Modelling Urban Development in New Zealand

F.G. Scrimgeour[a], G. Feng[a] and S. Barns[b]

[a]Department of Economics, University of Waikato, Hamilton, New Zealand (scrim@waikato.ac.nz)
[b] Environment Waikato, Hamilton, New Zealand

.

Keywords*:* urban; property; development; New Zealand

EXTENDED ABSTRACT

This paper analyses subdivision and development time paths in the Western Bay of Plenty of New Zealand. The research explores the determinants of subdivision and building consent applications. Results are used to forecasting consent applications and a simulation model is developed to facilitate forecasting by the relevant agencies.

Subdivision activity is very responsive to changes in the five year government bond rate. When long term interest rates increase by one percent, subdivision applications will fall by 1.27 percent with a lag of one quarter. The growth rate of new dwellings nationally is a strong indicator of subdivision activity in the Western Bay of Plenty. A one percent increase in the national new dwelling index will result in a 1.08 percent increase in new dwellings in the Western Bay of Plenty with a lag of two quarters.

The best model of building consents explained 76% of the variation. Mortgage interest rates lagged one period, national new dwelling index lagged two quarters, the current alterations index, the horticultural price index lagged two periods and dwelling consents for the previous period were the key explanatory variables. A 1% change in each of these variables would impact building consents as follows: mortgage interest rates lagged one period (1%), national new dwelling index lagged two quarters (0.5%), the current alterations index (0.8%), the horticultural price index lagged two periods (0.7%) and dwelling consents for the previous period (-.3%).

1. INTRODUCTION

This paper presents the results of an investigation into subdivision and development time paths in the Western Bay of Plenty district. The development of new sub-divisions and application for building consents fluctuates considerably from year to year. Efficient planning relies on a sound understanding of the relationship between subdivision applications, title issuance and dwelling consents. Subdivision application is a multi-stage process. New titles are obtained when the completion certificate (224 stage) is deposited with Land Information New Zealand.

The paper is based on data taken from the Western Bay of Plenty District Council (WBOPDC) database and from external economic indicators. WBOPDC provided data on building consents, subdivision applications, additional lots at 224 stage, additional lots at subdivision approval stage and building consents with subdivision detail. This data was checked for internal consistency. External data was obtained for construction indicators, interest rates, income variables and property sales data as these were expected to be the principal determinants of development activity.

Correlation analysis shows a strong relationship between subdivision at 224 stage and new dwelling consents. Correlation coefficients calculated were: Subdivisions and additional lots at 224 (0.43) Subdivisions and new dwelling consents (0.57) and Additional lots at 224 and new dwelling consents (0.63). Further analysis revealed correlation was significantly less for rural developments as opposed to urban developments.

2. RELEVENT RECENT HISTORY

The Western Bay of Plenty, located close to the city of Tauranga, is one of New Zealand's fastest growing districts, comprising five wards: Waihi Beach, Katikati, Kaimai, Te Puke and Maketu. The area covers 212,000 hectares, serving a population of 38,200 (Statistics New Zealand, 2001). The population growth of 28.0% for the district over the 10 years to 2001 has been well in excess of the New Zealand average of 10.8%, and brings with it pressure on land and housing resources in the region (Statistics New Zealand, 2001). But growth in some areas within the district has been well beyond 28.0%. The highest population growth over the 10 years has occurred in the areas Minden and Kaimai, where populations have increased by 65% and 62% respectively, to 3,675 and 4,719.

The development time path has not been consistent over time. The time taken from subdivision application to 224 stage has increased from 1990 to 2001. In 1990, 43 percent of subdivision applications were approved within six months, 10 percent within 12 months, and 86 percent within 18 months. By 2001 these proportions had fallen to 21 percent, 37 percent and 52 percent respectively, although the total of subdivision applications in 2001 was similar and additional lots were 43 percent lower than in 1990. During the last decade the time to reach 224 stage slowed for rural subdivisions but marginally reduced for urban subdivisions. Currently for dwelling consents to reach a level of 10% takes urban subdivisions approximately 8-10 months, while rural subdivisions take closer to two years.

There is no evidence of a significant urban land bank though there is some evidence of a significant rural land bank. Only two years (1997 and 1999) contributed significantly to the urban land bank. The total increase in lots without dwellings was 651 between 1990 and 2001. In contrast rural lots without dwellings increased by 1891. However there was a large variation between wards. Kaimai and Katikati have the largest number of additional lots without dwellings. Waihi Beach appears to have few undeveloped rural additional lots.

3. ECONOMETRIC ANALYSIS

Multiple regressions were used to examine how variables external to the Council determine the variables internal to the Council. In all models, the internal variables are modelled as the dependent variable and external variables are modelled as the independent variables. The modelling process is from general-to-specific, which means that firstly all the external variables are included in the models, then variables with insignificant coefficients are deleted and model is re-estimated. This process is continued until all the coefficients are significant differently from zero, which means that the variables determine the variation of dependent variable. All models were estimated in full sample (1990Q1:2002Q4) and tested in sub-sample periods to make sure the relations are robust. All results reported are estimated for the full sample.

The labelling of internal variables are as follows: Number of dwelling consents, D_{wt}; Number of subdivision applications received, R_{et}; Number of subdivision applications received in urban area, denoted as U_{ret}; Number of dwelling consents in urban area, denoted as U_{dwt}; Number of subdivision

application received in rural area, R_{ret}; Number of dwelling consents in rural area, $R_{dwt.}$

3.1 Subdivision applications as the dependent variable

The general model of the external variables to explain the subdivision application is:

$$\Delta RE_t = b_1 \Delta RE_{t-1} + b_2 \Delta RE_{t-2} + b_3 \Delta New_{t-2} + b_4 \Delta Long_{t-1} + \varepsilon_t \quad (1)$$

where ΔRE is change in subdivision applications, ΔNew change in new dwellings, ΔLong is change in the 5-year government bond yield, and ε is an error term. This model was estimated by Ordinary Least Square (OLS) regression. The estimation results are shown in table 1. The R-bar-square suggests that 28% of variability of subdivision application growth can be explained by changes of these external variables. F test statistics also indicate that these variables are jointly significant different from zero.

3.2 Dwelling consents as the dependent variable

The general model of the external variables to explain the dwelling consents includes past changes of dwelling consents and lags of mortgage interest rate, and the national construction indicators of dwellings additions/alterations and the new dwellings. The model is specified by statistical significance, residual based tests and other diagnostic tests.

$$\Delta Dw_t = b_1 \Delta Dw_{t-1} + b_2 \Delta Moga_{t-1} + b_3 \Delta Add_t + b_4 \Delta New_{t-2} + \varepsilon_t \quad (2)$$

where ΔDw is the first difference of dwelling consents, ΔMoga is the change in mortgage interest rates, ΔAdd is the change in the additions/alterations construction index, ΔNew is the change in the new dwellings index, and ε is an error term. The estimation results are shown in table 2.

The R-bar-square shows the explanatory power of regressors, suggesting that 53% of variation of dwelling consents can be explained by these external variables. This number is reasonably high. The F-statistic (20.23) indicates that these variables are jointly significantly different from zero.

3.3 Urban and rural dwelling consents

The model of urban dwelling consents is:

$$\Delta Udw_t = b_1 \Delta Udw_{t-1} + b_2 \Delta Add_t + b_3 \Delta New_t + \varepsilon_t \quad (3)$$

where ΔUdw is the first difference of urban dwelling consents, △Add is the first difference of additions/alterations index, △New is the first difference of new dwellings index, and ε is the error term. The estimation results are shown in table 3.

The model of rural dwelling consent is:

$$\Delta Rdw_t = b_1 \Delta Rdw_{t-1} + b_2 Add_t + b_3 New_t + \varepsilon_t \quad (4)$$

where ΔRdw is the first difference of rural dwelling consents, ΔAdd is the first difference of additions/alterations index, ΔNew is the first difference of new dwellings index, and ε is the error term. The estimation results are shown in table 4.

Subdivision activity is very responsive to changes in the five year government bond rate. When long term interest rates increase by one percent, subdivision applications will fall by 1.27 percent with a lag of one quarter. The growth rate of new dwellings nationally is a strong indicator of subdivision activity in the Western Bay of Plenty. A one percent increase in the national new dwelling index will result in a 1.08 percent increase in new dwellings in the Western Bay of Plenty with a lag of two quarters. Other variables were not found to be significant.

The relationship between external variables and building consent applications was explored further incorporating new variables. The best model explained 76% of the variation. The variables in this model were mortgage interest rates lagged one period, national new dwelling index lagged two quarters, the current alterations index, the horticultural price index lagged two periods and dwelling consents for the previous period. A 1% change in each of these variables would impact building consents as follows: mortgage interest rates lagged one period (1%), national new dwelling index lagged two quarters (0.5%), the current alterations index (0.8%), the horticultural price index lagged two periods (0.7%) and dwelling consents for the previous period (-.3%).

4. FORECASTING

In this section, the forecasting capability of models described is evaluated. The models were re-estimated with OLS in sub-sample period (1990Q1 to 2001Q4) and forecast last four quarters (2002Q1-2002Q4). In these figures, the dark blue lines are actual level of series, and light green lines are predications made by models. If the predication is very close to actual number, we will consider it as a good forecasting model.

Variables	Coefficient	Standard error	T-Ratio [Prob]
$\Delta SubApplications_{t-1}$	-0.312	0.129	-2.427 [.019]
$\Delta SubApplications_{t-2}$	-0.356	0.123	-2.884 [.006]
$\Delta NewDwellings_{t-2}$	1.083	0.459	2.359 [.023]
$\Delta LongTermInterestRate_{t-1}$	-1.273	0.574	-2.216 [.032]
$\bar{R}^2 = 0.282$	F-stat. (3, 43) = 7.281[.000]		

Table 1: Estimation results with subdivision applications as the dependent variable

Variables	Coefficient	Standard Error	T-Ratio[Prob]
$\Delta DwellingConsent_{t-1}$	-0.424	0.111	-3.810 [.000]
$\Delta Mortgage_{t-1}$	-0.881	0.284	-3.104 [.003]
$\Delta Additions/alts_{t}$	0.500	0.123	4.060 [.000]
$\Delta NewDwellings_{t-2}$	0.590	0.214	2.754 [.008]
$\bar{R}^2 = 0.532$	F-stat.(3, 45)= 19.159 [.000]		

Table 2: Estimation results with dwelling consents as the dependent variable

Variables	Coefficient	Standard Error	T-Ratio[Prob]
$\Delta RuralConsents_{t-1}$	-0.446	0.125	-3.572 [.001]
$\Delta Additions/alt_{t}$	0.338	0.139	2.435 [.019]
$\Delta NewDwellings_{t}$	0.631	0.217	2.911 [.005]
$\bar{R}^2 = 0.45190$	F-stat.(2, 45)= 21.1996[.000]		

Table 3: Estimation results with rural dwelling consents as the dependent variable

Variables	Coefficient	Standard Error	T-Ratio[Prob]
$\Delta UrbanConsents_{t-1}$	-0.560	0.118	-4.739 [.000]
$\Delta Additions/alt_{t}$	0.389	0.201	1.933 [.059]
$\Delta NewDwellings_{t}$	0.641	0.357	1.798 [.079]
$\bar{R}^2 = 0.381$	F-stat. (2, 45)= 15.751[.000]		

Table 4: Estimation results with urban dwelling consents as the dependent variable

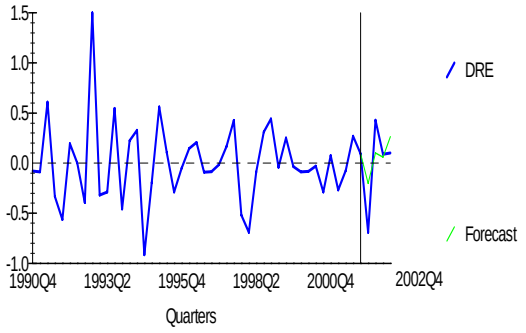

Figure 1. Forecasting subdivision applications received - model (1)

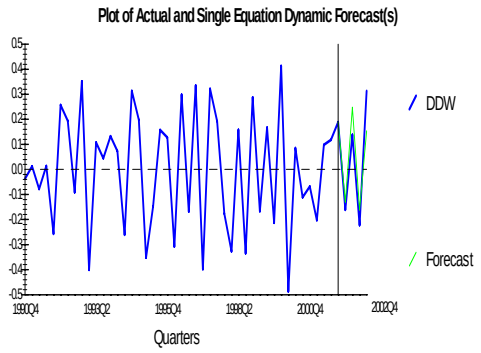

Figure 2. Forecasting dwelling consents issued - model (2)

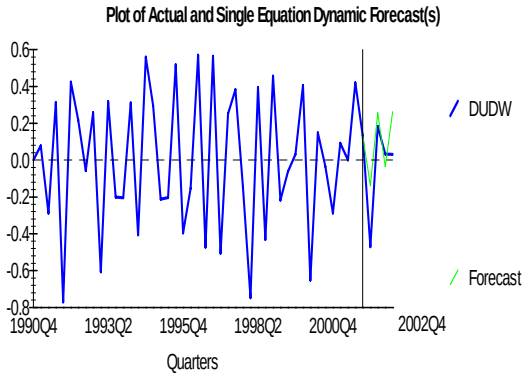

Figure 3. Forecasting urban dwelling consents issued - model (3)

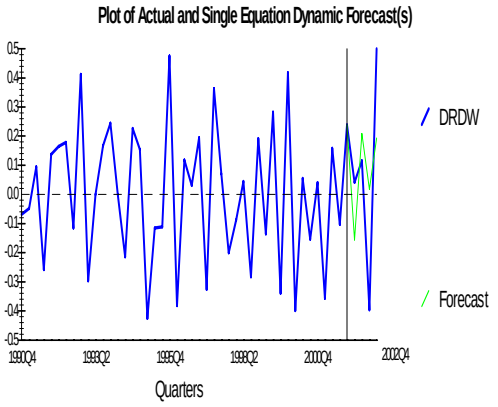

Figure 4. Forecasting rural dwelling consents issued - model (4)

These figures indicate that the forecasting ability of these models is quite good. All the predictions follow the actual number well, at least in directions. The best sample forecasting model is for aggregate dwelling consents issued, where the prediction is almost the same as actual series. Caution is required when using these models to forecast the future development activities. A good in-sample forecasting model does not necessarily mean they are also good out-of-sample (future) forecasting model. The important assumption behind these forecasting models is time-invariant coefficients which is not always true in real world. It is common for there to be structural change in the economic time series, which could cause coefficients to vary substantially.

5. DECISION SUPPORT SYSTEM

Given the analysis completed the researchers produced a decision support model to facilitate forecasting by Council staff and other interested parties. The model was built in an Excel spreadsheet. The front page gave users the options of:

- Forecasting using univariate model
- Forecasting using multivariate model
- View and expand original data
- Instructions
- View technical notes

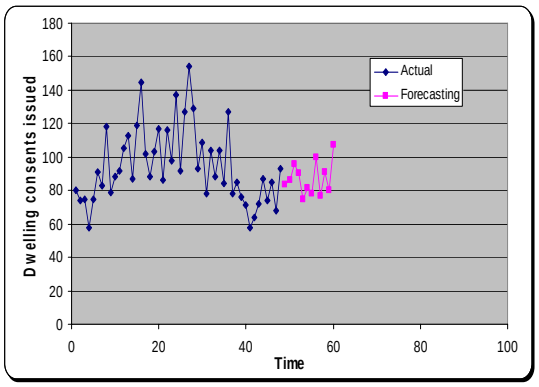

Figure 5. Output from Decision Support model

Forecasting future consent applications is dependent on key external variables, appropriately adjusting for lags, and having consistent flexible data management systems. Key external variables for the Council to monitor are national indices for new dwellings and additions/alterations, five year government bond yields and horticultural price indices. It is important to note varying time paths. During the last four years the average time until 10 percent of dwelling consents were approved was 696 days for rural lots and 272 days for urban lots. In addition the Council needs to ensure the ongoing integrity and flexibility of its data systems to facilitate both the checking and use of data.

5. DISCUSSION

Local government agencies are required to gather information, monitor and keep records in accordance with Section 35 of the Resource Management Act 1991. Further, management by local government is required to consider future needs, recognising the economic social, environmental and cultural diversity of the community, as set out in the Local Government Act 2003. This growing body of legislation makes it essential that local councils consider the impact of development on the community, and the impact of the community on development. Increasing accountability and a long-term view means councils must manage development in a structured manner to meet strategic objectives. A sound understanding of the time paths and drivers of development is essential. This includes the role that

the Council's own rules play in the process and is integral to directing future development along economically and environmentally sound paths.

Changes in subdivision activity in the Western Bay of Plenty have a strong positive relationship with changes in national new dwelling activity. The two quarter lag from the national index to the local index provides a useful forward indication to the Council. The relationship is elastic – that is, a one percent change in the growth of the national index tends to provoke a 1.08 percent delayed response at the local level. These changes move in the same direction.

Construction indices are important variables for dwelling consent applications. For the aggregate of rural and urban application trends both the national new dwelling and the additions/alterations indices are significant. As with the subdivision activity, there is a two period lag, allowing Council to monitor national trends and alter budgets accordingly. However, when separated into rural and urban, the current national dwelling consent activity is important, as is the additions/alterations index.

The strength of these construction indices for both subdivision activity and dwelling consents suggests that quarterly data produced by Statistics New Zealand would be useful in anticipating trends. Similarly, the monthly economic indicators released by Treasury New Zealand (www.treasury.govt.nz/mei) provide an in-depth analysis on national data with sources including Statistics New Zealand, the Reserve Bank and the Real Estate Institute of New Zealand. The Treasury analysis covers the past performance of various indicators including construction, housing, agriculture and primary food, and forecasts future performance in those areas.

Interest rates are important for changes in both subdivision activity and dwelling consent activity. The five year Government bond rate is useful in explaining variation in subdivision activity, while the mortgage interest rates is important for changes in aggregate building consents. Statistics New Zealand and the Reserve Bank of New Zealand are useful sources for past and future interest rate information.

Fluctuations in the time path for both rural and urban subdivision application to 224 stage is not determined solely by the volume of transactions. Moderate years have often had longer processing periods than those years with high volumes of applications. Council rules may have a significant role not just in the volume of activity, but also in the time path to 224 stage. There are clear changes in volume where rules have changed, which may be caused by a variety of factors. However, processing times for applications have shown quite distinct changes following rule changes. For example, post 1997 the time path to 224 stage has slowed significantly.

Subdivision activity can be examined in terms of supply factors and demand factors. On the supply side, rural land owners may be driven by desire to put away future savings, perhaps for retirement, future education for family members, ability to borrow, or some other reason. For these people, it may be that external influences such as interest rates or economic growth have little impact on decision-making relating to when to subdivide and when to sell. Rather they may respond more strongly to changes in local body regulation that encourages/discourages rural development.

Subdivision approval can be seen to have an option value, with the characteristics of an open exercise date and no expiry date. Once a landowner has subdivided there is no obligation to sell immediately or at any time. The current Council rating system for rural land rates the total land at the level as previously until ownership changes. The only additional financial investment has been the initial cost of subdividing. While this cost can be considerable, it may be able to be off-set by selling off a single block (if there is more than one additional lot), or the land may still be in production.

On the demand side though, the failure of land to sell may indicate that owners have unrealistic expectations of land values. In the region, more remote and non-producing lifestyle blocks are difficult to sell (WBOPDC, 2001). Also, new arrivals may be looking for existing housing. Development Trends (WBOPDC, 2001) notes that house and land packages are sought by mature new arrivals to the area, where younger buyers tend to buy in the existing market. A 2001 survey of characteristics of people moving into and out of the region found that 80% of new arrivals were aged 40 or older (Lidgard and McLeay, 2002), suggesting that there may be a good market for speculative building on land, although proximity to amenities is likely to also be important.

Not surprisingly, changes to the time path from subdivision to 224 stage has flow-on effects to dwelling consents. Years with slower processing times tend to have taken longer on average to reach prescribed levels of dwelling consents.

The uptake of rural land has been slower than urban land as a proportion of additional lots in the second half of the 1990s. The need to make a living plays an important role in the sale of rural land: 'lifestyle blocks either handy to Tauranga, Te Puke or Katikati … are the most saleable' (WBOPDC, 2001, p.9). Further it is noted that 'there is a scarcity of properties on the market with good soils and contour at low altitude for horticultural purposes. This also conflicts with the rural-residential sector whose demand is in the same localities, i.e. close to the Harbour, Tauranga, Katikati and Te Puke.' Clearly demand in some areas is greater than others; lack of dwellings on blocks may be a function of locality.

Much of the subdivision activity in the Western Bay of Plenty has remained in the more popular areas. Some areas appear to have built up land banks through subdivision activity. This is particularly so for rural areas. Rudimentary estimations suggest that some areas have a large number of vacant lots, although some lots may be intended for purposes other than dwelling lots, having other structures built on them.

6. ACKNOWLEDGEMENTS

All three authors wish to thank the WBOP District Council for supporting this research.

7. REFERENCES

Lidgard, J. and C. McLeay. (2002). *Researching characteristics of people moving into and out of the Western Bay of Plenty and Tauranga Districts: Some methodological issues*. Hamilton, New Zealand: University of Waikato.

Statistics New Zealand. *2001 Census information*. Accessed on the World Wide Web: www.stats.govt.nz on 3 July 2003.

Western Bay of Plenty District Council & Tauranga District Council (WBOPDC & TDC) (2001). *Development Trends 2001*.

Western Bay of Plenty District Council & Tauranga District Council (WBOPDC & TDC) (2003). *Development Trends 2003*.