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Real Estate Investment by Bank Holding Companies and Their Risk and Return: Nonparametric and GARCH Procedures

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Real Estate Investment by Bank Holding Companies and their Risk and Return: Non-Parametric and GARCH Procedures

1. Introduction

The deregulation movement in the U.S. banking industry in the last three decades has been far-reaching. For example, the Riegle-Neal Interstate Banking and Branching Efficiency Act (1994) permitted Bank Holding Companies (BHCs) to acquire banks in other states and allowed FDIC-insured banks to branch interstate, subject to some restrictions. Similarly, the Gramm-Leach-Bliley Act (GLBA) of 1999 allowed commercial banks, investment banks, and insurance companies to combine to form financial services holding companies. In brief, the former act relaxed the rules on geographic diversification while the latter allowed product diversification.[1]

The trend in deregulation in the U.S. stopped short of allowing commercial banks to engage in extensive real estate activities such as developing real estate, purchasing real estate for resale, or providing real estate brokerage services -- activities permitted in other countries, e.g., in Canada and Germany.[2] In the U.S., federal statutes and some state laws severely restrict real estate activity by banks and BHCs, although they do not entirely prohibit it. All banks and BHCs are allowed to own real estate for current and future operations. The degree of restriction beyond that differs depending on whether the institution is a BHC, a national bank (NB), a state-

[1] The Dodd-Frank Wall Street Reform and Consumer Protection Act of 2010 requires the Federal Reserve to restrict proprietary trading of securities, commodities, and derivatives by BHCs and forbids BHCs from investing in hedge funds and private equity firms. It does not, however, re-impose restrictions on interstate branching or ownership of investment banks and insurance companies that were relaxed in 1999. See H.R. 4173--111th Congress: Dodd-Frank Wall Street Reform and Consumer Protection Act. (2010). Available at: http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=111_cong_bills&docid=f:h4173enr.txt.pdf

[2] Recent World Bank surveys of national differences in bank regulations, including restrictions on real estate activity, have been led by James Barth, Gerard Caprio, and Ross Levine. Results of those surveys are available at: http://econ.worldbank.org.

chartered Federal Reserve-member bank (SMB), or a state-chartered Federal Reserve-non-member bank (SNMB).

Federal Reserve Regulation Y authorizes BHCs to engage in investment in real estate for purposes other than operations only with the permission of the Federal Reserve Board of Governors. Similarly, Federal Reserve Regulation H authorizes SMBs to invest in real estate for purposes other than operations only with the Board's prior approval. The National Bank Act of 1864 allows NBs to own real estate only for bank operations, as payment for loans (with a five-year time limit on such ownership) or if the real estate was acquired as a result of a default.[3] The least restrictive rules apply to SNMBs that are chartered in states that have relatively lenient rules on bank real estate investment. According to data supplied to the authors by the Conference of State Bank Supervisors, 39 states and the District of Columbia allow banks to either take equity stakes in real estate, develop real estate, or both. SNMBs in the remaining 11 states and Puerto Rico follow rules similar to or more restrictive than those followed by NBs and SMBs. The various real estate investment rules are summarized in Table 1.

In theory, real estate investment can have both positive and negative effects on BHC performance. Among the potential benefits are diversification of cash flows, economies of scale and/or scope (cost complementarity) and greater charter values.[4] The potential downsides are threefold. First, real estate investment returns may be more volatile than returns from traditional banking assets, thus raising, rather than lowering, overall BHC risk. Second, insufficient expertise may result in poor real estate investment and real estate management choices by BHCs,

[3] See the following links for information on the cited laws and regulations:
U.S. Code Title 12 Section 29 (National Bank Act section on real estate ownership by national banks): vlex.com/vid/sec-power-hold-real-property-19225851.
Federal Reserve Regulations H and Y: www.federalreserve.gov/bankinforeg/reglisting.htm.
[4] Gonzales (2005) and Ramirez (2002) find that bank product diversification raises charter value.

harming their return and risk performance. Third, greater complexity of BHCs that invest in real estate may make them more opaque and complicate their regulation and monitoring.

The purpose of this study is to empirically investigate the effects of real estate investment by BHCs operating in the U.S. on their stock returns; total risk (conditional variance of their stock returns); risk-adjusted stock returns (the Sharpe ratio); and market risk (market betas of the stocks). This study focuses on real estate investment activity outside of traditional real estate lending such as residential and commercial mortgage loans. The real estate business studied here includes the limited activities allowed by federal authorities as well as the more extensive activity allowed in 39 states and the District of Columbia. The non-parametric Wilcoxon procedure and an extended generalized autoregressive conditionally heteroskedastic (GARCH) framework of analysis are employed to conduct the tests.

Three sets of BHC stock portfolios are formed according to: i) investment versus non-investment in real estate, ii) investment in real estate under lenient versus strict regulatory constraints, and iii) the ratio of real estate investment to total assets. Portfolios based on BHCs that do and do not invest in real estate are used to test the hypothesis whether the risks, returns and risk-adjusted returns of the two groups are identical. Portfolios formed according to the type of regulation under which BHCs invest in real estate -- lenient or strict -- enable us to test hypotheses concerning the relationship between the type of regulation and the returns and risk of BHCs. Portfolios based on the real estate investment to total assets ratio are used to examine hypotheses concerning the effects of changes in the real estate investment ratio on BHC return and risk performance.

Several results are obtained. First, we provide evidence that real estate investment has a net negative impact on BHC performance. Specifically, using the non-parametric Wilcoxon tests, we find that BHCs investing in real estate show lower returns and risk-adjusted returns and greater total risk than BHCs not investing in real estate. Second, and similarly, portfolios of BHCs that invest in real estate under lenient rules have lower returns and risk-adjusted returns and greater total risk than portfolios of BHCs that invest under stricter rules. Third, among BHCs investing in real estate, portfolios of BHCs with higher shares of real estate relative to total assets have returns and total risks that are statistically identical to those of BHCs with lower shares. Using the GARCH framework, we find evidence indicating that the portfolio of BHCs with above-median shares of real estate relative to total assets has lower returns and greater market risk, compared to BHCs positioned below the sample median in terms of real estate holding.

These results are evidence that benefits from diversification, economies of scale, economies of scope, and increases in charter value associated with real estate investment are outweighed by greater variability of returns on real estate investment, lack of BHC expertise in real estate investment and greater BHC complexity due to engagement in real estate. If these results can be generalized to larger and wider levels of activity in real estate by banks, the implication for policy makers would be that allowing BHCs to enter the field of real estate or loosening the restrictions on such activities would enable BHCs to take greater risks that do not result in corresponding increases in returns. Because the amount of real estate investment as a percentage of the total assets of the BHCs is relatively small in our sample, the current results should not be taken as ruling out the possibility of a threshold level of real estate investment above which BHCs would indeed exhibit significant benefits from development of expertise and economies of scale within the field of real estate investment in the longer-run.

This study focuses on the banking industry rather than other industries, and we caution against generalizing the results to other industries. We focus on banks for several reasons, not the least of which is that data on the real estate holdings of U.S. firms in other industries are not available. The activities of banks and BHCs are also of particular concern due to the possibility of a contagion effect in the financial services industry and subsequent externalities in the economy's real sector, an example of which was observed during the financial crisis of 2007 to 2009. Finally, as banking is one of the most heavily regulated sectors of the economy, policy makers also have an interest in evidence regarding the effects of the numerous rules governing bank behavior. Indeed, much of the debate over bank regulation has revolved around questions of which industries to allow banks to enter, as with debate over GLBA's repeal of Glass-Steagall Act (1933) restrictions on insurance and investment banking activity by commercial banking companies.

The remainder of the paper is organized as follows. Section 2 covers the theoretical underpinnings of the subject of real estate investment by banks and reviews the literature. Section 3 and 4 describe the data and methodology, respectively, Section 5 develops the hypotheses to be tested and Section 6 presents the empirical analysis. Section 7 concludes.

2. Theory and Literature Review

Diversification of BHCs into real estate activities can produce several effects. According to modern portfolio theory (Lintner, 1965; Markowitz, 1959; Mossin, 1966; Sharpe, 1964), if returns from real estate and non-real estate activities are not perfectly correlated, BHC portfolios' efficient frontiers will shift above the traditional banking frontier, resulting in greater returns for each level of risk. Fewer regulatory restrictions on real estate activities would also allow banks and BHCs to more easily engage in these endeavors and to take advantage of economies of scale and scope, as argued in Claessens and Klingebiel (2000), and to overcome indivisibilities of the latest productivity-enhancing technology. These advantages may result in greater bank charter values compared to firms that are prevented from entering these activities (Ramirez, 2002), and may then, in turn, give banks incentives to reduce risk in order to preserve the higher charter value (Acharya, Santos, & Yorulmazer, 2010).

On the other hand, investment in real estate by BHCs may increase their riskiness because returns from real estate activity may exhibit greater variance than returns from traditional banking activities such as intermediation (Rosen, Lloyd-Davies, Kwast, & Humphrey, 1989). In addition, by investing in real estate, banks and BHCs may enter an area in which they have little expertise, exposing themselves to considerable downside risk and the possibility of failure. Finally, by engaging in non-traditional activities including real estate investment, banks become more complex and, hence, more opaque, which in turn makes them more difficult for regulators and investors to monitor, possibly resulting in greater risk (Barth, Caprio, & Levine, 2004).

Empirical research must answer the question of whether real estate investment by BHCs results in a net improvement in performance. Previous studies on the effects of real estate investment by depository institutions in the U.S. have used data from thrifts in the 1980s, a period of deregulation in that sector. Rosen et al. (1989) analyze 1980-1985 data on returns on direct investments in real estate assets by thrift service corporations,[5] market equity returns of real estate investment trusts (REITs), and profits of commercial banks that operated under strict restrictions on real estate investment. In their analysis, the low correlation between returns on real-estate and non-real-estate assets is outweighed by the greater variability of real estate returns when real estate investment exceeds a relatively low threshold of around 4 percent of total assets.

McKenzie, Cole, and Brown (1992) estimate the average returns on a set of nontraditional assets, including real estate, in which thrifts were allowed to invest following the

[5] Thrift service corporations are subsidiaries of thrift holding companies that are authorized to engage in any activity regulators deem reasonably related to the business of thrifts (Williams, 1988).

passage of the 1980 Depository Institution Deregulation and Monetary Control Act (DIDMCA) and the 1982 Garn-St. Germain Act. Based on data from one-year periods ending on June 30, 1987 and June 30, 1988,[6] they find that average returns on real estate investment were significantly lower than those on traditional assets, although they admit that during their sample period real estate investments in general performed poorly, especially for capital-deficient institutions. The authors explain this finding by arguing that since the deposit insurance system for thrifts was not risk-based at the time, thrifts managers of capital-deficient thrifts found it attractive to acquire high-risk, high-potential-return assets. They had little to lose, as any losses would be borne by the deposit insurance fund, a situation of moral hazard. The Federal Deposit Insurance Corporation Improvement Act (1991) now requires the FDIC to set premiums based on risk (Acharya et al., 2010).

As is well-known, the 1980s ended in crisis for the U.S. thrift industry, with regulators closing or placing into receivership more than 1,000 thrifts. Several authors (Cole, 1993; Cole, McKenzie, & White, 1990; Pantalone & Platt, 1987; Rudolph & Hamden, 1988) show that these failed institutions held large shares of non-traditional assets -- including equity stakes in commercial real estate -- in their portfolios, compared with well-capitalized thrifts. Using data from 1984 to 1989, Cole and McKenzie (1994) find that well-capitalized thrifts chose portfolios that were close to their efficient frontiers in order to protect their equity capital, while insolvent thrifts chose high-risk, high-return portfolios that *ex post* produced returns far below the efficient frontier. Boyd, Graham, and Hewitt (1993) simulate mergers of randomly selected BHCs and non-bank firms to examine the effect of expansion into non-bank activities. They find that BHC

[6] The authors chose the dates to reduce the effects on returns of the high initial costs of investing in nontraditional assets that were incurred in the years following the passage of these two acts in 1980 and 1982, respectively.

risk usually increases from simulated mergers with firms in real estate and real estate development.

Other related studies focus on the expansion of the U.S. commercial banks and BHCs into non-traditional banking activities without specifically examining real estate investment. Boyd and Graham (1986) examine the effect of BHC expansion into nonbank activities permitted by the Federal Reserve using data from 1971 to 1983. They find that from 1971 to 1977, when the Federal Reserve's regulatory policy was more permissive, BHCs' degree of involvement in non-banking activity was positively associated with risk, measured by the standard deviation of BHCs' returns on assets (ROA) and BHC Z-scores.[7] On the contrary, they find no statistically significant relationship between the extent of non-bank activity and risk over the 1978-1983 period, when Federal Reserve regulation was more stringent. Wall (1987) examines data on BHCs with nonbank subsidiaries and finds that these subsidiaries tend to increase (decrease) the risk of BHCs with less risky (highly risky) banks. Similarly, Brewer (1989) studies BHC stock market data from 1978 to 1986 and finds a weak negative relationship between BHC risk and level of non-banking activity, where the former is measured by the volatility of BHC stock returns and the latter by one minus the ratio of the BHCs total banking assets to total assets. Stiroh (2004) finds that greater reliance on noninterest income – a category that includes fiduciary income, service charges, trading revenue, and fees – is associated with higher risk and lower risk-adjusted profits at U.S. commercial banks from 1978 to 2001. Using data from U.S. financial holding companies from 1997 to 2002, Stiroh and Rumble (2006) report that gains from diversification made possible by deregulation are more than offset by the costs of increased exposure to volatile activities.

[7] The Z-score measures the probability that a BHC will fail or alternatively the number of standard deviations below mean that ROA must fall in order to bankrupt the firm. See Lown, Osler, Strahan, and Sufi (2000) for more details.

Several studies have used international data to test the effects of restrictions on banking activity on bank performance. Barth et al. (2004) compute an index of national restrictions on banking activity that accounts for restraints on real estate investment as well as securities investment and ownership of non-financial firms. They include this index with other independent variables in regression models of various bank risk indicators. With data from 107 countries from the 1990s and early 2000s, they find that greater banking activity restriction is associated with a greater likelihood of a banking crisis.

Gonzales (2005) tests the effects of restrictions on banking activity using a data set of 251 banks in 36 countries from 1995 to 1999. He finds that banks in countries with greater restrictions on banking activities have lower charter values, after controlling for the presence of deposit insurance, the quality of countries' rule of law, the historic origins of countries' legal systems, and balance sheet variables. He also finds evidence that greater bank risk is associated with reductions in charter value.

In summary, real estate investment by banks and BHCs can in theory have both positive and negative effects on bank performance as measured by risk, returns, and risk-adjusted returns. The net effect is an empirical question. Previous empirical studies have produced mixed results. Studies of U.S. thrifts' real estate activity in the 1980s indicate that the negative effects have generally outweighed the positive effects. More recent studies typically find increased risk, lower risk-adjusted returns, or both when U.S. banks and BHCs engage in a range of non-traditional activities. Evidence from some international studies, however, do find improvements in risk and returns associated with lower restrictions on banking activities including, but not limited to, real estate investment.

We contribute additional evidence to this body of research by using market data from the last 20 years and looking at risk and return effects simultaneously and within the same framework. To the best of our knowledge, this is the first study to examine the effects of real estate investment on U.S. BHC risk and returns without using a simulation. In addition, the approach taken in this study has two advantages over the methods followed in previous studies. First, we employ market-based, rather than accounting-based measures of risk and return. Market data are forward looking, incorporating investors' beliefs about BHCs' future prospects while accounting data are backwards looking, providing information on BHCs' past conditions. Moreover, unlike accounting data, market data are not subject to managers' "window dressing" of the results by, for example, spreading losses over time (smoothing). Additionally, if external factors are likely to impact BHC performance in the future, market-based risk measures are more likely than accounting-based measures to reflect them.

Second, we use a GARCH framework, which allows us to examine the effects of real estate investment on return and volatility simultaneously, accounts for heteroskedastic errors and permits the persistence of shocks to returns to be measured. The GARCH model produces, for every period, estimates of the conditional variance of returns, which are interpreted as measures of BHCs' total risk. This allows us to use quarterly accounting data on real estate investment (the only readily available and useful public data on BHC real estate investment) to estimate the effects of real estate investment on the market-based measures of total risk and return.

3. Data

Quarterly data on investment in real estate by BHCs are extracted from the BHC Reports available on the Federal Reserve Bank of Chicago Web site. BHCs have reported figures on real estate investment since the third quarter of 1990 on form FR Y9-C. Hence, the sample period runs from the third quarter of 1990 through the fourth quarter of 2010 (82 quarters). Of 4,187 BHCs that filed Y9-C reports during this time period, 595 reported positive real estate investment for at least one quarter during the sample period. The subset of that group that is publicly traded and for which stock price information is available numbers 204.

The real estate investment to total assets ratio (*RE)*, measured in percent, is calculated for each BHC for every quarter that the necessary data appear in the Y-9C reports. Real estate investment data are extracted from series BHCK3656 ("Direct and Indirect Investments in Real Estate Ventures") in those reports. They include real estate held for investment and development; loans secured by real estate that have virtually the same risks and rewards as the real estate used as security; investments in ventures that are primarily engaged in holding real estate for development or investment; and property originally acquired for future expansion but no longer intended for that purpose. Series BHCK3656 excludes real estate used for the operation of the BHC and its subsidiaries as well as real estate acquired to satisfy previously contracted debts, such as foreclosed-upon properties. Such real estate is reported, but it is excluded from this study because it is not acquired as a return-generating investment.

Each BHC's quarterly stock returns are calculated from monthly return data from the Center for Research on Security Prices (CRSP) by way of Wharton Research Data Services (WRDS). Three pairs of portfolios of BHC stocks are formed in the following manner (Table 2 summarizes the portfolio construction criteria). First, to determine whether BHC risk and return are influenced by BHC engagement in real estate investment, stocks of BHCs are divided into two portfolios called "*INVEST"* and *"NO_INVEST."* In each quarter, the *INVEST* portfolio includes stocks of BHCs that report positive real estate investment in that quarter. The *NO_INVEST* portfolio assembles BHCs that report no real estate investment for that particular quarter. The compositions of the two portfolios change each quarter as BHCs' start or stop investing in real estate.

Second, two portfolios are formed in order to examine differences between BHCs that invest in real estate under lenient rules versus those that invest under strict rules. To this end, call report data are used to identify state non-member banks (SNMBs) in the 39 states and the District of Columbia that allow banks to either buy equity stakes in real estate, develop real estate, or both, and matched with Bank Holding Company data using identifiers common between these two data sets. BHCs that control SNMBs in this group and that invested in real estate are included in a portfolio called "*LENIENT*", because such BHCs are able to invest in real estate under relatively lenient rules (rules on real estate investment are summarized in Section 1 and Table 1). The remaining BHCs control non-member banks (NMBs) falling under the relatively strict regulations of the National Bank Act, are SMBs under the relatively strict Regulation H, or are SNMBs that operate under similarly strict state rules (see Section 1). These BHCs that invested in real estate under relatively strict rules are included in a portfolio called "*STRICT*". Again, the compositions of the two portfolios change each quarter as some BHCs begin investing in real estate under lenient or strict regulations and others stop doing so.

Finally, we construct two portfolios to investigate whether greater investment in real estate is associated with greater or lesser BHC risk and return. To this end, BHCs that report positive investment in real estate are ranked each quarter by real estate to total assets ratio (*RE*). One of the two portfolios, called "*HIGH_HALF,*" includes BHCs with *RE* in the top half of the ranking. The other portfolio, called "*LOW_HALF,*" includes BHCs with *RE* in the bottom half. Again, the composition of each portfolio changes each quarter as values of real estate held by BHCs' change. Table 2 provides summary descriptions of the portfolios used in this study.

Portfolio returns (*R*) are calculated by averaging individual stock returns plus dividends with equal weights on each stock. Using equal weights prevents the stocks of large BHCs from disproportionately affecting the results. Other authors who use equal weights in studies of BHC portfolios include Elyasiani and Mansur (1998) and Elyasiani, Mansur, and Pagano (2007). The real estate investment to total assets ratio (*RE*) of each portfolio in each quarter is calculated by averaging the *RE* of each stock in the portfolio in each quarter with an equal weight on each stock. The portfolio construction process filters out possible noise that would obscure the effects of real estate investment or real estate investment rules on a single stock's returns and return volatility. This methodology is based on the assumption that the noise factors are not correlated with real estate investment. This process has been previously used in the literature by the authors cited earlier in this section.

4. Model and Methodology

The modeling framework employed is an expanded generalized autoregressive conditionally heteroskedastic (GARCH) capital asset pricing model. GARCH models include equations for both conditional mean and conditional variance (volatility) of the dependent variable, which in this case is the return on a stock portfolio (*R*). GARCH specifications are frequently employed to model the behavior of financial time series such as stock returns because most of these series exhibit time-varying variances (Campbell & Hamao, 1992; Hamilton, 1994; Greene, 2003). This category of models allows investigation of the effects of changes in the real estate investment to total assets ratios (*RE*) on mean BHC stock returns as well as return volatility. We employ two GARCH (1,1) models. Model 1 includes the effect of RE on return and volatility, while Model 2 excludes RE and its interaction term with market.

Model 1 is described by equations (1) – (3) below.

$$R_t = \alpha + \beta_M MARKET_t + \beta_{RE} RE_t + \beta_{INT} MARKET * RE_t + \varepsilon_t \quad (1)$$

$$h_t = \phi + \theta_1 \varepsilon_{t-1}^2 + \theta_2 h_{t-1} + \theta_{RE} RE_t \quad (2)$$

$$\varepsilon_{i,t} | \Omega'_{t-1} \sim GED \quad (3)$$

In this model, the dependent variable is the quarterly return (*R*) on a portfolio of BHC stocks. The market return ($MARKET$) in the mean equation is measured by the quarterly return on the market index constructed by CRSP.[8] The coefficient β_M, on the *MARKET* variable, is the portfolio's market beta or systematic risk. The coefficient β_{RE}, on the real estate investment ratio (*RE)*, allows us to test whether changes in the portfolio return (*R*) are associated with changes in real estate investment. A positive (negative) and significant estimate of β_{RE} is evidence that increases in *RE* are associated with higher (lower) BHC returns. We also include an interaction term between the *MARKET* and *RE* variables as a third regressor to investigate how an increase in *RE* affects the portfolio's market beta, or conversely, how the general state of the market alters the effect of real estate investment on the BHC portfolio return. We orthogonalize the interaction variable (*MARKET * RE*) to purify it from the influences of its two components, which are already accounted for. Hence, the coefficient of the interaction variable (β_{INT}) is viewed as a pure interaction effect.[9] For example, a positive and significant β_{INT} would indicate an increase in market risk due to real estate investment. Because we use portfolio returns, omitted firm specific effects are not a concern and cross-sectional regression approaches would not be appropriate.

The GARCH (1,1) structure models return volatility as a linear function of the squared lagged error term (ε_{t-1}^2) (the ARCH effect) and the lagged volatility (h_{t-1}) (the GARCH

[8] This index includes all of the stocks traded on the New York Stock Exchange (NYSE), the American Stock Exchange (AMEX), and the NASDAQ Stock Market (NASDAQ). Each stock in the portfolio is given equal weight, and dividends are included in the returns. The quarterly return is calculated from CRSP monthly return data.
[9] To this end, we regress the interaction term on a constant, MARKET, and RE and use the residuals in the Model. For a more detailed explanation of orthogonalized interaction terms, see (Aiken & West, 1991).

effect).[10] The approach enables the modeling of portfolio returns to reflect clustering of periods of high volatility and low volatility and persistence of shocks to the returns generating process. The real estate investment ratio (*RE*) is also included in the volatility equation to test whether increased real estate investment is associated with changes in the volatility (total risk). A positive estimate of this variable's coefficient (θ_{RE}) is interpreted as evidence that greater real estate investment is associated with greater total risk and vice versa.

The model parameters are estimated using the method of maximum likelihood (MLE) using the optimization algorithm of Broyden, Goldfarb, Fletcher, and Shanno (Broyden, 1970). Histograms in Appendix 1, and diagnostic statistics reported in Table 4, indicate that the distributions of returns for most of the portfolios have fatter tails than the normal distribution. In addition, the histograms show relatively large cusps, or flat regions, at the peaks of some of the distributions, the occurrence of which implies that more of the portfolio returns values are near the median than would be the case under normal distribution. For this reason the likelihood function is constructed using an error term that is assumed to follow the generalized error distribution (GED). The GED has a shape parameter, the estimates of which are reported in the tables of the regression results. When the shape parameter is equal to two, the GED is equivalent to the normal distribution.[11]

MLE produces estimates of the portfolio return's volatility (h_t) for each period t, which is interpreted as the portfolio's total risk in each period. A single-tailed Wilcoxon matched-pair signed-rank test (described e.g., in Berenson, Krehbiel, and Levine, 2006) is used to test the null hypothesis that the median difference in volatility between each two portfolios is zero against the

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[10] We tried to estimate other models, including EGARCH and GARCH-in-Mean (GARCH-M) models but, due to the relatively low frequency of the data, were unable to obtain estimates that converge using a variety of software that included RATS, SAS, and Stata. Ljung-Box test of the residuals and squared residuals of the fitted model (Table 6) are not significant, indicating the models fit the data well.

[11] An alternative distribution, the *t*-distribution, allows for fat tails too but has a peak rather than a cusp at the origin.

alternative that the median is positive. The Wilcoxon test of the medians, rather than the *t*-test of the means, is used because volatility distributions are skewed. Quarterly values of each portfolio's Sharpe ratio are also calculated by dividing the portfolio's quarterly return by the corresponding return standard deviation (the square root of the estimated return volatility). The Sharpe ratio is a measure of risk-adjusted returns and will be used to compare the risk-adjusted performance of the BHCs studied.

Model 2, described by equation 4-6, excludes *RE* from both the mean and volatility equations as well as the interaction term *MARKET*RE*. Model 2 is estimated for portfolios of BHCs with zero real estate investment. This simpler model is used for estimation of the *NO_INVEST* portfolio return model, in which *RE* always takes the value of zero. Model 2 is also estimated for the other five portfolios.[12]

$$R_t = \alpha + \beta_M MARKET_t + \varepsilon_t \quad (4)$$

$$h_t = \phi + \theta_1 \varepsilon_{t-1}^2 + \theta_2 h_{t-1} \quad (5)$$

$$\varepsilon_{i,t} | \Omega'_{t-1} \sim GED \quad (6)$$

5. Development of Hypotheses

Estimation of models 1 and 2 for each portfolio allows us to test several hypotheses concerning comparative performance of BHCs that are involved in real estate investment, not-involved, involved to a differential extent, or involved under differential regulatory constraints. These hypotheses are explained below and summarized in Table 2.

5.1. Hypotheses on the Effect of Real Estate Investment on Returns

[12] We also estimated additional models a) to include interest rate and exchange rate as additional regressors, b) to employ alternative volatility specifications, and c) to distinguish the stock market behavior during the recent crisis by introducing dummy variables. The algorithms for calculating MLE of these models frequently failed to converge, possibly because the number of model parameters is high relative to the number of observations (82). We also included the portfolio mean BHC size as a regressor in the volatility equation because volatility may be sensitive to the BHC size, but we then omitted it since it was insignificant. Results are available on request.

Based on the existing research, described in Section 2, we expect that greater investment in real estate will be associated with lower or, at best, the same returns. Hence, the following three hypotheses are proposed:

$H_{1\text{-}RET}$: *BHCs that invest in real estate have lower returns than BHCs that do not.*

$H_{2\text{-}RET}$: *Investment in real estate under relatively lenient rules is associated with lower returns than investment under relatively strict rules.*

$H_{3\text{-}RET}$: *Greater investment in real estate by BHCs is associated with lower returns.*

We test all three propositions by employing the Wilcoxon test. We test the null that the median difference in returns between portfolios (*INVEST - NO_INVEST* for $H_{1\text{-}RET}$, *LENIENT – STRICT* for $H_{2\text{-}RET}$, and *HIGH_HALF – LOW_HALF* for $H_{3\text{-}RET}$) is zero against the alternative that it is negative. For $H_{3\text{-}RET}$, we also use the sign and significance of the coefficient β_{RE} in the mean equation within the GARCH framework (Model 1). If β_{RE} is negative and significant, this is evidence that greater investment in real estate is associated with lower returns.

5.2. Hypotheses on the Effect of Real Estate Investment on Risk

Real estate investment may increase or decrease BHC risk depending on whether the risk reduction from diversification into real estate is outweighed by greater risk of real estate investments, relative to traditional banking activities. Based on the most closely related research on thrifts in the 1980s, we conjecture that greater investment in real estate is associated with greater total risk. Hence, we propose the following three hypotheses:

$H_{1\text{-}TR}$: *BHCs that invest in real estate have greater total risk than BHCs that do not.*

$H_{2\text{-}TR}$: *BHCs that invest in real estate under relatively lenient regulations have greater total risk than BHCs that do so under relatively strict regulations.*

$H_{3\text{-}TR}$: *Greater investment in real estate by BHCs is associated with greater total risk.*

We test each of these hypotheses using the Wilcoxon procedure which compares the medians of the volatility of returns on the portfolios. The null (alternative) hypotheses are that the difference in medians is zero (positive). Moreover, to put the differences in median total risk in economic terms, each portfolio's median 1%, one-quarter Value at Risk (VaR) is calculated so that the potential losses on investments in the portfolios from unexpectedly bad quarters can be assessed. (For a detailed description of VaR and how it is calculated, see Appendix 2). In addition, the GARCH framework is used to test $H_{3\text{-}TR}$. We test the null of zero effect on risk against the alternative of a risk increase. A positive and significant estimate of θ_{RE}, the coefficient of the real estate ratio (*RE*) in the volatility equation for each portfolio's returns, is interpreted as evidence in support of this hypothesis.

5.3: Hypotheses on the Effect of Real Estate Investment on Risk-Adjusted Returns:

If greater investment in real estate is associated with lower returns, as proposed in $H_{1\text{-}RET}$, and/or greater total risk, as proposed in $H_{1\text{-}TR}$, then it follows that it will be associated also with lower risk–adjusted returns. In this context, Stiroh (2004) has demonstrated that banks involved in non-traditional banking activities exhibit lower risk-adjusted returns. Thus, we propose the following three hypotheses.

$H_{1\text{-}RAR}$: *BHCs that invest in real estate have lower risk-adjusted returns than BHCs that do not.*

$H_{2\text{-}RAR}$: *Investment in real estate under relatively lenient rules is associated with lower risk-adjusted returns than investment under relatively strict rules.*

$H_{3\text{-}RAR}$: *Greater investment in real estate by BHCs is associated with lower risk-adjusted returns.*

Again, the Wilcoxon procedure will be employed to conduct a test of the null hypothesis of zero median difference between risk-adjusted-returns of the corresponding portfolios against the alternative that the difference is negative.

5.4 Investment in real estate and the level of BHC systematic risk

Returns from real estate investment are sensitive to macroeconomic fluctuations to a larger extent than returns from other assets. Indeed recessions during the recent years, e.g., the financial crisis of 2007-2009, have been greatly associated with downturns in the real estate market (Leamer, 2007). Hence, an increase in real estate investment by a BHC is likely to heighten its market risk. Thus we propose:

$H_{1\text{-}MR}$: *Greater investment in real estate by BHCs is associated with greater market risk.*

In our GARCH model, a shift in the market risk in response to increased real estate investment can be measured by the coefficient on the interaction term (*MARKET*RE*) in Model 1 (β_{INT}). A positive and significant β_{INT} indicates an increase in market risk due to real estate investment and serves as evidence in favor of this hypothesis. This coefficient also shows how the effect of real estate investment on BHC return changes when the market improves.

6. Empirical Results

In this section, we discuss first accounting data on all BHCs that filed reports with the Federal Reserve, then descriptive statistics on the BHCs that filed reports with the Fed and had publicly traded stock, and then results of the analysis of return and risk of BHCs that had publicly traded stock.

6.1 Financial Ratios on All BHCs Reporting to the Federal Reserve

To complement our analysis, in Table 3, we present mean financial ratios for six categories of BHCs that filed reports with the Federal Reserve during the period of our study. The data come from Y-9 reports from second and fourth quarters only, because small BHCs file Y-9 reports only in those quarters. The financial ratios are consistent with greater risk and lower return among BHCs that invest in real estate compared to those that do not; BHCs that invest in real estate under Fed regulation compared to those that invest under state regulation; and BHCs in the top half of the distribution of the real estate investment to total assets ratio when that distribution includes only BHCs that reported investment in real estate. BHCs that invest in real estate have lower capital ratios and higher loan loss ratios (greater risk) and lower return on equity and return on assets (lower returns) than BHCs that do not. Corresponding relationships for those four ratios hold between BHCs that invest in real estate under Fed regulation and those that invest under state regulation. Likewise, we see greater risk and lower returns for BHCs in the bottom half of the real estate ratio distribution relative to those in the top half of the distribution.

6.2 Descriptive Statistics

Table 4 presents the summary statistics on total assets, real estate investment level, and real estate investment ratio for the BHCs that were listed in CRSP and invested in real estate during the period studied (1990:3-2010:4). Total assets range from $96.2 million to $2.4 trillion with a mean of $89.1 billion. Its distribution is highly skewed to the right. The ratio of real estate investment to total assets (*RE*) ranges from zero to 4.54 percent with a mean value of 0.22 percent. As described in Section 2, federal laws and some state laws strictly limit the types of real estate in which banks and BHCs may invest. Even in states with lenient rules, however, real estate investment is a small part of BHC portfolios.

Descriptive statistics on the portfolios of BHCs described earlier (*INVEST, NO_INVEST*, *LENIENT*, *STRICT* and *HIGH_HALF*, *LOW_HALF)* are reported in Table 4. This table includes data on the quarterly mean total assets (Panel 2) and the quarterly mean real estate investment ratio (*RE*) (Panel 3) of the BHCs assembled in each portfolio. It is notable that the median of the quarterly average assets for the *INVEST* portfolio is $55.6 billion, a figure substantially larger than the corresponding $7.9 billion figure for the *NO_INVEST* portfolio. This reflects the fact that larger BHCs are more likely to invest in real estate than smaller BHCs. The BHCs that invested in real estate under lenient rules were also substantially larger than those that invested under strict rules with mean total assets of $72.0 billion and $15.4 billion, respectively.

The median real estate investment ratio (*RE)* for the *INVEST* and *NO_INVEST* portfolios are 0.229 and zero, respectively, because the latter includes only stocks of BHCs that do not invest in real estate. (Panel 3, Table 4.). The median *RE* values for the *LENIENT* and *STRICT* portfolios are 0.212 percent and 0.192 percent, respectively. For the *HIGH_HALF* and the *LOW_HALF* portfolios, the median *RE* values are 0.415 percent and 0.024 percent, respectively.

Descriptive statistics on the quarterly portfolio return series are presented in Panel 4 of Table 4. The mean return for *INVEST*, *HIGH_HALF* and *LENIENT* portfolios are lower and the standard deviation of their returns are higher than those of the *NO_INVEST*, *LOW_HALF* and *STRICT* portfolios, respectively. These figures indicate that greater involvement in real estate or real estate activity under more lenient regulations harm BHC performance. In terms of diagnostics, Ljung-Box *Q* statistics for return and squared return series at 5 and 10 lags, reported in Panel 5, lead to rejection of the hypothesis of no autocorrelation in the return and squared return series at high levels of significance, supporting the use of GARCH models. Jarque-Bera tests for normality and tests of skewness and kurtosis also both indicate that the return series are non-normal and skewed, further supporting GARCH modeling of the return series.

6.3 Tests of Comparative Performance, Risk and Risk-Adjusted Returns

We employ two procedures to contrast the performance of portfolios of BHCs in terms of return, risk and risk-adjusted return: the non-parametric Wilcoxon procedure and the parametric GARCH framework. We conduct tests on the three sets of portfolios described above: 1) BHCs that do and BHCs that do not engage in real estate investment, 2) BHCs that engage in real estate investment under lenient and strict regulatory restrictions and 3) BHCs in the top-half and bottom-half of the sub-sample of BHCs engaged in real estate investment.

6.3.1. The INVEST versus the NO_INVEST Portfolios

Wilcoxon test results for median differences in returns, risk, risk-adjusted returns (Sharpe Ratio) and value at risk (VaR) between *INVEST* versus *NO_INVEST* portfolios are reported in Table 5, panel A. The null hypothesis is that the median difference in these performance measures (D) between the two portfolios is zero ($D = 0$) against the alternative hypothesis of ($D < 0$) for returns and the Sharpe ratio (column 5), and ($D > 0$) for risk and VaR (column 4). In other words, the alternative hypothesis for returns is that engagement in real estate investment results in lower returns and lower risk-adjusted returns (Sharpe ratio) while the alternative for risk and VaR is that engagement in real estate investment leads to greater risk and greater VaR. According to p-values reported in panel A, the null of equality of the performance indicators of interest can be rejected between the *INVEST* and *NO_INVEST* portfolios in all cases in favor of the respective alternative. These findings indicate that involvement in real estate lowers returns and risk-adjusted returns while it raises risk and VaR to a statistically significant scale. The positive effects of scale and scope economies, cost complementarity and possible increase in charter value of the BHCs that might arise from real estate investment appear to be dominated by the negative effects due to the lack of expertise of BHCs in this area of activity or the fact that they do not own enough real estate to diversify within this field of activity. These findings support H_{1_RET} suggesting that investment in real estate lowers returns, $H_{1\text{-}RAR}$ proposing lower risk-adjusted returns and $H_{1\text{-}TR}$, purporting higher risk for BHCs that do invest in real estate compared to those that do not.

To put the difference in total risk in economic terms, the median difference in 1%, one-quarter value at risk (VaR) for $1 million investments in the two portfolios is calculated. This figure stands at $32,151. The Wilcoxon test supports rejection of the hypothesis of equal medians in favor of the alternative that the median VaR of the *INVEST* portfolio is greater. At a little more than 3% of the portfolio value, the difference in median VaR is economically significant, because a 3% difference in potential bad-quarter losses would likely cause portfolio managers to select different securities.

6.3.2. The LENIENT versus STRICT Portfolios

Wilcoxon test results for the *LENIENT* versus *STRICT* portfolios are presented in Table 5 Panel B. According to the p-values reported in this panel, the nulls of equality of the performance measures between the two portfolios are rejected in favor of the alternatives that the *LENIENT* portfolio has lower return and risk-adjusted return (column 5) and greater risk and VaR (column 4). These findings suggest that returns from real estate investment for resale or development are more volatile than returns on the few types of real estate investment allowed under the stricter rules. As a result, BHCs operating under lenient regulation on real estate investment did more poorly in terms of return performance and also had a greater risk, resulting in a lower Sharpe ratio. These findings support H_{2_RET} and H_{2_TR}, suggesting that relaxation of restrictions on real estate investment has a detrimental effect on returns and risk, respectively. Lenient real estate investment rules do create more opportunities for BHCs to take advantage of scale and scope economies and to increase their charter values, but they also provide BHCs more opportunities to exercise poor judgment in choosing real estate investments, resulting in lower returns and greater risk. In terms of economic value, the median difference in 1%, one-quarter value at risk (VaR) for $1 million investments in the two portfolios is $12,141. The Wilcoxon test supports rejection of the hypothesis of equal medians in favor of the alternative that the median VaR of the *INVEST* portfolio is greater. At a little more than 1% of the portfolio value, the difference in median VaR is economically significant, as it would likely influence a portfolio manager's security selection choices.

6.3.3. The HIGH_HALF versus the LOW_HALF Portfolios

Wilcoxon test results for the *HIGH_HALF* versus *LOW_HALF* Portfolios (BHCs in the top half and bottom half in terms of the real estate investment ratio (*RE*)) are presented in Table 5, Panel C. According to p-values reported in columns 4 and 5, unlike the previous portfolios, in this case the nulls of equality of the performance measures between the two portfolios cannot be rejected. This suggests that once BHCs enter the field of real estate investment activity, greater levels of real estate investment, within the limited range of activity observed in our sample, does not significantly impact their return, risk or the Sharpe ratio. In other words, there are no gains or losses for BHCs from increased involvement in real estate. In this case, the positive effects of scale and scope economies, cost complementarity and possible increase in charter value of the BHCs that might arise from greater real estate investment appear to be counter-balanced by the negative effects due to the lack of expertise of BHCs in this area of activity. These findings contradict H_{3_RET} and H_{3_TR} suggesting that greater investment in real estate is associated with lower returns and greater risk, respectively. One explanation for the latter finding is that the risk reduction brought about by diversification in real estate is not significantly greater than or less than the greater variance of returns from real estate investments relative to alternative investments. It is also possible that the diversification reduces risk, but the BHC organization becomes more complex, resulting in greater agency and monitoring problems that offset the former effect.

It is notable that the ratio of real estate investment to total assets (*RE*) in our sample is no greater than 4.54 percent. It is, therefore, possible that this scale of operation in real estate is too low to be profitable and that there exists a higher threshold level of real estate investment above which the gains would outweigh the losses, especially if BHCs become skilled in real estate investment over time. Our results do not reflect that effect.

6.3.4. Test Results within the GARCH framework

Table 6 reports estimation results for the GARCH models. Simultaneous inclusion of the real estate investment effects on return and volatility is an advantage of the GARCH framework but it may also make separation of these two effects more difficult as one can pick up the other, resulting in lower significance of one effect or the lack of it altogether. Two features of the estimates are notable. First, the regularity conditions are satisfied for all five portfolios for which Model 1 is estimated as the sums of the ARCH and GARCH parameters ($\theta_1 + \theta_2$) are below 1. Hence, the variance process is second-order stationary.[13] The sum ($\theta_1 + \theta_2$), which measures the persistence of the shocks received, lies between 0.745 and 0.961. Similarly, for the six portfolios for which Model 2 is estimated, this parameter sum ranges between 0.812 and 0.98. According to these parameter values, the proportion of a shock that persists after four quarters is at least $(0.745)^4$ or 30.8%.

Model 1 is estimated for the five portfolios with varying values of the real estate investment ratio (*RE)*: *INVEST*, *LENIENT*, *STRICT*, *HIGH_HALF* and *LOW_HALF*. This odel cannot be estimated for the *NO_INVEST* portfolio because the value of *RE* would always be zero. In these estimates, the real estate investment ratio (*RE*) is found to exhibit a negative and significant coefficient for the *STRICT* and *HIGH_HALF* portfolios, indicating lower returns in

[13] Chi-square tests of the restriction $\theta_1+\theta_2=1$ were performed for each model estimate for each portfolio. In each case, the restriction was rejected at the 1% level of significance.

response to increased real estate investment, with the remaining portfolios demonstrating insignificant coefficients. Lower returns on the *HIGH_HALF* and *STRICT* portfolios in response to greater real estate investment could occur if BHCs in these portfolios gave up more profitable investments when they increased the proportions of real estate in their portfolios, or if the other investments constituted a better niche for the bank. According to these results, the real estate investment ratio (*RE*) exerts an insignificant influence on the mean portfolio return for BHCs included in the *INVEST* portfolio, the portfolio of BHCs whose RE ratio falls below the median value, and *LENIENT*, the portfolio of BHCs operating in lenient real estate regulatory environments. The real estate investment ratio (*RE*) has no effect on the volatility (total risk) of any of the portfolios as the coefficient (θ_{RE}) is statistically insignificant. As said before, this may be because *RE* appears in both equations of the system. This may also be due to the limited number of observations in the sample (82 observations).

The GARCH framework produces estimates for the market beta as well as the coefficient of the interaction term (*MARKET * RE*). The market beta (β_M) measures the systematic risk of the portfolio while the interaction term coefficient (β_{INT}) measures the shift in the systematic risk when the share of real estate investment relative to total assets (*RE*) strengthens or weakens in value. The coefficient estimates in Table 6 show that the market betas of all estimated portfolios are positive and significant at the 1% level in both Model 1 and Model 2. Although statistical tests for differences in the market betas of different portfolios are not possible because they are estimated within different models, comparisons of their values may be made. For Model 1, the market beta estimate for the *HIGH_HALF* portfolio (0.55) is greater than the market beta estimate for the *LOW_HALF* portfolio (0.45), indicating that the portfolio of BHCs with a greater real estate investment ratios is riskier. These results provide basic evidence on the relationship between the level of real estate investment and market risk, which under hypothesis $H_{3\text{-}MR}$ is expected to be positive. For Model 2, the *INVEST* market beta (0.46) is 5 basis points greater than the *NO_INVEST* portfolio market beta (0.41), suggesting BHCs that invest in real estate have greater market risk than BHCs that do not. In both Models 1 and 2, the *LENIENT* portfolio's market beta is greater than the *STRICT* portfolio market beta – 8 basis points greater for Model 1 (0.57 compared to 0.48) and 7 basis points greater for Model 2 (0.51 compared to 0.44). Although this result is not from a formal test, it suggests that less-regulated real estate investment is associated with greater market risk than strictly regulated real estate investment.

The interaction term coefficient (β_{INT}) is positive and significant for the *INVEST*, *LENIENT*, and *HIGH_HALF* portfolios and insignificant for *LOW_HALF* and *LENIENT* portfolios. This means that for the BHCs included in the former three portfolios, real estate activity heightens their systematic risk (market beta). The positive coefficients for the *INVEST* and *HIGH_HALF* portfolios imply that for the average BHC that invests in real estate, greater real estate investment increases market risk and that this effect is due to BHCs ranked in the top 50 percent for real estate investment. The positive result for the *LENIENT* portfolio implies that under relatively lenient state rules, increases in real estate investment are associated with greater market risk. Contrary to these, for BHCs with relatively small investments in real estate or those operating under strict regulatory constraints, increases in real estate investment have no significant effect on market risk, as the coefficients on the *LOW_HALF* portfolio and the *STRICT* portfolio are statistically insignificant. An alternative interpretation of the positive and significant coefficient of the interaction terms is that as the general market rises, the effect of increased real estate investment on BHC returns strengthens in the positive directions for the respective portfolios.

7. Conclusions

We examine the effect of real estate investment on the risk, returns, and risk-adjusted returns of U.S. BHCs between 1990 and 2010. The analysis is performed by forming portfolios of BHC stocks according to BHCs' engagement and non-engagement in real estate investment, leniency versus strictness of regulations on BHC real estate activity and the BHC real estate investment to total asset ratios. Tests for differences in portfolio returns, risks risk-adjusted returns (Sharpe ratios) and Value-at-Risk (VaR) are conducted using the Wilcoxon test procedure as well as employing the generalized autoregressive conditionally heteroskedastic (GARCH) capital asset pricing model. Total risk and systematic risk are both considered.

Our results provide evidence that the benefits of allowing BHCs to invest in real estate, which could stem from diversification of cash flows, economies of scale, economies of scope, or increased charter value, are outweighed by the greater volatility of returns that could come from the greater volatility of real estate prices, BHCs' possible lack of expertise in real estate investment, or their inability to diversify within this field of activity because of their limited scale of operation in this area. In particular, based on the Wilcoxon test procedure, BHCs that do invest in real estate have lower returns and greater risk than BHCs that do not. In other words, mere engagement of the BHCs in real estate investment is associated with poor performance relative to BHCs' non-investment in real estate.

Similarly, BHCs which operate under lenient regulatory restrictions on real estate activity demonstrate lower return and greater risk than BHCs operating under strict rules. Our results show that BHCs operating under the regulatory environment allowing investment purchase of real estate for development or equity stakes in real estate have lower returns and risk-adjusted returns and greater risk than BHCs that invest in real estate under relatively strict rules. For policy makers, these results argue against allowing BHCs greater freedom to invest in real estate because real estate investment appears to be associated with undesirable consequences on BHC risk and return. If real estate investment is indeed allowed, it may be optimal for the regulators to impose additional capital requirements on this activity to prevent its unjustified growth.

Our GARCH results indicate that investment in real estate is associated with lower returns and greater risk for portfolios of BHCs that make the greatest investments in real estate as a proportion of their total assets *(HIGH_HALF).* This finding does not, however, extend to the portfolio of BHCs with below-median real estate investment ratios. For this latter portfolio, greater investment in real estate results in statistically identical returns, risk and risk-adjusted returns. Our GARCH results also indicate that increases in real estate investment increase market risk for portfolios of BHCs that invest in real estate versus those that do not, BHCs that invest the most in real estate versus those that invest the least, and BHCs that invest in real estate under relatively lenient rules versus those that operate under strict rules.

It is notable, however, that our results do not rule out the existence of a threshold of real estate investment beyond which BHCs would exhibit improved performance. None of the BHCs in the current sample invest more than 4.6 percent of their total assets in real estate, leaving the possibility that BHCs may not be investing enough in this area to develop expertise and to benefit from significant scale and scope economies, diversification within the specialization or increased charter value. A possible avenue for future research would thus be to examine the risk and return profiles of banks in other countries where real estate investment comprises a greater portion of portfolios.

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Table 1

Panel A: Real Estate Investment Rules for U.S. BHCs and Banks

Institution Type	Rules
Bank Holding Companies (BHCs)	Only with permission of Federal Reserve Board of Governors
National Banks (NBs)	Allowed for the following: • Payment for loans (five-year time limit on such ownership) • Acquired as a result of a default.
State Fed-member Banks (SMBs)	Only with permission of Federal Reserve Board of Governors
State Fed-non-member Banks (SNMBs)	Varies according to state as follows: *States that allow equity ownership:* Alabama, Alaska, Delaware, District of Columbia, Georgia, Hawaii, Rhode Island, South Dakota *States that allow development:* New Mexico, South Carolina, Wyoming *States that allow ownership and development:* Arizona, Arkansas, California, Colorado, Connecticut, Florida, Idaho, Illinois, Iowa, Kentucky, Maine, Massachusetts, Michigan, Missouri, Nevada, New Hampshire, New Jersey, New York, North Carolina, Ohio, Oklahoma, Pennsylvania, Tennessee, Texas, Utah, Virginia, Washington, West Virginia, Wisconsin *States that do not allow real estate activity:* Indiana, Kansas, Louisiana, Maryland, Minnesota, Mississippi, Montana, Nebraska, North Dakota, Oregon, Puerto Rico, Vermont

This table summarizes rules on real estate investment for bank holding companies (BHCs) and banks in the United States. Although it is not specified in each row of the table above, all U.S. BHCs and banks are allowed to own real estate for their own current and future operations.

Panel B: Portfolio Descriptions

Portfolio Name	Criteria for Inclusion
HIGH_HALF (LOW_HALF)	BHC reports investing in real estate during the quarter; real estate investment to total assets ratio (*RE*) is among the top half (bottom half) of BHCs that quarter.
INVEST (NO_INVEST)	BHC reports positive (zero) investment in real estate during the quarter.
LENIENT (STRICT))	BHC reports investing in real estate during the quarter; BHC does (does not) control a subsidiary bank that may invest in real estate under rules that allow equity purchases of real estate and real estate development.

Table 2

Panel A. Hypotheses and Summary of Findings: The Wilcoxon Procedure

Hypothesis abbreviation	Hypothesis statement	Supported?
$H_{1\text{-}RET}$	BHCs that invest in real estate have lower returns than BHCs that do not.	YES
$H_{1\text{-}TR}$	BHCs that invest in real estate have greater total risk than BHCs that do not.	YES
$H_{1\text{-}RAR}$	BHCs that invest in real estate have lower risk-adjusted returns than BHCs that do not.	YES
$H_{2\text{-}RET}$	BHCs that invest in real estate under relatively lenient rules have lower returns than BHCs that invest under relatively strict rules.	YES
$H_{2\text{-}TR}$	BHCs that invest in real estate under relatively lenient rules have greater total risk than BHCs that invest under relatively strict regulations.	YES
$H_{2\text{-}RAR}$	BHCs that invest in real estate under relatively lenient rules have lower risk-adjusted returns than BHCs that invest under relatively strict rules.	YES
$H_{3\text{-}RET}$	Greater investment in real estate by BHCs is associated with lower returns.	NO
$H_{3\text{-}TR}$	Greater investment in real estate by BHCs is associated with greater total risk.	NO
$H_{3\text{-}RAR}$	Greater investment in real estate by BHCs is associated with lower risk-adjusted returns.	NO

Panel B. Hypotheses Concerning Systematic Risk: The GARCH Procedure

$H_{3\text{-}MR}$	Greater investment in real estate by BHCs is associated with greater market risk.	Supported?
Portfolio	*INVEST*	YES
Portfolio	*NO-INVEST*	NO
Portfolio	*LENIENT*	YES
Portfolio	*STRICT*	NO
Portfolio	*HIGH-HALF*	YES
Portfolio	*LOW_HALF*	NO

Table 3

Financial Ratios on All BHCs Reporting to the Federal Reserve (1990:4 to 2010:4)

	BHCs that invest in real estate	***BHCs that don't invest in real estate***	***BHCs that invest in real estate under Fed regulation***	***BHCs that invest in real estate under state regulation***	***Bottom half of real estate ratio distribution***	***Top half of real estate ratio distribution***
Cap. Ratio	0.0863	0.0882	0.0870	0.0860	0.0878	0.0847
LL Ratio	0.0037	0.0027	0.0035	0.0037	0.0034	0.0039
ROE	0.0424	0.0521	0.0790	0.0272	0.0434	0.0414
ROA	0.0060	0.0069	0.0065	0.0058	0.0066	0.0054

N	3,106	56,724	914	2,192	1,545	1,561

Note: This table presents mean financial ratios for six categories of BHCs that filed Y-9 reports with the Federal Reserve between the fourth quarter of 1990 and the fourth quarter of 2010. The data come from second and fourth quarter reports, because small BHCs file Y-9 reports only in those quarters. "Cap. Ratio" is the equity capital ratio, equity capital divided by total assets; LL Ratio is the loan and lease loss provision ratio, loan and lease loss provisions divided by total assets; ROE is the return on equity, net income divided by equity capital; and ROA is return on assets, net income divided by total assets. The two rightmost columns contain mean ratios for two categories of BHCs that reported investment in real estate – those in the top half of the quarterly real estate ratio (real estate investment to total assets) distribution and those in the bottom half of the real estate ratio distribution. The number of observations differs because an odd number of BHCs invest in real estate in some quarters.

Table 4
Descriptive Statistics on BHCs & Portfolios in Sample of Stock Issuers (1990:3 to 2010:4)

	N	*Mean*	*Median*	*Minimum*	*Maximum*	*Std. Dev.*
Panel 1: Bank Holding Companies in sample						
Total Assets ($millions)	3,002	89,137	1,232,907	96,227	2,366,087	292,581
Real Estate Investment ($millions)	3,002	160.3	0	1.0	7,878.1	776.1
Real Estate Investment Ratio (%)	3,002	0.22	0	2.12×10^{-5}	4.54	0.38
Panel 2: Portfolio Mean Total Assets ($millions, quarterly observations)						
INVEST	82	130,890	55,589	17,564	453,635	129,356
NO_INVEST	82	8,852	7,907	5,568	17,970	3,128
LENIENT	82	221,630	71,998	17,467	1,068,064	254,768
STRICT	82	31,208	15,414	3,876	113,726	31,108
HIGH_HALF	82	116,779	42,610	6,685	547,467	135,633
LOW_HALF	82	145,638	69,860	22,438	475,993	131,051
Panel 3: Portfolio Real Estate Investment to Total Assets Ratio (RE) (%, quarterly observations)						
INVEST	82	0.218	0.229	0.127	0.463	0.075
NO_INVEST	82	0	0	0	0	0
LENIENT	82	0.233	0.212	0.132	0.501	0.086
STRICT	82	0.207	0.192	0.082	0.371	0.086
HIGH_HALF	82	0.427	0.415	0.237	0.901	0.140
LOW_HALF	82	0.034	0.024	0.009	0.100	0.023
Panel 4: Portfolio Mean Quarterly Returns (quarterly observations)						
INVEST	82	0.028	0.041	0.118	-0.363	0.272
NO_INVEST	82	0.033	0.042	0.093	-0.235	0.212
LENIENT	82	0.021	0.042	0.135	-0.475	0.295
STRICT	82	0.038	0.037	0.106	-0.308	0.231
HIGH_HALF	82	0.027	0.049	0.122	-0.486	0.246
LOW_HALF	82	0.029	0.03	0.123	-0.347	0.333
Panel 5: Portfolio Mean Quarterly Returns Series (quarterly observations)						
	N	*J-B (MSL)*	*Skewness*	*Kurtosis*	*Q(10)*	*$Q^2(10)$*
INVEST	82	0.00***	-1.164***	2.411***	12.962	32.133***
NO_INVEST	82	0.00***	-0.855***	1.059*	15.751	22.435**

LENIENT	82	0.00***	-1.485***	3.878*	14.554	28.198***
STRICT	82	0.00***	-0.742***	1.164***	13.842	25.300***
HIGH_HALF	82	0.00***	-1.628***	4.469***	15.573	25.378***
LOW_HALF	82	0.02**	-0.466*	1.23*	9.949	31.736***

Note: Portfolios are described in Table 1. J-B is the Jarque-Bera joint normality test statistic. MSL stands for marginal significance level. Kurtosis figures are in excess of three. *Q(10)* and $Q^2(10)$ are the Ljung-Box statistics for the 10th order autocorrelations in return and squared return series. The critical values at the 5% level for 10, 20, and 30 degrees of freedom are 18.30, 31.41, and 43.77, respectively. ***, **, and * represent significance at the 1%, 5%, and 10% levels, respectively.

Table 5
Wilcoxon Tests of Median Differences

Variable	*Median Difference (D)*	*Test Statistic (W)*	*p-value* H_A: *D > 0*	*p-value* H_A: *D < 0*
Panel A: INVEST and NO_INVEST (1990:3 to 2010:4)				
Model 2 Results				
Return	-0.006	-1.264	0.90	**0.10**
Total Risk	0.001586	6.521	**0.00**	>0.99
VaR	$32,151	6.886	**0.00**	>0.99
Sharpe Ratio	-0.1843	-2.489	0.99	**0.01**
Panel B: LENIENT and STRICT (1990:3 to 2010:4)				
Model 1 Results				
Return	-0.011	-2.129	0.98	**0.02**
Total Risk	0.0003627	1.727	**0.04**	0.96
VaR	$12,141	3.474	**0.00**	>0.99
Sharpe Ratio	-0.146	-1.431	0.92	**0.08**
Model 2 Results				
Return	-0.011	-2.129	0.98	**0.02**
Total Risk	0.001228	2.420	**0.01**	0.99
VaR	$15,777	3.049	**0.00**	0.99
Sharpe Ratio	-0.1503	-2.110	0.98	**0.02**
Panel C: HIGH_HALF and LOW_HALF (1990:3 to 2010:4)				
Model 1 Results				
Return	0.001	0.178	0.43	**0.57**
Total Risk	0.0001775	-0.685	**0.25**	0.75
VaR	$7,448	0.243	**0.40**	0.60
Sharpe Ratio	-0.0278	-0.460	0.68	**0.32**
Model 2 Results				
Return	0.001	0.178	0.43	**0.57**
Total Risk	0.0005753	0.485	**0.31**	0.69
VaR	$7,0003	-2.790	**0.45**	0.55
Sharpe Ratio	0.07117	0.918	0.18	**0.82**

Note: These tables present results of Wilcoxon matched-pair signed-rank tests of median differences. Each row presents the results of tests of the null hypothesis that the median difference in the series is zero against two alternative hypotheses: 1) that the difference is positive and 2) that the difference is negative. Differences are calculated by subtracting the value for the portfolio listed first from the portfolio listed second. Each row presents test results as follows: "Return" for portfolio returns, "Total Risk" for the estimated conditional variance of returns; "VaR" for the 1%, one-quarter portfolio Value at Risk; and "Sharpe Ratio" for the portfolio Sharpe ratio (returns divided by conditional standard deviations). Model 1 results are not presented in Panel A because Model 2 cannot be estimated for the *NO_INVEST* portfolio. All values of the real estate investment to total assets ratio (*RE*) are zero for that portfolio. The *p*-values in bold are associated with the alternative hypothesis of primary concern in the main text. The other *p*-values are given because they are occasionally discussed in the text, too.

Table 6: GARCH Estimates (1990:3 to 2010:4)

		Panel A: Model 1					*Panel B: Model 2*					
Coeff.	Variable	*INVEST*	*LEN-IENT*	*STRICT*	*HIGH_HALF*	*LOW_HALF*	*INVEST*	*NO_INVEST*	*LEN-IENT*	*STRICT*	*HIGH_HALF*	*LOW_HALF*
α	Intercept	0.05	0.02	0.08**	0.07***	0.03***	0.02**	0.03***	0.02	0.02***	0.02**	0.02**
		(1.43)	(0.80)	(2.12)	(69.95)	(2.40)	(2.25)	(3.15)	(1.62)	(2.96)	(2.26)	(2.19)
β_M	*MARKET*	0.53***	0.57***	0.48***	0.55***	0.45***	0.46***	0.41***	0.51***	0.44***	0.44***	0.46***
		(6.56)	(7.02)	(5.24)	(5.66)	(5.32)	(5.61)	(6.18)	(5.54)	(6.72)	(5.33)	(5.36)
β_{RE}	*RE*	-0.14	-0.03	-0.29*	-0.15***	-0.27						
		(-0.90)	(-0.24)	(-1.73)	(-65.75)	(-0.95)						
β_{INT}	*MARKET*RE*	2.15***	1.75***	0.49	0.85***	-4.84						
		(2.67)	(2.69)	(0.24)	(2.23)	(-1.30)						
Φ	ARCH(0)	1.00	3.00	3.00	1.00**	1.00	1.00	1.00	2.00*	1.00	1.00	1.00
	($\times 10^{-3}$)	(0.57)	(1.08)	(0.90)	(2.14)	(1.55)	(1.28)	(1.15)	(1.87)	(0.91)	(1.12)	(1.51)
θ_1	ARCH(1)	0.31	0.32**	0.14	0.14	0.54***	0.44**	0.44	0.34**	0.47	0.44*	0.51***
		(1.60)	(2.30)	(0.96)	(0.86)	(2.56)	(2.13)	(1.59)	(2.21)	(1.28)	(1.72)	(2.54)
θ_2	GARCH(1)	0.56***	0.45***	0.61***	0.66***	0.43***	0.49***	0.52***	0.47***	0.51***	0.51***	0.44***
		(3.64)	(2.54)	(2.38)	(5.22)	(3.12)	(3.32)	(2.56)	(2.94)	(2.88)	(3.88)	(3.44)
θ_{RE}	*RE*	0.00	-2.00	-0.00	0.00	-0.00						
		(0.00)	(-0.21)	(-0.56)	(0.17)	(-0.59)						
	SHAPE	1.31***	1.19***	1.73***	1.95***	1.04***	1.14***	1.05***	1.19***	1.46***	1.22***	0.99***
		(3.82)	(4.51)	(3.98)	(4.62)	(3.47)	(3.45)	(4.25)	(4.53)	(3.84)	(3.38)	(3.52)
$\theta_1 + \theta_2$	ARCH+GARCH	0.87	0.77	0.75	0.80	0.96	0.93	0.96	0.81	0.98	0.94	0.95
Model Diagnostics												
	Log Likelihood	89.53	80.44	90.07	88.32	81.35	86.71	102.08	78.58	87.79	86.06	79.74
	Q(5)	0.37	0.77	0.10	0.15	0.71	0.32	0.09	0.22	0.29	0.10	0.70
	$Q^2(5)$	0.00	0.00	0.71	0.04	0.00	0.00	0.00	0.00	0.64	0.04	0.00
	No. of Obs.	82	82	82	82	82	82	82	82	82	82	82

This table presents parameter estimates for two GARCH(1,1) models of the quarterly returns on portfolios of BHC stocks, Model 1:

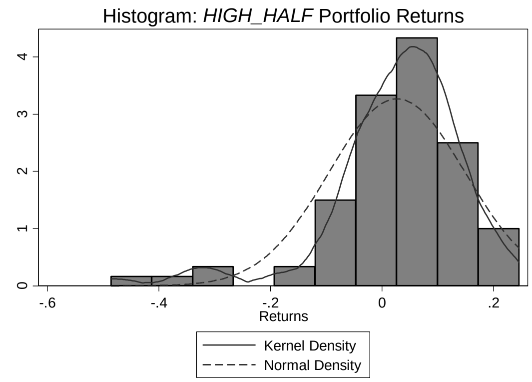
$$R_t = \alpha + \beta_M MARKET_t + \beta_{RE} RE_t + \beta_{INT} MARKET * RE_t + \varepsilon_t \quad (1)$$
$$h_t^2 = \phi + \theta_1 \varepsilon_{t-1}^2 + \theta_2 h_{t-1} + \theta_{RE} RE_t \quad (2)$$

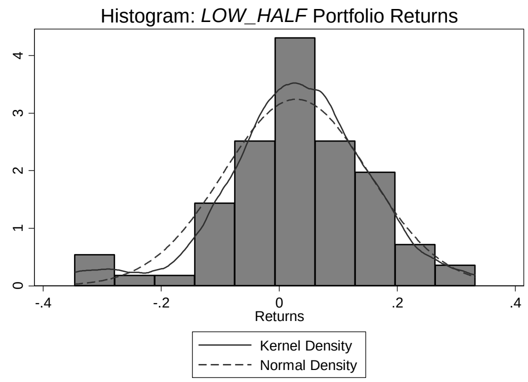
and Model 2:

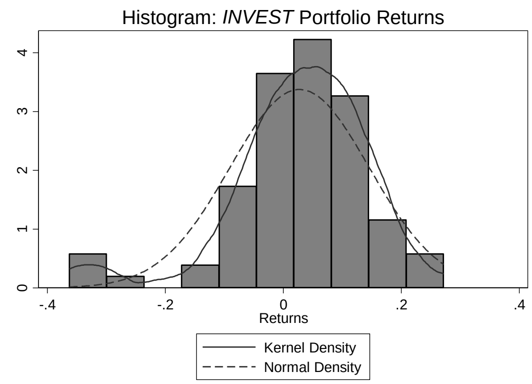
$$R_t = \alpha + \beta_M MARKET_t + \varepsilon_t \quad (3)$$
$$h_t^2 = \phi + \theta_1 \varepsilon_{t-1}^2 + \theta_2 h_{t-1} \quad (4)$$

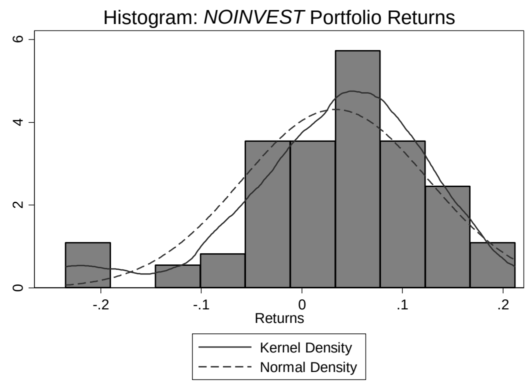
The models are estimated using the method of maximum likelihood under the assumption that the error term follows the generalized error distribution (GED). R_t is the portfolio return, $MARKET_t$ is the return on the market portfolio, RE_t is the mean real estate investment to total assets ratio of the BHCs in the portfolio in period *t*, and $MARKET*RE_t$ is an orthogonalized interaction of $MARKET_t$ and RE_t. Portfolios are formed as described in Section 4. Data cover the period from the 3rd quarter of 1990 through the fourth quarter of 2010. *t*-values are in parentheses. *Q(5) and* $Q^2(5)$ are the Ljung-Box test statistics for the 5th order autocorrelation for standardized and squared standardized residuals. The critical values at the 5% level for 10, 20, and 30 degrees of freedom are 18.30, 31.41, and 43.77, respectively. ***, **, * represent significance at the 1%, 5%, and 10% levels, respectively.

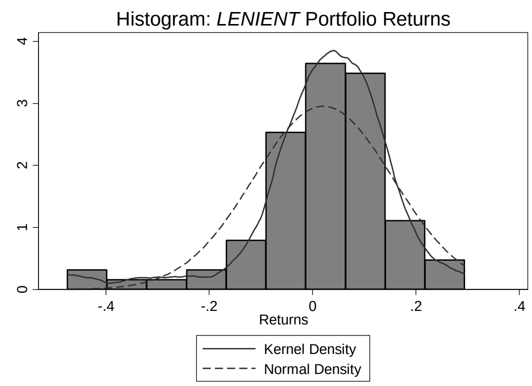
Appendix 1 – Portfolio Return Histograms

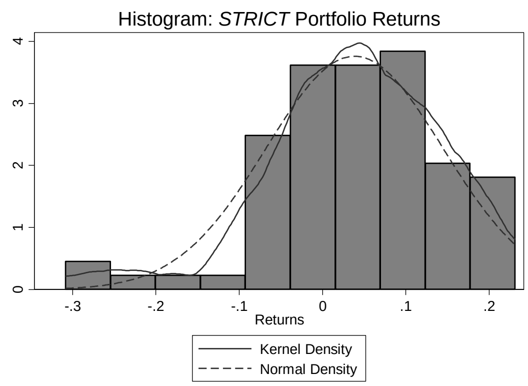












Appendix 2 – Value at Risk (VaR)

Value at Risk (VaR) can be viewed as the most that an investor could expect to lose from a financial position during a given time period for a given probability. A stock portfolio's 1%, one-quarter VaR is the amount by which the value of an investment in the portfolio would change if the portfolio's realized quarterly return equals the first percentile of its expected return distribution. For example, if the first percentile of the expected return distribution is -5%, the change in the value of a $1 million investment in the portfolio is expected to be no worse than a decline of $50,000 on 99% of all trading days. The expected return distribution of a portfolio with high total risk has a low first percentile because the distribution has a large variance and, thus, a wide distribution of possible returns. A portfolio with high total risk is, therefore, subject to high losses in unusually "bad" quarters and, thus, has a greater VaR.

For this study, portfolios' expected return distributions are calculated under the assumption that they are normal with mean equal to the estimated model's predicted return and variance equal to the estimated conditional variance, or total risk, for that quarter. The formula for VaR under these assumptions is:

$$VaR = I \times (\widehat{R_t} + zh_t)$$

where I is the initial value of the investment, $\widehat{R_t}$ is the predicted return, z is the value of the standard normal distribution at the desired percentile, and h_t is the standard deviation of the expected return distribution. Suppose a portfolio's predicted return for the quarter is 0.1 percent with estimated conditional standard deviation of 0.0006. Then the 1%, one-quarter VaR on a $1 million investment would be: $VaR = \$1{,}000{,}000 \times (0.001 + (-2.32 \times 0.006)) = -\$12{,}920.$

The negative sign on VaR indicates that the change in portfolio value would be a loss. In the empirical analysis in Section 6, the absolute value of the VaR is reported.