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Empirical Analysis of the Average Asset Correlation for Real Estate Investment Trusts

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ABSTRACT: The credit risk capital requirements within the current Basel II Accord are based on the asymptotic single risk factor (ASRF) approach. The asset correlation parameter, defined as an obligor's sensitivity to the ASRF, is a key driver within this approach, and its average values for different types of obligors are to be set by regulators. Specifically, for commercial real estate (CRE) lending, the average asset correlations are to be determined using formulas for either income-producing real estate or high-volatility commercial real estate. In this paper, the value of this parameter was empirically examined using portfolios of U.S. publicly-traded real estate investment trusts (REITs) as a proxy for CRE lending more generally. CRE lending as a whole was found to have the same calibrated average asset correlation as corporate lending, providing support for the recent U.S. regulatory decision to treat these two lending categories similarly for regulatory capital purposes. However, the calibrated values for CRE categories, such as multi-family residential or office lending, varied in important ways. The comparison of calibrated and regulatory values of the average asset correlations for these categories suggest that the current regulatory formulas generate parameter values that may be too high in most cases.

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I. Introduction

The Basel Committee on Banking Supervision (BCBS) issued the final draft of its updated capital adequacy framework for international banking institutions in June 2004; see BCBS (2004).[1] This draft will serve as a basis for the implementation of the proposed regulatory capital guidelines to be determined by each national regulatory authority. BCBS member nations are currently scheduled to implement the so-called Basel II Accord by 2008.

The minimum regulatory capital requirements of the new Accord have received the most attention to date, mainly due to the extensive analysis and calibration exercises that have gone into their crafting. Under the current proposal, banks can determine their regulatory capital requirements for credit risk using one of three possible approaches. Under the standardized approach, capital requirements are based on regulatory assessments of credit risk that are imposed commonly across institutions. In contrast, the foundation and advanced internal-ratings based (IRB) approaches are driven by banks' own internal credit assessments of individual borrowers. The IRB approaches within the Basel II Accord are based on the asymptotic single risk factor (ASRF) model developed by Gordy (2000, 2003), within which a key variable is the correlation of a given obligor's asset returns with the risk factor that summarizes general economic conditions. In typical economic capital calculations, every borrowing firm has a unique asset correlation that assists in determining possible credit losses. However, for the purposes of regulatory capital calculations, such a multitude of parameters is infeasible. Instead, the BCBS has proposed the use of formulas that would assign asset correlations that are a decreasing function of firm probability of default.

In this paper, we specifically analyze asset correlation parameters for commercial real estate (CRE) loans. Under the IRB approaches, CRE lending is a subcategory of corporate

[1] The BCBS was established by the central banks of the Group of Ten countries in 1974, but it does not have formal supranational supervisory authority. Its goal is the formulation of broad regulatory standards and guidelines, as well as recommendations of industry best practices, in the expectation that national supervisory authorities will implement them through arrangements best suited to their own financial systems.

lending, and it is further subdivided into income-producing real estate (IPRE) lending and high-volatility commercial real estate (HVCRE) lending. IPRE refers to CRE lending based primarily on the cashflows generated by an asset; for example, the rental payments generated by office towers or multifamily residential buildings. HVCRE generally refers to CRE lending more closely related to the acquisition, development and construction of commercial properties, which typically have a greater degree of repayment uncertainty.

We empirically analyze the value of the average asset correlation for CRE loan portfolios in the U.S. using the methodology developed by Lopez (2004), in which the ASRF modeling conditions are imposed on the Moody's KMV (MKMV) methodology for determining credit risk capital charges.[2] Specifically, a single risk factor is used to describe obligor asset value dynamics, and all obligors within a portfolio are assigned a common, or average, asset correlation with the model's single factor. We constructed CRE loan portfolios based on all U.S. publicly-traded real estate investment trusts (REITs) as of year-end 2002. Note that we thus explicitly assume that U.S. banks' CRE lending portfolios can be proxied for by these publicly-traded entities. Several research papers, such as Gyourko and Keim (1992) and Mei and Lee (1994), have shown that investment returns on REITs are reasonable proxies for the returns on real estate assets more broadly.

The paper makes two empirical contributions. First, it provides an alternative set of asset correlations whose calibration was targeted specifically to the ASRF framework underlying the Basel II Accord. For a CRE loan portfolio consisting of all 189 REITs in our sample, the average asset correlation was calibrated to be 0.1625. This value is exactly in line with the value for all U.S. firms reported by Lopez (2004), suggesting that CRE lending as a whole is no more or less correlated with overall economic conditions than corporate lending. This result is in

[2] The software firm Moody's KMV, LLC is a leader in the field of credit risk modeling and capital budgeting. This study was conducted using their Portfolio Manager™ software, version 1.4.7, which they kindly provided for this study. Since the empirical results in the paper are based solely on the MKMV methodology, they are highly dependent on its underlying structure. However, as shown by Gordy (2000), several credit risks models share similar mathematical structures.

contrast to some of the empirical results presented in Case (2003) that suggest CRE asset correlations are higher than corporate asset correlations. Second, the paper presents calibrated average asset correlations for seven CRE categories, which ranged from a low of 0.1000 for retail REITs to a high of 0.2375 for apartment and hotel REITs. Note that the highest value was actually 0.5000 for industrial REITs, but the accuracy of this estimate is questionable due to just seven REITs in that category. While this category is the extreme case, the limited number of REITs in almost all the categories imply that the estimation error bands around the calibrated parameter estimates should be considered. With regard to these CRE subcategories, our ratios of calibrated asset correlations for the different types of CRE lending relative to standard corporate lending align quite well with the ratios reported by Case (2003).

With regard to current policy discussions regarding Basel II implementation in the U.S., these empirical results can help to address two specific questions regarding CRE lending. The first question is whether specific CRE lending categories should be treated as IPRE or HVCRE for regulatory capital purposes. Under the current Basel II guidelines, all lending to finance acquisition, development and construction (ADC) of commercial properties, subject to certain exceptions, must be assigned to the HVCRE category. However, the national bank regulatory agencies have sole responsibility for determining, which if any, types of CRE lending that finance in-place CRE properties should be placed in that category.

As discussed by Case (2003), supervisory judgement and experience in the U.S. generally supports the high asset correlation assumption for most CRE lending. However, given the lack of clear empirical evidence in support of that assumption, the U.S. bank regulatory agencies have decided to place all in-place CRE lending in the IPRE category. Recall that the regulatory capital treatment of IPRE lending is equivalent to that of standard corporate lending. Our calibrated average asset correlations for all REITs supports this conclusion when combined with the calibration by Lopez (2004) for corporate borrowers. The calibrated correlation values for the REIT subcategories might be useful in deciding between IPRE and HVCRE treatment;

for example, the higher correlation value for residential CRE lending relative to retail CRE lending suggests that the former category is more reasonably considered as HVCRE. However, this type of ranking does not provide us with clear guidelines as to where the appropriate cut-off correlation value should be set.

The second policy issue that can be addressed is the current parameterization of the regulatory average asset correlation formula for IPRE lending. For banks capable of estimating all parameters required by the advanced IRB (AIRB) approach, the values for the regulatory asset correlation function for IPRE exposures, which is identical to the one for standard corporate exposures, ranges from 0.12 to 0.24. The function for HVCRE exposures would allow for higher values ranging from 0.12 to 0.30, implying that their repayment capabilities are more correlated with overall economic conditions.[3] Our calibrated average asset correlations for the seven CRE subcategories can be compared to the values generated by these regulatory formulas using the inter-quartile range of REIT PDs as determined by Moody's KMV.

We find that the calibrated values for hotel and mortgage REITs fall within the defined regulatory HVCRE ranges and above the regulatory IPRE ranges, suggesting that these categories could be classified as HVCRE. All other categories, again with the exception of industrial REITs, have calibrated asset correlations that fall below the specified HVCRE ranges. In fact, for these four subcategories, their calibrated values also fall outside of their defined regulatory IPRE ranges. The calibrated correlations for office, retail and other REITs fall below the defined regulatory range, suggesting that the current IPRE asset correlations may be too high for these types of CRE loans. For residential REITs, the calibrated correlation falls just above the specified IPRE range and just below the HVCRE range. In fact, the calibrated values for all REITs falls below the specified regulatory IPRE range. These results suggest that there is an

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[3] In the United States, the banking regulatory agencies are proposing to implement the Basel II Accord by allowing two methods for calculating minimum capital requirements for CRE loan portfolios; see Case (2003) for a complete discussion. The first method would be the AIRB approach discussed here. The second method, known as the supervisory slotting criteria approach, would be available only for CRE loans and for use only by banks that cannot reliably estimate the required AIRB parameters. In this paper, we focus only on the first method.

important degree of variation in credit risk correlation across CRE lending categories that may not be captured in the current IPRE formula. Hence, further analysis regarding the regulatory average asset correlation formulas may be needed, although the results and policy implications presented here need to be understood in the context of their empirical methods and the larger policy questions regarding regulatory capital requirements.

The paper is organized as follows. Section II briefly summarizes the treatment of commercial real estate lending under the new Basel II Accord and the current state of its implementation in the United States. Section III presents the methodology for imposing the ASRF framework within the MKMV PortfolioManager software, as per Lopez (2004), as well as describes the publicly-traded REIT data used in the analysis. Section IV presents the empirical calibration results and compares them to the extant literature on calibrated average asset correlations and the CRE correlation formulas currently in the Basel II Accord. We also discuss the implications of these results for current policy issues. Section V concludes.

II. CRE lending within the Basel II Capital Accord

In the United States, depository institutions are currently subject to minimum regulatory capital requirements consisting of a minimum leverage ratio and two minimum risk-based capital ratios. The risk-based ratios are based on the 1988 Basel Capital Accord developed by the Basel Committee on Banking Supervision (BCBS). Although the 1988 Accord was a useful tool for standardizing international capital requirements, it was determined to no longer be measuring banks' risk exposures adequately and thus setting regulatory capital requirements that deviated from economic capital requirements. To address these concerns, the BCBS issued a substantial revision of its regulatory capital framework, which has come to be known as the Basel II Accord, in June 2004.

The Basel II Accord consists of three mutually reinforcing pillars: minimum regulatory capital requirements as per the original Accord, enhanced review by national bank supervisory authorities, and market discipline. The first pillar has received the most attention because of the extensive quantitative efforts used to craft it and calibrate it regulatory parameters. A banking organization must calculate capital requirements for its exposure to both credit risk and operational risk, as well as market risk if the organization engages in significant trading activities. In this paper, we focus only on credit risk issues addressed within the Accord.

Two methodologies for determining credit risk capital requirements are permitted under the new Accord: the standardized approach, which is an extension of the original Accord, and the internal ratings-based (IRB) approach based on banks' own internal estimates of key risk parameters. The IRB approach is further subdivided into the foundation methodology, in which certain risk parameters are set by regulation and others are supplied by the banks, and the advanced (AIRB) methodology, where banks themselves provide more risk inputs. In the U.S., the bank regulatory agencies have determined that the AIRB approach is most appropriate for use by large and internationally-active banking organizations. This decision creates a bifurcated regulatory capital framework with two separate, but related, methodologies for setting credit risk capital requirements.

Under the AIRB approach for credit risk, a banking organization's own internal assessments of credit risk are the main inputs for calculating minimum regulatory capital requirements. Specifically, these assessments and associated parameters, such as firm default probabilities and loan losses given default, are to be used to derive regulatory capital requirements for each loan exposure. All credit exposures would be assigned to one of three portfolios: wholesale credit, which includes corporate, interbank and sovereign lending; retail credit, which encompasses residential mortgages and qualifying revolving credit lines; and equities. There is also specific treatment for exposures arising from asset securitizations and purchased receivables. We focus here on wholesale corporate exposures, which are exposures to private-sector, non-financial companies. Within the corporate asset class, there are five sub-classes of specialized lending identified as project finance, object finance, commodities finance, income-producing real estate (IPRE), and high-volatility commercial real estate (HVCRE).[4]

IPRE lending refers to CRE lending based primarily on the cashflows generated by an asset; for example, the rental payments generated by office towers or multifamily residential buildings. HVCRE lending generally refers to CRE lending more closely related to the acquisition, development and construction of commercial properties, which typically have a greater degree of repayment uncertainty. Under the new Accord, there are two categories of HVCRE. First, subject to certain exceptions, all lending to finance acquisition, development and construction (ADC) loans must be assigned to the HVCRE category.[5] Second, the national regulatory agencies have the responsibility of determining which, if any, types of CRE lending that finance in-place CRE properties should receive the HVCRE assignation in their country. As discussed by Case (2003), the U.S. bank regulatory agencies have concluded that there is not sufficient empirical evidence for including in-place CRE lending into the HVCRE category. Hence, almost all CRE lending will receive the same risk weights as corporate lending.

Under the AIRB approach, banks must assign four parameters to each credit exposure: probability of default (PD), loss given default (LGD), exposure at default (EAD), and maturity (M). The wholesale AIRB risk weight functions use the parameters to produce a specific capital requirement for each wholesale exposure; see Appendix A for an overview of this calculation. With respect to the two CRE categories of interest here, IPRE exposures would receive the same risk weights as standard corporate exposures. HVCRE exposures would receive more conservative risk weights; that is, for a given PD, LGD and M, a loan in an HVCRE portfolio would incur a higher capital charge than would a loan in an IPRE portfolio. This difference in capital charges is primarily driven by the higher range for regulatory asset correlation parameters. The exact functions are discussed in Section IV.C.

[4] CRE exposures are typically non-recourse exposures, often to special purposes vehicles, and are distinguishable from corporate exposures that are collateralized by CRE.

[5] All ADC loans will be treated as HVCRE exposures, unless the borrower has “substantial equity” at risk or the property is pre-sold or sufficiently pre-leased.

III. Calibration methodology and REIT data

III.A. Summary of the MKMV methodology

As in Lopez (2004), the empirical calibration of the asset correlations for all the REIT portfolios was conducted using the Portfolio Manager™ (PM) software produced by Moody's KMV (MKMV). The theoretical core of the MKMV methodology for evaluating credit risk is the Vasicek-Kealhofer model, which is an extension of the Merton model of a firm's stock as an option on the underlying assets; see Vasicek (1984) and Kealhofer (2003) as well as Crosbie and Bohn (2003) for further details. To measure the credit risk of a loan to a firm, the MKMV methodology models the distribution of the firm's asset value over the chosen planning horizon, its implied probability of default, and the corresponding distribution of the loan's value. Note that this loan value distribution explicitly accounts for both firm default and changes in firm credit quality.

Specifically, the MKMV methodology models the value of the assets of firm i, denoted as A_{it}, at some future point t+H. Based on the Merton model, future asset values A_{it+H} is modeled as

$$\ln\left(A_{it+H}\right) = \ln\left(A_{it}\right) + \left(\mu_i - \frac{\sigma_i^2}{2}\right) H + \sigma_i \sqrt{H} \varepsilon_{it+H},$$

where μ_i is the asset value drift term (typically positive), σ_i^2 is the firm's asset return volatility, and the firm-specific error term ε_{it+H} is a weighted average of a common (or systematic) random factor and an idiosyncratic random factor. That is, ε_{it+H} is modeled as

$$\varepsilon_{it+H} = R_i \xi_{it+H} + \sqrt{1 - R_i^2}\, \upsilon_{it+H} \ ,$$

where R_i^2 measures the percentage of the firm's asset return variance attributable to the common risk factors affecting the firm, ξ_{it+H} is a random variable representing the firm's H-period-ahead composite risk factor, and ν_{it+H} is an idiosyncratic random variable. Both ξ_{it+H} and ν_{it+H} are assumed to be uncorrelated and have standard normal distributions, ensuring that ε_{it+H} also has a standard normal distribution. Note that the R_i is referred to as the asset correlation for firm i.

For each firm of interest, MKMV determines its overall liabilities at time H. For a particular realization of A_{it+H}, a "distance to default" measure is calculated and used to determine a firm's "expected default frequency"™ (or EDF™) based on MKMV's proprietary default database. The firm's EDF value and its loans' recovery rates permit the calculation of the loan values if the firm defaults. For non-default states, the loans are valued by discounting their cashflows using market-based credit spreads corresponding to the firm's credit quality. Individual loan calculations can be aggregated up to the portfolio level in order to determine the distribution of loan portfolio returns, which in turn can be used for determining economic capital allocations and other credit risk management calculations.

III.B. Application of the ASRF framework to the MKMV methodology

In order to establish regulatory capital requirements applicable across institutions and across credit risk models, the Basel II Accord's calculations are based on a very general modeling framework, commonly known as the asymptotic single risk factor (ASRF) approach. As developed by Gordy (2000, 2003), the ASRF approach assumes that a single risk factor is responsible for all credit quality movements across all obligors in an "infinitely granular" portfolio.[6] Each obligor has a unique asset correlation R_i with the common risk factor, and the realization of this factor determines the obligors' individual outcomes. Further simplifying assumptions are often made to reduce the number of parameters; for example, all obligors could be assumed to have a common asset correlation with the composite risk factor; i.e., $R_i = R \forall i$. Within this analytic framework, the regulatory capital requirement for a portfolio equals the sum of the regulatory capital requirements for individual credits. This additive property permits the "bucketing" of credits based on certain characteristics, such as firm default probability and

[6] The impact of the assumption of infinitely granular portfolios was not part of our analysis. In our analysis, we imposed the assumption of common loan sizes across the obligors. We further assumed that the numbers of obligors in our sample portfolios were sufficiently large for this assumption to hold, even though the number of obligors in this study was significantly smaller than in Lopez (2004). Further research into the validity of these assumptions is needed.

recovery rates. This property of the ASRF approach clearly simplifies the allocation of regulatory capital.

To impose the ASRF approach within the MKMV methodology, a number of restrictions were imposed on the PM software. The first and most important restriction was imposing a single risk factor across all firms; i.e., $\xi_{it+H} = \xi_{t+H}\ \forall i$. Within the MKMV methodology, there are about 120 factors based on global, regional, country, sector and industry effects. These various factors are aggregated based on firm characteristics to construct a firm's composite factor. For example, the return on the composite factor (denoted CF_i) for a U.S. domestic firm that is 60% involved in paper production and 40% in lumber production would be

$$CF_i = 1.0\ r_{USA} + 0.6\ r_{paper} + 0.4\ r_{lumber},$$

where r_{USA}, r_{paper} and r_{lumber} are the returns on the factors for the entire U.S. economy, the global paper industry and the global lumber industry, respectively. A regression of firm i's asset returns on CF_i provides the asset correlation R_i used in the MKMV asset value simulations.

Thus, to impose the ASRF approach, we collapsed their many potential factors into a single factor common to all obligors. This restriction was imposed by forcing all of the firms within a portfolio to have the same degree of dependence on the same country and industry factors. In our analysis, we assumed that all obligors were dependent on the U.S. country factor and on the unassigned industry factor known as N57 within the MKMV industry database.[7]

The second key restriction is the imposition of a common degree of dependence by assuming a common R^2 value for all obligors in the portfolio. This common R value is termed the "average" asset correlation, even though it is not strictly an average, and it will be denoted here as $\bar{\rho}_A$. These two restrictions are obviously quite strong, but necessary for applying the ASRF framework.

There is no theoretical answer as to what the value of the average asset correlation should

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[7] Within the ASRF framework, the recommended capital requirements are independent of the common factor chosen. However, in the empirical implementation, differences will arise when different factor specifications are used. These differences should be minor, and preliminary results from Lopez (2004) support this hypothesis.

be, and thus purely empirical values must be determined. To calibrate the empirical $\bar{\rho}_A$ values for our CRE lending portfolios at the 99.9% percentile of the credit loss distributions, we minimized the absolute difference between the credit losses indicated by the unconstrained PM model and by the ASRF-constrained version. The calibrations were conducted using a grid search over a reasonable range of $\bar{\rho}_A$ values. Note that the relationship between this difference of credit losses and $\bar{\rho}_A$ values is roughly linear due to the standard normal distribution underlying the single common risk factor ξ_{t+H}. The convergence criteria used were that the calibrated $\bar{\rho}_A$ values would have only up to four significant digits and that the dollar differences between the two models' capital charges at the specified quantile were less than 0.1% of the total portfolio size. The calibrated $\bar{\rho}_A$ correlations for credit portfolios composed of REITs are the primary empirical contribution of this paper.

The third restriction needed to impose the ASRF framework within the PM software is that the LGD is constant. For the sake of simplifying our analysis, we also imposed a recovery rate of 50% across all obligors. Although this is a strong assumption, it is a commonly used value, as in Jackson et al. (2002).[8] Furthermore, we know that capital charges within the PM software for portfolios with other LGD values are a simple multiple of each other.

The fourth restriction imposed on the PM software for our analysis was a one-year maturity for all credits. Note that this restriction is not explicitly required by the ASRF framework. Further research on the impact of maturity on the calibrated $\bar{\rho}_A$ values derived within the ASRF approach is needed.

The procedure for implementing the ASRF approach within the PM software and analyzing the calibrated average asset correlations consists of three steps. The first step is to

[8] Within the PM software, LGD rates can be assumed to be random variables. For this study, they are set to be constant and are calibrated based on the extant empirical literature. Jackson et al. (2002) argue that an LGD value of 50% is close to the recovery rate of 51% commonly used for senior unsecured bond defaults. Gupton et al. (2000) suggest an LGD for bank loans of between 35% and 50%. Asarnow and Edwards (1996) found an LGD of 35%, while Carey (2002) used an LGD value of 30% for his analysis. For CRE lending, Case (2003) used a formula where LGD is an increasing function of PD with a minimum value of 24%.

create the REIT portfolios of interest. The loans to the chosen REITs are structured to have a maturity of one year, a floating rate coupon with a quarterly payment schedule, and a common commitment size of $100 million. These restrictions obviously impact the nature of the credit portfolios being analyzed; for example, the standard commitment size precludes analysis of the granularity issue. Further research into this issue is required. However, the empirical results should provide meaningful asset correlations for CRE lending types.

The second step consists of running the unconstrained version of the PM software on the constructed portfolios in order to generate the capital required at the one-year horizon for the 99.9% percentiles of the loss distribution.[9] Of the various definitions of capital used in the PM software, we chose to use capital in excess of expected loss. That is, PM generates the portfolio's credit loss distribution, designates its mean as the expected loss, and presents the tail quantiles as credit losses beyond the expected loss. Credit losses at the one-year horizon are transformed into capital charges by discounting them to the present with the appropriate risk-free rate. Total capital is the sum of the discounted expect loss and the specified tail loss. The final step is to calibrate the CRE portfolios' $\bar{\rho}_A$ values using a grid search as previously described.

III.C. NAREIT data description and REIT portfolios of interest

A significant portion of the CRE assets in the United States are owned by publicly-traded, real estate investment trusts (REITs). Publicly-traded REITs are companies that qualify as pass-through entities who pass the majority of their income directly to investors without corporate taxation providing that certain conditions are met.[10] REITs concentrate on buying,

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[9] The number of simulations used was 100,000 runs, which is the number recommended by MKMV for analysis of the 99.9% tail quantile.

[10] In order for a corporation to qualify as a REIT and gain the advantages of being a pass-through entity, it must be structured as a corporation, business trust, or similar association; managed by a board of directors or trustees; have fully transferable shares; have a minimum of 100 shareholders; and have no more than 50 percent of the shares held by five or fewer individuals during the last half of each taxable year. It must pay dividends of at least 90 percent of its taxable income; have at least 75 percent of total investment assets in real estate; derive at least 75 percent of gross income from rents or mortgage interest; and have no more than 20 percent of its assets consist of

developing and managing commercial real estate assets that generate rental income. The assumption underlying this paper is that the equity market valuations of these assets can be used to calibrate asset correlations for CRE loan portfolios. Several research papers, such as Gyourko and Keim (1992) and Mei and Lee (1994), have shown that investment returns on REITs are reasonable proxies for the returns on real estate assets more broadly.

Our database consists of 189 publicly traded REITs that were available in the MKMV Credit Monitor database and had a non-zero EDF as of year-end 2002; see the Appendix B for a complete listing.[11] As of year-end 2002, the market capitalization of these REITs was $153 billion. The REITs were subdivided into seven categories according to their primary type of activity. These categories are based on, but are not identical to, those used by the National Association of Real Estate Investment Trusts (NAREIT). The seven categories are residential, industrial, hotel, mortgage, office, retail and "other"; see the breakout of the sample in Table 1.

Residential REITs engage in the ownership, development, construction and management of multi-family apartment and residential facilities; they make up about 18% of the REIT sample's market capitalization. Industrial REITs own and manage industrial sites, such as warehouses and distribution centers, and make up almost 7% of the sample's market capitalization. Hotel REITs typically own, develop and manage hotels, resorts and other lodging facilities; they make up about 5% of total market capitalization. Mortgage REITs are engaged in the ownership, management, acquisition and disposition of mortgages, both residential and commercial, and make up a another 5% of the sample's market capitalization. Office REITs engage primarily in the ownership, management, acquisition, expansion and development of commercial office space and make up 17% of the market capitalization. Retail REITs focus on the ownership, acquisition, and management of retailing outlets, such as shopping centers and

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stocks in taxable REIT subsidiaries.

[11] The ASRF framework analyzed here assumes that the credit portfolios in question are infinitely granular, which may be an issue with only 189 obligors in the overall REIT portfolio and fewer in the subcategory portfolios. Further research into the impact of granularity on these results is needed.

account for almost a quarter of the sample's market capitalization. The 63 REITs in the "other" category engage in a wide variety of real estate activities that overlap, but do not fit neatly, into the previous six categories; this residual category makes up about 25% of the sample's market capitalization.[12]

Table 1 contains the various samples' distributions of one-year EDFs as generated by MKMV for year-end 2002; Chart 1 contains the same information in graphical form using a log scale. For all the REITs in the sample, the median EDF was 0.16% with an interquartile range of [0.06%, 1.16%] with a mean value of 1.70%. Four of the seven REIT categories have medians below the overall median. Industrial REITs have the lowest median value of 0.05%, but note that the small sample size of seven firms severely limits inference here. Retail REITs have a median of 0.07% with an interquartile range of [0.03%, 1.48%]. Office REITs have a median of 0.10% with a relatively narrow interquartile range of [0.09%, 0.29%], while residential REITs have a median of 0.12% with an interquartile range of [0.06%, 0.76%].

Three REIT subcategories have medians above the overall median. The REITs in the residual "other" category have a median of 0.18% with wide interquartile range of [0.04%, 0.93%]. Hotel REITs have a median of 0.80% with an interquartile range of [0.27%, 1.48%]. Mortgage REITs have the highest median of 1.92% with a relatively wide interquartile range of [1.38%, 3.95%].

IV. Empirical calibration results and comparative analysis

IV.A. Calibration results

The empirical calibration results presented here are based on the procedure described earlier and developed by Lopez (2004). Recall that lower $\bar{\rho}_A$ values suggest less sensitivity to the asymptotic common factor, which corresponds to general economic conditions, and hence

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[12] A typical example of the firms in this category is REITs that own and develop self-storage facilities, which are not used for either residential, office or industrial purposes.

more idiosyncratic risk, whereas higher values suggest more systematic and less idiosyncratic risk. Two important caveats regarding this procedure should be noted. First, the calibrations were conducted using only the MKMV methodology and software, making the results completely dependent on this approach. However, the underlying economic model and their implementation are well understood and common across several credit risk modeling approaches. Second, the assumption of infinite granularity within the ASRF framework may be violated by the limited number of obligors in our REIT portfolios. This data limitation does not invalidate the results, but it does require us to be circumspect in our interpretation of the results.

As shown in Table 2, the calibrated average asset correlation for all U.S. REITs in our sample is 0.1625, which is equal to the value found for all U.S. non-financial firms during a similar time period by Lopez (2004). Hence, the CRE sector as a whole can be seen to be as correlated with overall economic conditions as the corporate sector. However, we observe a reasonable degree of dispersion among the seven CRE subcategories.

The lowest $\bar{\rho}_A$ value was found for the retail REIT category at 0.1000, substantially below the overall REIT value. This result suggests that retail REITs are much less sensitive to overall economic conditions than other CRE and corporate lending. A possible reason underlying this outcome is the relatively long leases common to retail establishments in malls and shopping centers; these longer leases probably span the duration of downturns in the business cycle and hence are less sensitive to them.[13] The next highest value was for the "other" category at 0.1500. This category is the largest category encompassing 33% of the obligors, which is probably the main reason its calibrated $\bar{\rho}_A$ value is so similar to that for all REITs in the sample.

The other five CRE categories have $\bar{\rho}_A$ values above 0.1625, ranging from 0.2000 for both office and mortgage REITs to 0.2375 for residential and hotel REITs. Higher correlations

[13] Stanton and Wallace (2002) found the mean maturity for their dataset of retail leases to 11.5 years. Hendershott and Ward (2002) examine retail leases with twenty year maturities.

with general economic conditions is not surprising for hotel REITs, since travel of all types slows during economic downturns. The high correlation for office and residential REITs must probably reflect the shorter leases signed by the tenants of these properties, especially for residential leases that are typically yearly. The relatively high $\bar{\rho}_A$ value for mortgage REITs may be explained by their investment in commercial mortgage-backed securities and other types of CRE mortgages, but their ownership of more standard mortgage-backed securities and residential mortgage pools would be a countervailing influence. The highest $\bar{\rho}_A$ value was for industrial REITs at 0.5000, but the calibration is questionable given the relatively small sample of seven obligors in this category.

Placing this analysis within a policy context, our calibrated $\bar{\rho}_A$ value for all REITs is the same as the corporate $\bar{\rho}_A$ value calibrated by Lopez (2004). This result supports the decision of the U.S. bank regulatory agencies to assign all in-place CRE lending to the IPRE category, which receives the same risk weights as standard corporate lending. However, our calibrated $\bar{\rho}_A$ values for CRE lending categories indicate a reasonable degree of variation in these correlations, suggesting that further analysis regarding the placement of certain CRE lending categories into the HVCRE category, especially residential and hotel CRE lending, may be warranted.

IV.B. Comparison to other studies

The empirical literature on the asset correlation parameter within the ASRF framework of the Basel II is small. As mentioned, Lopez (2004) examined the properties of calibrated $\bar{\rho}_A$ values for corporate lending portfolios subdivided by obligor country of origin, PD and asset size. He found that the calibrated $\bar{\rho}_A$ parameter was a decreasing function of PD, as proposed in the Basel II Accord, and an increasing function of firm size. A reasonable degree of variation was found across U.S., European and Japanese obligors. The intuition for the inverse relationship between asset correlation and PD is that as a firm's PD increases due to its worsening condition and approaching possible default, idiosyncratic factors begin to take on a more important role relative to the common, systematic risk factor. Similarly, as a firm increases in size and potentially becomes more diversified, its risk and return characteristics could more closely resemble the overall asset market and be less dependent on the idiosyncratic elements of the individual business lines. Within an ASRF framework, this intuition suggests that a firm's asset correlation should increase as its asset size increases.

For U.S. non-financial firms as of year-end 2000, Lopez (2004) found the calibrated $\bar{\rho}_A$ parameter within the ASRF framework to be 0.1625, identical to the value for all REITs in our sample. This result suggests that the overall REIT loan portfolio analyzed in this exercise is not different from a large commercial loan portfolio. While sample size is an issue here compared to the larger portfolios examined in Lopez (2004), the inverse relationship between $\bar{\rho}_A$ and median PD for REIT subsectors is not observed. Three possible reasons for this difference of outcomes present themselves. First, the sample sizes used here are much smaller and hence imply much broader estimation error bands around the calibrated $\bar{\rho}_A$ values for REIT portfolios. Second, a specific industrial sector, such as REITs, could highlight idiosyncratic characteristics that would not be observed across sectors, and these characteristics might impact the previously observed patterns. Third, CRE lending is conducted differently from standard corporate lending in such a way as to weaken the inverse relationship. For example, as reported by the Risk Management Association (2003), some lending institutions use higher asset correlations for CRE lending than for corporate lending, although others reported using the same values.

Specific to real estate lending, two papers have examined the asset correlation parameter over longer periods of time than just at year-end 2002. For residential real estate lending, Calem and Follain (2003) found that the regulatory asset correlation parameter of 0.1500 within the Basel II Accord fell within the range of empirical estimates generated by several credit risk models. While CRE lending is quite different from residential lending, the highly aggregated nature of the ASRF exercise, especially at the level of loan categories, should not surprisingly generate results common across these categories.

With respect to CRE lending, Case (2003) provides estimates of the CRE asset correlation parameter from a variety of data sources, time periods, and estimation methods. Using bank Call Report data from 1991 to 2002 on loan charge-off rates, he generated $\bar{\rho}_A$ values for CRE lending that ranged from 0.1660 to 0.2950 using several estimation methods. Similar calculations based on CRE lending data from thrifts and life insurance companies, which need not necessarily be representative of bank CRE lending portfolios, generated higher values of 0.2340 to 0.7590 and lower values of 0.0960 to 0.1950, respectively. Our calibrated value of 0.1625 is quite close to the lower bound of the Call Report range, although still below it. Case (2003) argues that any biases in estimating these CRE asset correlations could be mitigated by examining the ratio of estimated correlations for CRE and commercial loans.[14] He reports ranges for these ratios of 2.34 to 3.96 using Call Report data; 0.52 to 2.09 using thrift data; and 0.93 to 2.44 using life insurance CRE data matched with Moody's and S&P data on commercial firms. Combining the calibrated values from our analysis and that of Lopez (2004), our ratio value of one is below that reported by Case (2003) for banks.

Case (2003) presents similar ratios for several CRE subcategories based on data from the market for commercial mortgage-backed securities and from the National Council of Real Estate Investment Fiduciaries; see Table 2. While the exact composition of the CRE portfolios cannot be directly be compared across the two studies, there were five subcategories that were readily matched. For three of these cases, our ratios fell within the range of ratios reported in the Case study. Our lowest ratio of 0.62 was for retail REITs, while the range of values for the retail category in the Case study was 0.52 to 0.74. For office REITs, our ratio of 1.23 falls within the Case range of 1.16 to 1.53. Similarly, for residential REITs, our ratio of 1.46 lies within the Case range of 0.75 to 1.57. However, for hotel REITs, our ratio of 1.46 falls just outside of the relatively narrow Case range of 1.54 to 1.62. For industrial REITs, our questionable CRE asset

[14] Note that this approach is appropriate if similar biases hold across loan types.

correlation leads to a ratio value of 3.08, which is well outside of the Case range of 1.21 to 1.32. Finally, comparing the residual "other" categories in both papers, our ratio of 0.92 falls just short of the wide Case range of 0.97 to 2.08.

In summary, our calibrated $\bar{\rho}_A$ values for CRE lending as extracted from the ASRF framework compare favorably with the extant literature. Our overall parameter value of 0.1625 is close to the values found for both residential and CRE lending in other studies. More tellingly from a Basel II implementation standpoint, U.S. regulations allow using the commercial corporate curve, which is in line with our finding. With regard to CRE subcategories, our ratios of calibrated asset correlations for different types of CRE lending and corporate lending align quite well with the ratios reported by Case (2003).

IV.C. Comparison to regulatory values

As discussed earlier, under the Basel II Accord, banking organizations that can use the IRB approach to calculate their regulatory capital requirements can use either the foundation or the advanced approaches. Under the advanced approach, the key regulatory parameter is the asset correlation, denoted ρ_A. For the two types of CRE lending addressed in the Accord, the regulatory formulas for this parameter are a decreasing function of obligor PD. The formula for IPRE lending is

$$\rho_A(PD) = 0.1200\left(\frac{1-e^{-50*PD}}{1-e^{-50}}\right) + 0.2400\left(1-\frac{1-e^{-50*PD}}{1-e^{-50}}\right),$$

or equivalently,

$$\rho_A(PD) = 0.2400 - 0.1200\left(\frac{1-e^{-50*PD}}{1-e^{-50}}\right),$$

and the formula for HVCRE lending is

$$\rho_A(PD) = 0.3000 - 0.1200\left(\frac{1-e^{-50*PD}}{1-e^{-50}}\right).$$

Clearly, the regulatory ρ_A ranges for the IPRE and HVCRE categories are [0.12, 0.24] and [0.12, 0.30], respectively.

In order to compare our calibrated $\bar{\rho}_A$ values to the range of regulatory values, we generate parameter ranges based on the inter-quartile range of PDs reported in Table 1. These regulatory $\bar{\rho}_A$ ranges for both IPRE and HVCRE lending are presented in Table 3. With respect to the HVCRE ranges, the calibrated $\bar{\rho}_A$ value for the overall REIT portfolio is well below the range's lower value of 0.2208. Similarly, the calibrated $\bar{\rho}_A$ values for the retail, office, residential and "other" CRE categories are below the regulatory HVCRE ranges. Only the $\bar{\rho}_A$ values for hotel and mortgage REITs fall into this higher range. The reason for this outcome is the higher PD ranges observed for these categories.

Turning to the regulatory IPRE ranges, the calibrated $\bar{\rho}_A$ values for all REITs and the five remaining CRE categories also fall outside of their IPRE ranges. The $\bar{\rho}_A$ value for all REITs falls below the regulatory IPRE range, as do the values for retail, office and "other" REIT categories, suggesting that these categories may exhibit more idiosyncratic risk than suggested by current regulatory formulas. For the residential REITs, the calibrated value of 0.2375 falls between the two defined regulatory ranges, although closer to the upper value of the IPRE range.

From a policy perspective, this comparative exercise most directly addresses the parameterization of the regulatory $\bar{\rho}_A$ formula for IPRE lending. Our calibration results and regulatory parameter ranges based on reported REIT PDs suggest that the formula generates generally high parameter values; i.e., for all REITs and for three of seven REIT categories, the lower values of the specified regulatory ranges were above the calibrated value. While using obligor PDs beyond the 75^{th} percentile of the samples would generate lower range values, the issue would not be resolved. Further consideration of this formula may be warranted.

V. Conclusion

The credit risk capital requirements within the current Basel II Accord are based on the asymptotic single risk factor (ASRF) approach. Within this approach, a key parameter is the average asset correlation, and the regulatory values of this parameter for commercial real estate (CRE) lending portfolios are to be determined using formulas for either income-producing real estate or high-volatility commercial real estate. We empirically examine the value of this parameter using portfolios of publicly-traded real estate investment trusts (REITs) as a proxy for CRE lending more generally. We find that CRE lending as a whole has the same calibrated average asset correlation as corporate lending, providing support for the U.S. regulatory decision to assign in-place CRE lending the same risk weights as corporate lending. However, the calibrated values for CRE categories, such as multi-family residential or office lending, vary in important ways. The comparison of calibrated and regulatory values of the average asset correlations for these categories suggest that the current regulatory formulas generate parameter values that may be too high.

It is important to note that our empirical analysis, as well as the analysis presented in other studies, is limited and cannot address the full range of issues present in the Basel II Accord. For example, we cannot address the issues of granularity and maturity easily within the calibration method developed by Lopez (2004). The results and policy implications presented in this paper need to be understood in the context of their empirical methods and the larger policy questions regarding regulatory capital requirements.

References

Asarnow, E. and Edwards, D., 1996. "Measuring Loss on Defaulted Bank Loans: A 24-Year Study," *Journal of Commercial Lending*, January, 11-23.

Basel Committee on Banking Supervision, 2004. "International Convergence of Capital Measurement and Capital Standards: A Revised Framework," Bank for International Settlements. (http://www.bis.org/publ/bcbs107.pdf)

Calem, P.S. and Follain, J.R., 2003. "The Asset Correlation Parameter in Basel II for Mortgages on Single-Family Residences," Manuscript, Board of Governors of the Federal Reserve System. (http://www.federalreserve.gov/generalinfo/basel2/docs2003/asset-correlation.pdf)

Carey, M., 2002. "Some Evidence on the Consistency of Banks' Internal Credit Ratings," in Ong, M.K., ed. *Credit Ratings: Methodologies, Rationale and Default Risk.* London: Risk Books. Pages 449-467.

Case, B., 2003. "Loss Characteristics of Commercial Real Estate Portfolios," White paper prepared as background for public comments on the forthcoming Advance Notice of Proposed Rulemaking on the proposed New Basel Accord, Board of Governors of the Federal Reserve System. (http://www.federalreserve.gov/generalinfo/basel2/docs2003/cre_060903.pdf)

Crosbie, P.J. and Bohn, J.R., 2003. "Modeling Default Risk," Manuscript, Moody's KMV LLC. (http://www.moodyskmv.com/research/whitepaper/ModelingDefaultRisk.pdf)

Gordy, M.B., 2000. "A Comparative Anatomy of Credit Risk Models," *Journal of Banking and Finance*, 24, 119-149.

Gordy, M.B., 2003. "A Risk-Factor Model Foundation for Ratings-Based Bank Capital Rules," *Journal of Financial Intermediation*, 12, 199-232.

Gupton, G.M., Gates, D. And Carty, L.V., 2000. "Bank Loan Loss Given Default," *Moody's Investors Services Global Credit Research*, Special comment, November.

Gyourko, J. and Keim, D., 1992. "What Does the Stock Market Tell Us about Real Estate Returns?," *AREUEA Journal*, 20, 457-485.

Hendershott, P.H. and Ward, C.W.R., 2002. "Valuing and Pricing Retail Leases with Renewal and Overage Options," NBER Working Paper #9214.

Jackson, P., Perraudin, W. and Saporta, V., 2002. "Regulatory and 'Economic' Solvency Standards for Internationally Active Banks," *Journal of Banking and Finance*, 26, 953-

976.

Kealhofer, S., 2003. "Quantifying Credit Risk I: Default Prediction," *Financial Analysts Journal*, January-February, 30-44.

Lopez, J.A., 2004. "The Empirical Relationship between Average Asset Correlation, Firm Probability of Default and Asset Size," *Journal of Financial Intermediation*, 13, 265-283.

Mei, J. and Lee, A., 1994. "Is There a Real Estate Factor Premium?," *Journal of Real Estate Finance and Economics*, 9, 113-126.

Risk Management Association, 2003. "Measuring Credit Risk and Economic Capital in Specialized Lending Activities - Best Practices," Manuscript, Risk Management Association.
(http://www.rmahq.org/NR/rdonlyres/65955133-B686-45BB-A7BC-F82ED1FDD550/0/RMA_Specialized_Lending_March2003.pdf)

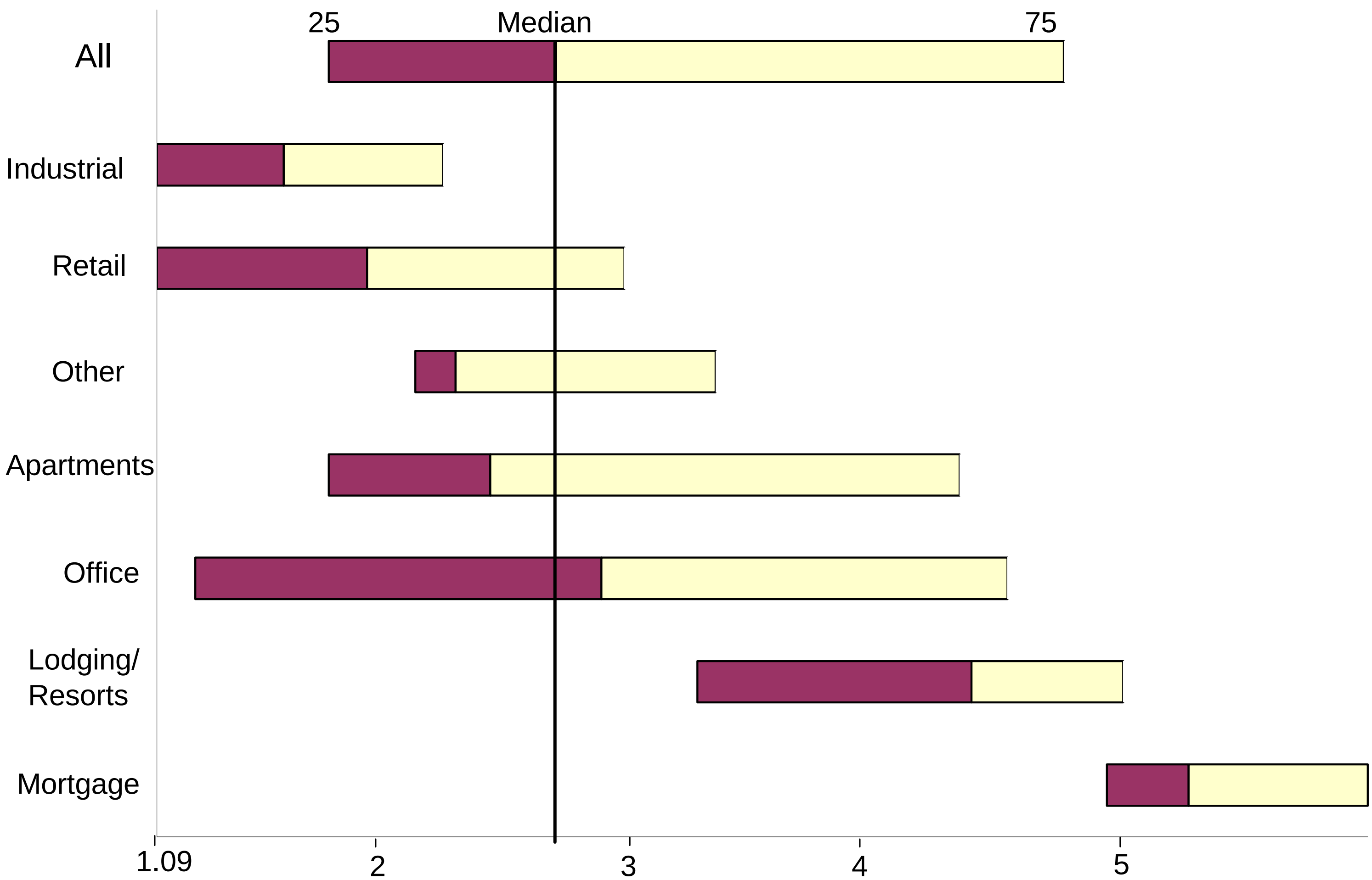
Stanton, R. and Wallace, N., 2002. "An Empirical Test of a Contingent Claims Lease Valuation Model", Manuscript, Haas School of Business, University of California, Berkeley.

Vasicek, O., 1984. "Credit Valuation," Manuscript, Moody's KMV.

Table 1. REIT categories and EDF ranges as of year-end 2002

	# REITs	% REIT mkt. cap.	EDF (%)		
			25% pct.	Median	75% pct.
All REITs	189	100.0%	0.06	0.15	1.16
Industrial	7	6.5%	0.03	0.05	0.10
Retail	40	23.6%	0.03	0.07	1.48
Office	19	17.0%	0.09	0.10	0.29
Residential	22	17.7%	0.06	0.12	0.76
Other	63	25.5%	0.04	0.18	0.93
Hotel	15	4.6%	0.27	0.80	1.48
Mortgage	23	5.1%	1.38	1.92	3.95

Chart 1. REIT categories and ln(EDF) inter-quartile ranges as of year-end 2002



Note: This chart presents the inter-quartile ranges of the natural logs of the EDF presented in Table 1.

Table 2. Calibrated $\bar{\rho}_A$ values for REIT lending portfolios

	# REITs	calibrated $\bar{\rho}_A$	ratio	Case (2003) range for CRE/corporate ratio	
All REITs	189	0.1625	1.0000	-	-
Industrial	7	0.5000	3.0769	1.21	1.32
Retail	40	0.1000	0.6154	0.52	0.74
Office	19	0.2000	1.2308	1.16	1.53
Residential	22	0.2375	1.4615	0.75	1.57
Other	63	0.1500	0.9231	0.97	2.08
Hotel	15	0.2375	1.4615	1.54	1.62
Mortgage	23	0.2000	1.2308	-	-

Note: The "ratio" column presents the ratios of calibrated $\bar{\rho}_A$ values for REIT borrowers to the calibrated ρ_A values for U.S. corporate borrowers as per Lopez (2004).

Table 3. Comparison of calibrated $\bar{\rho}_A$ values for REIT lending portfolios with regulatory formula values

	# REITs	calibrated $\bar{\rho}_A$	IPRE formula values based on EDF ranges			HVCRE formula values based on EDF ranges		
			25th pct.	Median	75th pct.	25th pct.	Median	75th pct.
All REITs	189	0.1625	0.2365	0.2313	0.1872	0.2947	0.2870	0.2208
Industrial	7	0.5000	0.2382	0.2370	0.2341	0.2973	0.2956	0.2912
Retail	40	0.1000	0.2382	0.2359	0.2286	0.2973	0.2938	0.2829
Office	19	0.2000	0.2347	0.2341	0.2238	0.2921	0.2912	0.2757
Residential	22	0.2375	0.2365	0.2330	0.2021	0.2947	0.2895	0.2431
Other	63	0.1500	0.2376	0.2297	0.1954	0.2964	0.2845	0.2331
Hotel	15	0.2375	0.2248	0.2004	0.1773	0.2773	0.2407	0.2059
Mortgage	23	0.2000	0.1802	0.1659	0.1367	0.2103	0.1889	0.1450

Note: The IPRE and HVCRE regulatory formula ranges are based on the observed EDF for the REITs in the defined categories as of year-end 2002. Specifically, we examined the median EDFs and the inter-quartile ranges, as reported in Table 1.

Appendix A. The calculation of risk-weighted assets under Basel II's AIRB approach

As presented on page 60 of Basel Committee on Banking Supervision (2004), under Basel II's advanced internal ratings based (AIRB) approach, the regulatory capital requirement (C_R) for a corporate debt exposure with a given probability of default (PD), loss given default (LGD), exposure at default (EAD) and maturity (M) is calculated as

$$C_R = K * EAD,$$

where

$$K = LGD * \left[\Phi\left(\sqrt{\frac{1}{1-R}} * \Phi^{-1}(PD) + \sqrt{\frac{R}{1-R}} * \Phi^{-1}(0.999) \right) - PD \right] * \left(\frac{1+(M-2.5)*b}{1-1.5*b} \right),$$

$\Phi(x)$ is the cumulative normal function, R is the regulatory asset correlation (denoted as $\rho_A(PD)$ in the text), and the maturity factor $b = (0.08451 - 0.05898 * \ln(PD))^2$. Note that PD and LGD are expressed in decimal form; M is measured in years; and EAD is expressed in dollars.

Appendix B. REIT sample as of year-end 2002, sorted alphabetically

	REIT name	Ticker
1	Acadia Realty Trust	AKR
2	Aegis Realty Incorporated	AER
3	Agree Realty Corporation	ADC
4	Alexander's, Inc.	ALX
5	Alexandria Real Estate Equities, Inc.	ARE
6	AMB Property Corp.	AMB
7	American Residential Investment Trust Inc.	INV
8	American Community Properties Trust	APO
9	American Land Lease, Inc.	ANL
10	American Mortgage Acceptance Company	AMC
11	American Spectrum Realty Inc.	AQQ
12	AmeriVest Properties, Inc.	AMV
13	Amli Residential Properties Trust	AML
14	AmREIT Inc.	AMY
15	Annaly Mortgage Management, Inc.	NLY
16	Anthracite Capital Inc.	AHR
17	Anworth Mortgage Asset Corp.	ANH
18	Apartment Investment & Management Co.	AIV
19	Apex Mortgage Capital Inc.	AXM
20	Archstone-Smith Trust	ASN
21	Arden Realty Group, Inc.	ARI
22	Arizona Land Income Corporation	AZL
23	Associated Estates Realty Corporation	AEC
24	AvalonBay Communities Inc.	AVB
25	Banyan Strategic Realty Trust	BSRTS
26	Bedford Property Investors, Inc.	BED
27	BNP Residential Properties, Inc.	BNP
28	Boston Properties, Inc.	BXP
29	Boykin Lodging Company	BOY
30	Brandywine Realty Trust	BDN
31	BRE Properties, Inc.	BRE
32	BRT Realty Trust	BRT
33	Camden Property Trust	CPT
34	Capital Alliance Income Trust	CAA
35	Capital Automotive REIT	CARS
36	Capstead Mortgage Corporation	CMO
37	CarrAmerica Realty Corporation	CRE
38	CBL & Associates Properties, Inc.	CBL
39	Cedar Income Fund, Ltd.	CEDR
40	CenterPoint Properties Trust	CNT
41	Century Realty Trust	CRLTS
42	Chateau Communities, Inc.	CPJ
43	Chelsea Property Group, Inc.	CPG
44	Clarion Commericial Holdings Inc.	CLNJZ.PK
45	Colonial Properties Trust	CLP
46	Commercial Net Lease Realty, Inc.	NNN
47	Cornerstone Realty Income Trust	TCR

48	Corporate Office Properties Trust	OFC
49	Correctional Properties Trust	CPV
50	Cousins Properties Incorporated	CUZ
51	Crescent Real Estate Equities Company	CEI
52	CRIIMI MAE Inc.	CMM
53	Crown American Realty Trust	CWN
54	Developers Diversified Realty Corporation	DDR
55	Duke Realty Corporation	DRE
56	Dynex Capital Inc.	DX
57	EastGroup Properties, Inc.	EGP
58	ElderTrust	ETT
59	Entertainment Properties Trust	EPR
60	Equity Inns, Inc.	ENN
61	Equity Office Properties Trust	EOP
62	Equity One, Inc.	EQY
63	Equity Residential	EQR
64	Essex Property Trust, Inc.	ESS
65	FBR Asset Investment Corporation	FB
66	Federal Realty Investment Trust	FRT
67	FelCor Lodging Trust Incorporated	FCH
68	First Industrial Realty Trust, Inc.	FR
69	First Union Real Estate Investments	FUR
70	Gables Residential Trust	GBP
71	General Growth Properties, Inc.	GGP
72	Getty Realty Corp.	GTY
73	Glenborough Realty Trust Incorporated	GLB
74	Glimcher Realty Trust	GRT
75	Great Lakes REIT	GL
76	Hanover Capital Mortgage Holdings Inc.	HCM
77	Health Care Property Investors, Inc.	HCP
78	Health Care REIT, Inc.	HCN
79	Healthcare Realty Trust Inc.	HR
80	Heritage Property Investment Trust	HTG
81	Hersha Hospitality Trust	HT
82	Highwoods Properties, Inc.	HIW
83	HMG/ Courtland Properties, Inc.	HMG
84	Home Properties of New York, Inc.	HME
85	Horizon Group Properties Inc.	HGPI.PK
86	Hospitality Properties Trust	HPT
87	Host Marriott Corporation	HMT
88	HRPT Properties Trust	HRP
89	Humphrey Hospitality Trust, Inc.	HUMP
90	Impac Mortgage Holdings Inc.	IMH
91	Income Opportunity Realty Investors	IOT
92	Innkeepers USA Trust	KPA
93	InnSuites Hospitality Trust	IHT
94	Investors Real Estate Trust	IRETS
95	IRT Property Company	IRT
96	iStar Financial Inc.	SFI
97	Jameson Inns, Inc.	JAMS

98	JDN Realty Corporation	JDN
99	Keystone Property Trust	KTR
100	Kilroy Realty Corporation	KRC
101	Kimco Realty Corporation	KIM
102	Koger Equity, Inc.	KE
103	Kramont Realty Trust	KRT
104	LaSalle Hotel Properties	LHO
105	Laser Mortgage Management, Inc.	LMM
106	Lexington Corporate Properties, Inc.	LXP
107	Liberte Investors Inc.	LBI
108	Liberty Property Trust	LRY
109	Liberty Self-Stor Inc.	LSSI.OB
110	LTC Properties, Inc.	LTC
111	Macerich Company, The	MAC
112	Mack-Cali Realty Corporation	CLI
113	Malan Realty Investors, Inc.	MAL
114	Manufactured Home Communities, Inc.	MHC
115	Maxus Realty Trust Inc.	MRTI
116	MeriStar Hospitaltiy Corporation	MHX
117	MFA Mortgage Investments, Inc.	MFA
118	Mid-America Apartment Communities, Inc.	MAA
119	Mid-Atlantic Realty Trust	MRR
120	Mills Corporation, The	MLS
121	Mission West Properties	MSW
122	Monmouth Capital Corporation	MONM
123	Monmouth Real Estate Investment Corp.	MNRT.A
124	National Golf Properties, Inc.	TEE
125	National Health Investors, Inc.	NHI
126	National Health Realty	NHR
127	Nationwide Health Properties, Inc.	NHP
128	New Plan Excel Realty Trust, Inc.	NXL
129	Newcastle Investment Corporation	NCT
130	Novastar Financial Inc.	NFI
131	Omega Healthcare Investors, Inc.	OHI
132	One Liberty Properties, Inc.	OLP
133	Palmetto Real Estate Trust	PTTTS.PK
134	Pan Pacific Retail Properties, Inc.	PNP
135	Parkway Properties, Inc.	PKY
136	Pennsylvania Real Estate Investment Trust	PEI
137	Philips International Realty Corporation	PHIR.PK
138	Pinnacle Holdings, Inc.	BIGT
139	Pittsburgh & West Virginia Rail Road	PW
140	PMC Commercial Trust	PCC
141	Post Properties, Inc.	PPS
142	Prentiss Properties Trust	PP
143	Presidential Realty Corporation (Class B)	PDL.B
144	Price Legacy Corporation	XLG
145	Prime Group Realty Trust	PGE
146	Prime Retail, Inc.	PRT
147	Prologis	PLD

148	PS Business Parks Inc.	PSB
149	Public Storage, Inc.	PSA
150	RAIT Investment Trust	RAS
151	Ramco-Gershenson Properties Trust	RPT
152	Realty Income Corporation	O
153	Reckson Associates Realty Corp.	RA
154	Redwood Trust, Inc.	RWT
155	Regency Centers Corporation	REG
156	RFS Hotel Investors, Inc.	RFS
157	Roberts Realty Investors, Inc.	RPI
158	Saul Centers, Inc.	BFS
159	Semele Group Inc.	SMLE.PK
160	Senior Housing Properties Trust	SNH
161	Shelbourne Properties I	HXD
162	Shelbourne Properties II	HXE
163	Shelbourne Properties III	HXF
164	Shurgard Storage Centers, Inc.	SHU
165	Simon Property Group, Inc.	SPG
166	Sizeler Property Investors, Inc.	SIZ
167	SL Green Realty Corp.	SLG
168	Sovran Self Storage	SSS
169	Stonehaven Realty Trust	RPP
170	Summit Properties Inc.	SMT
171	Sun Communities, Inc.	SUI
172	Tanger Factory Outlet Centers, Inc.	SKT
173	Taubman Centers, Inc.	TCO
174	Thornburg Mortgage Inc.	TMA
175	TIS Mortgage Investment Co.	TISM.PK
176	Town and Country Trust, The	TCT
177	Transcontinental Realty Investors Inc.	TCI
178	U.S. Restaurant Properties, Inc.	USV
179	United Dominion Realty Trust, Inc.	UDR
180	United Mobile Homes, Inc.	UMH
181	Universal Health Realty Income Trust	UHT
182	Urstadt Biddle Properties Inc.	UBP
183	Ventas, Inc.	VTR
184	Vornado Operating Company	VOO
185	Vornado Realty Trust	VNO
186	Washington Real Estate Investment Trust	WRE
187	Weingarten Realty Investors	WRI
188	Windrose Medical Properties Trust	WRS
189	Winston Hotels	WXH