Review of Empirical Estimation of the effects of Change of Use Charges (CUC) in the ACT

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Executive Summary

This report addresses the feasibility of implementing an empirically and theoretically coherent economic model to provide estimates of the effect of altering the change in use charge in the ACT on the local economy. Specifically, the effects on investment, and consequently on output and employment, as well as aspects of the housing market itself. As a starting point a coherent economic framework relates investment in housing and commercial property to other economic indicators including value of property, credit market conditions, local labour markets, and construction costs. This framework proposes a means of relating change in use charges to investment outcomes via a relative price mechanism.

Obtaining suitable data with which to estimate the proposed theoretical framework is problematic. The consultant, Macroeconomics Ltd and the ACT Government conferred extensively on obtaining alternative sources of data. The final conclusion is that at this point in time economically meaningful estimates are not obtainable due in part to the extensive uncertainty in the data generated by our need to construct many series. Three problems arise consistently: (i) the non-existence of required data (ii) inappropriate frequency of data and (iii) incompatible units of measurement. Although these issues often encountered in applied economics, in this case the severity of the problems leads to the outcome that empirical implementation is not appropriate at this time. Any implementation would be fraught with uncertainty due to the extensive proxying and data interpolation required to obtain a data set.

This report recommends that the ACT establish a data collection related to housing and commercial property values, prices, volumes and charges. These data collection should meet the following criteria:

(i) Be collected at a regular quarterly frequency, taking account of any seasonal issues which may arise. Consultation with the Australian Bureau of Statistics particularly on seasonal adjustment for government revenue and expenditure measures is advised.

(ii) Be collected with a consistent unit of measurement. In particular, the property prices, values, change of use charges and properties changing use should be measured in a consistent unit. This is a non-trivial problem given issues relating to adjusting for different quality measure. Although a reasonable proxy for residential housing may be residential blocks or dwellings, a somewhat more desirable unit is square meterage of dwelling and block. Commercial property is much more difficult due to different usages, however, this can probably be proxied with a locational indicator as like businesses cluster together. Prices, values and volumes for existing, new

release and change in use as well as the change in use charge itself must be available in the same unit of measurement.

(iii) Data need to be collected for a significant period before reliable estimates can be obtained. At least 10 years of reliable quarterly data are required from the future. Although backdata are available on a number of series, the current change of use charge data are not good indicators. This is because the charge has been largely unchanged for a number of years and most of the data are interpolated. To provide sensitivity estimates to the change of use charge requires independent variation in the variable. Interpretations of econometric results for economic policy are not reliable too far away from the range of sample observations. Once 10 years of reliable data are available it may be appropriate to use some of the proxied backdata as the proxies will not dominate the estimation period. The non-stationary (cointegrating) nature of the data mean that 10 years are at the minimal range for this project, as the short run dynamics need to be nested in the long run behaviour of the data series.

The report details the ideal dataset required for estimation, the currently available data, and covers the issues arising with these and a recommendation on how to proceed for each series. With this data in hand the proposed economic framework would be empirically implementable.

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1. Introduction

The brief for this report was to examine the feasibility of providing empirical estimates of a coherent economic theoretical framework which represents the potential effects of changes in the CUC charge in the ACT on economic activity in the ACT.

Unfortunately, the conclusion of the investigation is that empirical implementation of the proposed model is not recommended. The main reasons for this relate to data inadequacies. These data problems fall into three general areas:

(i) Inadequate data proxies for the required economic values

(ii) Data frequency including data at varying frequency and with inadequate time span for estimation

(iii) Units of measurement which are not necessarily compatible across different series.

While these problems often arise in applied economics, in this instance the extent of the problems, and the potential interactions between them, would lead to an unacceptably high level of uncertainty surrounding any estimates. Consequently, they would have very limited economic interpretation.

The remaining sections of this report proceed as follows. Section 2 briefly outlines the empirically relevant structure of the economic framework. Section 3 details the ideal dataset required for estimation of this model. Section 4 outlines the available dataset, much of which was compiled by the ACT Government and Macroeconomics Ltd as a result of requests originating with this report. Extensive cooperation between the ACT Government, Macroeconomics Ltd and myself, led to the exploration of a vast array of potential data sources, and the ACT Government themselves should be commended for their diligence in persevering with obtaining data. In light of the data problems arising Section 4 also contains a suggested means of addressing frequency issues and outlines the problems inherent in the series closest to those required for successful empirical implementation including some descriptive statistics and analysis of the data series.

2. Brief Description of Economic Model

The basic economic model requires estimation of the following equations, where dynamic relationships are not specified in the theoretical representation.

$$\Delta K_t = \mu\left(\frac{p_t^m}{p_t^l + p_t^c}\right) + \delta K_{t-1} \qquad (1)$$

$$p_t^m = p_t^0\left(1 - \pi e^{-rT}\right) \quad (2)$$

$$p_t^D = \beta\left(L_{t-1} + \Delta L_t + \Delta D_t\right) + \gamma_1 r_t + \gamma_2 i_t + \psi S_t \quad (3)$$

$$\Delta D_t = \varphi \log\left(\frac{c_t^D}{p_t^D}\right) \quad (4)$$

$$\Delta Z_t = \zeta \log\left(\frac{c_t^d}{p_t^m}\right) \quad (5)$$

The definitions of symbols are given in Table 1, below. Equation (1) represents the evolution of the capital stock (investment), assuming that there is a equilibrium value of capital stock and that adjustment towards that equilibrium will occur via a Tobin's Q model. Equation (2) represents the evolution of the market price of capital towards the time of change of use from some start value. Equation (3) is the combined demand and supply for housing in the economy, and shows the relationship between prices, land supply – given by the bracketed term representing the existing stock of land, L_t, new land releases ΔL_t and land changing in use from single to dual(multiple) occupancy ΔD_t – the economic conditions effecting housing investment through interest rates and inflation and a proxy for population pressure, S_t. Equation (4) represents the number of applications for change in occupancy, depending on the ratio of the cost of changing relative to the price of housing. An analogous representation can be made for commercial property demand and supply, where in that case the number of changes in use for commercial property, ΔZ_t, relates to the ratio of the cost of changing use for commercial property relative to its market price.

Table 1. Symbol Definitions (all variables, except interest rates, are expressed in log terms)

Symbol	Description
Variables	
K	Capital stock at the end of the period
p_t^m	Market value of a unit of capital
p_t^l	Average price of a unit of unimproved land
p_t^c	Unit price of construction
p_t^D	Market price of housing
T	Average time at which change of use take time
R	Real long term interest rates
I	Nominal long term interest rates
L	Stock of existing residential land
S	Population/workforce pressure
ΔD	Change in housing supply due to changes in use from single to multiple occupancy
ΔZ	Change in commercial property supply due to changes in use

Coefficients	
μ	Sensitivity of investment to Tobin' Q for land (that is the ratio of market price to price of existing stock of land)
δ	Sensitivity of investment to the prior level of existing stock of capital stock
π	Average fraction of market value accounted for by change in use charge
T	Average time to change of use or property
β	Sensitivity of price of land to the quantity of land available
γ_1	Sensitivity of the price of land to the current real interest rate
γ_2	Sensitivity of the price of land to the current nominal interest rate
ψ	Sensitivity of the price of land to population pressure
φ	Sensitivity of changes of use in residential market to the cost of the change of use charge relative to residential housing price
ζ	Sensitivity of changes of use in commercial property to the cost of the change of use charge relative to commercial property price

3. An Ideal Dataset

The data requirements for estimating the specification outlined in Section 2 need to satisfy some basic criteria:

(i) consistent units of measurement
(ii) consistent frequency of data availability
(iii) appropriate representation of the theoretical data

Of these the most difficult in the current problem relates to the consistent units of measurement. Prices in the theoretical model are for some theoretical unit of real estate (for example it could be a single dwelling, or an undeveloped piece of residential land, or a commercial premise). Consistently defining and implementing these theoretical units are a major challenge to the project.

The capital stock consists of the housing and commercial real estate stock of the ACT. The value of total capital stock can usually be achieved by a total estimated market value of capital stock, such as provided by the Australian Bureau of Statistics (ABS). However, we also require a price per unit of capital stock, and it is not clear what those units could or should be.

Residential investment: For residential investment we could use residential dwellings, and make the assumption that there is little heterogeneity between dwellings located say in Deakin from those in Gunghalin. For undeveloped residentially developed land this is also difficult, suggesting that perhaps value should be recorded as per residential block, but this creates difficulties where sizes

of blocks differ, as well as the housing stock (as opposed to the land value). An alternative would then be a square meterage of developed and undeveloped land measure which is likely the most consistent across the different categories of residential capital stock, but also the most difficult to fulfil.

Commercial Investment: Valuing commercial capital stock using a consistent volume unit is likely to be harder than in the residential case as the heterogeneity in use of the capital is far more pronounced. Capital tied up in storage warehouses is unlikely to have the same per meterage return as capital tied up in a retail trade enterprise. However, it may be possible to overcome this with the geographical clustering of different economic activities by using a postcode location dummy (representing for example Fyshwick, Civic, Mitchell) to control for these effects.

Likewise the price data required need to line up with the units of measurement used for volume data. For example, one possibility is to use representative house sales prices for single dwelling properties for residential investment (in this case hoping that there are sufficient observations to control for the heterogeneity in the properties sold). A similar logic could be applied to commercial property, although this is shown to be quite problematic in Section 4.

Specific data relating to the change in use charge for residential and commercial properties are required, again with a consistent unit to those used for the other prices in the system.

Nominal and real long term interest rates are readily available from the Reserve Bank of Australia and ABS sources. Estimates of the changing workforce and/or population of the ACT are available from the ABS, although it is more difficult to control for the immediate environs of Queanbeyan and other near-lying NSW population centres which also influence the ACT real estate market.

4. Available Data

The ACT Government and Macroeconomics Ltd. worked with the author of this report to obtain data which meet the criteria for the ideal dataset described above. This section presents the closest proxies obtained for the model estimation, and describes the features, advantages and disadvantages for each series.

A suitable frequency for estimation of macroeconomic time series in Australia is usually constrained by the quarterly frequency of national accounts, inflation and employment data. Thus, in a number of cases monthly data are transformed to quarterly frequency by either averaging the monthly observations (as in the real interest rate) or taking the mid month of the quarter (as in some employment series). Most of these data are available for a relatively long sample, and the following sections present data for 1986 Q2 onwards, limited by the beginning of the ABS house price index for the ACT. More difficulty is encountered with series with lower frequency. A number of the series are only available annually. Some

series provide annual data for only 7 years which is insufficient for this project. Annual data available over a longer time period may be able to be interpolated with the Chow-Lin (1971) regression technique and later developments to cope with non-stationary data. Another problem is the cessation of quarterly collection of some series, particularly government employment and earnings data after June 2007. This should be able to be interpolated using series from the monthly employment survey.

An aspect of the implementation not covered in the theoretical section is the need to account for the empirical properties of the data. A number of the series contain trends and exhibit non-stationary behaviour which must be specifically accounted for in estimation. The stationarity properties of the series are noted in the following sections, with descriptive statistics generally reporting results of the Augmented Dickey Fuller test for non-stationarity with the p-value of the test statistic reported in parentheses.

The following subsections contain an illustration and descriptive statistics and some analysis of a number of the series presented as potentially useful for estimating the equations specified in Section 2. Specifically, the report comments on the units of measurement, frequency of data and ability of the indicator to appropriately represent the theoretical concept referred to in Section 3.

4.1 Capital variables, K_t, ΔK_t, L_t, ΔL_t.

Quarterly gross fixed capital formation in the ACT for dwellings and non-dwellings is available from the ABS. The value of dwellings formation may be of some use as a proxy for the changing stock of built houses and is a stationary series.

The annual value of real estate capital stock was provided by the ACT Treasury as ABS Valuation summary for the years 2003-2010. This is clearly an insufficient time period for estimation. Interpolation and extrapolation could be attempted using the gross fixed capital formation data but a better course would be to continue to collect data until a sufficient time series is available. Additionally, it is important to consider how particularly the different purposes of the capital stock are to be aggregated – for example the commercial properties data contain varied categories from 17 early childcare establishments to 9 dog kennels. Finding a consistent unit for measuring an establishment is a persistent problem in this exercise.

Data on the release of new land into the market is fundamentally important to modelling price responses to volume. It is otherwise impossible to separate changes in value from changes in volume in the value of the capital stock. This raises the issues again of how to consistently measure the volume of land released – as residential blocks, commercial blocks, square meterage or some other metric. Compatible metrics need to be chosen and appropriate data collected.

Recommendation: Establish a collection of capital stock volumes and values using a set of consistent volume metrics so that price and volume effects can be effectively separated. One possibility is to use a suburban home/standard residential block as a unit of measurement for residential collections, although this may create difficulties with changes in use from single to multiple occupancy. For commercial use a square meterage collection is recommended, paying attention also to assigning a code of type of usage for each enterprise and its geographic location within the ACT so that different capital intensities may be captured.

4.2 Price variables, p_t^m , p_t^D , p_t^l

Several potential price indicators were provided. These include the value of commercial sales in the ACT (from ACT government), the average house sale price for the ACT (from ACT government), and a spliced series comprising the house price inflation index for the ACT (ABS) for project homes to March 2002 and the house price index thereafter (during the common period for the two series the correlation between them is 96%). The residential house price data could be proxied by either of the final two series, and they are shown in Figure 4.2a. Trends in the two series clearly track each other well. However, there is considerably greater volatility in the average house sale price series provided by the ACT government data (quarterly data were obtained by averaging monthly observations), visible in the quarterly changes shown in Figure 4.2b. The ability of the ABS to deal appropriately with seasonal fluctuations suggests the ABS house price index would be the better choice. As with most price series the series is stationary in first differences.

The average value of commercial sales in the ACT data is possibly the most difficult data provided in this analysis. The data analysed are the quarterly averages of monthly data, and display enormous variance. As it is an average unit price series, these are expected to rise over time in an inflationary environment displaying non-stationary behaviour. The log levels of the average commercial sale displayed in Figure 4.2c clearly indicate the difficulties in this series. It is so volatile in levels that there is virtually no information content in the series. The problems referred to in Section 2 of units of measurement, heterogeneity and in this case low volumes of sales are impinging on the quality of this data and its use is not recommended.

The average price for unimproved land was provided as annual data series for the period 1995 to 2010. Figure 4.2d shows the levels of the average prices and Figure 4.2e the annual inflation rates for the two series. Clearly they are extremely volatile with almost 30% annual price inflation apparent in both series in some years, and others with up to 10% deflation. These swings seem unlikely to be a true representation of the underlying changes in prices, reflecting the problems apparent in measurement units referred to previously. While these land price series could be interpolated using a Chow-Lin procedure the resulting quarterly series is likely to exhibit undesirably high levels of volatility.

Recommendation: The ABS house price index may provide a suitable representation of the price for housing in the ACT. The provided series on average house sale and average commercial sale are not recommended due to their extreme volatility. The annual average prices for unimproved residential and commercial land should be reviewed with a view to improving the quality of the data, mainly with respect to working out suitably comparable units of measurement for the quantity of land.

Figure 4.2a Residential house prices: log of ABS house price index and log of average sales price

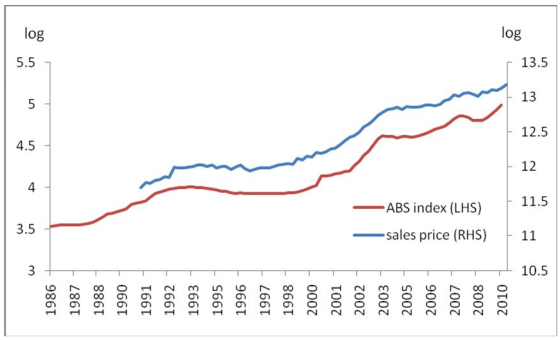
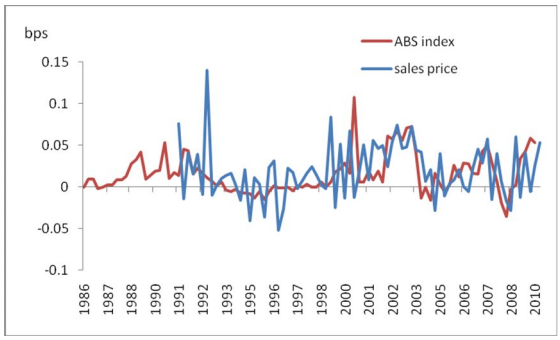


Figure 4.2b Quarterly change in residential log house prices: ABS house price index and log of average sales price



Descriptive statistics for quarterly change in the log ABS house price index.

	Statistic
Mean	0.015
Maximum	0.108
Minimum	-0.035
Standard Deviation	0.024
Skewness	1.171
Kurtosis	4.753
ADF test	-4.709 (0.000)
AR coefficient	0.598

Figure 4.2c Average commercial sales prices

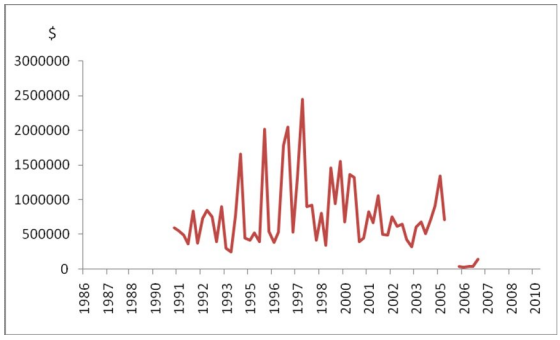


Figure 4.2d: Average unimproved value of residential and commercial land

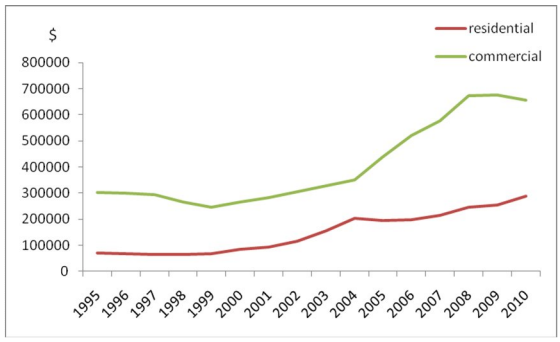
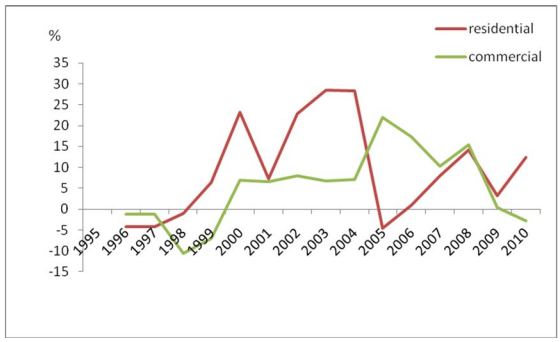


Figure 4.2e Annual percentage change in unimproved land value



Descriptive Statistics for Average Commercial sales ($)

	Statistic
Mean	742430.7
Median	611291.0
Maximum	2447839.0
Minimum	29927.51
Standard Deviation	507719.2
Skewness	1.296
Kurtosis	4.582
ADF test	-5.979 (0.000)
AR coefficient	0.251

Annual inflation in Unimproved land prices residential

	Statistic
Mean	9.421
Maximum	28.457
Minimum	-4.516
Standard Deviation	11.735

Annual inflation in Unimproved land prices commercial

	Statistic
Mean	5.181
Maximum	21.974
Minimum	-10.604
Standard Deviation	9.060

4.3 Construction costs, p_t^c

To proxy construction cost a reasonable indicator is the ABS price index series for materials used in house building for the weighted average of 8 capital cities, available quarterly, series number A2390558X. The assumptions required to use this data is that the overall price index is directly scalable to individual units of construction. The series are non-stationary in levels and stationary in first differences. For brevity Figures and descriptive statistics are omitted.

Recommendation: The ABS house building material price index provides a reasonably proxy for construction costs in the ACT.

Figure 4.4a Log total gross earnings of public servants in the ACT

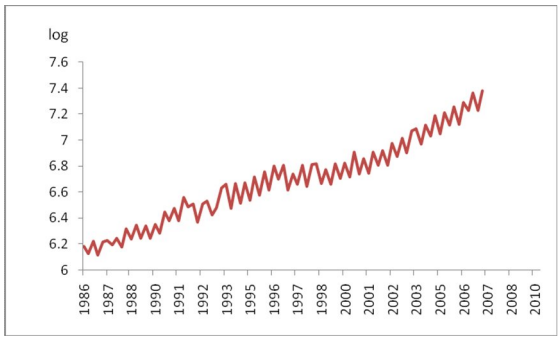


Figure 4.4b Log total public service employment in the ACT

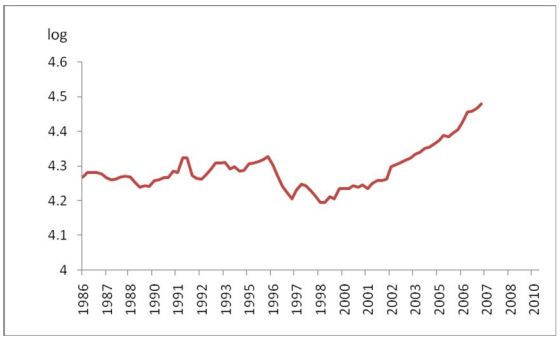
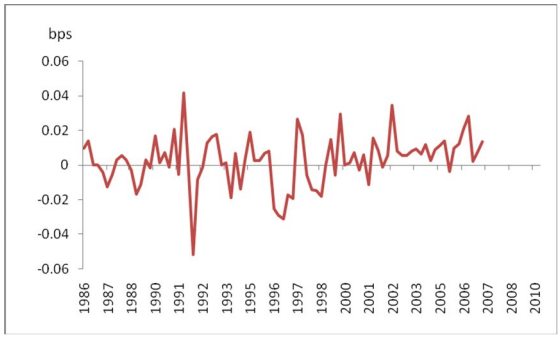


Figure 4.4c Quarterly changes in log total public service employment in the ACT



Descriptive Statistics for quarterly changes in log employment levels

	Statistic
Mean	0.003
Maximum	0.042
Minimum	-0.052
Standard Deviation	0.015
Skewness	-0.510
Kurtosis	4.765
ADF test	-6.838(0.000)

4.4 Population Pressures, S_t

Two potential alternatives were proposed for this category; the total gross earnings of public servants in the ACT (obtained as the sum of gross earnings ACT of the Commonwealth Government and of the Territory Government; available quarterly sourced from ABS series ID A591400W and A591420F). This series is shown in Figure 4.4a, and shows serious

seasonality. Simple attempts to remove this seasonality with moving average processes were unsuccessful; hence addressing this would be a prime consideration in the use of such an indicator. A slightly more promising indicator is the level of Government employment in the ACT (the sum of Commonwealth and ACT Territory employees from ABS catalogue A590900X and A59180F), collected quarterly in the mid-month of each quarter. The log level series is shown in Figure 4.4b and the quarterly log changes in Figure 4.4c. The upward trend in employment in the last part of the sample is clearly evident, strongly biasing tests towards a conclusion of non-stationarity in the data. The changes data are confirmed as stationary, but shows very strong negative observations in 1992 mainly reflecting large contractions in the Territory employment numbers recorded by the ABS.

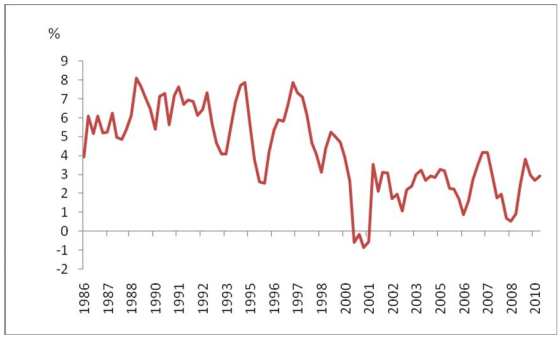
Recommendation: The employment numbers may be suitable as a representation of S_t.

4.5. Interest rates, r_t and i_t

Nominal interest rates are available daily from the Reserve Bank of Australia, and they provide an end month figure in the Bulletin Tables. Quarterly indicators are usually obtained by taking the monthly average of these data. Real interest rates are obtained by subtracting the annual inflation rate from the nominal interest rate. Both these series display strong persistence, often failing to reject non-stationarity tests. However, in empirical work it is usual to treat them as stationary with strong persistence as non-stationary short-term interest rates are incompatible with modern monetary policy operation, and consequently imply stationary longer term rates (the alternative of a non-stationary risk premium is unattractive). Figure 4.5a shows an indicative 5 year real interest rate calculated in this manner, and the descriptive statistics indicate the failure of the ADF test to reject the null hypothesis of non-stationarity in the data.

Recommendation: Standard sources of interest rate data may be used.

4.5a The 5 year maturity real interest rate



Descriptive Statistics for 5 year maturity real interest rate

	Statistic
Mean	4.245
Maximum	8.100
Minimum	-0.840
Standard Deviation	2.209
Skewness	-0.191
Kurtosis	2.255
ADF test	-1.472 (0.543)
AR coefficient	0.926

4.7. Change of use volumes and charges

To estimate the sensitivity of real estate in the ACT to changes in the change in use charge fundamentally requires good data on the change in use charges and the volumes of changes in use which have occurred. The currently available data is not sufficient for this purpose.

The annual change in use charges data provided for commercial and industrial use were generated by Macroeconomics Ltd, and provide 10 years of observations. Figure 4.7a shows a rise over the sample period. However, use of this data will result in a generated regressor problem resulting in an increased variance of any estimate. For most of the period with available data (fiscal years 2002-03 to 2009-10) the change in use charge for residential property was fixed at $3750 for dual occupancy and $1850 for multiple occupancy. This means that there is absolutely no variation in the change in use charge on which the model can estimate the effect of this charge on the real estate market. The only way this would be achieved is because in equations (4) and (5) the change in use charge enters as a ratio to the price of real estate which has been moving. Any estimate generated in this way relies on the hypothesis that changes in the relative prices generated by the numerator are received in the same way as changes generated by the denominator (that is that an increase in the change in use charge will be perceived by market participants in exactly the same way as a decline in market prices for real estate). Additionally, estimations produced with this data would be extrapolating the effects of a change in use charge movement around a local point which may be particularly fraught with hazard – that is movements in change of use from say $3750 to $5000 are outside the range of observed data and may not be captured well by the proposed system.

Recommendation: That a collection of change in use volume be established paying attention to consistent units of measurement to be consistent with price and volumes listed in previous recommendations, particularly with regard to commercial property. That change in use charges are collected quarterly going forward to establish a time series of this data.

Figure 4.7a Change in use charge for industrial and commercial property