COMMUTING PATTERNS OF SUNSHINE COAST RESIDENTS AND THE IMPACT OF EDUCATION[1]

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ABSTRACT: This paper provides an analysis of commuting patterns on the Sunshine Coast and from the Sunshine Coast to other Local Government Areas in south east Queensland. This is done for persons of different levels of education. Human capital theory suggests that commuting patterns may vary by level of education and this is explicitly tested in this study. Data from the 2001 Census of population and housing are used to undertake this analysis.[2]

1. INTRODUCTION

The analysis of commuting patterns has received considerable attention within the field of economic geography, however, relatively little work has been published in academic literature within Australia on this topic. This paper provides an examination of commuting patterns from the Sunshine Coast to surrounding regions, with a simple gravity modelling framework applied. In doing this, the analysis is confined to the flows of residents within the Sunshine Coast and to destinations outside the region.

The Sunshine Coast is located about 90 kilometres north of Brisbane and comprises three Local Government Areas (LGA's), Caloundra, Maroochy and Noosa. Unemployment rates in these LGA's were an average of 11.3 percent at the time of the 2001 census, 3.1 percentage points above the rate recorded for the whole of Queensland. Further, over the 1996 to 2001 intercensal period, the labour force on the Sunshine Coast outstripped growth in employment by 14,628 persons. This combination of proximity to the state capital and poor labour market performance suggest an important role for commuting.

The following section of this paper provides a descriptive analysis of the Sunshine Coast labour market. A brief review of the literature analysing commuting behaviour is provided in section three, while section four presents the results from the estimation of several gravity models to explain commuting

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[1] The views expressed in this document are those of the author(s) and should not be considered as necessarily representing the views of the Department of Employment and Training (DET) or the Queensland Government.

[2] This research is part of an ARC Linkage Grant (2003-2005) in which DET is an industry partner.

patterns in relation to different levels of education. This is followed by a brief conclusion, presented in section five.

2. JOURNEY TO WORK ON THE SUNSHINE COAST, THE CENSUS DATA

The Sunshine Coast region has been growing rapidly in recent years. Population growth was 16.6 percent over the 1996 to 2001 intercensal period, compared to only 8.6 percentage growth for Queensland. Similarly, labour force growth on the Sunshine Coast has also been above that of Queensland, with the overall growth over the 1996 to 2001 period, being 16.4 percent compared to 9.1 percent for Queensland.

While this growth in the labour force was above the Queensland average, it was outstripped by growth in the number of employed persons. Overall, employment increased by 10.8 percent in Queensland over the 1996 to 2001 period, just over half of the growth experienced by the Sunshine Coast (21.3 percent). In contrast, the number of persons that identified as being unemployed declined over the 1996 to 2001 period.

Table 1 provides a qualification profile for both the Sunshine Coast and Queensland, based on highest level of educational attainment. Of those who held a post school qualification in Queensland, almost half (49.5 percent) reported a certificate level qualification as their highest, while on the Sunshine Coast, the proportion was slightly higher at 54.6 percent. Overall, the Sunshine Coast has a lower education profile than the state average, with relatively fewer persons possessing higher level qualifications.

Table 1. Level of education qualifications for Sunshine Coast and Queensland, 2001

	Caloundra	Maroochy	Noosa	Sunshine Coast	Queensland
Postgraduate Degree	418	908	360	1,686	37,629
Graduate Diploma and Graduate Certificate	543	1,094	391	2,028	30,997
Bachelor Degree	3,471	7,114	2,492	13,077	229,876
Advanced Diploma and Diploma	3,232	6,170	2,363	11,765	151,868
Certificate	10,375	17,772	6,139	34,286	441,930
Not stated	6,548	10,914	4,397	21,859	296,980
Total	24,587	43,972	16,142	84,701	1,189,280

Source: ABS 2001 Census of Population and Housing.

The proximity of the Sunshine Coast to Brisbane means that commuting is an important component of the labour market activity in this region. Table 2 provides data from the ABS Journey to Work collection, again derived from the ABS 2001 Census of Population and Housing.

Table 2. Employed persons: place of usual residence by location of work, South-east Queensland, 2001

	- Origin region-			
Destination region	Caloundra	Maroochy	Noosa	**Sunshine Coast Regi**
Caloundra City	14,972	5,286	169	20,427
Maroochy Shire	4,014	33,689	2,338	40,041
Noosa Shire	151	1,980	11,013	13,144
Sunshine Coast Region	**19,137**	**40,955**	**13,520**	**73,612**
Brisbane	206	407	65	678
Caboolture	353	273	18	644
Cooloola	14	230	203	447
Rest of SEQ	139	273	65	477
TOTAL SEQ	19,849	42,138	13,871	75,858

Source: 2001 Census of Population and Housing, unpublished data

The data presented in Table 2 indicates that, for the Sunshine Coast overall, 97.0 percent of residents who live in the three LGA's that make up this region work within the Sunshine Coast. Of course, at the LGA level, the proportion that resides and works within the same LGA becomes smaller. For the Shires of Caloundra, Maroochy and Noosa, the proportion of employed persons who work locally are 75.4, 79.9, and 79.4 percent, respectively.

Relatively small numbers of people residing on the Sunshine Coast leave the region, with the largest proportion (3.6 percent) being from Caloundra. This shire is situated at the southern end of the Sunshine Coast and is the closest of these regions to Brisbane.

3. LITERATURE REVIEW

Journey to work patterns have been studied widely within the field of urban economics. While some employees may choose to migrate to the nearby areas for their work, travel to work is quite a common theme found by several studies (see for example, Kain, 1968; Madden, 1981 and Giuliano, 1998). In order to understand commuting behaviours, these studies have examined the role of several factors including distance, measured in either time spent travelling or the mileage covered, education level, age, home ownership, income, work status and gender (see for example, Giuliano, 1998 and Madden, 1981).

Both human capital and job search theories make predictions about commuting patterns. Human capital theory has been widely used to understand investment in education and training (see for example, Hartog, 1999). Within the human capital framework, the individual determines whether to invest in training, by calculating the opportunity cost and the life-time incremental earning of training compared to the situation where no additional training is undertaken. The individual undertakes the training if he or she believes that the increment to earnings is greater than the cost of the investment.

Individuals with higher education attainment tend to have higher participation rates, indicating that individuals with higher qualifications are more likely to participate in the labour force in order to recoup the cost for investing in training. However, it is important to match the qualification and experience to the work in order to gain the full benefits from the training, and the vacancies available in a particular area may not necessarily closely match the skills of all individuals. Therefore, human capital theory predicts that individuals with higher education attainment will be prepared to travel greater distances in order to earn higher incomes compared to those who invest less on education.

Another theory that has been used to explain commuting behaviour is job search theory. Within this framework, a person looking for work will choose between the option of continuing to search for a job or accepting a job offer. In the case of unemployed persons, the cost of continuing job search is made up of several components comprising the direct cost of job search, as well as an opportunity cost, mobility costs and the time spent during unemployment.

Within this framework the mobility cost represents the minimum opportunity cost for commuting, which occurs after accepting the job offer. In order to maximise the return and minimise the length of job search and chance of accepting a lower wage job, the individual will accept the first wage offer that is equivalent to, or above the reservation wage.

In a regional setting, the spatial distribution of jobs available to workers in a location depends on the accessibility of the employment opportunities. Regions that are closer to core regions, or regions with a large employment base, have higher levels of accessibility compared to the more peripheral regions. The information flow of job openings, the number of jobs available and the number of job offers in a given period increases as the accessibility increases. For this reason the cost of commuting decreases as the accessibility of a region increases.

Based on the empirical evidence that higher educated people tended to have higher mobility as their scope on job opportunities may be more national, the prediction of the job search theory is very similar to that of human capital theory. In both cases, individuals with higher educational attainment will be more likely to become mobile or willing to commute (see, for example, Giuliano 1998 and Harsman and Quigley 1998).

The prediction of these two theories is in general, supported by the literature. Giuliano (1998) and Lee and McDonald (2003) have found that part-time employees had shorter commuting times and are also associated with lower income, younger age and tended to be females. The same authors also found that having higher income was associated with longer commuting time. A similar conclusion is reached by Eliasson et al. (2003) and Johansson, et al. (2003) where both studies concluded that individuals with higher education tend to be more mobile than those with lower levels of education.

4. THE GRAVITY MODEL – FORMULATION AND ESTIMATION

Gravity models originated in the study of human geography and have frequently been used in the study of interregional trade flows (see, for example, Oguledo and MacPhee, 1994), migration decisions flows (see, for example,

Aroca and Hewings 2002), traffic flows and commuting patterns (see, for example, Southworth, 1996). These models are concerned with the role of space in determining flows of migration or commuting. The gravity model in its most general form, posits commuting flows within a regional network to be a function of origin and destination specific push and pull factors.

Within this modelling framework, the flow of commuters is determined by the choices of residential location relative to the work area. Uboe (2004) notes that the gravity model measures the individuals' behaviour in response to distance, reflecting spatial characteristics. The basic structure of a simple gravity model, for use in studying commuting patterns can be represented by the function:

$$T_{ij} = \alpha R_i^{\beta} W_j^{\gamma} / d_{ij}^{\delta} \qquad (1)$$

where,
T_{ij} (α) = the gravity concept or the commuting flow between region *i* and region *j*;
R_i (β) = the number of employees living in region *i*;
W_j (γ) = the number of people working in region *j*;
d_{ij} (δ)= the distance or commuting time from origin region *i* to destination region *j*.

The underlying assumption to this model is that every worker is equally attracted to any type of job and they also have an equal chance to obtain any job. However, employees are rarely homogeneous in regards to their qualifications and their residential distance to work. As a result, it is unlikely that all people living in the same residential area will have the same level of qualification. Further, as we have already seen, both the human capital and job search explanations of commuting patterns suggest that there may be different levels or preferences for commuting according to level of education. To examine this, it is necessary to rewrite equation (1), allowing for different education categories. Thus equation (1) can be rewritten as:

$$\log T_{ij} = \sum_k \alpha_k^{'} + \sum_k \beta_k \log R_i + \sum_k \gamma_k \log W_j + \sum_k \delta_k \log d_{ij} \qquad (2)$$

where k represents the number of education categories.

A further important point to note, when using the gravity modelling framework is that, as noted by Uboe (2004), employees are heterogeneous with regards to their levels of qualifications and their responses to commuting distance. Thus, the results derived from the estimation of an aggregate model may not be stable if using a simple gravity model and the disaggregation by level of education may also improve the modelling results.

The journey to work data by level of highest qualification was, for the purpose of the current study, aggregated into three education levels, being high (Bachelor and higher level university qualifications), medium (Advanced

Diploma, Diploma and Certificate level III and IV level qualifications) and low (being Certificate level I and II and no post school qualification categories). Table 3 provides the results for the estimation of this model using the ordinary least squares (OLS) estimation procedure for the three separate levels of education, as well as with the aggregate data, comprising all levels of education. In this analysis all flows of 0have been omitted, following Harsman and Quigley (1998). In this table four versions of the model are presented. The diagnostics indicate that these models explain 76 to 83 percent of commuting patterns from the Sunshine Coast. Further, the Jacque-Bera test for the normality of residuals and the White test for heteroscedasticity suggest that the errors from these models are well behaved.

Table 3. Gravity Model Coefficient Estimates by Dummy Variables, Pooled Model

	I	II	III	IV
α	1.4944***	3.5967***	3.6751***	3.4174***
β	0.4549***		0.3806***	0.3907***
β low		0.4324***		
β medium		0.3803		
β high		0.5808***		
γ	0.9288***	0.5638***		0.6213***
γ low			0.6044***	
γ medium			0.5505**	
γ high			0.7588***	
δ	-2.4719***	-2.7152***	-2.7289***	
δ low				-2.6687***
δ medium				-2.5689**
δ high				-2.4190***
R^2	0.7591	0.8230	0.8252	0.8214
$\overline{R}^2$	0.7538	0.8164	0.8186	0.8147
F- degrees of freedom	(3, 136)	(5, 134)	(5, 134)	(5, 134)
F - Statistic	142.8340***	124.6320***	126.5070***	123.2060***
White's test for heteroscedasticity	7.8312	11.8680	17.8642	11.9721
Test for normality of residual	3.6501	8.6598	7.7035	8.9363
Akaike information criteria	0.2408	0.1820	0.1798	0.1837
Bayesian information criteria	0.2619	0.2065	0.2039	0.2084

Notes: *** represents significant at 1%; ** represents significant at 5%; * represents significant at 10%; AIC represents Akaike information criterion; BIC represents Schwarz Bayesian criterion

Model I is the aggregate model, it uses pooled data for all levels of education. In model II, β the coefficient of the log of the number of employees in each zone, is disaggregated by level of education. In this model the dummy variable for highly educated workers is significant and negative (0.58), suggesting that the size of the origin zone has relatively less impact on highly educated workers choice of workplace. In this model the dummy variable for medium level education is not significant.

In model III, γ, the coefficient of the log of the number of people working in the destination zone is disaggregated by level of education. In this model the dummy variables for both medium and highly educated workers is significant. For the highly skilled, the result suggests that they are less sensitive to the size of the destination region, while the reverse appears to be the case for middle level skilled workers.

Finally, in model IV, δ, the coefficient of the log of distance is disaggregated by level of education. A clear result coming out of this estimated equation is that the absolute size of the coefficient is inversely related to the level of the qualification. This result suggests that distance has a smaller deterrent effect on more highly skilled workers.

Overall, the results from this analysis suggest that more highly educated workers commute longer distances. Further, the significant and negative coefficients of all dummy variables suggest that the more highly educated are less sensitive to the size of the origin and destination regions, perhaps suggesting that they undertake a more extensive search process when seeking employment.

Figure 1 summarises the partial effect of travel time on trip behaviour as a function of education level. The figure graphs the value of the access measure (coefficient of distance) presented in Table 3. That is, holding the demand and supplies of education constant for the three groups, it illustrates decay in work trips with increasing distance. We can see in this figure that there is some difference in work trip behaviour by level of education with work trips for those possessing vocational training and university level qualifications tending to be longer than persons with no post school qualifications.

The model result suggests that more highly educated workers are more likely to commute longer distances. The results presented in Figure 1 at first sight suggest that the probabilities are similar. However, over the range of 5 to 50 minutes travel time, persons with medium level education (vocational level qualifications) are on average 6.7 percent more likely to commute than unskilled workers, while persons with high level qualifications are on average 10.5 percent more likely to travel.

5. CONCLUSION

This study has provided an analysis of commuting patterns on the Sunshine Coast and between the Sunshine Coast and the remainder of south east Queensland. The impact that education level has on the commuting preferences has also been explored. This has been done using data from the 2001 Census of Population and Housing.

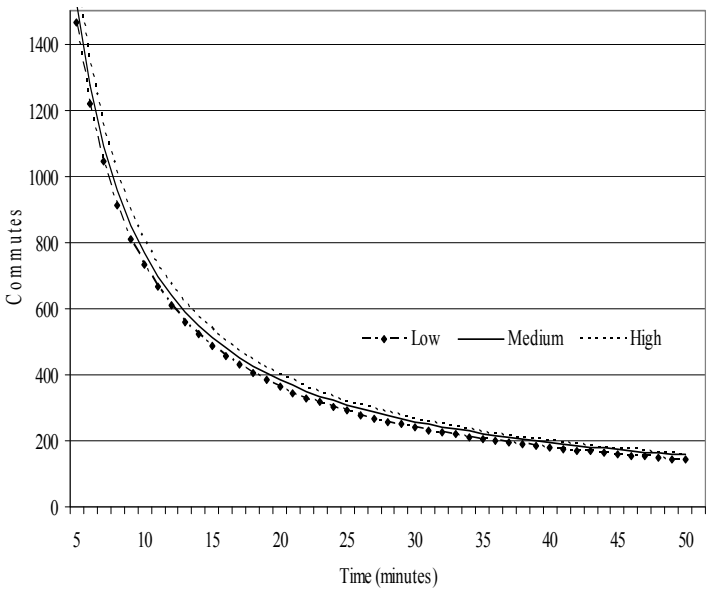

Figure 1. Estimated Commuting Flows by Level of Education

It has been shown that both the human capital and job search theories predict that distance will have a smaller deterrent effect on commuting, the higher the qualifications of the person. This particular prediction of these theories is explored in this paper, and the results suggest that higher levels of education are associated with relatively longer commutes. That is, the deterrent effect of distance declines with higher levels of education. This result is consistent with that of Harsman and Quigley (1998), Giuliano (1998), Lee and McDonald (2003) and Eliasson et al. (2003). Further, the results in table 3 indicate that the commuting patterns of more highly educated workers are less sensitive to origin and destination region size in terms of numbers employed. This suggests that more highly educated workers are more likely to seek jobs providing a greater return, again as predicted by both the human capital and job search theories.

An implication of these results is that regional economic cycles may have different impacts on different demographic groups within regions. In particular, less skilled people are less likely to commute longer distances for employment. All things being equal then, an adverse regional impact to any given region, the Sunshine Coast in the current example, would suggest that lower skilled persons would be more adversely affected than higher skilled persons. This seems particularly important given that, as shown in section two, this region's education profile is below the average for Queensland.

This outcome suggests two possible policy options to improve the social and economic situation of low skilled or marginalised workers. Firstly, improvements could be made to public transport to reduce travel times and costs

of commuting to industrial centres in neighbouring regions. Alternately local councils could foster a more diverse industrial structure within the region to create more employment opportunities for the local residents. This latter policy may be at odds with the aims of some local councils where the desire to create "green" local areas is seen to have benefits to a regions amenity value. However, given that people with lower levels of education follow less geographically expansive job search patterns, they are in effect, relatively more captive to the performance of their local labour market. In this situation, policies that discourage industry locating within an LGA's boundaries are likely to have the detrimental impact of reducing the chance of these groups participating in the labour force.

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