

Risk Management of Commercial Real Estate Loans at Banks

by

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Abstract

According to the Federal Reserve, banks hold about 40% of the commercial real estate debt outstanding in the market. Because real estate continues to grow in preeminence as banks and the competition heightens in the lending market, the risk that banks take on has become an increasingly important topic of interest. This paper addresses risk management of commercial real estate loans at banks. As a significant cornerstone of our financial system and a major player in the commercial real estate lending market, the paper lays out the current state of the market, risks that the banks will face from these loans, typical risk management practices, and the specific metrics that banks utilize. Next, the paper dives into the topic of stress testing, one of the most commonly implemented risk management practices. To support these assertions and illustrate these calculations in action, the paper includes a quantitative application in which loans are simulated as a portfolio of “bank loans” undergoing aggregate economic and idiosyncratic stressors. Through a quantitative application, the paper is able to evidence the importance of diversification of risk management practices and the importance of the integration of risk management within its lending practices.

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Risk Management of Commercial Real Estate Loans at Banks

Introduction

Warren Buffet once said, "... risk comes from not knowing what you're doing."¹ The ubiquity of commercial real estate makes the issue of risk management of commercial real estate loans important to society. Commercial real estate has different risk factors than that of other loans that banks extend, so the banks must properly assess the risks of their commercial real estate loans. Many small banks failed during the financial crisis because they did not understand the risk that they had undertaken. Because banks are in the business of risk intermediation, proper due diligence is essential to maintain the banking industry's strength.²

This paper will analyze the risk management practices of commercial real estate loans with the goal to suggest improvements in current practice. As evidenced by the regulatory agencies' guidance documents, banks must assume a more active role in management of the risk of their commercial real estate loan portfolios. The lack of proper risk management procedures caused many banks to fail during the Great Recession due to the high concentration of poorly underwritten loans without proper risk management procedures.³ To this day, commercial real estate remains one of the largest loan categories for smaller and mid-sized banks.⁴ Yet, commercial real estate loan stress testing remains challenging and the framework is elusive in terms of properly delineating the risks posed.

This paper will study current risk management and Federal Reserve procedures as they pertain to stress testing. Beginning with the increasing relevance of commercial real estate, the paper then transitions to banks' role within commercial real estate lending. After analysis of

¹ Morgan Stanley Real Estate Investing Research Team (2015).

² Buehler, Freeman and Hulme (2008), pg. 4.

³ Office of Comptroller of Currency (2013), pg. 64.

⁴ Integrated Banking Information System (OCC).

banks' position within the industry, the various risks of commercial real estate loans are discussed. An analysis of stress testing follows. The paper then progresses to the existence of hidden risks and the presence, or lack thereof, of regulation and the role of regulators. From these problems, commercial real estate- specific loan metrics are analyzed followed by some additional metrics and calculations. The paper then undergoes analysis of its quantitative application to demonstrate these calculations in practice. To conclude, the paper makes recommendations for the future landscape of commercial real estate risk management. Ultimately, this paper's objective is to draw broader conclusions on current practices and how best to safeguard banks from the risks of commercial real estate.

Why Commercial Real Estate Loans?

As a critical real asset that enables, facilitates and drives businesses, commercial real estate is a major industry that many closely consider and observe. In the 1980s, overbuilding and excessive construction lending contributed to the banking crises. Many of the phenomena of the 1980s crisis could arguably be recurring today,⁵ yet the banking system seems unaware of these concerning trends. commercial real estate markets are cyclical,⁶ and they are more volatile than other loans.⁷ Though we operate in a boom and bust cycle, there are better ways to manage the risks that banks undertake as evidenced by the repetition of weak underwriting standards in the "Great Recession." Though some of these practices may have improved, the underlying risk has remained intact due to the heightened competition within the market.⁸ Recently, concentrations in real estate loans increased in tandem with the diminishing of underwriting standards.⁹

⁵ The FDIC has published a book entitled *An Examination of the Banking Crises of the 1980s and Early 1990s* as an effort to help the financial system learn from its mistakes. Federal Deposit Insurance Commission (2000).

⁶ Eliasov, Härle and Schifter (2009).

⁷ Igan and Pinhiero (2009), pg. 6.

⁸ Federal Deposit Insurance Commission (2000), pg. 154.

⁹ Office of Comptroller of Currency (2013), pg. 4.

Commercial banks have accumulated rising commercial real estate concentrations.¹⁰ The concentration guidelines and construction lending limits continue to shape the regulatory agencies' recommendations and guidelines.

The OCC defines a commercial real estate loan as a loan "... where the cash flow from the real estate collateral is the primary source of repayment rather than loans to a borrower where real estate is a secondary source of repayment or is taken as collateral through an abundance of caution."¹¹ Because commercial real estate is highly volatile and susceptible to market shifts,¹² additional precaution and careful management is required to protect the bank.

Increasing Renown of the Real Estate Industry

Recently, real estate has gained prominence for its importance and has been a hot button issue in the press. Historically, the real estate industry was lumped into the financial sector Global Industry Classification Standard (GICS)¹³ code. The markets recently recognized the importance of the role that real estate plays within the economy on a broader scale.¹⁴ Real estate now has its own GICS classification industry code that recognizes the growth of the industry. Because sector classifiers are industry standards, this recent addition speaks to the differentiation of the industry and the requirement to consider its risks differently. This introduction of market-wide recognition of the industry proves that real estate risk is not homogenous to other loan types, so banks must modify their procedures and considerations in accordance with these varying risks.

¹⁰ Office of Comptroller of Currency (2013), pg. 8.

¹¹ Department of the Treasury (2006), pg. 74582.

¹² Office of Comptroller of Currency (2013), pg. 2.

¹³ GICS, or Global Industry Classification Standard as designed by S&P and MSCI to be used as an industry standard for the financial industry in 1999. MSCI (2008).

¹⁴ MSCI and S&P (2015).

Types of Commercial Real Estate Loans

Construction Loans.

Because of the various inputs and factors directly associated with construction, there is additional risk inherent in the loan due to the absence of collateral to protect the bank in the event of borrower default. Following the financial crisis, regulators recognized the riskiness of construction because the origination of these acquisition and construction loans leads to added risk from the missing collateral that existing properties necessarily have. Historically, the fee income that construction loans had generated aided many banks in times of struggle.¹⁵ Along the same lines, banks tended to evaluate loans with less stringent guidelines to sustain the cash flows of fee income, rather than an accurate and true assessment of the borrower's ability to pay and qualification of the to-be-constructed asset in order to bolster their income artificially.¹⁶ Construction loans are usually reliant upon successful completion of the building,¹⁷ so the bank's capital is more at risk because the collateral does not possess a true value that the bank can secure in the market. The collateral in these loans is raw land.¹⁸

Due to this heightened concern, regulators implemented High Volatility Commercial Real Estate (HVCRE) as a measure to try to monitor and mandate the capital necessary to support the bank.¹⁹ Beyond the uncertainty, there are risks associated with the construction process such as budgeting and unforeseen costs.²⁰ Due to the unique underwriting standards whereby construction loans are underwritten without amortization of principal or standardized interest expense, a certain level of expertise and industry knowledge is required to properly

¹⁵ Federal Deposit Insurance Commission (2000), Vol. 1, pg. 154.

¹⁶ Federal Deposit Insurance Commission (2000), Vol. 1, pg.155.

¹⁷ Johnson, Sheely, Fitzgerald, and Foster (2007).

¹⁸ Felton and Nichols.

¹⁹ Tryon (2015).

²⁰ Office of Comptroller of Currency (2013), pg. 3.

underwrite an acquisition, development and construction loan.²¹ Furthermore, construction loans are dependent on the borrower's reputation and tenacity to project guidelines. Lenders only assess the traits of the project and the borrower's ability to stick to project guidelines because there is no collateral to serve as recourse for the loan.²² Ultimately, the discussion of commercial real estate loans requires a clearly outlined discrepancy between non-recourse construction loans, which are riskier, and the somewhat less risky income-producing property mortgages.

Income-Producing Property Loans.

Banks also extend loans to finance already-existing, income-producing commercial properties. Though there is still risk associated with the borrower and property, these risks are idiosyncratic. The bank can diversify away some of this risk through diversification within its portfolio because each commercial real estate asset is unique in its location and features.²³ Banks can perform due diligence to assess the risks that they are taking on. Furthermore, the bank backs these loans with the collateral of the property underlying the loan, such that it can seize the asset in the event of default. Nevertheless, the bank must still perform due diligence procedures on rent roll so that the bank is assured that they can recover the value of the loan. However, the value of the collateral is usually not the full recovery value of the asset due to the bank's desire to quickly liquidate.²⁴ Banks will secure financing for many properties regardless of their stage of development, even stabilization.²⁵

²¹ Office of Comptroller of Currency (2013), pg. 16.

²² Please see **Appendix 1** for the types of loans that banks will typically extend for construction in terms of Acquisition, Development and Construction (ADC) financing. Office of Comptroller of Currency (2013), pg. 16-19.

²³ MSCI (2015), pg. 13.

²⁴ Halaj (2017) pg. 151.

²⁵ Please see **Appendix 2** for the stages of development.

Typical Terms

Commercial mortgages tend to amortize on a 30-year schedule, if at all, much like their residential counterparts, however these loans have a much smaller life than their respective amortization period, typically about 10 years.²⁶ Because most commercial mortgages are partially amortizing or are interest only, the loans tend to have large balloon payments at maturity. As loans intended for business owners, the borrower is responsible for paying the balloon payment at the end of the life of the loan. Borrowers can refinance by taking out another loan for the balance of the balloon payment. Refinancing requires the originator to assess the borrower and underwrite the loan, confident that the borrower will repay the loan or refinance at maturity while properly covering debt its new debt service on the loan.²⁷ The borrower's original lender does not have to refinance the loan. The refinancing can be underwritten by another bank so long as the borrower can meet the principal repayment as well as the final interest payment. Alternatively, the borrower can simply repay the loan balance at maturity. Often, this is the case because the loans are non-amortizing and will be interest-only for the life of the loan, the borrower will be responsible for the principal payment in full at maturity.

Additionally, most commercial real estate loans tend to follow a similar cycle due to the typical covenants of lockouts and prepayment penalties. Most commercial real estate loans have a lockout period whereby the borrower cannot prepay the loan; this stipulation will assist the bank in managing maturity for asset-liability matching. Because most commercial real estate loans are interest-only, the borrower is only responsible for the interest payments, unable to prepay principal due to lockout provisions within the contract. Following the lockout period may be required to exercise a loan covenant in order to "prepay." Among these options to prepay, the

²⁶ Mortgage Bankers' Association (2016). "Sources," pg. 5.

²⁷ Mortgage Bankers' Association (2016) "Sources," pg. 4.

most common prepayment penalties are defeasance²⁸ and yield maintenance.²⁹ Defeasance is a process whereby the borrower is required to match the upcoming cash flows with Treasuries (or some other safe liquid asset), rather than return cash to the lender.³⁰ Borrowers that really want to prepay will elect this option so that they are no longer liable for the payments of the loan, despite the higher charge (especially in the current low rate environment).³¹ On the other hand, lenders will add a yield maintenance covenant for their own benefit to ensure that they are able to receive an identical yield as if the borrower did not prepay. Because lenders are left vulnerable in the event that the borrower decides to prepay after the lockout period, these loan covenants are common in commercial real estate loans.³² Nevertheless, the commercial real estate loan market will likely dictate the benefits and drawbacks of these terms of commercial real estate loans.

Current Commercial Real Estate Environment³³

There is nearly three trillion dollars of commercial mortgage debt outstanding, and banks hold 40% of these loans (as of December 31, 2016).³⁴ Commercial real estate loans have been increasing in volume following the “Great Recession” and have regained momentum. A large part of this involves banks expanding their holdings. Despite a drop-off in commercial mortgage originations, banks have been able to maintain their portion of the loan volume throughout that decade.³⁵ Though the increase in bank holdings of commercial real estate loans does not alone

²⁸ Defeasance, a frequent loan covenant for prepayment penalties, requires that the borrower must purchase Treasuries to match the cash flows that are still required of the loan. Often, in the case of securitization, this process generates even safer cash flows because the established credit is typically then that of the U.S. government, not the borrower anymore. Investopedia. “Defeasance.”

²⁹ Yield maintenance is a prepayment penalty that mandates that the borrower must pay the difference between current market rates and the rate at the time of loan origination. This process acts as a protection to the bank who may no longer be able to source a deal of the same sum within the time that the borrower prepays at the prevailing market rate of the time. Stammers (2017).

³⁰ Petosa, Bertino and Weber.

³¹ Campbell and Walsh (2008).

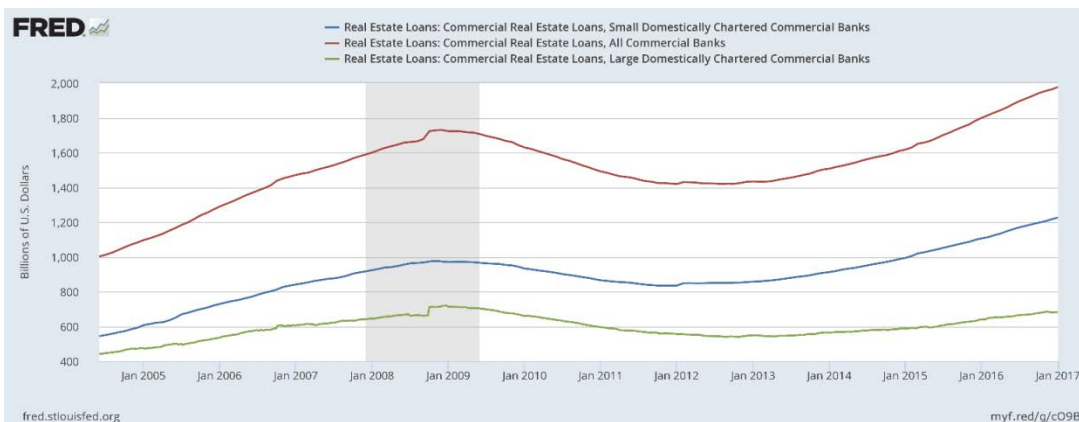
³² Silpe (2012).

³³ Federal Reserve Bank of St. Louis (2017).

³⁴ Mortgage Bankers’ Association (2016). “Commercial/Multifamily.”

³⁵ Friend, Glenos and Nichols (2013), pg. 1.

prove the growth of the industry, there are other metrics to prove that commercial mortgages are a growing business. In fact, there is evidence to support a trend that banks will begin to increase their commercial real estate loan holdings when other banks also decide to grow their commercial real estate loan portfolio, in line with “herd mentality.”³⁶



Deterioration of Underwriting Standards

The industry, banks and non-banks alike, has been substantially loosening its criteria for underwriting following a period of harsh and strict regulation.³⁷ When assessing loans, the underwriting process is intended to reveal weaknesses and underlying risks. Leading up to the financial crisis, however, lenders extended many loans that should not have been underwritten. When the economy persistently performs well, lenders disregard their underwriting and risk management procedures to originate loans that violate their standards and policies. Regulators have evidence that the banks have weakened their underwriting standards.³⁸ Though there are many possible causes or underlying explanations for the loosening of underwriting standards, possible factors include the competitive environment, the relationship between the lender and borrower (which likely leads to underwriting of less secure loans),³⁹ or market influences like the

³⁶ Wilcox (2012), pg. 16.

³⁷ Wilcox (2012), pg. 47.

³⁸ Board of Governors, FDIC and OCC (2012), pg. 1.

³⁹ Banks are less likely to reject clients that they have a pre-existing relationship. Ostromogolsky (2016), pg. 4.

increasing valuations of collateral.⁴⁰ The market will likely rectify these poor underwriting standards with higher default rates. Arguably, the “wall of maturities” is the materialization of these poor standards whereby uncertainty heightens the likelihood of default due to the relaxation of commonly held standards to maintain bank profitability.

Impending “Wall of Maturities”

Due to poor origination and underwriting standards, many of the commercial mortgage-backed securities (CMBS) that originated during the financial crisis are now maturing in 2016-2017. With these vintages of commercial real estate loans leading up to the crisis finally coming due, the “wall of maturities” is currently nearing the end of rapidly lapsing maturities. Because many lenders originated more loans than they should have in the bubbling period of 2006-2007, the status of many of these loans originated through 2007 raises some doubt.⁴¹ Because real estate was performing well, the banks originated more loans, stretching their underwriting standards. As a result, many of these commercial real estate loans were delinquent or defaulted at maturity. These delinquencies have increased attention on bank lending procedures due to the prior decade’s weak underwriting standards. Furthermore, these weak underwriting criteria led the regulating agencies to revamp CMBS, a popular securitization product.

The current CMBS market has slowed down tremendously since the financial crisis. Securitization has long-served as a financial process that allowed banks to originate the loans, package them into asset-backed securities and sell them to outside investors. Though the packaging and selling of risk did contribute in part to the most recent financial crisis, banks will undoubtedly continue the securitization process as they operate in the business of managing and

⁴⁰ Wilcox (2012), pg. 57.

⁴¹ Liu (2017).

allocating risk.⁴² CMBS has permitted banks to originate loans without requiring that the institution retain any of the risk associated with these loans, so securitization was an extremely attractive option where the bank could divide the risk and distribute to investors based on its desired risk-return profile.⁴³ Securitization still remains a favored method of many banks due to the ability to offload the credit risk despite the new regulatory stipulation that bank must now retain part of the capital stack on balance sheet.

Impact of Risk Retention

Through implementation of Dodd-Frank, regulators introduced and recently implemented risk retention as a new regulatory obstacle to securitize a CMBS deal. Recently, as of December 24, banks that underwrite a CMBS deal are required to retain 5% of the pool's risk.⁴⁴ By requiring that banks retain a portion of the risk, regulators were hoping to reign in some of the risk that these banks were infusing into the market due to the off-balance sheet nature of securitizing mortgages off balance sheet to better align incentives by forcing banks to maintain some "skin in the game." Though Dodd Frank initiated the rule in 2016, the market was unsure of the acceptance of such a regulation. The "B piece buyer"⁴⁵ that underwrites the junior tranches, can hold the five percent stake on behalf of the bank.⁴⁶ The recent addition of "risk retention" has nevertheless made securitizing commercial mortgage backed securities less

⁴² Buehler, Freeman and Hulme (2008). "The New Arsenal of Risk Management," pg. 5.

⁴³ Buehler, Freeman and Hulme (2008). "The Risk Revolution," pg. 4.

⁴⁴ Faulkner (2015).

⁴⁵ "B-Piece Buyers" are typically hedge funds or private institutional funds that will participate in CMBS securitization by purchasing the most junior tranches of the capital stack in an effort to get the highest return in exchange for the most risk assumed. These buyers are highly involved in the process because they are exposed to the first losses following the equity tranche, so they often re-underwrite the deal, only accepting the loan risks that they are interested in. Schwartz (2017).

⁴⁶ Mortgage Bankers' Association (2016), pg. 8.

appealing due to the added burden of risk retention⁴⁷ in securitized deals (making it more difficult to underwrite the junior tranches). The regulators added risk retention to require “skin in the game,” tighten underwriting standards and require additional disclosure of information related to overburden originators and deter securitization.

Nevertheless, originators have been securitizing deals with the added regulatory mandate of 5% risk retention for approximately four months, though the regulation is still in its nascent stages with four months of viability. Risk retention infuses additional uncertainty into the commercial real estate loan market, which has created greater regulatory attention and awareness in the market. Therefore, the market is already aware of the need to monitor risks of commercial real estate loans, making the loans that banks do retain on balance sheet even more critical to monitor and manage.

The Role of Banks in Commercial Real Estate Lending

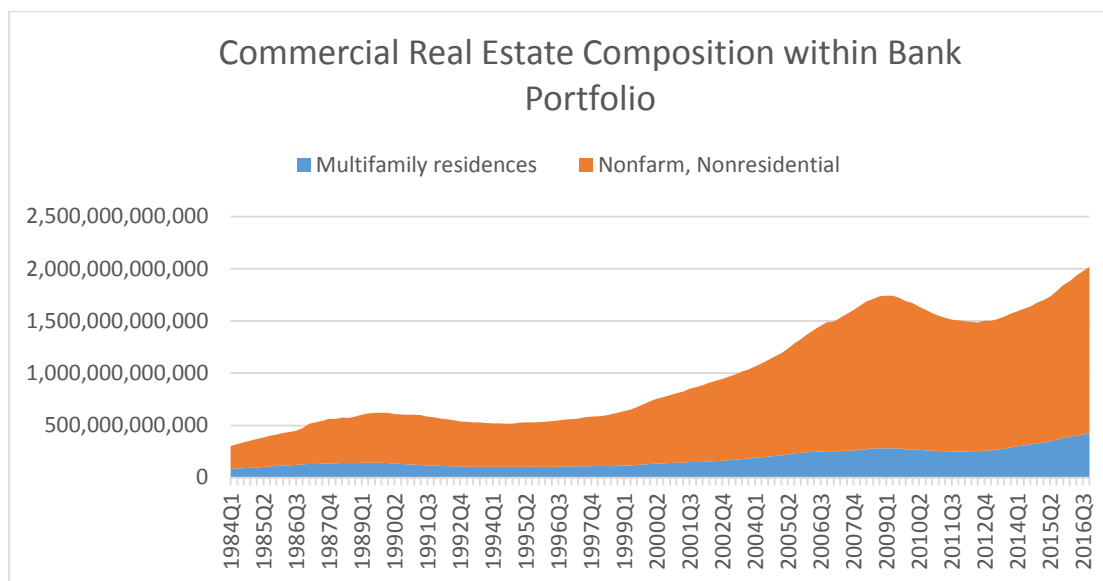
As a major activity of banks, commercial real estate lending has contributed to the rising relevance of proper management of these commercial real estate loans. The bank is responsible for closely monitoring and underwriting their loans updating the conditions as they see fit within the market.⁸ Banks require proper due diligence procedures to prevent unmanageable concentrations. Properly assessing the loan requires careful consideration of the purpose of the loan, the likelihood of repayment and adequate collateral in place.⁴⁸ Many banks, especially smaller banks, underwrite a substantial amount of commercial real estate loans. commercial real estate remains one of the largest loan categories for mid-size banks.⁴⁹ As a result, proper risk

⁴⁷ Dodd Frank Act mandated a new rule that requires banks to retain 5% of their securitized deal horizontally (same class), vertically (5% of all classes) or some combination of the two. The horizontal 5% tranche could be held by the B Piece Buyer. Mattson-Teig (2016). Yablonski, Joshua and Mike Shaffer (2016).

⁴⁸ Federal Reserve Bank of Atlanta.

⁴⁹ DiSalvo and Johnston (2016). “The Growing Trend of CRE Lending.” *Federal Reserve Bank of Philadelphia. Research Department.*

management procedures should become a matter of economic concern to ensure that these banks can sustain unfavorable economic circumstances.



The Importance of Commercial Real Estate Lending for Community Banks⁵⁰

Commercial banks hold about 40% of commercial mortgages.⁵¹ The 300% minimum capital standard causes difficulty for smaller banks due to the large portion of their business that banks generate through commercial lending.⁵² Community banks have always maintained a focus or specialization; it is possible that this specialization is derived from proximity.⁵³ Nevertheless, this proximity is not the only reason for the focus on commercial real estate loans. In fact, 70% of all community bank loans were secured by real estate which has only grown since 1984 to be 78% by 2011.⁵⁴ Small and mid-sized banks rely on relationship lending, which

⁵⁰ The FDIC defines “community banks” as smaller, largely non-public banks that focus on lending and providing banking services to their local neighborhood. These banks are measured by size, in terms of assets. FDIC (2012).

⁵¹ Mortgage Bankers’ Association (2016). “Commercial/Multifamily.”

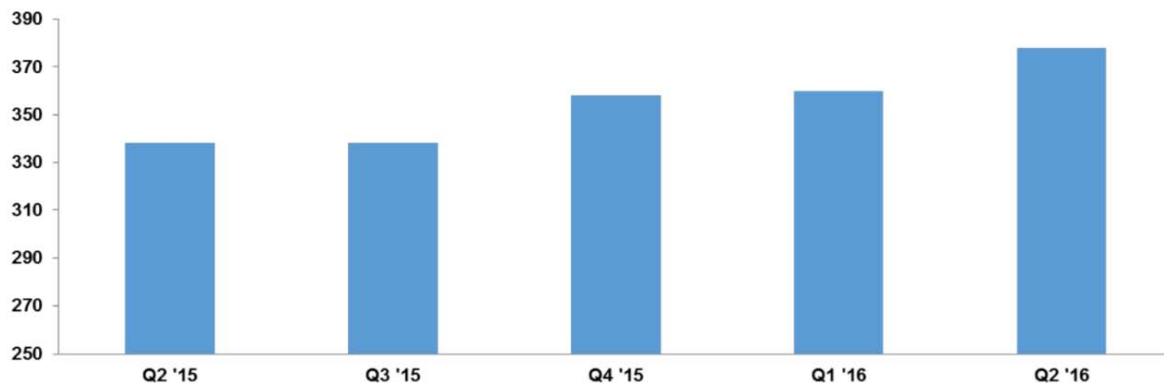
⁵² Biery, Mary Ellen (2014).

⁵³ In this case, “proximity” is hard to decipher and disentangle because in more rural areas of the country, as opposed to self-selection, these banks may be selected because they are the only bank local to the area. “Lender-Borrower Relationships and Loan Origination Costs” Ostromogolsky, pg.15.

⁵⁴ FDIC Community Banking Study – December 2012, “Chapter 5: ‘Comparative Performance of Community Bank Lending Specialty Groups” pg. 5-1.

enables a great deal of commercial real estate lending in their local market.⁵⁵ Small banks are able to leverage their proximity and network in many smaller commercial real estate origination deals. Previously, however, these banks lacked the competency to analyze and understand their risks in the 1990s.⁵⁶ By and large, these institutions lacked a clear understanding of all the risks that they undertook, most specifically in real estate.⁵⁷ Smaller banks originated more loans than they should have given the underlying risk. Because of the volatility of the real estate market, banks' concentration of commercial real estate loans, smaller commercial banks are highly concentrated in commercial real estate lending. Due to the reliance on relationships with commercial real estate lending, smaller commercial banks conduct commercial real estate lending.

Figure 9: Number of Banks With 25 Percent of Capital in CRE and Three-Year Growth Rate of 50 Percent or More



Source: Integrated Banking Information System (OCC)

Note: Data are quarterly from the second quarter of 2015 through the second quarter of 2016.

Furthermore, a shift toward certain asset types could lead to higher risk,⁵⁸ so smaller banks often skew their loan portfolios by increasing their commercial real estate lending

⁵⁵ Long (2013). Looking at the size of banks, typical convention dictates the three sizes as follows for banks:

Community Bank: < \$10B

Mid-Size Commercial Bank: Between \$10B and \$50B

Large Commercial Bank: >\$100B.

⁵⁶ Buehler, Freeman and Hulme, (2008), pg. 4.

⁵⁷ Smaller commercial banks did not even have basic risk management tools like VAR in place. Buehler, Andrew Freeman and Hulme.

⁵⁸ Department of Treasury (2006).

concentration. Because a concentration in commercial real estate loans could lead to overreliance on real estate as an asset class, the risk management of commercial real estate loans becomes more important due to the increased likelihood of larger losses. Evidence of these large losses is portrayed by past substantial commercial real estate concentrations is shown above.⁵⁹ These large concentrations of commercial real estate loans add additional dimensions of risk make proper risk management of the loans particularly pertinent. The expertise in real estate extends beyond lending and includes the pragmatism and conservatism utilized when assigning assumptions and riskiness. The high volatility and focus on real estate lending enhances the importance of risk management to protect the bank.

Lenders must be equipped with real estate market knowledge to originate and underwrite the loan. A large part of the underwriting process relies upon market-specific information to get the most realistic market price and projected cash flows. Due to the required expertise, non-major metropolitan areas would otherwise be at a severe disadvantage if not for relationship lending and intimate knowledge that comes with proximity for local banks. Because smaller banks engage in “relationship lending,” the bank and loan officers are able to get to know the borrower. This deep understanding of the local market paired with familiarity is a large part of why smaller commercial banks tend to issue a great deal of commercial real estate loans. This unique advantage and the quantity of real estate outside of major metropolitan areas creates a large market and explains why commercial real estate lending is predominantly done by small and mid-sized banks. Furthermore, a shift toward certain asset types could lead to higher risk,⁶⁰ so smaller banks often skew their loan portfolios by increasing their commercial real estate lending concentration. Additionally, smaller banks are not as closely targeted or regulated, they

⁵⁹ Department of Treasury (2006), pg. 74581.

⁶⁰ Department of Treasury (2006), pg. 74581.

are able to extend loans in-line with their own standards. As a result, the vacillating nature of the requirements creates flexibility to extend more loans to borrowers,⁶¹ but also a higher likelihood to poor risk management and risky underwriting. Because a concentration in commercial real estate loans could lead to overreliance on real estate as an asset class, the risk management of commercial real estate loans becomes more important due to the increased likelihood of larger losses. Evidence of these large losses is portrayed by past substantial commercial real estate concentrations.⁶² Large concentrations add additional dimensions of risk, so the high volatility in real estate lending only enhances the importance of risk management to protect the bank.

Because banks play such a vital role in the economy and financing of real estate, the regulatory agencies have placed increased emphasis on proper regulation and oversight of the risk that banks face. However, there has been limited regulation apart from the supervisory guidance, “Concentrations in Real Estate Lending, Sound Risk Management Practices,” issued by the OCC, Federal Reserve and FDIC in 2006.⁶³ Since this 2006 regulation, concentrations in commercial real estate loans have continued increasing and have nearly returned to 2009 levels, which affects financial stability. Regulation has tightened banks’ ability to extend loans. Because real estate loans possess unique attributes that vary from that of other types of loans that banks may extend, regulatory agencies monitor and supervise concentration levels. As depicted below,⁶⁴ there has been an increase at banks in commercial real estate lending.

⁶¹ Rob Nichols (2017).

⁶² Department of Treasury (2006), pg. 74581

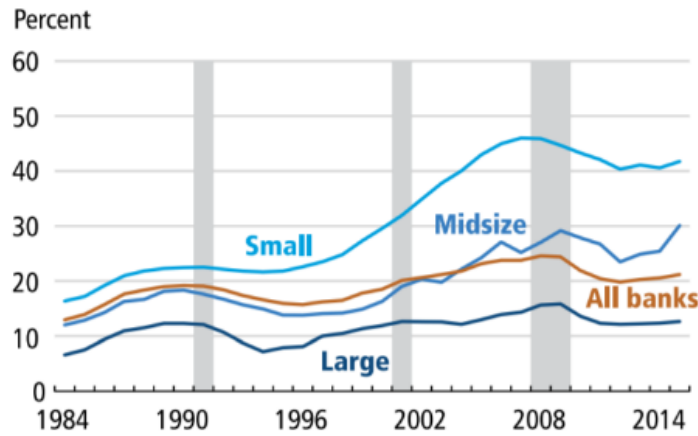
⁶³ 2006 OCC Guidance laid out the increasing importance of regulation and various supervisory restrictions on concentrations to ensure that banks are able to match their risk management practices to their sophistication and concentration of CRE loans. Department of Treasury (2006).

⁶⁴ Office of Comptroller of Currency (2016). “Semiannual Risk Perspective.”

FIGURE 6

Small Banks Rely Heavily on CRE

CRE loans as percent of total bank loans.



Source: Federal Reserve Flow of Funds.

Note: Data are from the Federal Financial Institutions Examination Council Call Reports, which include commercial mortgages and multifamily and CLD loans.

The OCC has released supervisory guidelines for banks to monitor their commercial real estate concentrations.⁶⁵ Though these actions are a step toward greater monitoring, regulators still require that the banks properly assess their own risk. Increased real estate concentration causes smaller banks to take on more risk due to a commercial real estate loan concentration.⁶⁶ Because smaller banks' assets are more concentrated in commercial real estate concentrations, they have a weakened ability to withstand major market fluctuations.⁶⁷ Starting in 2016, the OCC increased supervision to include examinations of commercial real estate if the bank has a high concentration.⁶⁸ Recognizing the rapid expansion of commercial real estate loan holdings as a potential indicator of risky lending, the regulators have alerted banks of their plans to ramp up

⁶⁵ These guidelines outline supervisory criteria upon which the "risk-based capital" metric should be based. Office of Comptroller of Currency (2016). "Semiannual Risk Perspective."

⁶⁶ Looking at the graph, the trend indicates that the amount of CRE loan concentration is at least 30%, not an insignificant sum.

⁶⁷ Department of Treasury (2006), pg. 74581.

⁶⁸ Office of Comptroller of Currency (2016) "Semiannual Risk Perspective."

oversight. Potentially hindered by the added capital and regulatory requirements, banks have become very highly regulated as a stronghold in the financial system.

The Looming Effect of Shadow Banking

With these additional regulatory restrictions to extend loans, many borrowers have had to move toward shadow banking institutions to borrow money at the desired cost of borrowing. There has been an increased pressure on banks regarding their extension of loans through metrics like “risk-based capital”⁶⁹ and concentration.⁷⁰ Because banks are so highly regulated, non-bank financial institutions have stepped in to fill the gap of lending without the required capital ratio or strict underwriting standards. Without any regulatory reporting agency monitoring every transaction, non-banks are more nimble and able to fill the gap in the market due to the tight standards imposed on banks.⁷¹

Shadow banking institutions include private equity funds, hedge funds, life insurance companies and others. However, these financial institutions are not the only players involved. Following implementation of EB-5, foreign money has been entering into commercial real estate industry. In the case of institutional money, they are able to charge higher rates and willing to take a larger risk on a transactional basis.⁷² Whereas, life insurers will elect to only originate low risk deals.⁷³ Because these institutions have the financial capacity to seek out deals, they have been able to step in to fill the liquidity need within the market given their freedom to lend.⁷⁴

Banks have lost a lot of their momentum in the space due to heightened regulation and

⁶⁹“Risk-based capital” is a regulatory metric that was created to have a guaranteed capital buffer to protect the bank’s assets. Basel III recently enhanced the regulatory capital and modified the weighting of assets in terms of the total risk based capital. Sageworks (2015).

⁷⁰ The Office of Comptroller defines a “concentration” in real estate as “...loans secured by construction and other land loans, residential multifamily properties and nonfarm nonresidential properties.” Department of Treasury (2006).

⁷¹ Balbi (2016).

⁷² Mulholland and Perlberg (2016).

⁷³ Watugala, Wang, Chen, Cai and Bao (2014), pg. 12.

⁷⁴ Schwarcz (2012).

intensified competition. The competitive landscape has become a pricing war whereby competitors try to price out their peers, which has eliminated most of the banks' profit margins.⁷⁵ Furthermore, banks have lost ten percent of the commercial mortgage market in the last twenty years to the emergence of non-bank investors.⁷⁶ With banks' margins already narrowed, it is not surprising that the non-bank financial institutions were able to fill the need within the financial services industry.

One regulation that has helped facilitate this shift is the implementation of High Volatility commercial real estate (HVCRE), which has made it substantially more expensive for a bank to issue construction financing due to the 150% capital reserve requirement.⁷⁷ HVCRE requires higher capital reserves to support a construction loan to deter "unique risks for which the agencies believe banking organizations should hold additional capital."⁷⁸ Though the regulation does permit exceptions, the regulators thus continue to allow access to banks for construction financing. Additionally, the size of these loans varies from that of banks depending upon the size of the bank.⁷⁹

While non-bank financial institutions are nimbler in their approach and ability to extend loans to developers, this flexibility does not in and of itself require shadow banks to extend loans. Additionally, non-bank lenders are unable to extend loans at the same rates as banks, so this liquidity remains inaccessible to many developers and businesses due to the higher rates.⁸⁰ Like banks, the institution will only extend loans that are prudently underwritten, though they are designated to be more speculative in nature than a typical bank loan.⁸¹ Proper due diligence is

⁷⁵ Eliasov, Härle and Schifter. (2009).

⁷⁶ Wilcox (2012).

⁷⁷ Tran (2016).

⁷⁸ Rubin, Giczewski and Olson (2013), pg. 2.

⁷⁹ Felton and Nichols, pg. 1.

⁸⁰ Rubin, Giczewski and Olson (2013), pg. 3.

⁸¹ Mulholland and Perlberg (2016).

non-negotiable in the case of commercial real estate loans due the undertaken risk.

Notwithstanding, shadow banking provides a limited role in the realm of commercial real estate lending. This phenomenon could be an overcorrection in the market for poor underwriting standards for which non-bank lenders readily adopted.

This emergence of shadow banking could be resulting from the associated risk level of particularly risky lending projects. Banks have and will continue to serve as the most secure form of financing with the most attractive rates. Even with the enhanced regulatory requirements, most lenders still prefer to secure financing with a bank. As a result, non-bank lenders could be temporarily involved in this make-shift structure to overcorrect for risky lending practices. To understand these practices, the risks that the bank is facing must be assessed more closely.

Commercial Real Estate Loan Risks

Risk is widely and broadly defined, so the definition of risk is ever-evolving. Risk can be captured as anything that adversely affects the bank.⁸² DeLisle defines risk as the difference between expectation and reality capturing both the pessimistic and the optimistic outlooks.⁸³ Risk is widely applied, however what sets real estate apart is the additional wrinkle of the asset is the property itself.⁸⁴ Because real estate is a tangible, physical real asset class, there are additional risk factors to assess when looking at the industry. Within the Comptroller's Handbook for commercial real estate Lending, risk is defined from a regulatory or supervisory perspective as "...the potential that events, expected or unexpected, will have an adverse effect on a bank's earnings, capital or franchise or enterprise value."⁸⁵ However, commercial real estate loans introduce unique risks that differ from other loans typically issued by banks.

⁸² Holberton, Hallissey, Chang and Chirgwin (2012), pg. 2.

⁸³ DeLisle, pg. 97.

⁸⁴ DeLisle, pg. 99.

⁸⁵ Office of Comptroller of Currency (2013), pg. 3.

The nature of the underlying commercial real estate asset introduces a considerable amount of risk for a commercial real estate loan. The bank heavily relies upon the underlying cash flows of the property, not physically the asset itself. Commercial real estate loans are loans whose primary source of repayment is through the cash flow of the real estate collateral, excluding owner-occupied real estate.⁸⁶ During the financial crisis, many developers defaulted on their loans because commercial real estate loans comprised a large proportion of banks' assets without the proper risk protocols in place.⁸⁷ Because the property price shock was an aggregate economic shock that affected real estate markets worldwide, these banks failed due to the failure to adequately stress test and manage risks. The dramatic decline in property prices of the underlying assets minimized the collateral value in foreclosure proceedings which the banks failed to consider in underwriting. Banks should already be aware of the impact of shocks to their portfolio as well as knowing the amount of tail risk to arm itself in the event of default or economy-wide property price decline. Knowing the risks that the bank is facing is a critical first step to managing them.

Risk management includes assessment of credit risk, asset risk, market risk, liquidity risk, operational risk and business risk.⁸⁸ In the case of commercial real estate loans, asset risk is a major factor because commercial real estate loans are collateralized by underlying real estate property.⁸⁹ Market risk is also a major consideration because of the importance of interest rates in the loan. Because of the cyclical nature of the real estate market, the risk and exposure of a particular property at any stage of development process cannot be assessed properly given the

⁸⁶ Wells.

⁸⁷ Office of Comptroller of Currency (2011), pg. 5

⁸⁸ "DFAST Overview."

⁸⁹ "DFAST Overview."

dynamic market, lack of organization and asymmetric information between involved parties.⁹⁰

Though these measures cannot be quantified accurately, they must be assessed and analyzed by the banks. Among the most important of these risks is interest rate risk.

Interest Rate Risk

Because commercial mortgages are typically interest only and have prepayment penalties, interest rate exposure is unavoidable. The volatility of interest rates and lockout period of commercial real estate loans create a position of vulnerability to interest rate exposure. Banks are unable to modify or update these rates that they lock in at origination. So, this risk depends on the concentration of the commercial real estate loan portfolio.⁹¹ Though the fluctuation of interest rates is a concern to lenders, commercial real estate loans are typically originated on a floating rate basis to reduce the bank's total exposure to interest rate risk.⁹² Notwithstanding, interest rate risk is a key determinant in whether the loan is repaid, prepaid or becomes delinquent. Because of the prepayment penalties and the lockout periods, the banks will concentrate their risk to the time of the repayment of principal. Because this repayment period is narrowed by loan covenants, the majority of the risk that the bank faces lies at the time of maturity and is independent of the risk related to debt service during the life of the loan. The repayment of principal at maturity is reliant upon the current rate environment and commercial real estate market.

Commercial Real Estate Price Risk

An additional risk dimension at the time of maturity is that of the valuation of the property. The pricing process of real estate is unique due to the long holding period and private

⁹⁰ Federal Deposit Insurance Commission (2000). Vol. 1, pg. 138.

⁹¹ Office of Comptroller of Currency (2013), Pg. 4.

⁹² Anderson (2016).

ownership of real estate. As a long-term, durable asset, the assessment of value of real estate must be treated and assessed on a different scale. Banks must adjust their processes to account for discrepancies that systemically vary from highly liquid, tradable securities. The regulatory agencies also recognize the importance of market factors such as capitalization rates⁹³ (which directly relates to market prices), vacancy rates and rental rates.⁹⁴ Low capitalization rates are likely due to the intense competition within the industry and rapidly rising property values, which has piqued regulators' interest. The capitalization rate must be analyzed because the income-generating capabilities of properties do not sufficiently cover values of real estate.⁹⁵ The property market is among the most important risk factors that banks consider, as indicated by ING's survey of European banks.⁹⁶ The loan is primarily focused on income generation, which is largely derived in relation to property values.

Illiquidity Risk

As an illiquid asset, real estate transactions do not occur at a high frequency, so pricing is not consistent nor linear. Because real estate is a durable asset and not liquid enough to be priced on a regular basis, prices are not determined at the same frequency as other securities. Direct properties trade very infrequently on the market, so the private and opaque markets make it increasingly difficult to properly price.⁹⁷ Furthermore, real estate is occupied while generating income, so valuation cannot occur with the same frequency. Properties are typically appraised to determine market prices and assess the "fair market value," so institutions have an estimable figure for the valuation of the property. However, this process often generates misleading

⁹³ Within the real estate industry, the capitalization rate, or "cap rate" is defined as the net operating income of a property divided by its property price.

⁹⁴ Department of the Treasury (2006), pg. 745820.

⁹⁵ Minneapolis Federal Reserve Bank

⁹⁶ Berkhout, Kil, Post and Schrader (2014).

⁹⁷ MSCI (2015), pg. 4.

information related to the market's valuation of the property. Appraisals are inaccurate because the buildings are transacted far less frequently than the appraisals are conducted which leads to greater uncertainty related to the true property value.

In addition to properties' illiquidity, appraisal values deviate from "true" market values because of other introduced biases. For one thing, appraisers often overestimate the value of the buildings. These appraisals bias the valuation toward an overpriced, artificial stability related to "smoothing."⁹⁸ As a result, the artificially high value will tack leading to unrealistic valuations of properties. Furthermore, appraisals excessively rely on "comparable properties" to estimate the value of the property.⁹⁹ However, this "comparability," that is often utilized in relative valuation, is ill conceived for commercial real estate because of the heterogeneity of commercial properties, catered to property tenants. Additionally, these valuations of the property are often backward looking, which does not aid the bank in assessing its value position.¹⁰⁰

The illiquidity of properties is not limited to the physical asset, but the lack of liquidation also extends to the loans. In order to remedy this illiquidity, banks must have strategies in place to liquidate. These options in terms of how to best allocate include loan sales or securitization. Nevertheless, these markets are not liquid. In fact, the times for which the banks are most likely to require contingency plans are the times that market illiquidity poses a major concentration risk to the bank. As noted by the FDIC, the condition of the market dramatically changes the demand, modifying pricing.¹⁰¹ Therefore, the lack of access to readily available funds is a major source of

⁹⁸ Müller and Lausberg (2010).

⁹⁹ Müller and Lausberg (2010), pg. 12.

¹⁰⁰ Reid (2015), pg. 4.

¹⁰¹ Johnson, Sheely, Fitzgerald and Schrader (2007).

risk for banks. In fact, most models will exclude liquidity risk through the assumption that the commercial real estate are strictly illiquid.¹⁰²

Model Risk

However, the accessibility of capital is often a function of the bank's ability to model, so the bank could be relying on a model with inaccurate assumptions. The bank faces model risk due to their strict reliance on their models to account for the commercial real estate loans on their books. Because the banks will often model with a particular price in mind for the future, it is risky when the true property price deviates from that which the bank derived for its assets. As a result, the bank is exposed to the risk that the price embedded within the model is incorrect. Beyond that, the modeling risk is derived from the assumptions made because a model is only as powerful as its assumptions.¹⁰³ Failure to evidence or support assumptions and stress portfolios is likely to generate a much larger risk exposure.¹⁰⁴ Due to the intricacies of modeling, strict reliance on these models introduces additional risk that the model fails to operate as originally intended.

Cash Flow Risk

Another risk that affects commercial banks is cash flow risk, which has contributed to many bank failures.¹⁰⁵ Though banks are able to offload a large portion of commercial real estate risk through the process of securitization, banks retain some commercial real estate risk on the balance sheet.¹⁰⁶ These loans are inherently riskier than other loans that commercial banks issue due to their size, idiosyncratic nature and unusual cash flow cycle, making it harder for the bank

¹⁰² "Stress Testing CRE Portfolios." *Radley & Associates*, pg. 4.

¹⁰³ "Stress Testing CRE Portfolios." *Radley & Associates*, pg. 12.

¹⁰⁴ Rossi (2010), pg. 46.

¹⁰⁵ Antoniadis (2015), pg. 2.

¹⁰⁶ Antoniadis (2015), pg. 2.

to diversify away the risk.¹⁰⁷ The structure of the market and banking industry is ill equipped for the added stress that is generated from its leverage and commercial real estate risk.¹⁰⁸ An additional aspect of the cash flows is the basis that the borrower places in the property because of its role in driving project performance.¹⁰⁹

Concentration Risk

Regulatory agencies require that banks actively manage their real estate concentrations to ensure that they are able to adequately maintain their real estate concentration. Beyond the management of the individual loans that the bank extends, regulators mandate management of the portfolio of all loans.¹¹⁰ Though the regulatory agencies recognize and account for the varying degrees of concentration and sophistication of lending underwriting and risk management, the regulations are set forth to ensure that these banking institutions are able to properly report and oversee lending activity as outlined by the bank's board of directors.¹¹¹ Due to the varying levels of risk and exposure within different portfolios, the stress testing procedures will dramatically differ. Nevertheless, the regulation is designed such that the institution is sufficiently armed with the information necessary to make educated decisions as well as properly monitor commercial real estate loan concentrations and the plans in place in the event of a stress or disruption to its commercial real estate loan concentrations.¹¹² The regulatory agencies stipulate that a concentration greater than "...100 percent or more of the institution's total capital or total commercial real estate loans as defined in the Guidance represent 300 percent or more of the institution's commercial real estate loan portfolio has increased 50 percent or more during the

¹⁰⁷ Antoniadis (2015), pg. 8.

¹⁰⁸ Antoniadis (2015), pg. 18.

¹⁰⁹ Morgan Stanley Real Estate Investing Research Team (2015).

¹¹⁰ Department of the Treasury (2006), pg. 74583.

¹¹¹ Department of the Treasury (2006), pg. 74583.

¹¹² Department of the Treasury (2006), pg. 74583.

prior 36 months,”¹¹³ must be supervised under the guidance of the agencies. The agencies outline that sudden spikes in concentrations should be further investigated. Because of the dynamic nature of the real estate industry, banks must carefully review dramatic fluctuations to ensure that they are adequately managing risk. By ramping up real estate concentrations quickly, it is likely that the institution is ill-prepared to undertake the real-estate risks that constitute its largely concentrated real estate loan portfolio. Henceforth, banks must maintain concentration management practices to properly maintain the risk profile of loans. Notwithstanding proper underwriting and due diligence, the mere existence of a concentration suffices to act as a risk agent for which the accumulation ultimately contributes to losses due to overexposure to market fluctuations.¹¹⁴ Market liquidity directly affects the riskiness of the loans, so the selected method must be able to endure fluctuations in the market.

Additionally, risk management contingency plans must manage the bank’s concentration levels irrespective of market conditions so that the bank manages its risk levels despite the divergent character of commercial real estate loans. Banks accumulate concentrations through an increase in lending to a particular geographic area due to the increase in the unpredictability of commercial real estate loans.¹¹⁵ Smaller, regional banks are more highly susceptible to geographic concentrations because of the close proximity of the loans within their commercial real estate portfolio. Though a concentration of merely commercial real estate loans suffices as a concentration, banks face dramatic risks if they fail to diversify their loan portfolios. A concentration in particular asset type is likely to require careful monitoring and planning of risk management procedures because of the enhanced vulnerability.¹¹⁶ In fact, the behavior of

¹¹³ Department of the Treasury (2006), pg. 74584.

¹¹⁴ Office of Comptroller of Currency (2011), pg. 14-15.

¹¹⁵ Office of Comptroller of Currency (2011), pg. 7.

¹¹⁶ Minneapolis Federal Reserve Bank. “CRE Concentrations and Risk Management.

concentration formation aligns with that of asset bubble formation, exposing a great weakness and need for greater awareness.¹¹⁷

Even with strong underwriting standards, the bank is exposed to the vulnerabilities of its specific pool of loans. Furthermore, concentration risk, in terms of its official definition, does not comprise all commercial real estate concentration risk. The supervisory guidelines fail to consider owner-occupied real estate as a risk.¹¹⁸ However, these loans are risky and an aspect of the banks' commercial real estate concentration nevertheless. Therefore, the bank is at risk for substantial losses due to the co-movement of these loans that can simultaneously decline in value in a poor market.¹¹⁹

Portfolio Risk

As also evidenced by the concentration risk, banks should not exclusively analyze a deal through the perspective of individual loans. The level and nature of the concentration largely dictates the sophistication and required real estate knowledge to properly manage the portfolio of loans.¹²⁰ Ultimately, the concern for banks is at the portfolio level due to the institution's overall exposure. Because of the fluctuation of the real estate market, the bank is highly susceptible to market fluctuations.¹²¹ Banks should use market standards as a benchmark in terms of underwriting, loan loss reserving, and maintaining securitization standards.¹²² Even with strictly maintained underwriting standards, individual loans ultimately comprise the bank's portfolio. Banks must manage risk at the portfolio to ensure that the bank has the wherewithal to maintain its current concentration in the event of a market-wide liquidity crisis.¹²³ As a result, portfolio

¹¹⁷ Rossi (2010), pg. 49.

¹¹⁸ Office of Comptroller of Currency (2013), p. 57.

¹¹⁹ Office of Comptroller of Currency (2013), p. 64.

¹²⁰ Department of the Treasury (2006), pg. 74586.

¹²¹ Department of the Treasury (2006), pg. 74583.

¹²² Department of the Treasury (2006), pg. 74583.

¹²³ Office of Comptroller of Currency (2013), pg. 8.

concentrations must be actively managed to mitigate risk posed by portfolios utilizing strategies like loan participations,¹²⁴ whole loan sales¹²⁵ and securitizations in order to maintain concentration levels.¹²⁶ Furthermore, reassessment of contingency plans is imperative to ensure that the option remains viable irrespective of volatility of the markets.¹²⁷ Due to the nature of commercial real estate loans, concentrations pose “structural risk” through added fiscal burden.¹²⁸ Because the loans themselves each have idiosyncratic qualities, many banks must still manage their portfolios on an individual loan basis in addition to at the aggregate portfolio level. Across all real estate activities, the industry has encountered many challenges as they relate to portfolio risk exposure.¹²⁹

Credit Risk

Because of the cash flows’ sole reliance on the real estate asset, the maintenance of credit is imperative to the success of the portfolio and the associated risk management. The embedded market risk of any commercial real estate loan is underlying as credit risk because the “...risk posed by changing market conditions is magnified to the extent that portfolio concentrations of commercial real estate are present.”¹³⁰ Credit risk is critical for commercial real estate loans due to the over-valuation of properties and the poor underwriting standards that banks have recently adopted.¹³¹ The amount of credit accessible to borrowers within the market dramatically

¹²⁴ Loan participations are agreements that transfers ownership interests from the original entity to others. Typically, the seller of ownership interests will retain only a partial interest yet retain all documentation and servicing rights. These risky behaviors hurt many banks when the portfolios underwent the downturn. Poprik (2013).

¹²⁵ Whole loan sales occur when the bank sells the entire loan from their portfolio. Motivation for this behavior is usually to diversify or utilize a bank’s competitive advantage. Demsetz (2000).

¹²⁶ Department of the Treasury (2006), pg. 74586.

¹²⁷ Department of the Treasury (2006), pg. 74586.

¹²⁸ Berkhout, Kil, Post and Schrader (2014).

¹²⁹ Lausberg (2004), pg. 11.

¹³⁰ Office of Comptroller of Currency (2013), pg. 4.

¹³¹ Berner (2016).

influences the price due to major fluctuations.¹³² As one would expect, the financial markets are highly correlated, so the loans' credit risk is highly affected by market risk factors like interest rates, rents and vacancy rates.¹³³ Market fluctuations directly affect loans' credit risks that are shaped through leases and rent agreements or the structuring of loans. However, the effect is not symmetrical in bullish and bearish markets. In recessionary phases of the economic cycle, credit factors and market rates deteriorate simultaneously;¹³⁴ this phenomenon is referred to as negative convexity.¹³⁵ As an industry, commercial real estate hardly generates profits such that any positive gain is the only cushion for the impending and unlimited downside potential in the next downturn of the cycle. This trend was observed in commercial real estate specialty banks whereby the FDIC observed that real estate specialized banks perform marginally better in good times, whereas they perform substantially worse in times of crisis.¹³⁶ Mortgages are negatively convex due to their relationship with the economy whereby defaults and vacancies rise when the economy is in a downturn.¹³⁷ Availability of funds dictates pricing on the market that influences the commercial real estate loan market.

Property-Specific Risks

As a tangible fixed asset, commercial real estate loans also have property-specific risks in addition to loan-related risks. Therefore, the type of commercial real estate will influence loan characteristics and risk factors to consider.¹³⁸ The geography and quality of the property

¹³² Federal Deposit Insurance Commission (2000). Vol. 1, pg. 139.

¹³³ "Stress Testing CRE Portfolios." *Radley & Associates*, pg. 3.

¹³⁴ Igan and Pinheiro (2009), pg. 6.

¹³⁵ Negative convexity is the phenomenon whereby a financial security has a limited upside but unlimited downside risk. Alliance Bernstein (2011).

¹³⁶ FDIC Community Banking Study – December 2012, "Chapter 5 – Comparative Performance of Community Bank Lending Specialty Groups," pg. 5-22.

¹³⁷ *Radley & Associates*, pg. 4.

¹³⁸ Rubin, Giczewski and Olson (2013), pg. 3.

influence the risk exposure.¹³⁹ The quality of the real estate is reliant upon the risk exposure as derived from the purpose of the project. The industry classifications for these “risk classifications are core, value-added and opportunistic. Depending on the investment required, stability of the asset and the risk tolerance on a project basis dictate the type of real estate. There are five major types of commercial real estate: multifamily, office, retail, industrial and hotel.

Multifamily.

Though all real estate contributes to society, multifamily real estate fills an important role for society. In terms of real estate, housing is an inelastic good that fulfills the need for shelter for many urban residents. Because of the inelastic demand for housing, multifamily is the least risky due to the inelasticity of the real estate and, in turn the consistency of the cash flows.¹⁴⁰ Though turnover can be high, management of the building must be able to adjust the space as necessary to accommodate tenants.¹⁴¹ The multifamily industry exhibits unique behavior as a result of its relationship to housing and the involvement of the government-sponsored entities (GSE) - Fannie Mae (FNMA), Freddie Mac (FRMC) and Ginnie Mae (GNMA). Because the federal government would like to protect the mortgages, the GSEs guarantee the default risk of the mortgages undergo securitization through the GSEs.¹⁴² As of 12/31/2016, the GSEs held about 46% of multifamily debt outstanding, meanwhile banks hold approximately 34% of the outstanding multifamily mortgages. Currently, multifamily mortgages are primarily operated by the GSEs with an eight percent drop in the value held within their portfolios followed by banks

¹³⁹ Morgan Stanley Real Estate Investing Research Team (2015), pg. 5.

¹⁴⁰ Office of Comptroller of Currency (2013), pg. 44

¹⁴¹ Office of Comptroller of Currency (2013), pg. 45

¹⁴² Sources of Commercial and Multifamily Mortgage Financing in 2016 (MBA), pg. 9

which saw a 2% increase in value in Q4 2016.¹⁴³ As a property type, multifamily is able to marry features of the residential market and the commercial market.

Industrial.

Industrial properties are considered risky due to their overreliance on tenants and the personalization of the space to accommodate the tenant.¹⁴⁴ Unlike office space that can be reasonably easily repurposed, industrial properties are harder to customize. A large portion of the risk undertaken by lenders relies upon the features of the warehouse: proximity, ceiling height and amount of space.¹⁴⁵

Office.

As a type of property, office is considered riskier than multifamily because of the greater customization of properties because office properties tend to have fewer tenants who rent or occupy large spaces within office buildings for longer time frames. So, the underwriting process is reliant upon many aspects including the credit-worthiness of its tenants and the ability to perform tenant improvements and the property repositioning if a tenant leaves.¹⁴⁶ Typically, tenants are responsible for all expenses related to their property because these leases are originated and extended on a gross basis.¹⁴⁷

Retail.

Retail is a unique property type in that the landlord and tenant often establish a percentage rent lease in which the tenant pays a base level rent and delivers a percentage of sales above a threshold.¹⁴⁸ Unlike office properties, retail properties are leased on a net basis in which

¹⁴³ Multifamily/Commercial Mortgages, Q4 2016

¹⁴⁴ Office of Comptroller of Currency (2013), pg. 44

¹⁴⁵ Office of Comptroller of Currency (2013), pg. 43

¹⁴⁶ Comptrollers' Handbook, pg. 41

¹⁴⁷ Comptrollers' Handbook, pg. 41

¹⁴⁸ Comptrollers' Handbook, pg. 42

landlords assume the costs of maintenance (and tenants pay a fee for common area maintenance).¹⁴⁹ An additional aspect of retail real estate is the co-tenancy clause in which a tenant can tie itself to an anchor tenant and can reserve its right to terminate its lease in the case of the elimination of a major tenant.¹⁵⁰ In light of recent economic trends in terms of the track record of retail, these loan covenants could be detrimental to a mall as many major big box retailers are closing many of their locations.¹⁵¹ Heavily reliant upon tenants to meet sales objectives, banks must carefully assess borrowers' tenants, desired plan and local demographics to help ensure the property's success.

Hotel

Of the real estate types, hotel real estate is among the riskiest due to its elasticity and the shortness of the "lease terms," typically on a nightly basis. Though there is business need, a large portion of hotel cash flows heavily rely upon leisure travelers whom fill the need and weekends that business travelers are unable to fulfill. Because leisure travel is elastic, there is a great deal of volatility infused into the industry and dependent upon the status of the economy.¹⁵² The brand, location and features of the hotel are crucial to the underwriting procedure.¹⁵³ Hotels have highly volatile cash flows due to the limited predictability to analyze the loans, so the bank should underwrite the loan with the respective risk and unpredictability.

Other Risk Factors

Because there are more facets to the risk of commercial real estate than that of a typical financial instrument, the analysis of commercial real estate loans varies from typical financial risks. In addition to the internal and external factors that banks face, there are also the added

¹⁴⁹ Comptrollers' Handbook, pg. 42

¹⁵⁰ Comptrollers' Handbook, pg. 42

¹⁵¹ Trepp

¹⁵² Comptrollers' Handbook, pg. 45

¹⁵³ Comptrollers' Handbook, pg. 45

dimensions of the property, market, regulators and the real estate enterprise overall.¹⁵⁴ Property level risks range from the physical elements of the property to the financing and income collection of rent payments. The value of the property is dependent on the solvency value of the property itself and the market. Assessing enterprise level risks requires careful examination of the property including the expenses associated with the property directly.¹⁵⁵ Management risk is often overlooked, yet banks must underwrite the loan and its borrower's ability to meet its debt service.¹⁵⁶ Because there may be guarantors and collateral embedded within the deal, the bank must institute criteria to originate the loan with covenants that ensures the borrower maintains credit.¹⁵⁷ The loan itself carries risk, one of which is the leverage of the borrower, the more borrowed, the greater the risk of default due to overexposure.¹⁵⁸ commercial real estate loans have the added dimension of asset-level risks in addition to those of the loan as a financial instrument.

As a public good, real estate is closely monitored by the government to ensure fairness and proper city planning. The commercial real estate itself is under a great deal of scrutiny as well as financing. The government introduces additional risk dimensions through regulation, zoning and tax laws.¹⁵⁹ On the other hand, banks face the risk of fraud in relation to commercial real estate loans. During the 1980s, the appraisal process was rampant with fraud through the inaccurate inflation of property values and the unethical hiring and working practices maintained within the industry.¹⁶⁰ To begin with, appraisals require honesty and independence to successfully act as the neutral third party, so this comprised neutrality worsens the problem.

¹⁵⁴ DeLisle "Ch. 4," pg. 103g

¹⁵⁵ DeLisle, pg. 104.

¹⁵⁶ Berkhout, Kil, Post and Schrader (2014).

¹⁵⁷ Office of Comptroller of Currency (2013), pg. 56.

¹⁵⁸ Morgan Stanley Real Estate Investing Research Team (2015), pg. 3.

¹⁵⁹ Federal Deposit Insurance Commission (2000). Vol. 1, pg. 139.

¹⁶⁰ Federal Deposit Insurance Commission (2000). Vol. 1, pg. 157.

Because real estate is such an integral aspect of the economy, the mortgage financing industry adds additional complexities beyond that of merely the loan as a financial instrument.

Meanwhile, banks are engaging in their own fraud in which they mask additional reserves for their loans as interest reserves, whereby they are actually eating into their own profits in order to hide a loan's delinquency.¹⁶¹

Risk Management

Elroy Dimson stated that risk "...means more things can happen than will happen."¹⁶²

Risk can be defined by expected losses or the likelihood of inadequate capital. Ultimately, risk has a time-specific element that banks must try to model to better position itself for its unanticipated elements.¹⁶³

Volatility

When trying to quantify the risk that a bank faces, a logical first step would be to assess the past pricing fluctuations as a predictor for future shocks. For highly liquid and tradable securities, volatility is frequently utilized as a risk measure. For volatility, returns must be normally distributed in order to utilize volatility as a risk measure, which is not the case in terms of real estate wherein the returns are not normally distributed.¹⁶⁴ Notwithstanding, property prices are able to normalize when provided sufficient time for individual property's cash flows to achieve a normal distribution.¹⁶⁵ In fact, the returns in real estate are classified as heteroskedastic¹⁶⁶ because returns are adjusted over time; the fluctuation in value of real estate properties creates a fluctuating valuation whereby the true value is often indiscriminate from the

¹⁶¹ Thomson (2008), pg. 1.

¹⁶² Saft (2014).

¹⁶³ Keppler (1990).

¹⁶⁴ Müller and Lausberg (2010), pg. 9.

¹⁶⁵ Müller and Lausberg (2010), pg. 11.

¹⁶⁶ Heteroskedasticity refers to the uncertainty of standard deviation and volatility in the future. Because future real estate prices are uncertain, the distribution is identified as "heteroskedastic." Investopedia.

appraised value.¹⁶⁷ Predictive models will often understate the true amount of risk related to real estate.¹⁶⁸ Furthermore, the appraised value is often biased in favor of consistency, the “smoothing factor.” Internal appraisers will commit to the external appraiser’s estimation of value rather than trying to capture the property’s true value.¹⁶⁹ Unlike REITs and other highly liquid securities that are traded and valued by the market constantly, real estate is a long-term asset that is rarely transacted, so volatility loses its utility.

Notwithstanding the flaws of the metric of volatility, reliance on merely one risk metric is ill-advised and fails to accurately depict the risk that the financial institution is facing. Because risk is uniquely defined, one sole metric for a financial institution will inevitably lead to gaps in analysis.¹⁷⁰ When considering real estate, volatility is an inappropriate measurement due to its widespread application to upside and downside exposure.¹⁷¹ Real estate risk is not monotonic¹⁷² in that real estate prices fluctuate dramatically, so volatility is unable to capture the broadly defined risk that lacks defined and normally distributed data.¹⁷³

Value-at-Risk (VAR)

Because volatility lacks direct applicability to illiquid real estate assets, the value-at-risk method of risk management may prove a more viable risk metric. VAR is commonly used at banks to assess possible losses, therefore only capturing the downside of risk for banks.¹⁷⁴

Through estimation of the downside, the probability of loss is calculated for a specific time

¹⁶⁷ Müller and Lausberg (2010), pg. 11

¹⁶⁸ DiBartolomeo, Gold, Baldwin and Belev (2005).

¹⁶⁹ Müller and Lausberg (2010), pg. 12.

¹⁷⁰ Müller and Lausberg (2010), pg. 23.

¹⁷¹ Müller and Lausberg (2010), pg. 24..

¹⁷² Monotonicity is defined as higher losses for all risk factors therefore implies that the portfolio with higher losses than the other. Symes.

¹⁷³ Müller and Lausberg (2010), pg. 22.

¹⁷⁴ Damodaran 1-2

period within a particular confidence interval.¹⁷⁵ Though VAR can successfully identify the maximum amount of loss given a specific probability distribution, it often fails to identify dangerous risks that the bank faces.¹⁷⁶ Unfortunately, the metric is manipulated and only considers possible losses for a specific set of circumstances. As a result, a more comprehensive assessment is necessary so that the bank is equipped for various market conditions.¹⁷⁷

As a risk management tool, VAR is a backward-looking metric that focuses on the past, not an effective risk management tool in isolation. Understanding the bank's approach to risk management is crucial to accurately assess and manage risk though some may argue that a holistic risk profile of the bank would be overwhelming or distracting.¹⁷⁸ Successful stress test planning involves risk and governance and establishment of risk.¹⁷⁹ By ensuring proper allocation of capital with the lending officers and Board, the institution has a more solid understanding of its mission.¹⁸⁰ Once the risk is quantified, the bank must undergo stress testing to assess the portfolio during a downturn.

Other

Beyond calculation of the risk metrics, there are many other aspects of risk management, some of which are prescribed by the regulatory agencies, whereas others are conducted industry-wide or are merely bank specific. As was written in the Morgan Stanley research report, "... there are no bulletproof deals, and we can only try to insulate ourselves from "known unknowns"

¹⁷⁵ Damodaran 2

¹⁷⁶ Damodaran .

¹⁷⁷ Damodaran .

¹⁷⁸ Damodaran.

¹⁷⁹ Blokhin, Keever and Scheinbart (2016),

¹⁸⁰ Blokhin, Keever and Scheinbart (2016),

to a certain degree. The exogenous¹⁸¹ variables, “the unknown unknowns” are impossible to foresee.”¹⁸²

Stress Testing

As John Dugan of the Office of the Comptroller of Currency said regarding stress testing of commercial real estate lending, “The potential for rapid deterioration in this business is simply too great not to conduct such testing on an ongoing basis.” Banking has and will continue to become more regulated.¹⁸³ Stress testing is performed to assess the bank’s ability to withstand and model severely adverse credit conditions as a result of abrupt economic changes.¹⁸⁴ The large banks are required under the Dodd Frank Act to comply with the specific hypothetical scenarios of Dodd Frank Act Stress Testing (DFAST) to ensure that the bank had sufficient capital in such scenarios.¹⁸⁵ Due to the specificity and uniqueness of such situations, the capital levels and risk appetite of community banks does not align with that of the DFAST scenarios and testing.¹⁸⁶ As a risk management tool, stress testing is required to be conducted by the Federal Reserve for banks with more than \$50B.¹⁸⁷ The scenarios are laid out for the banks such that the Federal Reserve is confident that the bank could endure the shocks outlined as “adverse” and “severely adverse” as well as the base case (which simply serves as the starting point). The goal of stress testing is to identify correlated pools of loans and seeing effect of stressors to ensure the

¹⁸¹ The report defines “exogenous variables” as qualitative variables that affect but are not necessarily directly linked to the portfolio. Essentially, items to review that lack an inextricable link. Morgan Stanley Real Estate Investing Research Team (2015).

¹⁸² Morgan Stanley Real Estate Investing Research Team (2015).

¹⁸³ McCoy.

¹⁸⁴ Yeager (2015), pg. 3.

¹⁸⁵ Yeager (2015), pg. 9.

¹⁸⁶ Yeager (2015), pg. 9.

¹⁸⁷ Blokhin, Keever and Scheinbart (2016).

bank's survival.¹⁸⁸ If too large a concentration accumulates, the bank could suffer a depletion of capital due to poorly underwritten loans.¹⁸⁹

The Current Dodd-Frank Stress Testing Framework

The current stress testing framework provides a detailed look for the risks that banks are exposed to within these extreme scenarios. Please see **Appendix 3** to see the current standards as they were provided to the banks required to conduct DFAST in 2016. These standards lay out hypothetical scenarios to ensure that the banks can in fact endure that could be forced to endure in the case of market failures for both "adverse" and "severely adverse."¹⁹⁰

Though the Fed does not conduct these stress tests for smaller banks, banks up to \$10B are required to conduct their own stress tests.¹⁹¹ Community banks (with less than \$10B) are not mandated by law but are encouraged to closely examine commercial real estate loan concentrations.¹⁹² Because there is no required testing for smaller banks, the procedures in place are less known and standardized.¹⁹³ This lack of regulation is in large part the reason that the financial crisis led to many bank failures.

Due to the complex nature of the banking industry that is undergoing stress tests, the method selected is reliant upon the organizational structure, strategy, risk and accessible capital of the bank.¹⁹⁴ There are two types of stress tests: sensitivity tests and scenario tests.¹⁹⁵

Sensitivity tests are performed to see how a change in a variable affects the portfolio.¹⁹⁶

¹⁸⁸ Office of Comptroller of Currency (2011), pg. 11.

¹⁸⁹ Office of Comptroller of Currency (2011), pg. 12

¹⁹⁰ In the case of "Severely Adverse" for CRE scenarios, the vacancy rates and other metrics are similar in scale to that of the "Great Recession pg. 9

¹⁹¹ Blokhin, Keever and Scheinbart (2016).

¹⁹² Blokhin, Keever and Scheinbart (2016).

¹⁹³ Please see **Appendix 4** for the standards and key risk factors that the Federal Reserve recommends.

¹⁹⁴ Blokhin, Keever and Scheinbart (2016).

¹⁹⁵ Blokhin, Keever and Scheinbart (2016).

¹⁹⁶ Blokhin, Keever and Scheinbart (2016).

Meanwhile, scenario tests reflect the impact of a significant economic event.¹⁹⁷ A further level of analysis is whether the stress test adopts a ‘top down’ or ‘bottom up’ approach. The Fed adopts a top down approach wherein they analyze the major risks facing the bank and fully utilize external data and create the scenarios: baseline, adverse, severely adverse to ensure that the bank is equipped for substantial economic events.¹⁹⁸

In fact, the Federal Reserve conducts stress tests to test the bank’s risk policies given various scenarios to run the tests. commercial real estate risk is tested within the Federal Reserve’s stress testing procedures to examine the risks associated with the banks’ commercial real estate loans. The Federal Reserve tests the banks’ future financial health by providing guidelines for metrics that the banks would face in “baseline,” “adverse” and “severely adverse” circumstances.¹⁹⁹ As a regulatory tool, the Federal Reserve is interested in testing the wherewithal that the banks would endure in economic downturns to see if the banks’ risk management practices for riskier assets is adequate to protect the bank. Though the “top-down” approach is crucial to the institution’s risk management policy, the “bottom-up” approach captures the granular loan level data.²⁰⁰ Though stress testing can vary in terms of its applicability, it nevertheless adds value irrespective of the level of testing because stress testing exposes a bank’s vulnerabilities.

Commercial Real Estate Loan Stress Testing

Stress testing is a tool that should be utilized to identify correlated pools and concentrations so that the bank can stress various variables to understand the bank’s true positioning given the exposure. There are varying levels of analysis whereby a bank can test and

¹⁹⁷ Blokhin, Keever and Scheinbart (2016).

¹⁹⁸ Please see **Appendix 3** for the graphs that depict some critical variables for each situation.

¹⁹⁹ Board of Governors of the Federal Reserve System (2016).

²⁰⁰ Blokhin, Keever and Scheinbart (2016).

manage its exposure levels. Beginning in the most narrowly defined “bottom-up” approach, transaction stress testing looks at the individual loss levels of loan and the borrower’s ability to service debt. Banks can elect to run borrower-specific simulations, meanwhile portfolio-level analysis (not currently required) shows a bank’s true exposure.²⁰¹ For a portfolio level analysis, the bank can elect to perform “top-down” or “bottom-up” approach depending on the level of detail.²⁰² For a “bottom-up” portfolio stress test, the results of individual stress tests aggregate for different scenarios.²⁰³ Whereas, “top-down” approaches implement the loans with stress loss rates under different scenarios.²⁰⁴ Other useful stress testing methods are that of enterprise-wide stress testing and reverse stress testing as additional means to assess the portfolio given a particular set of circumstances.²⁰⁵ It seems counterintuitive to assess hypothetical situations at the individual level but only perform sampling at a higher level.

The level of lending at smaller banks is far more involved with the borrower, so regulators should mandate, rather than merely suggest, that these smaller banks conduct portfolio-wide analysis. The regulatory guidance suggests that small banks build out its stress testing capabilities as it grows its commercial real estate capabilities, yet the lack of sophistication in risk management practices is more likely to yield inexperience and poorly risk-focused decisions. The regulators clearly state that “... banks of all sizes will benefit by supplementing stress testing of significant individual loans with portfolio and firm-wide stress

²⁰¹ Office of Comptroller of Currency (2011), pg. 11.

²⁰² Office of Comptroller of Currency (2012).

²⁰³ Office of Comptroller of Currency (2012).

²⁰⁴ Office of Comptroller of Currency (2012).

²⁰⁵ “Enterprise level stress testing” involves running the portfolio of loans through supervisory guideline limits to see the interrelated effect. Meanwhile, “reverse stress testing” assumes severely adverse outcomes to see if the portfolio would be able to survive the adversity. Office of Comptroller of Currency (2012).

testing.”²⁰⁶ Irrespective of the size of the bank, analysis of relevant risk measures is crucial in the assessment of a bank’s portfolio in terms of “stresses” in the market.

When considering stress testing, the accuracy and precision of the model are essential to the usefulness of the procedure. By providing more specific information, the stress test becomes more realistic and applicable to risk management practices such that the results are properly assessed against firm limits.²⁰⁷

Are There Hidden Risks?

Due to the inherent nature of real estate as an asset class, the bank cannot avoid property-specific risks. The identification and acknowledgement of risks is crucial to the bank’s risk management policies. Even the best banks are unable to manage for all risks. In spite of the ability to diversify away idiosyncratic risk, the unpredictability of the market and individual properties exposes system-wide vulnerability that requires excellent risk management policies. The most important component of the program is proper identification of risks because such risks are fatal only when they fail to identify risks.²⁰⁸ Risk management should identify the major risks at the very least so that the entity is well equipped to solve risks exposures. Considering that banks are in the business of intermediating risk, the bank must acknowledge and aim to diversify away idiosyncratic risk exposure. Real estate risk is multifaceted and complex in its accounting for its exposed risk factors.²⁰⁹ Recognizing the inherent risks of commercial real estate, banks must be aware of the risks they face and ensure adequate management of their current risks.

²⁰⁶ Office of Comptroller of Currency (2011), pg. 11.

²⁰⁷ Long (2013). Pg. 7.

²⁰⁸ DeLisle, pg. 105.

²⁰⁹ DeLisle, pg. 101.

Problems within Regulatory Environment

Properly maintained risk management practices and underwriting standards are critical to stability of banks with real estate concentrations. “The sophistication of a bank’s [commercial real estate] risk management processes should be appropriate for the size of the portfolio as well as the level and nature of concentrations and the associated risk to the bank.”²¹⁰ Yet, sophistication, concentration and diversification are critical factors in the assessment of risk that is primarily ignored by the regulators. This assessment does not argue that regulators should mandate reporting structures like DFAST, but the agencies seem to leave the issue of poorly monitored risk management untouched. Failure to acknowledge seems more likely to lead to the redevelopment of risky lending practices like 2007-2008, whereby the banks were ill-equipped for the risk that they assumed. commercial real estate lending has remained a primarily local lending activity, so the small banks will need to continue to conduct risk management practices.

Do Stress Tests Cover Unforeseen Risks Faced by commercial real estate Loans?

Stress testing is a regulatory mandate for the country’s largest banks, but the regulatory agencies lack any mandate for smaller banks. Community banks need stress testing on their more concentrated, riskier commercial real estate portfolios. The most recently issued regulation merely issued guidance, yet the Mortgage Banker Association, a renowned industry group, recognized this as a warning of heightened awareness. Following this guidance, there has been substantially more press, yet this press still tends to focus on larger banks (or the wall of maturities as it pertains to CMBS). The guidance broadly addresses the specificity of stress tests, so testing procedures align with precision and character of their loan portfolio.²¹¹ Yet, the regulation lacks greater detail beyond the effort and acknowledgement to track directly to loan

²¹⁰ Office of Comptroller of Currency (2013), pg. 64.

²¹¹ Department of Treasury (2006), pg. 74587.

type. Thus, the agencies are requesting that the banks match their stress testing and due diligence procedures, however this is problematic and too simplistic in nature. The disclosure states, “For example, well-margined and seasoned performing loans on multifamily housing normally would require significantly less robust stress testing than most acquisition, development and construction loans.”²¹² While such a generality may blanket all banking institutions, the vagueness and subjectivity embedded within the assumptions enables incredibly risky behavior. While many may argue that risk management is truly in the best interest of the institution, one could also argue that an ill-equipped or unfamiliar institution may undergo due diligence in a different manner than that of an experienced institution. While the supervisory limits provide benchmarks for the establishment of a commercial real estate concentration, they are easily avoidable and less likely to detect the smaller institutions that may require greater risk management. In fact, the regulatory guidance explicitly states that the supervisory limitations fail to serve as safe harbors for the institution to successfully evade risk.²¹³

Because of impending concentration risk, banks should conduct stress testing at the individual loan level but also at the portfolio level. Portfolio stress testing’s objective is to assess economic conditions, “... asset quality, earnings and capital, and to identify potential exposures to external events.”²¹⁴ Though it is understandable that smaller banks are unable to run stress testing at the same level as their larger financial institution peers, it is highly problematic that regulators are so willing to create leeway for smaller banks, when in fact these are the institutions that need these regulations the most.

Focus on Larger Banks, What about the Smaller Banks?

²¹² Department of Treasury (2006), pg. 74587.

²¹³ Johnson, Sheely, Fitzgerald and Foster (2007).

²¹⁴ Office of Comptroller of Currency (2013), pg. 66.

The regulators tend to apply a lot of regulation to the larger bank, but these banks are already highly sophisticated. Though the regulation of these large entities is undeniably necessary in the financial system. However, there is evidence that these smaller banks lack the sophistication to analyze their portfolios. So, why would do the regulators not mandate regulatory reporting? Many regulators anticipate that the local banks experiencing hardship as a result of adverse economic trends on concentrated commercial real estate loans.²¹⁵ Furthermore, the regulatory agencies discuss the importance of implementation of stress testing and the proper policies, and they recognize many banks' inability to collect this information.²¹⁶ However, if there is a need for this information, the regulators should require collection or aggregation of this information

Lack of Follow-Through

Though laying out policies is a great step in the right direction, the framework alone will not influence the risk landscape. Many may argue that regulation is unnecessary and counterproductive, but banks themselves are not enforcing their own loan monitoring policies in terms of underwriting and policing their underwritten loans to maintain an understanding of their status.²¹⁷ Instituting these policies without monitoring their progress to maintain their portfolio of interest renders them useless. Notwithstanding the argument that the system will systematically remove the weak ones in the current "survival of the fittest" economic environment, a dearth of follow-through introduces a flawed system of risk management across the economy. In fact, the entire risk function is often separate from the remainder of the team and lacks integration. If risk is not front and center, the exposure of risk is unclear and uncertain.²¹⁸ As an afterthought, risk

²¹⁵ Bhaskar, Gopalan and Kliesen (2010).

²¹⁶ Johnson, Sheely, Fitzgerald and Foster (2007), pg 4.

²¹⁷ Morgan Stanley Real Estate Investing Research Team (2015), pg. 9.

²¹⁸ Morgan Stanley Real Estate Investing Research Team (2015), pg. 9.

quantification and mitigation is ineffective. Throughout the process of the loan portfolio building, risk management should be a top priority, especially considering that banking is the business of intermediating risk.

Limitations of Stress Tests

Regulators are concerned with the amount of risk that banks take on as well as the tenacity of banks' risk management policies. The Federal Reserve and the Office of the Comptroller of Currency release regulations and guidance that banks use to quantify risks. The Federal Reserve uses stress tests to measure the effectiveness of a bank's risk management given its risk exposure. The stress tests simulate the worst-case scenario, "severely adverse," to ensure that that bank can withstand severely strained conditions. If banks can pass the stress tests in all scenarios, the Federal Reserve assesses the durability of the bank's risk management procedures. The Federal Reserve does not perform stress tests to assess all of banks' risks, so many risks remain hidden. Stress testing may be time- and cost-intensive early on, but the extensive modeling and predictive results that these models generate make it a worthwhile and, often, necessary expense.²¹⁹ If properly utilized and integrated, however, stress testing can be a remarkably powerful risk management tool that *all* banks should be utilizing. The value of the stress tests performed is solely and exclusively derived from the assumptions built into the model. As discussed above, model risk is a commonly faced risk in the market, but it is worth noting that historically, there were no benchmarks or indicators of how severe the losses might be. These banks suffered because they were blindsided by the tremendous amount of unprecedented losses.²²⁰ By introducing severely adverse circumstances into the stress testing environment, the

²¹⁹ Mazingo, Papanides, Petrov and Schröck. (2014).

²²⁰ Rossi (2010), pg. 31.

Current regulatory framework does not require stress testing at the community banking level.²²¹ Though understandable that the regulators would not expect that the smaller banks conduct enterprise-wide stress testing procedures, the current regulatory literature seems to eliminate the necessity to conduct stress testing. Despite the benefits of stress testing discussed, the procedures only allude to these benefits in a vague fashion.²²² Many of the issued supervisory guidance statements (including the “Guidance on Concentrations in commercial real estate, Sound Risk Management Practices”²²³) recommend the usage of stress testing, however these policies are never mandated or further specified. Though “... it may be sufficient for such institutions to analyze the portfolio in a simple spreadsheet to simulate base-case and severe stress scenarios,”²²⁴ there is no way to measure the effectiveness of adequate stress testing.²²⁵ The Dodd Frank Act primarily focuses on the larger bank stress testing procedures, meanwhile marginalizing the smaller banks who face greater risk in terms of their commercial real estate loan concentrations.

Metrics that Banks Use to Analyze Loans

When looking at the risks that banks face, the metrics that are utilized to benchmark are critical in proper assessment of the variables. Consideration of the wrong benchmarks or improperly set underwriting standards will dramatically affect the bank’s portfolio lending decisions and risk exposure.²²⁶

Debt Service Coverage Ratio (DSCR)

²²¹Long (2013), pg. 8.

²²² “Community banks may find the implementation of an effective stress-testing process will help the board and senior management better understand the potential impact of adverse scenarios.” Long (2013), pg. 8.

²²³ Department of Treasury (2006).

²²⁴ Department of Treasury (2006). pg. 10.

²²⁵ Long (2013), pg 20.

²²⁶ Rossi (2010), pg. 8.

Banks will look at a borrower's Debt Service Coverage Ratio (DSCR) to determine whether a borrower earns enough income, in this case, rent, to cover the mortgage's debt service. The DSCR is calculated by dividing the Net Operating Income by the Annual Debt Service.²²⁷ The metric assesses a borrower's ability to service its debt.²²⁸ This is a commonly used measure because it assists the bank ascertain that the loan will in fact be repaid as of the time of origination. However, in the case of real estate, there is collateral in the form of the property that is backing the loan. By setting a minimum DSCR, the bank ensures that borrowers can at least service interest on the loan at the time of origination.²²⁹ Because different property types generate different frequencies of cash flows, the type of commercial real estate will dictate the ratio required by the bank to underwrite the loan within its stipulated standard.²³⁰ Because the DSCR is reliant on the incoming cash flows as the income produced by the property to cover debt service, this is an ideal metric for assessing core properties.²³¹

Loan to Value (LTV)

Because the bank typically secures the right to the underlying property, the risk that surrounds the collateral relates to the loan to value (LTV) metric. LTV is calculated by dividing the loan amount by the property value.²³² Because the lender can seize the property to extract value from their borrower in the case of foreclosure, the LTV determines whether the lender can recover the full value of the loan through seizure of the asset. As a result, lenders will place supervisory limits on the LTV when assessing property loans, especially in the case of

²²⁷ Schmidt (2014).

²²⁸ Office of Comptroller of Currency (2013).

²²⁹ Office of Comptroller of Currency (2013), pg. 8.

²³⁰ Office of Comptroller of Currency (2013), pg. 40.

²³¹ As a risk classification, core is a stable asset that generates steady, stable cash flows. This is ideal for a debt service coverage ratio because the majority of money returned is through income as indicated in the ratio. Morgan Stanley Real Estate Investing Research Team (2015), pg. 7.

²³² Schmidt (2014).

construction loans where the property doesn't entirely exist yet.²³³ LTV functions as the most common metric to measure leverage. Unfortunately, using the value leads to the possibility of skewing the data down in the case of rising property prices.²³⁴ However, this issue is easily resolved by using loan to cost as opposed to loan to value to avoid fluctuations in value.²³⁵

SLTV Limits by Loan Category

Loan category	SLTV limit (less than or equal to)
Raw land	65%
Land development or improved lots	75%
Construction	
Commercial, multifamily, ^a and other nonresidential	80%
One- to four-family residential	85%
Improved property—commercial, multifamily, and other nonresidential	85%
Owner-occupied one- to four-family and home equity	90% ^b

^a Multifamily construction includes condominiums and cooperatives.

^b An LTV limit has not been established for permanent mortgage or home equity loans on owner-occupied, one- to four-family residential property; however, for any such loan with an LTV ratio that equals or exceeds 90 percent at origination, the bank should require appropriate credit enhancement in the form of either mortgage insurance or readily marketable collateral.

Banks set guidelines for each type of loan transaction that reflect consideration of SLTV (Supervisory Loan to Value) guidelines.²³⁶ SLTV guidelines are set by supervisory agencies such that the banks have guidance in terms of the expectation and limitation in terms of the amount of risk that these banks are permitted to take on. Though these limits provide some guidelines, these limits are not guaranteeing the soundness of the loans that are individually underwritten loans.²³⁷ These supervisory limits provide the LTV at the time of origination, but the bank must regularly update and calculate the Refresh LTV so that the bank knows that a particular loan is within

²³³ Office of Comptroller of Currency (2013), pg.10.

²³⁴ Morgan Stanley Real Estate Investing Research Team (2015).

²³⁵ Office of Comptroller of Currency (2013).

²³⁶ Office of Comptroller of Currency (2013), pg. 10.

²³⁷ Johnson, Sheeley, Fitzgerald and Foster (2007).

limits or acts in accordance with proper policy. The regulators mandate that no more than 100% of total capital can be in excess of SLTV limits,²³⁸ however this stipulation excludes refresh LTV when the property values fluctuate throughout the life of the loan. Furthermore, the agencies further stipulate that commercial real estate loans (including agriculture, multifamily and non-1 to 4 family homes) cannot exceed 30% of total capital.²³⁹ As a result, the agencies place restrictions on the amount of commercial real estate embedded within banks' portfolios.

Debt Yield

In addition to these two metrics, banks will also assess a borrower's debt yield whereby they can test that the borrower generates enough income to cover the debt in its entirety. The Debt Yield is a metric calculated by dividing the Net Operating Income by the Loan amount.²⁴⁰ Expressed as a percentage, debt yield measures risk without consideration of interest rate, amortization period and capitalization rate such that the lower the percent, the higher the leverage. Because the rates are a major factor in loan underwriting, the debt yield is a useful metric given the dynamic nature of real estate. Assessing the debt yield is important for commercial real estate loans because of the unique payment structure of commercial real estate loans whereby the loans typically amortize over 30 years yet require a balloon payment for all remaining principal at the end of 10 years. Therefore, the accelerated time frame and increased balloon payments introduce risks inherent to commercial real estate loans. As opposed to the debt service coverage ratio which only juxtaposes net operating income with the interest payment, the debt yield serves as a proxy by listing the

In addition to the calculation of loan criteria, a requirement of risk management is the establishment of criteria for the portfolio that sets the minimum and maximum statistics for

²³⁸ U.S. Government Publishing Office. 12 CFR 3.2 (e).

²³⁹ Office of Comptroller of Currency (2013) Pg. 14-15.

²⁴⁰ Schmidt (2014).

various aspects of the portfolio.²⁴¹ For example, regulators set the supervisory limits upon which the banks are supposed to remain.

Metrics that Banks Utilize in Portfolio-Level Analysis

When looking at portfolios of loans, banks analyze metrics like probability of default, loss given default, and exposure at default.²⁴² Because the bank assumes risk for each loan that it originates, the bank must also assess the portfolio's overall exposure given inputs like market conditions in order to perform sensitivity analyses.²⁴³

Probability of Default (PD)

Probability of default captures the likelihood that the borrower is unable to repay the loan. The probability of default assesses the likelihood that a loan will transition from current to delinquent and then, more importantly, delinquent to default over a given time period.²⁴⁴ The PD captures the loans' DSCR and LTV for portfolio level analysis while also incorporating other effects like that of the property and market.²⁴⁵ The probability of default is calculated²⁴⁶ based on past portfolios of a similar credit and risk profile such that the bank can calculate a probabilistic likelihood of default.²⁴⁷ As a "measure of term risk,"²⁴⁸ PD assesses the risk that the real estate portfolio faces as compared to historic losses.

Exposure At Default (EAD)

²⁴¹ Office of Comptroller of Currency (2013), pg. 9.

²⁴² Blokhin, Keever and Scheinbart (2016).

²⁴³ Johnson, Sheeley, Fitzgerald and Foster (2007).

²⁴⁴ Investopedia, "Probability of Default."

²⁴⁵ Trepp (2016), pg. 4.

²⁴⁶ Regulatory agencies accept multiple methodologies in terms of calculation through migration analysis to yield the probability of default for similarly rated loans. Bierman (2012).

²⁴⁷ Sageworks (2014).

²⁴⁸ Trepp (2016), pg. 5.

Meanwhile, exposure at default adopts a more holistic view of the bank's exposure at the time of default.²⁴⁹ The EAD looks more specifically at the exposed amount at risk in event of default.

Loss Given Default (LGD)

Whereas, the loss given default reports the loss as a dollar figure if a loan defaults.²⁵⁰ The loss given default gives a percentage of net loss given the loans that default within the industry. The metric is calculated using industry data²⁵¹ and is based upon historical performance. Said another way, the LGD is the percentage of the exposure at default that will not be recovered. Frequently in literature, loss given default is commonly referred to as "loss severity" to depict the magnitude of the losses that the institution is going to incur because of default. As the unrecoverable portion of the exposure in the event of default, this figure is heavily reliant upon the definition of default outlined at the start of the underwriting process.

Expected Loss (EL): $EL = EAD * PD * LGD$

The expected loss is then taking the probability of default and multiplying it by the exposure at default and then by the loss given default to yield an annual expected loss figure. Though each metric independently adds value for trend analysis, the expected loss is the most holistic in terms of its interpretation at the bank level. In stress testing, this desired output is able to diversify away idiosyncratic risk.²⁵²

Additional Measures to Implement

In addition to quantitative metrics that the bank collects, there are many actions that a bank should take to ensure that it is properly monitoring its loans. One aspect of monitoring is

²⁴⁹ Investopedia, "Exposure At Default."

²⁵⁰ Investopedia, "Loss Given Default."

²⁵¹ Regulators permit use of third party vendors to gain access to industry data if the institution does not have data. Bierman (2012).

²⁵² "Stress Testing CRE Portfolios." Radley & Associates, pg. 10.

the periodic review of financials and the property to ensure the accuracy of borrower reported numbers.²⁵³ Due diligence requires that the information listed on the financial statements is correct. An additional indicator of the status of the properties is the timely payment of real estate taxes. If a borrower is unable to meet its tax payments, it is an early sign that the borrower is in distress.²⁵⁴ The stratification of commercial real estate loans is critical to the success of the bank in terms of understanding the bank's risk exposure. Regulators recommend segmentation in terms of the following areas: type of commercial real estate, location, tenancy, risk rating, credit structure, and debt service coverage.²⁵⁵ Nevertheless, this paper is supported by a quantitative application of a simulated bank portfolio of loans to demonstrate this risk management techniques in practice.

Quantitative Application

In an effort to simulate a bank's true loan portfolio, this paper includes a quantitative application that serves as a representation of the economy through utilization of Markov Chains and Monte Carlo simulations.²⁵⁶ The infusion of randomness more accurately represents the economy.

Framework for Model

The application was coded into matrices in MATLAB so that it could run 1,000 simulations over the ten year life of the portfolio of 191 loans.²⁵⁷ The data is delivered in quarters due to the dataset used to derive historical property price and net operating income changes

²⁵³ Office of Comptroller of Currency (2013), pg. 49.t

²⁵⁴ Office of Comptroller of Currency (2013), pg 49.

²⁵⁵ Office of Comptroller of Currency (2011) – Concentrations of Credit, pg. 5.

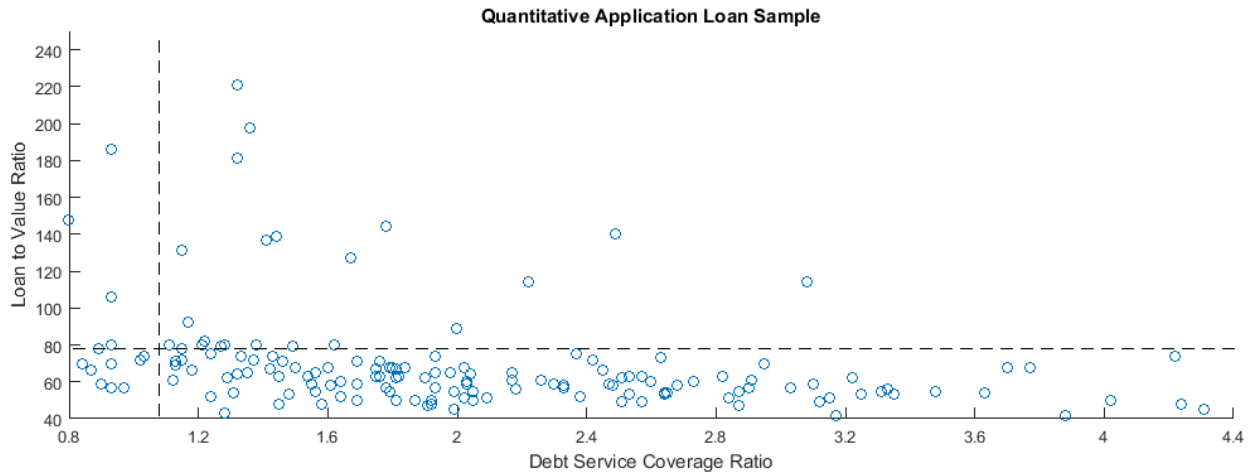
²⁵⁶ Monte Carlo simulations are used to develop probability distributions for the purposes of forecasting risks associated with cash flows. Buehler, Freeman and Hulme (2008), pg. 27.

²⁵⁷ One assumption that is embedded into the model is that each loan is interest-only with a life of 10 years. Please see **Appendix 5** for more information on assumptions.

(NCREIF).²⁵⁸ Because these two data sets are quarterly, rates were also generated quarterly (FRED). By operating on a quarterly time frame, the datasets are consistent. Some loan statistics were standardized across the sample of 191 loans for assumptions throughout the model. For example, all loans in the sample were ten-year interest-only mortgages with principal due at maturity

Loans – Trepp

Loan Sample Statistics					
Number of Loans	Aggregate Loan Balance	Avg. DSCR	Avg. LTV	Avg. Rate	Rate Range
191	\$ 31.3 bn	2.2	67.5	4.8%	2% - 7%



Using the loans provided by Trepp using TreppLoan, a sample of 191 loans was selected. Sample selection relied exclusively upon availability of data of interest (loan metrics such as DSCR, LTV or loan type). Though the data may be subject to a slight bias due to the limitation of the availability of data, these 191 loans serve as a representative sample. There is no discrimination in terms of location or type of real estate. In essence, any concentration risk due to location or property type is displayed in the sample portfolio through the possible biases that arise because of the presence of all requested data points. Loans for the model were selected

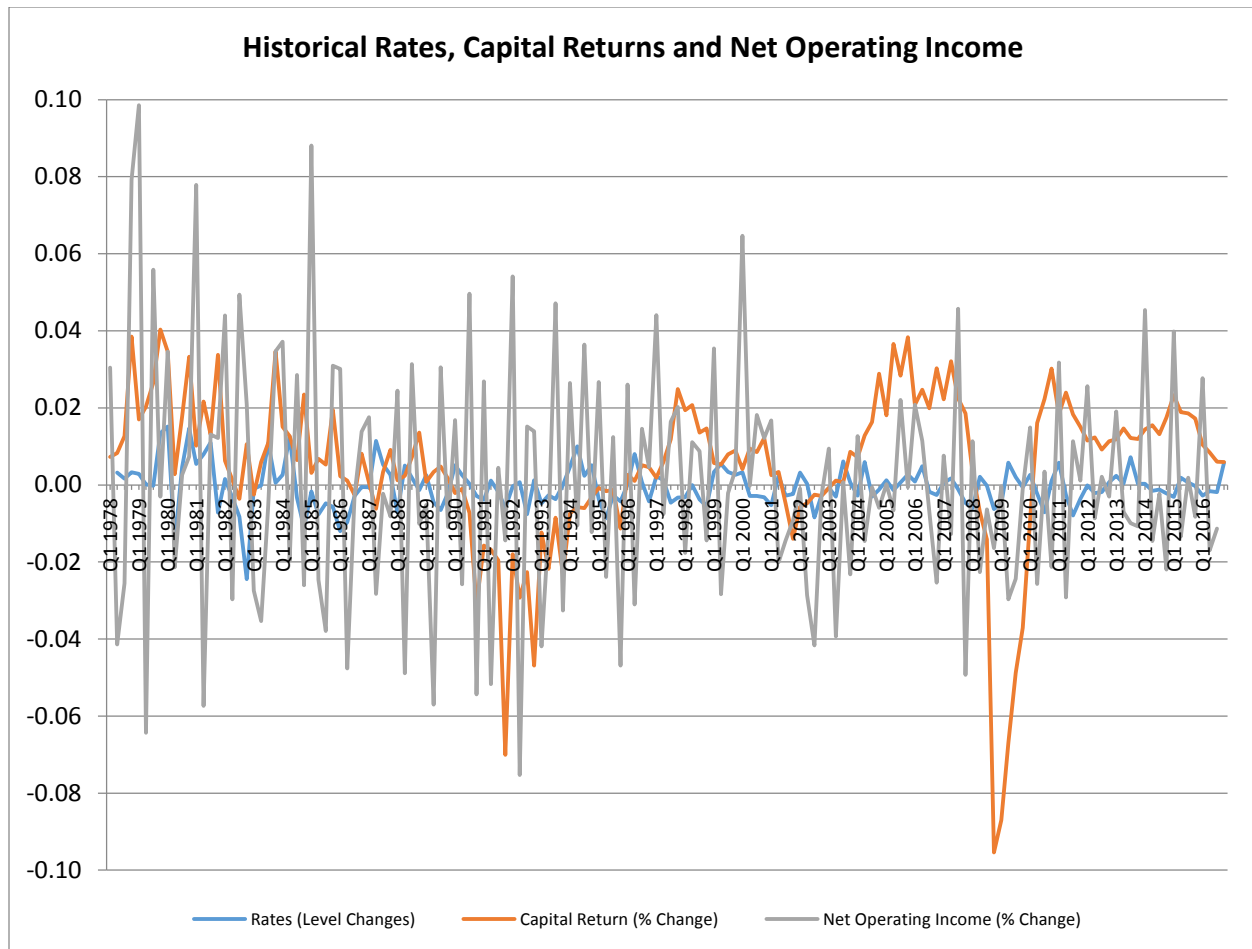
²⁵⁸ NCREIF index data provided by Professor Stijn Van Nieuwerburgh.

based upon availability of the information provided, The loans that were selected possessed data for their LTV and DSCR. Through selection of the model's sample, the model excludes and eliminates the loans did not undergo the underwriting process, which functions as a control for the data set.²⁵⁹ Because today's underwriting standards are diminishing as banks underwrite increasingly risky commercial real estate loans, this portfolio of loans is more prudently underwritten than most seen within the market. The loans that are listed within this portfolio is rather strongly underwritten with very few loans that are outside of typical industry standards. The portfolio has most loans with a DSCR above 1.25 and LTV below 80%. These loans are very useful, yet they are not necessarily representative of today's market.

Data for Regression

This model assumes that the past is a reasonable predictor for the future. As a result, past data for property prices, or capital returns, net operating income and rates are required as predictors.

²⁵⁹ Trepp (2016), pg 3.



National Council for Real Estate Investment Fiduciaries (NCREIF).

Quarterly pricing data was used in an auto-regression of the changes in property prices with its own changes. The source of this data is the National Council of Real Estate Investment Fiduciaries (NCREIF), an index commonly used to measure property prices. The NCREIF pools all information reported by its participants, all institutional fiduciaries invested in commercial real estate. For property prices, the model utilizes “Capital Returns” as the designated measure of changes in property prices and “NOI” to calculate quarterly NOI growth.²⁶⁰ Though NCREIF data are seen as limited given the lack of specificity and understanding beyond basic

²⁶⁰ This is a graph of the price and NOI changes provided by NCREIF and the rate levels projected for Federal Reserve. Please note that the rates data is sourced from the Federal Reserve. The graph shows quarterly fluctuations expressed as a percentage change.

performance metrics,²⁶¹ the data functions perfectly for this model. Banks often work closely with institutional capital. Even though the smaller banks may lend to smaller institutions, the property prices and trends are more likely to follow similar trends to those of institutional money due to the overall functioning of the market. These changes are quarterly percentage changes as reported by NCREIF (for NOI and price) and the Federal Reserve (for rates). These data predict future prices, incomes and rates respectively. The model relies upon the underlying assumption that the past is a good predictor of the future. When simulating the loan portfolio, the mean, standard deviation and autocorrelations of these changes with themselves generates meaningful predictors used within the Monte Carlo simulations in order to infuse randomness into the simulation. Many riskier commercial real estate deals require excess capital that lacks the financial backing and collateral support that banks require to successfully originate the loan and hold on balance sheet. Shadow banking institutions may elect to finance these riskier deals instead because they are significantly less restricted in terms of their underwriting standards than banks of any size. Though the NCREIF data are limited to the specific pool of assets from the reporting fiduciaries, the prices and income are largely representative of the entire market.²⁶² Fragmentation and constant modification of the real estate market makes it difficult to capture the market in its entirety, as a result, this model utilizes NCREIF data for its consistent and reliable index of prices and income.

Federal Reserve.

The model utilizes quarterly rates as posted on the Federal Reserve. These quarterly rates are utilized in a regression. The quarterly averages are used in the as levels. Taking the changes period to period, the projected rate is modeled by increasing the rate by the average quarterly

²⁶¹ Southard.

²⁶² Federal Deposit Insurance Commission (2000). Vol. 1, pg. 150.

change. Because there is a time component to this rate whereby rates rarely change by large amounts because the Fed maintains a policy of stability, levels must be used in the analysis of rates unlike property prices and net operating income.²⁶³

Discretized Auto-Regressive Processes

This quantitative application utilizes the Rouwenhorst method²⁶⁴ to discretize the continuous autoregressive processes. By regressing NOI changes with themselves through utilization of the process, the model predicts the variables of interest. Markov chains are used to conduct binomial Monte Carlo simulations for the life of the profile of loans to generate values for property prices and net operating income. For simplicity, the model assumes that if a variable is in a particular state, high or low, then it will “stay” with a higher probability. With two states of the world and the autocorrelation inputs into the function to generate a value for persistence. The model assumes two states of the world: high, increase by the mean and standard deviation, or low whereby the value increases by mean and decreases by the standard deviation.

As outlined in the autocorrelation procedure of the Rouwenhorst Process, the model utilizes a 2x2 matrix in a Markov chain in which $p = q$.

$$\begin{bmatrix} p & 1 - p \\ 1 - q & q \end{bmatrix} = \begin{bmatrix} P^{HH} & P^{HL} \\ P^{LH} & P^{LL} \end{bmatrix}$$

The model generates probabilities for the 4 scenarios – $P^{HH} = P^{LL} = p$ and P^{HL} and $P^{LH} = 1 - p$.²⁶⁵ In assessing the model, p is set equal to q such that the likelihood of the high state to stay high is identical to the likelihood of the low state staying low.

²⁶³ NCREIF (as provided by Professor Van Nieuwerburgh) and Federal Reserve.

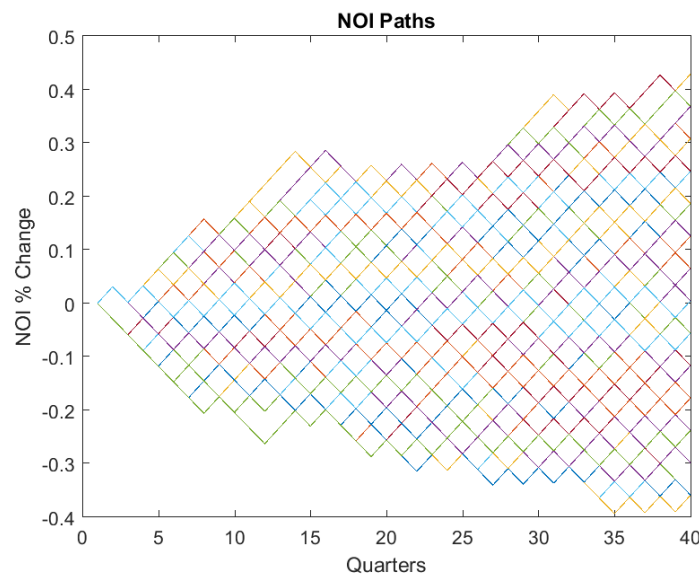
²⁶⁴ Kopecky and Suen (2010).

²⁶⁵ As coded into MATLAB, as $p = q$ whereby $p = q = (1 + \rho)/2$ where ρ is the autocorrelation of the changes with themselves. Please see **Appendix 6** for more information.

Loan Shocks

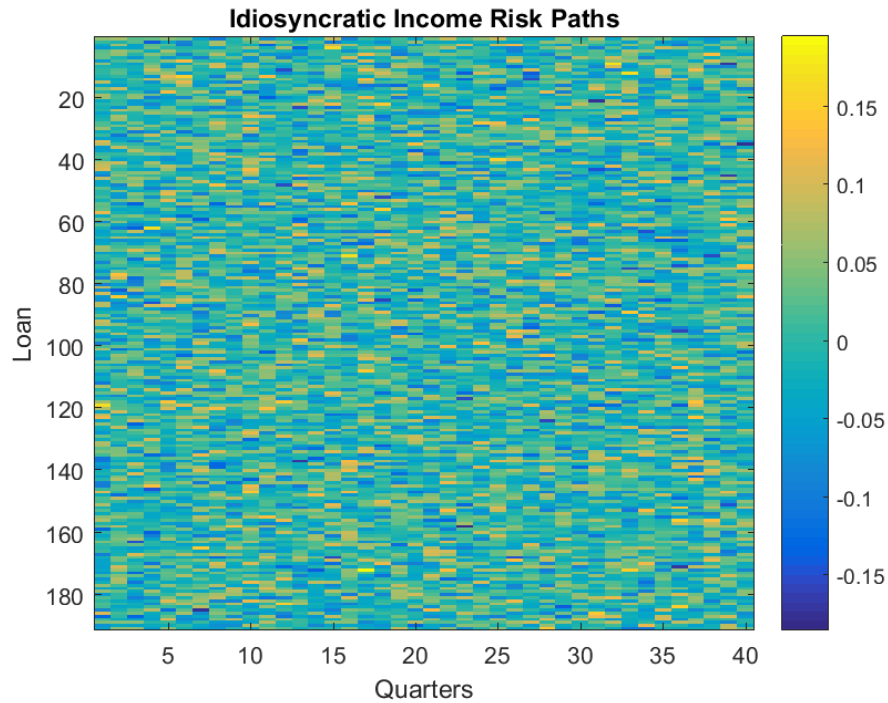
Within the simulation, there are two degrees of randomness delivered through shocks: an aggregate shock and an idiosyncratic shock. The aggregate shock is used to represent the economy. The aggregate shock is binary in nature to either the high state (add the standard deviation to the mean) or the low state (subtract the standard deviation from the mean).

Each tree originates with zero (with the exception of rates). For the random scenarios that result in low, the tree branch adds the mean and subtracts the standard deviation. Whereas, the scenario that results in high adds the mean and adds the standard deviation. Therefore, this process re-generates for every period, building upon the prior year's changes. The distribution of percentage changes is normally distributed around zero because the percentage change will either rises or falls by the same quantity with the mean of the changes being added irrespective of the respective standard deviation.



The idiosyncratic shock infuses loan-specific risk because the entire portfolio would otherwise default simultaneously. Embedded within epsilon, is a randomly assigned loan-specific metric that is used across periods within a simulation, which represents the risk inherent to one

specific loan. By creating a loan-specific risk measure, the entire portfolio of loans does not move together in unison.



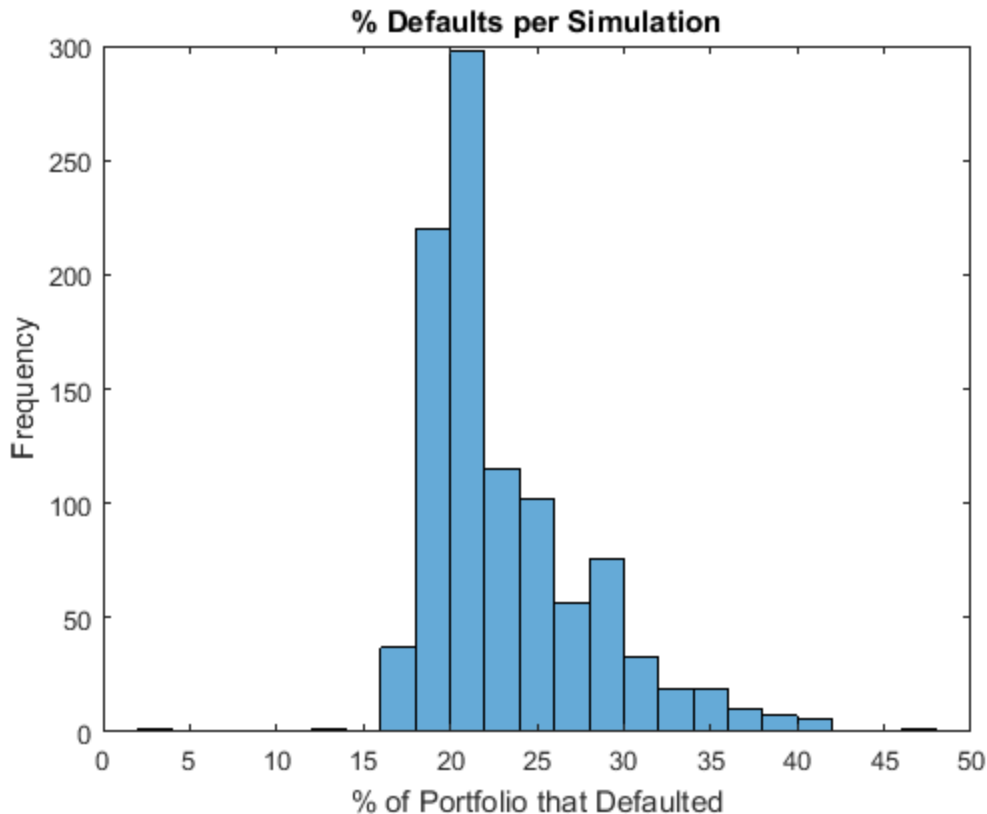
For the Property Prices and Net Operating Income,²⁶⁶ the matrix of predicted values for the aggregate economic shock and idiosyncratic shock. These shocks are forecasted separately and then combined. The aggregate economic shock is intended to simulate the economy on a macro scale, so each simulation generates a different state of the economy, for which treatment is applied to all loans simultaneously.²⁶⁷ Because aggregate economic shocks inevitably lead to immediate default of all loans and embedded within each loan is loan specific risk, an idiosyncratic risk component is added.²⁶⁸ This idiosyncratic risk encompasses all property and loan specific factors that independently embody each loan that the bank originates.

Defaults

²⁶⁶ The Net Operating Income graphs are shown above, however the property prices follow an identical procedure, along with rates that follow a similar procedure. Please see **Appendix 8** for a detailed discussion of the procedures and the graphs of the other processes also embedded within the model.

²⁶⁷ Igan and Pinheiro (2007), pg. 8.

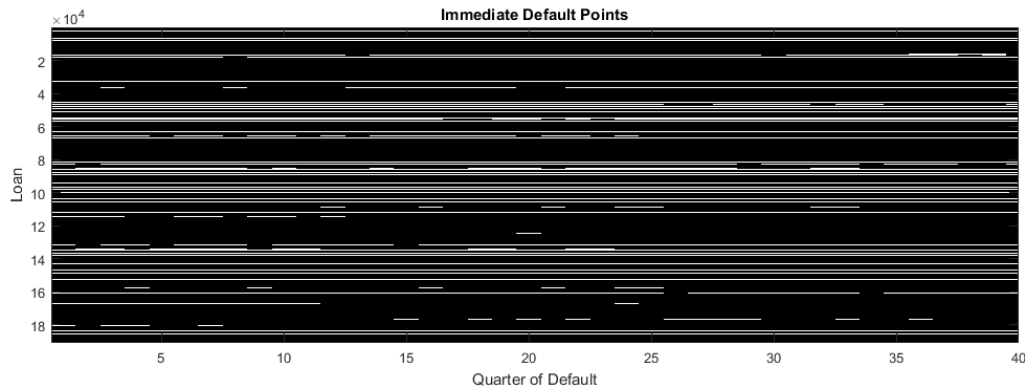
²⁶⁸ This idiosyncratic risk is randomly generated in conjunction with the assumptions in **Appendix 7**.



In its analysis of defaults, the model maintains two types of defaults: immediate defaults and term defaults. The immediate defaults occur during the life of the loan (within the loans' 10 year, or 40 quarter, life. The determining factor of default in this case is the borrower's ability to fulfill its debt service coverage. A borrower immediately defaults once the income that its property is generating is not enough to fulfill interest payments.²⁶⁹ Meanwhile, a term default occurs at maturity after all of the interest payments have been fulfilled and relates to relative valuation of the loan to the property price at maturity. Because all loans in the model are assumed to be interest only, like most loans in the industry, borrowers are often able to fulfill their debt service. Given the typical underwriting standard of a DSCR of 1.2 or 1.25, lenders

²⁶⁹ A borrower immediately defaults when the debt service coverage ratio falls below 1 because the income no longer meets the needs of the debt service.

typically protect themselves from borrowers' inability to pay in order to prevent immediate defaults in the underwriting phase.



The immediate default concept arises from the “ability to pay hypothesis.” Due to data constraints and simulated future projections, the interest payment was the only proxy available for discerning technical defaults. The model utilizes the debt service coverage ratio as the indicator for assessing whether the borrower can continue to fulfill its debt service. If the DSCR falls below 1, then the model assumes immediate default of the borrower. This assumption seems reasonable because of the 3 months for which the borrower could be fulfilling debt service coverage. In fact, delinquencies are typically defined in terms of 90 days delinquent,²⁷⁰ so this assumption is reasonable and simplifies the model. Also embedded within the model, immediate and strategic defaults are able to seize total market value for properties. Due to fire sales, however, in the case of a liquidity crisis, the full value of the building will not be captured. In the case of an economy-wide crisis, banks will quickly shed assets, which contributes to the systemic risk that banks face.²⁷¹ Therefore, this assumption simplifies the model and may lead to a slight upward bias of properties.

²⁷⁰ Ross and Shibut (2015).

²⁷¹ Halaj (2017), pg. 151.

Whereas, the term default is more heavily reliant upon the valuation of the property relative to the value of the loan. The model utilizes the LTV ratio as a proxy to determine if the borrower undergoes term default at maturity. The technical default occurs at maturity and assumes that a borrower will strategically default when the property value is higher than the loan value. A borrower will experience a term default when the value of the loan is higher than the value of the underlying property.

Using the strategic default concept, technical defaults signify that the loan has defaulted upon completion of its term once it is mature. "... [I]f the 'inability to refinance loans on commercial terms with other lenders' is taken as a technical default, then default rates in some books exceed 50%."²⁷² This model utilizes the "strategic default policy whereby the borrower defaults" in the case of the loan amount exceeding the value of the property.²⁷³ The ability to strategically default is an assumption built into the model for conservatism because commercial real estate loans are issued to borrowers who are business, so commercial lenders are typically more aware, so the model assumes that these borrowers would default at maturity if provided the opportunity. The failure of the borrower to obtain refinancing will result in default.²⁷⁴

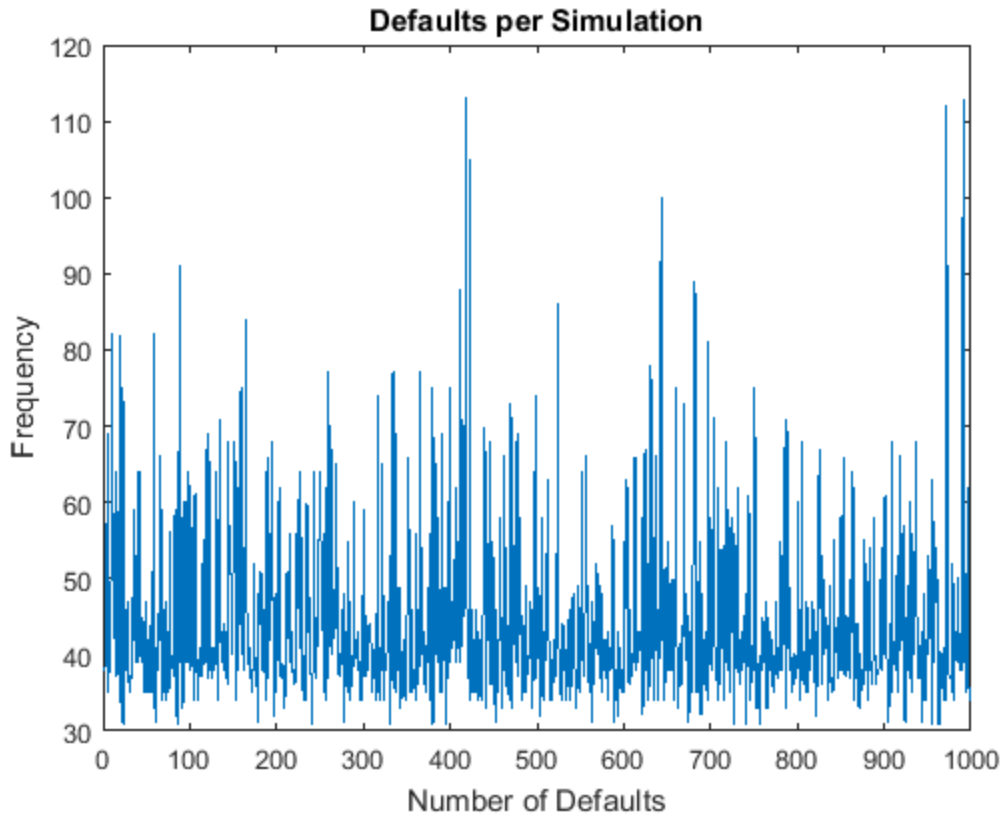
There has been an increasing trend toward greater concentration. As lending competition increases, there has been heightened awareness and competition on rates. As a result, banks may be entering into riskier deals than they perhaps should due to the substantially larger concentration than that which the bank could feasibly undertake due to the magnification of the risk that occurs in the case of commercial real estate concentrations as evidenced in the crisis. Therefore, closer analysis of the portfolio and concentration-focused metrics are required due to

²⁷² Radley & Associates.

²⁷³ Igan and Pinheiro (2007), pg. 10.

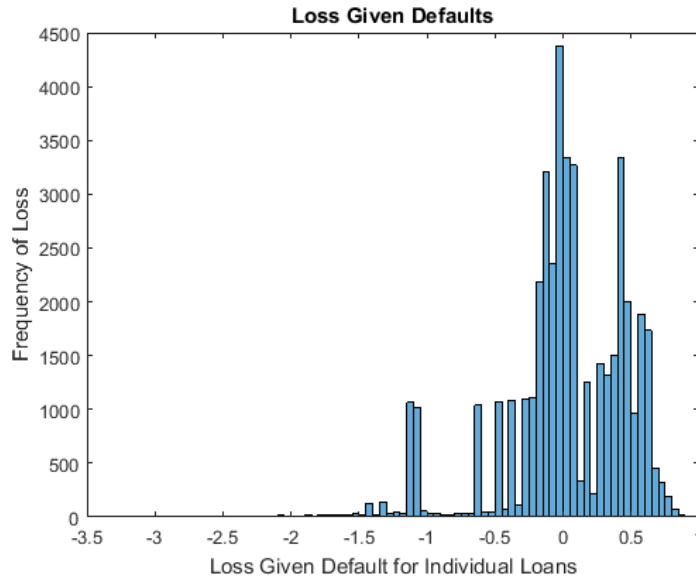
²⁷⁴ Ross and Shibut (2015).

the added risk factors that are inherent with a more focused and concentrated real estate loan portfolio.



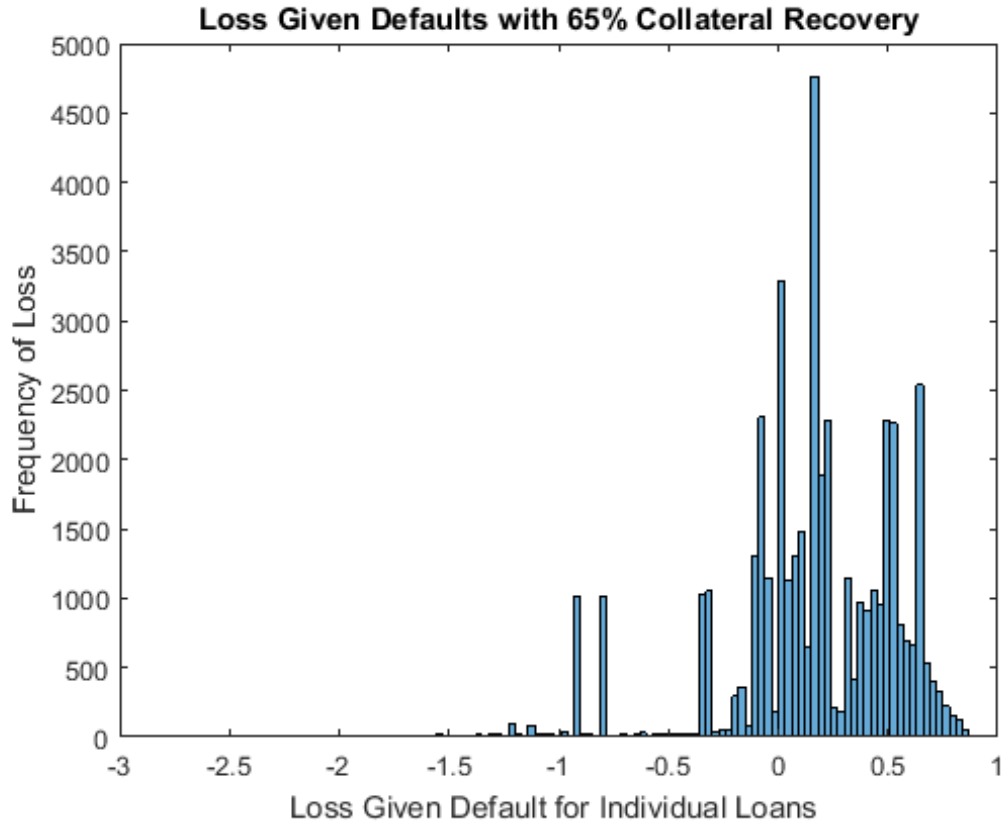
Loss Given Default.

When looking at the defaults that a bank experiences within its portfolio, the loss given default yields a valuable metric, the amount of exposure that would be lost in the case of default. The model is able to assess the loss given default to see the portfolio's percentage exposure to losses in the case of default. Using the formula, $LGD = 1 - \left(\frac{\text{recoveries}}{\text{original loan balance}}\right)$, the results yielded are the following graph provided below:



The likely reason for the abnormal nature of the distribution of the losses given default for this particular portfolio arises from the assumption that the recovery of the loan is simply the entire value of the property. This assumption acted as one of simplification, however this assumption has limited applicability in practice. When considering defaulted loans, it is doubtful that a bank could successfully earn all of a particular property's price appreciation in foreclosure proceedings. As a result, the recovery assumption, directly related to the loss given default,²⁷⁵ must be modified to a more realistic measure.

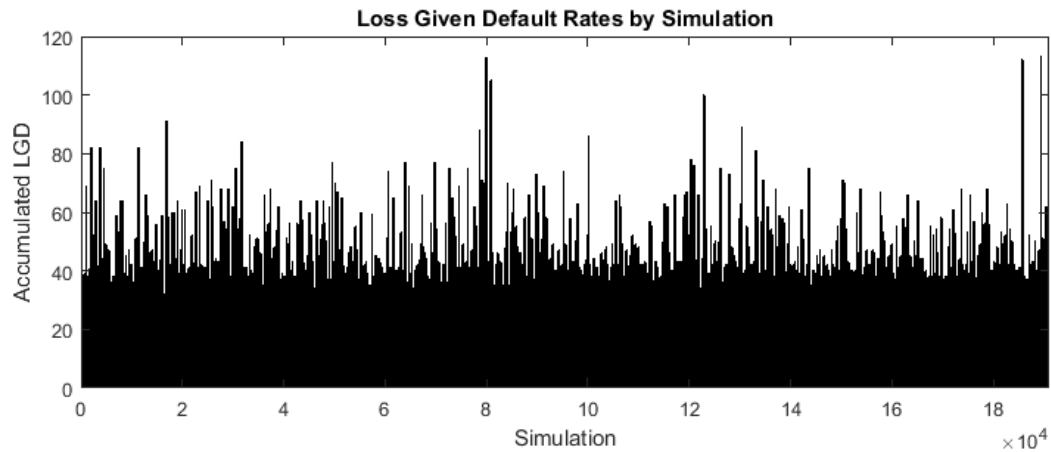
²⁷⁵ Ross and Shibut (2014).



In order to be certain that the model provides reasonable losses, the model is compared against the mean of a typical distribution of commercial real estate loans at banks which is around 44%.²⁷⁶ Due to the remarkably high property price growth within some of the simulations paired with the strong underwriting standards strictly implemented across this portfolio, the losses are limited. Nevertheless, the distribution depicts the importance of the recovery assumption, especially when contemplating this assumption as a standard with the presence of fire sales and foreclosure proceedings. The bank is not in commercial real estate business, so a borrower in real estate that strategically defaults in real estate is not an ideal situation for the bank and likely indicative of the current state of the market. As a more aggressive assumption, the model next tests the model's mean LGD in the case of 65% recovery due to this likely possibility that the borrower, the expert, is only interested in strategically defaulting if the loan

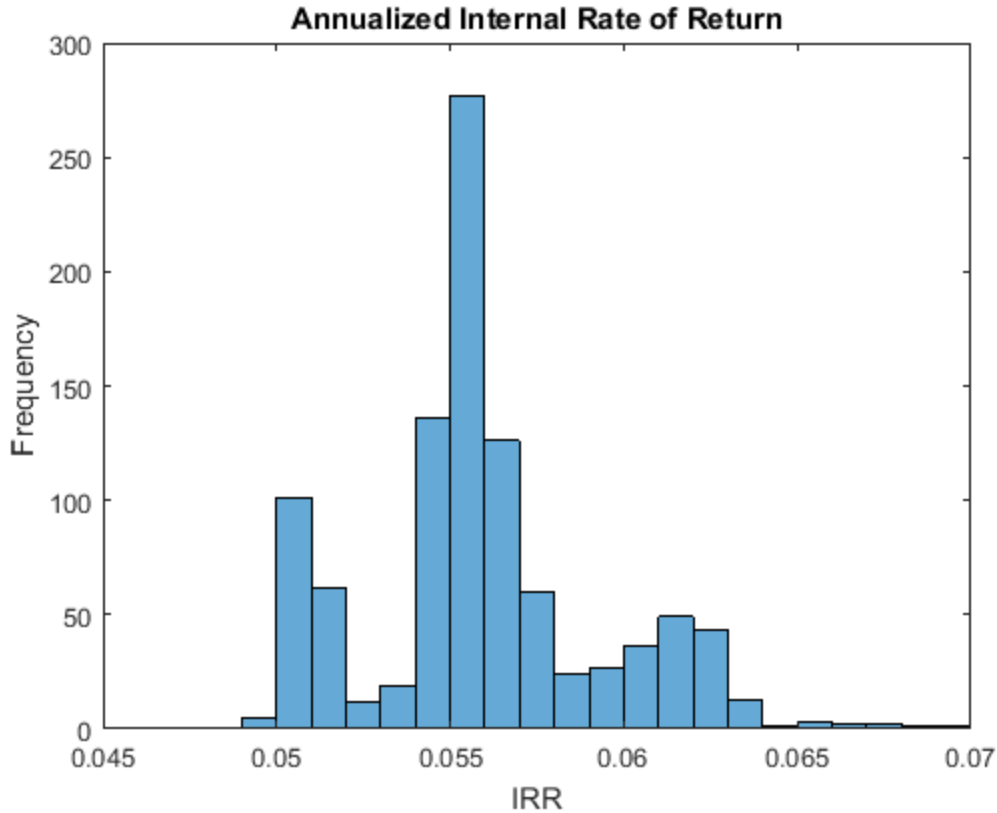
²⁷⁶ Ross and Shibut (2014).

value exceeds the value of the property. A loss given default with 65% recovery aligns with the severely adverse stress testing scenarios as required under DFAST, making it a reasonable assumption.



The loss given default is calculated as the proportion of a portfolio's basis that is exposed to loss in the event of default. Meanwhile, many of these other risk management practices rely upon historical trends or the loss given default itself. To determine the expected loss, the model requires the input of historical defaults for property prices. As an indicator of this metric, the model provides a model to assess the number of loans that default within each simulation.

Returns



Mean Rate of Return	5.52% (1.38% quarterly IRR)
1 st percentile	5% annualized IRR
5 th percentile	5.04% annualized IRR

Findings

The purpose of the model was to simulate a bank’s portfolio in order to practice the risk management techniques that bank should undergo and incorporate into their risk management procedure. Stress testing, similar to this procedure, is in an effort to see the status of the bank and its coverage making assumptions of the implementation. Though modeling is valuable and useful in terms of its forecasts, the model is only as valuable as its assumptions. The degree to which the bank elects to stress the portfolio paired with the methodology and practices utilized in the procedures will dictate its usefulness. Stress testing can be proven a useful tool, however in

isolation the tool is useless and meaningless unless integrated into a larger risk management system due to the integrated nature of risk and lending. Though these metrics can be useful in understanding and preparing for the “unknowns” that banks face in relation to their commercial real estate loans, these tests and models are a step, granted an important step, but they are only one aspect of the larger portfolio.

Conclusion: Recommendations of Best Practices for Future

Though regulations are extensive in terms of treatment of commercial real estate loans, the current procedures in place could prove too narrowly focused. The regulators stress the importance of stress testing and mandate that the large and medium-sized banks perform these exercises. Though stress testing is valuable as a risk management tool, as evidenced by the quantitative application performed. Stress tests expose weaknesses, however these outputs are heavily reliant upon the inputs as well as the applicability of these findings thereafter in managing the risk of the portfolio overall. Risk management is necessary to the bank’s lending decisions and cannot be considered in isolation, nor reliant on one calculation or procedure.

When engaging in commercial real estate lending, banks must take a more active role in terms of managing and understanding the risks that they face. Smaller banks often extensively engage in commercial real estate transactions at very high volumes. Evidence shows that banks have higher success rates when they locally specialize and invest heavily in risk management so that they can properly manage the risk of their book.²⁷⁷ Though specialization contributes to the likelihood of success, the narrowing of fields also functions as a limiting factor such that these banks are no longer able to expand beyond their core competencies.²⁷⁸ Without the infrastructure

²⁷⁷ Eliasov, Härle and Schifter (2009).

²⁷⁸ Ross and Shibut (2015).

and specialized knowledge, these banks put themselves at risk and more importantly a severe disadvantage as compared to the larger or more specialized competitor banks.

As competition continues to increase in an ever-evolving industry, the pricing and management of the underwritten loans becomes an issue of the utmost importance. As an industry exposed to fluctuations within the market, the real estate market is highly volatile. The commercial real estate loan industry has been trapped in a vicious cycle whereby the banks and lenders readily relax their lending standards,²⁷⁹ so implementation and maintenance of risk management policies is the only way to break the cycle. Albeit regulators forcing policies is not the way to do it, mandatory reporting would make risk management a part of the lending conversation, which is the only way to begin the topic of discussion.

Notwithstanding the former view of the risk management function as overly conservative or inefficient,²⁸⁰ risk management must be considered a top priority and serve as a nexus upon which all lending decisions are based. Banks' Boards of Directors are now being urged to establish a "risk management culture in which the firm's risk exposures operate as a central force upon which the bank bases its lending decisions."²⁸¹ With the rapidly fluctuating status of underwriting standards,²⁸² banks should focus on risk management and concentration management.

Ultimately, risk management ought to be a cornerstone of lending practices. While commercial real estate loans introduce diversity for the bank, they also introduce a slew of other risks that must be addressed and considered at time of origination to avoid. Banks and regulators must consider these risks in aggregate and ensure that they actively manage against these risks.

²⁷⁹ Eliasov, Härle and Schifter (2009).

²⁸⁰ Rossi (2010), pg. 46.

²⁸¹ Biery (2016).

²⁸² The Federal Reserve Board revealed that banks were modifying CRE transactions and tightening underwriting standards in Q3 2017, Federal Reserve (2016), so risk management is critical.

Banks cannot afford to loosely underwrite or fail to manage their real estate holdings given the additional risk exposures that come with concentrations in commercial real estate loans. As a central and critical component of the banking industry, risk management should be at the cornerstone of lending as opposed to an afterthought or superfluous function.

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Appendices

Appendix 1: *Types of Acquisition, Development and Construction Loans*²⁸³

Land Acquisition Loans. Banks should be cautious in acquisition of land acquisition loans because the land in and of itself does not generate cash flows. Undeveloped land lacks cash flow generating features, so until the bank must assess the borrower's plan for land and require larger equity stake as collateral in the case of riskier securities.

Land Development Loan. These loans are often extended in conjunction with a land acquisition loan and serve as funding to prepare the land for construction.

Tract Development Loan. Similar to a land development loan, but the loan is able to finance structure with five or more units within it.

Unsecured Working Capital Construction Loan. When a developer is in need of immediate capital through an unsecured line of credit. Because the developer does not yet possess the asset to back the loan as collateral. Proper due diligence in the underwriting stage is critical due to the riskiness associated with this lending. The bank lenders should be cautious in the case of overruns or deviations from project deadlines or budget as it may be indicative of the quality of their borrower.

Repositioning Construction Loan. Banks can elect to extend a loan to a borrower who is trying to revitalize or rehabilitate a building to try to enhance its value. Careful consideration of the qualifications of the borrower is required so that the bank originates projects that it can monitor closely. The riskiness of rehabilitation is in it unforeseen costs and circumstances.

Bridge Loan. Following construction, a property may require financial assistance prior to stabilization of income generating potential for the property. This loan is shorter term by nature

²⁸³ Office of Comptroller of Currency, pg. 11.

and functions only as a temporary form of financing as the property works to secure permanent financing with more established terms and expectations with that respective lender.

Permanent Loan Commitments. Banks will originate these loans so that the properties can secure more permanent financing. The terms by which can be extended on stand-by or forward commitment

Stand-by Commitment. Through implementation of an excessive fee structure, banks try to deter actual origination of the loan if the borrower is able to secure alternative means of funding. Conditions of these loans are fundamental because the commitment is not formalized with borrower upon agreement.

Forward Commitment. During the development phase, borrowers can secure a fixed rate early in the process. The nature of this loan is such that the rate is only unlocked once a feature of the property is activated, usually lease-up. Because the rate is not flexible and is fixed, the bank minimizes risk by ensuring a steady stream of income through rent payments.

Appendix 2: Valuation Methods ²⁸⁴

“As Is.” The “as is” value is simply the current market price given the current condition.

“As Completed.” The value of the property once construction is complete is considered to be “as complete”, which anticipates market value upon termination of the project.

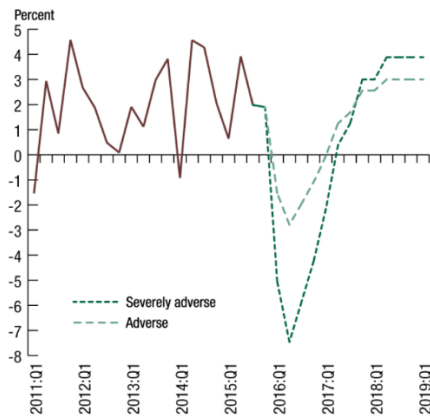
“As Stabilized.” Because all buildings can only generate cash flows once occupied, the “as stabilized” value considers the value of the building once the building reaches its target occupancy.

The valuation method is used in determining the desired value and is critical to the lender’s analysis to determine if the cash flows are correct and ensure that the borrower can meet the outlined debt service within the loan contract.

Appendix 3: DFAST Scenarios

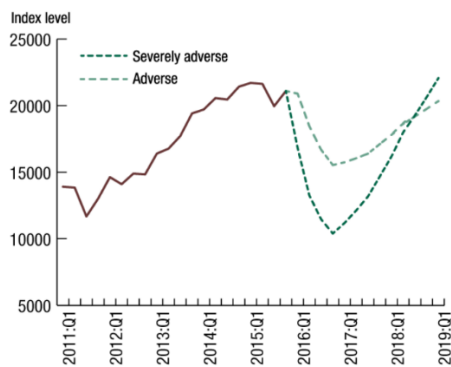
²⁸⁴ Comptroller’s Handbook, pg. 11.

Figure 3. Real GDP growth rate in the severely adverse and adverse scenarios, 2011:Q1-2019:Q1



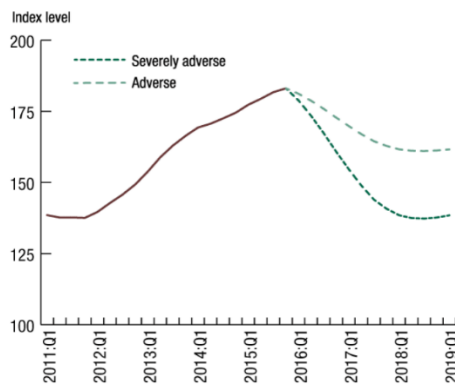
Source: Bureau of Economic Analysis and Federal Reserve assumptions in supervisory scenarios²⁸⁵

Figure 4. Dow Jones Total Stock Market Index, end of quarter in the severely adverse and adverse scenarios, 2011:Q1-2019:Q1



Source: Dow Jones and Federal Reserve assumptions in the supervisory scenarios.²⁸⁶

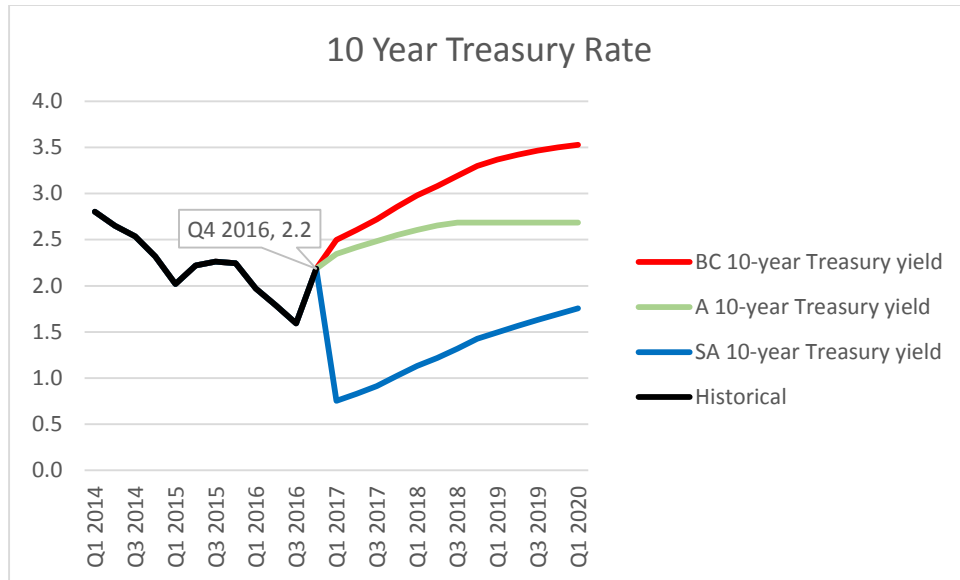
Figure 5. National House Price Index in the severely adverse and adverse scenarios, 2011:Q1-2019:Q1



Source: CoreLogic (seasonally adjusted by Federal Reserve)²⁸⁷

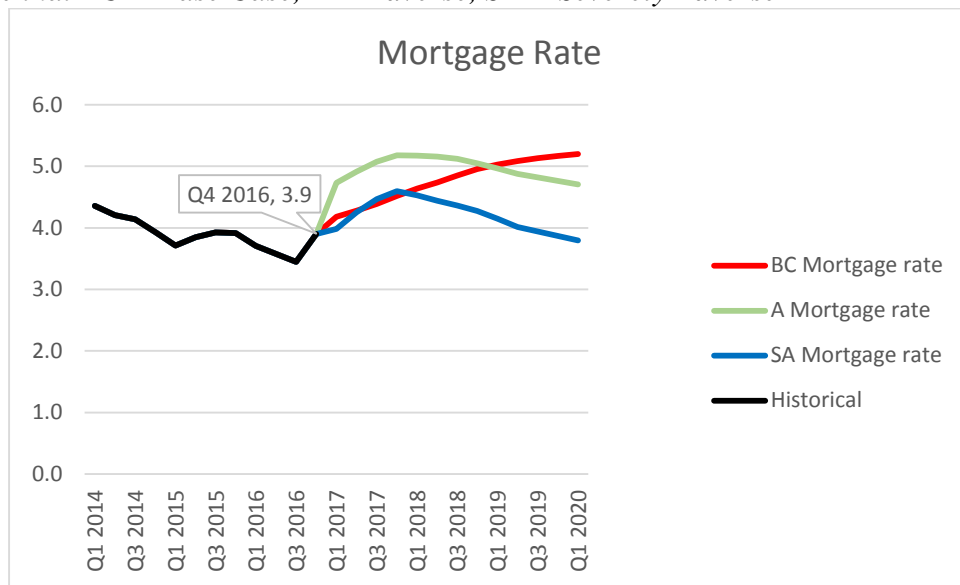
²⁸⁵ Board of Governors of Federal Reserve System (2016).

²⁸⁶ Board of Governors of Federal Reserve System (2016).



Source: DFAST Framework²⁸⁸

Please note that BC = Base Case, A = Adverse, SA = Severely Adverse

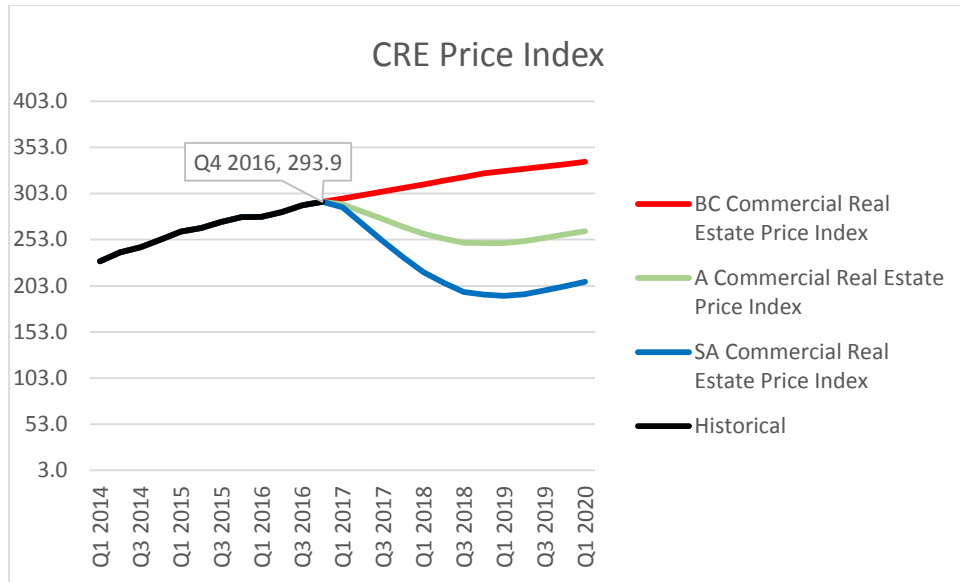


Source: DFAST Framework²⁸⁹

²⁸⁷ Board of Governors of Federal Reserve System (2016).

²⁸⁸ Board of Governors of Federal Reserve System (2016).

²⁸⁹ Board of Governors of Federal Reserve System (2016).



Source: DFAST Framework²⁹⁰

Appendix 4: *Stress Testing for Real Estate*

²⁹⁰ Board of Governors of Federal Reserve System (2016).

FIG. 1—*Stress Testing Factors.*

STRESS FACTORS	Land Acquisition & Development	Residential Construction	Commercial Construction (1)	Multi-Family Residential	Residential & Commercial Condominium Development & Construction	Leased Commercial Office Space	Leased Industrial and Warehouse Distribution	Retail Boxes & Strip Malls
Decreases In:								
Rents				✓	✓	✓	✓	✓
Sales Prices	✓	✓						
Absorption/Sell-Out Rates	✓	✓	✓		✓			
Collateral Values	✓	✓	✓	✓	✓	✓	✓	✓
Increases In:								
Vacancy Rates				✓		✓	✓	✓
Marketing Costs	✓	✓		✓	✓	✓	✓	✓
Utility and/or Energy Costs	✓	✓	✓	✓	✓	✓	✓	✓
Maintenance Costs	✓			✓	✓	✓	✓	✓
Material Costs	✓	✓	✓					
Labor Costs	✓	✓	✓		✓			
Tenant Concessions				✓		✓	✓	✓
Interest Rates	✓	✓	✓	✓	✓	✓	✓	✓
Capitalization Rates	✓	✓	✓	✓	✓	✓	✓	✓
Changes In:								
Property Use					✓			

(1) Includes multi-family residential, leased commercial office space, leased industrial and warehouse distribution, and retail boxes and strip malls.

Source: Philadelphia Fed²⁹¹

Appendix 5: MATLAB Assumptions

For the MATLAB code written, the simulation makes the following assumptions:

²⁹¹ Adams and Wells (2008).

- 1) For the loans, all loans are considered “*IO*,” interest only. For the purposes of simplifying the simulation process, all loans are considered interest-only whereby the loans do not have any amortizing principal and owe a balloon payment with all principal and the final interest payment. Though Trepp includes “partial *IO*” and “Amortizing Balloon” as loan classifications, yet the model assumes that all of these loans are interest-only
- 2) The system is assuming that the loan will survive throughout the life of its loan as long as the debt service coverage ratio stays above one.
- 3) For the sake of simplicity and consistency across the loan portfolio, all loans are considered to have a ten year life.
- 4) Though interest is likely to be assessed on an annual basis, the NCREIF data that is regressed to design the predictive Monte Carlo model. To remain consistent across the board, the loans are assessed on a quarterly basis throughout the life of the 40 quarters in order to generate the simulation paths. The model assumes that the interest is paid on a quarterly basis in order to model on a consistent basis. “int_pmt” is the interest payment based on the loan’s rate and principal calculated on a quarterly basis.
- 5) Interest is only incurred on a quarterly basis. The quarter in which a loan defaults, it is assumed that all default proceedings occur within that period. The interest payments cease in period of default and thereafter.

Appendix 6: *Rouwenhorst Equations Utilized in the Model*²⁹²

²⁹² Kopecky and Suen (2010).

Starting with the z as outlined in the process, $z_t = \rho z_{t-1} + \varepsilon_t$, where ρ has an absolute value less than 1 and ε captures white noise. $N=2$ because the simulation assumes only two states of the world [High, Low].

$$\Theta(n=2) = \begin{pmatrix} p & (1-p) \\ (1-q) & q \end{pmatrix}$$

This model assumes that $p = q$ meaning that the probability of the following period remaining high if it was high is equal to the probability if it was low that it will stay low. This is a reasonable assumption because these factors, though volatile on a daily basis, there are never drastic measures and the movement is more likely to stick to a particular direction. Therefore, the autocorrelation, ρ is simply $2p - 1$. The standard deviation is simply Ψ . Please find the selected moments of the Markov chain recalculated below:

Metric	Calculation	Rouwenhorst Method	With $p = q$
Conditional mean	$E(y_{t+1} y_t = y_i)$	$(q - p)\psi + (p + q - 1)y_i$	$y_i + \Psi$
Conditional variance	$var(y_{t+1} y_t = y_i)$	$4\psi^2 / (N - 1)^2 [(N - i)(1 - p)p + (i - 1)q(1 - q)]$	$4\varphi^2 (p - p^2)$
Unconditional mean	$E(y_t)$	$(q-p)\psi / (2-(p+q))$	0
Unconditional 2 nd moment	$E(y_t^2)$	$\varphi^2 \{1 - 4s(1 - s) + 4s(1-s)N-1\}$	φ^2
First-order auto covariance	$Cov(y_t, y_{t+1})$	$(p + q - 1)var(y_t)$	$\varphi^2 (2p - 1)$
First-order autocorrelation	$Corr(y_t, y_{t+1})$	$p + q - 1$	$2p - 1$

Appendix 7: Calculations for Idiosyncratic Risk

Using the property price change's risk as a benchmark, set $\frac{P(t)}{P(t-1)} - 1 = \frac{P(t)^a}{P(t-1)^a} - 1 + \varepsilon(t)^i$.

Embedded within each loan is some amount of idiosyncratic, loan-specific risk that is captured within the epsilon term, $\varepsilon(t)^i$. Fortunately, banks can diversify away this idiosyncratic risk through portfolio diversification. Since this risk is loan-specific, the model must account for each loan's additional risk dimension. In a large enough portfolio, total returns are solely based on the aggregate economic risk, but the sample is only 191 loans, so the idiosyncratic risk is critical.

To derive a value for the idiosyncratic risk, first we must look at total risk:

$$r_t = \sqrt{r_a^2 + r_i^2}, \text{ therefore } r_i = \sqrt{r_t^2 - r_a^2}$$

As a baseline assumption, $r_t = 2 * r_a$, so we are able to get a value for epsilon which we then generate for each loan for each of the 40 quarters so that there is a total risk.

This idiosyncratic risk adds the idiosyncratic noise for NOI. The bank also assumes additional risk than the aggregate shock which affects the entire economy. Ideally, the bank has the capacity to diversify away this risk component.

As the epsilon term, the model must assume a value for this rate of risk that is specific to loans as opposed to simulations, or states of the economy. Therefore, N_epsi and P_epsi are matrices that generate a loan-specific risk at each time interval. The idiosyncratic risk is generated by assuming that total risk of the loan (aggregate economic + idiosyncratic) is double the systemic risk. Using the rand function to generate a random distribution, we then multiply these randomly distributed numbers between -1 and 1 and multiply by our derived constant, $\sqrt{(2 * systemic\ risk)^2 - (systemic\ risk)^2}$ to provide a projected idiosyncratic risk term.

Appendix 8: MATLAB Methodology

Establish Variables

For the variables within the MATLAB code, the loan specific information was imported from a file that was downloaded from Trepp and filtered to contain only information relevant to the simulation. The following variables were coded in:

- *Loan*: Loan number (specifically for simulation)
- *Interest_rate*: The interest rate that the loan was originated with
- *Orig_bal*: The original balance of the loan.
- *Value_0*: The initial value of the property at the time of origination.
- *NOI_0*: The net operating income of the property at time of loan origination.
- *LTV_0*: The loan to value ratio of the property at origination using *Orig_bal* and *Value_0* to yield the ratio.
- *DSCR_0*: The debt service coverage ration of the property at origination using the *Interest_rate*, *Orig_bal* and the *NOI_0*.
- *DY_0*: The debt yield is the ratio of the net operating income to loan amount, utilizing the *NOI_0* and the *Orig_bal* are used.
- *Int_pmt*: This is the quarterly interest payment calculated using the *Interest_rate* and *Orig_bal* .

In addition to the loan variables, simulation variables are also created

- *nsim*: The simulation utilizes 1,000 simulations to gain a more comprehensive understanding of what can happen in all cases of the economy.
- *nquarters*: The assumed 10 year lives of the loans yields a time horizon of 40 quarters.
- *nloans*: The sample of 191 loans.

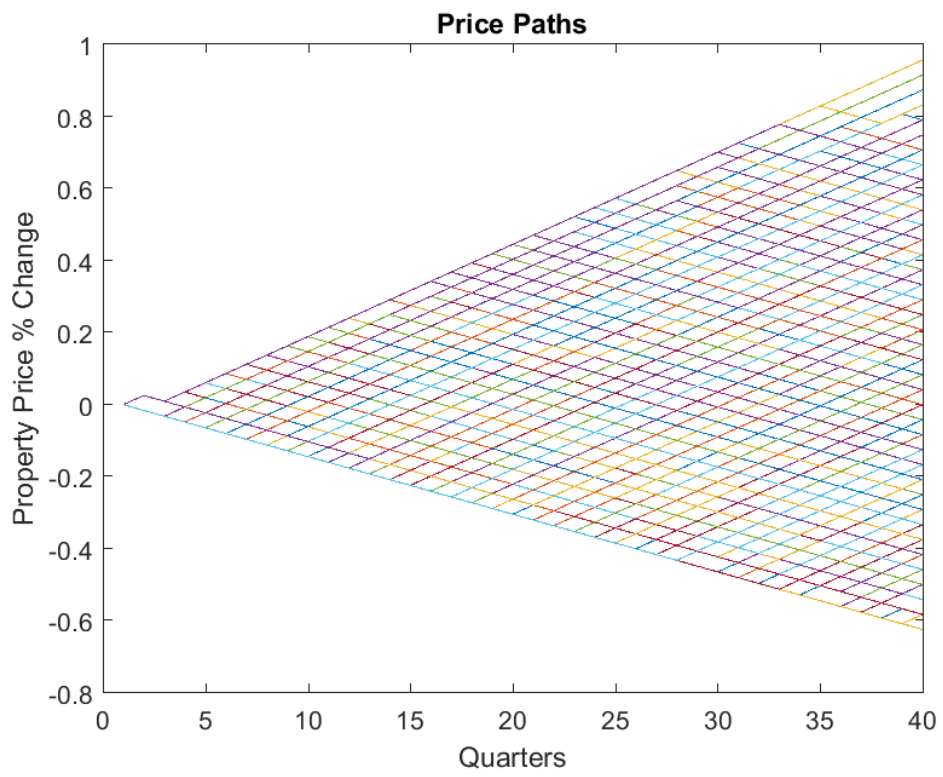
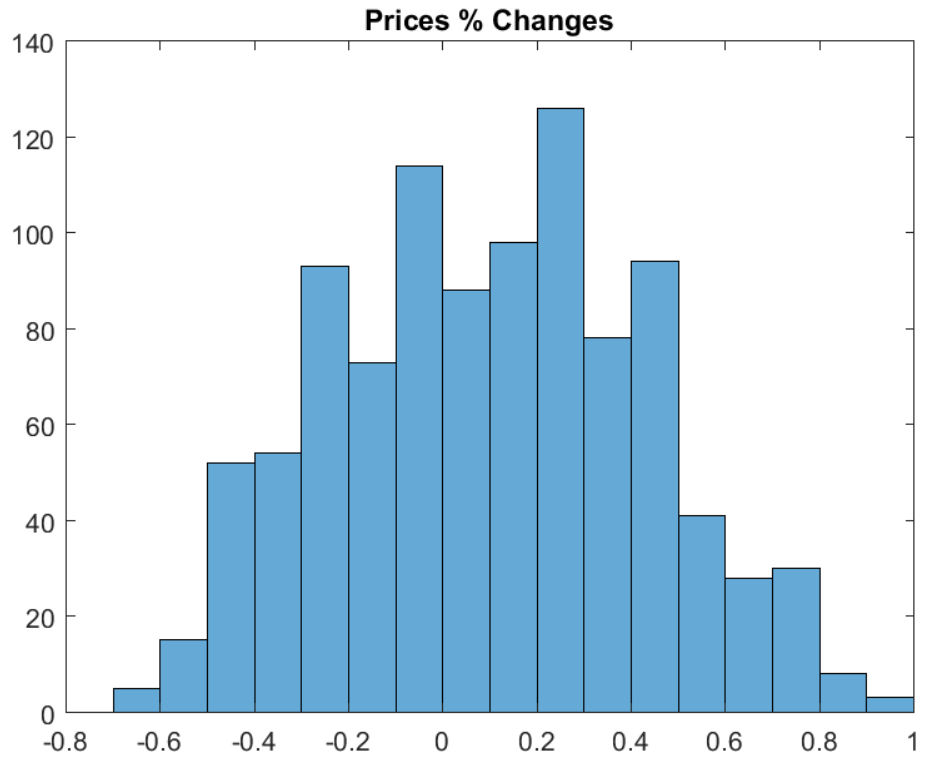
Establish Markov Chains for the Aggregate Economic Variables for Changes

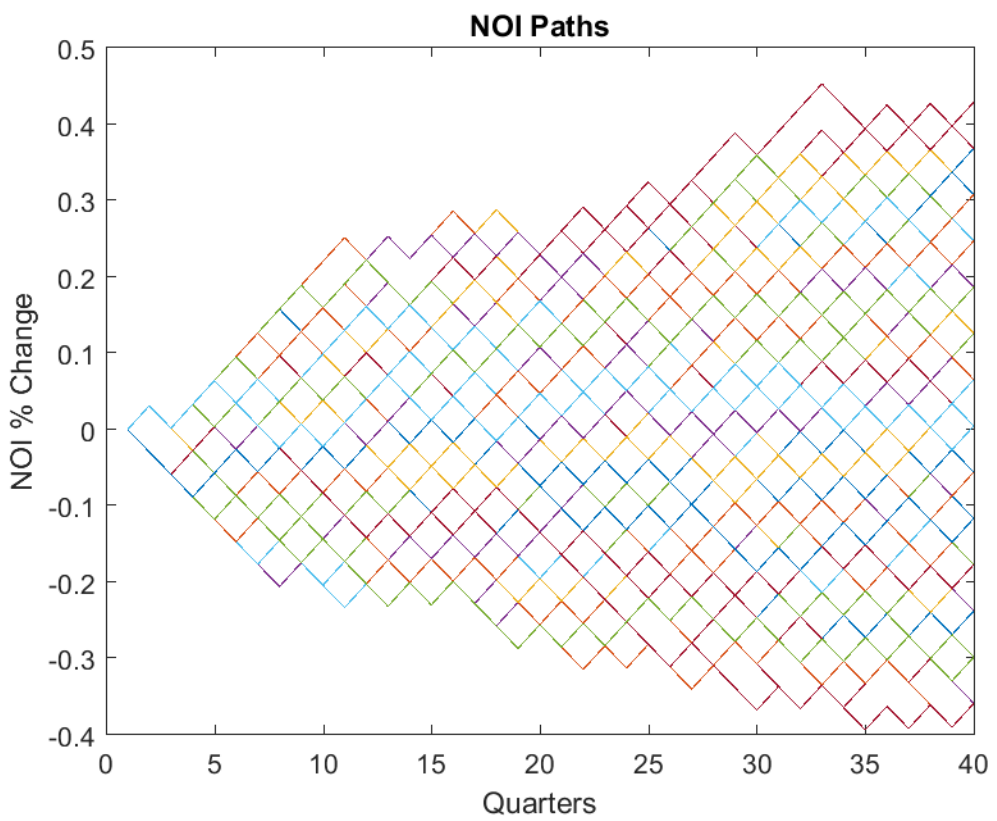
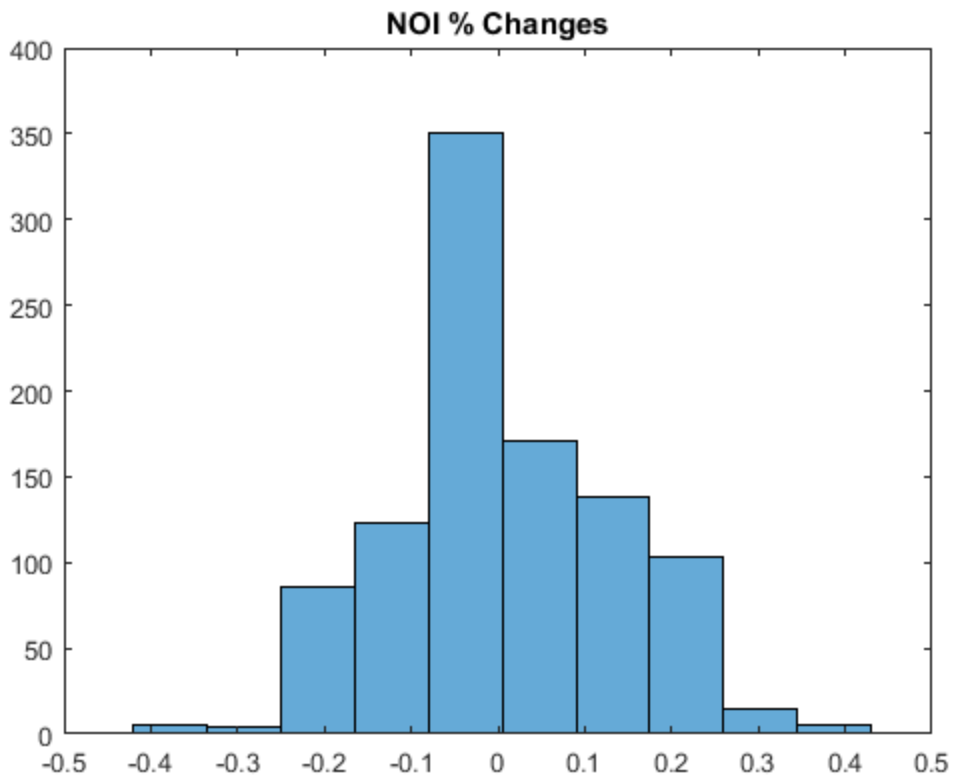
To simulate the economy, the model sets up three independent Markov chains with Monte Carlo simulations. The process will be run for Property Prices, Net Operating Income and Rates.

First, the matrix for the changes to be reported is created [P, N, R]. These matrices are established as 1000x40 matrices. Then, the transition matrix is established [$P_state, N_state, R_state$]. The $_state$ matrix will generate either 0 or 1 in line with the probability determined using the Rouwenhorst process. The p in the model is designated as the threshold, $thr_$.

For the first period, the P_state matrix is generated with 0.5 probability of the high [$P_state = 1$] or low state [$P_state = 0$]. Every period thereafter is selected through the randomly generated number through $draw$ ($draw_p, draw_n$ and $draw_r$). If the number designated to be between 0 and 1 is less than the probability then P_state will be the same as the prior period ($_state(k,n+1) = _state(k,n)$). If the randomly generated number is greater than $thr_$ then $_state(k,n+1) = 1 - _state(k,n)$. Therefore, if the state was high (1) and is now low (0), the new state will be $1 - 1 = 0$, or the other way from low to high with $1 - 0 = 1$ (high).

Utilizing these $_state$ matrices, the model then tabulates these changes across the 40 periods [P, N, R]. The calculation is conditional based upon the $_state$ matrix whereby 1 yields the *prior period's value + μ_p + ψ_p* and for zero whereas 0 or false lead the model to add the mean and subtract the standard deviation from the prior period's value.



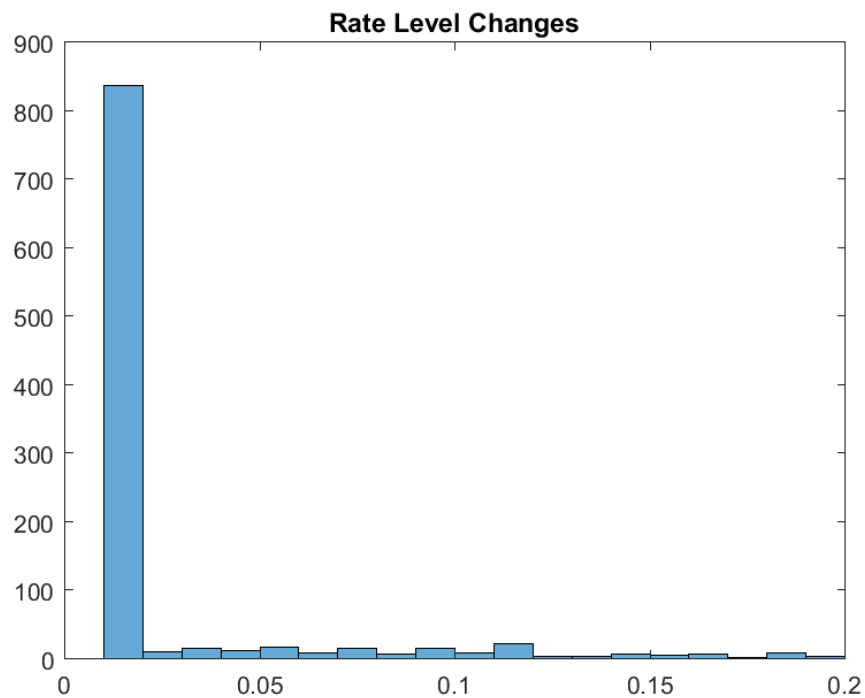


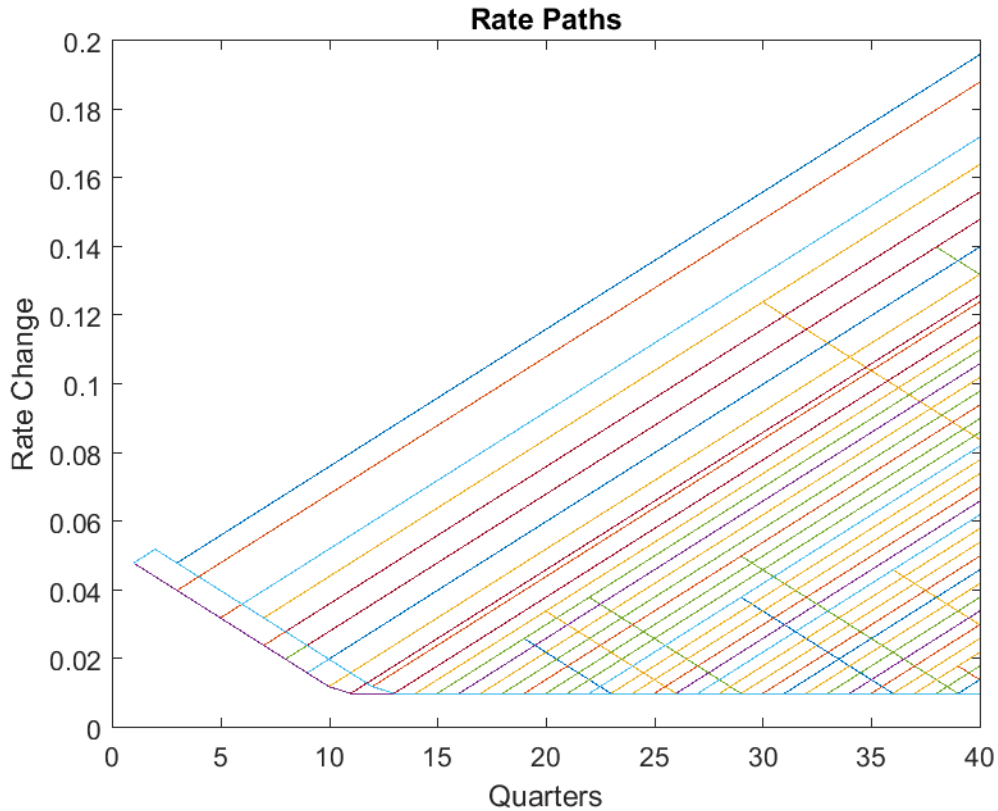
P and N serve as the percentage changes upon which the price and net operating income fluctuate. The trees accumulate over time, creating aggregate changes over the life of the loan. P and N are then used to calculate the prices [*Property_prices*] and income [*Net_op_income*].

Rates

Though the model runs a similar process throughout, there are some differences for the rates process. Because rates fluctuate at a greater rate, they cannot be projected on the basis of percentage change on a quarterly basis like prices and income. As a result, the rates are projected on the basis of levels, not percentage change like property prices and NOI.

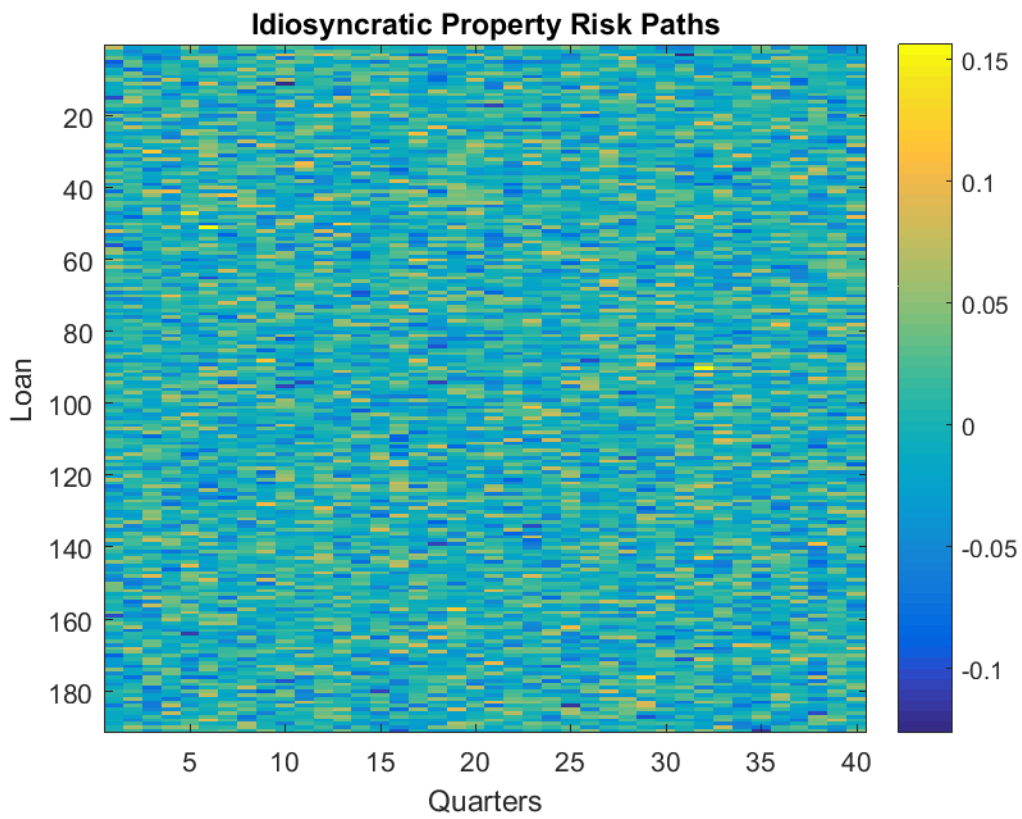
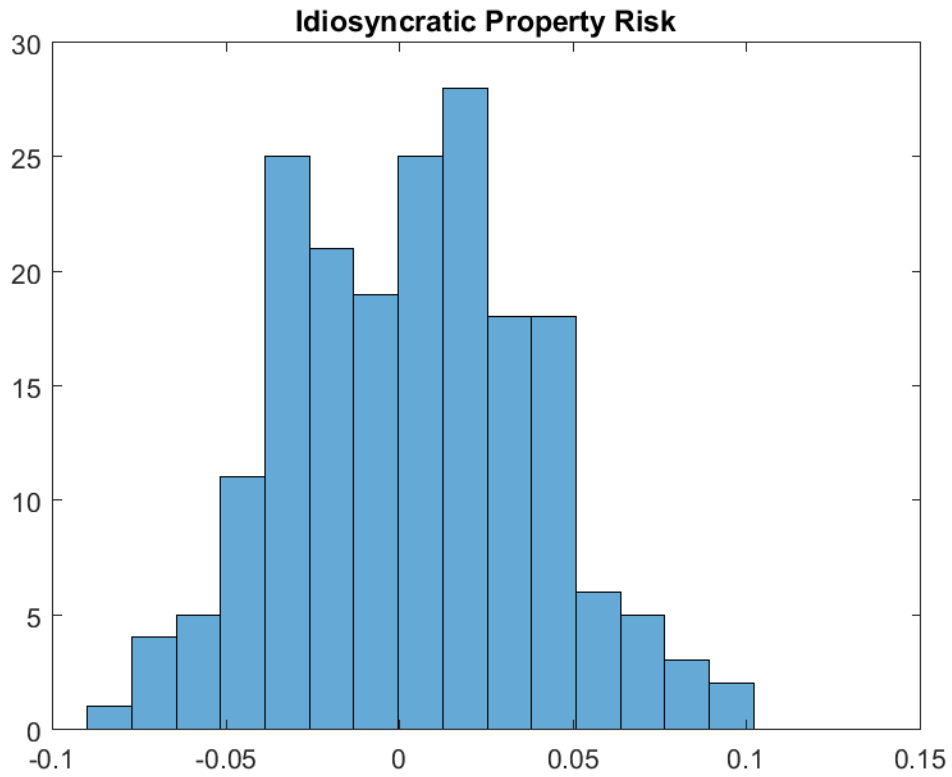
Rates are in levels. Unlike the percentage growth method utilized in the case of the income and property prices, rates do not fluctuate at such dramatic levels. As a result, the rates move in levels rather than % changes. The rate binomial tree originates at mean and add or subtract the ψ_r value.

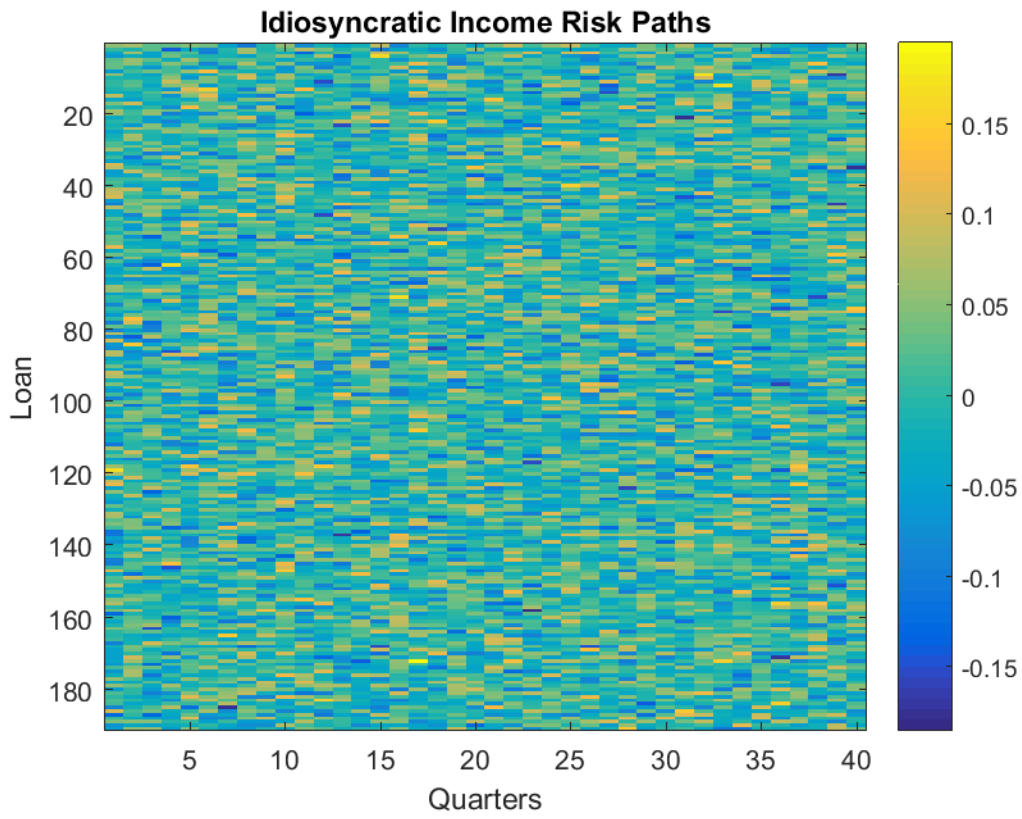
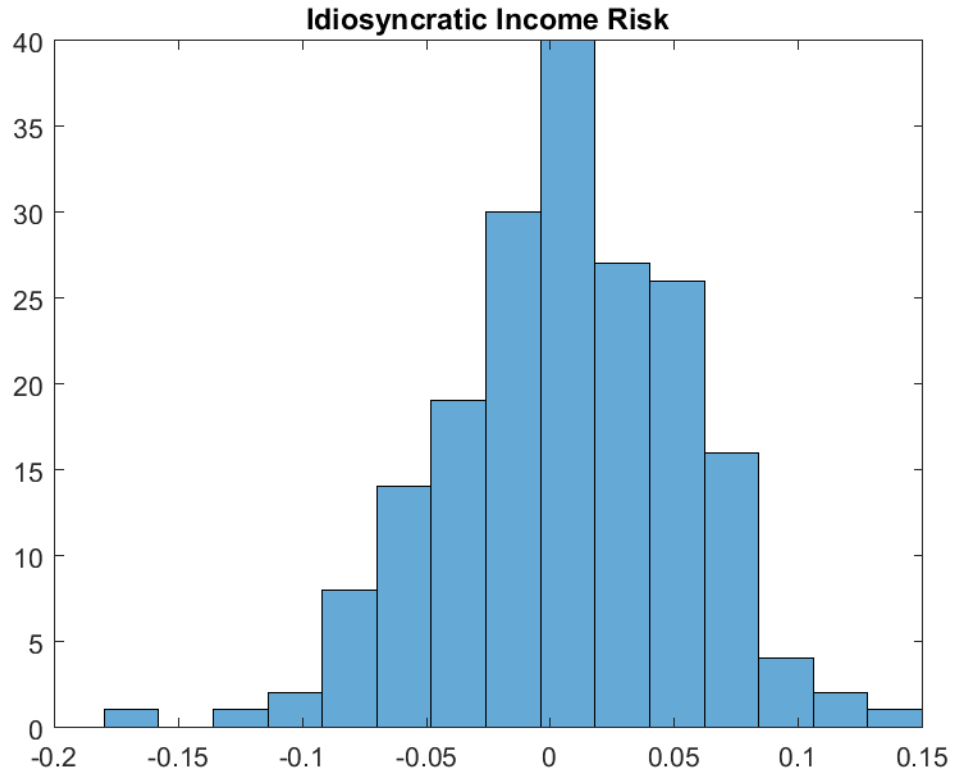




Establish the Idiosyncratic Shocks for Price & Net Operating Income

Because mere establishment of the aggregate shocks would lead to a simultaneous boom or bust, it is necessary that the model incorporates some idiosyncratic risk. As a result, the property price and NOI shocks also have idiosyncratic components due to the inherently unique attributes of these properties. The model establishes matrices with these values whereby the idiosyncratic price risk is predicted as IR_p and income risk, IR_n , utilizing the function as depicted in **Appendix 5**. $IR_$ is then utilized in the calculation of these risks, P_{epsi} and N_{epsi} are thus a combination of this amount of projected risk, normally distributed around 0, is multiplied by a constant based upon the assumption that total risk.



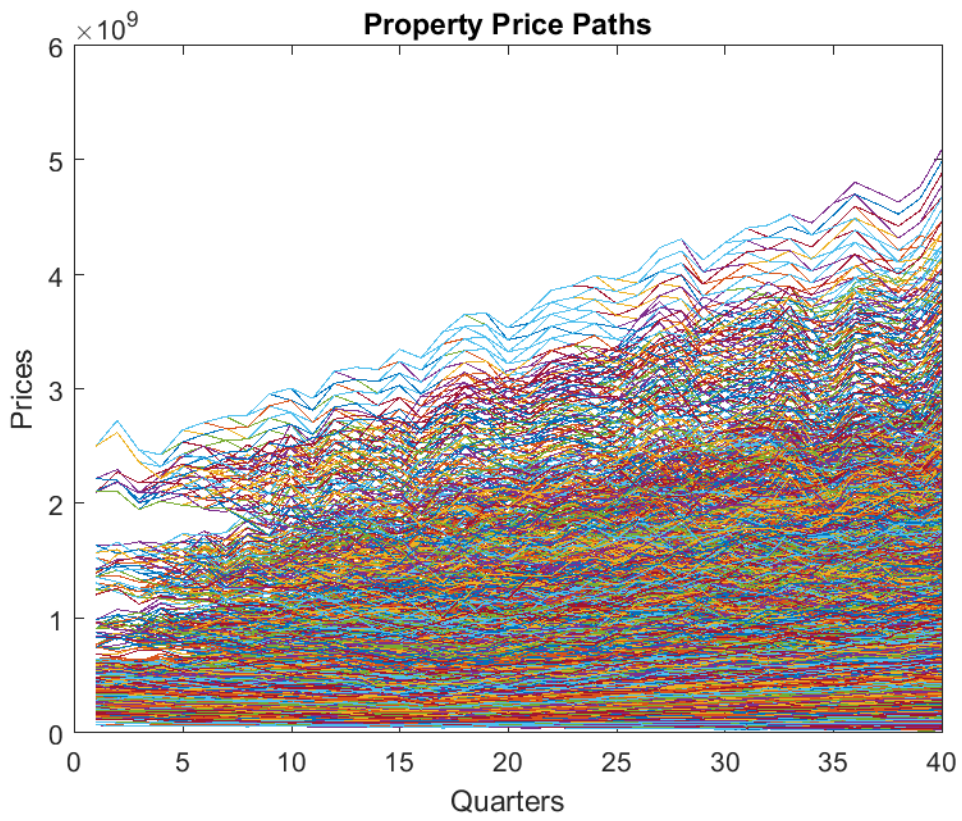
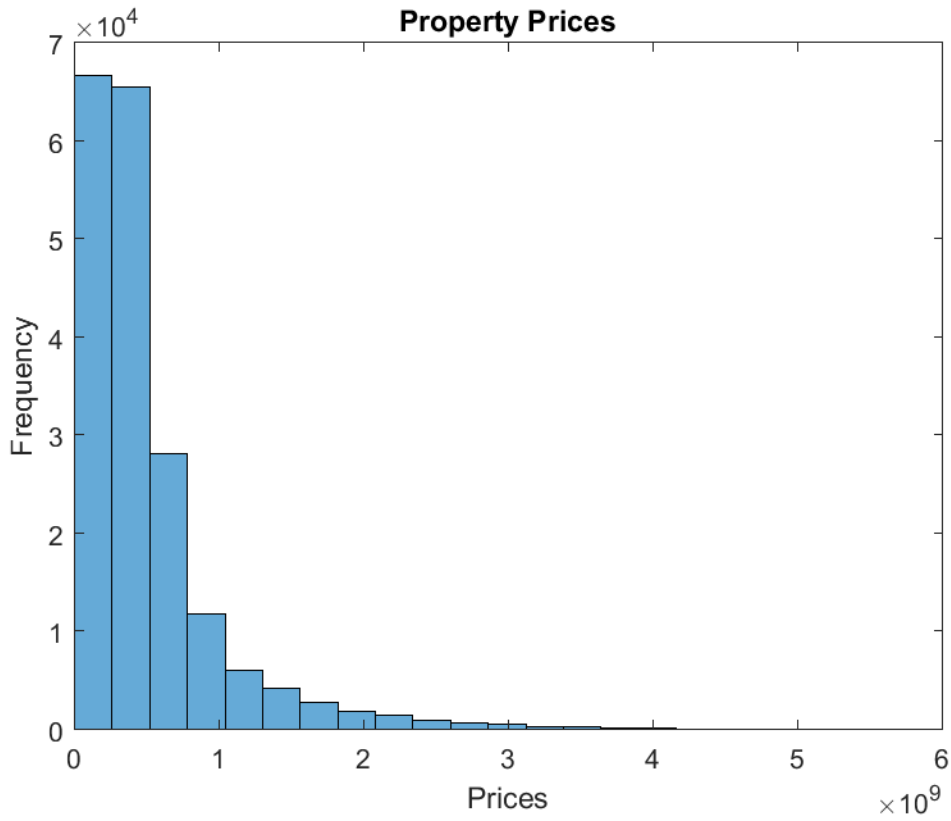


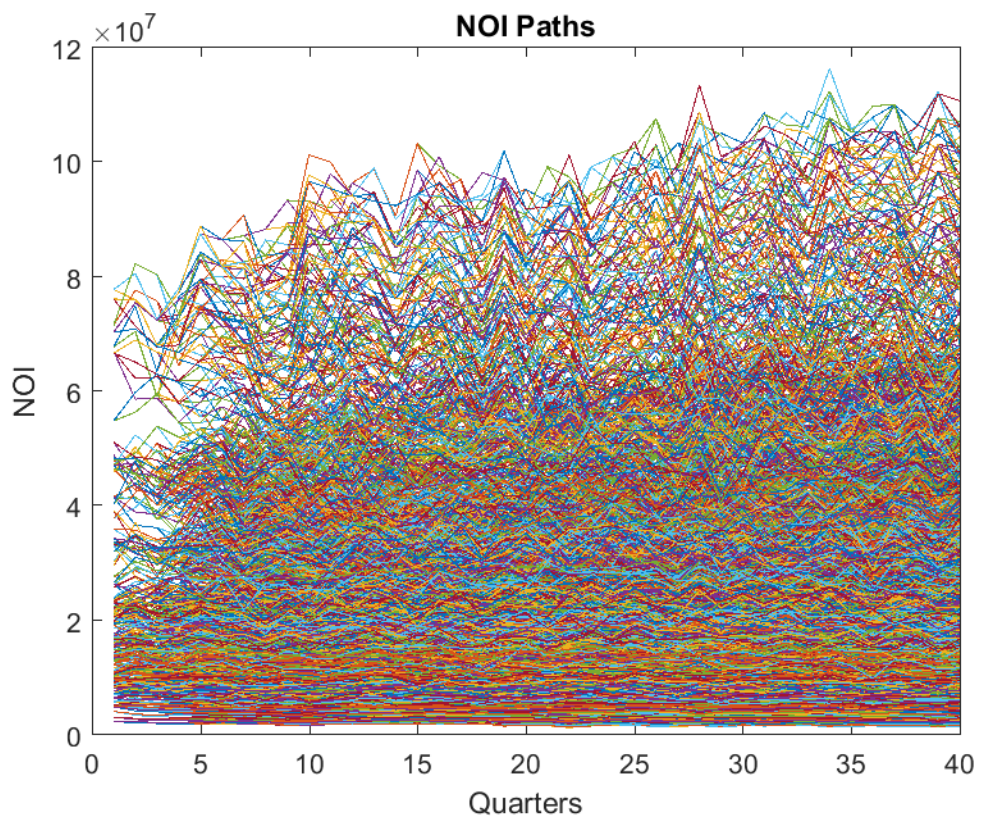
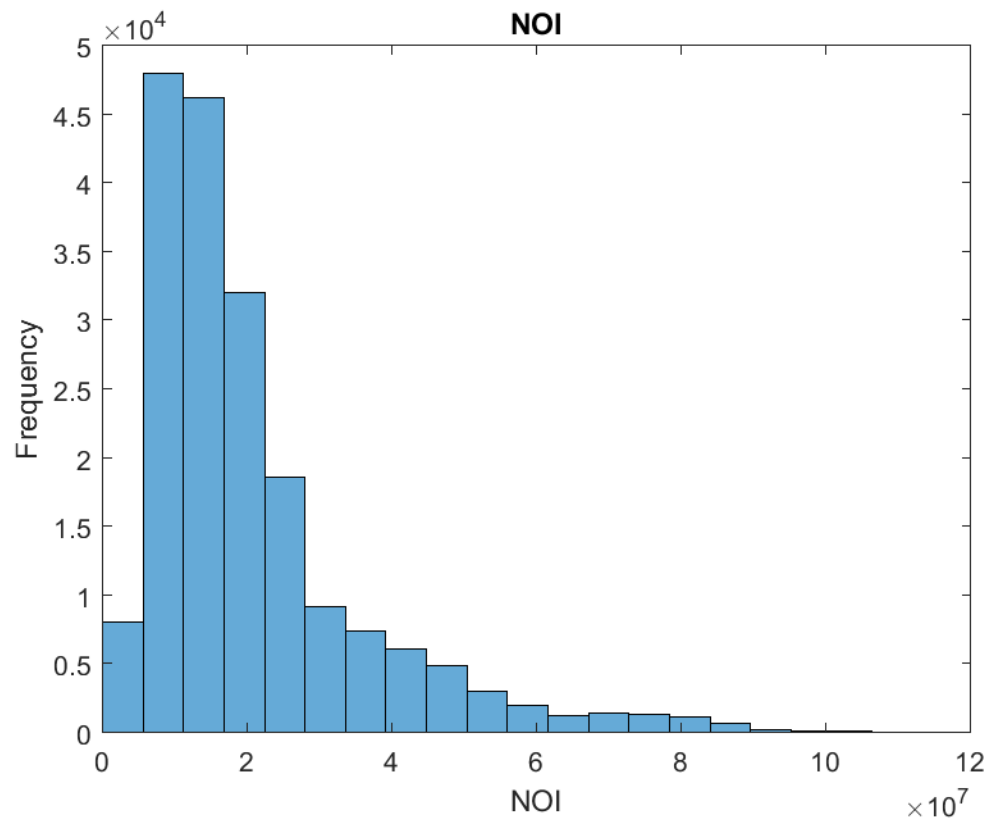
Determine Projected Property Prices and Net Operating Income

In order to properly combine the aggregate and the idiosyncratic components, transformation of the matrices is required. Currently, the aggregate economic factors are generated into P and N $[1000 \times 40]$ and the idiosyncratic factors are generated into P_epsi and N_epsi $[191 \times 40]$. So, the simulation specific shock (aggregate) must be applied to the loan specific shock for each simulation, therefore yielding a $[191000 \times 40]$ matrix to provide a systematic and idiosyncratic treatment to every loan. As a result, we must create 1,000 simulation groups whereby each loan is receiving simulation treatment, along with its own personal risk that carries across simulations.

With this transformed matrix of changes, the idiosyncratic and aggregate shocks are combined in out_p and out_n $[191,000 \times 40]$ to yield the projections for changes in prices and income. Out_p and out_n serve as the percentage change of the total risk as it relates to property price and income respectively. The $out_p = P_epsi(n,:) + P(k,:)$ and $out_n = N_epsi(n,:) + N(k,:)$ enable the model to see the simulation-specific and loan-specific risks in all combinations in terms of creating portfolio simulations. The changes are reshaped so that every loan is listed, providing the same size matrix of changes $[191000 \times 40]$.

Next, these changes must be applied to the loans themselves using the property prices and net operating incomes as is listed at origination. These resized matrices $[v_o$ and $noi_o]$ are going to be used to yield the projected prices and incomes, not their changes. The prices are listed within the newly replicated v_o and income within the newly replicated noi_o . To arrive at the projections, the v_o and noi_o are multiplied by their percentage change. The equations utilized are: $Prop_price = (1 + out_p) .* v_o$; $Net_op_income = (1 + out_n) .* noi_o$. Using these price and income figures, the model then assesses the performance of the portfolio.





Default Modeling: Determination of Immediate and Term Defaults

The immediate defaults must be assessed through interest expense against projections of NOI. The interest expense is calculated at origination on a quarterly basis. The benchmark utilized in this calculation will be the DSCR. The interest expense matrix [*interest_expense*] is replicated to be the same size as *Net_op_income* [191000 x 40]. However, for proper assessment of the debt service coverage, we cannot look at the yearly net income like *Net_op_income*, but we must look at quarterly income. So, the model transforms the *Net_op_income* by a scalar of $\frac{1}{4}$.

To determine if a loan immediately defaults, we must assess if the loan's net operating income falls below its debt service coverage. While DSCR is benchmarked to at least 1.2 in the case of origination, the borrower will not immediately default unless it is unable to fulfill debt service. As a result, the model creates a new variable, *Imm_Def*.

To calculate *Imm_Def*, the model assesses the quarterly income and quarterly interest payment and generates a 1 for *Imm_Def* when the condition is true. Then, the model uses the variable *def_quarter* to identify the first time that the loan's income fails to fulfill debt service, indicating an immediate default. Then, once provided that quarter, the variable, *imm_def_price* pulls the according property price and fills it into the matrix in the correct column such that the cash flows can account for the early seizure of asset and cease interest payments. The *imm_def_price* matrix yields only 2 variables to avoid confusion and mark the time of default. *Imm_def_price* maintains 0 unless recognizing default payment. Upon default, the value is provided in the *imm_def_price* matrix.

In addition to the immediate defaults, there are term defaults. The model assumes that the borrower will strategically default at $n = 40$ if the value of the loan is more than the value of the property because the bank can seize the asset as collateral instead. As a result, the model assesses

loan to value at maturity. If the $rLTV > 1$, the model assumes strategic default and sells the asset at its market price. In reality, this may be too generous given that the bank would not be able to capture the full value of the property. Nevertheless, the model assumes ability to capture full value because in average or above-average times, the bank may be able to seize a higher value. Whereas, the bank won't be able to capture full market value because of fire sales in poor times. Using the LTV as a proxy for determination of term defaults, the model assigns *Term_Def* as the variable to mark the term defaults. *Term_Def* relies upon $rLTV(:, 40) > 1$ and an additional condition such that the loan did not immediately default during its life. Therefore, the *term_def_price* variable captures projected property prices at maturity because the bank is no longer able to receive the balance of the loan and has not immediately defaulted.

Cash Flow Analysis: Defaults, Interest Payments & Repayment of Principal

To arrive at the total default values, immediate and term, the *default_price* matrix combines these cash flows to yield the seizure of collateral in the event of default albeit immediate (*imm_def_price*) or term (*term_def_price*). In fact, the default price matrix is utilized to assess the loans that defaulted, immediately or during the life of the loan.

Principal recovery is calculated by assessing whether a number appears within a given row, *s*, and assigns the principal to the loan in the case of no default. The repayment of principal is stored in the *repay_principal* variable. The *repay_principal* variable returns the original loan balance (*ob_o*) only in the case of no default (*def_quarter == 41 && Term_Def == 1*).

Next, the cash flows of interest payments must be determined. Because defaulted loans are no longer able to collect interest payments the *interest_payment* variable must be modified accordingly. As such, the model implements a variable, *interest_collection*, to provide the interest payments leading up to the precise period of default so that the model does not

inadvertently add interest flows that it will never see. *Interest_collection* is a variable upon which the period, n is compared with *def_quarter*, the period upon which the loan defaults. The loan only delivers interest prior to default and then terminates its interest payments.

The next step in assessing the bank's portfolio is to calculate the total cash flow.

The comprehensive cash flows will include 4 components:

1. Original balance of the loans [*original_loan_balances* = *ob_o(:,1)*]
2. Interest payments (excluding defaults) [*interest_collection*]
3. Repayment on principal (non-defaulted loans) [*repay_principal*]
4. Default Recoveries (collateral of properties) [*default_price*]

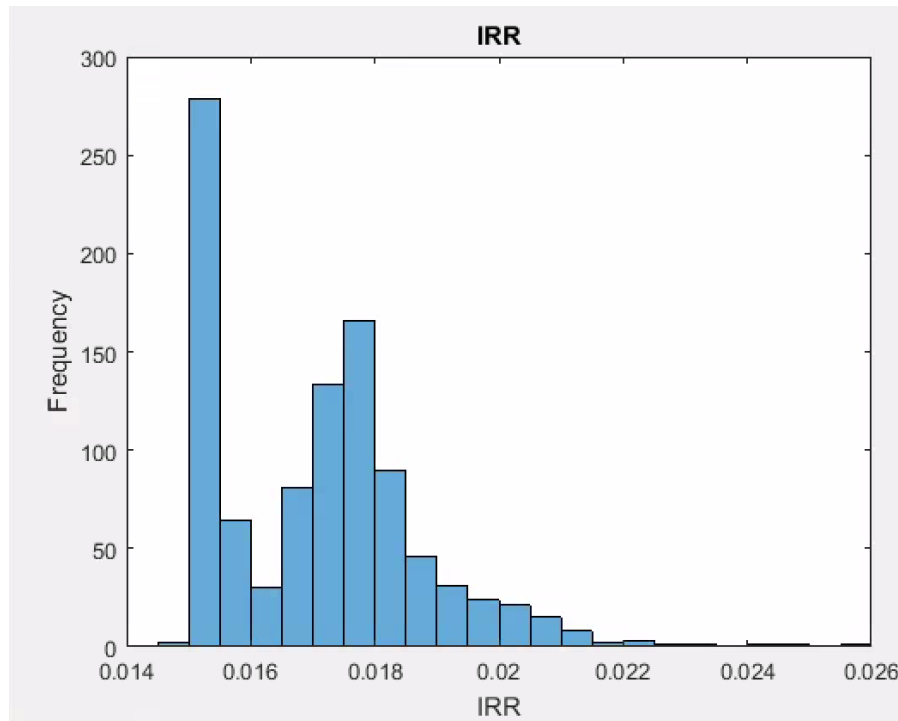
Please note that that original balances are the amounts lent to the borrowers at origination.

When calculating the cash flows, this initial outlay of principal is the only outgoing payment that the bank must recognize. Therefore, the model does have a separate cash flow calculation for the incoming payments. Incoming and outgoing cash flows are reflected in the *total_cash_flow*.

Because the *total_cash_flow* is listed as a [191000×40] matrix, the *pf_cash_flow* matrix reshapes the matrix to be a [$191 \times 1000 \times 40$] such that it is [*nloans, nsim, nquarters*]. Creating three dimensions, this matrix facilitates analysis of the cash flows of the loans on a portfolio level across simulations. This matrix is summed across loans to enable returns to be calculated across periods within portfolios. The sum of the cash flows is indexed to the loans such that the *cash_flow_sim* matrix generates a simulation result for each quarter [1000×40].

Armed with the cash flow, the model then calculates the internal rate of return for each period. This number is generated using the *irr* function embedded in MATLAB whereby it takes all incoming evenly spaced cash flows, including the initial investment or borrowed funds in

period 1. The IRR functions as the rate of return for the bank for this portfolio. The return metric presented below is the quarterly output generated by the model.



In addition to the derivation of a return metric to track the bank's cash flows, portfolio-level metrics like the loss given default are also yielded in the model. The procedure involves location of defaults within simulations within the model and pulling the respective property price based on the aggregate economic effect within the simulation, which influences the recovery price. As defined as $recoveries ./ original_loan_balances$, the loss given default is then indexed to its specific simulation in which it defaults through discretization as well as the *lgd* matrix which has the *loss_given_default* in column 1 and the *row* from the *find* function used to identify defaults. The graph below depicts the number of defaults per simulation

Appendix 9: Commercial Real Estate Loans at FDIC Banks²⁹³

Commercial/Multifamily Mortgage Bankers Originations Index
2001 quarterly average = 100

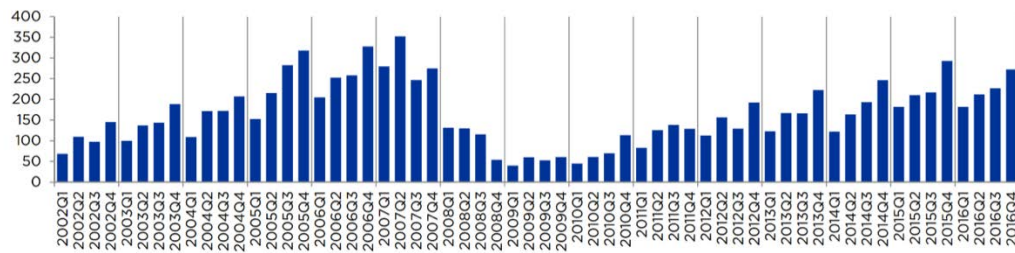
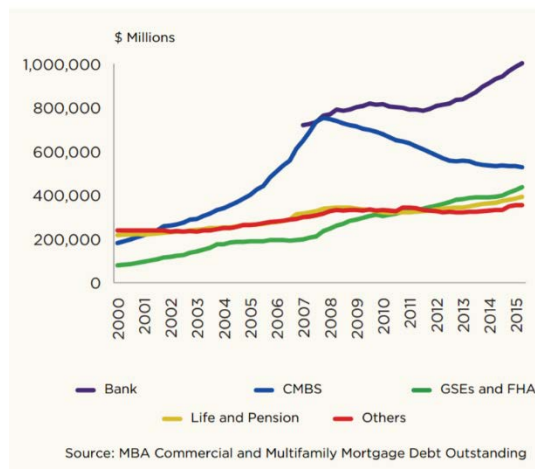
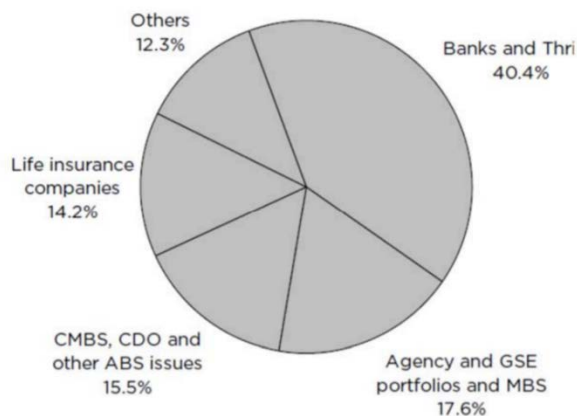


FIGURE 4. COMMERCIAL / MULTIFAMILY MORTGAGE DEBT OUTSTANDING



Commercial Multifamily Mortgage Debt Outstanding
By Investor Group, Fourth Quarter 2016



²⁹³ Mortgage Bankers Association “DataBook”

²⁹⁴ Mortgage Bankers Association, “4Q2016 Originations”