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REAL ESTATE EXPOSURE OF US BANKING INDUSTRY STOCK RETURNS: EVIDENCE FROM COMMERCIAL AND RESIDENTIAL MARKETS

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Abstract. This study is the first to address the exposure of banking industry stock returns to both the commercial and residential real estate markets. The empirical findings show that U.S. banking industry stock returns are significantly sensitive to real estate market returns after controlling for stock market, interest rate, and exchange rate effects. Moreover, the commercial and residential real estate markets have very different effects on banking industry stock returns. Furthermore, the effects on banking industry stock returns are state-dependent. The findings have valuable implications for investors, managers and regulatory authorities.

Keywords: real estate, bank, stock return, commercial real estate, residential real estate, quantile regression.

Introduction

Identifying the sources of risk for U.S. banking industry stock returns is important for global stock investors as well as for regulatory control purposes. The U.S. banking industry is of great importance to investors in global equity markets. In the middle of July 2013, the market capitalization of U.S. banking institutions, which exceeded $1 trillion, was more than twice that of resource companies from the Bric countries – Brazil, Russia, India and China (Atkins & Fray, 2013). Knowledge of the sources of risk of U.S. bank stock returns is without question crucial for investing in the banking industry. Moreover, since the deregulation of the asset and liability powers of banking institutions in the 1980s and 1990s, the importance of regulatory control over the risk-taking behavior of U.S. banking institutions has increased. After years of discussion, international recommendations, including the Basel Accord II, have increasingly emphasized the use of market discipline as a major regulatory device. However, the use of market discipline to evaluate and control bank risk-taking behavior requires an understanding of the market factors that influence the security price movements of these institutions (Tai, 2000, 2005; Viale, Kolari, & Fraser, 2009).

The research on the various market factors that impact bank stock returns has been extensive. Surprisingly, only a limited number of studies investigate the impact of real estate factors on bank returns (Elyasiani, Mansur, & Wetmore, 2010), although real estate mortgages now represent a large share of the total loans in asset portfolios on an international basis (Apergis, 2012). In addition, many banks have other links to the real estate market, such as fee income from real estate investment banking, profits from direct investments, and dividends from indirect investments (Lausberg, 2004). These studies thus ignore the implicit view of the Basel Accords, including Basel Accords I, II, and III, that the commercial and residential real estate markets have differential impacts on banking institutions (Panagopoulos & Vlamis, 2008; Pu, 2008; Basel Committee on Banking Supervision, 2014; Chandan & Zausner, 2015). Moreover, the possibility that bank stock returns react asymmetrically to real estate market movements in good and bad economic times has received very little attention, although the mortgage literature indicates that default risk could be asymmetric in good and bad economic times. Together with real estate collateral values,

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the major risk of mortgage lending is driven by mortgagors' financial health, which likely suffers in bad economic times (Elmer & Seelig, 1999). Additionally, the literature also suggests that bank lending standards naturally change with market conditions. In particular, banks tend to adopt lax standards and engage in aggressive competition during periods of economic expansion (Berger & Bouman, 2009; Viale & Madura, 2014; Weinberg, 1995). Banks' lending risk is therefore likely to be asymmetric during good and bad economic times.

The purpose of this paper is to explore the sensitivities of U.S. bank stock returns to commercial and residential real estate price changes by implementing a time-series multi-factor framework. This paper offers the following contributions.

First, this study investigates the sensitivity of bank stock returns to commercial and residential real estate. Banks lend to and/or invest in both commercial and residential real estate markets (Choulet & Quignon, 2009). The price dynamics of the two markets often diverge from one another (Zhu, 2003). Moreover, commercial mortgages and residential mortgages have distinct provisions (Ambrose & Sanders, 2003). Consistent with the foregoing, the view that the commercial and residential real estate markets have different impacts on banking institutions is implicit in the Basel Accords. However, existing studies focusing on real estate returns do not distinguish between the two markets. Obviously, to have a clearer picture of the risk exposure of banks to real estate, it is essential to understand the separate influences of the commercial and residential real-estate markets. To fill the void in the literature, the present work addresses for the first time both commercial and residential real-estate sensitivities.

Second, this study employs direct commercial real estate data to address the sensitivity of bank stock returns to real estate. When using commercial real estate returns to examine real estate sensitivity, existing studies utilize real estate investment trust returns (REITs). Whether REIT performance closely follows the commercial real estate market, however, is the subject of debate (Allen, Madura, & Wiant, 1995; Elyasiani et al., 2010; Lee & Chiang, 2010; M. L. Lee, M. T. Lee, & Chiang, 2008). To amend this deficit in the research, the present work utilizes direct commercial real estate data to address the sensitivity of bank stock returns to real estate.

Third, this study is the first to examine non-linear sensitivities of bank stock returns using quantile regression (QR), which examines the conditional dependence of specific quantiles of bank stock returns with respect to the factors that have been studied. The QR approach can provide specific insights on the impact of real estate factors – including additional market factors that have been studied – on bank stock returns given different states of the banking industry, including bearish (lower quantile) and bullish (upper quantile) markets (Baur, Dimpfl, & Jung, 2012; G. Li, Y. Li, & Tsai, 2015). Thus, this approach reveals information regarding the non-linear effects of the studied factors on bank stock returns (Baur, 2013; Mensi, Hammoudeh, Reboredo, & Nguyen, 2014)[1].

The remainder of the paper proceeds as follows. Section 1 provides a summary of the literature on the sensitivities of banks to interest rates, exchange rates, and real estate. Section 2 describes the data and empirical methodologies. Sections 3 and 4 present and discuss the empirical results. Section "Concluding remarks" concludes the paper.

1. Interest rate, exchange rate, and real estate sensitivities

Banks are considered to operate in a unique industry, and they differ in many respects from other industrial companies (Bessler & Kurmann, 2014; Fama, 1980; Gande & Saunders, 2012). In addition to equity market returns, the literature has proposed that interest rates, foreign exchange rates, and real estate returns reflect the inherent risks involved in banking to render the pricing of bank stocks more efficient (Bessler & Kurmann, 2014). The rest of this section proceeds as follows. Section 1.1 summarizes interest rate sensitivity studies, Section 1.2 summarizes exchange rate sensitivity studies, and Section 1.3 reviews the literature on real estate sensitivity.

1.1. Interest rate sensitivity

A traditional feature of the banking business is borrowing short-term in the form of deposits and lending long in the form of loans. In this way, banks transform debts with short maturity into credits with long maturities and collect the difference in rates as profit. The practice of maturity transformation creates a maturity mismatch between bank assets and liabilities and exposes banks to interest rate changes. Based on this view, a considerable number of empirical studies have examined the impact of interest rate changes on bank returns since the early 1970s (Baele, De Bruyckere, De Jonghe, & Vander Vennet, 2015; Elyasiani et al., 2010).

Consistent with the mismatch issue, early studies in general document a significantly negative effect of movements in interest rates on bank stock returns (Au Yong & Faff, 2008; Bae, 1990; Czaja, Scholz, & Wilken, 2010; Dinenis & Staikouras, 1998; Elyasiani & Mansur, 1998, 2003; Flannery & James, 1984; Stevenson, 2002). Moreover, bank stock returns tend to exhibit stronger sensitivity to changes in long-term interest rates and to changes in short-term rates. Studies that provide supporting evidence include Akella and Chen (1990), Yourougou (1990), Kwan (1991), Akella and Greenbaum (1992), Song (1994), Elyasiani and Mansur (1998), Kane and Unal (1988),

[1] Examining only the 50 percent quantile, Bessler and Kurmann (2014) in fact performed a median regression and thus did not explore the non-linear sensitivities of bank stock returns.

Saporoschenko (2002), Elyasiani and Mansur (2004), and Czaja et al. (2009).

More recent studies, however, suggest that the effect has declined (Benink & Wolff, 2000; Faff & Howard, 1999; Lael Joseph & Vezos, 2006; Ryan & Worthington, 2004) and may have reversed from negative to positive over time. Specifically, Ferrer, González, and Soto (2010) and Ballester, Ferrer, and González (2011) find that Spanish banks are significantly and positively exposed to interest rate changes in the post-euro period. Bessler, Kurmann, and Nohel (2015) also find that US banking industry stock returns are positively related to interest rate changes post 1999. Proposed reasons include the lack of adequate competition in the banking industry, the widespread use of adjustable rate loans, expansion of asset securitization, intensive use of interest rate derivatives, and difficulties maintaining margins in the low interest rate environment of recent years (Ballester et al., 2011; Bessler et al., 2015; Faff & Howard, 1999; Ferrer et al., 2010; Ho & Saunders, 1981; Lepetit, Nys, Rous, & Tarazi, 2008; Sukcharoensin, 2013). Nevertheless, the positive interest rate sensitivity might also be attributed to the short periods of time covered by these studies. In conclusion, the literature has reported both negative and positive interest rate sensitivity. The seemingly conflicting results may be caused by the various sample periods covered by these studies and thus indicate that the response of banking industry stock returns to interest rate changes may be dependent on the banking environment.

1.2. Exchange rate sensitivity

Changes in exchange rates is another potential risk source that has attracted a great deal of attention (Elyasiani et al., 2010; Tai, 2000) because of the increasing volatility of exchange rates after the advent of the flexible exchange rate system in the 1970s as well as the increasing globalization of the economy (Choi, Elyasiani, & Kopecky, 1992; Tai, 2000). In particular, fluctuations in exchange rates may result in translation gains or losses based on banks' net foreign positions and therefore may be another potential determinant of bank stock returns (Tai, 2000). However, banks can hedge their foreign exchange exposure with currency derivatives and reduce the exposure of stock returns to exchange rate risk (Choi & Elyasiani, 1997).

While certain studies have had limited success in detecting the influence of fluctuations in foreign exchange rates (Baele et al., 2015; Joseph & Vezos, 2006; Martin, 2000), many empirical studies have verified the significant impact on bank stock returns from an international standpoint, including Australia (Shamsuddin, 2009), China (T. C. Wong, J. Wong, & Leung, 2009), Korea (Hahm, 2004), Malaysia (Rahman, 2010), Thailand (Vithessonthi, 2010), Turkey (Kasman, Vardar, & Tunç, 2011), and the U.S. (Choi & Elyasiani, 1997; Choi et al., 1992; Gounopoulos, Molyneux, Staikouras, Wilson, & Zhao, 2013; Harris, Wayne Marr, & Spivey, 1991; Tai, 2000, 2005; Wetmore & Brick, 1994). Moreover, Choi and Elyasiani (1997) and Tai (2005) report that exchange rate sensitivity is even more significant than interest rate sensitivity for U.S. banks. In contrast, Chamberlain, Howe, and Popper (1997), Ryan and Worthington (2004), Joseph and Vezos (2006), Di Iorio, Faff, and Sander (2013) find that exchange rate sensitivity is not very pronounced for their sample Australian, European, Japanese, and U.S. banks. In conclusion, some prior studies have had limited success in detecting significant foreign exchange sensitivity, while others reveal significant foreign exchange sensitivity. The apparently contradictory results may be caused by the selective hedging activities of banks on exchange rate risk over the various sample periods covered by these studies.

1.3. Real estate sensitivity

In countries with a large scope of permissible real estate activity, real estate loans often constitute a major portion of the banks' balance sheets (He, Myer, & Webb, 1996; Lausberg, 2004; Mei & Saunders, 1995). Moreover, internationally, banks have dramatically shifted their assets to real estate loans over the past decades (Apergis, 2012; Blaško & Sinkey, 2006; He et al., 1996; Young, Wiseman, & Hogan, 2014). In particular, since 1989, U.S. banks have shifted more of their assets from commercial loans to real estate loans in response to risk-based capital requirements or their possible implementation and the increased use of commercial paper by corporations as a substitute for bank loans (Blaško & Sinkey, 2006; Elyasiani et al., 2010). This asset substitution has potentially exposed banks to the risk of changes in real-estate prices (Blaško & Sinkey, 2006; Elyasiani et al., 2010). In fact, the subprime crisis has dramatically highlighted the significance of real estate risk (Huizinga & Laeven, 2012).

Surprisingly, the real estate effect has received only limited research attention. In the literature, factor models for bank stock returns have only sparsely incorporated real estate price changes as an additional risk factor. The few exceptions regarding U.S. banks include Allen et al. (1995), He et al. (1996), Mei and Saunders (1995), Elyasiani et al. (2010), Bessler and Kurmann (2014), and Bessler et al. (2015), all of whom document positive sensitivity of bank stock returns to REIT returns. The only exception is a study by He and Reichert (2003) showing that bank returns are positively exposed to housing returns. The positive sensitivities are consistent with the view that increases in real estate prices lead to declines in the inability of borrowers to meet their obligations for mortgage loans and uncollateralized loans and declines in expected losses, which lead to increases in bank profitability (Apergis, 2012; Elyasiani et al., 2010).

However, rises in real estate values do not necessarily increase bank profitability because institutions tend to extend lending to borrowers with a declining risk premium when real estate values are rising (Apergis, 2012; Herring & Wachter, 2003, 1998). Moreover, apart from myopia and intensive competition, when making efforts to expand lending to households and firms, banking institutions are motivated by short-term incentive structures and accounting and regulatory arrangements to engage in higher risk exposure, and hence, their risk premium may fail to compensate for potential losses (Apergis, 2012; Berger & Udell, 2004; Borio, Furfine, & Lowe, 2001). Supporting the above arguments, Cavallo and Majnoni (2002), Arpa, Giulini, Ittner, and Pauer (2001), and Laeven and Majnoni (2003) provide empirical evidence showing a negative relationship between lending growth and profitability. Consistent with this view, Apergis (2012), in contrast to the above U.S. studies, produces negative sensitivities of Greek bank stock returns to REIT returns.

To summarize, previous studies generally document positive sensitivity of bank stock returns to real estate returns. However, there are also theories that suggest negative sensitivity. It is worth noting that, with the exception of He and Reichert (2003), the abovementioned studies regarding the effects of real estate risk on bank stock returns employ REIT returns as a real estate factor. However, REITs are primarily securitized commercial estate investments, and thus, REIT returns arguably largely reflect commercial real estate market movement. Moreover, whether REIT returns closely resemble commercial real estate returns is disputed (Allen et al., 1995; Elyasiani et al., 2010; Lee & Chiang, 2010; Lee et al., 2008). Nevertheless, to date, no study has employed direct commercial real estate returns to investigate the sensitivity of bank stock returns to real estate.

Furthermore, the above studies apparently ignore the fact that banking activities involve both commercial and residential real estate markets, whose prices often diverge from each other (Choulet & Quignon, 2009; Zhu, 2003). Commercial real estate has unique characteristics, such as longer construction lags, long-term leases, volatile income streams, high maintenance costs, and low consumption values; as a result, commercial and residential real estate cycles show distinct patterns (Chiu, M. T. Lee, M. L. Lee, & Chiang, 2010; Zhu, 2002, 2003). In fact, the Basel Accords, which were developed by the Bank for International Settlements, assign different risk weights for commercial and residential mortgages (Panagopoulos & Vlamis, 2008; Pu, 2008; Basel Committee on Banking Supervision, 2014; Chandan & Zausner, 2015), which have distinct characteristics (Chiu et al., 2010). However, no study has examined the sensitivity of bank stock returns to both commercial and residential real estate. Moreover, no study, to the best of our knowledge, has employed quantile regressions to explore the asymmetric and non-linear effects of factors on bank stock returns.

2. Data source and description

Following He et al. (1996), Ryan and Worthington (2004), Elyasiani et al. (2010), and Bessler and Kurmann (2014), this study performs empirical analyses on the industry level. In this study, banking industry stock returns (*BANK*) are computed based on the Datastream US bank total return index (Kolb, 2011). Stock market returns (*MRK*) are calculated based on the Datastream world total equity return index (Tai, 2005). Interest rate changes (*INT*) are the changes to the 10-year Treasury constant maturity rate (Elyasiani et al., 2010).

Exchange rate changes (*FX*) are changes to the index based on the trade-weighted average of the foreign exchange values of USD against the currencies of major US trading partners (Bessler & Kurmann, 2014; Tai, 2005); thus, positive changes indicate increasing values of the US dollar. Commercial real estate returns (*CRE*) are the changes to the US Moody's/RCA major-market commercial property price index[2], and residential real estate returns (*RRE*) are the changes in the seasonally adjusted S&P CoreLogic Case-Shiller-20-city composite home price index[3].

Moody's Investors Service and Real Capital Analytics, Inc. jointly publish the US Moody's/RCA commercial property price index monthly. S&P Dow Jones Indices, CoreLogic and MacroMarkets LLC together publish the S&P CoreLogic Case-Shiller home price index monthly. Both index series are constructed using the repeated sales regression approach and are designed to measure average prices at the property level[4]. The indices thus are based on the price changes actually experienced by individual properties and the same types of price changes that direct property investors and homeowners actually experience.

All the indexes are monthly series because of the availability of direct real estate data and the relative low noise compared with the high noise in high-frequency data (Du, Hu, & Wu, 2014; Elyasiani et al., 2010). Due to data availability, the sample period is from January 2001 to May 2014. Before being differenced, all indexes are set to 1.00 in January 2002 to eliminate scaling effects, and the logarithm is taken (M.-T. Lee, M.-L. Lee, Lai & Yang, 2011).

Figures 1 and 2 plot the time series dynamics of the six return series under study. As expected, the return series experience strong fluctuations over time and stronger swings during the recent global financial crisis (GFC) period. These fluctuations suggest the possibility of different economic states in the sample period. Figure 3 plots the

2 The empirical results are similar when either the Moody's RCA national all-property index or the core commercial property index is used instead of the major-market commercial property index.

3 As suggested by one anonymous referee, loan value indices are preferred to real estate indices because banks rarely hold real estate as an investment or as a capital asset. Similar to previous studies, this study utilizes real estate indices because of data availability. Readers should keep this limitation in mind.

4 Based on actual transaction prices, the indices are generally considered to measure property value movements more accurately over time compared to appraisal-based indices (Geltner & Ling, 2006). However, the repeat sale indices are not perfect and might suffer from some inherent problems, such as aggregate bias and selection bias (Parker, MacFarlane, Newell, & Rossini, 2007).

Table 1. Summary statistics

	BANK	MRK	INT	FX	RRE	CRE
Mean	0.078%	0.491%	–0.455%	–0.195%	0.473%	0.264%
Median	0.172%	1.213%	–0.952%	–0.012%	0.811%	0.542%
Max.	33.343%	14.759%	25.926%	6.895%	3.516%	1.718%
Min.	–31.971%	–26.304%	–38.550%	–5.429%	–3.656%	–2.011%
Std. Dev.	0.080	0.050	0.085	0.021	0.013	0.009
Skewness	0.079	–1.218	–0.106	0.059	–1.518	–0.821
Kurtosis	7.486	7.340	5.524	3.317	5.435	2.736
Obs.	161	161	161	161	161	161

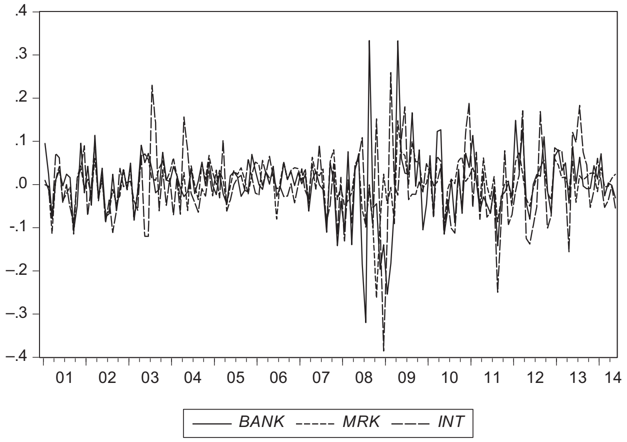

Figure 1. Time series plot for *BANK*, *MRK* and *INT* series

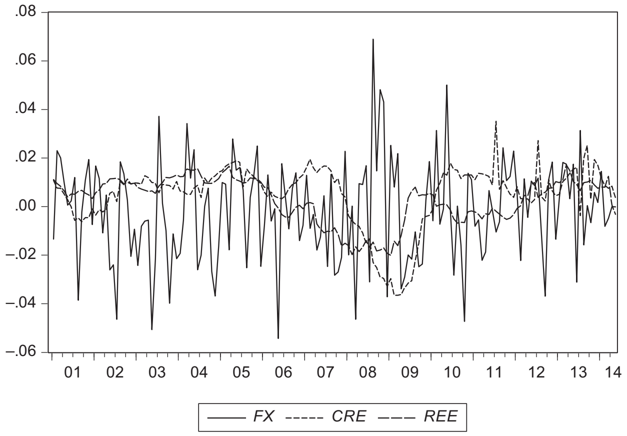

Figure 2. Time series plot for *FX, CRE* and *REE* series

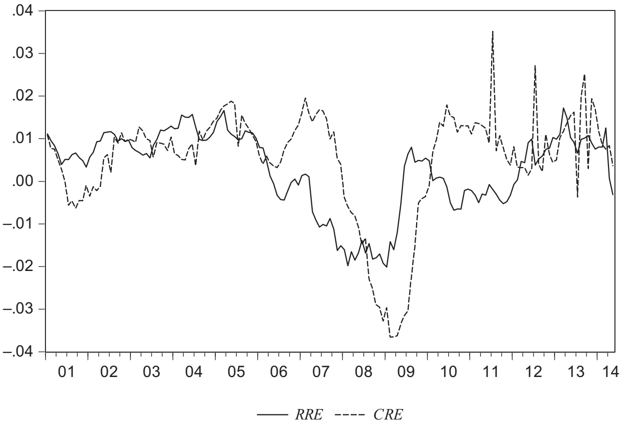

Figure 3. Time series plot for commercial and residential real estate returns

commercial and residential real estate return dynamics to present a clear picture of their co-movements. As expected, both real estate markets experience the largest losses during the GFC period. Importantly, the two markets, however, do not move in tandem and diverge from each other often. This observation highlights the importance of investigating the impact of commercial and residential real estate markets on banking industry stock returns.

Table 1 reports summary statistics for the six studied return series. The mean values of *BANK, MRK, INT, FX, RRE, and CRE* are 0.078%, 0.491%, –0.455%, –0.195%, 0.473%, and 0.264%, respectively. These values indicate that the world stock market performs best during the sample period, followed by the commercial real estate market and then the residential real estate market. More importantly, *BANK* has a skewness value of 0.079 and a kurtosis value of 7.486, with maximum and minimum values of 33.343% and –31.971%, respectively, suggesting that the US bank stock industry index returns are not normally distributed[5].

This result raises concerns about the normality assumption on the error term from an OLS (ordinary least squares) regression with *BANK* as the dependent variable. In fact, this concern is confirmed and shown in the empirical result section. In this case, OLS estimates, which focus on the central tendency in the data, are likely to miss some important aspects and probably produce poor results (Allen, Powell, & Singh, 2011; Fin, Gerrans, Singh, & Powel, 2009; Santa-Clara & Valkanov, 2003). Hence, quantile regression is a better choice because it pertains to nonnormally distributed data (Petscher & Logan, 2014; Hao & Naiman, 2007) and allows us to explore the relationships among the studied variables under different quantiles of

[5] Evidence already exists that bank stock returns and real estate returns are not normally distributed (Young & Graff, 1995; Kosfeld & Robe, 2001; De Vries, 2005; Young, Lee, & Devaney, 2006).

the bank stock returns. Therefore, the QR approach can provide specific insights on the impact of the studied factors on the different banking industry states of the bank stock return because the banking industry stock return contains information about the state of the banking industry (Baur, 2013; Baur et al., 2012; Li et al., 2015; Mensi et al., 2014). To the best of our knowledge, no previous study examines the effect of real estate market returns on bank stock industry returns using quantile regression.

3. The empirical model

Extended from previous studies, the following multi-factor model forms the foundation of the banking industry return-generating process[6]:

$$BANK_t = \beta_0 + \beta_M MRK_t + \beta_I INT_t + \beta_F FX_t + \beta_C CRE_t + \beta_R RRE_t + \sum_d \beta_d DIFO_t + u_t \quad (1)$$

In Equation (1), $BANK_t$ is the US banking industry stock return; MRK_t is the stock market stock return; INT_t is the interest rate change; FX_t denotes the changes in the foreign exchange rate index; CRE_t denotes the commercial real estate market return; RRE_t indicates the residential real estate market return,[7] and $DIFO_t$ are dummy variables for influential observations identified by the RSTUDENT and DIFFITS diagnostics[8] (Belsley, Kuh, & Welsch, 2005); u is the error term and independent from the independent variables.

Existing studies adopt the OLS approach to estimate conditional mean dependence between banking industry returns and the studied factors. However, this approach is not effective for the non-normal sample of this study, which is confirmed and shown in the empirical result section. Moreover, the OLS approach does not accommodate the possible non-linearity of bank stock return sensitivities revealed in the literature review section. Since being proposed by Koenker and Bassett (1978), QR has become a popular tool to address non-normal samples and captures potential non-linear dependence between financial data series. In this study, the multi-factor quantile regression takes the following form[9]:

$$BANK_t^\tau = \beta_0^\tau + \beta_m^\tau MRK_t + \beta_i^\tau INT_t + \beta_f^\tau FX_t + \beta_c^\tau CRE_t + \beta_r^\tau RRE_t + \sum_d \beta_d^\tau DIFO_t + \nu_t^\tau \quad (2)$$

In Equation (2), $BANK^\tau$ is the τth quantile of *BANK*; the definition of the independent variables *MRK*, *INT*, *FX*, *CRE*, *RRE*, and *DIFO* is the same as in Equation (1); various β^τ are the coefficient estimates at quantile τ, and ν^τ is independent from the independent variables, with the conditional τth quantile of the error term being equal to zero.

4. Empirical results and discussions

The Basel Accords assign different risk weights for commercial and residential mortgages. However, previous studies on bank stock returns fail to differentiate commercial and real estate markets. As banks' lending risk is likely asymmetric, bank stock return sensitivities could therefore be non-linear and state dependent. Previous studies, however, do not address this possibility. In contrast, this study distinguishes between commercial and real estate markets. Section 4.1 presents and discusses the OLS regression results that incorporate both markets' returns as independent variables. This study further models the state-dependent sensitivities of bank industry stock returns in regressions. Section 4.2 presents and discusses the QR results that further allow state-dependent sensitivities.

4.1. OLS results: on average, do real estate market returns affect bank industry stock returns?

Table 2 presents the OLS estimation results from Equation (1). The top panel reports the estimated coefficients and the related t-statistics and variance inflation factors. The variance inflation factors are all less than three and thus show no collinearity problem. This finding supports the incorporation of both commercial and residential real estate market returns in regressions and also indicates that the two real estate market returns are likely to have separate influences on banking industry stock returns.

[6] As discussed in the literature review, asset composition could have effects on bank returns and risk exposure. To the best of our knowledge, none of the existing industry-level studies have included explicit control variables for asset composition in their regressions. These studies implicitly presume stable asset composition of the industry as a whole and measure the average effects during the studied periods. Because of data availability, the current study adopts a similar approach. In addition, this study employs dummy variables for influential observations to help address the effects. The Ramsey RESET test results reported later reveal no model mis-specification and thus provide confidence for the approach used. However, as suggested by an anonymous referee, it might be fruitful to include asset composition variables in the regressions in future research.

[7] Based on the majority of existing studies, this study utilizes actual returns. Orthogonalized or unexpected returns are not used for the following reasons: (1) Orthogonalizing the factors results in biased estimators (Giliberto, 1985). (2) It is not apparent which are the driving factors and which are the driven factors (Kane & Unal, 1988). (3) The use of actual returns has been a common practice in previous empirical studies, and this practice makes it more difficult to find significant coefficients (Choi et al., 1992). (4) Actual changes are likely to be largely unexpected if the market is informationally efficient (Tai, 2000).

[8] Specifically if an observation with the absolute value of RSTUDENT or DFFITS is greater than 2, the *DIFO* for the observation is equal to one; otherwise, it is equal to zero. This study identifies nine influence observations during the GFC period. Greatrex and Rengifo (2010) also adopt dummies for influence observations to incorporate the influence of GFC into their study.

[9] The approach is consistent with studies showing the state-dependent exposure of firms to systematic risk (Ozoguz, 2009; Perez-Quiros & Timmermann, 2000; Viale & Madura, 2014).

Table 2. OLS estimates of bank stock return sensitivities

	Coefficient	t-statistics	VIF
Constant	−0.004	−1.124	
MRK	0.956***	11.204	2.114
INT	0.129***	3.056	1.494
FX	0.535***	2.988	1.612
CRE	−0.312	−1.087	1.610
RRE	1.212***	3.181	1.477
Panel B: Model diagnosis			
R squared	0.803	Cramer-von Mises	0.139**
BG test	1.762	Watson	0.138**
RESET	1.043	Anderson-Darling	0.790**

Notes: 1. VIF stands for variance inflation factor. 2. BG test stands for Breusch-Godfrey serial correlation test. 3. RESET is the Ramsey regression equation specification error test. 4. Cramer-von Mises is the Cramer-von Mises normality test. 5. Watson is the Watson normality test. 6. Anderson-Darling is the Anderson-Darling normality test. 7. The coefficients of dummy variables for influential observations are included but not reported in the table. 8. ***, **, and * indicate significance at the 1%, 5%, and 10% significance levels, respectively.

In fact, the estimated coefficients of the real estate market returns support this expectation. In particular, *CRE* has an insignificant and negative coefficient. This coefficient indicates that commercial real estate market returns have no significant influence on U.S. bank industry stock returns. Arguably, the finding is at odds with the results of previous studies that utilize REIT returns – which should largely reflect movement in the commercial real estate market – as a real estate factor. However, the finding is consistent with the view that rises in real estate values do not necessarily increase banking institutions' profitability (Apergis, 2012; Herring & Wachter, 2003, 1998). In contrast, *RRE* has a significant and positive coefficient. Consistent with He and Reichert (2003), this coefficient indicates bank returns are linked positively to housing returns. This finding supports the view that house price increases enhance the ability of borrowers to meet their loan obligations, leading to increases in banks' profitability (Apergis, 2012; Elyasiani et al., 2010).

As expected, the coefficient of *MRK* is positive and statistically significant, suggesting that the US banking industry benefits from a global bull market. The magnitude of the coefficient is 0.956, which indicates that the U.S. banking industry is somewhat less risky than the world stock market portfolio. Tai (2005), using weekly data and three-factor models, also finds world stock market betas for US banks, on average, to be close to and less than unity. Studies using US domestic stock market portfolios, such as He et al. (1996), and Elyasiani et al. (2010), find stock market betas to be of smaller magnitude than that found here. The comparison suggests that the world stock market influences the US banking industry more strongly than the US domestic stock market.

In contrast with early bank stock return studies, *INT* has a significant and positive coefficient with a value of 0.129. This magnitude indicates that interest rate changes have less influence on banking industry returns than world stock market returns do. The positive coefficient reflects the suggestion by recent studies that the sensitivity to interest rate changes has become positive because of the changing banking environment. Moreover, the finding of the present study is consistent with the findings of Ferrer et al. (2010) and Ballester et al. (2011) on Spanish banking industry stock returns in the post-euro period and the findings of Bessler et al. (2015) on US banking industry stock returns after 1999. These findings reveal that environmental changes, such as the widespread use of adjustable rate loans, extraordinary expansion of asset securitization, intensive use of interest rate derivatives, and low interest rate environments, have become more important than the mismatch issue in terms of the effect on the link between interest rate changes and banking industry stock returns. However, the findings here should be treated with caution because the banking environment could change again in the future; for instance, the low interest rate environment may end at any time.

The coefficient of *FX* is 0.535 and statistically significant. However, in contrast to the finding of Baele et al. (2015) and Martin (2000), the significance of the *FX* coefficient is consistent with the findings of previous U.S. studies and implies that complete hedging is not likely for the US banking industry (Choi & Elyasiani, 1997; Choi et al., 1992; Gounopoulos et al., 2013; Harris et al., 1991; Tai, 2000, 2005; Wetmore & Brick, 1994). Consistent with Tai (2005), the positive coefficient indicates that the US banking industry benefits from a strong home currency. The finding is also in line with studies by Choi et al. (1992) and Chamberlain et al. (1997), who suggest that US banks by and large maintain a net long position in domestic currency positions. Consistent with Chamberlain et al. (1997), the coefficient of *FX* is larger than that of *INT* and indicates greater exchange rate sensitivity than interest rate sensitivity for the US bank industry.

The bottom panel of Table 2 reports the model diagnosis. The R squared is reasonably high and indicates the OLS regression's explanation power for approximately 80% of the movement of bank stock returns. The Breusch-Godfrey serial correlation test statistic shows that the model does not suffer from autocorrelation. The Ramsey RESET test statistic shows no omitted important variables. These measures of model diagnosis indicate that the dummies for influential observations have taken into account the influence of the GFC on banking industry stock returns[10]. However, the normality test statistics are all statistically significant and thus clearly show that the normality assumption of the error term required by OLS regression is violated. Therefore, the OLS approach is not effective, and the QR approach should be pursued.

[10] This conclusion is also supported by the unreported CUSUM test, which shows no structural breaks for the banking industry returns during the sample period. The unreported White test statistics show no heteroscedasticity.

4.2. QR results: are the effects of real estate market returns on bank industry stock returns state dependent?

Table 3 presents the QR results from Equation (2). Panel A exhibits the results for quantiles 0.1 to 0.4, and Panel B exhibits the results for quantiles 0.5 to 0.9. The Ramsey RESET test statistics show that the regression is well specified for every quantile. The table clearly shows that the effects of real estate market returns on bank industry stock returns are state dependent. In particular, *CRE* has a significant and negative coefficient for quantiles 0.6 to 0.9, and *RRE* has a significant and positive coefficient for quantiles 0.1 to 0.7. The estimated coefficients again support the expectation implicit in the Basel Accords that commercial and residential real estate markets have distinct influences on banking industry stock returns.

Table 3. QR estimates of bank stock return sensitivities

Panel A: Quantiles 0.1 to 0.4				
Quantile	Q(0.1)	Q(0.2)	Q(0.3)	Q(0.4)
Constant	–0.051*** (–5.637)	–0.038*** (–6.054)	–0.024*** (–3.533)	–0.014** (–2.055)
MRK	0.786*** (3.825)	0.790*** (4.857)	0.815*** (6.105)	0.885*** (7.450)
INT	0.130** (2.005)	0.159*** (2.860)	0.167** (2.465)	0.159** (2.010)
FX	0.569 (1.378)	0.456 (1.205)	0.380 (0.217)	0.352 (1.312)
CRE	–0.158 (–0.225)	0.433 (0.835)	0.223 (0.714)	–0.296 (–0.524)
RRE	2.158*** (3.007)	1.492*** (2.855)	1.434*** (2.921)	1.438*** (2.893)
Pseudo R^2	0.618	0.576	0.546	0.528
RESET	0.827	1.256	0.232	0.314

Panel B: Quantiles 0.5 to 0.9					
Quantile	Q(0.5)	Q(0.6)	Q(0.7)	Q(0.8)	Q(0.9)
Constant	0.001 (0.191)	0.009 (1.548)	0.016*** (2.733)	0.031*** (5.772)	0.047*** (6.041)
MRK	0.946*** (9.093)	0.969*** (9.275)	1.029*** (9.652)	1.016*** (10.064)	1.040*** (8.598)
INT	0.097 (1.325)	0.103 (1.510)	0.086 (1.112)	0.174** (1.999)	0.208** (2.315)
FX	0.515** (2.269)	0.548** (2.445)	0.508** (2.315)	0.351** (2.090)	0.433** (2.067)
CRE	–0.683 (–1.339)	–0.788* (–1.803)	–0.888** (–2.355)	–1.022*** (–3.197)	–0.890* (–1.799)
RRE	0.959** (1.998)	0.909* (1.967)	1.007* (1.972)	0.667 (1.239)	0.598 (0.655)
Pseudo R^2	0.519	0.521	0.522	0.542	0.566
RESET	1.163	2.572	2.434	1.492	1.990

Notes: 1. Parentheses enclose t-statistics obtained using XY-pair bootstrapping procedure. 2. RESET is the Ramsey regression equation specification error test. 3. The coefficients of dummy variables for influential observations are included but not reported in the table. 4. ***, **, and * indicate significance at the 1%, 5%, and 10% significance levels, respectively.

The negative coefficients of *CRE* at the upper quantiles are consistent with the findings of Cavallo and Majnoni (2002), Arpa et al. (2001), and Laeven and Majnoni (2003), who document a negative relationship between lending growth and the profitability of banking institutions[11]. The finding indicates that, when making commercial mortgage lending in bullish periods, banks may not charge enough of a risk premium possibly because of myopia, intensive competition, and incentive structures (Apergis, 2012; Berger & Udell, 2004; Borio et al., 2001). On the other hand, the insignificant coefficients of *CRE* at lower quantiles indicate that banks are not significantly influenced by commercial real estate market fluctuations in bearish periods. This finding is consistent with the view that commercial mortgage markets are relatively stable during downturns because of the cash flow support from underlying properties (Chiu et al., 2010).

The positive coefficients of *RRE* at the lower and middle quantiles are consistent with the study by He and Reichert (2003), in which bank returns are positively exposed to residential real estate returns. This finding supports the view that residential real estate price increases could lead to declines both in the inability of borrowers to meet their loan obligations and in expected losses, leading to increases in banks' profitability (Apergis, 2012; Elyasiani et al., 2010). On the other hand, the coefficients of *RRE* are insignificant at upper quantiles. This finding indicates that banks are not significantly influenced by residential real estate market fluctuations in bullish periods. This is consistent with the view that residential real estate price appreciation affects bank stock returns primarily by lowering the chance of mortgage defaults as a result of reductions in the imbedded put option value (Downing, Stanton, & Wallace, 2005; Koetter & Poghosyan, 2010).

In every quantile, *MRK* has a significant and positive coefficient. The coefficients range from 0.786 to 1.040. The results show that bank stock returns are always closely linked to general stock market returns. In quantiles 1 to 4 and quantiles 8 and 9, *INT* has a significant and positive coefficient. However, *INT* has no significant coefficient in quantiles 5 to 7. The results indicate that interest rate changes have a more positive impact on bank industry returns during bearish and bullish periods than moderate periods. Possible reasons for these results include difficulties maintaining margins in low interest rate environments (Ballester et al., 2011) and selective hedging behavior with respect to interest rate risk (Ruprecht, Entrop, Kick, & Wilkens, 2014). The coefficient of *FX* is positive and statistically significant only for quantiles 0.5 to 0.9. The results indicate that the US banking industry benefits from a strong home currency during moderate and bullish periods. Likewise, banks may engage in selective hedging on exchange rate risk and thus be immune to the influence of exchange rate changes during bearish periods.

[11] The negative coefficients do not violate the belief in the positive risk-return tradeoff because *BANK* and *CRE* are measures of returns.

Concluding remarks

This study investigates the relationship between changes in commercial and residential real estate prices and US banking industry returns using OLS and quantile regression. Several interesting results are obtained. First, consistent with the implicit view in the Basel Accords, commercial and residential real estate markets have a very different impact on banking industry stock returns. The stock returns are positively linked with price appreciation in the former market and could be adversely linked in the latter market. Second, the effects of real estate market returns on bank industry stock returns are state dependent. Commercial real estate returns influence banking industry stock returns during bullish periods. Residential real estate returns have an impact on bank industry stock returns during bearish periods. Third, the findings here reinforce the conclusion reached in earlier studies that US bank stock returns are exposed to interest rate and foreign exchange risks.

These findings have valuable implications for investors, managers and regulatory authorities. In particular, the results regarding the influence of real estate markets should encourage stock investors, bank managers, and regulatory authorities to look into commercial and residential real estate markets individually to observe their links with bank stock returns. Admittedly, further research is required to establish final conclusions. Additional studies employing other real estate indices should be conducted. In addition, future studies are needed to determine whether the results of this study can be generalized to banking industries outside of the US.

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