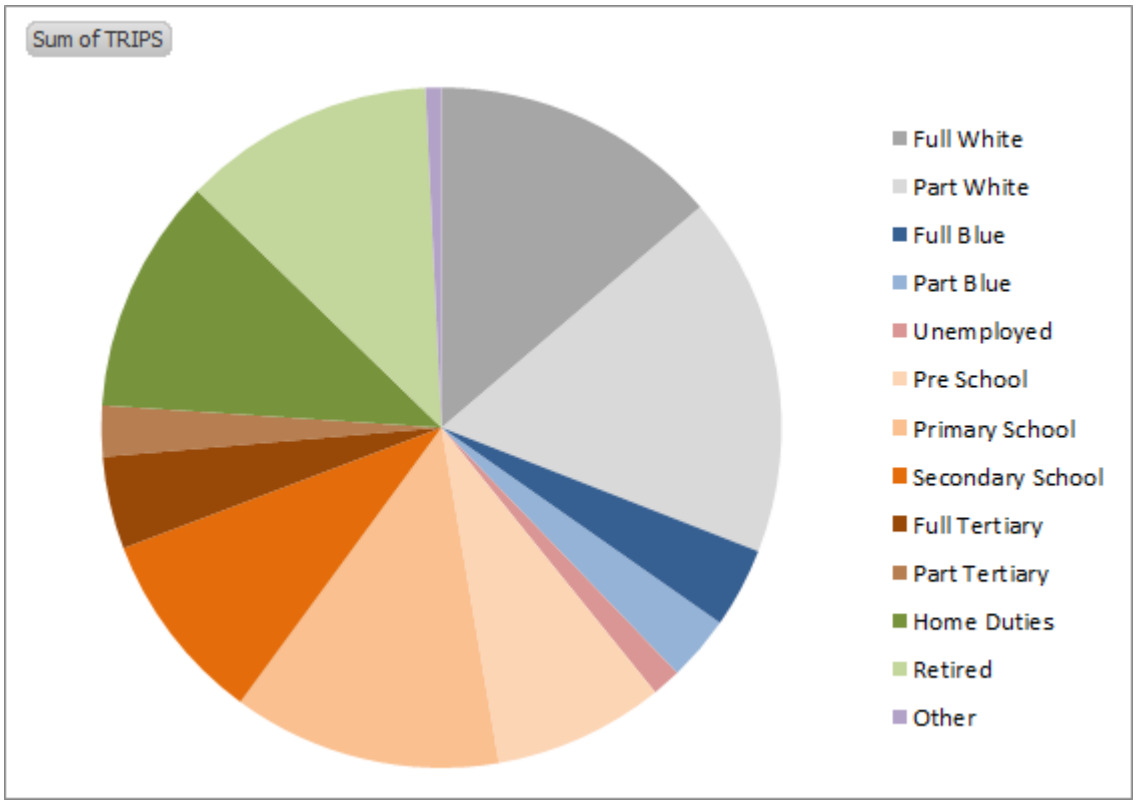


Figure 34 - The Breakdown of Shopping Based Other Trips by Main Activity Group

Figure 35 shows the SBO trip rates for each of the Zenith person types. It is evident that Dependants aged 0-17 and 18-64 make SBO trips most frequently, with an average daily trip rate of around 0.3.

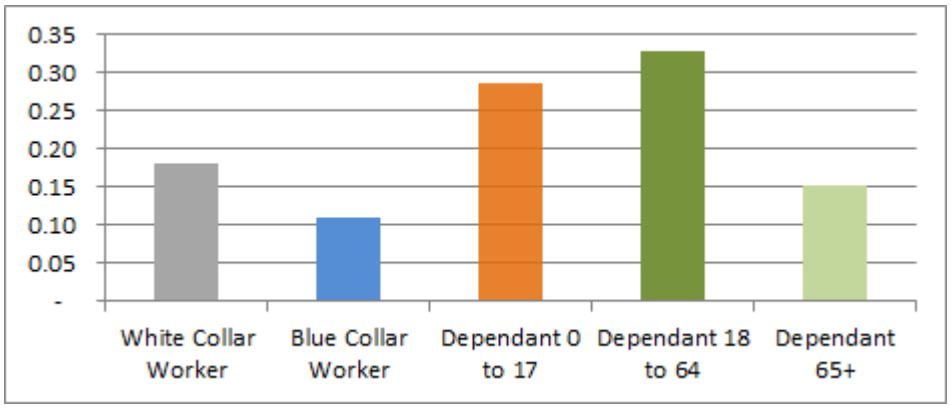


Figure 35 - Trip Rates for Shopping Based Other by Zenith Person Types

Further disaggregating the trip rates by Main Activity group, it can be seen that part time tertiary students, and those undertaking home duties are most likely to make a SBO trip, with an average daily trip rate of around 0.45. It is notable that the average part time worker makes roughly 3x the number of SBO trips made by the average full time worker.

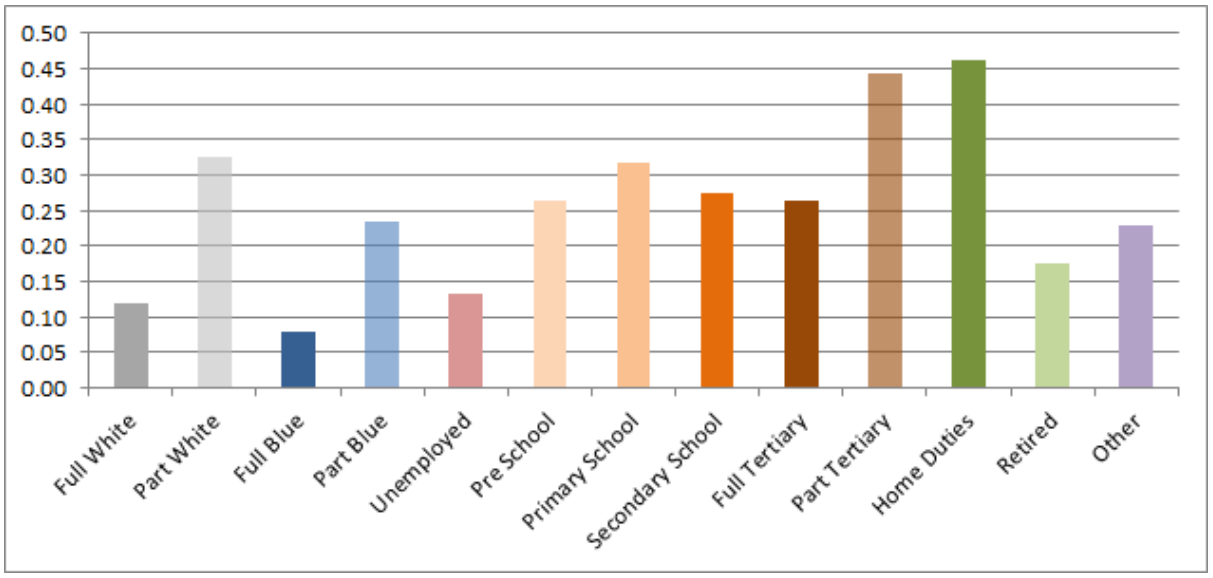


Figure 36 - Trip Rates for Shopping Based Other by Main Activity Group

5.6.2 Model Estimation

The Trip Production model for Shopping Based Other has been re-estimated, with the resulting model parameters presented in Table 15 below. The parameters are then compared in Figure 37.

Parameter	Re-estimated-DZ PARAMETER ESTIMATE	T-STATISTIC	P-VALUE	STANDARD ERROR
Households	0.171	9.217	0.000	0.019
EMP - Recreation & Personal Services	0.351	4.813	0.000	0.073
EMP - Retailing	1.262	22.151	0.000	0.057
ENROLMENTS - Primary	0.158	3.023	0.003	0.052
ENROLMENTS - Secondary	0.179	5.208	0.000	0.034

Table 15 - Model Parameters for Shopping Based Other

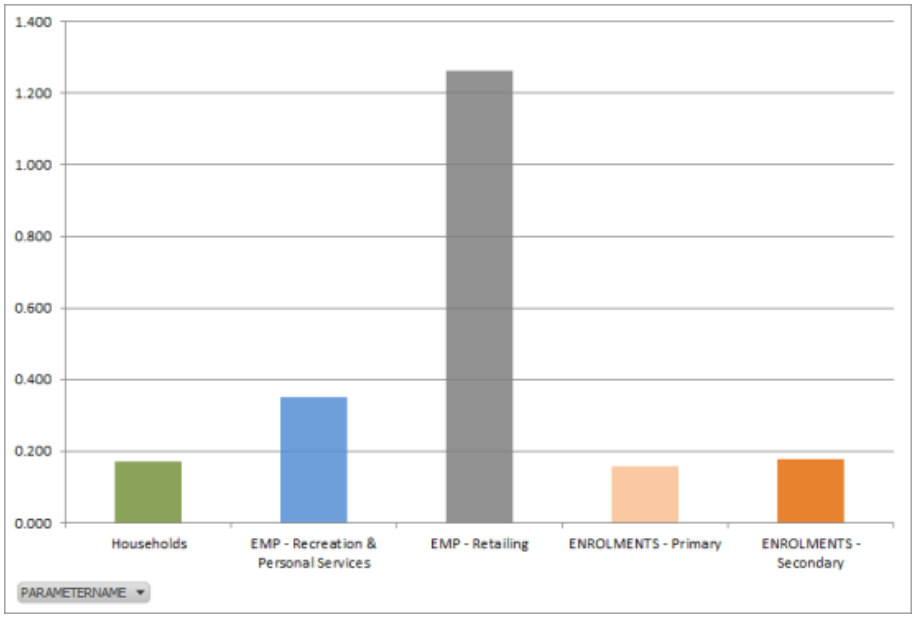


Figure 37 - Model Parameters for Shopping Based Other

As with shopping based shopping, retail employment is the most important predictor of the shopping end of SBO trips, with a parameter of 1.26. This means that around 1.26 SBO trips will be produced by each job in the retail industry.

Employment in the Recreation & Personal Services industry is the next most important variable, with a parameter of 0.35. Interestingly, however, enrolments in primary and secondary schools, and households also produce SBO trips.

Given that our focus is the shopping end of the trip, it may appear unintuitive that schools and households act as a producer of SBO trips (not many people shop at schools or home). However, a more logical interpretation is that the shopping end of a SBO trip is more likely to occur *near* a school (as parents and their children drop in at the shops on the way home). Therefore, the presence of a school in a travel zone increases the likelihood that shopping trips will be undertaken in that travel zone (where the school and shops are in the same zone).

Unfortunately, the zones immediately surrounding a school travel zone have no explicit variable that indicates their nearness to a school. Given this, we postulate that the households variable has come through as significant because schools tend to be located in the suburbs (and thus near households).

The inclusion of an explicit "Accessibility to Schools" variable might improve the model, and may be worth exploring at a later date. The move to a tour based model would also help in this instance.

5.6.3 Model Validation

The re-estimated model has been applied to the study area of the VISTA07 survey, with predicted and actual trips compared at various levels of spatial aggregation.

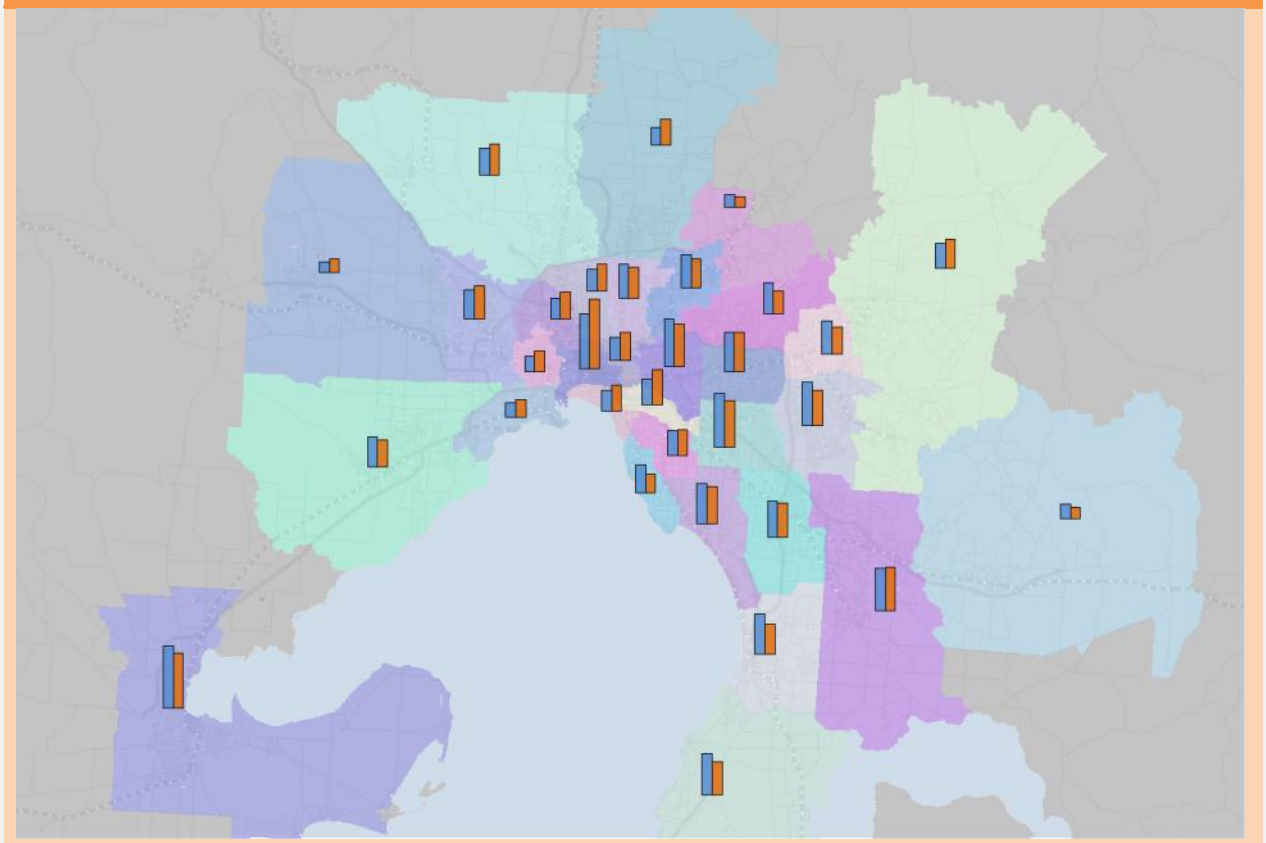
Referring to the LGA analysis (Figure 38 and Table 16), it can be observed that:

- The distribution of SBO trips is fairly even across the metropolitan area. The proportion of trips produced in the Melbourne LGA is only 5%; considerably lower than the work based purposes, and also lower than for SBS.
- As with SBS, the model tends to over-predict trips in the west, and under-predict trips in the south-east, particularly in the LGAs which hug the south-east coastline. However, unlike SBS, the model also has a tendency to over-predict in the inner city and inner suburbs. It is likely that a measure of accessibility to other activities (particularly schools), combined with the socio-demographic variables identified as important for SBS (income, retirees) would improve this model.
- Overall, however, the model does a reasonable job of predicting the scale of SBO trips, with an R-Squared of 0.75.

Referring to the Concentric Region analysis (Figure 39 and Table 17), it can be observed that:

- There is a noticeable pattern of model over-prediction of trips in the inner city, and inner suburbs, and under-prediction in the middle suburbs. This is consistent with the LGA based analysis.

Trips by LGA
Shopping Based Other | Re-estimated Zenith Model



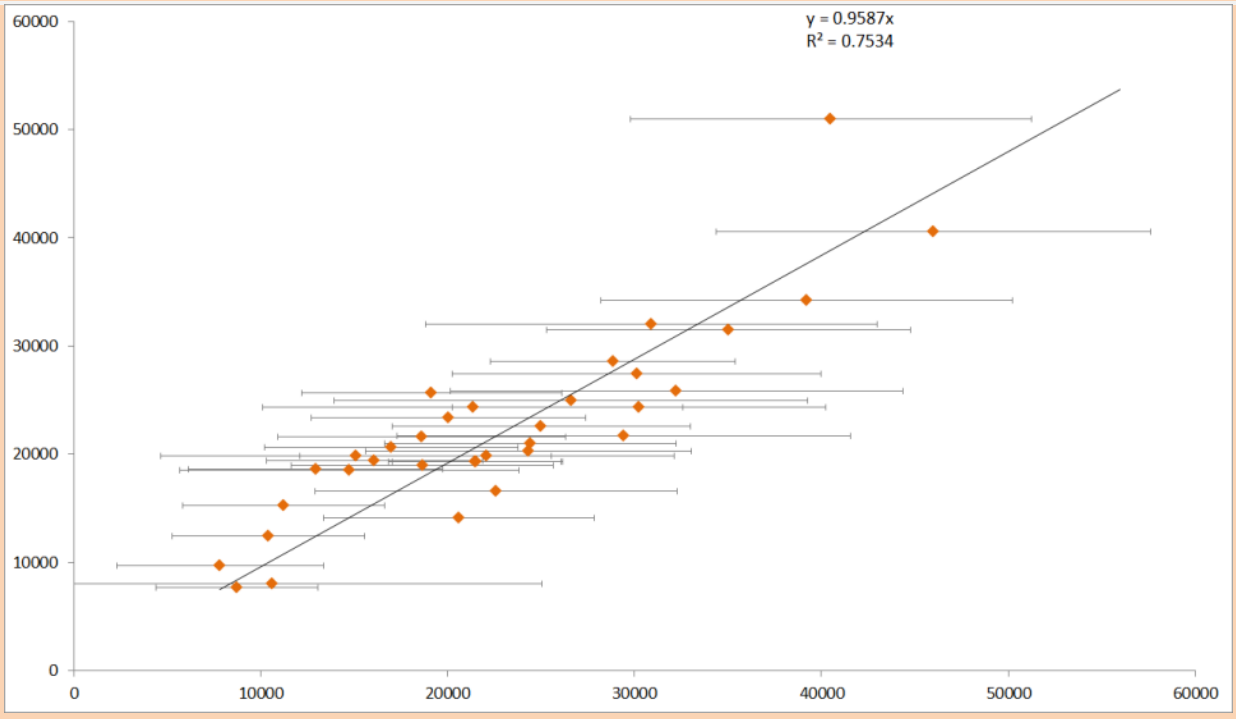
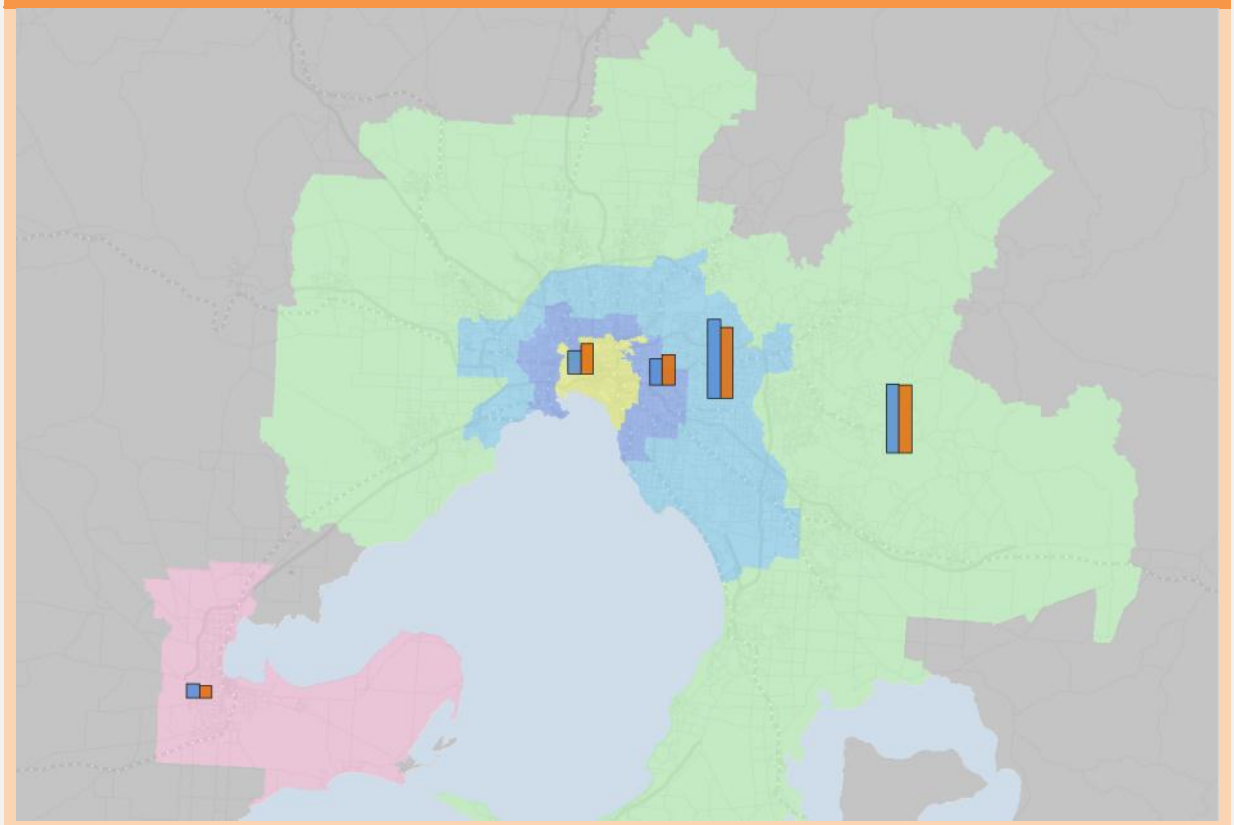


Figure 38 - Modelled and Surveyed Trips for Shopping Based Other, by LGA

Sum of TRIPS	VISTA07	Re-estimated-DZ	% Diff	95% C.I.	Unweighted trips in VISTA07 Sample
Ballarat (C)	21,481	19,283	-10%	± 22%	466
Banyule (C)	24,451	21,013	-14%	± 32%	151
Bayside (C)	20,621	14,136	-31%	± 35%	135
Boroondara (C)	35,042	31,438	-10%	± 28%	213
Brimbank (C)	21,349	24,323	14%	± 53%	80
Cardinia (S)	10,605	8,031	-24%	± 136%	23
Casey (C)	30,887	31,980	4%	± 39%	126
Darebin (C)	25,007	22,567	-10%	± 32%	128
Frankston (C)	29,440	21,662	-26%	± 41%	129
Glen Eira (C)	18,657	18,988	2%	± 38%	100
Greater Bendigo (C)	21,545	19,318	-10%	± 21%	377
Greater Dandenong (C)	26,602	24,950	-6%	± 48%	105
Greater Geelong (C)	46,003	40,530	-12%	± 25%	425
Hobsons Bay (C)	10,427	12,441	19%	± 49%	61
Hume (C)	20,066	23,330	16%	± 37%	82
Kingston (C)	30,120	27,448	-9%	± 33%	154
Knox (C)	32,254	25,803	-20%	± 37%	172
Manningham (C)	22,578	16,620	-26%	± 43%	146
Maribyrnong (C)	11,222	15,231	36%	± 48%	63
Maroondah (C)	24,321	20,283	-17%	± 36%	150
Melbourne (C)	40,509	50,982	26%	± 27%	239
Melton (S)	7,822	9,744	25%	± 71%	24
Monash (C)	39,214	34,192	-13%	± 28%	204
Moonee Valley (C)	15,096	19,868	32%	± 69%	65
Moreland (C)	16,084	19,398	21%	± 36%	85
Mornington Peninsula (S)	30,261	24,374	-19%	± 33%	180
Nillumbik (S)	8,729	7,701	-12%	± 50%	56
Port Phillip (C)	14,764	18,515	25%	± 61%	80
Stonnington (C)	19,154	25,697	34%	± 36%	121
Whitehorse (C)	28,843	28,572	-1%	± 23%	180
Whittlesea (C)	12,954	18,615	44%	± 53%	75
Wyndham (C)	22,096	19,810	-10%	± 45%	117
Yarra (C)	16,994	20,595	21%	± 40%	114
Yarra Ranges (S)	18,628	21,624	16%	± 41%	91
Grand Total	773,827	759,059	-2%		4,917

Table 16 - Modelled and Surveyed Trips for Shopping Based Other, by LGA

Trips by Concentric Region
Shopping Based Other | Re-estimated Zenith Model



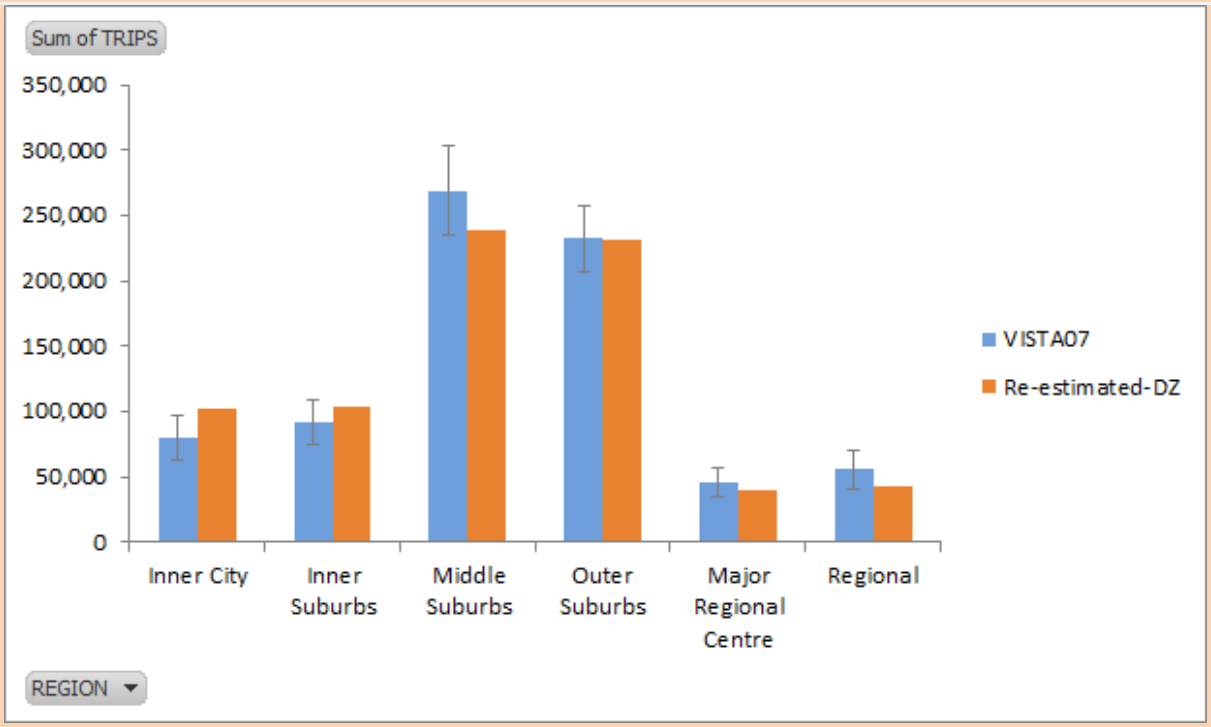


Figure 39 - Modelled and Surveyed Trips for Shopping Based Other, by Concentric Region

Sum of TRIPS	VISTA07	Re-estimated-DZ	% Diff	95% C.I.	Unweighted trips in VISTA07 Sample
Inner City	79,613	101,838	28%	± 21%	485
Inner Suburbs	91,596	103,589	13%	± 19%	539
Middle Suburbs	269,189	239,518	-11%	± 13%	1,426
Outer Suburbs	232,402	231,130	-1%	± 11%	1,170
Major Regional Centre	45,290	40,134	-11%	± 25%	422
Regional	55,737	42,849	-23%	± 27%	875
Grand Total	773,827	759,059	-2%		4,917

Table 17 - Modelled and Surveyed Trips for Shopping Based Other, by Concentric Region

5.7 Other Non-Home Based

5.7.1 Travel Market

This section provides a high level analysis of the market for *Other Non-Home Based* trips, which we will refer to as ONHB.

ONHB trips occur when an individual makes a trip between any combination of the following activities:

- recreation,
- education,
- picking up or dropping someone off, or
- accompanying someone.

Examples might include:

- a tertiary student travelling from their university (education) to visit a friend (recreation),
- a child accompanying their parent to the shops (accompanying someone) after being picked up from school (education),
- a child who leaves their school (education) to go play sport (recreation),
- a parent who drops their child off at school (dropping someone off) then goes to the gym, or to meet a friend (recreation).

The breakdown of ONHB trips according to the Zenith person classification is seen in Figure 40 below. Interestingly, nearly half of all ONHB trips are made by dependants aged 0-17.

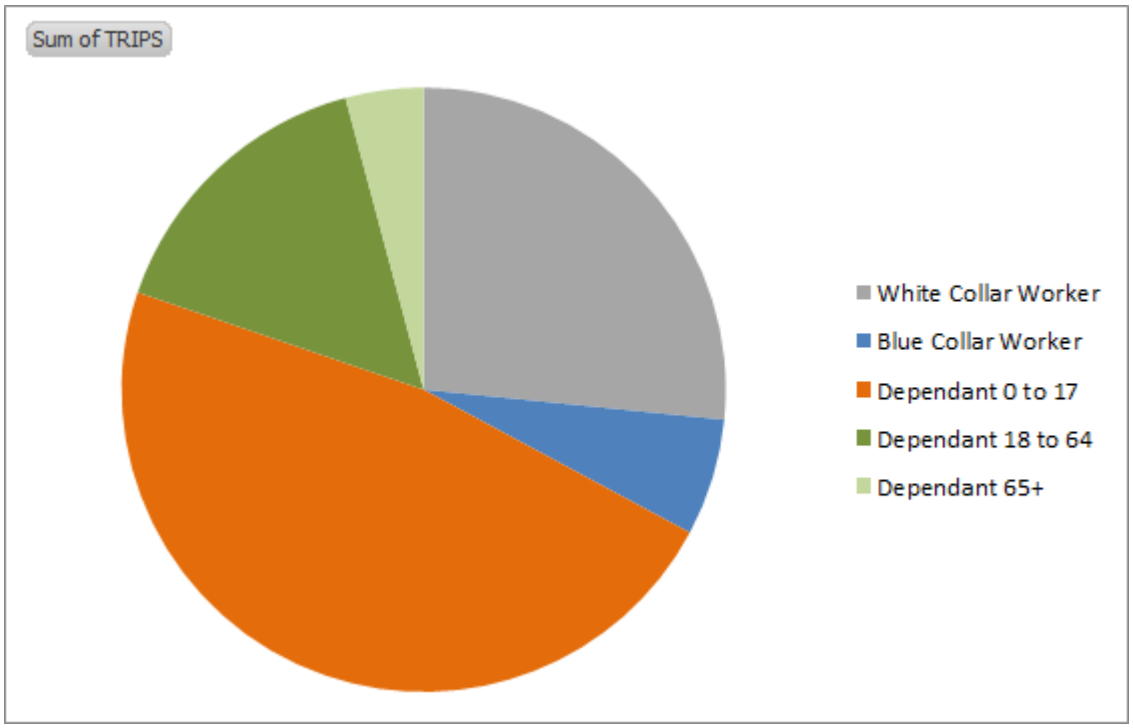


Figure 40 -The Breakdown of Other Non-Home Based Trips by Zenith Person Types

Further disaggregating the travel market by Main Activity group, we can see that nearly a third of all trips are made by primary school children, and children who are not yet of school age. It is evident

that a significant portion of these trips are made by children accompanying their parents. Part time white collar workers are also a significant part of the market (15%), suggesting that parents who work part time (many of them Mothers), make up a lot of trips ferrying their children from one activity to another.

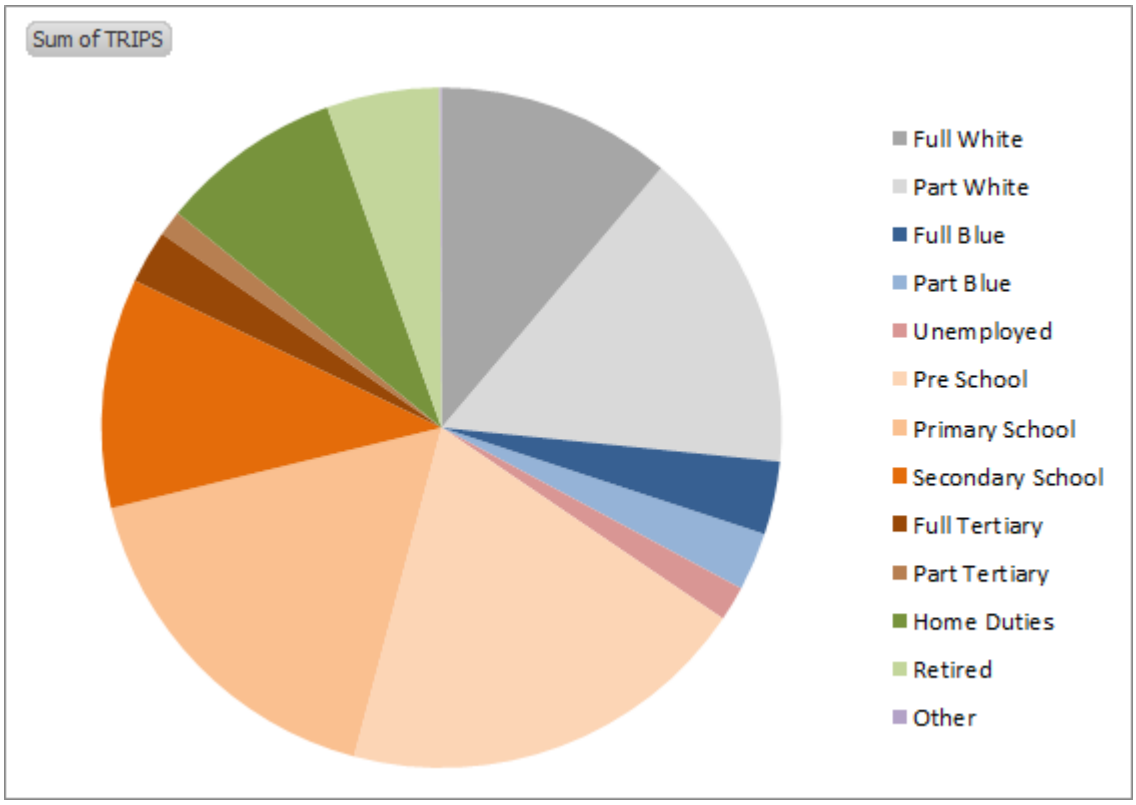


Figure 41 - The Breakdown of Other Non-Home Based Trips by Main Activity Group

The ONHB trip rates by Zenith person type are presented in Figure 42. Consistent with the previous analysis, dependants aged 0-17 have by far the highest trip rate, followed by dependants 18-64.

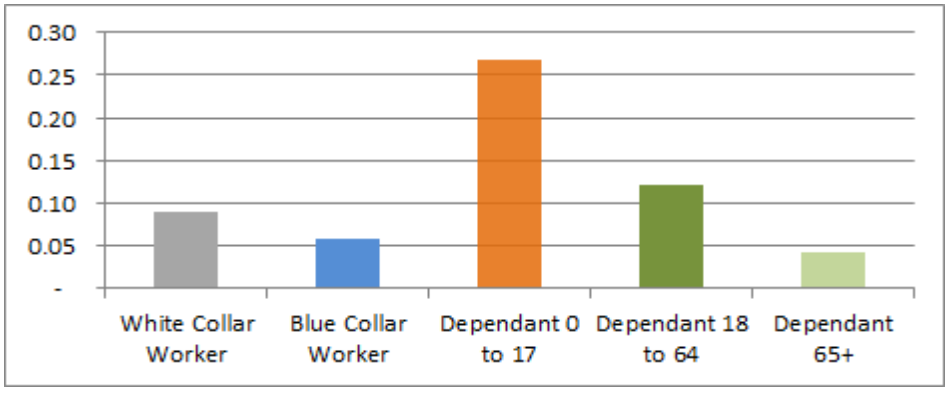


Figure 42 - Trip Rates for Other Non-Home Based Trips by Zenith Person Types

Further disaggregating the trip rates by Main Activity group, it is evident that children non-yet at school have by far the highest trip rate, followed by primary school children. Their parents (many of them identified as home duties and part time workers) also have high trip rates.

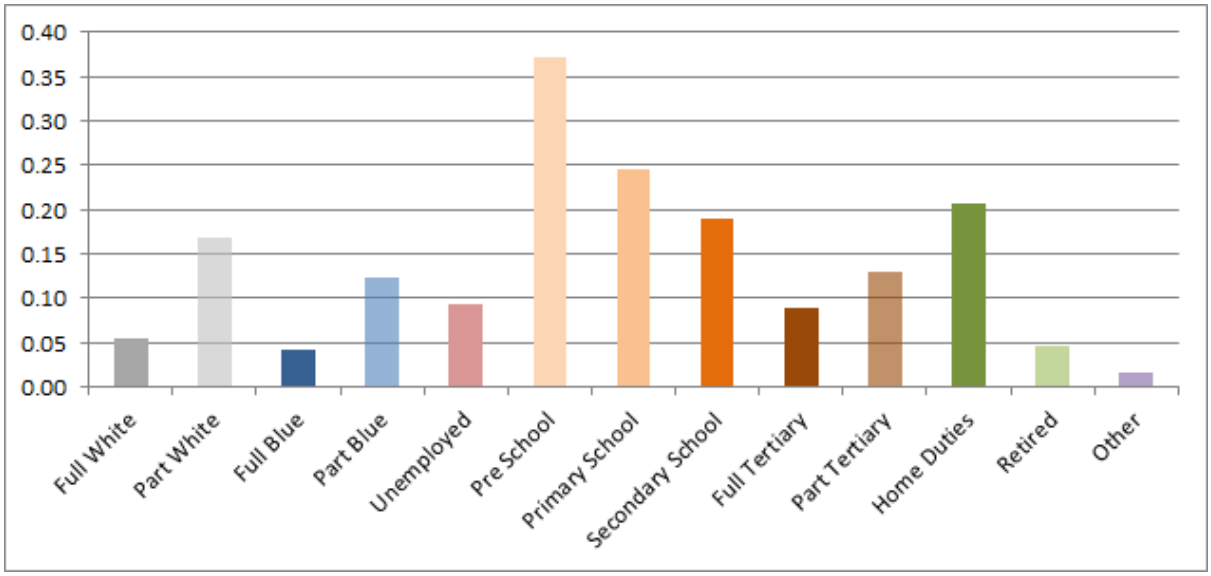


Figure 43 - Trip Rates for Other Non-Home Based Trips by Main Activity Group

5.7.2 Model Estimation

The Trip Production model for Other Non-Home Based has been re-estimated, with the resulting model parameters presented in Table 18 below. The parameter estimates are then compared in Figure 44.

Parameter	Re-estimated-DZ PARAMETER ESTIMATE	T-STATISTIC	P-VALUE	STANDARD ERROR
HOUSEHOLDS	0.095	8.054	0.000	0.012
EMP - Recreation & Personal Services	0.119	2.545	0.011	0.047
EMP - Retailing	0.220	6.052	0.000	0.036
ENROLMENTS - Primary	0.252	7.582	0.000	0.033
ENROLMENTS - Secondary	0.249	11.360	0.000	0.022
ENROLMENTS - Tertiary	0.040	6.005	0.000	0.007

Table 18 - Model Parameters for Other Non-Home Based

Primary and secondary educational institutions are a major producer of ONHB trips, with parameters of 0.252, and 0,249 trips per enrolment.

This means that a primary school with 100 students will produce an average of 25.2 ONHB trips per day.

Employment in the retail and recreation and personal services industries is also a major producer of ONHB trips.

Households are also a producer of ONHB trips; this may reflect travel made to a friend's house, but it may also simply reflect a tendency for ONHB trips to be undertaken in the suburbs.

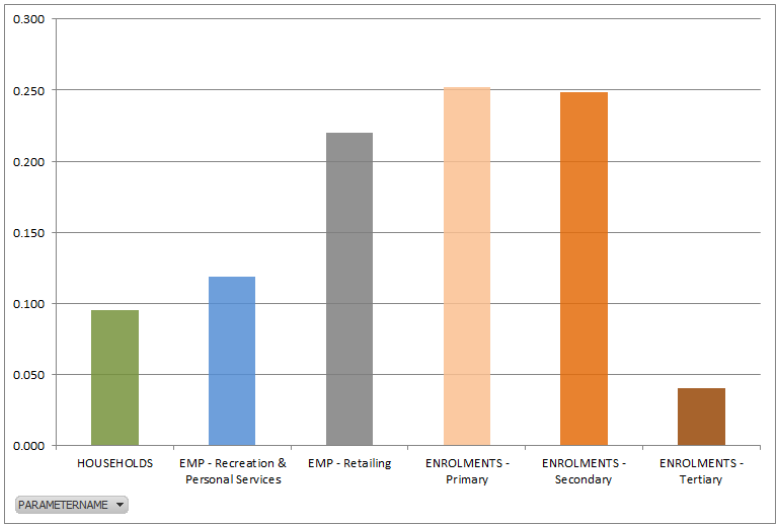


Figure 44 - Model Parameters for Other Non-Home Based

5.7.3 Model Validation

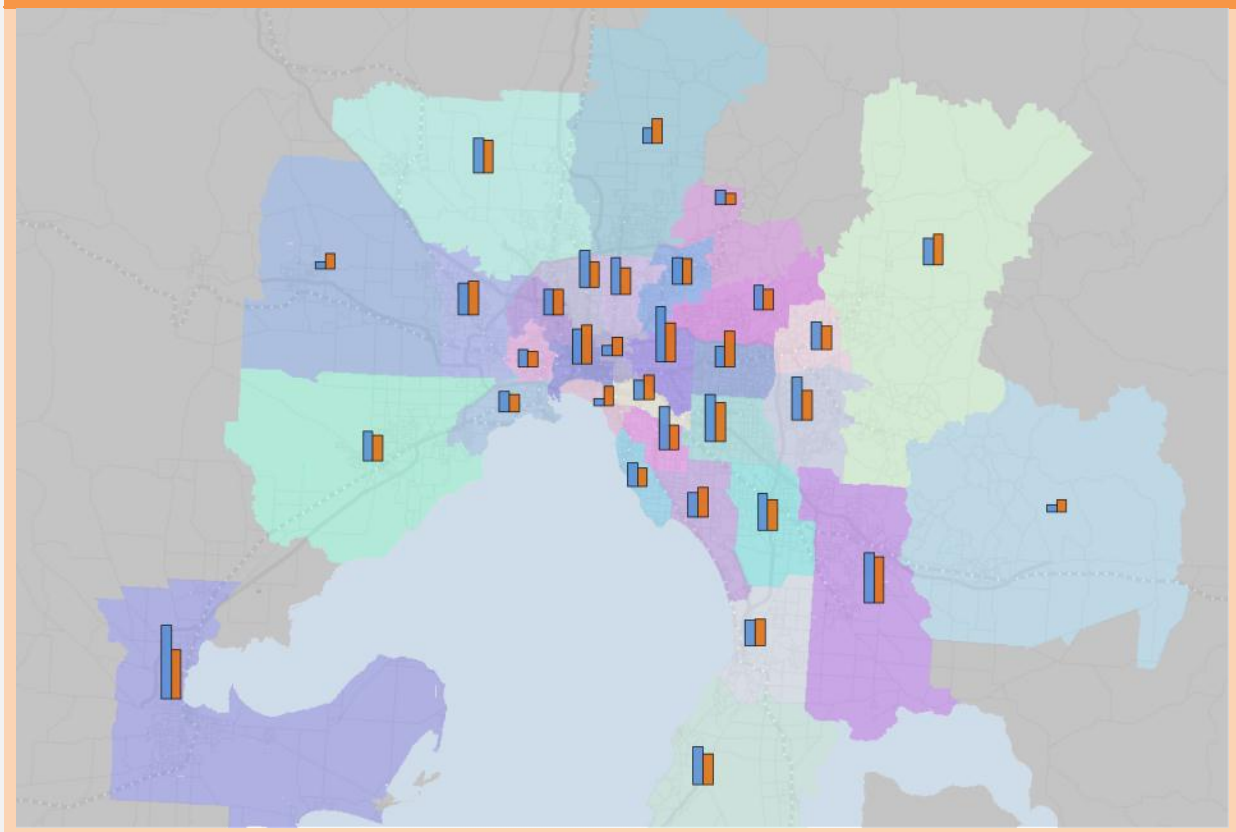
The re-estimated model has been applied to the study area of the VISTA07 survey, with predicted and actual trips compared at various levels of spatial aggregation.

Referring to the LGA analysis (Figure 45 and Table 19), it can be observed that:

- Most ONHB trips are undertaken in the middle and outer suburbs, with only a small number of trips occurring in the inner city and inner suburbs.
- There is a reasonable degree of variation between the survey estimates of trips and the modelled estimates. An R-Squared of 0.31 is achieved. It is likely that some key variables are missing from the model, with the distribution of land uses *surrounding* a zone having a significant impact on the trips produced *in* the zone. To account for this, we would need to move to a tour based model, or include variables which measure accessibility to various land uses.

Referring to the Concentric Region analysis (Figure 46 and Table 20), the pattern of over-prediction in the inner city and inner suburbs, and under-prediction of trips in the middle and outer suburbs can be observed clearly.

Trips by LGA
Other Non-Home Based | Re-estimated Zenith Model



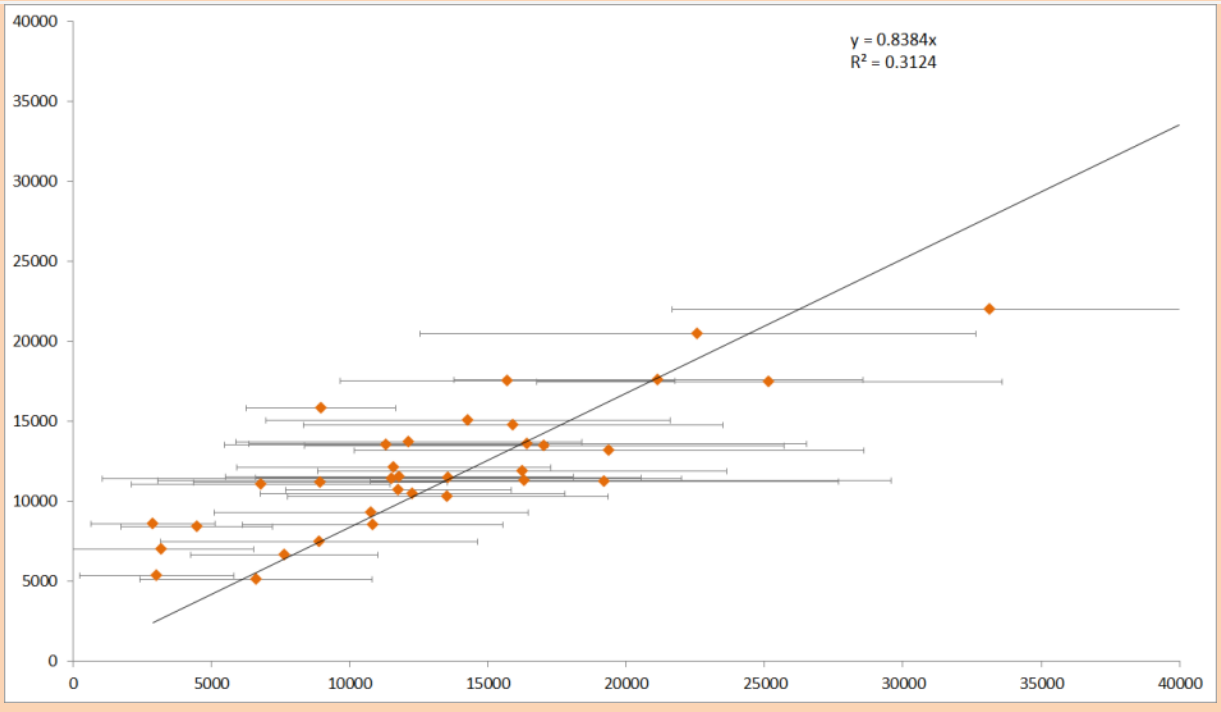


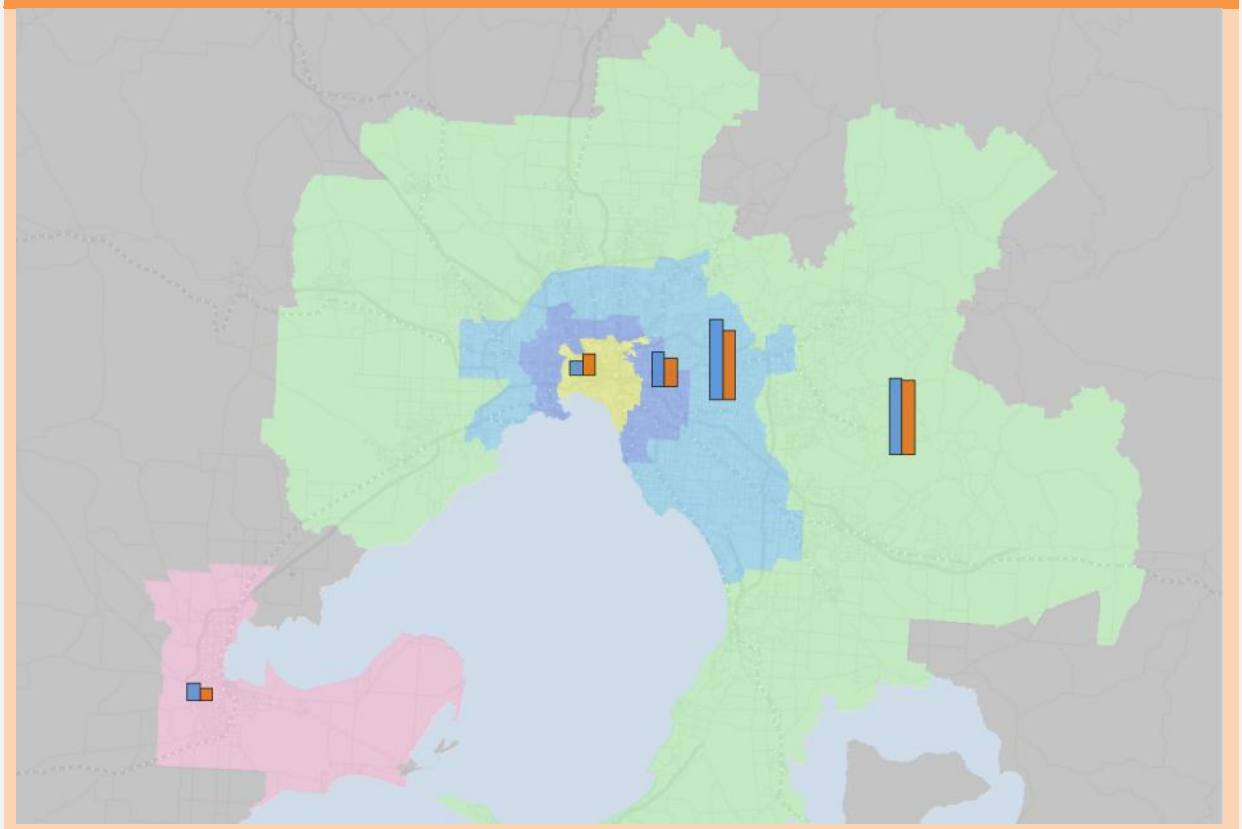
Figure 45 - Modelled and Surveyed Trips for Other Non-Home Based, by LGA

Sum of TRIPS	VISTA07	Re-estimated-DZ	% Diff	95% C.I.	Unweighted trips in VISTA07 Sample
Ballarat (C)	11,768	10,685	-9%	± 35%	365
Banyule (C)	11,799	11,548	-2%	± 53%	126
Bayside (C)	10,837	8,544	-21%	± 44%	88
Boroondara (C)	25,173	17,443	-31%	± 33%	172
Brimbank (C)	14,274	15,060	6%	± 51%	76
Cardinia (S)	3,035	5,360	77%	± 92%	10
Casey (C)	22,591	20,457	-9%	± 44%	112
Darebin (C)	16,242	11,898	-27%	± 45%	113
Frankston (C)	11,603	12,103	4%	± 49%	101
Glen Eira (C)	19,196	11,254	-41%	± 44%	128
Greater Bendigo (C)	13,550	10,284	-24%	± 43%	298
Greater Dandenong (C)	16,429	13,592	-17%	± 61%	92
Greater Geelong (C)	33,141	22,014	-34%	± 35%	386
Hobsons Bay (C)	8,897	7,458	-16%	± 64%	59
Hume (C)	15,917	14,783	-7%	± 48%	94
Kingston (C)	11,332	13,520	19%	± 52%	80
Knox (C)	19,371	13,149	-32%	± 48%	139
Manningham (C)	10,771	9,270	-14%	± 53%	110
Maribyrnong (C)	7,648	6,669	-13%	± 44%	65
Maroondah (C)	12,277	10,476	-15%	± 45%	119
Melbourne (C)	15,715	17,532	12%	± 39%	121
Melton (S)	3,201	7,010	119%	± 104%	14
Monash (C)	21,158	17,602	-17%	± 35%	178
Moonee Valley (C)	11,522	11,396	-1%	± 91%	56
Moreland (C)	16,312	11,270	-31%	± 81%	94
Mornington Peninsula (S)	17,039	13,438	-21%	± 51%	141
Nillumbik (S)	6,619	5,136	-22%	± 63%	68
Port Phillip (C)	2,900	8,607	197%	± 77%	27
Stonnington (C)	8,940	11,185	25%	± 51%	64
Whitehorse (C)	8,976	15,811	76%	± 30%	86
Whittlesea (C)	6,790	11,038	63%	± 69%	54
Wyndham (C)	13,568	11,440	-16%	± 51%	128
Yarra (C)	4,478	8,384	87%	± 61%	37
Yarra Ranges (S)	12,152	13,704	13%	± 51%	86
Grand Total	**445,223**	**409,120**	**-8%**		**3,887**

Table 19 - Modelled and Surveyed Trips for Other Non-Home Based, by LGA

Trips by Concentric Region

Other Non-Home Based | Re-estimated Zenith Model



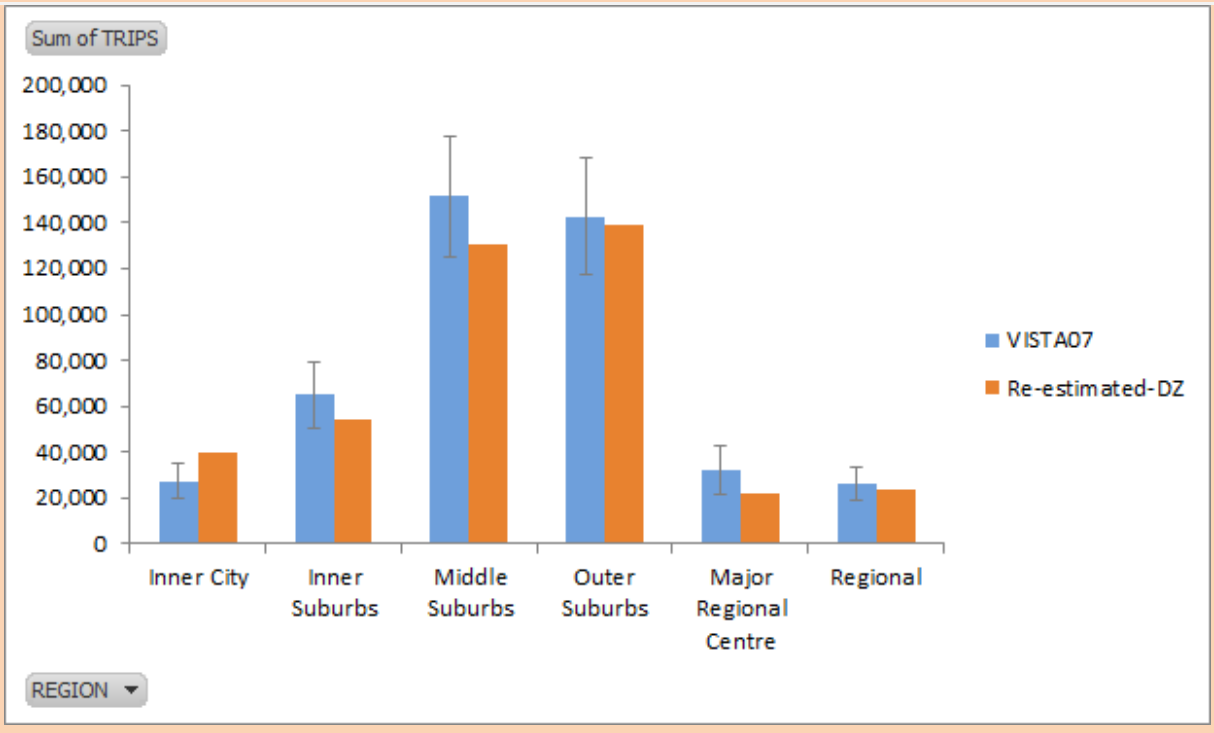


Figure 46 - Modelled and Surveyed Trips for Other Non-Home Based, by Concentric Region

Sum of TRIPS	VISTA07	Re-estimated-DZ	% Diff	95% C.I.	Unweighted trips in VISTA07 Sample
Inner City	27,288	39,821	46%	± 28%	214
Inner Suburbs	64,938	54,185	-17%	± 22%	446
Middle Suburbs	151,681	130,346	-14%	± 17%	1,138
Outer Suburbs	142,857	138,998	-3%	± 18%	1,040
Major Regional Centre	32,215	21,794	-32%	± 33%	382
Regional	26,245	23,975	-9%	± 29%	667
Grand Total	**445,223**	**409,120**	**-8%**		3,887

Table 20 - Modelled and Surveyed Trips for Other Non-Home Based, by Concentric Region

5.8 All Non-Home Based Combined

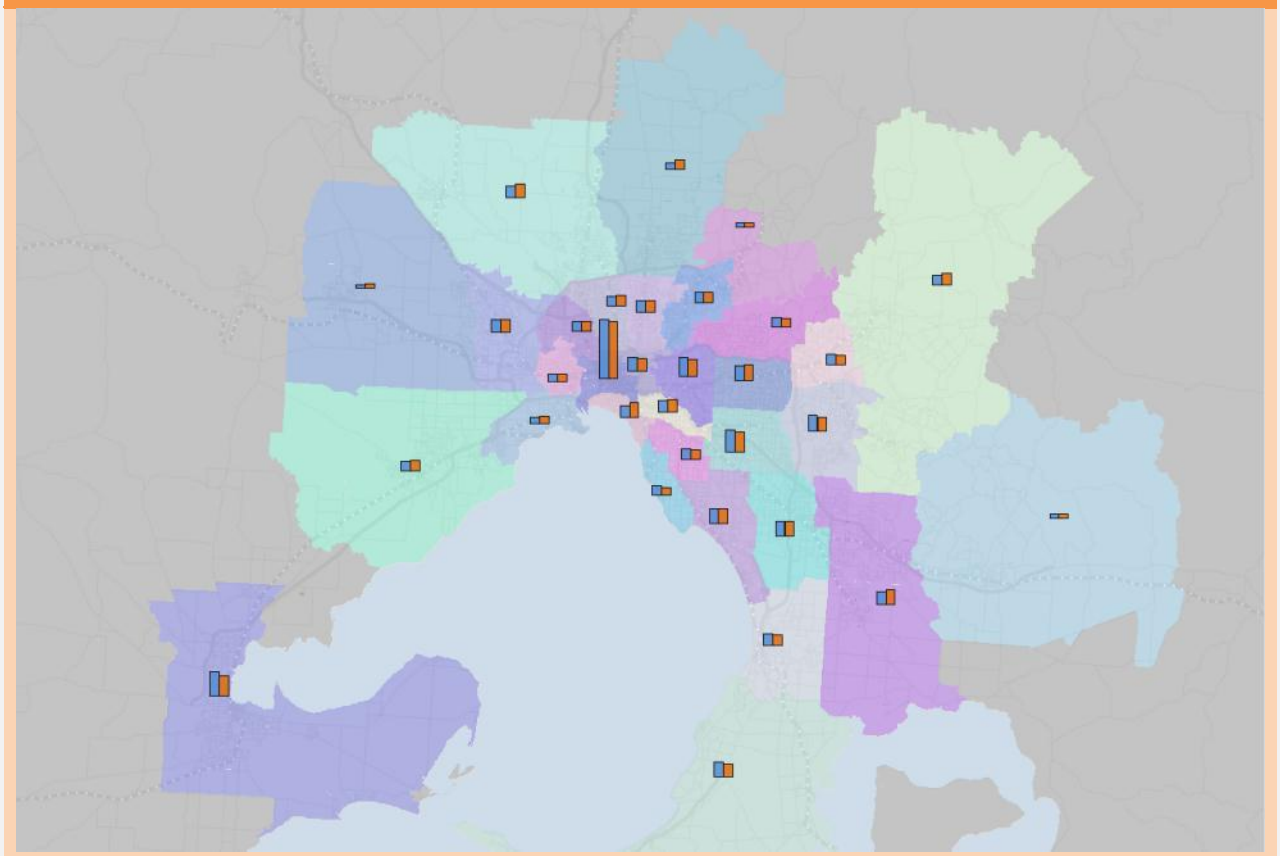
5.8.1 Model Validation

This section provides the validation outputs for all non-home based purposes combined. At the level of LGAs (Figure 47 and Table 21), there is excellent agreement between the model and the VISTA survey. It is evident that some of the differences which have been observed at the *by purpose* level cancel each other out when the purposes are aggregated. This will be partly due to greater certainty in the VISTA estimates, due to pooling the sample.

An R-Squared is of 0.97 is achieved, including all LGAs. Excluding the Melbourne LGA, the R-Squared drops to 0.83.

Figure 48 and Table 22 provide the equivalent analysis at the level of Concentric Regions. It is evident that the model and the VISTA survey are in close agreement for the inner city, inner suburbs and outer suburbs, with the model slightly under-predicting travel relative to VISTA in the middle suburbs and regional areas.

Trips by LGA
All Non-Home Based Combined | Re-estimated Zenith Model



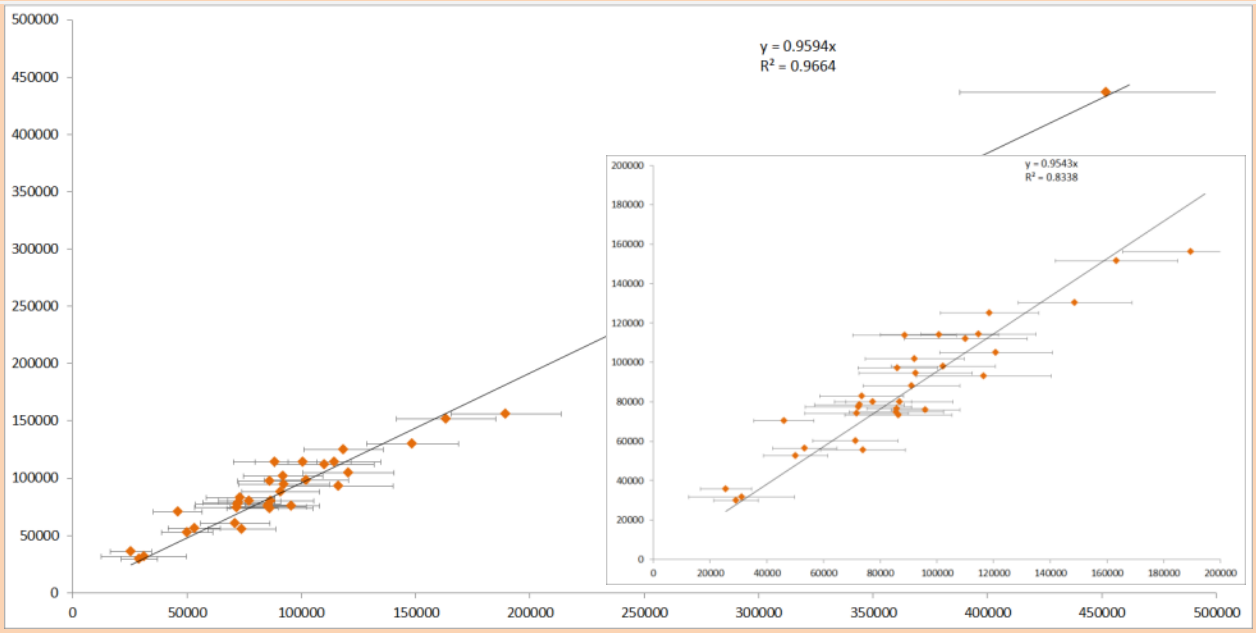
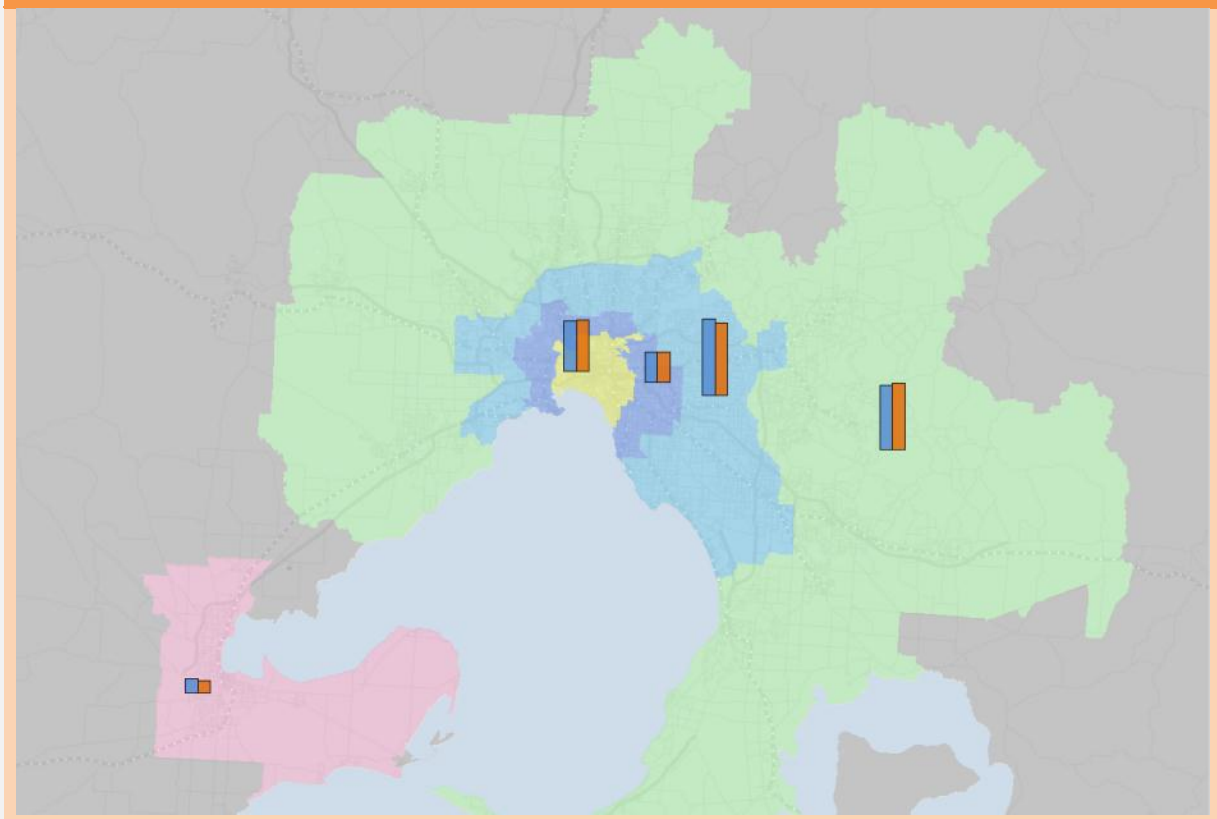


Figure 47 - Modelled and Surveyed Trips for All Non-Home Based Combined, by LGA

Sum of TRIPS	VISTA07	Re-estimated-DZ	% Diff	95% C.I.	Unweighted trips in VISTA07 Sample
Ballarat (C)	95,885	76,026	-21%	± 13%	2,174
Banyule (C)	77,460	80,073	3%	± 18%	538
Bayside (C)	74,018	55,533	-25%	± 20%	468
Boroondara (C)	148,605	130,217	-12%	± 13%	823
Brimbank (C)	92,466	94,549	2%	± 22%	369
Cardinia (S)	31,198	31,531	1%	± 60%	72
Casey (C)	100,848	114,002	13%	± 21%	423
Darebin (C)	91,073	88,134	-3%	± 19%	515
Frankston (C)	86,786	80,075	-8%	± 22%	473
Glen Eira (C)	86,380	73,410	-15%	± 22%	470
Greater Bendigo (C)	85,782	76,433	-11%	± 12%	1,535
Greater Dandenong (C)	110,123	111,949	2%	± 20%	502
Greater Geelong (C)	189,529	156,346	-18%	± 13%	1,852
Hobsons Bay (C)	50,208	52,518	5%	± 22%	304
Hume (C)	92,180	101,751	10%	± 19%	409
Kingston (C)	114,632	114,268	0%	± 18%	587
Knox (C)	120,850	104,935	-13%	± 16%	664
Manningham (C)	71,252	60,276	-15%	± 21%	504
Maribyrnong (C)	53,329	56,361	6%	± 21%	309
Maroondah (C)	85,701	74,723	-13%	± 19%	550
Melbourne (C)	451,915	436,980	-3%	± 14%	2,165
Melton (S)	25,648	35,665	39%	± 35%	110
Monash (C)	163,301	151,538	-7%	± 13%	888
Moonee Valley (C)	72,322	77,367	7%	± 26%	332
Moreland (C)	71,703	74,161	3%	± 25%	391
Mornington Peninsula (S)	116,524	93,053	-20%	± 20%	682
Nillumbik (S)	29,127	29,816	2%	± 27%	203
Port Phillip (C)	88,604	113,839	28%	± 21%	463
Stonnington (C)	86,163	97,205	13%	± 16%	506
Whitehorse (C)	118,519	125,197	6%	± 15%	723
Whittlesea (C)	46,062	70,376	53%	± 23%	279
Wyndham (C)	72,699	78,428	8%	± 22%	439
Yarra (C)	102,214	98,149	-4%	± 18%	519
Yarra Ranges (S)	73,472	82,814	13%	± 20%	376
Grand Total	**3,376,579**	**3,297,699**	**-2%**	**± 4%**	**21,617**

Table 21 - Modelled and Surveyed Trips for All Non-Home Based Combined, by LGA

Trips by Concentric Region
All Non-Home Based Combined | Re-estimated Zenith Model



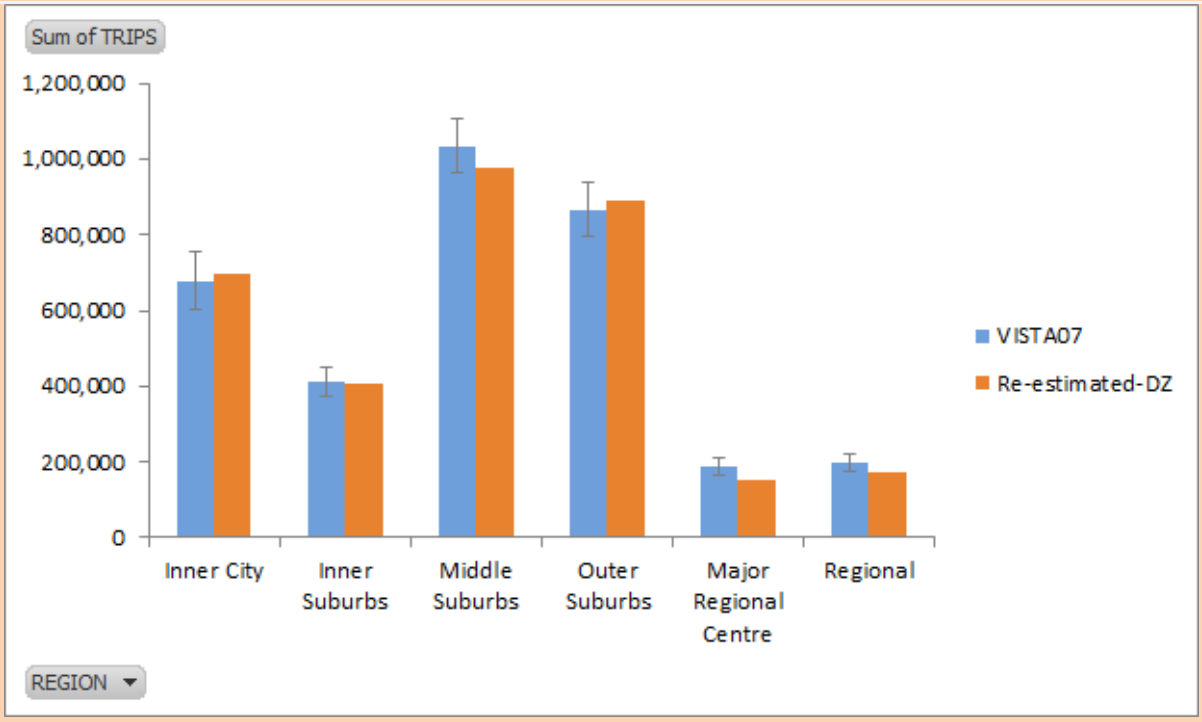


Figure 48 - Modelled and Surveyed Trips for All Non-Home Based Combined, by Concentric Region

Sum of TRIPS	VISTA07	Re-estimated-DZ	% Diff	95% C.I.	Unweighted trips in VISTA07 Sample
Inner City	678,375	696,629	3%	± 11%	3,364
Inner Suburbs	411,648	408,469	-1%	± 9%	2,327
Middle Suburbs	1,033,996	976,712	-6%	± 7%	5,765
Outer Suburbs	865,912	892,161	3%	± 8%	4,553
Major Regional Centre	186,660	153,220	-18%	± 12%	1,834
Regional	199,988	170,508	-15%	± 11%	3,774
Grand Total	3,376,579	3,297,699	-2%		21,617

Table 22 - Modelled and Surveyed Trips for All Non-Home Based Combined, by Concentric Region

6 Correction Factors for Under-Reporting in VISTA

VLC has compared the amount of travel reported in VISTA with other observed sources of travel data, including:

- Screenline Traffic Counts
- 2009 Rail OD survey
- 2008 Tram OD survey
- Bus ticket validations

Based on these comparisons, it appears that VISTA07 under-reports travel, especially in the Off Peak. This work is presented in *Working Paper 2 – Analysis of VISTA.*

Based on this work, correction factors have been estimated, by Trip Purpose. These factors scale up the model parameters reported in Section 5.

The correction factors are:

Trip Purpose	Inter Peak (9am - 3pm)	Evening Peak (6pm - midnight)
HBW (white)	1.35	1.00
HBW (blue)	1.75	1.00
HBE (tertiary)	2.00	1.00
HBS	1.05	1.75
HBR	1.15	1.50
HBO	1.30	1.50
WBW	1.10	1.00
WBS	2.10	1.80
WBO	3.00	1.00
SBS	1.30	2.00
SBO	1.50	1.50
ONHB	1.40	1.00

Table 23 - Under-Reporting Correction Factors

Appendix A – Definition of School and Public Holidays

The aim of defining school and public holidays is to be able to remove such dates from the VISTA07 sample, resulting in the remaining surveys representing a typical or "heavy" weekday. Key public holidays and school holiday periods were compiled for the VISTA07 survey period between 23rd April 2007 to 15th June 2008 and are described below.

Public Holidays

A list of public holidays in Victoria for the survey period was compiled and are summarised in the Table below. Public holidays for regional areas were not considered, and holidays for the metropolitan area were applied to the entire VISTA07 sample.

Victorian public holidays As set by the Public Holidays Act 1993.

Holiday	2007	2008	2009
New Year's Day	Mon 1 January	Tue 1 January	Thu 1 January
Australia Day	Fri 26 January	Mon 28 January *in lieu of Sat 26th	Mon 26 January
Labour Day	Mon 12 March	Mon 10 March	Mon 9 March
Good Friday	Fri 6 April	Fri 21 March	Fri 10 April
Easter Saturday	Sat 7 April	Sat 22 March	Sat 11 April
Easter Monday	Mon 9 April	Mon 24 March	Mon 13 April
Anzac Day	Wed 25 April	Fri 25 April	Sat 25 April
Queen's Birthday	Mon 11 June	Mon 9 June	Mon 8 June
Melbourne Cup Day (metro area only)	Tue 6 November	Tue 4 November	Tue 3 November
Christmas Day	Tue 25 December	Thu 25 December	Fri 25 December
Boxing Day	Wed 26 December	Fri 26 December	Sat 26 December

Business Victoria, 2008, *Victorian Public Holidays and Daylight Saving*, Small Business Victoria: Information Sheet.<http://www.business.vic.gov.au/busvicwr/_assets/main/lib60208/victorian_public_holidays_and_daylight_saving_time.pdf>

Using the above list, and data recorded for those travel dates was filtered out of the VISTA07 results.

School Holidays

The typical school term dates for 2007 and 2008 were used to compile a list of school holidays

As private schools account for approximately 30 % of primary school enrolments, and 40% of secondary enrolments (ABS, 2009), a review of the school term dates in 2011 for a number of private schools was completed in order to try and better understand the scale of variation of the school term from the public school system.

A summary of the findings is listed below:

- All schools appear to begin first term around the same time
- The break at the end of first term appears to begin and end at approximately the same time for all schools
- The break at the end of second term varied significantly, with some schools ending term a week earlier, and some schools beginning third term a week later
- At the end of third term, some schools finish a week earlier, but all schools seem to begin fourth term around the same time
- Some schools finish as early as first week in December, while other schools finish the year a week before Christmas

These findings were applied to the typical school term dates for 2007 and 2008, and the resultant school holiday periods were filtered out of the results.

A list of the dates considered to be school holidays is shown below:

- 23/06/2007 until 22/07/2007
- 15/09/2007 until 7/10/2007
- 1/12/2007 until 28/01/2008
- 21/03/2008 until 6/04/2008

Appendix B – Definition of Zenith Activities and Trip Purposes

In the Zenith model, resident travel is related to the demand for the following 9 activities:

- Being at home
- Work (white collar)
- Work (blue collar)
- Education (primary)
- Education (secondary)
- Education (tertiary)
- Shopping / personal business
- Recreation / social
- Serve passenger / other (e.g. dropping someone off)

In order to build a model based on this set of activities, the locations visited by each VISTA07 respondent were each assigned a Zenith activity.

In the VISTA07 survey, the respondent was asked to choose or described a purpose (i.e. a reason) for visiting each location; examples include work, education, at home, buy something, and social.

Furthermore, each respondent was asked to report on their,

- Employment status ([full time, part time, casual], occupation, industry), and
- Studying status (primary, secondary, full time tertiary, part time tertiary)

The Zenith activity was inferred then by combining the recorded purpose with the employment and studying status of the respondent. The mapping is shown in Table 24 below. The VISTA07 database fields are shown in parentheses.

VISTA07 Purpose (PURP1)	Study Status (STUDYING)	Occupation (ANZSCO1)	Zenith Activity
Home			Being at Home
Work related		[1,2,4,5,6]	Work (white collar)
		[3,7,8]	Work (blue collar)
Social			Recreation / social
Recreation			Recreation / social
Buy something			Shopping / personal business
Personal business			Shopping / personal business
Accompany Someone			Serve passenger / other
Pickup/Deliver Something			Serve passenger / other
Pickup/Dropoff Someone			Serve passenger / other
Other Purpose			Serve passenger / other
Education	Primary		Home based education (primary)
	Secondary		Home based education (secondary)
	Tertiary		Home based education (tertiary)

Table 24 - Derivation of Zenith Activity from VISTA07 survey

Note that white and blue collar have been defined using ANZSCO1 as follows in Table 25 below.

ANZSCO1 classification	White / blue
1. Managers	White
2. Professionals	White
3. Technicians and Trades Workers	Blue
4. Community and Personal Service Workers	White
5. Clerical and Administrative Workers	White
6. Sales Workers	White
7. Machinery Operators and Drivers	Blue
8. Labourers	Blue

Table 25 - Definition of White and Blue Collar (using ANZSCO1)

Each unique pair of activities constitutes a trip purpose; for example, travel between the activities: "Being at home", and "Shopping / personal business", (in either direction) is allocated the trip purpose: "home based shopping / personal business". Note that it doesn't matter whether the trip is from home *to* shopping, or from shopping *to* home; the trip is still a "home based shopping" trip. In this case, the word "based" should not be taken to mean "to".

The resident trip purposes in the Zenith model are:

Home Based

- Home based work (white collar)
- Home based work (blue collar)
- Home based education (primary)
- Home based education (secondary)
- Home based education (tertiary)
- Home based shopping / personal business
- Home based recreation / social
- Home based serve passenger / other

Non-home based

- Work based work
- Work based shopping
- Work based other
- Shopping based shopping
- Shopping based other
- Other non-home based

Note that in the non-home based trip purposes, some level of grouping has occurred: For example, "Work based other" is the combination of the following activity pairs:

- [Work, Education (primary)]
- [Work, Education (secondary)]
- [Work, Education (tertiary)]
- [Work, Recreation / social]
- [Work, Serve Passenger / Other]

Grouping is required where there is insufficient sample size in the household travel survey to estimate separate models for each trip purpose.

The full list of activity pairs, and their corresponding Zenith trip purpose is provided in Table 26 below.

Activity1	Activity2	Zenith Trip Purpose
Being at home	Work (white collar)	Home based work (white collar)
	Work (blue collar)	Home based work (blue collar)
	Education (primary)	Home based education (primary)
	Education (secondary)	Home based education (secondary)
	Education (tertiary)	Home based education (tertiary)
	Shopping / personal business	Home based shopping / personal business
	Recreation / social	Home based recreation / social
	Serve passenger / other	Home based serve passenger / other
Work (white collar) OR Work (blue collar)	Work (white collar)	Work based work
	Work (blue collar)	Work based work
	Education (primary)	Work based other
	Education (secondary)	Work based other
	Education (tertiary)	Work based other
	Shopping / personal business	Work based shopping
	Recreation / social	Work based other
	Serve passenger / other	Work based other
Shopping / personal business	Education (primary)	Shopping based other
	Education (secondary)	Shopping based other
	Education (tertiary)	Shopping based other
	Shopping / personal business	Shopping based shopping
	Recreation / social	Shopping based other
	Serve passenger / other	Shopping based other
Education (primary) OR	Education (primary)	Other non-home based
Education (secondary) OR	Education (secondary)	Other non-home based
Education (tertiary) OR	Education (tertiary)	Other non-home based
Recreation / social OR	Recreation / social	Other non-home based
Serve passenger / other	Serve passenger / other	Other non-home based

Table 26 - Zenith Trip Purpose Definitions