Risk adjusted asset valuation using a probabilistic approach with optimized asking rents and resale timing options

by

Sarwesh Paradkar

BTech & MTech Mechanical Engineering, 2009

Indian Institute of Technology Bombay

Submitted to the Program in Real Estate Development in Conjunction with the Center for Real Estate in Partial Fulfillment of the Requirements for the Degree of Master of Science in Real Estate Development

at the

Massachusetts Institute of Technology

September 2013

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Signature of Author: ____________________________

Center for Real Estate
July 30, 2013

Certified by: ____________________________

David Geltner
or of Real Estate Finance
Thesis Supervisor

Accepted by: ____________________________

David Geltner
Chair, MSRED Committee,
Interdepartmental Degree Program in Real Estate Development
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ABSTRACT

The model developed here provides an enhancement of the traditional DCF asset acquisition valuation template, in Excel. It provides a relatively transparent and user-friendly yet flexible risk-adjusted valuation of a subject individual acquisition, structured to consider the asset either as a core asset or a value-add asset.

This study applies a basic stock flow model of space market dynamics to address the question of covariance among input variables. The model is designed with optional probabilistic inputs and historical data for the local space market (employment, rents, net rentable area, occupied space, new completions, vacancy and absorption) and the asset market (cap rates history) to produce a 15-year forecast for the relevant space and asset market for the subject property. An optional optimal rent module in the model uses the forecasted cap rates and consequent opportunity cost of capital to arrive at optimal asking rents for the subject property. The existing rent roll is combined with the future rents and vacancies along with asset level projections of operating costs and capital expenditures to arrive at the cash flow projections. Renewal probability and probability to lease up are major differentiating factors between the core and value add asset.

The model also enables the user to optionally consider how flexibility in resale timing can improve the overall return performance from a probabilistic perspective. The output of the model includes an apprehension of the entire going-in risk return relationship, depicted relative to a relevant security market line generated by the input risk free interest rate and the opportunity cost of capital in the relevant asset market.

Key words: Probabilistic, risk adjusted valuation, forecast, optimal rent, flexibility, renewal probability, probability to lease up

Thesis Supervisor: David Geltner
Title: Professor of Real Estate Finance
ACKNOWLEDGEMENTS

I would like to thank Jacques Gordon, Global Head of Research & Strategy at MIT/CRE Industry Partner firm LaSalle Investment Management for providing me with the opportunity to work with LaSalle on this thesis, and helping me with his valuable guidance. I also would like to thank Nathan Kane, Vice President at LaSalle Investment Management and his team for providing the data required to calibrate the model.

I would like to thank Professor David Geltner from the MIT Center for Real Estate for advising me on the thesis and for providing his invaluable insight on the topic. Throughout this thesis experience and all the previous courses I have taken with him, he has been a source of knowledge and inspiration for me. His book, Commercial Real Estate Analysis and Investment has been a great source of reference for developing the financial model used in this thesis.

I would like to thank Lisa Thoma, Associate Director at the MIT Center for Real Estate and my classmate Ryan Butler for helping me network with LaSalle Investment Management and set up the first meeting with Jacques Gordon, where the idea of this thesis was generated.

Last but not the least, I would like to thank my mother, Sujata Paradkar for encouraging me to go for my second post graduation and attend the Real Estate Program at MIT.
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A snapshot of the excel template is attached after the introduction.
The substance and content of this thesis consists of an Excel model template. In this narrative written component we only present a brief introduction to the model.

INTRODUCTION

The discounted cash flow (DCF) pro-forma has been the classical work horse for estimating property value and analyzing individual asset investment acquisition decisions for over a generation now in the professional real estate world. But with the recent experiences in the Financial Crisis of 2008, many prudent investment managers are seeking to upgrade this trusty work horse a bit. As commercial property market data has become richer and more available, there is a desire to incorporate local market data into the cash flow projections for the subject asset. And there is growing interest in explicitly recognizing and somehow accounting for risk and uncertainty in the forecasted future values, within the DCF valuation framework, effectively to examine the investment’s likely IRR outcome probability distribution. This initiative in acquisition DCF modeling complements growing academic interest in places like the MIT Center for Real Estate in using basic economic and engineering systems models to improve real estate and infrastructure investment decision making. Analytical tools such as optimal search and risk simulation models can help decision makers understand and quantify the value of flexibility in real estate investment. For acquisitions of existing properties such flexibility prominently includes the ability of the investor (landlord) to choose optimal asking rents and vacancy management for the asset, and/or to choose the timing of asset resale (reversion). The present thesis consists of an original Excel model (DCF 2.0), which aims to reflect and incorporate all of these considerations and enhancements in a tool that is user-friendly and relatively transparent, a “new generation” valuation model.

The model developed here provides a risk-adjusted valuation of a subject individual acquisition, structured to consider the asset either as a “core” asset (stabilized leased-up) or a “value-add” asset (substantial vacancy initially). Acquisition managers have been interested in understanding if they are sufficiently compensated for the lease up risk involved in making a relatively high return, high vacancy value add asset acquisition against a lower return, lower vacancy core asset acquisition, and this model should help in such understanding.

Users of risk simulation in DCF valuation have also been concerned to adequately reflect not only the individual uncertainty surrounding individual variables of interest (such as rents and vacancy), but also the correlation or covariance between the individual variables. This study applies a basic stock flow model of space market dynamics (of the type first introduced into the real estate literature by Wheaton) to address the covariance question. The model is designed with optional probabilistic inputs, so that the user does not have to employ uncertainty where s/he does not wish to. But the model is set up to facilitate calibration of the uncertainty inputs based on historical data for the local space market (employment, rents, net rentable area, occupied space, new completions, vacancy and absorption) and the asset market (cap rates history). The model uses the historical data to produce a 15-year forecast for the relevant space and asset market for the subject property. If the user invokes the optional “optimal rent” module in the model, then the forecasted cap rates and consequent opportunity cost of capital are used to arrive at optimal asking rents for the subject property. The existing rent roll is combined with the future rents and vacancies along with asset level projections of operating costs and capital expenditures to arrive at the cash flow projections. Renewal probability and probability to lease up are major differentiating factors between the core and value add asset.

The model also enables the user to optionally consider how flexibility in resale timing can improve the overall return performance from a probabilistic perspective. The output of the model
includes not just a single valuation number, but an apprehension of the entire going-in risk return relationship, depicted relative to a relevant security market line generated by the input risk free interest rate and the opportunity cost of capital in the relevant asset market.

Some of the specific features of the model include (but are not limited to) the following:

- Use of a stock-flow model of the local real estate market to reflect the relationships between the various space market variables.
- Linkage of the space market replacement rent (long-run equilibrium rent) to the asset market via the cap rate, and explicit forecasting of cap rates based on user input (such as bond yields or empirical cap rate histories allowing explicit incorporation of cyclicality in the asset market).
- Optional explicit modeling of optimal asking rent and lease-up timing.
- Optional consideration of a valuation mean reversion based decision rule for strategic resale timing to improve reversion value and lifetime IRR result.
- Explicit comparison of ex ante core asset investment risk/return performance with that of corresponding or otherwise similar value-add asset.
- Optional valuation based on direct capitalization and DCF analysis.

For further instructions on using the model, the user should refer to the “Index” worksheet of the accompanying Microsoft Excel File “DCF 2.0”. In the same package is a “NO SIM” version labeled “DCF NO SIM” which can be used for calibrating the parameters so that long run times are avoided at calibration stage. The full model including the simulations (activated by “recalculation” – such as F9 on a PC) can take up to 3-4 minutes to run on a laptop. The “NO SIM” version runs instantaneously but produces only one future forecast or scenario. (The simulation runs 2000 randomly generated “trials.”) The NO SIM file can therefore be used to “play around” with input parameters, particularly for the uncertainty inputs (such as volatilities), to see what the future space and asset market (cap rate) forecasts look like (based on graphical output). When the user is satisfied with the input parameters, then the full simulation model can be invoked to generate the implied ex post performance probability outcome distributions for the subject investment. The passwords for opening the files in read only format and editable format are “sujata” and “psujata” respectively.

This model was invited for a presentation and received wide appreciation at the Global Planning Session of LaSalle Investment Management, Chicago, July 22-23, 2013, attended by the Global CEO, and heads of Europe, Asia and North America.
<table>
<thead>
<tr>
<th>Index</th>
<th>Sheet Name</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Executive Summary</td>
<td>This sheet summarizes the goal of this financial model and the interpretation of the results obtained. It also presents the major sources of data used to calibrate this model. The overall architecture of the model is also presented in this sheet.</td>
</tr>
<tr>
<td>2</td>
<td>Historical Data</td>
<td>Enter the historic data for gross rent, cap rates, net rentable area, occupied stock, absorption, completions, vacancy and employment for the period under consideration in this sheet. The data has to be recorded on a quarterly basis for 94 quarters. This data is used in the different modules of the model for future projection.</td>
</tr>
<tr>
<td>3</td>
<td>Control Panel</td>
<td>Enter the different parameter values to be used as input to the different modules of this model. The user can change the specified inputs based on the market under consideration. Note that, it is possible to enter uncertainty into the parameters and exogenous variables, but that such uncertainty input is optional. Further instructions are provided on the sheet.</td>
</tr>
<tr>
<td>4</td>
<td>Forecast</td>
<td>This is the forecasting module of this financial model. It uses the stock flow approach to connect and co-vary the rent, vacancy, occupied stock, net rentable area and new completions using the sensitivity and trigger parameters entered by the user in the control panel. A forecast for 90 quarters in the future is generated by this model. The forecast generated is used by the downstream modules for risk assessment.</td>
</tr>
<tr>
<td>5</td>
<td>Forecast Sim</td>
<td>This is the simulation for the forecasting module. Depending on choice, the user can view how the different components of the forecast vary over time. If the uncertainty is activated in the control panel, the relationships between the variables would be dynamic and would change with every run of the simulation. The user can choose a particular quarter in the future to see how the different components vary across trials in the same cross section in time.</td>
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<tr>
<td>6</td>
<td>Optimal Rent</td>
<td>This is an add on module to the forecasting module. It uses the forecasted cap rates, rent, vacancy and gross absorption data from the market to calculate an optimal rent which the landlord would settle for depending on the market conditions. The optimal search algorithm embedded in this module reflects the amount of uncertainty or volatility in the forecasted rents. The optimal decision is based on maximizing the present value of the property. The higher the volatility, higher is the optimal asking rent, optimal long term vacancy and the maximum building value.</td>
</tr>
<tr>
<td>7</td>
<td>Core Asset</td>
<td>This module creates an asset level occupancy and rent for the core asset under consideration. The module considers four possibilities namely, already occupied, renewed, new lease and vacant. Depending on this, the rents, occupancy levels, costs and final net operating income and 5 year hold IRR is estimated.</td>
</tr>
<tr>
<td>8</td>
<td>VA Asset</td>
<td>This module creates an asset level occupancy and rent for the value add asset under consideration. The value add asset has a considerably larger vacancy than the core asset. The amount of vacancy can be adjusted using the level switches in the control panel. The module considers four possibilities namely, already occupied, renewed, new lease and vacant. Depending on this, the rents, occupancy levels, costs and final net operating income and 5 year hold IRR is estimated.</td>
</tr>
<tr>
<td>9</td>
<td>Flexibility</td>
<td>This module presents an option for the user to have the asset holding period flexible between 5 and 15 years. The HOLD/SELL decision is taken based on the ex post knowledge of the investor. The reversion price is compared with the current expected value based on a long term growth trajectory plus a premium to trigger the resale under the prediction of a future mean reversion.</td>
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<td>10</td>
<td>IRR Sim</td>
<td>This is the simulation of the 5 year hold IRRs for both the core and value add asset. Simulations for both, the fixed holding period and the flexible holding period. The higher the uncertainty activated in the control panel, the more valuable is the flexibility in holding periods. This module allows the user to look at the statistical parameters of the distribution of the IRRs over 2000 trials.</td>
</tr>
<tr>
<td>11</td>
<td>Summary</td>
<td>This sheet summarizes the risk return relationship for the core and value add assets for both the fixed 5 year hold and for the flexible holding period between 5 and 10 years. The ex ante risk is measured in terms of the Treynor ratios. The user input risk free rate of interest and the opportunity cost of capital (with a unit risk) are used to generate the security market line.</td>
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</table>
**Intent**
The intent of this model is to develop a risk adjusted asset valuation model for a single core and value add asset using a probabilistic approach combined with optimized asking rents and selling options.

**Strategy**
The strategy adopted is to use the historical data for the local space market (employment, rent, occupied space, net rentable area, new completions, vacancy, and absorption) and asset market (cap rates history) in order to produce a 15 year forecast of the relevant space and asset market for the subject property. We then use the rent roll data for the asset under consideration to project cash flows for the specific subject asset. We assume the asset to be almost 100% occupied for the core investment and the same asset 50% occupied for the value add investment. Renewal probability and expected time to lease up are major inputs differentiating the two types of assets.

**Source**
In the present example, the rent, occupied space, net rentable area, new completions, vacancy and absorption is obtained from CBRE. Employment data is obtained from the New York Labor Department. The cap rate data is obtained by assuming Moody's BAA bond ratings as an unbiased estimator.

**Developer**
Sanwesh Paradkar under the guidance of Professor David Geltner.

**Academic Reference**
Commercial Real Estate Analysis and Investments (Third Edition) - David Geltner
This model is designed for 04 quarters of historical data. However, if the user has better parameter estimates, we can override the parameters in the control panel.

<table>
<thead>
<tr>
<th>Period</th>
<th>Nominal Gross Rent (M$)</th>
<th>Vacancy Rate (%)</th>
<th>Net Rentable Area (OMSF)</th>
<th>Occupied Space (OMSF)</th>
<th>Vacancy (OMSF)</th>
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<td>289,714 253,739</td>
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<td>3,036</td>
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<td>1.12%</td>
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<td>19882</td>
<td>1988.231 2 9.80%</td>
<td>292,866 253,915</td>
<td>1,128</td>
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<td>19883</td>
<td>1988.333 3 9.87%</td>
<td>312,426 264,527</td>
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<td>19884</td>
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**Summary Observations**

- The IRR Core Asset with flex shows a higher range of values compared to the IRR VA Asset with flex.
- The frequency distribution for both assets indicates a concentration in the 0% to 10% range.
- The IRR Core Asset with flex has a slightly higher count frequency in the 0% to 5% range compared to the IRR VA Asset with flex.

**Core Inflex vs. VA Inflex**

- Core Inflex ranges from 0% to 15.00%
- VA Inflex ranges from 0% to 15.00%
- The frequency distribution for both core and VA assets shows a concentration in the 0% to 10% range.
The security market line (SML) in the adjoining graph is generated using the risk free rate of interest and the ex ante opportunity cost of capital having a risk of 1 unit. The SML is used to price the assets under the assumption that the risk premium per unit of risk equals the market price of risk.