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EXAMING THE IMPACT OF DEBT VALUATION METHODOLOGIES AND REPORTING ON INVESTMENT PERFORMANCE

ALEXANDER CARL BENOIT
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Reviewed and approved* by the following:

Jiro Yoshida
Associate Professor of Business
Thesis Supervisor

Brian Davis
Clinical Associate Professor of Finance
Honors Adviser

* Signatures are on file in the Schreyer Honors College.

ABSTRACT

Real estate is one of the largest investment asset classes in the world and a significant portion of many individuals' net worth. Although publicly-traded REITs have helped increase liquidity and transparency in the industry, there is still is a need for improvement in reporting and valuation. This dissertation will provide an overview of the current debt valuation and reporting landscape by reviewing the available sources of information and literature. Next, fair value is defined and a framework of how to implement it is provided. The framework is derived mostly from the NCREIF PREA Reporting Standards manual. Finally, the Vasicek model is used to forecast interest rates in order to simulate the value of a loan through time considering interest rate and default risk. The simulation finds that debt valuations can vary significantly depending on the risks considered in the model, specifically in a rising interest rate environment. Additionally, companies with below investment grade ratings see a relatively large decrease in value of their loans compared to those above investment grade.

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Chapter 1

Introduction

The real estate investment industry is undergoing an unprecedented transformation due to real estate becoming the 11th sector in the Standard & Poor's Global Industry Identification System in September 2017. The new classification comes with increased scrutiny on the industry and a greater need for transparency. Some of the thought leaders in the space have already begun using third-party valuation companies, but the majority are still valuing their assets and liabilities on their own. Companies being able to value their own assets in an illiquid trading environment presents risks to investors and markets alike.

My research examines the conflicting information about the fair value of real estate debt and the lack of consistency in regulation and reporting. While this presents many opportunities for studying inaccurate valuation, I selected to focus on the impact of omitting interest rate and default risk in the fair value of real estate debt. A simulated comparison of the book value to fair value of a loan shows the possible variation in valuation that could be attributed to real estate firms' chosen methodology.

The simulation is based on a Microsoft Excel model that uses an interest rate forecast and default probabilities to produce a valuation of a loan over ten years through quarterly time periods. The interest rate forecast is based on the Vasicek model with a Monte Carlo simulation using 10,000 iterations for each time period. The average of the iterations is used as the forecast interest rate for the period. The default data is from Moody's Research which provides the

probabilities of default over a ten-year time period for different credit ratings. My analysis shows there can be a significant variation in valuation, especially in a rising interest rate environment.

My research focuses heavily on the net asset value (NAV) calculation done by real estate investment trusts (REITs). The publicly-traded REITs allow access to information about commercial real estate (CRE) that the companies must report due to regulations from the Securities Exchange Commission (SEC). The National Association of Real Estate Investment Trusts (NAREIT) serves as an advocate and database for information regarding REITs. A similar institution that instead focuses on private real estate firms is the National Council of Real Estate Investment Fiduciaries (NCREIF). They are currently working diligently to improve real estate firms reporting standards. They have partnered with the Pension Real Estate Association (PREA) to produce the NCREIF PREA Reporting Standards that firms should use as a guide to fair value reporting. The Open End Diversified Core Equity funds (OCDE) are the champions of their ideas and have benefitted from increasing fund sizes. This paper discusses the shortcomings of the Generally Accepted Accounting Principles (GAAP) and how the firms can improve on them (Please see Appendix A for full table of acronyms).

My proposal mandates the use of third-party valuation companies to protect investors and bring stability to the real estate industry. The companies would offer an unbiased valuation that could give investors more transparency and encourage more capital to move into the sector. Also, they would be overseen by an independent regulatory body to ensure the market is operating in the best interest of the investors.

Effects of Leverage on Real Estate

The use of debt is one of the major tenants of real estate, dating back to the 11th century when the English pioneered the use of mortgages. Over time the uses and laws of mortgages have developed significantly and helped the real estate asset class grow. Although, it is important to note that leverage and risk have a positive correlation. Bernanke, Gertler, and Gilchrist (1998) find that credit markets intensify the fluctuations that occur in the macro economy. The real estate credit markets are a driving force that power economies from boom to bust and everywhere in between, most recently in the financial crisis of 2007-2008. Clayton (2009) stresses the importance of debt in real estate transactions and valuations. The study shows that the use of leverage can be inadequately factored into investment decisions which creates bubbles in what the article refers to as the "financial leverage cycle". The findings suggest that money managers can abuse the use of debt to drive higher property prices in a growing real estate market because investors accept lower cap rates. The lower cap rates then make the property valuation higher. That justifies increased loan proceeds for lenders which then increases the availability of commercial mortgage debt and fuels the cycle. It is important to note that an investor could face a significant decrease in investment value when the eventual market correction of the bubble occurs.

In contrast, it seems that the most recent financial crisis is causing lenders to be more stringent with their issuances. In 2016, the Mortgage Bankers Association's reports that lenders issued $491 billion of loans secured by commercial property, representing a 3% decline from the previous year. The consistent price appreciation of commercial real estate has pushed valuation above pre-crisis levels. Green Street Advisor's U.S. Commercial Property Price Index has increased 103% from August 2009 to August 2017. Additionally, the Dodd-Frank Act requires

additional liquidity for banks to offer the loans. The banks have turned to using stricter lending requirements to pass stress testing. The National Association of Realtors found that over 60% of failed sales transactions in 2016 were due to loan underwriting or lender requirements. This is compared to the less than 15% of transactions that weren't completed due to a lack of financing. The reduced leverage isn't necessarily bad for investors.

A comprehensive study about leverage and how it affects investors is done by Sun, Titman, and Twite. They show that the REITs with high debt-to-asset ratios and shorter maturity debt experience more share price depreciation compared to less leveraged REITs with longer-term debt. Additionally, they discover that in the financial crisis REITs' valuation significantly deviated from their underlying commercial real estate holdings. In the financial crisis, the NAREIT index fell 60% compared to a NCREIF Property Index which fell 15%. The 45% difference is large, but there are some caveats which make the comparison not apples-to-apples. REITs are actively traded investment vehicles making them more volatile than the commercial real estate in the NCREIF Property Index. Investors are constantly buying and selling their shares to express their view of the companies causing fluctuations in the index. In comparison, the real estate in the NCREIF Property index is given a specific value from an appraisal. Additionally, REITs' pricing could have factored in growth opportunities that investors felt disappeared during the crisis because the future of the financial markets was in question.

Debt Valuation and Reporting Industry Landscape

The primary sources of information and research regarding real estate debt valuation and reporting are produced by the following: academics, auditors and accounting standards boards, real estate firms, and third-party valuation companies. The former two produce the best information about the subject, with the latter two beginning to become stronger voices as the real estate industry develops. The main subjects of debate in real estate debt valuation are who should value the debt, what accounting model should be utilized, and what valuation method is most accurate.

The main entities who could value debt are internal departments at real estate firms (such as their accounting department or valuation department), the auditors, or firms can choose to outsource to a third-party valuation firm. The current market is trending towards third-party valuation firms because thought leaders, such as the ODCE funds, are pushing for more conformity throughout the industry. The firms have made the changes partly due to U.S. GAAP requirements for certain investments held by tax exempt investors, but also find the enhanced transparency broadens their appeal to the investment community. The proactive steps give investors confidence that the firms will be able to quickly adapted to changes in the regulatory and legal environment.

Finally, there is no industry-standard for a debt valuation model or what inputs should be used in the model. The variation in methodologies present a unique challenge to investors seeking to invest in closed end funds with self-determined NAVs. Real estate debt valuation used to be a niche skill, but as real estate shifts from an alternative asset class to major allocation in individual and institutional portfolios, the need to understand it has become paramount for investors to make informed decisions.

Accounting and Fair Value Codification

The accounting framework that lays out how real estate debt should be reported is unclear and inconsistent. FAS 157 is a code that was produced by the Financial Accounting Standards Board ("FASB") and is meant to guide valuation and reporting pertaining to real estate. The document lays out the framework for measuring fair value in GAAP and is the basis for how all fair value is measured.

Table 1. Fair Value Hierarchy

Fair Value Hierarchy	
Level 1	Valuation is based upon quoted prices for identical instruments traded in active markets.
Level 2	Valuation is based upon quoted prices for similar instruments in active markets, quoted prices for identical or similar instruments in markets that are not active, and model-based valuation techniques for which all significant assumptions are observable in the market.
Level 3	Valuation is generated from model-based techniques that use significant assumptions not observable in the market. These unobservable assumptions reflect our own estimates of assumptions that market participants would use in pricing the asset or liability. Valuation techniques include use of option pricing models, discounted cash flow models, and similar techniques.

Along with defining the levels of fair value, the document covers three key concepts about fair value. The first being that fair value is a market-based measurement, and is not entity-specific. Therefore, firms must use the assumptions used by market participants when valuing assets or liabilities. Second, FAS 157 details the assumptions about risk that market participants must consider. This includes, but isn't limited to, risk in valuation techniques, risk of restriction on sale or use of an asset, and risk of nonperformance in liabilities. Finally, it defines the three levels of the fair value hierarchy and how observable and unobservable input are to be utilized.

IFRS 13 Fair Value Measurement is published by the International Accounting Standards Board ("IASB") and is similar in many ways to FAS 157. The Institute of Chartered Accountants in England and Wales ("ICAEW") writes, "IFRS 13 applies where another IFRS requires or allows fair value measurements or disclosures about fair value measurements. The new standard provides guidance on establishing fair values and introduces consistent disclosure requirements." The most critical contribution of IFRS 13 is that after a convergence project with FASB and IASB, the code produced a unified definition of fair value as, "the price that would be received to sell an asset or paid to transfer a liability in an orderly transaction between market participants at the measurement date." The definition lays out three important concepts of fair value. First, fair value measurement is to be based upon an exit price. Next, fair value is not an entity specific value and that it is supposed to be a market value. Finally, the statement suggests that the value of liability is based on the notion of its transferability. Even with this increased coordination, the process of valuing and reporting fair value assets and liabilities remains a mystery to most market players. It wasn't until the introduction of ASC 820 in 2011 that transparent fair value reporting began to gain traction.

Topic 820 is another critical primary source for my research as it updates the current standards and seeks to provide more clarity for how to report. The previous two document detail the fair value measurement system and what disclosures are required for companies adhering to GAAP and International Financial Reporting Standards ("IFRS"). The update ensures that the two boards have more coordination on how they define fair value and how they want it reported. Previously, it was required that fair value be applied to instruments but there was no explanation of how it should used for measuring the value of the instruments. Additionally, Topic 820 clarifies that companies need to disclose quantitative information to investors about the

unobservable inputs they use in the fair value measurement of Level 3 instruments. The amendment was significant for real estate debt valuation because many are classified as Level 3 instruments within the fair value hierarchy and utilize a significant number of unobservable inputs. Even with the amendment, few firms adhere to the request to cite their unobservable inputs or how they value their level 3 assets. Later, I will address how the ability to alter inputs can have an impact on valuations.

Chapter 2

Real Estate Fair Value Reporting

Fair Value Implementation and Guidance

NCREIF PREA Reporting Standards (Wincott, 2017) published an updated manual on the current standards and guidance on fair value measurement and accounting in 2017. The manual is NCREIF PREA's response to FASB's Topic 820 in an effort to provide more clarity for real estate fund managers trying to uniformly report fair value to their investors. The guidance details the fair value hierarchy and the importance of its use. In this section, there is quotations from many of the major pieces of GAAP's and FASB's literature on fair value followed by more color from NCREIF PREA. Next, the manual details accounting at the fund level, investment level, and property level. This is significant because many managers just look at their investments from the property level, but the other levels are equally, if not more, important than the property level. Finally, the manual contains two illustrative financial statement models for real estate firms to use as a template in their accounting procedures.

The industry standard should be the operating model but many firms, most notably publically-traded REITs, are using the non-operating model or a similar model. The non-operating model is not recommended because it's less comprehensive and transparent about fair value measurements than its counterpart. NCREIF PREA Reporting Standards hopes that all firms will use their template to adopt the operating model. Figure 1 shows how companies could use the provided model to disclose their valuation methodologies to investors. This would allow them to assess any discrepancies between their views and the real estate investment firms.

	Fair Value	Valuation Technique(s)	Unobservable Inputs	Ranges (Weighted Average)
Real Estate Properties:				
Residential	$ -	Discounted cash flows (DCF)	Discount rate	xx% to xx% (xx%)
			Capitalization rate	xx% to xx% (xx%)
			DCF Term (years)	10 years (10 years)
			Revenue growth rate	xx% to xx% (xx%)
		Direct capitalization method	Direct Cap Rate	xx% to xx% (xx%)
Office	-	Discounted cash flows	Discount rate	xx% to xx% (xx%)
			Capitalization rate	xx% to xx% (xx%)
			DCF Term (years)	10 years (10 years)
			Revenue growth rate	xx% to xx% (xx%)

Figure 1. Operating Model Fair Value Inputs

PwC also offers a guide (Fair Value Measurements, 2015) with comprehensive coverage of fair value measurements from the perspective of the largest Big 4 Auditor. My research wouldn't be complete without considering the auditors' stance on fair value as they play a large role in its enforcement. The guide is very similar to the manual produced by NCREIF PREA, but it does have some interesting features.

The first being that when addressing why fair value is important, the perspective is more centered around the investors and the timeliness in which they receive the information. It was interesting that they addressed it because the lack of transparency in how fair value is used and calculated is counterintuitive to the investor-centered approach the firm discusses. Second, the guide had great information on the three valuation techniques of market, cost, and income approach shown in Table 2. It will be important later when the methods blend together to produce debt valuations in the simulated portfolio.

Table 2. Valuation Techniques

Valuation Techniques	
Market	The market approach uses prices and other relevant information generated by market transactions involving identical or comparable (that is, similar) assets, liabilities, or a group of assets and liabilities.
Cost	The cost approach reflects the amount that would be required currently to replace the service capacity of an asset (often referred to as current replacement cost).
Income	The income approach converts future amounts (for example, cash flows or income and expenses) to a single current (that is, discounted) amount. When the income approach is used, the fair value measurement reflects current market expectations about those future amounts.

Finally, PwC's coverage of how to apply fair value to financial assets and financial liabilities was top-notch. The coverage in the third chapter of the guide applies a five-step process to applying fair value. It is a great reference for firms just beginning their compliance with fair value.

Current Reporting Standards

All publicly-traded real estate investment are required to produce financial reports for their investors, but the methodology used to determine the fair value of their debt is not reported. The SEC oversight of the firms mostly focuses on the meeting the requirements for maintaining the tax-exempt status of the firms. Additionally, due to these REITs being traded on an open marketplace, their value is determined in a similar fashion to all other publicly-traded asset. The companies that present more risk to investors are privately-traded REITs and private real estate investment firms that calculate their own NAV.

Many of these firm's capital comes from pension funds and large institutional investors that are pooling a large number of individuals' assets. The industry needs to come together to improve the reporting standards because the prices these investors pay is based off the calculation, which could have substantial variation from firm to firm. Additionally, the firms' revenue could be largely based on fees that are calculated as a percentage of the NAV, providing incentive to maximize the metric. The field of finance has a track record of bending ethics to maximize revenue, therefore it is paramount to remove the opportunity.

Fair Value Significance and Reliability

The significance of the fair value measurements is examined by Chang, Thomas, and Han. The journal article from the Accounting Review examines FAS No. 157 and how it prioritizes the sources of information used in the fair value measurements hierarchy (Chang Joon, S., Thomas, W. B., & Han, Y., 2010). One of the most interesting findings of the study is the relationship of corporate governance to the value relevance of the fair value measurements. It

finds that the value relevance of fair value is greater for firms with strong corporate governance. On the other hand, firms with weaker corporate governance mechanisms may see reductions in the relevance of the measures. Finally, the most striking data relevant to my research is that when the value relevance testing focuses on loans, it finds that Level 1 fair value liabilities are priced at 286 cents on the dollar compared to Level 3 fair value only being priced at 35 cents on the dollar. The shortcomings of these findings were that they were only based on the balance sheets of 431 banks and only a small fraction of the items on the balance sheet are measured at fair value.

Another journal article by Lawerence and Sloan (2015) is a great primary source in which the researchers uncover the value relevance of the different levels of the fair value hierarchy. The first test on value relevance uses the standard regression of stock prices on accounting-determined fair values. It's an important test for my research because it reflects to what extent the closed-end funds' NAV reflect the fair value of their portfolios'. The next test utilized is change-based regressions employing quarterly stock returns and NAV returns. This test of timeliness brings to light that estimated fair values can lag market values which negatively affects investors. In addition to producing unique findings, the article provides a comprehensive literature review on fair value providing many spring boards for further research.

Carroll and Petroni (2003) provide a thorough analysis of the reliability of fair value accounting and a great comparison of historical cost accounting versus fair value accounting. It looks at closed-end funds because the balance sheets and income statements are usually reported at fair value. Expectedly, the findings show that that there are a significant association between stock prices and the fair value of the underlying investment securities. Additionally, it is found that there is a correlation between the stock returns and the fair value securities gains and losses.

Finally, the research suggests that the problems in measuring fair value are derived from the incomplete availability of fair value measurements in other settings. This is important because it contrasts the popular opinion that fair value measurements are unreliable because the system is flawed, but rather suggests that the incomplete adoption of fair value causes reliability issues. Further research and additional resources can help increase adoption of fair value practices to resolve the issue.

Chapter 3

Construction of Simulated Porfolio

Contractual Cash Flows

The goal of the simulated loan valuation is to highlight mispricing risk that exists when models do not integrate the fair value of real estate debt. I use Microsoft Excel to conduct the simulation, but Matlab could also be used with similar results. The first step in the process is to produce an amortization table of the loan. I selected to model a $1,000,000 non-recourse 5% loan, although the loan amount could be changed to simulate any size loan with varying interest rates.

The Excel PMT function makes it easy to calculate the monthly payments on the mortgage. Then the interest rate portion of the payment can be calculated by taking the monthly interest rate multiplied by the opening balance. Next, the interest payment can be subtracted from the monthly payment to determine the principal payment. Finally, the cash flows can be discounted to the present in order to determine the value. The discount rate applied is where the possible variation valuation can occur. The credit or default risk of the firm, interest rate risk, prepayment risk and market risk are all major factors to be considered when calculating the proper discount rate.

Interest Rate Model

The future interest rates can be forecasted with different models, such as Merton's model (Merton, 1973), the Cox-Ingersol-Ross model (Cox, Ingersol, Ross, 1985), and the Vasicek model (Vasicek, 1977). I selected to use the Vasicek model for my research, which is as follows:

$$dr_t = a(b-r_t)dt + sdW_t$$

The model produces the valuation of the instantaneous interest rate, representing the "dr_t" term or the output of the model. The forecast is over 40 time periods from t=0 to t=10 in .25 intervals, representing quarterly interest rates. The first term on the right side of the equation is the speed of mean reversion displayed as "a". The next term is the long term mean of interest rates (3-Month Treasury Bill in this simulation) subtracted by the interest rate in the time period, shown as "$(b-r_t)$". The final term "sdW_t" is the volatility, "s", multiplied by the random market movement.

Interest Rate Data

In order to construct the simulated portfolio, I assembled data from a variety of sources. The historical interest rate data comes from the economic research of the St. Louis Federal Reserve Bank, a top source for economic data. The data is available for free and is updated in real time. The FRED tool can be accessed on their website, which produces the daily rate for the 3-Month Treasury Bill that I use to forecast the future interest rates. The investment vehicle was chosen because it is widely used as the risk-free rate when calculating investment value. An alternative option would be to use London Interbank Offer Rate (Libor), but following scandals

around the benchmark, U.K. regulators have chosen to begin phasing it out. Therefore, the 3-Month Treasury Bill is a better long-term option to avoid future complications that could arise from using Libor. The model uses data from January 1982 to October 2017, which provides 8,961 data points to calculate the long-term level of the mean. The time period saw multiple business cycles and recessions of varied severity. The latest and most severe recession, the Great Recession, has a significant impact on my simulation because dovish monetary policy has left us in an ultra-low rate environment. Although, in the U.S., interest rates are trending back up as the Federal Reserve has begun to tighten monetary policy.

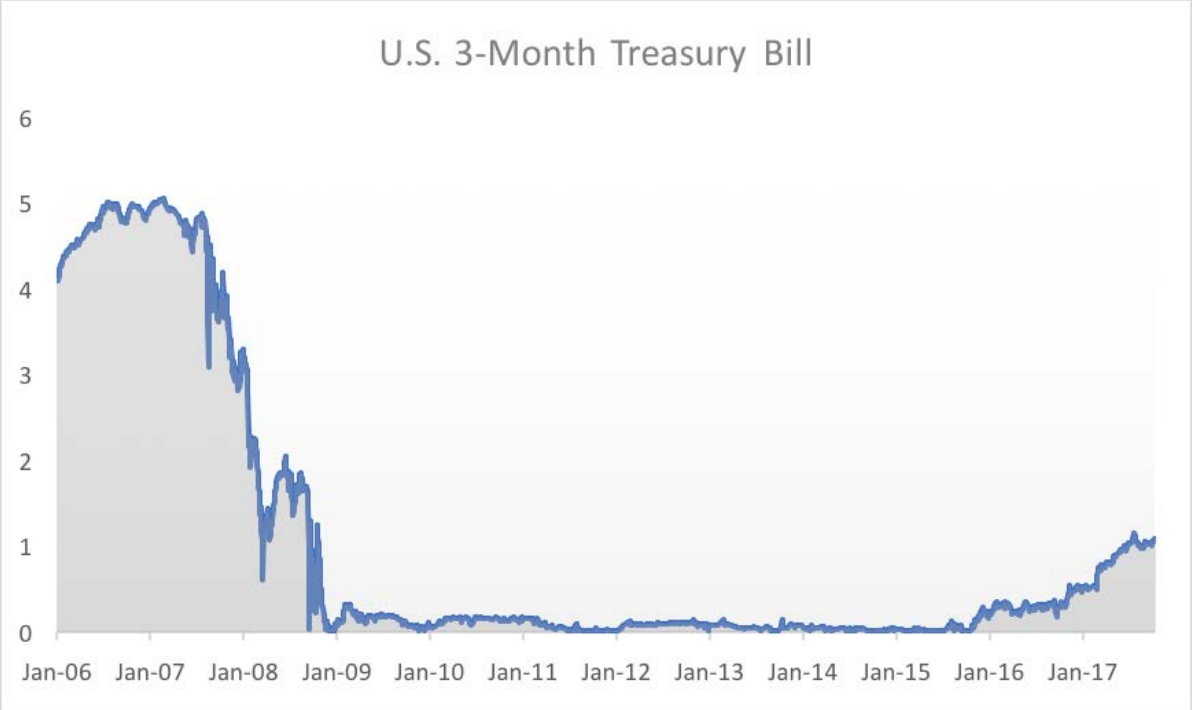


Figure 2. U.S. 3-Month Treasury Bill

The figure above uses the FRED data to show the slow increase of the U.S. 3-Month Treasury Bill. The rising interest rate environment makes proper debt valuation even more important because not accounting for the increase could lead to significant mispricing. The simulated portfolio provides the data behind this theory, showing that the value of the loans can

be quite variable if the future interest rates are considered in the valuation. On the other hand, in a time period when interest rates are falling, real estate portfolios could be undervalued and offer a discounted investment opportunity if there are refinancing options.

Real Estate Investment Firm Data

The REIT data comes from S&P Global Market Intelligence's SNL platform that aggregates information from the companies' financial reporting data. The data can be accessed on their website, but I utilized the Excel add-in to gather the information. The REIT data is a proxy for the data from real estate investment companies that are not required to publicly disclose their financial data. Although some of the ODCE funds have their investor presentations posted online, there is not enough information available to create a meaningful data set. The presentations are still useful to show the lack of reporting on the companies' debt valuation methodologies. The REIT credit rating data is used to value the companies' bonds, which give an approximation of the valuation and cost of debt for the private real estate investment companies that produce their own NAV numbers.

Another source of data is NAREIT and NCREIF PREA because they seek to act as independent third parties to produce information about investment opportunities, mostly focusing on real estate. NAREIT has been around for over 50 years collecting data and serves as an advocate for U.S. REITs and publicly-traded real estate companies. On the other hand, the NCREIF PREA partnership focuses on establishing uniformity in reporting for real estate investment firms, especially those who serve pension and retirement funds. Their data is more

qualitative than NAREIT, but still important because they are the leading source for proper real estate investment reporting.

Credit Default and Recovery Rate Data

The credit default data comes from the June 2017 Moody's Default Research Report which provides the average probability of default over a ten-year period for corporates. The report separates companies into four ratings of A, Baa, Ba, and B (Shown below in tables 3 and 4).

Table 3. Default Probabilities (Year 1 to 5)

Year	1	2	3	4	5
A	0.14%	0.33%	0.55%	0.81%	1.15%
Baa	0.20%	0.47%	0.66%	0.81%	0.97%
Ba	0.56%	1.77%	2.75%	3.65%	4.79%
B	2.02%	5.64%	8.82%	11.43%	14.19%

Table 4. Default Probabilities (Year 6 to 10)

Year	6	7	8	9	10
A	1.50%	1.71%	1.85%	1.98%	1.98%
Baa	1.17%	1.30%	1.41%	1.55%	1.97%
Ba	5.86%	6.79%	8.01%	9.86%	10.71%
B	16.76%	19.09%	21.73%	24.48%	27.71%

The other choices for default data would be S&P or Fitch, but the data comes from real world corporate defaults so there would be minimal variation. I also examined Bloomberg's default probability data, but the probabilities were unrealistically low. The recovery rate of 31.3% comes from the Moody's report as well and was found by surveying recovery rate on real world defaults.

Model Calibration

The speed of mean reversion, the long-term mean of interest rates, and the volatility all need to be calibrated to the selected data set in order to produce accurate results in the simulation. The values are determined from a maximum likelihood estimation using Excel functions. I selected this method because it is commonly used in association with the Vasicek model.

The first step is to select initial assumed values to put into the three inputs below. I used the values from the 10th edition of Options, Futures, and Other Derivatives by Hull. The values were based of the calibration of their model which used data up until 2016 and were as follows:

Table 5. Initial Model Inputs

Variable	Hull Calibration Input Value
a	0.2
b	0.041
sigma	0.03

Next, using the initial rate at time 0 of 0.0107, I compared the estimated interest rate change in each time period using the formula ($a*b-r_{t-1}/100$) and compared it to the actual

historical change. The actual historical change subtracted by the estimated change equals the error for each period. Then using the NORM.DIST Excel function I was able to find the probability density function which I took the natural log of to simplify the number. Next, I used the Sum function in Excel to find the sum of all the natural logs. Finally, I minimized the cell's value with the Solver's minimize function by changing the three variables in the table above. The output from the Solver produced the values below that have the estimated least error based on the maximum likelihood estimation.

Table 6. Calibrated Model Inputs

Variable	Calibrated Model Inputs
r(0)	0.0107
a	0.200048829
b	0.039009522
sigma(vas)	0.01

The values in table 6 were used as the inputs for the Vasicek model covered above. In order to produce a meaningful distribution of possible outcomes, I utilized Excel What-if analysis to produce a Monte Carlo simulation with 10,000 iterations of the Vasicek model over each of the 40 time periods. Each time period results are averaged to produce the interest rate forecast for the time period which was then used to value the interest rate risk.

Debt Valuation with Interest Rate Risk Methodology

Firms ignoring the industry's call for fair value increase the risk of inaccurate valuations of their liabilities, specifically because there are no mandated appraisals like the quarterly or annual appraisals of real estate properties. The practice of projecting out the contractual mortgage cash flows and using a constant discount to find the present value of the remaining principal balance as a method of valuation is insufficient. For my research, I first focus on interest rate risk and its impact on real estate portfolio's valuation over time.

I use the interest rate forecast produced by the Vasicek model to determine an adjusted discount rate to use for each time period. The discount rate is equal to the forecasted rate of the 3-Month Treasury Bill plus a constant spread of 3.8% to highlight just the interest rate risk. The constant spread of 3.8% sets the initial discount rate of both the contractual method and the fair value method to 5% for the first time period. The discount rate is then applied to the contractual cash flow formula (shown below) as the rate in the Excel PMT function.

$$V_t = CF_1 / (1 + R_1)^1 + CF_2 / (1 + R_2)^2 + \ldots + CF_t / (1 + R_t)^t$$

The formula represents "V_t" as the adjusted value of the cash flow at time t and "CF_1" as the first cash flow. The time period specific cash flow is then divided by the rate, "R", from the same time period to produce the adjusted value. The "R" term in the interest rate scenario is equal to the constant spread of 3.8% plus the forecasted rate of the 3-Month Treasury Bill for the matching time period. The summation of all of the time periods is equal to the "V_t" term.

Debt Valuation with Default Risk Methodology

Every company with debt has a chance that they will be unable to make the contractual cash flow payments. The percentage chance of default needs to be combined with a recovery rate. Both of these number must be estimated and applied to the following formula:

$$V_t = CF_t * (1 - DP) + (LB * RR) * DP$$

Where the "V_t" represents the adjusted value of the cash flow at time t and the "CF_t" is the unadjusted value of the cash flow. The "LB" equals the loan balance and "RR" represents the recovery rate. "DP" is equal to the estimated default probability for the specific credit rating. The "(1 – DP)" term produces the probability of survival. The result produces a value of the cash flow when considering the probability of default.

Chapter 4

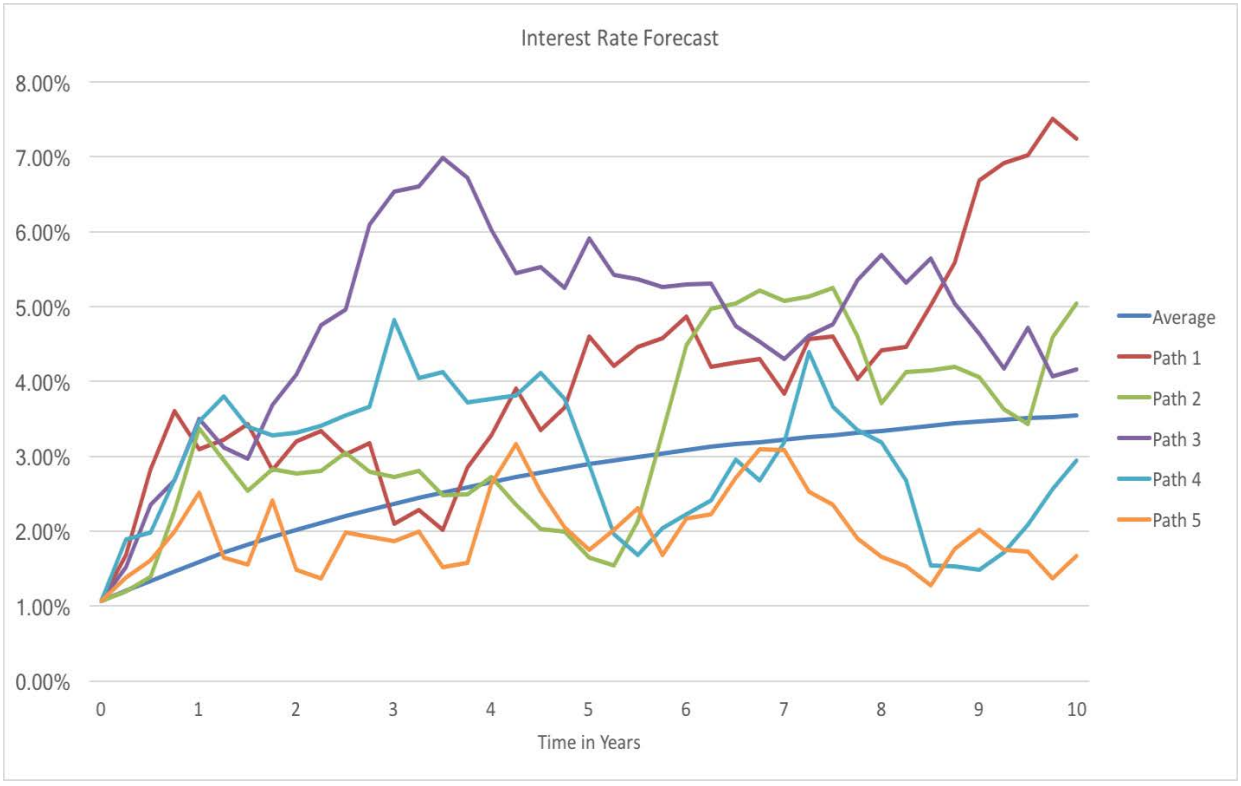
Results

The average of the results from the Monte Carlo simulation produced an interest forecast that predicts a significant appreciation in the 3-Month Treasury Bill rate show in the table below.

Table 7. Average Interest Rate Forecast

Time in Years	**0**	**2.5**	**5**	**7.5**	**10**
Average	1.07%	2.20%	2.90%	3.28%	3.54%

The forecast shows a 2.47% increase in the 3-Month Treasury Bill rate which results in a significant impact to the valuation of the simulated loan shown later. Although, in the 10,000 iterations of the Monte Carlo simulation the outcomes varied. The graph below shows a sample of possible interest rate paths.



When examining the two extremes, it's clear that based on the rate's past volatility that a wide range of outcomes is possible. Path 1 fluctuates around the average initially, but around year 8 begins to climb up to 7.23% in year 10. On the other hand, Path 5 starts to dip down in year 7 resulting in a final rate of 1.67%. Looking at one of the possibilities closer to the average, Path 3 jumps up to 6.98% in year 3.5 before settling down to around 5% for a few years and finishing at 4.15% in year 10. Any one of the paths could be possible, therefore it is important to consistently update forecasts at least quarterly to produce an accurate estimation of the most likely interest rate path.

Similar to my results, Geltner, D. M. (2014) finds that using the contract rate in a yield-to-maturity calculation often produces results that are distinct from a realistic expected return. Over the course of a five-year to ten-year commercial mortgage, the interest rate could varying significantly. According to the Federal Reserve Bank of St. Louis's Economic Research, the U.S. 3-Month Treasury Bill rate can vary over 10% in a five-year period representing the massive interest risk firms could potentially face (see appendix B for graph of historical U.S. 3-Month Treasury Bill rate).

Table 8. Debt Valuation with Interest Rate Risk

Year	Contract Value	Fair Value	Percent Reduction
0	$1,000,000.00	$920,861.44	-7.91%
2	$758,235.34	$680,526.19	-10.24%
4	$539,432.18	$469,667.09	-12.93%
6	$341,409.76	$287,741.81	-15.72%
8	$162,194.43	$132,283.38	-18.44%

Table 8 shows the results from the first exercise in the model simulation where the value is equal to the sum of the present value of the loan's cash flows. Initially, the loan's value is 7.91% less when considering the interest rate risk in the current rising interest rate environment. This is due to the expectation that if the future interest rates are higher than they are currently, the investments in the future would be more attractive. The decrease in valuation continues as the loan ages and exhibits an 18.44% decrease in value in year 8. The results highlight the importance of including interest rate risk because it shows how the same loan could have different valuations based on the methodology used. The graph below shows the difference in valuation through time on left y-axis and the percent reduction in value on the right y-axis.

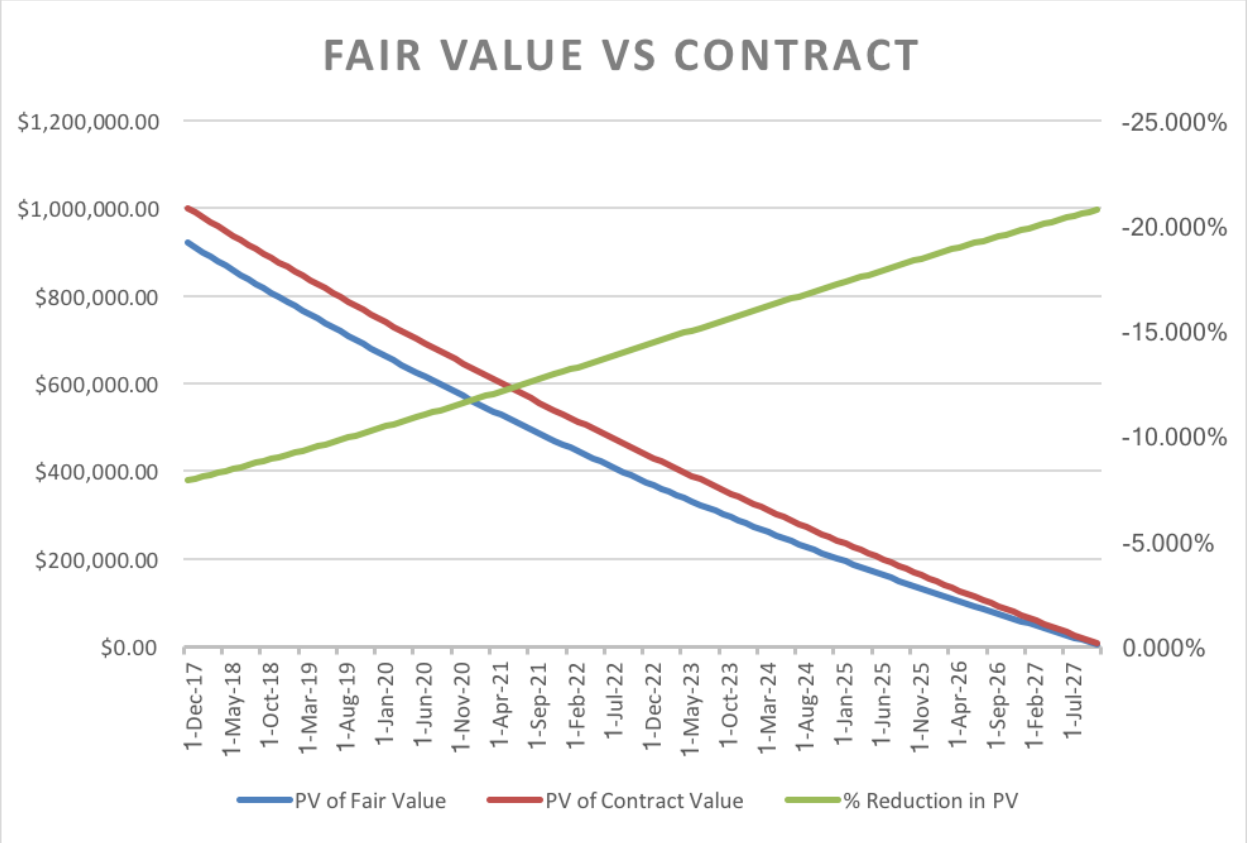


Figure 3. Fair Value vs Contract Value

Table 9. Debt Valuation with Default Risk

Credit Rating	**Value with Constant Discount Rate and Default Risk**	**Percent Reduction**
Unadjusted Discount Rate	$1,000,000.00	0.00%
A	$996,807.15	0.32%
Baa	$991,610.78	0.84%
Ba	$956,297.84	4.37%
B	$878,775.39	12.12%

Table 9 shows the results from the model using a constant discount rate of 5% along with an adjustment for the probability of default. The results show that the impact of default risk is small for firms that are rated above investment grade (Baa or higher) by Moody's. In contrast, if a firm is below investment grade, default risk has a significant impact on the value of the loan. If a B rated firm is borrowing, then the loan's value shows a 12.12% variation.

Table 10. Debt Valuation with Interest Rate and Default Risk

Credit Rating	***Value with Interest Rate and Default Risk***	**Percent Reduction**
Unadjusted Discount Rate	$1,000,000.00	0.00%
A	$918,065.91	8.19%
Baa	$913,384.21	8.66%
Ba	$881,568.77	11.84%
B	$811,724.38	18.83%

Table 10 shows the cumulative results of valuing the loan with interest rate and default risk in the model. In the rising interest rate environment, the initial present value of all of the loans, regardless of credit ratings, are reduced by 7.91%. The rest of the variation is due to the difference in default probabilities for the different credit ratings. A loan borrowed by a B rated firm experiences an 18.83% reduction in valuation compared to the unadjusted value.

Chapter 5

Conclusion and Further Research

The results of the simulation show the variation that can arise from incorporating two risk factors, interest rate and default risk, into the valuation model. When only considering those two factors, there could be additional fluctuations in valuation based on the data sources used. Then additional factors such as prepayment risk, credit migration risk, and geographic risk could be factored into the model resulting in additional volatility. A uniform valuation process needs to be established for debt valuation to increase stability in the industry and to protect investors from inaccurate valuation.

Recommendation

The real estate industry must follow a four-step process to fix the valuation methodology and to improve market efficiency. The steps are as follows:

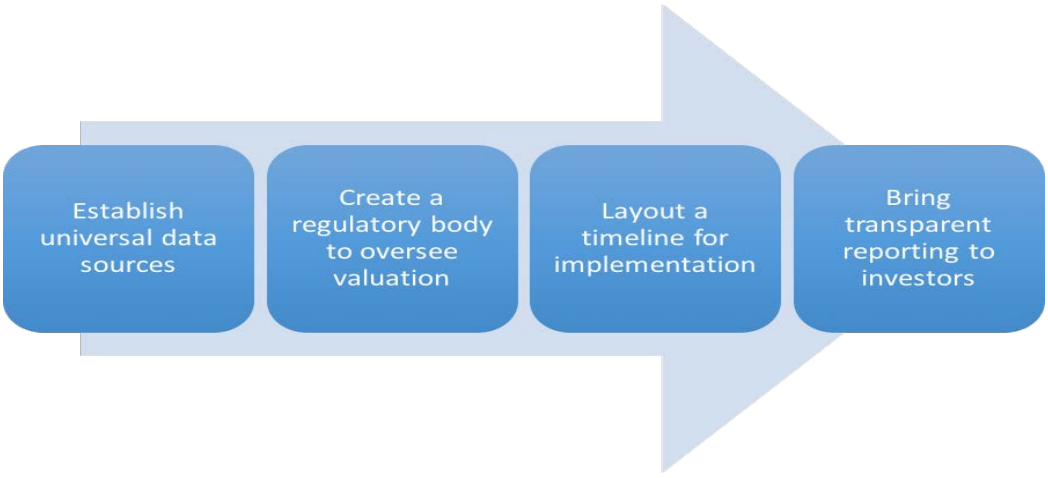


Figure 4. Recommended Steps

The primary data source should be any of the available information that the network of Federal Reserve Banks put out. Market interest rates and sales volumes from the network would be the most reliable and unbiased, both important factors for valuation. Also, the banks being regionally based could help factor in geography. Next, software from modular construction companies could be converted to estimate the replacement cost of the buildings. This would be one of the more difficult steps, but would yield the best returns in terms of improving efficiency and valuation accuracy.

The most effective way to create a regulatory body to oversee real estate would be to add a division into the SEC. The Securities and Exchange Council already oversees REITs and have a base understanding of the real estate industry. The main road block would be funding the division, but it could be ceded with a small fee charged to real estate investors. While initially there would be push back, the value of the protection would be far greater than a minimal fee.

The timeline for implementation would be six months to allow firms a test run in their quarterly reporting before requiring full adherence. The test run would also allow for the regulators and auditors to give the companies feedback on their valuation and reporting.

A key element of the plan is to bring transparency to investors when they are deciding how to invest their money and to keep them updated on their investments performance. All of the effort to correctly value the real estate assets is only worthwhile if it can be transformed into digestible information for the investor. The educational process will take time, but online learning has made educating investors easier than ever. NCREIF PREA has done a phenomenal job producing educational material for their investors and real estate firms. The SEC has a much more robust distribution network that could help build on the progress NCREIF PREA has

already made. An educated consumer is one of the most effective defenses against investment fraud.

JLL conducted a study that found the real estate markets that are the most transparent tend to be the most successful. Real estate investment firms goal is to generate revenue through raising capital to purchase property. The entire industry needs to understand that increased transparency and accurate valuations will only increase their revenue through increased investment. The trend has already begun with the ODCE funds, which are a group of 24 large real estate investment firms who established higher standards for transparency and valuation. The funds represented over $525 billion of the real estate market place. The firms attributed a large portion of their growth to increased investor confidence in their investments. The real estate industry will have to adopt the transparency standards that the rest of the capital markets hold one way or another. Investors need to combine their voting power by using their capital to show the industry they only trust transparent firms with their most valuable assets.

Further Research

My research focuses on two of the risk factors associated with real estate loans, leaving an opportunity for additional studies. Some of the other factors to consider are the risk of prepayment, credit rating migration risk, and geographical risks. The risk of prepayment would be mostly based on the loan underwriting and the prepayment penalties or restrictions. The credit migration risk could be incorporated into the model by utilizing a transition matrix that estimates the probability of a credit upgrade or downgrade. This would then be combined with the binomial default probabilities of each credit rating to produce a multinomial processing tree

model to incorporate credit migration and default risk. The geographical risks could be incorporated by adding a spread adjustment to the discount rate based on the location of the property. This could be a useful additional to the model because regions are more volatile than other, which is reflected in the interest rates.

I utilize an interest rate forecast with a constant spread, but ideally the spread would have been based on the historical spread of commercial real estate loans over the 3-Month Treasury Bill. Additionally, my study uses data from publicly-traded REITs as a proxy for private real estate firms that many large institutional investors have sizable holdings with. Further research could be done with data from the private real estate firms. Currently, NCREIF has the best opportunity to conduct the research because they aggregate data from the ODCE funds to create their benchmark.

Along with being able to choose between a market or contract rate, the real estate firms decide if they want to value their mortgages with a constant or remaining term methodology. The constant term methodology means that when valuing the loan, the term of the loan will remain constant. When using the remaining term method, firms value the liability based off the rate of a loan with a term closest to the term remaining on the loan. The yield curve risk of the decision could vary greatly depending on the prevailing rates at the time. Further research could examine the potential variation in valuation that this could produce.

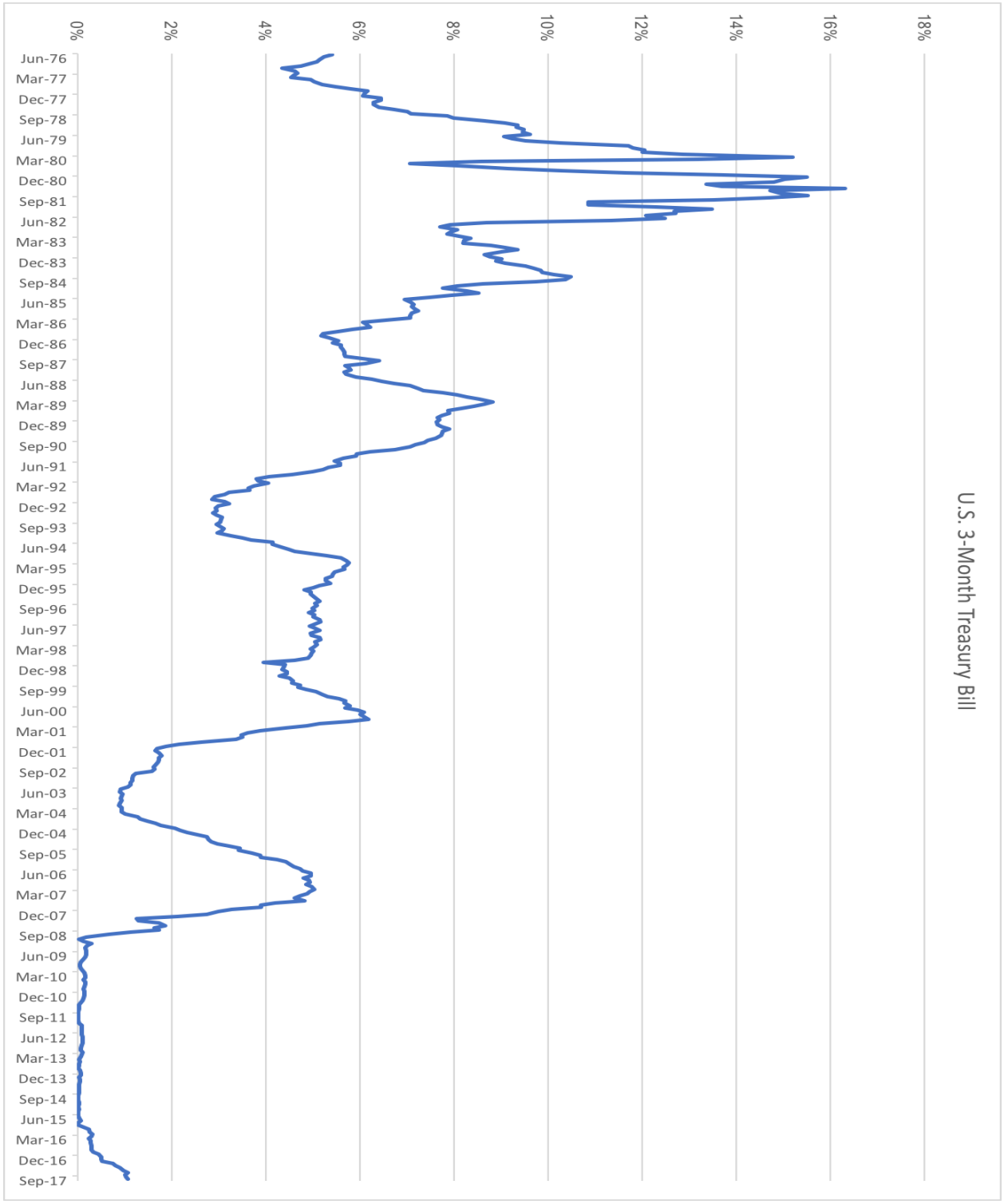
Appendix A

Terminology

Acronym	Definition
ASC	Accounting Standards Code
CRE	Commericial Real Estate
FAS	Financial Accounting Standards
FASB	Financial Accounting Standards Board
GAAP	Generally Accepted Accounting Principles
IASB	International Accounting Standards Board
ICAEW	Institute of Chartered Accountants in England and Wales
IFRS	International Financial Reporting Standards
Libor	London Interbank Offer Rate
NAREIT	National Association of Real Estate Investment Trusts
NAV	Net Asset Value
NCREIF	National Council of Real Estate Investment Fiduciaries
ODCE	Open End Core Diversified Equity
PREA	Pension Real Estate Association
PwC	Price Waterhouse Cooper
REIT	Real Estate Investment Trust
SEC	Securities Exchange Commission

Appendix B

U.S. 3-Month Treasury Bill



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Alexander C. Benoit

EDUCATION

Pennsylvania State University, Smeal College of Business Expected Graduation: Dec. 2017
Bachelor of Science in Finance, Minor in International Business, Spring Abroad 2016 in Florence, Italy

- **Honors:** Dean's List (seven consecutive semesters), Provost Award Scholarship, Honors in Finance

Schreyer Honors College Spring 2015 – Present

- Faculty-selected into an intensive track within the Finance major that provides an accelerated education.
- Researching and writing a thesis related to real estate debt valuation.

WORK EXPERIENCE

American International Group, Inc. **New York, NY**
Enterprise Risk Management Analyst May 2017 – Aug. 2017
-Spearheaded the aggregation of documents for the Federal Reserve Bank of New York's review of AIG's Counterparty Credit and provided updates to senior leadership.
-Developed an internal model to forecast potential covenant breaches on over $9 billion of real estate assets.
-Utilized a variety of data sources to analyze developing global economic news' impact on the portfolio.

Chatham Financial **Kennett Square, PA**
Valuation Analyst May 2016 – Aug. 2016
-Created a database of over 400 potential clients that could be sorted using a dynamic ranking system.
-Assisted in building loan valuation models for large real estate fund managers.
-Received over 50 hours of derivative training including multiple workshops with senior management.

Julex Capital Management **Boston, MA**
Rotational Analyst May 2015 – July 2015
-Worked independently and efficiently to make up to 85 calls a day to potential and current clients.
-Provided supporting research for allocation decisions made for the $500 million ETF portfolio.
-Recommended the implementation of Salesforce and led the integration into business operations.

IMA, Inc. **Worcester, MA**
Rotational Insurance Intern May 2014 – Aug. 2014
-Worked closely with CFO to analyze the company's financial performance and identify cost savings.
-Outsourced over 1,100 personal insurance lines to improve efficiency and increase profitability.

LEADERSHIP EXPERIENCE

Lambda Chi Alpha International Fraternity **State College, PA**
Vice President and Executive Board Member Nov. 2014 – Nov. 2015
-Collaborated with the board to make the allocation decisions for the $300,000 fraternity budget.
-Organized the execution of several 150+ person events and negotiated contracts with local businesses.
-Handled judiciary actions for the fraternity and improved quality of membership.

Penn State Asset Management Group **State College, PA**
Lead Analyst in Real Estate and REIT Division Dec. 2014 – Dec. 2015
-Helped educate members on real estate and REIT valuation techniques and metrics.
-Analyzed a variety of growth and dividend-yielding stocks for potential investment opportunity.

INTERESTS

• Reading • Backpacking • Snowboarding • Technology • Data Visualization