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The significance of financial barriers caused by holding costs in greenfield residential development

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The significance of financial barriers caused by holding costs in greenfield residential development

ABSTRACT

Developer infrastructure contributions are regularly cited as the most significant contributor of planning or development costs. However, other non-financial barriers are also emerging as significant impactors. This includes inconsistent planning requirements, development assessment procedures, and conflicts between developers and local councils. Such findings have underpinned a diverse range of planning reforms currently underway in various regions throughout Australia, many of which are specifically designed to target these "non-financial" barriers. Examples include systematic enhancements intended to provide greater standardisation, and reduced administrative requirements, system complexity and timeliness. However, aside from the advent of new infrastructure charging regimes that address cost barriers, it is apparent that these reforms actually address another invasive impact relating to holding costs - rather than the infrastructure charging regime itself. It is indisputable that developer infrastructure costs strongly impact housing costs and therefore affordability: and, compared to holding costs, they are much more visible and easily quantified. In contrast, holding costs may seem less tangible as they typically stem from issues revolving around uncertainty, timeliness and inconsistency. Nonetheless, it can be established that they represent a potentially formidable financial barrier. In determining the impact of holding costs, this paper presents a number of operating scenarios and in the process identifies the financial benefits arising from planning reform and intervention. Whilst in many cases it may be true that development contributions expended towards infrastructure represent the largest planning related cost, their existence also impacts part of the holding cost equation which together with its other elements may be demonstrated to rival apparently more pervasive, obvious costs involved in property development.

KEYWORDS

Holding costs; greenfield development; infrastructure costs

1. INTRODUCTION

This research investigates the dimensions of holding costs (i.e. essentially, those costs revolving around an assessment of "carrying costs" related to capital and other outlays) in the context of midsized to larger (15-200 lot) residential greenfield property development in South East Queensland. While the findings in this study are limited to those parameters, it is possible that the outcomes have application outside this specification.

Although there is a considerable body of literature evolving in relation to welfare aspects and various theories and concepts related to housing affordability, there has been far less work completed on the delivery side of the equation. Furthermore, despite the quantum and high economic impact of related statutory intervention by policy makers, only limited research into the impact of holding costs on housing affordability has been hitherto undertaken in Australia. At the very least, a better understanding is required (Gurran et al., 2009, p. 41; Matthew et al., 2010, p. 16; Randolph, 2007; UDIA, 2010; ULDA, 2010). One of the main difficulties in conducting research in this area is due to the lack of base-line information – i.e. highly sensitive commercial-in-confidence data that is tightly held by major industry players (a problem well documented by researchers, e.g. Gurran et al., 2009, p. 22). Furthermore, there has been little evidential material identifying to whom the burden of these effects are passed (Gurran et al., 2009, pp. 9,51,59; Matthew et al., 2010, p. 9; UDIA, 2010, p. 17).

Holding costs are nevertheless emerging as an important factor impacting housing affordability, having particular application in the case of new housing "greenfield" development. The fact that holding costs are widely held to impact housing affordability is well established in the literature (Barnes, 2007; Bourassa, 1992; Brown et al., 1986; Çorbacıoğlua & van der Laan, 2007; Department of Families Housing Community Services and Indigenous Affairs, 2010; Eagles, 2008; Gurran et al., 2009, pp. 30-31, 63-64; *Housing Affordability Fund Consultation paper*, 2008; Marshall, 2010; Set, 2007; Tse, 1998, pp. 1, 6-7; ULDA, 2010; Yardney, 2007). The Queensland Housing Affordability Strategy (QHAS) calculates that development holding costs typically add at least $15,000 to $20,000 per dwelling, for greenfield developments (*Queensland Housing Affordability Strategy*, 2007, p. 3). Even though investigations into the methodology behind this computation reveal lack of rigour, until now it has never been seriously challenged. This research authenticates not only the quantum amount, but also the extent of their significance - especially where time taken for regulatory assessment is excessive. The perception that land use planning requirements and government taxes are increasingly responsible for rising costs of residential development and consequent housing un-affordability (Gurran et al., 2008, p. 1) is therefore scrutinised.

Having developed a theoretical model, this investigation proceeds to utilise information derived from actual mid-sized to large greenfield property developments (i.e. those sized between 15-200 lots) carried out by property developers operating in South East Queensland. Such case studies provide not only statistical and economic data, but also an opportunity to collect qualitative information from participants as to what they perceive the impact and effect of holding costs are, particularly in relation to housing affordability.

The reason why these matters are of particular significance is because of the implications for public policy and the associated potential (in association with other factors outside the scope of this study) for the development of a strategic jurisdictional framework likely to promote or assist housing affordability.

2. METHODS

Holding Cost Economic Model

The development of a preliminary economic model of holding cost components evaluating the relationship between the length of the development period and holding costs sets an appropriate background for proceeding with additional statistical analysis capable of presenting predictive models that quantify the impact of planning delays, and other holding cost variables. This economic model quantifies the theoretical impacts of holding costs on housing affordability in South East Queensland. Methodology used in the commencement of this study is therefore in part experimental since it is based on casual-comparative analysis of holding cost components.

Case Studies (Field Research)

The utilisation of case studies provides a means to test the authenticity and workability of the theoretical holding cost model. Participants consist of property development organisations who have been engaged in greenfield residential development projects in the specific market, i.e. those small number of organisations involved in the mid-sized to large-sized market in South East Queensland - determined to be between 15-200 residential allotments in the total development. Developments outside this range are unlikely to be compatible. For example, smaller "six-pack" and "eight-pack" developments[1] are niche market property developments likely to exhibit characteristics peculiar to that quite distinct style and size of development. On the other hand, larger developments (200 allotments plus) are likely to exhibit different sets of characteristics common to very large or even state significant projects. Such large scale developments are more specialised: research has shown (Garner, 2008) that projects of state significance often means that they are more susceptible to manipulation by non-economic parameters, especially political and other behavioural influences, e.g. special treatment by regulatory authorities, particularly in terms of environmental compliance and certain economic and other government support measures. In summary then, restricting and stratifying the data sets in the manner described maximises the potential collegiality and homogeneity of data sets, since the information is derived from

[1] "Six Packs", alternatively known as "walk-ups", have been described (Pickett, 2006) as being "two or three floors high, devoid of elevators", and "the most common apartment format in Australian cities and towns".

congruent geographic areas and development sizes less susceptible to non-economic influences.

Econometric Modelling

The investigation devolves to correlational research based on case study analysis. The acquisition of live data through case study analysis and subsequent application of econometric modelling techniques can often prove effective in the pursuit to explain trends in real estate values, despite characteristically limited availability of data sets (observations) especially – as in this case – the analysis of large property developments. Regression techniques are used in this instance to establish the extent of the relationship between holding costs and housing affordability (and by implication, mortgage stress), by looking at a range of explanatory variables in holding cost components (i.e. independent variables) such as interest rates, inflation, and time frames for statutory approvals and overall holding period.

Measuring the sensitivity of the independent variable to holding costs can achieved by measuring the slope of the equation for incrementally increasing, or decreasing values. The trend / slope of the arctangent (measured in degrees) is measured and compared against arctangents for other variables that have been increased or decreased at the exact same increments (percentages). This process is sufficient to provide indicative levels of sensitivity based on the steepness of the angle, i.e. this comparison assists in the determination of which variables holding costs are the most responsive to, e.g. is it interest rates, or development time, or undeveloped land cost, etc.

A range of "what-if" scenarios for all independent variables can be used to compare the outcomes against one another in order to determine the impact those variables have in relation to holding cost outcomes. Ultimately, it is then possible to measure their impact upon housing affordability since we can convert the holding cost outcome into a mortgage repayment equivalency expressed as a proportion of mean household income. The establishment of a "best fit" linear trend line expresses the equation relating to the dependant variable y (in this case, mortgage repayment equivalent as a result of holding costs, expressed as a % of mean household income) and the independent variable x being the relevant factor impacting holding cost (e.g. interest rate, development time, number of lots in the subdivision, undeveloped land cost, developments costs, etc). Since the independent variable x's are all equally incremented (increased or decreased) when conducting the "what-if" scenarios, it is then possible to measure the angle (arctangent or inverse tangent) of the best fitting linear regression equation for that variable. This is in concert with the two variable linear regression model which assumes that, with α being the constant, the dependant variable y is a linear function of an independent variable x under the general formula (Pindyck & Rubinfeld, 1987; Studenmund, 2010 and others):

$y = \beta_0 + \beta_1 X + \epsilon_i$ or alternatively $y = \alpha + \beta X_i + \epsilon_i$.

…where the stochastic error term is represented by ε, on the ith observation, with β_1 representing the constant or intercept of the equation.

Where linear regression models are found not to be appropriate because the regression function is curvilinear (nonlinear), the employment of a second degree polynomial regression function is utilised. Thus, regardless of functional form, sensitivity can be determined, i.e. the greater (more steeper) the angle, the higher the degree of sensitivity is the independent variable x.

Case study data is used to verify such modelling. In this instance, best fit trend equations – linear or non-linear - are established for each case study based on the dependant variable y (once again, measured by the mortgage repayment equivalent as derived from the quantum of holding costs, expressed as a percentage of mean household income,) and the independent variable x, this time being the length of development period. Thus we can establish a *"Holding Cost - Housing Affordability Trend Line"* based on actual results for each specific (i.e. case study) property development. A significant point here is that the *"Holding Cost - Housing Affordability Trend Line"* in addition to plotting the actual result, has the ability to determine the theoretical impact of shortened or lengthened time frames on housing affordability – whatever their cause. These trend lines (created for both a base case scenario, and the case studies) therefore establish the impact of holding costs over time against housing affordability, both for the theoretical model and actual cases.

Sample Size Limitations & Case Study Approach

As a general rule it is accepted that as the number of observations increase, the reliability of the obtained correlations also increases; at the other extreme, if the sample size is sufficiently large virtually any null hypothesis can be rejected – often found to be a problem in finance (Comrey & Lee, 1992). However, the nature of real estate data is often characterised by infrequency of transactions, evidence of yields, rents (if applicable) and prices (Brooks & Tsolacos, 2010). This is certainly so in the case of recent mid-sized residential developments in South East Queensland where the overall number of larger sized developments are extremely small, and as a result there is limited data availability. Although this may indicate limitations due to sample size, in this instance the regression analysis conducted informs the Holding Cost Economic Model by firstly, determining indicative sensitivity (slope of the regression trend) of the base case scenario independent variables (which is also confirmed and tested by the case study data); and secondly, developing a table of cross sectional bivariates to assist in interpretation of the Holding Cost – Housing Affordability trend lines.

This leads to consideration of the institutional context, and the related experience of researchers who are typically inhibited not only by limited market evidence, but more particularly non-disclosure of transactional details - a point not lost on AHURI (Australian

Housing & Urban Research Institute) researchers[2]. The most important criteria in relation to sampling has therefore been to obtain survey data that includes this sensitive information from participants - proven to be more easily derived from a target specific property development market. Critically, quantitative material collected during the course of field investigations consists of capital and other outlays incurred during development phase of greenfield property developments. This essentially comprises not only the more obvious holding cost components, but also any outlay or financial commitment undertaken or incurred either during the development phase, or as part of the development phase.

In accordance with methodology similar to that developed over recent years by AHURI (Gurran et al., 2008), each developer was asked to provide financial data relating to a specific development. Financial data was compiled and analysed against standard development costings methodology to arrive at a quantitative dollar amount against each cost item, as well as an indicative percentage of total expenditure associated with planning approval and expenditure as a total of project cost. Accordingly, two types of cost data were compiled: pre-development feasibility estimates (where available), and actual expenditure. Obtaining both sets of financial data allows the exploration of shifts in planning requirements and development contribution levies between project inception, lodging of development applications, determination and approval; and the capacity to accurately estimate and cost planning requirements at project feasibility stage.

In summary, research for this project confines itself to a primarily quantitative approach. However, it should be noted that utilisation of qualitative data collected from case study participants, potentially assisting further explanation and understanding of the quantitative data (i.e. adopting an explanatory sequential, mixed method approach) has not been included in this analysis and is therefore outside the scope of this paper.

3. RESULTS AND DISCUSSION OF MAJOR OUTCOMES

Quantum of Holding Costs Determined

The Holding Cost Economic Model indicates calculated total holding costs for the "base case scenario" is $15,039 per lot (refer Table 4). This amount tends to confirm Queensland Housing Affordability Strategy (QHAS) estimations suggesting that development holding costs can add between $15,000 - $20,000 per dwelling (*Queensland Housing Affordability Strategy*, 2007, p. 3). However, the Holding Cost Economic Model extends the

[2] It was recorded by researchers that their overall analysis of planning costs was limited by a lack of financial data provided by the sample of case study developers. In itself, this inability or unwillingness to provide specific cost data on planning related expenses supports claims that this information is difficult to ascertain with certainty (Gurran et al., 2009, p. 13). This prevented scrutiny of, inter alia, holding costs, and other key variables.

scenario both up to and beyond the assumptive timeframe of a two and a half years (thirty months) development. Results for alternate time frames indicate significant volatility. For example, if the time taken for completing a development is reduced by 6 months, the holding costs will reduce by 36.2 per cent to approximately $9,600 per lot, and if time is increased by 6 months, the holding costs will increase by 38.6 per cent to approximately $20,800 per lot. Put simply, for every month the assessment time is delayed, the end-user (whom ultimately incurs the holding costs) will pay over $800 more – equating to around $5,000 for every six months differential). If any of the assumptions used vary, then there will be a commensurate (or more usually accentuated) impact on the project. Those assumptions (independent variables) having the greatest singular impact include interest rates, and development timing (incorporating holding period). Initial acquisition cost and developers margin tend to be a functions related to gross realisation expectations.

Furthermore, the effect of extended timeframes rapidly accelerates holding costs over time. For example, as shown at Table 1, holding costs rise by 123.6 per cent to nearly $34,000 per allotment where there is a four year total development period, or by 328.4 per cent to just over $64,000 for a six year development period. Regardless whether the fundamental cause of excessive time delay is due to the assessment period or not, the model demonstrates how readily holding costs can climb to these levels, and beyond. The ultimate impact is highlighted by examining gross realisation where, assuming a total development period rises to five years, the average cost of each allotment is effectively raised from $170,000 (Base model assumption) to over $220,000.

Moreover, if the "base case" model of an 18 month assessment period (i.e. the time taken to obtain approval of planning consents including DA)[3] is reasonably representative, it may be demonstrated that total holding costs for a project are over $11,000 greater than if the time taken for assessment was zero. If the assessment period becomes extended for any reason, there is a commensurate impact on additional holding costs.

In order to assess the impact on housing affordability, the quantum of holding costs can be converted to a mortgage repayment equivalent required to cover these additional costs, i.e. the additional costs of holding can be expressed in terms of additional mortgage repayment required to cover those costs. This amount can be further converted into a proportionate amount of average household income. In this way, calculated holding cost amounts can be directly applied against the "30/40 affordability rule" or other commonly used measures that identify impact against housing affordability.

The ability to provide this information linking the data to housing affordability measures is the reason behind the Holding Cost Economic Model requiring data pertaining to mean household income, average home mortgage terms and home mortgage interest rates. For example, reverting to our base case scenario, the holding cost amount of $15,309 can be

[3] Equivalent to a total development period of 2 ½ years

expressed as being equivalent to a mortgage payment of an additional $154 per month to cover all holding costs, or $55 per month to cover the costs of the assessment period alone. Expressed as a percentage of average household income (sourced from: Australian Bureau of Statistics, 2009 - data for Brisbane, Queensland), the amount of total holding costs for our base case scenario would be 3.58% of which 1.27% is contributed by the assessment period. The impact of even lengthier assessment periods *accelerates* as time proceeds (i.e. accelerating increase of mortgage repayments due to holding costs over time).

Table 1 - Economic Analysis to Examine the Sensitivity of Time on a Development Project – Gross realisation required to cover holding costs (per lot basis)

Per Lot Basis							
Statutory Planning / subdivision including DA (months)	0	12	24	36	48	60	n/a*
TOTAL development time from acquisition (months)	12	24	36	48	60	72	84
(years)	1.0	2.0	3.0	4.0	5.0	6.0	7.0
AUD$							
Total Development costs including interest	81,795	90,778	105,126	120,999	138,559	157,987	179,481
Total Costs of Development including acquisition costs	**120,458**	**129,440**	**143,789**	**159,662**	**177,222**	**196,649**	**218,143**
Developers Margin	24,092	25,888	28,758	31,932	35,444	39,330	43,629
Selling Costs	5,544	5,958	6,618	7,349	8,157	9,051	10,040
Gross realisation	**150,094**	**161,286**	**179,165**	**198,943**	**220,823**	**245,030**	**271,812**
TOTAL HOLDING COSTS	**3,702**	**9,592**	**20,847**	**33,627**	**48,094**	**64,429**	**82,830**
n/a* not applicable – statutory approval times in this timeframe is unrealistic							

Utilisation of Case Study Data

Case study investigations assist the quantitative data modelling by providing "live data" for input into the Holding Cost Economic Model; testing the ability of it to capture all possible project variations and financial / physical combinations across a range of scenarios. They facilitated changes to be made to the structure of the model, and provided the means to check the componetry aspects of holding costs, as well as ensuring that the output of the model is consistent and logical.

The case study projects range in size from 17 to 142 allotments, with their scope ranging from AUD$1.3m to AUD$23.4m, with the cost of greenfield site (undeveloped land) acquisition ranging from $0.1m to $7.2m. Average gross realisations (i.e. the final sale prices for the allotments) range from $86,621 to $521,303 per allotment. Development timeframes range from 28 months to 52 months, as per Figure 1.

Variability in the case studies can be further appreciated with reference to Table 2, where the extent of the variability between case studies is explored with reference to the SD Standard Deviation σ, VAR Variance σ^2, and Population Mean μ for all major cost components. The confidence interval $\hat{p}$ (for the population mean) with a confidence level alpha α of 0.05 is completed for each of the major cost components and relative percentage proportions of (1) Acquisition (land) cost, (2) Levies, charges, DA, consultants; (3) Development Costs (building and construction); (4) Developers Margin; (5) Selling Costs; and (6) Holding Costs. Since the population size N is only 4 (i.e., four case studies), financially "significant" differences may not be statistically significant, but confidence intervals nevertheless do highlight the significant variability between the case studies, and provide a comparison between the extent of the variables with respect of each individual cost component. For example, the confidence interval $\hat{p}$ for selling costs @ 0.97% and standard deviation σ of 0.98% is at the extreme low end of variability, compared to development costs (building and construction) which, at a confidence interval $\hat{p}$ of 47.06% and standard deviation σ of 11.06%, are at the extreme high end of variability.

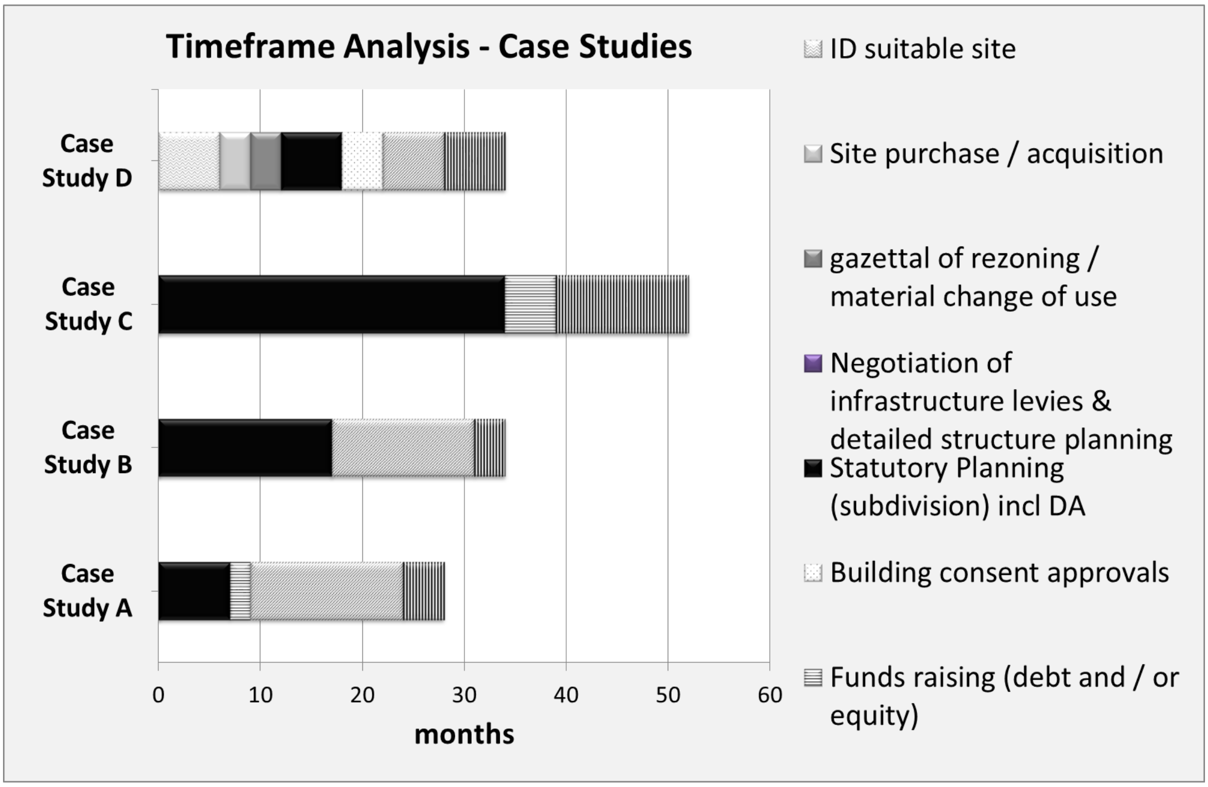

Figure 1 - Case Study timeframes for property development pipelines

An analysis of the holding costs for the case studies indicates that they are, by comparison, relatively non-volatile. They account for up to approximately 12% of all costs in the case studies with a standard deviation σ of 3.41% (by way of comparison, development costs account for up to approximately 64% of all costs in the case studies with a standard deviation σ of 11.06%). For a 95% confidence level $\alpha = 0.05$ the population mean for holding costs of 6.08% has a confidence interval $\hat{p}$ of only $\pm$5.96% (or in other words we can be 95% confident that the interval from 0.12% to 12.04% contains the true value of p). This may be referenced against the actual holding costs for the case studies which range between $5,006 and $32,941 per lot (i.e. accounting for between 4.25% and 12.05% of gross realisation), whilst development costs range between $55,000 and $227,824 per lot (accounting for between 38.7% and 64.2% of gross realisation).

It is important to note here that those cost components which have the greatest level of volatility and variability (in order of variability - development costs, developer's margin, and acquisition costs) are also, especially by comparison with holding costs, least directly affected by increases in interest rates and time. This is quite apart from their overall significant impact on gross realisation.

Table 2 - Case Study population statistics: variations in cost components as a percentage of gross realisation

Percentage of Gross Realisation						
Case Study Population Statistics	**SD Standard Deviation** σ	**VAR Variance** σ^2	**Population Mean** μ	**Confidence interval** $\hat{p}$ **(population mean)**	**Confidence (min)**	**Confidence (max)**
Gross Realisation	**190,690**	**4.E+10**	**$254,573**	**$249,477**	**$5,096**	**$504,051**
Acquisition (land)	9.43%	0.89%	**17.86%**	17.51%	0.36%	35.37%
Levies, charges, DA, consultants	4.78%	0.23%	**7.34%**	7.19%	0.15%	14.53%
Development Costs (building and construction)	11.06%	1.22%	**47.06%**	46.12%	0.94%	93.18%
Developers Margin	7.32%	0.54%	**20.56%**	20.15%	0.41%	40.70%
Selling Costs	0.98%	0.01%	**0.99%**	0.97%	0.02%	1.96%
Holding Costs	3.41%	0.12%	**6.08%**	5.96%	0.12%	12.04%
Confidence level alpha α **=**				0.05		
Population size ***N*** **=**				4		

The table of bivariate regressions enables the sensitivity of the independent variables to be demonstrated as per Table 5 - Linear Trend line Analysis: Sensitivity of Factors Impacting Holding Costs and Subsequent Effect on Housing Affordability. The output of that analysis is summarised at Table 3; it contains critical results from which we can derive our conclusions. For example, this analysis shows that interest rates and development timeframes are critical to the holding cost equation. This confirms the general thrust of the literature on that topic, yet perhaps highlights that the extent of these impacts may not have been fully appreciated.

It should be noted that although some of the variables have limited or no impact on holding costs (as measured by the sensitivity assessment), that does not mean they have a correspondingly limited impact on housing affordability. This is important in the context of housing affordability, since a factor could have a limited or even no impact on holding costs, yet have a significant impact on housing affordability because it affects gross realisation prices. A good example of this is the developer's margin: it has no impact on holding costs at all, yet could be significant for end-users.

Table 3 - Sensitivity of nine factors impacting holding costs, and subsequent effect on housing affordability

Sensitivity Assessment	Angle	Variable
Very Extreme	>10 °	• Interest / Inflation rate Change
Extreme	7-10 °	• Mean equivalised household income • Development time from acquisition
Significant	4-7 °	• Undeveloped Land Cost • Number of Lots in subdivision
Moderate	1-4 °	• Development Costs, including major civil works, building and construction - per lot
Minor	up to 1 °	• Rates, infrastructure charges, DA, consultants, etc - % land acquisition costs per lot p.a. • Acquisition costs (% of undeveloped land cost)
Nil	zero °	• Developers Margin

The "best fit" trend equations – linear or non-linear – are established for each of the case studies, based on the dependant variable y (once again, measured by the mortgage repayment equivalent as derived from the quantum of holding costs, expressed as a % of mean household income,) and the independent variable x, being the length of development period. First, we establish the *"Holding Cost - Housing Affordability Trend Line"* (shown at Figure 2). This is achieved by inputting the actual results for each specific property development project (along with a base case scenario) into the Holding Cost model. The baseline data inputs, and the primary outputs of the model is shown at Table 6 - Case Study Comparisons against the Base case Scenario (summary data).

It is then possible to run the best fit linear or non-linear trend analysis on the *"Holding Cost - Housing Affordability Trend Lines"*, which in this case results in polynomial regression equations which are summarised at Table 4. Here, polynomial regression equations are used to solve for the housing affordability variable y.

Table 4 - Polynomial trend line equations summary for case studies and the Holding Cost Economic Model base case scenario

Base case Scenario - Case Study Comparisons	**Base case model scenario**	**Case Study A**	**Case Study B**	**Case Study C**	**Case Study D**
Detail	**Per Lot**	**Per Lot**	**Per Lot**	**Per Lot**	**Per Lot**
Holding Costs	$15,039	$14,072	$32,941	$21,423	$5,006
Gross realisation (total price of allotment)	$170,000	$331,349	$521,303	$177,798	$85,621

Detail	Gross	Gross	Gross	Gross	Gross
Number of Lots in subdivision:	200	83	17	142	20
Project Commencement	Dec-10	Aug-06	Jun-06	Feb-04	Dec-03
Project Completion (final settlement)	Dec-13	Jun-09	Jul-09	Dec-08	Apr-06
Total Project time - acquisition to final settlement (years)	3.0	2.8	3.1	4.8	2.3
Development time from acquisition (months)	30.00	28.00	34.00	52.00	28.00
Development time from acquisition (years)	2.50	2.33	2.83	4.33	2.33
Mean equivalised household income utilised - per annum *	$51,656	$47,320	$50,936	$42,120	$35,620
Cost of mortgage repayment equivalent due to holding costs as a % of mean household income	3.58%	3.19%	7.70%	5.85%	1.56%
Polynomial (curvilinear) trend line equation	$y = 7E\text{-}05x^2 + 0.0027x + 0.0027$	$y = 5E\text{-}05x^2 + 0.0026x + 0.0044$	$y = 1E\text{-}04x^2 + 0.0061x - 0.0102$	$y = 9E\text{-}05x^2 + 0.0012x - 0.0064$	$y = 2E\text{-}05x^2 + 0.0019x - 0.0029$
** Mean equivalised household income utilised is calculated as at date of first settlement*					
Holding Costs	$3,007,720	$1,168,000	$560,000	$3,042,000	$100,122
Gross realisation (total price of allotment)	**$33,999,962**	**$27,501,945**	**$8,862,145**	**$25,247,313**	**$1,712,420**
Detail	**% of Gross Realisation**	**% of Gross Realisation**	**% of Gross Realisation**	**% of Gross Realisation**	**% of Gross Realisation**
Holding Costs	8.85%	4.25%	6.32%	12.05%	5.85%

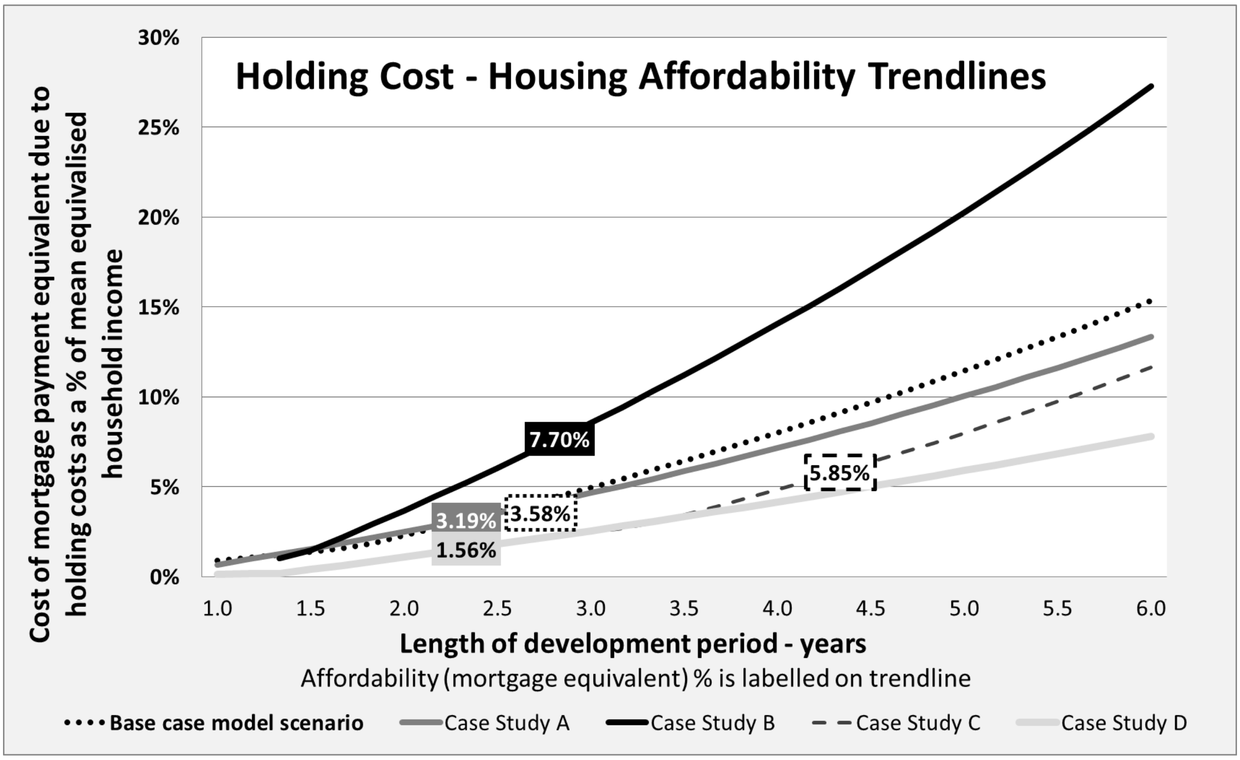

Figure 2 Holding Cost – Housing Affordability Trend Lines

4. CONCLUSIONS

This study has established that the impact of holding costs on housing affordability is not only profound, but also exceedingly variable. In the case of a midsized greenfield residential development in South east Queensland, the quantum amount is “typically” in the order of $15,000 per allotment - based on a 2.5 year total development period and prevailing commercial interest rates of 9 per cent effective per annum. Whilst this amount is generally in alignment with expectations of some commentators, by no means does this figure on its own give a real sense of its profundity, or reveal the true nature and extent of potential impact. This is because even slight changes to key underlying holding cost component variables have a severe and disproportionate effect. At the extreme end, the level of prevailing interest rates and / or development timeframes (including regulatory assessment timeframes) is critical. Lot density and the undeveloped land cost are also significant. At the moderate to minor end are development costs and infrastructure charges. These sensitivities are borne out by field investigations which also demonstrate that the quantum amount of holding costs can readily double. As a consequence, the impact on the housing affordability equation is such that end-users can be easily pushed into mortgage stress if they ultimately absorb holding cost variations. This lack of affordability can be measured by calculating the increased mortgage repayment equivalent required as a result of increased holding costs, and subsequently expressing this amount as a proportion of mean household income. Furthermore, particular combinations of varying holding cost elements demonstrate the potential for even greater levels of volatility. There is additional significance here in that increases in holding costs overall accelerate at a faster rate over time than other components that aggregate to constitute final sale value of the end product.

Furthermore, the *combined* effects of holding cost components can be extreme. For example, it is clear that combined shifts in interest rates and timeframes can drastically affect housing affordability. Furthermore, the potential for mortgage stress increases not only when income levels are falling, but also when they are stable since the equation becomes unbalanced in the event of even small "corrections" occurring with prevailing market rates. Solving these complex and often contradictory problems therefore calls for novel solutions.

The penultimate development of *"Holding Cost - Housing Affordability Trend Lines"*, along with the Holding Cost Economic Model itself, provides the ability to determine the impact of shortened or lengthened time frames on housing affordability. It also emphasises, in relation to holding costs, the critical nature of interest rates and inflation; the importance of the cost of the greenfield undeveloped land, density (number of lots in subdivision), and development costs more generally. This contrasts with the relative limited impact of other factors like developers margin, and other costs such as acquisition costs, rates, infrastructure charges, and consultant fees.

The importance of this research potentially emphasises a number of aspects such as the impact of land banking behaviour by developers (the kind of which has been outlined by various researchers such as Rowley & Costello, 2010; Tse, 1998, pp. 1377-1391; Walker et al., 2008, pp. i. 14-19, 21), and the significance of timely processing of development applications and other relevant statutory documents by regulatory authorities. This latter aspect has been a major consideration in establishing legislation and statutory authorities in many Australian states - in the case of Queensland, notably the Affordable Housing Strategy, and establishment of the Urban Land Development Authority. It was actually through the Queensland Housing Affordability Strategy that the Queensland Government established the Urban Land Development Authority, and according to the QHAS (*Queensland Housing Affordability Strategy*, 2007) undertook certain other changes to speed up the planning and development assessment process as a primary means to significantly reduce timelines and associated holding costs of bringing new housing to the market. Yet, whilst the problem has received much attention, the significance of this research is highlighted since quantification of its impact has not hitherto been rigorously undertaken. Accordingly, the determination of holding cost variables (including assessment period impacts) on housing affordability has significant policy implications for changing the framework that promotes, retains, or maximises the opportunities for affordable housing.

Table 5 - Linear Trend line Analysis: Sensitivity of Factors Impacting Holding Costs and Subsequent Effect on Housing Affordability

Sensitivity* (Holding costs)	**Very Extreme >10 deg**	**Extreme 7-10 deg**		**Significant 4-7 deg**		**Moderate 1-4 deg**	**Minor up to 1 deg**		**Nil zero deg**
"What If" Scenario:	**Interest / Inflation rate Change**	**Mean equivalised household income**	**Development time from acquisition**	**Un-developed Land Cost**	**Number of Lots in sub-division**	**Develop-ment Costs-per lot**	**Rates, infrastructure charges, DA, consultants, etc -**	**Acquisition costs (% of undeveloped land cost)**	**Developers Margin**
Regression Formula #	y=0.0078x - 0.00241	y= 0.0041x +0.0833	y = 0038x - 0.0046	y = 0.0027x + 0.012	y = 0.0029x + 0.699	y = 0.0011x + 0.0264	y = 0.0004x + 0.0326	y = 8E-05x + 0.0351	y = 3E-18x + 0.0358
R^2 #	0.8452	0.9336	0.9002	0.9554	0.9336	0.9554	0.9554	0.9564	0.00E+00
Regression Formula (forced intercept@ zero)	y = 0.0059x	n/a	y = 0.0042x	y = 0.0036x	n/a	y = 0.0031x	y = 0.0029x	y = 0.0028x	y = 0.0028x
R^2 (forced intercept zero)	0.7826	n/a	0.8904	0.813	n/a	3.496	-54.4	-1444	3.00E+14
x Coefficient (forced)]	0.0059	0.0041	0.0042	0.0036	0.0029	0.0031	0.0029	0.0028	0.0028
Arctangent, in degrees (forced)	0.34	0.23	0.24	0.21	0.17	0.18	0.17	0.16	0.16
Width	4.33	2.33	2.14	1.69	1.55	0.38	0.27	0.07	0.00
Height	14.05	15.85	15.75	15.90	15.84	15.91	15.91	15.89	16.76
Tangent of the linear trend	0.31	0.15	0.14	0.11	0.10	0.02	0.02	0.00	0.00
Angle[4]	17.13	-8.36	7.74	6.07	-5.59	1.37	0.97	0.25	0.00

Linear Trend Analysis - conducted on cost of mortgage repayment as a result of holding costs as a % of equivalised disposable household income
* Sensitivity - based on angle of variable (arctangent [inverse tangent], in degrees) achieved in + - 10% incremental shifts
# Unforced intercept

[4] Angle: Arctangent (inverse tangent), in degrees - unforced

Table 6 - Case Study Comparisons against the Base case Scenario (summary data)

Base case Scenario - Case Study Comparisons: Summary Data	**Base case model scenario**	**Case Study A**	**Case Study B**	**Case Study C**	**Case Study D**
Detail	**Per Lot**	**Per Lot**	**Per Lot**	**Per Lot**	**Per Lot**
Acquisition cost (undeveloped land)	$38,663	$49,771	$107,941	$50,627	$5,225
Rates, infrastructure levies / charges, DA, consultants, special council charges & land tax	$7,733	$26,687	$34,529	$23,585	$1,400
Development Costs, including major civil works, building and construction	$75,000	$167,048	$227,824	$68,887	$55,000
Developers Margin	$27,287	$72,122	$112,906	$11,516	$16,658
Selling Costs	$6,279	$1,649	$5,161	$1,760	$2,332
Holding Costs	**$15,039**	**$14,072**	**$32,941**	**$21,423**	**$5,006**
Gross realisation (total price of allotment)	$170,000	$331,349	$521,303	$177,798	$85,621
Number of Lots in subdivision:	200	83	17	142	20
Total Project time - acquisition to final settlement (years)	3.0	2.8	3.1	4.8	2.3
Development time from acquisition (months)	30.00	28.00	34.00	52.00	28.00
Developers Margin	20%	28%	28%	7%	25%
Mean equivalised household income utilised - per annum *	$51,656	$47,320	$50,936	$42,120	$35,620
Cost of mortgage repayment equivalent due to holding costs as a % of mean household income	3.58%	3.19%	7.70%	5.85%	1.56%
Polynomial (curvilinear) trend line equation	y = 7E-05x2 + 0.0027x + 0.0027	y = 5E-05x2 + 0.0026x + 0.0044	y = 1E-04x2 + 0.0061x - 0.0102	y = 9E-05x2 + 0.0012x - 0.0064	y = 2E-05x2 + 0.0019x - 0.0029
** Mean equivalised household income utilised is calculated as at date of first settlement*					

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