Financial Risk Assessment: A Property Investment Case Study

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Abstract

Residential property has become a common and increasingly popular form of investment in Ireland. With modest returns in recent years, from a somewhat depressed stock market, property has become the investment of choice for many prospectors. Rising house prices over the past few years have given some investors spectacular returns. However, future gains can not be guaranteed. A Monte-Carlo simulation model was developed to investigate the issues involved in residential property investment and to identify the risk factors which should be prioritised when considering investment in the residential property market. The model uses probability distributions to take account of the inherent uncertainties in input parameters such as: interest rate, rental income and property price inflation. The model revealed that the single biggest impact on return from residential property was property price inflation (correlation coefficient 0.949). The interest rate had a smaller impact on return (correlation coefficient -0.24). The model acts as a decision support tool for both potential investors and financial institutions.

1. Introduction

There has been a move from investment in stocks and shares to investment in property by investors in recent years [1]. Property investment can offer diversification opportunities to equity market investors [2,3]. However, this form of investment is not without its risks [2,4,5]. The initial capital investment and start up costs added to the large uncertainties surrounding the market make residential property investment extremely risky and by no means a guaranteed return on investment [2]. The volatile nature of the property market was highlighted in the United Kingdom (UK) [6] and Canada [7] in the 1990's where a property boom and subsequent slump resulted in negative equity. Property "gurus" suggest a 12-year cycle between property boom and bust and there are those who suggestion that a property bubble bust is on the horizon in the UK [8].

Ireland has seen a large surge in property investment with investors accounting for 40% of all buyers in Dublin in 2003. House prices continue to rise throughout the country with the greatest growth occurring in major cities like Dublin, Cork and Galway [9]. Residential property investment is fraught with risks and there have been few published attempts to quantify the risk factors in relation to property investment in a manner which is intuitive to the average investor.

This paper looks at the development of a Monte-Carlo simulation model which simulates the return to investor following a given number of years and prevailing economic conditions. Return On Investment (ROI), in this paper, is defined as the ratio of gross return and capital invested, less all incurred expenses. The model takes account of economic uncertainties in inputs such as interest rates, rental income and property price inflation. A sensitivity analysis enables the risk factors to be identified, providing a scientific based ranking of the criteria which should be considered when investing in residential property.

2. Material and Methods

2.1. Model development

The model developed in this paper consists of a number of inputs and factors affecting the final return on investment. The model used distributions to account for parameter uncertainty/variability and was created in Excel with the add-on package @Risk (Pallisade Corporation, New York, USA).

2.2. Model inputs

The model considers a variety of costs including purchase costs, mortgage costs and ongoing costs. Details of the potential rental income and investment term are also included. Distributions are used, where appropriate, to indicate the uncertainty about the likely value of the input parameter resulting in a dynamic Monte-Carlo simulation model. The model input parameters and distributions used in the model are summarised in Table 1.

The various inputs used will all influence the final return on investment. The model simulates a number of calculations and outputs, relating to costs and return on investment. These calculations and outputs are summarised in Table 2.

Table 1: Model input parameters and distributions.

Parameter	Symbol	Distribution/Model	Units
Purchase Costs			
Property Cost	PC	Fixed value	€
Legal Fees	L	Fixed value	%
Valuation and Survey Fee	VS	Fixed value	%
Stamp Duty	SD	Rate applied	%
Mortgage Details			
Mortgage Term	T	Fixed value	Years
Loan Amount	A	0.9 × PC	€
Interest Rate	IR	Triangular Distribution	% (CAR)
Repayment per month	RPM	A/(((1+(IR/12))^(T × 12)-1)/((IR/12) × (1+(IR/12))^(T × 12)))	€
Capital Invested	CI	PC - A	€
Ongoing Costs			
Insurance	S	Fixed value	%/year
Rates	R	Fixed value	€/year
Repairs	P	Fixed value	€/year
Rental Income			
Rental Income	RI	Triangular Distribution	€/month
Vacant Periods	VP	Uniform Distribution	Months
Rent Inflation/Deflation	RID	Fixed value	%
Income Tax Rate	ITR	Fixed value	%
Investment Term			
Property Inflation	PI	Triangular Distribution	%/year
Selling Costs	SC	Fixed value	%

The input parameters were combined onto a spreadsheet (Microsoft Excel 97) running the @Risk add-on package (Palisade Software, Newfield, USA) and the simulation was performed using Latin Hypercube sampling. This process involves sampling in which random values are drawn from the input probability distributions for each iteration of the simulation. Latin Hypercube is a stratified sampling technique where the random variable distributions are divided into equal probability intervals. The technique enables probability distributions and confidence intervals to be generated for model outputs.

Table 2: Model Calculations and outputs.

Parameter	Symbol	Distribution/Model	Units
Interest in month 1	I_1	(IR/12) × A	€
Principle payed in month 1	P_1	RPM - I_1	€
Principle remaining after 1 month	PR_1	A - P_1	€
Interest payed in month *n*	I_n	(IR/12) × PR_{n-1}	€
Principle payed in month 1	P_n	RPM - I_n	€
Principle remaining after month *n*	PR_n	PR_{n-1} - P_n	€
Interest payments after *m* months	IP_m	$\sum_{n=1}^{m} I_n$	€
Principle payments after *m* months	PP_m	$\sum_{n=1}^{m} p_n$	€
Gross rental income per year	RIY_G	(RI × (12 - VP)) × (1+RID)	€/year
Taxable rental income for year y	RIY_T	RIY_G - R - P - (S × PC) - IP_{12}	€/year
Net Rental Income for year y	RIY_N	RIY_T × (1 - ITR)	€/year
Additional input	AI	IP_{12} + PP_{12} - RIY_N	€/year
Additional input per month	AIM	AI/12	€/month
Property value after 1 year	PV_1	PC × PI	€
Property value after x year(s)	PV_x	PV_{x-1} × PI	€
Gross return after x years	GR	PV_x - $PR_{(x \times 12)}$ - C I- (PC × (L + VS + SD)) - (AI × x) -((R + P +(S × PC)) × x)	€
Gross Return on Investment after x years	ROI	GR/(C I- (PC × (L + VS + SD)) - (AI × x) -((R + P + (S × PC)) × x)	%

Two scenarios were tested representing two different investment opportunities in Ireland. The first looked at a one bed terraced cottage valued at €250,000 in Dublin. From a survey of five similar properties in the area, rent varied from €1,000 to €1,050 per month with three of the five renting for €1,000 per month. The condition of the property will obviously influence the rental income. This variation in rental income was modelled using a triangular density distribution with a minimum value of €950, mode of €1,000 and a maximum of €1,050. The second scenario looked at three bed semi-detached house in Dublin costing €310,000. A survey of five similar properties in the area revealed that rental income varied from €1,200 to €1,500 per month. The variability was modelled using a triangular density distribution with a minimum €1,100, mode of €1,200 and a maximum of €1,500 per month. A summary of the data used in the model for both scenarios, including all costs, is given in Table 3. The model applies probabilistic techniques to existing data to generate input distributions.

Table 3: Scenarios tested.

Parameter	Scenario 1	Scenario 2
Purchase Costs		
Property Cost - PC (€)	€250,000	€310,000
Legal Fees (% of PC)	1%	1%
Valuation and Survey Fee (% of PC)	0.50%	0.50%
Stamp Duty (% of PC)	4%	5%
Mortgage Details		
Mortgage Term (years)	25	25
Interest Rate (% - CAR)		
min	3.5%	3.5%
mode	4.0%	4.0%
max	5.0%	5.0%
Ongoing Costs		
Insurance (% of Property Value)	0.50%	0.50%
Rates (€/yr)	€500	€500
Repairs (€/yr)	€500	€500
Rent Inflation/Deflation (%/year)	0	0
Rental Income		
Rental Income (€/month)		
min	€950	€1000
mode	€1000	€1100
max	€1050	€1200
Vacant Periods (months)		
min	0.5	0.5
max	1.5	1.5
Rent Inflation/Deflation (%/year)	0	0
Investment Term		
Property Inflation (%/year)		
min	-2.00%	-2.00%
mode	1.00%	1.00%
max	5.00%	5.00%
Selling Costs (% of Property Value)	2.00%	2.00%

3. Results and discussion

The simulation was run with 10,000 iterations of the model. Three investment periods were monitored (3, 5 and 10 years). The return on investment for both scenarios 1 and 2 following these three time periods is given in Figures 1 and 2 respectively.

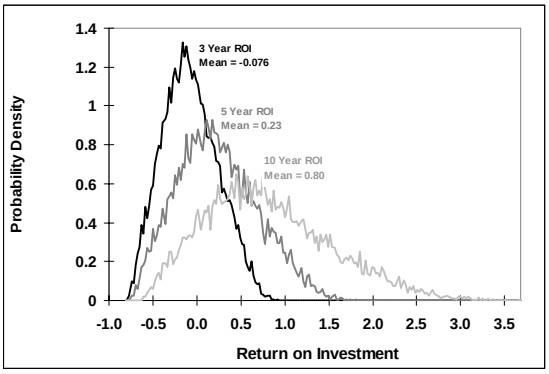

Fig. 1: Scenario 1: Return on investment (ROI) after 3, 5 and 10 years.

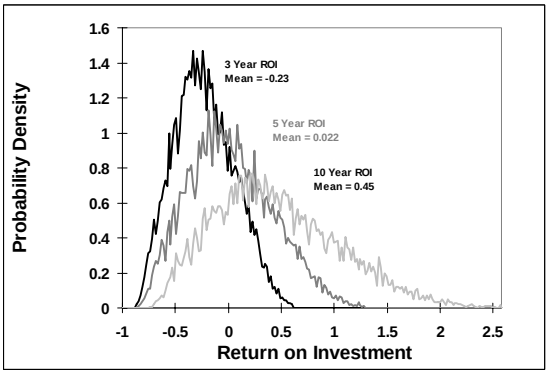

Fig. 2: Scenario 2: Return on investment (ROI) after 3, 5 and 10 years.

The results indicate that investment in residential property should be considered a long-term investment giving sufficient time to absorb transaction costs. Figures 1 and 2 indicate the greater potential for return on investment with longer investment terms. After an investment period of 3 years, the model indicated the likelihood of a potential loss, under the assumptions of both scenarios. Scenario 1 indicated a potential loss of 7.6% while scenario 2 indicated a potential loss of 23% on investment. The real power of this model is not only in its predictive power but, perhaps primarily, in its ability to compare different property investment options. For example, from Figures 1 and 2, it appears that scenario 1 would provide an investor with the greater long-tern return on investment.

The scenarios tested resulted in conditions which meant that the mortgage repayment was not fully covered by the rent obtained. Thus, the scenarios necessitated additional monetary input from the investor which would be required to keep up the mortgage repayments. A comparison of the probability density distributions for the additional monetary input required for both scenarios 1 and 2 is given in Figure 3. The figure clearly shows that, for the two scenarios tested, the investor would need to be prepared to contribute extra money to keep up the mortgage repayments. Both scenarios required substantial input. Clearly scenario 2 would require a large monthly contribution in addition to rental income and would make the investment very unattractive for most investors.

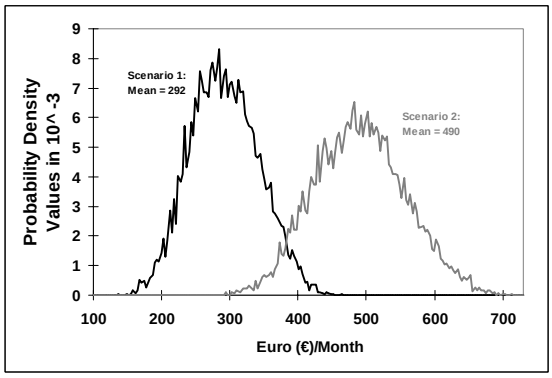

Fig. 3: Sensitivity analysis for ROI

The effect various inputs have on model predictions can be assessed by means of a sensitivity analysis. A sensitivity analysis is a systematic evaluation of model inputs, parameters and assumptions. The analysis is presented here in the form of tornado plots. The parameters are ranked in accordance with the magnitude of effect they are having on model predictions. The sensitivity of ROI to model inputs is given in Figure 4. On the x-axis is the "Rank Order Correlation Coefficient" which is a measure of the degree of effect the parameter is having on the model ranging from –1 to +1. A bar extending to the right hand side indicates a positive correlation between that parameter and model predictions, while a bar extending to the left hand side indicates a negative correlation between that parameter and model predictions.

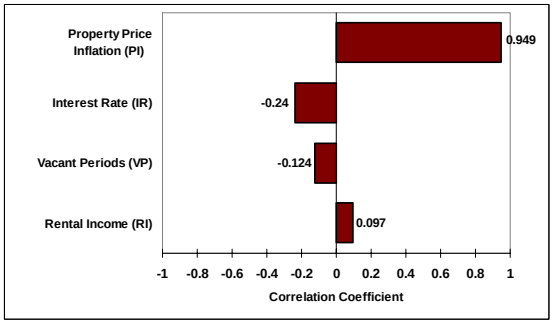

Fig. 4: Sensitivity analysis for ROI.

The analysis reveals that the parameter having the greatest impact on ROI is clearly Property Price Inflation with a correlation coefficient of 0.949. This indicates that the number one priority when

looking for a property should be the potential for value appreciation. It certainly lends considerable credence to the adage that the most important factor is “location, location, location”!

The next parameter having the greatest impact on model predictions is the mortgage interest rate charged by the lending institution, indicating the importance of shopping around for the best deal available and to deal with the lender offering the lowest interest rate. The next parameter having an impact is the amount of vacant periods (i.e. periods where there are no tenants in the property). This indicates the importance of getting good tenants and the necessity to minimise vacant periods as much as possible. Lastly, rental income is having a lesser effect than the other inputs. The sensitivity analysis provides a scientific based ranking system for the most important criteria to be considered when purchasing an investment property.

4. Conclusions

The model developed in this research represents an initial attempt to quantify the risks of residential property investment and to test different investment scenarios. Investment in property is not risk free, house prices are not guaranteed to continue to increase and interest rates are not guaranteed to remain low. Given these uncertainties a risk assessment model provides a concise methodology of accessing different property investment options while taking account of the inherent economic uncertainties. The model indicated that property investment should be considered a long-term investment, mainly due to the high transaction costs. The power of the model is in its predictive power and its ability to compare multiple scenarios. The model considered pessimistic, but not unrealistic, economic conditions.

The model created in this study is dynamic and allows for a change of values and distributions if required, including its ability to incorporate fluctuations in property appreciation/depreciation. Inputs taken as fixed values in the current model scenarios can be changed to relevant distributions if deemed necessary. It is important to note that the model is only valid in light of the assumptions taken. Correlations between inputs have not been taken into account; doing so would reduce the uncertainty distribution spread for the model outputs. In addition, an individuals tax liability resulting from the proceeds of a property sale have not been taken into account in this model.

This model can be a valuable tool in assessing financial risk and is dynamic and non-specific, thus it can be used to evaluate any property in any location, while taking account of uncertainty in economic conditions by simply altering the input distributuions and parameters. The model may be useful for financial institutions in assessing the merits of a proposed investment. The model is a powerful decision support tool for both financial institutions and perspective property purchasers.

5. References

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