

International Review of Accounting, Banking and Finance

CONTENTS

- 1** The Impact of Financial Restatements on Audit Fees:
Considerations of Restatement Severity
Young-Won Her, Jane Lim, and Myungsoo Son
- 23** Revisiting Mean Reversion in the Stock Prices for Both the U.S.
and its Major Trading Partners: Threshold Unit Root Test
Chun-An Li, Tsung-Hsien Chen
- 39** The Impact of Internationalization on Firm Performance:
A Quantile Regression Analysis
Tan (Charlene) Lee, Kam C. Chan, Jin-Huei Yeh and Hsin-Ya Chan
- 60** Do Mortgage REITs Reflect the Underlying
MBS Market Performance?
Xiaoqing Eleanor Xu

International Review of Accounting, Banking and Finance

IRABF Winter 2010 Volume 2 Number 4

Editors:

Beth Cooperman *Hung-Gay Fung* *Chung-Hua Shen*
University of Colorado Denver *University of Missouri-St. Louis* *National Taiwan University*

Associate Editors:

James Barth *Johnny Chan* *Tsang-Yao Chang*
Milken Institute *Western Kentucky University* *Feng Chia University, Taiwan*

Iftexhar Hasan *Gary Patterson*
Rennselaer Polytechnic Institute *University of South Florida*

Editorial Board Members:

Aigbe Akhigbe
University of Akron

Charles Register
Florida Atlantic University

Richard Burns
University of Alabama Birmingham

Liu-Rong Sheng
China Construction Bank Xiamen Branch

Fatma Cebenoyan
Hunter College, The City University of New York

Chung-Su Wu
National Dong Hwa University Taiwan

Carol Dee
University of Colorado Denver

Subhrendu Rath
Curtin University of Technology, Perth, Australia

Thomas Eyssell
University of Missouri-St. Louis

Steve Swidler
Auburn University

William E. Jackson
University of Alabama

Amine Tarazi
University of Limoges, France

Susan Jordan
University of Kentucky

John Wagster
Wayne State University

Brian Lucey
Trinity College, The University of Dublin

Glenn Wolfe
University of Toledo

Ronnie Phillips
Colorado State University

Jot Yau
Seattle University

Rob Nash
Wake Forest University

Meng-Nan Zhu
Xiamen University

Editorial Staff: Annie Huang, Managing Editor

Assistant Editors: Chang Yuan and Kunli Lin

Sponsored by: Association of Chinese Management Exchange

Journal Website: www.irabf.org

Published By: University of Missouri-St. Louis & Taiwan Financial Institution Management Association

Print copy ISSN: 1946-6404

Online version ISSN:1946-6412

CONTENTS

The Impact of Financial Restatements on Audit Fees: Considerations of Restatement Severity <i>Young-Won Her, Jane Lim, and Myungsoo Son</i>	1
Revisiting Mean Reversion in the Stock Prices for Both the U.S. and its Major Trading Partners: Threshold Unit Root Test <i>Chun-An Li and Tsung-Hsien Chen</i>	23
The Impact of Internationalization on Firm Performance: A Quantile Regression Analysis <i>Tan (Charlene) Lee, Kam C. Chan, Jin-Huei Yeh and Hsin-Ya Chan</i>	39
Do Mortgage REITs Reflect the Underlying MBS Market Performance? <i>Xiaoqing Eleanor Xu</i>	60



The Impact of Financial Restatements on Audit Fees: Consideration of Restatement Severity

Young-Won Her,^a Jane Lim,^b Myungsoo Son,^b

a. University of Missouri, St. Louis, MO.

b. California State University, Fullerton, CA.

Abstract: This study extends prior research on audit fees and financial restatements by examining whether audit fees are higher for firms with more severe types of restatements. We hypothesize that auditors charge higher audit fees following a firm's restatement to compensate for the risk of audit increased from the restatement as restatements are considered as financial reporting failures. We further hypothesize that more severe restatements lead to higher audit fees due to the increased audit risk from the severity of the restatements. We first separate restatements into three subgroups based on their perceived severity (from most to least severe): restatements that affect net income, restatements that do not affect net income, and technical restatements. We then test for the effect that each type of restatement has on audit fees relative to firms that have no restatements. We find evidence that audit fees are higher for more severe types of restatements: net income restatements have the highest audit fees out of the three subgroups; non-net income restatements have lower audit fees than net income restatements, but higher audit fees than technical restatements; and technical restatements have the lowest audit fees. Furthermore, we find evidence that restatements related to fraud result in higher audit fees than restatements in general. Overall, the evidence suggest that audit fees increase in response to restatements and that the extent audit fees increase depends on the severity of the restatements.

1. Introduction

The purpose of this paper is to examine the effect that different categories of financial restatements have on audit pricing in a subsequent period. A financial restatement is generally considered as a reporting failure since it

represents an acknowledgement that previously issued financial statements were not in accordance with generally accepted accounting principles (GAAP) (Srinivason, 2005; Kinney et al., 2004). Accordingly, we hypothesize that auditors charge higher audit fees following a restatement to compensate for the increased risk of audit from the restatement. We further hypothesize that a more severe form of restatement leads to higher audit fees due to the greater audit risk associated with it. Given the rise in audit fees and an increasing number of financial restatements in recent years (Taub, 2009; Taub, 2008; Turner & Weirich, 2006), it is important to examine how audit fees are related to a firm's disclosure of restatements, to provide increased transparency into the drivers of rising audit costs and to add further insight into the consequences of financial misstatements.

The body of research on audit fees and determinants of audit fees is extensive. In prior literature, audit risk has been identified as one of the most influential drivers of audit fees (Hay et al., 2006). For example, prior research has documented that higher audit fees are associated with higher-risk clients (e.g., Bedard & Johnstone, 2004). In particular, Kinney, Palmrose, and Scholz (2004) found that there is a significant positive relationship between audit fees and the riskiness of a client having financial restatements. They conjecture that this positive relationship could reflect the additional risk of misstatement undertaken by the auditor, and that the increase in audit fees may be the result of expanded audit effort required in the subsequent audit engagement. As such, prior research suggests that auditors likely assign a higher audit risk to clients who experienced a financial reporting failure in prior periods, and thereby plan increased audit effort, which in turn may lead to higher audit costs and fees to be claimed.

While studies concerning the determinants of audit fees are numerous, there are fewer recent studies looking at the relationship between audit fees and financial restatements. Among them, Feldmann, Read, and Abdolmohammadi (2009) observed that firms that restated their 2003 financial statements experienced higher audit fees in subsequent years compared to firms that did not restate. Although these authors provide evidence that higher audit fees are additional costs that firms bear when the reporting credibility was compromised, their evidence is limited by the relatively short sample period. In addition, they did not identify the specific nature of restatements included in their sample, although it may be important to

distinguish different types of restatements which could have differential impacts on audit fees (Turner & Weirich, 2006; Srinivasan, 2005; Palmrose & Scholz, 2004).¹

The present study extends Feldmann et al.'s (2009) work in several ways. First, we used data from multiple years, thereby increasing the sample size. With a larger number of firm-year observations, we hoped to improve the generalizability of the findings by Feldmann et al. Second, we considered the specific nature of restatements by determining the type of restatements and examining the separate effects of these variables on audit fees. Specifically, we divided our restatement observations into three different categories based on the severity of the corrections involved, as follows (from most to least severe): restatements that affected net income, restatements that did not affect net income, and restatements due to technical errors. These three subgroups of financial restatements were then included as separate indicator variables in our regression model to compare their effect sizes on audit fees, relative to the control group of non-restatements. Finally, given its significant implications for auditors' risk assessment, we considered fraud-related restatements as a separate group and examined whether this group of restatements have any incremental effect on audit fees over other types of restatements that are not related to fraud.

Empirical results were generally consistent with our hypotheses. After controlling for various other factors known to affect audit fees, we found that audit fees are higher for financial restatements with greater severity: the net income restatement group had the highest audit fees out of the three subgroups; the non-net income restatement group had lower audit fees than the net income restatement group, but higher audit fees than the technical restatement group; and the technical restatement group had the lowest audit fees and their fees were not statistically different from those of the control group with no restatements. Further, in a separate comparison of fraud versus non-fraud related restatements, we found that fraud related restatements resulted in higher audit fees than any other types of restatements. Overall, this evidence is supportive of our prediction that more severe types of financial restatements will be related to higher audit fees, perhaps due to the increased audit risk perceived for those types.

The remainder of this paper is organized as follows. The next section provides background information on financial restatements. This is followed by an overview

¹ Financial restatements can occur due to fraud, error, or merely technical changes. Stanley and DeZoort (2007), however, suggest that restatements related to fraud or error are "de facto reporting errors" (p. 133).

of prior literature and development of hypotheses. Next is the research method used to test the hypotheses, followed by empirical results and concluding remarks.

2. Literature Review and Hypothesis Development

2.1 Background on Financial Restatements

Restatements are an acknowledgement that the financial statements, as originally issued to the public, were not in accordance with GAAP and thus need to be corrected (Palmrose & Scholz, 2004). A firm's financial restatement is typically disclosed on the U.S. Securities and Exchange Commission's (SEC) Form 8-K ("*Current Report*") under Item 4.02, "*Non-Reliance on Previously Issued Financial Statements or a Related Audit Report or Completed Interim Review.*" Upon discovery of a material error that indicates that financial statements issued previously are no longer reliable, a company has four days to file Form 8-K to announce the restatement and to alert investors of this important event. The restatement is then filed on an amended report for the period affected.

Although restatements are required to be disclosed on Form 8-K, some companies restate their financial statements without making the necessary disclosures, a practice known as "stealth restatements" (GAO, 2006; Turner & Weirich, 2006). Turner and Weirich (2006) outlined a few different methods used by companies to restate financial statements with less than optimal transparency. For example, companies may restate financial figures from prior periods in their next regularly scheduled quarterly or annual report without filing a separate, amended report for the affected period (i.e., a Form 10-Q/A for a quarterly period or a Form 10-K/A for a year period, where "A" alerts investors that something has changed). Therefore, the restatement may go unnoticed by users of the financial statements.²

In another method, companies may circumvent the Form 8-K filing requirement if they disclose the same information to be reported on the Form 8-K (i.e., the announcement of restatements) in their next quarterly or annual report, provided that such information is disclosed within four days after the necessity of restatement is determined. Since companies have control over the timing of when they identify the need for a restatement, they may be able to issue a stealth

² Turner and Weirich (2006) suspect that this problem is by design because investors reading a company's current financial statements simply may not notice the small print or may dismiss a restatement as relatively insignificant when the company was able to tuck it away quietly behind the current period's numbers.

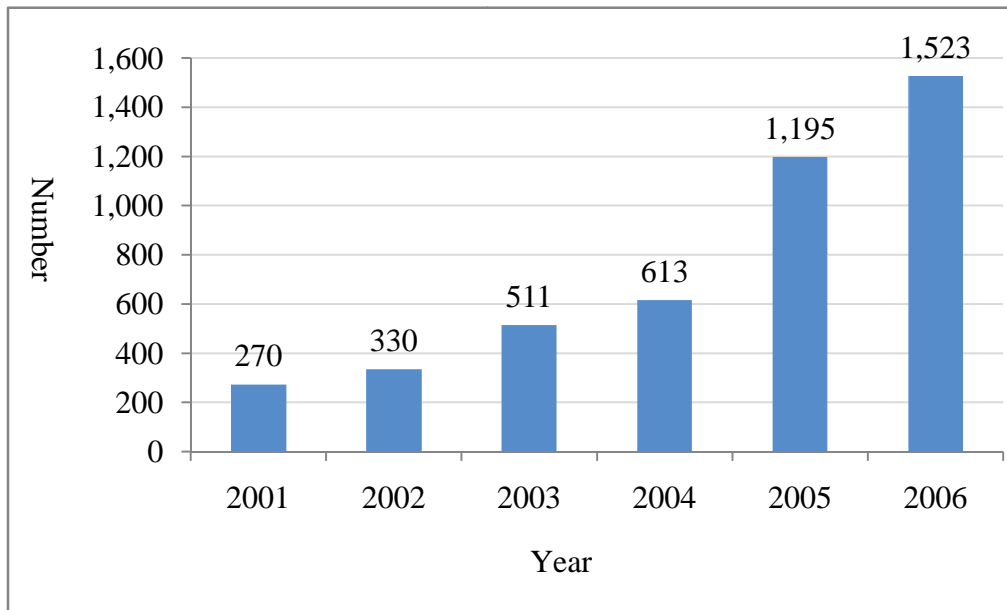
restatement and claim that the decision to restate happened to fall within four days of their next regularly scheduled periodic reports.

The number of financial restatements filed in recent years increased dramatically after 2002 and reached its peak in 2006. From 1997 to 2002, the number of restatements rose slowly from year to year, and by 2002, public companies in the U.S. had filed 330 restatements (Turner & Weirich, 2006). In subsequent years, the upward trend in the number of restatements accelerated sharply.

In 2005, there were 1,195 restatements filed by U.S. public companies, an increase of 362% from 2002 (Turner & Weirich, 2006). In the following year of 2006, the number of restatements increased 27% to 1,523 (Taub, 2008). Figure 1 shows a historical overview of the trend of financial restatements filed by U.S. public companies from 2001 to 2006. The rising trend reversed in 2007 and 2008, when the number of restatements declined to 1,235 and 869, respectively (Taub, 2009).

Figure 1:

Number of financial restatements by U.S. public companies from 2001-2006



This rise in the number of restatements is critical because restatements can lead to concerns regarding the quality of management and auditors engaged. Such a loss of investor confidence may carry serious financial consequences in the form

of decreased market capitalization. For instance, Hribar and Jenkins (2004) observe that a firm's cost of capital increases following a restatement announcement. Other research has shown that restatements have a material adverse effect on firm valuation (GAO, 2006; Palmrose et al., 2004; Wu, 2003). Among others, Palmrose, Richardson, and Scholz (2004) show that announcing restatements are associated with negative market reactions. In particular, they find greater stock price declines when restatements involve fraudulent activity (i.e., intentional misstatements), are initiated externally (i.e., attributed to auditors), and have large, negative income effects. This provides evidence that the content or nature of a restatement as well as the fact of the restatement can be an important determinant of the market responses. The same expectation may be applied to the research on the relations between audit fees and restatements because different types of restatements may have differential effects on audit fees, which is of primary interest to the current study.

The recent surge in restatements can be attributed to two major factors. First, the Sarbanes-Oxley Act of 2002 (SOX) created more stringent financial reporting requirements, specifically in sections 302 and 404. Section 302 requires the chief executive officer (CEO) and chief financial officer (CFO) to evaluate the effectiveness of their firm's internal control systems and to include their conclusions in quarterly and annual reports. Section 404 requires that companies hire independent auditors to attest to the management's report on the effectiveness of internal controls over financial reporting. Compliance with these new requirements inevitably resulted in a higher number of restatements since a greater amount of misstatements were uncovered through the examination of companies' internal controls.

Second, in their 2006 study on financial restatement trends, the U.S. Government Accountability Office (GAO) attributed the surge in restatements to the increasing pressure from governmental bodies on both public companies and auditors. For example, as a result of additional resources available in their enforcement division, the SEC was able to increase their reviews of company filings, after which more companies had to restate their financial statements in accordance with the findings of the SEC (GAO, 2006; Palmrose et al., 2004).

Meanwhile, the creation of the Public Company Accounting Oversight Board (PCAOB) in 2002 increased scrutiny placed on auditors in the form of annual inspections for larger audit firms (GAO, 2006; Turner & Weirich, 2006). Under this heightened scrutiny from government regulators, auditors should have

experienced a greater pressure to catch their client's reporting errors that eventually required restatements. As such, a soaring number of financial restatements in recent years have been caused mainly by enhanced government scrutiny in response to growing investor concerns over the quality of financial reporting in the wake of numerous accounting scandals (e.g., Enron, WorldCom, Adelphia, Tyco, etc.).

2.2 Audit Fees and Severity of Financial Restatements

While earlier research on financial restatements focused on various financial costs that can be imposed on restatement firms (e.g., stock price declines, higher cost of capital, increased likelihood of litigation), Feldmann et al. (2009) are among the first to show that higher audit fees are another cost levied on firms experiencing restatements. In particular, they propose that the higher audit fees are reflective of both an increase in perceived audit risk and a loss of organizational legitimacy resulting from financial restatements.

A financial restatement is likely to increase an auditor's assessment of the client's audit risk as the restatement is indicative of financial reporting failure and may call management credibility in question. As the SEC continues to describe restatements as "the most visible indicator of improper accounting – and source of new investigations"(Schroeder, 2001), a recent reporting failure admitted by a client may lower the auditor's perception of the client's competence and integrity in reporting process, thereby increasing their perceived risk of material misstatements. Accordingly, firms that restated their financial figures in prior periods are more likely to be perceived as high-risk clients.

Auditors are subject to professional guidance from the American Institute of Certified Public Accountants (AICPA). According to this guideline, especially as described in Statement on Auditing Standards (SAS) No. 107, *Audit Risk and Materiality in Conducting an Audit*, auditors are required to plan their audit procedures and coverage appropriately based on their assessment of audit risk associated with the client (AICPA, 2006). If a higher audit risk is perceived, they must provide additional substantive testing to reduce the risk of failing to recognize material misstatements, thereby increasing their planned audit hours and scope. This enhanced audit effort would be costly, thus increasing audit fees as the costs of audit are passed on to the client. Audit fees may also increase due to a fee premium implicitly charged by audit firms to offset additional costs or losses from

potential litigation (Feldmann et al., 2009).³ Hence, it follows that firms with a higher audit risk will likely experience higher audit fees.

As described above, auditors may consider restatement firms to be higher-risk clients due to a higher assessed risk of material misstatements, and higher-risk clients are typically charged higher audit fees. Accordingly, for a firm that had prior financial restatements, auditors would likely charge higher audit fees than they would for a firm with no financial restatements. Feldmann et al. (2009) tested this proposition empirically and reported evidence in support of it: firms that restated their 2003 financial statements had higher audit fees than did a control group of non-restatement firms. The authors posited that the higher audit fees are a result, in part, of the higher audit risk assessed by auditors.

Although Feldmann et al. (2009) demonstrate a positive association between audit fees and financial restatements, showing that higher audit fees are additional costs or penalties that firms bear when the quality of accounting was impaired, they did not consider the specific nature of restatements examined. Prior studies, however, suggest that it is important to distinguish between the types of restatements, especially in terms of their severity (Turner & Weirich, 2006; Srinivasan, 2005; Palmrose & Scholz, 2004). This is because different types of restatements may have different implications and may lead to different economic consequences. To the extent that the severity or type of restatements affects audit fees differentially, it would be important to examine various subgroups of restatements. We consider this issue explicitly by identifying different types of restatements and examining their effects on audit fees separately.

Our first hypothesis considers potentially differential effects of fraud versus non-fraud related restatements on audit fees. As implied in the above discussion, auditors' assessed risk of clients may vary depending on the type of a restatement identified. A restatement related to fraudulent financial reporting would be considered more severe than a regular restatement. Prior research has shown that restatements with greater severity (e.g., fraud-related) are associated with more negative market reactions (Palmrose et al., 2004) and higher likelihood of costly litigation (Palmrose & Scholz, 2004), consistent with investors being more

³ Civil litigation has long been considered an important potential consequence for both issuers and auditors of non-GAAP financial reporting. Palmrose and Scholz (2004), in particular, provide evidence that restatements involving the misstatement of core earnings (earnings from primary, recurring operations) increase both the likelihood of lawsuits and payments by defendants to resolve them. They also find that having auditors as defendants tends to increase total resolution amounts.

concerned about the potential for material misstatements when there is a severe reporting failure. In their 2004 study, Palmrose et al. define fraud as “intentional, non-GAAP financial reporting” (p. 63). As such, fraud indicates a lack of management integrity and thus further increases uncertainty about the reliability of management representation. Accordingly, the risk of audit perceived for this type of restatement should be higher than those perceived for other types of regular restatements. Thus we expect that restatements related to fraud will be associated with higher audit fees relative to restatements not related to fraud. The following hypothesis formalizes this expectation:

H1: Audit fees are higher for firms issuing restatements that are related to fraud relative to firms issuing restatements that are not related to fraud.

Our second hypothesis is concerned with a more detailed categorization of financial restatements. A firm’s restatement (whether fraud-related or not) may be classified into one of the three mutually exclusive categories based on the perceived severity of the amendment involved: restatements that affect reported net income (net income restatements), restatements that do not affect reported income (non-net income restatements), and technical restatements (not misstatements and arising from routine actions, such as compliance with new accounting rules and guidance).

Similar to Palmrose et al. (2004), we define a net income restatement as involving changes to revenue, cost of sales, operating expenses, gains or losses, and accruals. This type of restatement should be considered more serious than a non-net income restatement because it compromises the reliability of a firm’s performance measure, an item generally considered more important than others. A non-net income restatement includes reclassification of the balance sheet and statement of cash flow items, which should not affect the firm’s performance prospect substantially. Accordingly, a lower level of perceived severity will follow. A technical restatement includes merger- and acquisition-related items and effects of accounting principle changes. This type of restatement will be regarded as the least severe because it does not imply improper accounting. We based our classification of restatements on a firm’s audit information available in the *Audit Analytics* database (see Appendix).

As explained above and verified by Feldmann et al. (2009), if audit fees and financial restatements are positively associated, the extent of an increase in audit

fees would likely depend on the severity of the problems addressed in the restatement. In other words, given its greater negative implication for reporting credibility, a restatement with greater severity may lead to higher perceived audit risk, which in turn requires a higher level of audit scope to be planned. Hence, higher audit costs and fees are expected to occur for more severe types of restatements.

The following hypotheses formalize this prediction.

H2a: Audit fees are higher for firms issuing net income restatements relative to firms issuing either non-net income restatements or technical restatements.

H2b: Audit fees are higher for firms issuing non-net income restatements relative to firms issuing technical restatements, but lower relative to firms issuing net income restatements.

H2c: Audit fees are lower for firms issuing technical restatements relative to firms issuing restatements that are not technical.

3. Methodology

3.1 Sample Selection

The sample used in this study includes firms that restated financial statements in the years 2000 to 2005. Our sample consists of firms whose audit reports are available on *Audit Analytics*. It is noted that the *Audit Analytics* database includes stealth restatements, which are financial statements that are restated in a quarterly or annual report without formally filing a disclosure announcement in Form 8-K. Firms that changed auditors in this time period are excluded from the study to remove any effect that changes in auditors would have on audit fees.⁴

To estimate our multivariable models of audit fees, it was necessary to assure that each restatement firm had financial information available in the *Compustat* database. Thus excluding firms that restated but were not available in *Compustat*

⁴ In their 2009 study on financial restatements, Feldmann, et al. found that many companies in their sample, especially in the restatement sample, changed auditors within the period of investigation; most of these changes were from Big 4 audit firms to non-Big 4 firms. Consistent with this observation, their regression analyses on audit fees show that an auditor change has a significantly negative impact on audit fees, suggesting that this variable be controlled for when testing other factors affecting audit fees.

resulted in a sample of 2,114 restatement cases, which included multiple restatements from a given unique filer if the restatement incidences were related to separate issues.

Out of these total observations, 58 restatements (2.74%) are flagged as fraud-related restatements. Additionally, 1,208 (57.14%) are identified as net income restatements, 704 (33.30%) as non-net income restatements, and 202 (9.56%) as technical restatements. The entire sample population of audit fees from 2001 to 2006 consists of 33,911 firm-year observations, including both restatement and non-restatement firms.⁵

3.2 Regression Models

To test the hypotheses proposed earlier, we estimate multivariate regression models of audit fees as shown in Equations (1) and (2). Equation (1) tests for the relationship between the natural log of audit fees (*LAF*) in year *t* and the test variables of fraud-related restatements (*FRAUD*) and restatements other than frauds (*REST*) in the prior year, *t-1*. There is one-year lag between *LAF* and the two test variables (*FRAUD* and *REST*) as well as other control variables, as an attempt to draw a cause-and-effect relationship. As noted earlier, *FRAUD* and *REST* are mutually exclusive two distinct groups since we define *REST* as restatements filed for reasons other than frauds. Equation (1) is used to test our first hypothesis.

$$\begin{aligned}
 LAF_t = & \beta_0 + \beta_1 FRAUD_{t-1} + \beta_2 REST_{t-1} + \beta_3 SIZE_{t-1} + \beta_4 FOREIGN_{t-1} + \\
 & \beta_5 SEGNUM_{t-1} + \beta_6 ABSACC_{t-1} + \beta_7 RECV_{t-1} + \beta_8 INVT_{t-1} + \\
 & \beta_9 OPINION_{t-1} + \beta_{10} DY_{t-1} + \beta_{11} BIG4_{t-1} + \beta_{12} LVRG_{t-1} + \beta_{13} LOSS_{t-1} + \\
 & \beta_{14} CATA_{t-1} + \beta_{15} EBIT_{t-1} + \beta_{16} QUICK_{t-1} + Year\ fixed\ effects + \\
 & Industry\ fixed\ effects + \varepsilon
 \end{aligned} \tag{1}$$

Equation (2) tests for the relationship between the natural log of audit fees in year *t* and the test variables representing the presence of the three subgroups of non-fraud restatements (*INCREST*, *NONINCREST*, and *TECHREST*) in year *t-1*. The fraud-related restatement group (*FRAUD*) is also included here for a comparison purpose. As defined earlier, *INCREST* represents a group of restatements that affect reported net income, *NONINCREST* a group of restatements that do not affect reported income, and *TECHREST* a group of

⁵ The SEC rules requiring the disclosure of audit and non-audit service fees became effective for proxies filed on or after February 5, 2001.

restatements that include only technical issues. More detailed explanations of this classification can be found in Appendix (Mande & Son, 2011). Equation (2) is used to test our second hypotheses.

$$\begin{aligned}
 LAF_t = & \beta_0 + \beta_1 INCREST_{t-1} + \beta_2 NONINCREST_{t-1} + \beta_3 TECHREST_{t-1} + \\
 & \beta_4 FRAUD_{t-1} + \beta_5 SIZE_{t-1} + \beta_6 FOREIGN_{t-1} + \beta_7 SEGNUM_{t-1} + \\
 & \beta_8 ABSACC_{t-1} + \beta_9 RECV_{t-1} + \beta_{10} INVT_{t-1} + \beta_{11} OPINION_{t-1} + \beta_{12} DY_{t-1} + \\
 & \beta_{13} BIG4_{t-1} + \beta_{14} LVRG_{t-1} + \beta_{15} LOSS_{t-1} + \beta_{16} CATA_{t-1} + \beta_{17} EBIT_{t-1} + \\
 & \beta_{18} QUICK_{t-1} + Year\ fixed\ effects + Industry\ fixed\ effects + \varepsilon
 \end{aligned} \tag{2}$$

Table 1 provides descriptions of the dependent variable (*LAF*) and test variables (*FRAUD*, *REST*, *INCREST*, *NONINCREST*, and *TECHREST*) used in Equations (1) and (2) above. The primary purpose of these models is to determine whether the predicted fee differences hold after controlling for other factors known to influence audit fees. Accordingly, along with the test variables, various factors known as drivers of audit fees are included as control variables, whose definitions are also provided in Table 1.

The control variables in Equations (1) and (2) are related to characteristics of the audit itself, the auditor and the client firm, closely modeled after Francis and Wang (2005). More specifically, client firms with larger, more complex operations, proxied by *SIZE*, *FOREIGN*, *SEGNUM*, *ABSACC*, *RECV* and *INVT*, are expected to create greater audit complexity and require lengthier audit process, thereby associated with higher audit fees. Higher audit fees are also expected for firms with qualified audit opinions (*OPINION*) since qualified opinions may require additional audit effort to be planned. Firms with December fiscal year ends (*DY*) are also expected to have higher audit fees due to peak-season audit staff constraints. The same expectation is made for firms engaging Big 4 audit firms (*BIG4*) as it is well known that large auditors have a fee premium relative to smaller auditors due to their reputation and quality of service. Additionally, clients with higher litigation risk, proxied by *LVRG*, *LOSS* and *CATA*, may experience higher audit fees due to the higher assessed audit risk or fee premium charged by auditors who take on a potentially insolvent company (Feldmann et al., 2009). In contrast, clients with lower litigation risk (*EBIT* and *QUICK*) are expected to have lower audit fees. Finally, our regression models also include indicator variables for year and industry (*Year and industry fixed effects*) to control for temporal

variations or general trends in audit fees across the sample period and industry (measured by two-digit SIC codes).

Table 1:
Definitions of variables

Variable	Expected Sign	Definition
<i>Dependent Variable</i>		
<i>LAF</i>		Natural log of audit fees in millions of dollars;
<i>Test Variables</i>		
<i>FRAUD</i>	+	1 if the restatement is related to a fraud, and 0 otherwise;
<i>REST</i>	+	1 if a firm announces a non-fraud restatement, and 0 otherwise;
<i>INCREST</i>	+	1 if the restatement has impact on net income, and 0 otherwise;
<i>NONINCREST</i>	+	1 if the restatement has no impact on net income, and 0 otherwise;
<i>TECHREST</i>	+	1 if the restatement is only a technical issue, and 0 otherwise;
<i>Audit and Auditor Characteristics</i>		
<i>SIZE</i>	+	Natural logarithm of the firm's market value of equity;
<i>FOREIGN</i>	+	Ratio of sales made by foreign subsidiaries to total sales;
<i>SEGNUM</i>	+	Number of business segments;
<i>ABSACC</i>	+	Absolute value of total accruals divided by total assets;
<i>RECV</i>	+	Ratio of total receivables to total assets;
<i>INVT</i>	+	Ratio of total inventory to total assets;
<i>OPINION</i>	-	1 if unqualified opinion, and 0 otherwise;
<i>DY</i>	+	1 if December fiscal year end, and 0 otherwise;
<i>BIG4</i>	+	1 if Big 4 auditor, and 0 otherwise;
<i>Firm Characteristics</i>		
<i>LVRG</i>	+	Ratio of debt to total assets;
<i>LOSS</i>	+	1 if earnings before extraordinary items is less than 0, and 0 otherwise;
<i>CATA</i>	+	Ratio of current assets to total assets;
<i>EBIT</i>	-	Ratio of earnings before interest and tax to total assets; and
<i>QUICK</i>	-	Ratio of current assets (less inventory) to current liabilities.

4. Results

4.1 Descriptive Statistics

Table 2 presents the summary statistics (mean, median, and standard deviation) of variables for the sample data used in this study. Audit fees for 2001 to 2006 had a mean of \$1.154 million and a median of \$336 thousand. Table 2 also shows that 56.7% of the firm years received unqualified opinions from auditors and 74.9% of the observations were audited by a Big 4 firm. In addition, 40.1% involved earnings losses, and the average return on total assets (*EBIT*) was -27.2% with a median of 4.4%.

Table 2:
Descriptive statistics ($n = 33,911$)

Variable	Mean	Median	Std. Dev.
<i>AF</i> (\$ millions)	1.154	0.336	2.431
<i>SIZE</i>	5.373	5.483	2.64
<i>FOREIGN</i>	0.08	0	0.326
<i>SEGNUM</i>	2.187	1	1.75
<i>ABSACC</i>	0.427	0.07	1.388
<i>RECV</i>	0.157	0.116	0.161
<i>INVT</i>	0.094	0.028	0.135
<i>OPINION</i>	0.567	1	0.496
<i>DY</i>	0.7	1	0.458
<i>BIG4</i>	0.749	1	0.434
<i>LVRG</i>	0.789	0.538	1.577
<i>LOSS</i>	0.401	0	0.49
<i>CATA</i>	0.445	0.449	0.3
<i>EBIT</i>	-0.272	0.044	1.362
<i>QUICK</i>	2.105	1.153	3.211

4.2 Multivariate Tests of Hypotheses 1 and 2

Table 3 provides the ordinary least square regression results for the two models used to test our hypotheses. The table shows the coefficient estimates and their associated t-statistics for Equations (1) and (2), by which we attempted to test the relationships between audit fees and different categories of restatements, relative to the control sample (non-restatement firms).

Table 3:
OLS regression results for Equations (1) and (2)
Dependent Variable: LAF

Variable	Predicted Sign	Equation 1		Equation 2	
		Estimate	t-value	Estimate	t-value
<i>Intercept</i>	?	8.986	256.14***	8.988	256.20***
<i>FRAUD</i>	+	0.261	3.02***	0.334	3.69***
<i>REST</i>	+	0.169	11.29***	-	-
<i>INCREST</i>	+	-	-	0.201	10.47***
<i>NONINCREST</i>	+	-	-	0.146	5.87***
<i>TECHREST</i>	+	-	-	0.034	0.69
<i>SIZE</i>	+	0.533	275.99***	0.533	275.95***
<i>FOREIGN</i>	+	0.235	20.86***	0.235	20.86***
<i>SEGNUM</i>	+	0.044	19.67***	0.044	19.65***
<i>ABSACC</i>	+	-0.024	-4.80***	-0.024	-4.78***
<i>RECV</i>	+	0.026	0.89	0.026	0.88
<i>INVT</i>	+	-0.194	-5.10***	-0.194	-5.11***
<i>OPINION</i>	-	-0.143	-18.44***	-0.143	-18.46***
<i>DY</i>	+	0.137	16.67***	0.137	16.63***
<i>BIG4</i>	+	0.303	30.90***	0.303	30.88***
<i>LVRG</i>	+	0.006	1.98**	0.006	1.97**
<i>LOSS</i>	+	0.216	24.85***	0.216	24.84***
<i>CATA</i>	+	0.616	31.53***	0.615	31.50***
<i>EBIT</i>	-	-0.005	-1.03	-0.005	-1.02
<i>QUICK</i>	-	-0.043	-29.87***	-0.043	-29.84***
F-Value		1860.52***		1818.90***	
Adjusted R ²		0.825		0.825	
N		33911		33911	

*, **, *** represent significance at 0.10, 0.05, and 0.01 levels, respectively.

In Equation (1), we tested the relationship between audit fees and fraud-related restatements (*FRAUD*) as well as the relationship between audit fees and restatements in general which do not involve fraud (*REST*). The estimated regression model was highly significant ($p < 0.0001$) with an adjusted R² of 0.8251,

indicating that 82.51% of the variation in audit fees was explained by the two test variables and control variables included. We find that the coefficient for the test variable *FRAUD* is positive (0.261) and statistically significant ($p = 0.0026$). This indicates that firms with fraud-related restatements experience higher audit fees than those with no restatements, after filing their restatement. The coefficient for another test variable *REST* is also positive (0.169) and significant ($p < 0.0001$). This finding is comparable to Feldmann et al.'s (2009) and suggests that in general, financial restatements are positively associated with audit fees, i.e. the presence of restatements leads to higher audit fees in a subsequent period.

Perhaps a more interesting observation would be whether fraud-related restatements will lead to higher audit fees than non-fraud restatements, as predicted in our first hypothesis. As shown in Table 3, the coefficient of *FRAUD* (0.261) is greater than that of *REST* (0.169) and an F-test revealed that this difference is statistically significant ($p < 0.01$). This evidence supports H1 and suggests that fraud-related restatements have a significant incremental effect on audit fees.

Also presented in Table 3 are the results for the second model used to test our second hypotheses. In Equation (2), we tested the relationship between audit fees and the three subgroups of restatements which were categorized by the level of severity (*INCREST*, *NONINCREST* and *TECHREST*). The group of fraud-related restatements (*FRAUD*) was also included in this model to compare its effects with those of other subgroups. The regression model was statistically significant ($p < 0.0001$) and its adjusted R^2 was 0.8251, which is identical to that of the first model.

As in the first model, the *FRAUD* variable was found significant and positively related to audit fees, with a coefficient of 0.334 ($p < 0.0002$). More importantly, this variable appeared to have a more positive association with audit fees than all the other test variables included in the model. This implies that auditors are more concerned about fraudulent financial reporting than any other types of reporting failures. Among the variables of main interest in the second model, *INCREST* and *NONINCREST* had a positive and significant coefficient with a value of 0.201 and 0.146 respectively ($p < 0.0001$ for both), whereas the coefficient of *TECHREST* (0.034) did not reach statistical significance ($p = 0.489$) although it has a positive sign.

A series of F-tests comparing the coefficients of *INCREST*, *NONINCREST* and *TECHREST* revealed that net income restatements have higher fees than non-net income restatements ($p < 0.05$) and that non-net income restatements have

higher fees than technical restatements ($p < 0.01$). These results indicate that the different categories of restatements with varying degrees of severity have differential effects on audit fees. As predicted, the most severe form of restatement, net income restatements, was more positively associated with audit fees than either of the less severe forms of restatements. Technical restatements were least positively associated with audit fees, while non-net income restatements fell in between the other two categories in terms of their effects on audit fees. These findings support H2a, H2b and H2c.

5. Conclusions

This study confirms Feldmann et al.'s (2009) initial evidence that firms announcing financial restatements tend to experience higher audit fees in a subsequent period than those with no financial restatements. Feldmann et al. suggest that higher audit fees experienced by restating firms may reflect an additional cost that firms bear when there is a reporting failure, as auditors likely assign a higher audit risk to clients with financial reporting errors. Using an expanded sample of restatements which includes observations from multiple years rather than a single year, we confirmed the generalizability of this idea. Throughout the entire sample period, we found a significantly positive association between audit fees and financial restatements, regardless of the type of restatement (except for technical), which implies that auditors are more likely to increase their audit fees in response to the filing of restatements by firms.

This study also extends Feldmann et al.'s (2009) work by examining the potentially differential effects of different types of restatements on audit fees. It was found that the extent that audit fees increase depends on the level of severity associated with the restatement. Relative to control firms that had no restatements, firms with restatements affecting net income had significantly higher audit fees in the following year, perhaps due to the increased audit risk perceived by auditors. Firms issuing restatements that did not affect net income also had higher fees, but with a lesser extent. Restatements related to technical issues, on the other hand, did not lead to statistically different fees from those of control firms, but significantly lower fees than those of the other two categories of restatements. Finally, restatements related to fraud led to higher fees than any other categories of restatements included in this study. We believe this evidence is of importance to the management of restating firms because it suggests that auditors would likely assess their clients' audit risk differentially depending on the severity of the

restatements identified. Accordingly, the management needs to know that they could suffer significantly higher audit costs and fees in addition to other types of costs (e.g., stock price declines, potential loss from lawsuits, etc.) if the reporting failure they need to address through financial restatements involves greater severity (e.g., fraud).

As noted earlier, this study benefited from the SEC's decision to mandate registrants to disclose audit fees paid to auditors and also from their regulative effort to increase financial reporting scrutiny on both management and auditors. The SEC's mandated public disclosure of audit fees made such informative data more readily accessible and their increased regulatory scrutiny on firms' reporting process resulted in a higher number of detections of financial reporting failures than ever before. These two critical events together allowed us to test and find a potentially important relationship between audit fees and restatements, which otherwise may not be easily discovered.

One limitation of this study is that while it examined the effects of restatements that changed net income, it did not differentiate between the directions of the change, i.e. an increase or decrease in net income. This was due in part to the time constraints we experienced with the large sample size, as it would have been difficult to subdivide the numerous observations further based on the direction of the income change. This concern may be addressed in future research with an additional effort in classification. Future research may also expand our research model to include other potentially relevant factors, such as a stealth restatement (e.g., does a stealth restatement lead to higher audit fees than a more appropriate type of disclosure of restatement, such as filing a Form 8-K or a Form 10-K/A? are stealth restatements more likely to be observed with severe forms of restatements, such as fraud-related or income-decreasing restatements?)

Although the number of restatements has fallen in the past two years, the numbers are still at historically high levels. By demonstrating the increase in audit fees following restatements, this study contributes to the growing body of research on the financial and reputational ramifications of restatements. In particular, this study shows that more severe types of restatements are more positively associated with audit fees. Firms are, thus, informed that while there may be a financial cost to most types of restatements, those resulting from willful fraud or those causing an income change could carry an additional penalty. With a knowledge of the growing costs of misstating financials, firms may be motivated to avoid unnecessary restatements by enhancing their internal controls or by taking other

measures to accurately disclose their financial condition to the investing public in their initial report.

References

- American Institute of Certified Public Accountants. (2006). Audit risk and materiality in conducting an audit. Statement on Auditing Standards No. 107. New York, NY: AICPA.
- Bedard, J. C., & Johnstone, K. M. (2004). Earnings manipulation risk, corporate governance risk, and auditors' planning and pricing decisions. *The Accounting Review*, 71(4), 443-465.
- Feldmann, D. A., Read, W. J., & Abdolmohammadi, M. J. (2009). Financial restatements, audit fees, and the moderating effect of CFO turnover. *Auditing: A Journal of Practice & Theory*, 28(1), 205-223.
- Francis, J. R., & Wang, D. (2005). Impact of the SEC's public fee disclosure requirement on subsequent period fees and implications for market efficiency. *Auditing: A Journal of Practice & Theory*, 24(Supplement), 145-169.
- Hay, D. C., Knechel, W. R., & Wong, N. (2006). Audit fees: A meta-analysis of the effect of supply and demand attributes. *Contemporary Accounting Research*, 23(1), 141-191.
- Hribar, P., & Jenkins, N. T. (2004). The effect of accounting restatements on earnings revisions and estimated cost of capital. *Review of Accounting Studies*, 9, 337-356.
- Kinney, W. R., Jr., Palmrose, Z., & Scholz, S. (2004). Auditor independence, non-audit services, and restatements: Was the U.S. government right? *Journal of Accounting Research*, 42(3), 561-588.
- Mande, V., & Son, M. (2010). Do financial restatements lead to auditor changes? Working paper, California State University, Fullerton.
- Palmrose, Z., Richardson, V. J., & Scholz, S. (2004). Determinants of market reactions to restatement announcements. *Journal of Accounting and Economics*, 37, 59-89.

- Palmrose, Z., & Scholz, S. (2004). The circumstances and legal consequences of non-GAAP reporting: Evidence from restatements. *Contemporary Accounting Research*, 21(1), 139-180.
- Schroeder, M. (2001). SEC list of accounting-fraud probes grows. *Wall Street Journal* (July 6), C1.
- Srinivasan, S. (2005). Consequences of financial reporting failure for outside directors: Evidence from accounting restatements and audit committee members. *Journal of Accounting Research*, 43(2), 291-334.
- Stanley, J. D., & DeZoort, F. T. (2007). Audit firm tenure and financial restatements: An analysis of industry specialization and fee effects. *Journal of Accounting and Public Policy*, 26, 131-159.
- Taub, S. (2008, June 3). Restatements plunge after record 2006. CFO.com. Retrieved from http://www.cfo.com/article.cfm/11483610/c_2984368
- Taub, S. (2009, March 10). The state of restatements: Sharply falling. CFO.com. Retrieved from http://www.cfo.com/article.cfm/13270658/c_2984368
- Turner, L. E., & Weirich, T. R. (2006). A closer look at financial statement restatements. *The CPA Journal*, 76(12), 12-23.
- U.S. Government Accountability Office. (2006). Financial restatements: Update of public company trends, market impacts, and regulatory enforcement activities, GAO-06-678. Washington, DC: Orice M. Williams.
- Wu, M. (2003). Earnings restatements: A capital market perspective. (Ph.D. dissertation, New York University, Graduate School of Business Administration, 2003).

APPENDIX: Restatements Classification

INCOME	NOINCOME	TECH
Capitalization of expenditures issues	Accounts/loans receivable, investments & cash issues	Acquisitions, mergers, disposals, re-org acct issues
Deferred, stock-based and/or executive comp issues	Audit or auditor related restatements or non-reliance	Acquisitions, mergers, only (subcategory) acct
Depreciation, depletion or amortization errors	Audit (or) consent re opinion in f/s issues	GAAP- Changes in Acct Principles FASB/EITF or Foreign GAAP
Expense (payroll, SGA, other) recording issues	Balance sheet classification of assets issues	Others without explanation
Gain or loss recognition issues	Capital adequacy and calculation issues	Restatements made while in bankruptcy/receivership
Inventory, vendor and/or cost of sales issues	Cash flow statement (SFAS 95) classification errors	Retrospective revisions to p/y financials for consistency
Lease, leasehold and FAS 13 (98) only	Comprehensive income issues	Unspecified restatement adjustments
Liabilities, payables, reserves and accrual estimate failures	Consolidation issues incl Fin 46 variable interest & off-B/S	
PPE intangible or fixed asset (value/diminution) issues	Consolidation, foreign currency/inflation (subcategory) issue	
Revenue recognition issues	Debt and/or equity classification issues	
Tax expense/benefit/deferral/ other (FAS 109)	Debt, quasi-debt, warrants & equity (BCF) security issues Derivatives/hedging (FAS 133)	
	EPS, ratio and classification of income statement issues	
	Fin Statement, footnote & segment disclosure issues	
	Financial derivatives/hedging (FAS 133) acct issues	
	Foreign, related party, affiliated, or subsidiary issues	
	Foreign, subsidiary only issues (subcategory)	
	Intercompany, investment in subs./affiliate	
	Lease, SFAS 5, legal, contingency and commitment issues	
	Loan covenant violations/issues	
	Material Weakness - Section 404 or 302 issues	
	Pension and other post-retirement benefit issues	
	Proforma financial information reporting issues	
	Registration/security (incl. debt) issuance issues	

This classification is based on the field 'RES_ACC_RES_TITLE_LIST' in Audit Analytics. If RES_ACC_RES_TITLE_LIST contains any item of INCOME,

then the observation is classified into INCOME. If RES_ACC_RES_TITLE_LIST contains any item of NOINCOME, but not any of INCOME, then the observation is classified into NOINCOME. If RES_ACC_RES_TITLE_LIST contains only items of TECH, then the observation is classified into TECH.



Revisiting Mean Reversion in the Stock Prices for both the U.S. and its Major Trading Partners: Threshold Unit Root Test

Chun-An Li,^a Tsung-Hsien Chen,^b

a. Department of Finance, National Yun-lin University of Science &
Technology, Yun-Lin, TAIWAN

b. Graduate Institute of Management, National Yun-lin University of
Science & Technology, Yun-Lin, TAIWAN, Department of Insurance,
Chaoyang University of Technology, Taichung, TAIWAN

Abstract: This study aimed to re-investigate whether mean reversion of stock prices exists for the stock markets of the U.S. and its major trading partners: Canada, China, Japan and Mexico, using threshold unit root test developed by Caner and Hansen (2001). Sample periods are from November 1998 to August 2010. The empirical results from our threshold unit test indicate that the null hypothesis of $I(1)$ unit root in stock prices can not be rejected for any of the U.S. and its major trading partners, with the exception of China. Our results highlight the fact that the efficient market hypothesis is valid in the stock markets of the U.S. and its major trading partners, with the exception of China. These findings should prove valuable to individual investors and financial institutions holding long-term investment portfolios in these markets.

1. Introduction

Researchers in finance have long been interested in the time-series properties of equity prices, with particular attention paid to determining whether stock prices can be characterized as random walk (unit root) or mean reverting (trend stationary) processes. Much research has focused on the best way to characterize the dynamic properties of economic and financial time series. The issue, whether stock prices follow a mean reverting or random walk process, has been much

debated among economists.¹ The empirical evidence on the random walk hypothesis from these studies is mixed (see Fama & French, 1988; Poterba & Summers, 1988; Richardson & Stock, 1989; Kim et al., 1991; McQueen, 1992; Zivot & Andrews, 1992; Richardson, 1993; Lo and MacKinlay, 1997; Zhu, 1998; Grieb & Reyes, 1999; Balvers et al., 2000; Caner & Hansen, 2001; Chaudhuri & Wu, 2003; Alimov et al., 2004; Narayan, 2005, 2006, 2007, 2008; Narayan & Smyth, 2005, 2006; Narayan & Prasad, 2007).

If it is established that stock prices are mean reverting, i.e. they are $I(0)$ stationary processes, then this implies that shocks to stock prices will have a transitory effect, in that prices will return to their trend path over time. From an investment point of view, this ensures that one can forecast future movements in stock prices based on past behavior, and trading strategies can be developed in order to earn abnormal returns. An important implication of the efficient market hypothesis (hereafter, EMH^2) is that stock prices should follow a random walk, where the future price changes should be, for all practical purposes, random and therefore unpredictable. However, if it is found that stock prices are non-stationary (or a $I(1)$ process) then shocks will have a permanent effect, implying that stock prices will attain a new equilibrium and future returns cannot be predicted based on historical movements in stock prices. This would signify that future returns cannot be predicted based on historical movements in stock prices and that volatility in stock markets will increase in the long run without bound (Chaudhuri & Wu, 2003; Narayan, 2008). Much of the controversy concerning the issue of mean reversion arises because of the speed of reversion; if it exists, perhaps very slow and standard econometric tests do not have sufficient power to discriminate a mean reversion process from a random walk process (Chaudhuri & Wu, 2003). Nelson and Plosser (1982) point out that whether stock prices are modeled as a trend stationary or as a difference stationary process has important implications regarding modeling, testing and forecasting.

Various methodological approaches have been utilized to investigate the random walk properties of stock prices. One such approach has been to test whether stock prices contain a unit root. The conventional unit root tests aimed at a unit root in stock prices have employed either the Augmented Dickey Fuller (ADF) unit root test or Phillips and Perron (PP) unit root test. Although numerous studies

¹ For example, see Chaudhuri and Wu, 2003, Narayan (2005, 2006, 2008), and Narayan and Smyth (2005).

² The efficient market hypothesis (EMH) is built based on the assumption that newly generated information is instantaneously and sufficiently reflected in stock prices.

have found support for a unit root in stock prices, critics have staunchly contended that drawing such a conclusion may be attributed to the lower power of the conventional unit root tests employed when compared with near-unit-root but stationary alternatives (see Taylor et al., 2001). Perron (1989) proposes a model which imposes the null hypothesis that a given series has a unit root with drift and an exogenous structural break against the alternative of stationary regarding a deterministic trend which has an exogenous structural break. Perron (1989) argues that the conventional ADF and PP unit root tests are biased towards the non-rejection of the unit root null hypothesis in the presence of structural breaks. A number of authors, including Christiano (1992) and Zivot and Andrews (1992),³ urge the importance of endogenous rather than exogenous selection of a break date. Enders and Granger (1998) also show that the standard tests for unit root all have lower power in the presence of erroneously specified dynamics. Taylor et al. (2000) demonstrate that the adoption of linear stationary tests is inappropriate for the detection of mean reversion if the true process of the data generation is in fact a stationary non-linear process. The presence of nonlinear mean-reverting adjustment for stock prices has been advanced by recent theoretical developments that emphasize the role of transaction costs. Taylor and Peel (2000), Taylor and Taylor (2004), Juvenal and Taylor (2008) and Lothian and Taylor (2008) argue that different speeds of adjustment at the disaggregated goods level average out to smooth nonlinearity at the aggregate level. An alternative view is that nonlinearity at the aggregate level is caused by other influences, such as the effects of official government intervention (Menkhof & Taylor, 2007; Reitz & Taylor, 2008) or heterogeneous agents (Kilian & Taylor, 2003). Additionally, the existence of structural changes in stock prices might imply broken deterministic time trends, resulting in a nonlinear pattern (Bierens, 1997). It should, therefore, not be unexpected that these shortcomings have seriously called into question many of the earlier findings based on a unit root in stock prices.

Motivated by the above consideration, in this study we revisit the issue of stock market mean reversion for the markets of the USA and its major trading partners of Canada, China, Japan and Mexico, using threshold unit root test developed by Caner and Hansen (2001). The main reason for choosing these four countries is that strong international trade-ties exist between the USA and these four countries. For the year 2009, the share of US exports to these four countries

³ Christiano (1992) and Zivot and Andrews (1992) both argue that structural breaks should be treated as unknown a priori.

was 43.0% and the share of the US imports from these four countries was 50.9% (see Table 1). The results from this test suggest that a unit root in stock prices is not rejected for all countries, with the exception of China. This implies that returns on the U.S. and its major trading partners' stock market cannot be predicted using its own history of stock prices.

Table 1

UAS's International Trade with Top Five Trading Partners, 2000-2009

Panel A. The Proportional of Export

Country	Canada	Mexico	Japan	China	SubTotal	Rest of the world
2000	178.9	111.3	64.9	16.2	0.475	0.525
2001	163.4	101.3	57.5	19.2	0.468	0.532
2002	160.9	97.5	51.4	22.1	0.479	0.521
2003	169.9	97.4	52	28.4	0.48	0.52
2004	190.2	110.8	54.4	34.4	0.478	0.522
2005	211.3	120.1	55.4	41.2	0.475	0.525
2006	198.2	114.6	55.6	53.7	0.411	0.589
2007	213.1	119.4	58.1	62.9	0.395	0.605
2008	261.4	151.5	66.6	69.7	0.427	0.573
2009	204.7	129	51.2	69.6	0.43	0.57

* Exports of Total All Merchandise: in a hundred million (\$ USD)

Panel B. The Proportional of Import

Country	Canada	Mexico	Japan	China	SubTotal	Rest of the world
2000	230.8	135.9	146.5	100	0.503	0.497
2001	216.3	131.3	126.5	102.3	0.505	0.495
2002	209.1	134.6	121.4	125.2	0.508	0.492
2003	221.6	138.1	118	152.4	0.501	0.499
2004	255.9	155.8	129.6	196.7	0.502	0.498
2005	287.9	170.2	138.1	243.5	0.502	0.498
2006	303	197.1	148.1	287.8	0.505	0.495
2007	312.5	210.2	144.9	321.4	0.505	0.495
2008	335.6	215.9	139.2	337.8	0.489	0.511
2009	224.9	176.5	95.9	296.4	0.509	0.491

* Imports of Total All Merchandise : in a hundred million (\$ USD)

Source: FTDWebMaster, Foreign Trade Division, U.S. Census Bureau, Washington, D.C. 20233

The paper is organized as follows. Section 2 discusses the data used in this study. Section 3 first discusses the methodology employed and then the empirical findings. Some economic implications of our empirical findings are also discussed in this section. Section 4 summarizes and concludes the paper.

2. Data

The data set consists of weekly stock market indices for the U.S. and its major trading partners. The stock market indices for the U.S. and its major trading partners include: American S&P 500 Index, Mexico IPC Index, China Shanghai A Stock Index, Japanese NK-225 Index (Tokyo), and Canada S&P/TSX Composite Index. Sample periods span November 1998 to April 2010. Table 2 reports the summary statistics on the data studied. We find that Mexico (IPC) and Japan (NK-225) have the highest and lowest average stock market returns of 0.15% and -0.02%, respectively, over this sample period. The measures for skewness and excess kurtosis show that the stock market return series are highly leptokurtic and negatively skewed with respect to the normal distribution, with the exception of China, indicating that stock market returns are not normal. This result is consistent with that of the current literature.

Table 2

Summary Statistics of the Data: $\Delta \ln P$ (1998.11.06-2010.08.30)

Statistic	USA	Mexico	Canada	Japan	China
Mean	-0.0000	0.0014	0.0005	-0.0003	0.0005
Sum Sq. Dev.	0.0931	0.1415	0.0861	0.1153	0.1580
Median	0.0005	0.0025	0.0016	0.0008	0.0008
Maximum	0.0718	0.0551	0.0523	0.0429	0.0835
Minimum	-0.1250	-0.1004	-0.1014	-0.1135	-0.0544
Std. Dev.	0.0124	0.0153	0.0119	0.0138	0.0162
Skewness	-2.0407	-0.7706	-1.7494	-1.0259	0.1680
Kurtosis	24.5210	7.3379	16.6206	10.6272	4.8061
Jarque-Bera	12075.24***	533.34***	4977.01***	1570.01***	84.94***
Observations	604	604	604	604	604

Notes: 1. *** and ** indicate significance at the 0.01 and 0.05 levels, respectively.

$$2. \Delta \ln P = \ln P_t - \ln P_{t-1}.$$

3. Methodology: Empirical Results and Economic Implications

3.1 Caner and Hansen (2001) Threshold Unit Root Test

Following the work of Caner and Hansen (2001),⁴ we adopt a two-regime threshold autoregressive (TAR (k)) model with an autoregressive unit root as follows:

$$\Delta P_t = \theta_1' \chi_{t-1} I_{\{Z_t < \lambda\}} + \theta_2' \chi_{t-1} I_{\{Z_t \geq \lambda\}} + e_t \quad t = 1, \dots, T \quad (1)$$

where P_t is the stock price indices for $t = 1, 2, \dots, T$, $\chi_{t-1} = (P_{t-1}, v_t', \Delta P_{t-1}, \dots, \Delta P_{t-k})$, $I_{\{s\}}$ is the indicator function, e_t is an i.i.d. disturbance, $Z_{t-1} = P_{t-1} - P_{t-m}$ is the threshold variable, m represents the delay parameter and $1 \leq m \leq k$, v_t is a vector of exogenous variables including an intercept and possibly a linear time trend. The threshold value λ is unknown and takes the values in the compact interval $\lambda \in \Lambda = [\lambda_1, \lambda_2]$, where λ_1 and λ_2 are selected according to $P(Z_t \leq \lambda_1) = 0.15$ and $P(Z_t \leq \lambda_2) = 0.85$. The components of θ_1 and θ_2 can be partitioned as follows:

$$\theta_1 = \begin{pmatrix} \rho_1 \\ \beta_1 \\ \alpha_1 \end{pmatrix} \quad \theta_2 = \begin{pmatrix} \rho_2 \\ \beta_2 \\ \alpha_2 \end{pmatrix} \quad (2)$$

where ρ_1 and ρ_2 are scalar terms. β_1 and β_2 have the same dimensions as v_t , and α_1 and α_2 are k -vectors. Thus (ρ_1, ρ_2) are the slope coefficients on P_{t-1} , (β_1, β_2) are the slopes on the deterministic components, and (α_1, α_2) are the slope coefficients on $(\Delta P_{t-1}, \dots, \Delta P_{t-k})$ in the two regimes.

⁴ Caner and Hansen (2001), using Monte Carlo simulations, show that when the data generating process has a nonlinear nature and bootstrapped critical values are employed, the R_{1T} and R_{2T} tests are more powerful than the conventional ADF test.

The threshold effect in Eq. [1] has the null hypothesis of $H_0 : \theta_1 = \theta_2$, which is tested using the familiar Wald statistic⁵ $W_T = W_T(\hat{\lambda}) = \sup_{\lambda \in \Lambda} W_T(\lambda)$.⁶ The stationary of the process P_t can be established in two ways. The first is when there is a unit root in both regimes (a complete unit root). Here, the null hypothesis $H_0 : \rho_1 = \rho_2 = 0$ is tested against the unrestricted alternative $H_1 : \rho_1 \neq 0$ or $\rho_2 \neq 0$ using the Wald statistic. This statistic is:

$$R_{2T} = t_1^2 + t_2^2 \tag{3}$$

Here, t_1 and t_2 are the t ratios for ρ_1 and ρ_2 from the least squares estimation. The parameters of ρ_1 and ρ_2 from Eq. [1] will control the regime-dependent unit root process of the stock price. If $\rho_1 = \rho_2 = 0$ holds, then we say that the stock price is I(1) and can be described as having a unit root. Second, when there is a unit root in only one of the regimes, a case of partial unit root, the alternative hypothesis is in the form, $H_1 : \rho_1 < 0$ and $\rho_2 = 0$, or $\rho_1 = 0$ and $\rho_2 < 0$. However, Caner and Hansen (2001) claim that the two-sided Wald statistic may have less power than a one-sided version of the test. As a result, they propose the following one-sided Wald statistic:

⁵ The asymptotic distribution of W_T for stationary data has been investigated by Davies (1987), Chan (1991), Andrews and Ploberger (1994), and Hansen (1996).

⁶ $W_T = W_T(\hat{\lambda}) = \sup_{\lambda \in \Lambda} W_T(\lambda)$ $W_T(\lambda) = T \left[\frac{\hat{\sigma}_0^2}{\hat{\sigma}^2(\lambda)} - 1 \right]$, where $\hat{\sigma}_0^2$ and $\hat{\sigma}^2$ are residual variances

from least squares estimation of the null linear and TAR models, respectively.

$$R_{1T} = t_1^2 I_{\{\rho_1 < 0\}} + t_2^2 I_{\{\rho_2 < 0\}} \quad (4)$$

To distinguish between the stationary case given as H_1 and the partial unit root case given as H_2 , Caner and Hansen (2001) suggest using individual t statistics t_1 and t_2 . If only one of $-t_1$ and $-t_2$ is statistically significant, this will be consistent with the partial unit root case H_2 . This means that the stock price behaves like a non-stationary process in one regime, but exhibits a stationary process in the other regime, and vice versa. Caner and Hansen (2001) show that both tests R_{1T} and R_{2T} will have power against both alternatives.⁷ To obtain maximum power from these tests, critical values are generated using bootstrap simulations with 10,000 replications, as suggested by Caner and Hansen (2001).

3.2 Empirical Results

Table 3 presents the country-by-country results for the unit root and stationary tests (i.e., the ADF, PP and the KPSS⁸). At first sight, the individual unit test statistics seem to show that stock prices are non-stationary for the U.S. and its major trading partners. As stated earlier, there is a growing consensus that the stock prices exhibit nonlinearities; consequently, conventional unit root tests such as the ADF test, have low power in detecting the mean reversion of the stock prices. Therefore, we proceed to test the stock prices by using Caner and Hansen's (2001) Threshold Unit Root Test.

First, we use the Wald test W_T to examine whether or not we can reject the linear autoregressive model in favor of a threshold model. The results of the Wald test along with the bootstrap critical values generated at conventional levels of significance are reported in Table 4. The bootstrap p-value for $Z_{t-1} = P_{t-1} - P_{t-m}$ threshold variables of the form for delay parameters m varies from 1 to 12. Since

⁷ As stated by Caner and Hansen (2001), R_{1T} has more power than that of R_{2T} ; here we only report the results of R_{1T} in our study.

⁸ Kwiatkowski et al.'s (KPSS, 1992) unit root tests were also conducted, yielding identical results.

the parameter m is generally unknown, there is no reason to assume that the optimal delay parameter will be the same across countries. The selection of m can be made endogenous by choosing the least squares estimate of m that minimizes the residual variance. It follows that one can obtain m at the value that maximizes the W_T statistic (Caner and Hansen, 2001). We find that the W_T statistic is maximized for the U.S. and Canada when $m=2$, for the Mexico when $m=9$, for Japan when $m=5$, and for China when $m=6$. Taken together, these results imply strong statistical evidence against the null hypothesis of linearity at least at the 1% significance level in all countries' markets, indicating that simple linear models are inappropriate; the TAR model is our preference.

Table 3

Univariate Unit Root Tests: (1998.11.06-2010.08.30)

Panel A. Without trend

Country	Levels			First Differences		
	ADF	PP	KPSS	ADF	PP	KPSS
USA	-1.774(1)	-1.963 [2]	0.292[18]	-28.683 (0)***	-28.683 [0]***	0.083[5]
Mexico	-0.947(0)	-0.955[6]	3.111[18]***	-24.826(0)***	-24.831[6]***	0.075[6]
Canada	-1.717(0)	-1.742[11]	1.997[18]***	-27.225 (0)***	-27.079[11]***	0.082[10]
Japan	-1.319(0)	-1.354[7]	0.469[18]**	-24.854(0)***	-24.852[6]***	0.115[6]
China	-1.221(0)	-1.426[9]	1.284[18]***	-23.970(0)***	-24.314[9]***	0.095[9]

Note: *** and ** indicate significance at the 0.01 and 0.05 levels, respectively. The number in parenthesis indicates the lag order selected based on the recursive t-statistic, as suggested by Perron (1989). The number in the brackets indicates the truncation for the Bartlett Kernel, as suggested by the Newey-West test (1987).

Panel B. With trend

Country	Levels			First Differences		
	ADF	PP	KPSS	ADF	PP	KPSS
USA	-1.871(1)	-2.068 [2]	0.257[18]***	-28.665 (0)***	-28.665[6]***	0.073[5]
Mexico	-1.880(0)	-1.961[6]	0.298[18]***	-24.811(0)***	-24.816[7]***	0.071[5]
Canada	-1.989(0)	-2.067[11]	0.236[18]***	-27.210 (0)***	-27.066[11]***	0.069[10]
Japan	-1.532(0)	-1.567[7]	0.322[18]***	-24.841(0)***	-24.839[6]***	0.106[6]
China	-1.345(0)	-1.645[9]	0.298[18]***	-23.951(0)***	-24.297[9]***	0.097[9]

Note: *** and ** indicate significance at the 0.01 and 0.05 levels, respectively. The number in parenthesis indicates the lag order selected based on the recursive t-statistic, as suggested by Perron

(1989). The number in the brackets indicates the truncation for the Bartlett Kernel, as suggested by the Newey-West test (1987).

Table 4

Threshold test

Countries	Wald Statistic	Bootstrap p-value	Optimal delay parameter m	Threshold parameter λ	Number of observations in Regime 1 and its percentage
USA	78.22	0.004	2	-0.0112	111(18.8%)
Mexico	66.46	0.000	9	-0.0312	88(14.9%)
Canada	71.73	0.002	2	-0.0128	88(14.9%)
Japan	55.03	0.008	5	-0.0308	88(14.9%)
China	60.58	0.000	6	-0.0268	135(22.8%)

Note: Following much of the existing empirical literature on monthly stock prices, we set a maximum lag of 12 and base all our bootstrap tests on 10,000 replications. All of the statistics are significant, which supports the presence of threshold effects.

Table 5

One sided unit root tests

Countries	Optimal delay parameter m	R_{IT} Statistic	Bootstrap critical values			Bootstrap p-value
			10%	5%	1%	
USA	2	6.059	9.872	12.396	18.224	0.283
Mexico	9	1.162	9.314	11.271	16.258	0.847
Canada	2	1.847	9.581	11.840	17.353	0.756
Japan	5	2.493	9.336	11.590	17.092	0.674
China	6	23.443	9.383	11.524	15.944	0.001

In the preceding section, we found strong evidence that the U.S. and its major trading partners' stock prices were nonlinear processes. Next, we explore the threshold unit root properties of stock prices based on the R_{IT} statistic for each delay parameter m , ranging from 1 to 12. However, we will pay particular attention to the results obtained from the preferred models. The R_{IT} test results, together with the bootstrap critical value at the conventional levels of significance and the bootstrap p-value, are reported in Table 5. We are able to reject the unit root null hypothesis for the China market at the 1% significance level. Taken

together, our results provide strong support for the EMH of the stock markets, with the exception of the China market for which the stock prices are characterized as non-linear stationary.

The one-sided test statistic of the R_{1T} , however, is unable to distinguish the complete and partial unit root in stock prices; we examine further evidence on the unit root hypothesis (partial unit root) by examining the individual t statistics, t_1^2 and t_2^2 . The results are reported in Table 6. Also, for the China market, the statistics for t_1^2 are smaller than the critical value at the 1% level of significance, and this leads us to the conclusion that stock prices in the U.S.'s and its major trading partners' stock prices are nonlinear processes that are characterized by a unit root process, which is consistent with the EMH.

Table 6

Partial unit root results

Countries	Optimal delay parameter m	t_1^2 statistic	Bootstrap p-value	t_2^2 Statistic	Bootstrap p-value
USA	2	-0.697	0.937	2.461	0.113
Mexico	9	-0.710	0.928	1.078	0.497
Canada	2	0.364	0.735	1.309	0.425
Japan	5	1.398	0.392	0.733	0.625
China	6	4.605	0.001	1.497	0.362

3.3 Economic Implications

Several important economic implications emerge from our study. First, if the data were erroneously treated as non-stationary and the causality tests for stock prices and other macroeconomic variables were applied to the first difference, then a spurious causality would result. Second, overwhelming evidence in favor of the I(1) non-stationary hypothesis is found, implying that the stock markets in the US and its major trading countries (i.e., Canada, Japan and Mexico), with the exception of China, are characterized by the EMH, thereby showing that profitable arbitrage opportunities among the stock prices in these four countries (i.e., Canada, Japan, Mexico and the US) are not possible. Third, our findings suggest that shocks to stock price are permanent. This result implies that following a major structural

change in the global financial markets, stock prices will not return to their original equilibrium over a period of time. The fact that stock prices show I(1) non-stationarity indicates that it should not be possible for the series to forecast future movement in stock prices based on past behavior.

Equally important, the results here are consistent with those of Narayan (2005, 2006) and Munir and Mansur (2009), since these three studies also used the TAR unit root test of Caner and Hansen (2001) and determined that the stock markets of the U.S., Australia/New Zealand and Malaysia exhibit nonlinear behaviors with a unit root process, respectively.

4. Conclusions

Testing for stationary or otherwise of stock prices has become an important topic in the financial economics literature. Faced with the possibility that stock prices may be characterized by a nonlinear data generating process, we were motivated to test for nonlinearities in stock prices for the U.S. and its major trading partners (i.e., Canada, China, Japan and Mexico). Results from the Caner and Hansen (2001) TAR unit root test indicate that a unit root in stock prices can not be rejected for all countries, with the exception of China. This implies that returns on the U.S.'s and its major trading partners' stock markets cannot be predicted using its own history of stock prices. These results might cast some doubts regarding the active investment strategies of international mutual funds.

References

- Alimov, A. A., D. Chakraborty, R. A. Cox, and A. K. Jain, 2004. The random walk hypothesis on the Bombay stock exchange, *Finance India*, 18, 1251-1258.
- Andrews, D. W. K., and W. Ploberger, 1994. Optimal tests when a nuisance parameter is present only under the alternative, *Econometrica*, 62, 1383-1414.
- Balvers, R., Y. Wu, and E. Gilliland, 2000. Mean reversion across national stock markets and parametric contrarian investment strategies, *Journal of Finance*, 55, 745-772.
- Bierens, H. J., 1997. Testing the unit root with drift hypothesis against nonlinear trend stationarity, with an application to the U.S. price level and interest rate, *Journal of Econometrics*, 81, 29-64.

- Caner, M., and B. E. Hansen, 2001. Threshold autoregression with a unit root, *Econometrica*, 69(6), 1555-1596.
- Chan, K. S., 1991. Percentage points of likelihood ratio tests for threshold autoregression, *Journal of the Royal Statistical Society*, 53, 691-696.
- Chaudhuri, K., and Y. Wu, 2003. Random walk versus breaking trend in stock prices: evidence from emerging markets, *Journal of Banking and Finance*, 27, 575-592.
- Christiano, L. J., 1992. Searching for a break in GNP, *Journal of Business and Economic Statistics*, 10, 237-250.
- Davies, R. B., 1987. Hypothesis testing when a nuisance parameter is present only under the alternative, *Biometrika*, 74, 33-43.
- Dickey, D. A., and W. A. Fuller, 1979. Autoregressive time series with a unit root, *Journal of the American Statistical Association*, 74, 427-431.
- Enders, W., and C. W. J. Granger, 1998. Unit-root tests and asymmetric adjustment with an example using the term structure of interest rates, *Journal of Business and Economic Statistics*, 16, 304 - 311.
- Fama, E. F., and K. R. French, 1988. Permanent and temporary components of stock prices, *Journal of Political Economy*, 96, 246-273.
- Grieb, T. A., and M. G. Reyes, 1999. Random walk tests for Latin American equity indexes and individual firms, *Journal of Financial Research*, 22, 371-383.
- Hansen, B. E., 1996. Inference when a nuisance parameter is not identified under the null hypothesis, *Econometrica*, 64, 413-430.
- Juvenal, L., and M. P. Taylor, 2008. Threshold adjustment of deviations from the law of one price, *Studies in Nonlinear Dynamics and Econometrics*, 12, 1-44.
- Kilian, L., and M. P. Taylor, 2003. Why is it so difficult to beat the random walk forecast of exchange rates? *Journal of International Economics*, 60(1), 85-107.
- Kim, M. J., C. R. Nelson, and R. Startz, 1991. Mean reversion of stock prices: A reappraisal of the empirical evidence, *Review of Economic Studies*, 58, 5151-5280.

- Kwiatkowski, D., P. C. B. Phillips, P. Schmidt and Y. Shin, 1992. Testing the null hypothesis of stationarity against the alternative of a unit root, *Journal of Econometrics*, 54, 159-178.
- Lo, A.W., and A. C. MacKinlay, 1997. Stock market prices do not follow random walks: evidence from a simple specification test, *The Review of Financial Studies*, 1, 41-46.
- Lothian, J. R., and M. P. Taylor, 2008. Real exchange rates over the past two centuries: How important is the Harrod-Balassa-Samuelson effect? *Economic Journal*, 118 (532), 1742-63.
- Lumsdaine, R., and D. Papell, 1997. Multiple trend breaks and the unit root hypothesis, *Review of Economics and Statistics*, 79, 212-18.
- McQueen, G., 1992. Long-horizon mean reverting stock process revisited, *Journal of Financial and Quantitative Analysis*, 27, 1-18.
- Menkhoff, L., and M. P. Taylor, 2007. The obstinate passion of foreign exchange professionals: Technical analysis, *Journal of Economic Literature*, 45(4), 936-972.
- Munir Q., and K. Mansur, 2009. Is Malaysian stock market efficient? Evidence from threshold unit root tests, *Economics Bulletin*, 29, 1359-1370.
- Narayan, P. K., 2005. Are the Australian and New Zealand stock prices nonlinear with a unit root? *Applied Economics*, 37, 2161-2166.
- Narayan, P. K., 2006. The behavior of US stock prices: Evidence from a threshold autoregressive model, *Mathematics and Computers in Simulation*, 71, 103-108.
- Narayan, P. K., 2008. Do shocks to G7 stock prices have a permanent effect? Evidence from panel unit root tests with structural change, *Mathematics and Computers in Simulation*, 77, 369-373.
- Narayan, P., and R. Smyth, 2005. Are OECD stock prices characterized by a random walk? Evidence from sequential trend break and panel data models, *Applied Financial Economics*, 15(8), 547-56.
- Narayan, P., and R. Smyth, 2006. Random walk versus multiple trend breaks in stock prices: Evidence from fifteen European markets, *Applied Financial Economics Letters*, 2(1), 1-7.

- Narayan, P., and A. Prasad, 2007. Mean reversion in stock prices: New evidence from panel unit root tests for seventeen European countries, *Economics Bulletin*, 3, 1-6.
- Nelson, C., and C. Plosser, 1982. Trends and random walks in macroeconomic time series, *Journal of Monetary Economics*, 10, 139-162.
- Nunes, L., P. Newbold, and C. Kaun, 1997. Testing for unit roots with structural breaks: Evidence on the great crash and the unit root hypothesis reconsidered, *Oxford Bulletin of Economics and Statistics*, 59, 435-48.
- Perron, P., 1989. The great crash, the oil price shock, and the unit root hypothesis, *Econometrica*, 57, 1361-1401.
- Poterba, J.M., and L.H. Summers, 1988. Mean reversion in stock prices: Evidence and implications, *Journal of Financial Economics*, 22, 27-59.
- Reitz, S., and M. P. Taylor, 2008. The coordination channel of foreign exchange intervention: A nonlinear microstructure analysis, *European Economic Review*, 52(1), 55-76.
- Richardson, M., and J. H. Stock, 1989. Drawing inferences from statistics based on multiyear asset returns, *Journal of Financial Economics*, 25, 323-348.
- Richardson, M., 1993. Temporary components of stock prices: A skeptic's view, *Journal of Business and Economic Statistics*, 11, 199-207.
- Taylor, M. P., and D. A. Peel, 2000. Non-linear adjustment, long-run equilibrium and exchange rate fundamentals, *Journal of International Money and Finance*, 19, 33-53.
- Taylor, M. P., D. A. Peel, and L. Sarno, 2001. Nonlinear mean reversion in real exchange rates: Towards a solution of the purchasing power parity puzzles, *International Economic Review*, 42, 1015-1042.
- Taylor, A. M., and M. P. Taylor, 2004. The purchasing power parity debate, *Journal of Economic Perspectives*, 18(4), 135-58.
- Zhu Z., 1998. The random walk of stock prices: evidence from a panel of G7 countries, *Appl. Econ Letters*, 5, 411-413.

Zivot, E., and D. Andrews, 1992. Further evidence of the great crash, the oil-price shock and the unit-root hypothesis, *Journal of Business and Economic Statistics*, 10, 251-70.

Acknowledgement: we would like to thank the anonymous referee for his helpful comments, suggestions and time spent in reading our paper. These all make this paper more valuable and readable. Any errors that remain are our own.



The Impact of Internationalization on Firm Performance: A Quantile Regression Analysis

Tan (Charlene) Lee,^a Kam C. Chan,^b Jin-Huei Yeh,^c Hsin-Ya Chan,^d

a. Department of Accounting and Finance, The University of
Auckland, Auckland, New Zealand

b. Department of Finance, Western Kentucky University, Bowling
Green, KY 42101, USA

c. Department of Finance, National Central University, Chung-Li,
Taoyuan, Taiwan

d. Department of International Business, Yuan Ze University,
Chung-Li, Taoyuan, Taiwan

Abstract: In the context of internationalization, we study the impact of a firm's breadth and depth on its performance using quantile regression. Quantile regression allows us to study the effects of internationalization on performance at various quantiles of conditional performance distribution. Our results suggest that breadth (measured by the number of foreign countries where a firm has direct investments) has positive effects on firm performance (measured by Tobin's Q) and depth (measured by the number of foreign investment sites in top two countries divided by total number of foreign investment sites) is negatively correlated with firm performance. The quantile regression analysis also shows that the impacts of breadth and depth are heterogeneous across levels of performance. The implication is that, for firms with high performances, their performances are sensitive to internationalization activities; however, for firms with low performances, the stock market barely recognizes their attempts to internationalize.

1. Introduction

Previous studies have investigated the relation between internationalization

and firm performance. In general, some studies find that internationalization is positively correlated with firm performance while others conclude the opposite. We argue that the mixed findings are due, in part, to using ordinary least square estimation methods. The statistical property of ordinary least square models cannot show the fact that Firms with different firm performance across the distribution respond differently in magnitude to their degree of internationalization.

The objective of this study is to use a quantile regression analysis to examine the effects of internationalization on firm performance. Our study is distinct but related to literature in two aspects. First, we provide evidence to suggest that a firm's breadth (depth) in internationalization is positively (negatively) correlated with firm performance (Tobin's Q). These positive and negative relations, however, are not uniform across firm performance distribution. That is, level of internationalization in terms of breadth and depth has differential impact on firms with high, moderate, and low performances. Hence, our findings help explain the mixed conclusions regarding internationalization and firm performance in the literature. Second, we use a sample of Taiwanese firms in our analysis. With the exceptions of Chiang and Yu (2005) and Contractor, Kumar, and Kundu (2007), the literature primarily focuses on developed markets. The results from an emerging market offer different perspectives on the impact of internationalization on firm performance.

In addition, the findings of distinct breadth and depth effects on Tobin's Q across Tobin's Q distribution suggest that for firms with high performances, their market values are sensitive to internationalization activities; but for firms with low performances, the stock market barely recognizes their attempts to internationalize.

2. Literature review

There are two strands of literature in internationalization and firm performance. The first strand discusses the theoretical foundation and measures of internationalization. Vernon (1966) first proposes the international product life cycle theory. He argues that there are three stages in the development of a product: new product stage, mature product stage, and standardized product stage. These stages indicate a process in which a firm develops a new product and sells to its home market, then exports to foreign markets, and finally establishes subsidiaries in foreign countries. As a product evolves through the product life cycle, a firm gradually gets involved in foreign markets and increases its degree of internationalization. Although Vernon does not explicitly formulate a definition of

“internationalization,” he does show that internationalization is a dynamic and continuous process.

Johanson and Vahlne (1977) propose that internationalization means the attitudes of a firm towards overseas activities or its established activities overseas. Dunham and Pierce (1989) define internationalization as the level and style of a firm’s commitment and its management toward foreign sources of sales. Fayerweather (1978) considers that internationalization happens when a firm transfers specific resources across countries, including nature resources, capital, labor, technology, and management skills. Although the definitions of internationalization proposed by researchers vary widely, they all agree that internationalization is a type of behavior that a firm’s operations have developed outwardly or/and inwardly. Hitt, Hoskisson, and Kim (1997) suggest that a firm is pursuing internationalization as long as it extends any kind of operation across national borders or penetrates into different geographic regions (or foreign markets).

Sullivan (1994a) classifies various measures of multinationality employed by researchers into three attributes: performance, structure, and attitudinal attribute, respectively.¹ The most commonly used performance attribute is “foreign sales as a percentage of total sales” (e.g., Geringer, Beamish, and daCosta, 1989), while “number of overseas subsidiaries” (e.g., Morck and Yeung, 1991) is the most widely adopted structural attribute. Although Sullivan suggests researchers use “top managers’ international experience” to measure the attitudinal attribute of multinationality, this attribute is relatively rarely seen compared to the other two categories.

The second strand of literature examines the impact of internationalization on firm performance. The literature uses different model specifications to study the relations. Previous studies present six general models to explain the relation: linear and positive, linear and negative, U-shaped, inverted U-shaped, S-shaped, and inverted S-shaped. A number of studies examine the internationalization and firm performance relation using square or cubic measure of internationalization in an ordinary least square empirical model. While different studies use different measures of internationalization, many of them use a firm’s ratio of foreign sales to total sales to capture a firm’s level of multinationality.

¹ See Sullivan (1994a, 1996) for the rationale and detailed classification for degree of internationalization.

Errunza and Senbet (1984), Morck and Yeung (1991), and Tallman and Li (1996) support a positive linear relation between firm performance and degree of internationalization. The recent research finds that the positive and linear relation is augmented by other factors such as a firm's R&D and marketing capabilities (Kotabe, Srinivasan, and Aulakh, 2002). Other studies, such as Siddharthan and Lall (1982) and Geringer, Tallman, and Olsen (2000), however, reveal a negative relation between internationalization and firm performance.

Kogut (1985), Porter (1985), Sullivan (1994b), Contractor (2002), and Contractor, Kumar, and Kundu (2007) offer arguments and evidence to suggest that the assertion "more internationalization is better" is not always true. These studies recognize that internationalization encounters with both risks and advantages, and thus, introduce costs and benefits. Because of the characteristics, these studies incorporate squared terms to be curvilinear model. There exists a "threshold" in the curvilinear model. Thus, the relation between internationalization and firm performance becomes U shaped or inverted-U shaped.

Contractor, Kundu, and Hsu (2003) integrate the literature into a three-stage theory of international expansion, an S-shaped relation. They consider the possibility that the past inconsistent findings could be due, in part, to the S-shaped model. Specifically, a firm's performance declines, then increases, and finally decreases as the degree of internationalization increases, creating two thresholds. Contractor, Kundu, and Hsu (2003) argue that the prior contradictory findings may capture only part of an overall S-shaped function. Lu and Beamish (2004) offer evidence to support the S-shaped relation in a sample of Japanese firms.

Chiang and Yu (2005) find an inverted S-shaped relation between internationalization and Taiwan firms' performances for the period from 1998 to 2002. They argue that foreign direct investments of Taiwan firms concentrate in Asia (especially in Mainland China), which is both geographically and culturally in close proximity to Taiwan, in order to obtain the "market familiarity" advantage. The market familiarity facilitates the transfer of technology and managerial skills, but the continued expansion has to contend with the increasing complexity of global operation.

Different from other researchers who use uni-dimensional measures of internationalization, Allen and Pantzalis (1996) study two dimensions of multinationality on a firm's performance: breadth and depth. Breadth is measured by the number of foreign countries where a firm has subsidiaries, while depth is

measured by a firm's number of foreign subsidiaries in its top two countries divided by total number of foreign subsidiaries. Allen and Pantzalis find that breadth is a value-enhancing effect of internationalization, but, depth is a value-reducing effect of internationalization on a firm's performance.

We follow Allen and Pantzalis (1996) to investigate how the two characteristics of a multinational network, breath and depth, affect multinational corporation's (hereafter as MNC) performance. However, in contrast to Allen and Pantzalis, we focus on the impacts of the two dimensions of internationalization on firms with variant levels of performances. A quantile regression analysis allows us to capture the unequal marginal effects of multinationality on performance among MNCs. As compared to traditional ordinary least square model results, our empirical findings provide strategic implications for MNCs with different levels of performances to penetrate into foreign markets.

Furthermore, a quantile regression model also enables us to study the association between the degree of internationalization and performance in a cross-sectional basis. Therefore, our results complement recent literature which focuses on the S-shaped or inverted S-shaped relation between internationalization and firm performance. Our quantile regression model helps us capture different stages among firms in the S-shaped or inverted S-shaped relation between internationalization and firm performance in a cross-sectional sample of firms that fall on different positions on the S-shaped or inverted S-shaped function.

3. Research method

It is common to use the ordinary least squares (OLS) model to specify a linear regression model and to estimate its unknown parameters. It is well known that the OLS method computes parameter estimates by minimizing the sum of squared errors and leads to an approximation to the "mean" function of the conditional distribution of the response variable. On the other hand, an alternative to the OLS method is the least absolute deviation (LAD) model. The LAD method minimizes the sum of absolute errors and yields an approximation to the "median" function of the conditional distribution of the response variable.

Many internationalization studies use OLS methodology to estimate the "average" marginal effect of the degree of internationalization on firm performance. The OLS regression technique generally provides summary point estimates that calculate the average effect of the independent variables on the "average firm"

(Coad and Rao, 2006). The focus on the average firm can mask important features of the underlying relationship, however. A quantile regression analysis allows us to estimate the marginal effect of internationalization at various quantiles of conditional performance distribution.

Koenker and Bassett (1978) first introduce the quantile regression analysis. Quantile regression utilizes the concepts of regression analysis to quantile and extracts the information from whole conditional distributions of the dependent variable. While the least square estimator leads to the approximation of the conditional mean function of the dependent variable by minimizing the sum of the squared errors, a quantile regression approach yields estimates for the conditional quantile functions by minimizing an asymmetric version of the absolute errors and nests the LAD estimator as a special case. Let the conditional distribution of Y be linearly associated with covariates X at a given θ , as follows:

$$Q_{\theta}(y_t | x_t) = \zeta_{\theta}(x_t, \beta) = x_t \beta(\theta), \quad t = 1, \dots, n, \quad (1)$$

where $\zeta(\theta)$ is the response of the explanatory variables for the given θ . It is quite easy to see that:

$$\theta = \int_{-\infty}^{x_t \beta(\theta)} f_Y(s | x_t) ds,$$

where $f_Y(\cdot | x_t)$ is the conditional density function of Y , given X . The key to determining the conditional quantile function involves the identification of the parameter vector $\beta(\theta)$, which is essentially the optimum:

$$\beta(\theta) = \arg \min_{\beta \in \mathcal{R}^k} E[\rho_{\theta}(y_t - x_t \beta)]; \quad (2)$$

$\rho_{\theta}(\cdot)$ is an asymmetric weighting *check function* that for any $\theta \in (0, 1)$:

$$\rho_{\theta}(u) = u \cdot [\theta - I_{\{u < 0\}}], \quad (3)$$

where $I_{\{A\}}$ is an indicator function of event A. The parameter $\beta(\theta)$ varies with different θ .

To obtain the sample counterpart, just as the least square estimator is produced through the minimization of the sum of the squared residuals, the conditional quantile estimators are the solutions resulting from the minimization of the sum of the asymmetrically weighted absolute residuals from a pre-specified model as

$$\begin{aligned} & \min_{\beta \in \mathbb{R}^k} \frac{1}{n} \sum_{t=1}^n [\theta - I_{\{y_t - x_t \beta < 0\}}] (y_t - x_t \beta) \\ & = \min_{\beta \in \mathbb{R}^k} \frac{1}{n} \left[\sum_{t \in \{t: y_t \geq x_t \beta\}} \theta |y_t - x_t \beta| + \sum_{t \in \{t: y_t < x_t \beta\}} (1 - \theta) |y_t - x_t \beta| \right]. \end{aligned} \tag{4}$$

We can numerically solve for the estimated coefficient $\hat{\beta}_\theta$ for different $\theta \in (0,1)$ by means of linear programming. $\hat{\beta}_\theta$ measures the extent to which the θ -th quantile of the response variable y_t changes, given a unit change in the covariate x_t . The estimates obtained from this pre-specified model, $\hat{\beta}(\theta)$, are then capable of characterizing the response variable over the whole conditional distribution, given any different θ . Plotting the quantile coefficient of specific covariates, x_k , against $\theta \in [0,1]$ is a *quantile process plot* which is employed to see how the impact from x_k to Y evolves as we change our focus on Y from the lower tail to the upper tail.

On the issue of asymptotic properties, both Koenker and Bassett (1978) and Powell (1986) have proven that $\hat{\beta}_\theta$ is consistent with β_θ and asymptotically distributed as:

$$\sqrt{n}(\hat{\beta}_\theta - \beta_\theta) \overset{A}{\sim} N(0, G(\beta_\theta)^{-1} \Sigma(\beta_\theta) G(\beta_\theta)^{-1}),$$

where

$$G(\beta_\theta) = -E[x_t x_t' f_{e(\theta)|x}(0)]$$

$$\Sigma(\beta_\theta) = \theta(1-\theta)E[x_t x_t']$$

and where $f_{e(\theta)|x}(0)$ is the conditional density of the error term under quantile θ evaluated at 0. A typical way is to assume that $f_{e(\theta)|x}(0)$ is the same as its unconditional counterpart, $f_{e(\theta)}(0)$. $G(\beta_\theta) = -f_{e(\theta)}(0)E[x_t x_t']$; therefore, the asymptotic distribution reduces to:

$$\sqrt{n}(\hat{\beta}_\theta - \beta_\theta) \overset{A}{\sim} N\left(0, \frac{\theta(1-\theta)}{f_{e(\theta)}(0)} E[x_t x_t']^{-1}\right).$$

However, the unconditional density function of e within the asymptotic variance covariance matrix is difficult to estimate; thus, we use the bootstrap method here, as suggested by Buchinsky (1998), as the means of resolving this problem. It has also been proven that, although computationally intensive, going through the bootstrapping process, as opposed to approximating $f_{e(\theta)}(0)$, does indeed produce more accurate estimates.

We can test the differences between the parameter estimates from the different conditional quantiles in order to determine whether the impact from a specific covariate is constant across the quantiles of the response variable (as is assumed in the least squares regression). To verify whether the effects of a specific covariate are vastly different from one firm performance quantile to another, we test the inter-quantile difference in the estimated coefficients, based on bootstrapped standard errors with 1,000 iterations; $H_0 : \beta_{k,\theta_i} = \beta_{k,\theta_j}$, where β_{k,θ_i} denotes the coefficient for the k -th covariate under the θ_i -th quantile. We set symmetric θ_i s simply to see whether parametric coefficient of degree of internationalization, especially breadth and depth, are heterogeneous across the firm performance distribution under investigation.

In summary, by estimating quantile regressions for various θ , we are able to characterize the conditional distribution of the Tobin's Q . There have been some

quantile regression applications in labor economics (e.g., Buchinsky, 1998), health economics (e.g., Koenker and Hallock, 2001), finance (e.g., Fattouh, Scaramozzino and Harris, 2005; Coad and Rao, 2006; and Hallock, Madalozzo, and Reck, 2010), and real estate (e.g., Zietz, Zietz and Sirmans, 2008). In general, these studies find that the estimated quantile regressions can be quite different across quantiles. The quantile regression results usually lead to interesting empirical interpretations in the literature.²

There are two advantages to using quantile regression. First, we can attain multiple vectors of estimators in breadth and depth corresponding to each conditional quantile of firm performance distribution. Quantile regression provides more information about the relation between the degree of internationalization and firm performance. Second, we can abandon the normality assumption of OLS regression because quantile regression does not presume the normality of unobserved errors. Quantile regression enables researchers to apply it to asymmetric, fat-tailed, or truncated distributions. Quantile regression estimators are characteristically robust to outliers, skew-tailed, or truncated distribution (Coad and Rao, 2006).

We use quantile regression to estimate whether there exists different effects of breadth and depth at different quantile points of conditional performance distribution. In addition, we use interquantile regression to examine whether there are asymmetric effects of breadth and depth at opposite quantile points of conditional firm performance. With the method, we are able to characterize the behavior at each quantile of the conditional firm performance distribution and to test whether parametric coefficients of degree of internationalization, especially breadth and depth, are heterogeneous across the firm performance distribution.

² For instance, Zietz, Zietz, and Sirmans (2008) study the determinants of housing price using quantile regression. The findings suggest that higher-priced home buyers value certain housing characteristics such as square footage, the number of bathrooms, and age very different from buyers of lower-priced homes. The results help explain why prior studies find that the determinants of housing prices are different in different price ranges. Thus, it would be less informative to use an ordinary least squares method to estimate the determinants of housing prices.

4. Data, variables, empirical model, and testable hypotheses

4.1 Data

The basic firm data are from the Taiwan Economic Journal (TEJ) database and covers a six-year period from 2000 to 2005. We collect the necessary financial information to calculate the Tobin's Q and various control variables from each firm's financial reports. We also use the overseas operations database of the Taiwan Economic Journal and the website of Taiwan Securities & Futures Information Center to collect the number of foreign countries where a firm has direct investments to represent a firm's breadth.³ We use the following criteria to choose the sample:

- (1) Non-financial Taiwanese firms listed on Taiwan Stock Exchange and over-the-counter markets,
- (2) Firms with at least 20 percent equity share of any foreign subsidiary to help us confine the sample of firms as "multinational corporations", and
- (3) Firms that have complete financial data covering a set of accounting items, including total assets, long-term debts, and market value of equity, that are required for the construction of Tobin's Q to represent the firm performance.
- (4) After screening, our research sample consists of an unbalanced data of 4,667 firm-year observations during the six-year period from 2000 to 2005.

4.2 Variables

Similar to other studies, we use the Chung and Pruitt (1994) approach to calculate Tobin's Q:

$$\text{Tobin's } Q = \frac{MVE + PS + DEBT}{TA}$$

where *MVE* = market value of the equity; *PS* = book value of preferred stock; *DEBT* = book value of long-term debt plus short-term liabilities minus short-term assets; and

³ These two data sets include the data of all significant foreign physical capital investments of Taiwanese based firms without specifically classifying its type of legal entity as subsidiaries, branches, or service sites.

TA = book value of total assets.

We measure breadth by the number of foreign countries in which a firm has direct investments. Depth is a measure of concentration of the firm's foreign investment sites in a few foreign countries. Depth is calculated as follows:

$$Depth = \frac{\text{Number of Foreign Investment Sites in the Top Two Foreign Countries}}{\text{Number of Total Foreign Investment Sites}}$$

We include several variables to control the potential influences on firm performance:

(1) Advertising Intensity (ADI)

Advertising expenditure is widely used to measure intangible assets of a firm. We use advertising intensity (annual advertising expenditure as a percentage of sales) as our measure of advertising assets, such as goodwill, brand name, and marketing capability. The ADI is computed as follows:

$$ADI = \frac{\text{Advertising Expenditure}}{\text{Sales}}$$

(2) R&D Intensity (RDI)

Research and development expenditure is also often used to measure intangible assets of a firm. We use R&D intensity (annual R&D expenditure as a percentage of sales) as our measure of technological assets, such as patents and technological know-hows. R&D intensity is computed as follows:

$$RDI = \frac{\text{Research and Development Expenditure}}{\text{Sales}}$$

(3) Debt ratio

LTDEBT (long-term debt as a percentage of total assets) is included to control the potential impact of leverage on firm performance. It is computed as the follows:

$$LTDEBT = \frac{\text{Long-term Debt}}{\text{Total Assets}}$$

(4) SIZE

SIZE (nature log of total assets) is used to control the influence of firm size on firm performance. It is shown as follows:

$$SIZE = \text{Log} (\text{Total assets})$$

We summarize the statistics of the variables in Table 1. The distributions of all variables do not conform to normal distributions as shown in the large values of skewness and kurtosis. Specifically, the asymmetries in the distribution of the dependant variable (the Tobin's Q distribution exhibits a rightward skewness of 4.01 and leptokurtosis of 33.88) should be taken into account by employing the quantile regression. On average, each firm has 2.86 foreign countries as its direct investment sites (breadth) and an approximate 0.35 concentration (depth) in its internationalization effort.

Table 1:

Descriptive statistics of variables (N=4,667)

We present the summary statistics of all variables in Table 1. The distributions of the variables do not conform to normal distributions as shown in the large values of skewness and kurtosis. Tobin's Q = (market value of the equity + book value of preferred stock + book value of long-term debt plus short-term liabilities minus short-term assets)/book value of total assets; Breadth = the number of foreign countries in which a firm has subsidiaries; Depth = number of foreign subsidiaries in the top two foreign countries/total number of foreign subsidiaries; Advertising Intensity (ADI) = advertising expenditure/sales; R&D Intensity (RDI) = R&D expenditure/sales; LTDEBT = long-term debt/total assets; SIZE = nature log of total assets.

	<i>Tobin's Q</i>	<i>Breadth</i>	<i>Depth</i>	<i>ADI</i>	<i>RDI</i>	<i>LTDEBT</i>	<i>SIZE</i>
Mean	0.7543	2.8620	0.3505	0.0052	0.0260	0.4498	6.6333
Median	0.5520	2.0000	0.3636	0.0003	0.0088	0.4568	6.5455
STD.	0.7758	3.0828	0.3008	0.0162	0.1002	0.1718	0.5777
Skewness	4.0127	2.3039	0.3786	8.0452	32.9070	0.1683	0.7855
Kurtosis	33.8780	15.5040	2.2277	106.4300	1559.6000	3.0997	3.6148

4.3 Empirical model

We follow Morck and Yeung (1991), Allen and Pantzalis (1996), and others to relate a firm's Tobin's Q and its degree of internationalization in terms of breadth and depth. We use the following functional relation:

$$Tobin's\ Q = \beta_0 + \beta_1 Breadth + \beta_2 Depth + \beta_3 RDI + \beta_4 ADI + \beta_5 LTDEBT \\ + \beta_6 SIZE + \sum \beta_j Industry + \varepsilon,$$

where industry is the dummy variable for 17 industries and other variables as defined earlier.

4.4 Testable hypotheses

Kogut (1985) asserts that MNCs derive their advantages over domestic firms from a transnational network of operations that provides them with operating flexibility. Operating flexibility is the ability of the MNCs to arbitrage markets by shifting factors of production across borders and by transferring resources within their network of affiliates that includes production, marketing, sales, research, and financial subsidiaries located in foreign countries. We argue that a MNC, as if owns a real option, can respond to uncertain events, such as government policies, competitors' decisions, or the arrival of new technologies. Therefore, the breadth of geographical dispersion determines the option value of multinational operating flexibility. For instance, the number of foreign countries in which the MNC has investment sites enables the MNC to transfer firm-specific knowledge, innovation technologies, and marketing competences within a network of multinational diversification. Additionally, the value of operating flexibility partially derives from the effect of operating hedge under uncertain exchange rate changes.⁴

Specifically, breadth offers a value-enhancing effect in internationalization. It acts like a valuable portfolio of real options to manage operating exposure by engaging in "real hedging". By contrast, depth is a value-reducing effect of internationalization stemming from the agency cost of managing or coordinating extensive multinational networks. Allen and Pantzalis (1996) find that a MNC's performance is maximized resulting from breadth, but not depth. They suggest that the returns to internationalization increase as the firm expands its holdings of real options (i.e., widens the breadth of its multinational network), but decrease with the acquisition of redundant real options (i.e., multiple subsidiaries in each country) that increase agency costs.

⁴Kogut and Kulatilaka (1994) and Mello, Parsons, and Triantis (1995) use a real options approach to demonstrate the product value enhancing mechanism and agency cost reducing effect of MNC's operational flexibility, respectively.

Therefore, we expect that MNCs having high performance (Tobin's Q) derive more value of real options from the breadth of geographical dispersion. There is a positive influence of breadth on firm performance and the influence gradually increases from lower quantiles to upper quantiles of firm performance distribution. Similarly, we argue that MNCs with lower (higher) firm performance suffer more (less) agency costs of managing or coordinating multinational networks and do not (do) effectively hedge currency risk in a few geographic regions. We hypothesize that there is a negative influence of depth on firm performance and the influence gradually decreases from lower quantiles to upper quantiles of firm performance distribution. In sum, breadth and depth have opposite effects on firm performance across firm performance distribution. The testable hypotheses are:

H1A: The effects of breadth are significantly positive for all quantiles in the conditional firm performance distribution.

H1B: The magnitude of positive effect of breadth is significantly larger for upper quantiles or/and are significantly smaller for lower quantiles in the conditional firm performance distribution.

H2A: The effects of depth are significantly negative for all quantiles in the conditional firm performance distribution.

H2B: The magnitude of negative effect of depth is significantly smaller for upper quantiles or/and are significantly larger for lower quantiles in the conditional firm performance distribution.

5. Results and discussion

5.1 Estimated effects of breadth and depth on Tobin's Q

We present the quantile regression results in Table 2 using nine different quantiles (0.1 to 0.9). We also show the estimation results of OLS to contrast with the results of quantile regression. Breadth variable coefficients are both significantly positive with Tobin's Q in OLS and quantile regression models, indicating that the breadth or geographical dispersion of firms has a positive impact on Tobin's Q. The finding supports our Hypothesis 1A. More precisely, we observe that the magnitude of the estimated positive effects of breadth gradually increases from lower quantile to upper quantile of the Tobin's Q distribution, which offers support to Hypothesis 1B. For example, the breadth coefficient is 0.009, 0.028, and 0.064 at 10th, 50th, and 90th quantiles, respectively. As the quantiles increase, the

magnitude of breadth coefficient also increases. The results imply that firms with high Tobin's Q derive more value from a higher degree of breadth than firms with low Tobin's Q for the same degree of breadth. We conjecture that high Tobin's Q firms are able to conduct real hedge or have better operating flexibility responding to uncertain events, such as exchange rate fluctuations, production cost changes, and competitor's decisions; and therefore, these high Tobin's Q firms are able to capture the benefits of higher degree of breadth than low Tobin's Q firms.

Table 2:

OLS and quantile regression results (dependent variable is Tobin's Q) (N=4,667)

We present the quantile regression results in Table 2 using nine different quantiles (0.1 to 0.9). The standard errors are reported in the parentheses. We obtain the standard errors of the coefficients by bootstrapped methods using 1,000 bootstrap replications. We also show the estimation results of OLS to contrast with the results of quantile regression. As the quantiles increase, the magnitude of breadth coefficient also increases. The magnitude of the estimated negative effects of depth gradually increases from middle quantiles (40th, 50th, 60th) to upper quantiles (70th, 80th, 90th). As the quantiles increase, the magnitudes of depth coefficient also increase. *, **, and *** denote coefficients that are significantly different from zero at 10%, 5%, and 1% significance levels, respectively.

Independent variable	OLS	Quantile at								
		0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
ADI	-0.723 (0.698)	0.336 (0.358)	-0.228 (0.383)	-0.135 (0.413)	-0.220 (0.429)	-0.719 (0.456)	-0.521 (0.677)	-1.071 (0.790)	-1.476 (1.000)	-0.427 (1.545)
RDI	0.369*** (0.108)	0.156 (0.169)	0.284 (0.243)	0.466 (0.285)	0.479* (0.282)	0.572 (0.353)	0.563 (0.392)	0.953** (0.401)	1.353 (0.848)	3.413** (1.706)
LTDEBT	-1.124*** (0.064)	-0.159*** (0.044)	-0.247*** (0.049)	-0.312*** (0.047)	-0.362*** (0.045)	-0.506*** (0.055)	-0.715*** (0.070)	-0.847*** (0.074)	-1.109*** (0.099)	-1.392*** (0.153)
SIZE	0.120*** (0.021)	0.121*** (0.014)	0.116*** (0.017)	0.124*** (0.013)	0.114*** (0.014)	0.119*** (0.016)	0.124*** (0.020)	0.121*** (0.022)	0.095*** (0.033)	0.136*** (0.045)
Breadth	0.045*** (0.004)	0.009*** (0.003)	0.010** (0.004)	0.011*** (0.003)	0.018*** (0.004)	0.028*** (0.006)	0.041*** (0.007)	0.053*** (0.006)	0.063*** (0.006)	0.064*** (0.005)
Depth	-0.227*** (0.039)	0.027 (0.024)	0.003 (0.027)	-0.014 (0.023)	-0.063** (0.027)	-0.119*** (0.034)	-0.156*** (0.037)	-0.247*** (0.037)	-0.300*** (0.048)	-0.372*** (0.062)
Industry dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

To depict the property of quantile regression, we show estimated breadth coefficients at 19 points of the conditional Tobin's Q distribution in increments of 0.05 for breadth variable in Figure 1 of Panel A. As shown in Panel A, significant breadth coefficients are smaller in the magnitude for low-Q firms, with a coefficient of 0.009 at the 10th quantile, indicating that a one-country increase in geographical dispersion leads to a 0.009 increase in Tobin's Q. Breadth effects increase monotonically when moving from the 10th quantile to the 40th quantile,

and then progressively increase to a coefficient of 0.064 at 90th quantile. The breadth coefficient of OLS is a significant 0.045. Thus, we find that the OLS method underestimates the effects of firms located in the upper part of the conditional distribution (70th, 80th, 90th), and the bias is economically significant because those quantile estimates fall out of the confidence interval of the OLS coefficient.

We find that the estimated coefficients of depth are significantly negative in the OLS model and at 40th, 50th, 60th, 70th, 80th, and 90th quantiles in the quantile regression model. The results indicate that the depth of geographical concentration has a negative impact on Tobin's Q. The findings also lend support to Hypothesis 2A. The magnitude of the estimated negative effects of depth gradually increases from middle quantiles (40th, 50th, 60th) to upper quantiles (70th, 80th, 90th). For example, the depth coefficients are -0.063, -0.119, -0.156, -0.247, -0.300, and -0.372 at 40th, 50th, 60th, 70th, 80th, and 90th quantiles, respectively. As the quantiles increase, the magnitudes of depth coefficient also increase. The finding does not support Hypothesis 2B. Figure 1 of Panel B plots the coefficients for depth and the interpretations are similar to Panel A.

5.2 Inter-quantile regression

We examine the inter-quantile differentials for estimated coefficients of breadth and depth. The t-test rejects the null hypothesis of homogeneous coefficients at the conventional significance level for two symmetrical quantiles, indicating that the impact of the explanatory variables is different across the firm's performance distribution. The purpose of the inter-quantile regression is to provide conclusive evidence of the heterogeneity of breadth or depth across the firm performance distribution.

Table 3 presents inter-quantile results of Tobin's Q. There are statistically significant differences in the parameter estimates of breadth/depth for two symmetrical quantiles. For the explanatory variable breadth, there is a statistically significant positive difference, indicating that breadth has a significantly stronger positive effect on the firms located at the 90th quantile than the effect on those located at the 10th quantile. For example, the difference between the 90th and 10th quantiles is a significant 0.0539, suggesting that the firms located at the 90th quantile have an additional 0.0539 increase for Tobin's Q. As for explanatory variable depth, there are also statistically significant differences for two symmetrical quantiles.

Table 3:

Inter-quantile regression results (dependent variable is Tobin's Q) (N=4,667)

Table 3 presents inter-quantile results of Tobin's Q. The standard errors are reported in the parentheses. We obtain the standard errors of the coefficients by bootstrapped methods using 1,000 bootstrap replications. There are statistically significant differences in the parameter estimates of breadth/depth for symmetrical two quantiles, which suggest that both breadth and depth have heterogeneous effects across the Tobin's Q distribution. *, **, and *** denote coefficients that are significantly different from zero at 10%, 5%, and 1% significance levels, respectively.

Independent variable	Quantile								
	95 th -5 th	90 th -10 th	85 th -15 th	80 th -20 th	75 th -25 th	70 th -30 th	65 th -35 th	60 th -40 th	55 th -45 th
ADI	-1.695 (2.459)	-0.763 (1.575)	-1.875 (1.196)	-1.248 (1.013)	-0.719 (0.828)	-0.936 (0.680)	-0.433 (0.576)	-0.300 (0.511)	0.043 (0.345)
RDI	5.935** (2.278)	3.256** (1.606)	1.575* (0.956)	1.070 (0.703)	0.443 (0.489)	0.487 (0.317)	0.343 (0.256)	0.083 (0.219)	0.204 (0.145)
LTDEBT	-1.589*** (0.204)	-1.232*** (0.153)	-1.028*** (0.118)	-0.862*** (0.095)	-0.646*** (0.093)	-0.535*** (0.065)	-0.452*** (0.061)	-0.353*** (0.050)	-0.160*** (0.039)
SIZE	-0.002 (0.078)	0.015 (0.045)	0.008 (0.036)	-0.022 (0.033)	-0.022 (0.026)	-0.002 (0.022)	0.007 (0.018)	0.010 (0.016)	0.011 (0.012)
Breadth	0.052*** (0.010)	0.0539*** (0.006)	0.0538*** (0.006)	0.053*** (0.006)	0.047*** (0.006)	0.041*** (0.005)	0.034*** (0.005)	0.023*** (0.004)	0.013*** (0.004)
Depth	-0.343*** (0.116)	-0.399*** (0.070)	-0.342*** (0.053)	-0.300*** (0.046)	-0.276*** (0.041)	-0.232*** (0.032)	-0.185*** (0.029)	-0.093*** (0.027)	-0.056** (0.022)

Figure 1.

Estimated coefficients and 95% confidence interval (Dependent variable is Tobin's Q)

(a) Estimated coefficient: breadth

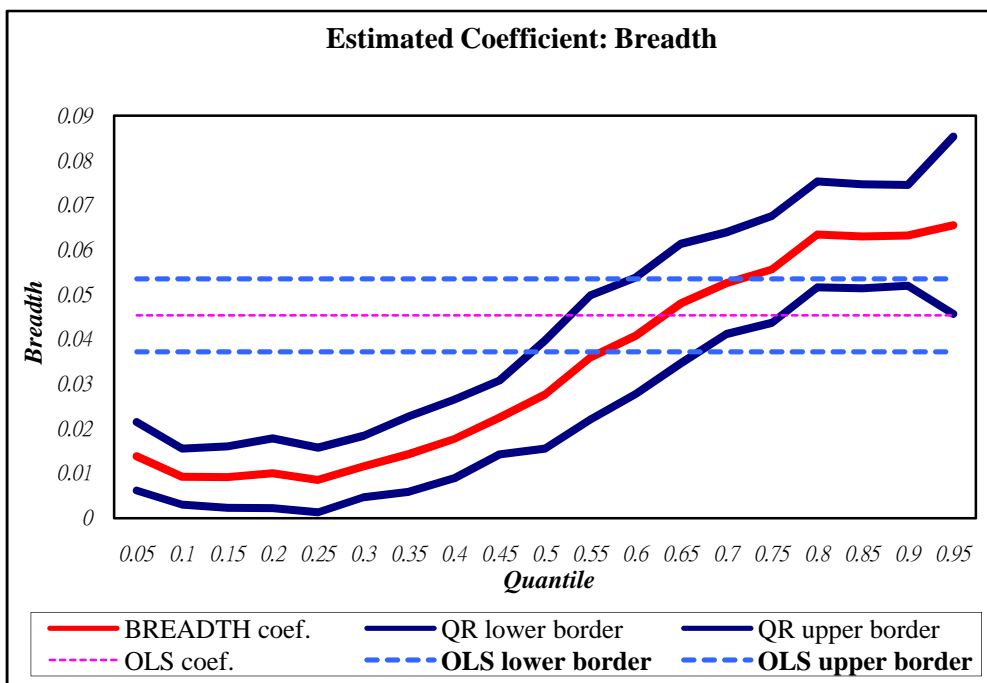
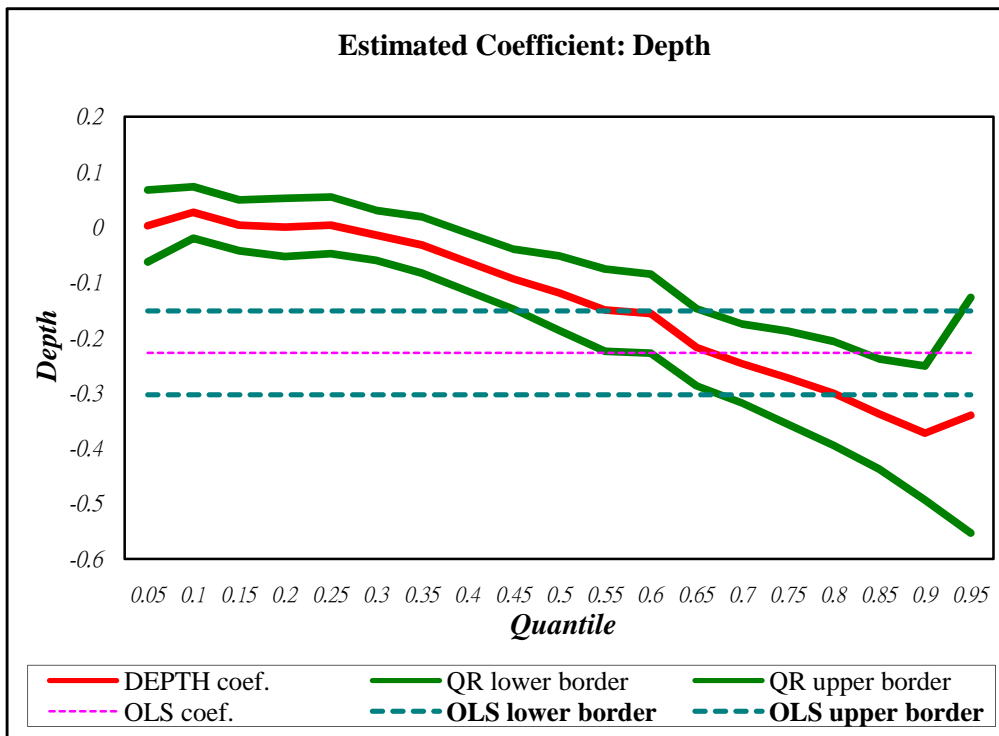


Figure 1.

Estimated coefficients and 95% confidence interval (Dependent variable is Tobin's Q)

(b) Estimated coefficient: depth



6. Conclusions

By using cross-sectional firm-level data covering a period from 2000 to 2005, we investigate the effects of internationalization activity on firm performance. The quantile regression provides a useful and powerful approach to evaluate the differences on the effects of internationalization activity across firm performance distribution. The conventional OLS estimation results only provide limited information about the differences in the effects of internationalization activity on firm performance because it only provides a summary point estimator.

In general, we find that breadth (i.e., number of foreign countries in which a firm has investment sites) has positive effects on market-based performance (Tobin's Q). By using inter-quantile tests, we find that the breadth effect on Tobin's Q is significantly different in the magnitude across Tobin's Q distribution. The results suggest that the effect of breadth on Tobin's Q varies dramatically across the market value distribution. Additionally, the finding has important

implications for firms with the high values of Tobin's Q as their market value is particularly sensitive to internationalization activity; however, for firms with low values of Tobin's Q, the stock market barely recognizes their attempts to internationalize. Furthermore, the study also finds that depth (i.e., the number of foreign investment sites in top two countries divided by the total foreign investment sites) has negative effect on Tobin's Q especially for firms with better performances. To sum up, our findings imply MNCs, even with high firm values, should still be aware of the negative impact on firm value from investing deeperly in several specific countries/regions, since they don't tend to have superior management skills which help them avoid the possible arising agency costs.

References

- Allen, L. and C. Pantzalis, 1996. Valuation of operating flexibility of multinational corporations, *Journal of International Business Studies* 27(4), 633-653.
- Buchinsky, M., 1998. Recent advances in quantile regression models: A practical guideline for empirical research, *Journal of Human Resources* 33(1), 88-126.
- Chiang, Y.-C. and T.-H. Yu, 2005. The relationship between multinationality and the performance of Taiwan firms, *Journal of American Academy of Business* 6(1), 130-134.
- Chung, K.H. and S.W. Pruitt, 1994. A simple approximation of Tobin's q, *Financial Management* 23(3), 70-74.
- Contractor, F.J., 2002. International Expansion Strategies, *International Encyclopaedia of Business and Management*. (International Thomson Business Press, London).
- Contractor, F.J., S.K. Kundu, and C.C. Hsu, 2003. A three-stage theory of the multinational enterprise, *Journal of International Business Studies* 34(1), 5-18.
- Contractor, F.J., V. Kumar, and S.K. Kundu, 2007. Nature of the relationship between international expansion and performance: The case of emerging market firms, *Journal of World Business* 42 (4), 401-417.
- Coad, A. and R. Rao, 2006. Innovation and market value: A quantile regression analysis, *Economics Bulletin* 15(13), 1-10.
- Dunham, R.B. and J.L. Pierce, 1989. *Management*. (Scott, Foresman and Company, Glenview, IL).

- Errunza, V.R., and L.W. Senbet, 1984. The effects of international operations on the market value of the firm: Theory and evidence, *Journal of Finance* 36(2), 401-417.
- Fattouh, B., P. Scaramozzino, and L. Harris, 2005. Capital structure in South Korea: A quantile regression approach, *Journal of Development Economics* 76, 231-250.
- Fayerweather, J., 1978. *International Business Strategy and Administration*. (Ballinger, Cambridge, MA).
- Geringer, J.M., P.W. Beamish, and R.C. daCosta, 1989. Diversification strategy and internationalization: Implications for MNE performance, *Strategic Management Journal* 10, 109-119.
- Geringer, J.M., S. Tallman, and D.M. Olsen, 2000. Product and international diversification among Japanese multinational firms, *Strategic Management Journal* 21(1), 51-80.
- Hallock, K.F., R. Madalozzo, and C.G. Reck, 2010. CEO pay-for-performance heterogeneity using quantile regression, *Financial Review*, 45 (1), 1-19.
- Hitt, M.A., R.E. Hoskisson, and H. Kim, 1997. International diversification: Effects on innovation and firm performance in product-diversified firms, *Academy of Management Journal* 40(4), 767-798.
- Johanson, J. and J.E. Vahlne, 1977. The internationalization process of firms: model of knowledge development and increasing foreign market commitments, *Journal of International Business Studies* 8(1), 23-32.
- Koenker, R. and G. Bassett, Jr., 1978. Regression quantiles, *Econometrica* 46(1), 33-50.
- Koenker, R. and K.F. Hallock, 2001. Quantile regression, *Journal of Economic Perspectives* 15(4), 143-156.
- Kogut, B., 1985. Designing global strategies: Profiting from operation flexibility, *Sloan Management Review* 27(1), 27-38.
- Kogut, B., and Kulatilaka, N., 1994. Operating Flexibility, Global Manufacturing, and the Option Value of a Multinational Network, *Management Science* 40(1), 123-139.

- Kotabe, M., S.S. Srinivasan, and P.S. Aulakh, 2002. Multinationality and firm performance: The moderating role of R&D and marketing capabilities, *Journal of International Business Studies* 33(1), 79-97.
- Lu, J.W. and P.W. Beamish, 2004. International diversification and firm performance: The S-curve hypothesis, *Academy of Management Journal* 47(4), 598-609.
- Mello, A.S., J.E. Parsons, and A.J. Triantis, 1995. An integrated model of multinational flexibility and hedging policies, *Journal of International Economics* 39(8), 27-51.
- Morck, R. and B. Yeung, 1991. Why investors value multinationality, *Journal of Business* 64(2), 165-178.
- Porter, M.E., 1985. *Competitive Advantage: Creating and Sustaining Superior Performance*. (The Free Press, New York).
- Powell, J.L., 1986. Censored regression quantiles, *Journal of Econometrics*, 32 (1), 143-155.
- Siddharthan N.S. and S. Lall, 1982. The recent growth of the largest U.S. multinationals, *Oxford Bulletin of Economics and Statistics* 44(1), 1-13.
- Sullivan, D., 1994a. Measuring the degree of internationalization of a firm, *Journal of International Business Studies* 25(2), 325-342.
- Sullivan, D., 1994b. The “threshold of internationality”: replication, extension, and reinterpretation, *Management International Review* 34(2), 165-186.
- Tallman, S. and J. Li, 1996. Effects of international diversity and product diversity on the performance of multinational firms, *Academy of Management Journal* 39(1), 179-196.
- Vernon, R., 1966. International investment and international trade in the product cycle, *The Quarterly Journal of Economics* 111(2), 190-207.
- Zietz, J., E.N. Zietz, and G.S. Sirmans, 2008. Determinants of house prices: A quantile regression approach, *Journal of Real Estate Finance and Economics* 37(4), 317-333.



Do Mortgage REITs Reflect the Underlying MBS Market Performance?

Xiaoqing Eleanor Xu,^a

a. Professor of Finance, Stillman School of Business, Seton Hall
University, 400 South Orange Avenue, South Orange, NJ 07079, USA

Abstract: Equity REITs own and operate income-producing real estate properties, while mortgage REITs (MREITs) invest in mortgage loans and/or mortgage-backed securities (MBS). Since MBS are debt instruments created through securitization of mortgages, the MREIT and MBS markets should be closely related due to the similarity in their underlying asset claim. This study shows that MREITs and the underlying MBS market indices exhibit completely different return and risk characteristics. In addition, returns on MREITs are much more strongly driven by the stock market systematic factors than the underlying MBS market factors. The results are remarkably robust using either daily or monthly data, full sample or subsample data, and residential or commercial MREITs data. While these results suggest possible inefficiency of the MREIT market, we discuss the limitation of this study and implications for future research.

1. Introduction

In the past two decades, dramatic growth in both the equity and debt sides of real estate has led to increasing investor interest in Real Estate Investment Trusts (REITs). As of 2009, there are 142 REITs traded on stock exchanges in the U.S. with a total market capitalization of \$271 billion, which is equivalent to 23 times the total REIT market capitalization 20 years ago. REITs can be classified into one of three categories: equity REITs (EREITs), mortgage REITs (MREITs) or hybrid REITs. EREITs own and operate income-producing real estate

properties, while MREITs invest in mortgage loans and/or mortgage-backed securities (MBS).

There is a large and growing body of research in REITs in recent years. The relationship between REITs, the general equity market, and the property market has been well researched. Okunev and Wilson (1997), Peterson and Hsieh (1997), Liu and Mei (1998), Oppenheimer and Grissom (1998), Glascock, Lu and So (2000), and Clayton and MacKinnon (2001, 2003) examine the integration and segmentation of the markets for REITs, Real Estate, stocks, and bonds. Waggle and Moon (2006) and Waggle and Agrawal (2006) analyze the correlation between REITs, stocks, and bonds in an optimal portfolio setting. Stevenson (2002) and Cotton and Stevenson (2006) examine the volatility spillover between REITs and the broad U.S. equity market indices. At the cross-sectional level, Capozza and Seguin (2000, 2003) and Hartzell, Sun and Titman (2006) examine the effect of corporate governance on the cross-sectional performance of REITs. Chui, Titman, and Wei (2003), Ambrose, Highfield, and Linneman (2005), and Ott, Riddiough, and Yi (2005) examine other cross-sectional determinants of REIT returns, such as size, financing structure, momentum, turnover and analyst coverage. The existing research, however, has focused on the aggregate REIT market and the EREITs, with little guidance on the MREITs. He (1998) analyzes the relationship between the stock prices of EREITs and MREITs while Cotton and Stevenson (2006) examine the return and volatility linkages between EREITs and MREITs. Jirasakuldech and Knight (2005) test the weak-form efficiency of the REITs and find efficiency in EREITs but some return predictability in MREITs. Lee and Chiang (2004) study the EREITs and MREITs and find that existence of informational commonality and substitutability between these two classes of REITs, suggesting that market participants may not have fully understood the differences between the property-based EREITs and the mortgage-based MERITs. While previous research has examined the linkages between MREITs and the general stock, bond and real estate property markets, none has examined the dynamic linkage between the MREITs and the underlying mortgage market in which the MREITs are investing.

Since MREITs are publicly-traded real estate investment funds that invest in unsecuritized or securitized mortgages, and the MBS are debt instruments created through the securitization of mortgages, these two markets should be closely related due to the similarity in their underlying asset claim. The objective of this study is to examine whether the performance of mortgage REITs reflects the

underlying MBS market performance. In addition, since MREITs can be further grouped into two major categories, those who invest in residential mortgage loans or residential MBS, and those who invest in commercial mortgage loans or commercial MBS, we separately examine the linkage between home MREITs and residential MBS, and that between commercial MREITs and commercial MBS.

2. Data and Empirical Analysis

The National Association of Real Estate Investment Trusts, Inc. (NAREIT) has developed REIT indices for all REITs as well as three REIT categories (Equity, Mortgage and Hybrid) since 1972. The NAREIT mortgage REIT index has been further broken down into home financing and commercial financing REIT indices since 2000. We obtained the daily and monthly data from January 2000 to January 2008 on NAREIT mortgage REIT index and the home financing and commercial financing sub-indices from the FTSE.

Table 1.

Daily Descriptive Statistics (in %)

Panel A. Full Sample Period from January 2000 to January 2008

Variable	Variable Definition	Mean	Median	Maximum	Minimum	Std. Dev.
TRM	Total Return on Mortgage REITs	0.059	0.141	9.233	-12.902	1.329
TRMH	Total Return on Residential Mortgage REITs	0.062	0.146	9.250	-16.428	1.432
TRMC	Total Return on Commercial Mortgage REITs	0.057	0.106	10.654	-10.997	1.469
TRE	Total Return on Equity REITs	0.064	0.085	8.751	-5.581	1.040
TRA	Total Return on All REITs	0.062	0.095	8.392	-5.457	1.030
RMBS_T	Total Return on RMBS Index	0.025	0.025	1.584	-1.971	0.191
ABHE_T	Total Return on Home Equity ABS Index	0.015	0.025	0.993	-7.803	0.278
CMI_T	Total Return on Investment-grade CMBS Index	0.027	0.029	1.322	-1.322	0.293
CMH_T	Total Return on High-yield CMBS Index	0.046	0.062	6.615	-7.658	0.462
MBS_Y	Yield on MBS Index	5.733	5.584	8.123	3.479	0.893
ABHE_Y	Yield on Home Equity ABS Index	5.289	5.337	8.834	2.599	1.383
CMI_Y	Yield on Investment-grade CMBS Index	5.398	5.359	8.327	3.212	1.111
CMH_Y	Yield on High-yield CMBS Index	12.208	11.818	15.243	9.803	1.261
CPI_Y	Yield on Investment-grade Corporate Bond Index	5.806	5.684	8.512	3.769	1.055
CPH_Y	Yield on High-yield Corporate Bond Index	9.886	8.733	14.929	6.737	2.361
HMYSP	Yield Spread between Home Equity ABS and MBS	-0.444	-0.458	3.901	-2.088	0.776
CMYSP	Yield Spread between High-Yield and Investment-Grade CMBS	6.809	6.604	9.531	5.370	0.882
CPYSP	Yield Spread between High-Yield and Investment-Grade Corporate Bonds	4.081	3.484	8.381	1.559	1.756
SPTR	Total Return on S&P 500 Index	0.010	0.046	5.734	-5.828	1.121
ERM	Excess Return on the Stock Market	0.001	0.050	5.310	-6.650	1.127
SMB	Small minus Big Stock Return	0.015	0.030	2.900	-4.570	0.607
HML	High minus Low Book-to-market Stock Return	0.041	0.030	3.360	-4.930	0.627

Table 1. (Continued)**Daily Descriptive Statistics (in %)**

Panel B. First Half (January 2000- December 2003) and Second Half (January 2004- January 2008)

Variable	First Half (January 2000- December 2003)					Second Half (January 2004- January 2008)				
	Mean	Median	Maximum	Minimum	Std. Dev.	Mean	Median	Maximum	Minimum	Std. Dev.
TRM	0.151	0.214	5.616	-5.419	1.026	-0.030	0.056	9.233	-12.902	1.564
TRMH	0.148	0.227	5.519	-7.305	1.172	-0.022	0.053	9.250	-16.428	1.644
TRMC	0.155	0.185	5.953	-7.510	1.112	-0.039	0.012	10.654	-10.997	1.743
TRE	0.076	0.075	4.762	-3.453	0.764	0.053	0.097	8.751	-5.581	1.253
TRA	0.079	0.097	4.683	-3.361	0.756	0.046	0.093	8.392	-5.457	1.240
RMBS_T	0.030	0.030	1.584	-1.971	0.200	0.021	0.021	0.928	-0.817	0.181
ABHE_T	0.030	0.037	0.612	-0.658	0.143	0.001	0.013	0.993	-7.803	0.363
CMI_T	0.041	0.056	1.197	-1.322	0.334	0.013	0.016	1.322	-1.226	0.246
CMH_T	0.057	0.087	6.615	-5.905	0.482	0.035	0.046	4.863	-7.658	0.442
RMBS_Y	6.076	6.137	8.123	3.479	1.103	5.399	5.478	6.227	4.436	0.403
ABHE_Y	5.431	5.272	8.354	2.599	1.604	5.151	5.394	8.834	2.831	1.110
CMI_Y	5.753	5.806	8.327	3.212	1.369	5.051	5.227	6.050	3.510	0.607
CMH_Y	12.835	13.051	14.709	10.352	0.975	11.598	11.413	15.243	9.803	1.207
CPL_Y	6.306	6.380	8.512	3.769	1.204	5.318	5.482	6.269	3.967	0.549
CPH_Y	11.893	12.332	14.929	7.364	1.695	7.936	7.884	10.394	6.737	0.693
HMYSP	-0.645	-0.597	0.464	-2.088	0.601	-0.249	-0.104	3.901	-1.732	0.872
CMYSP	7.079	7.232	7.867	6.057	0.516	6.547	6.144	9.531	5.370	1.066
CPYSP	5.586	5.578	8.381	2.892	1.222	2.619	2.587	5.029	1.559	0.533
SPTR	-0.011	-0.020	5.734	-5.828	1.383	0.030	0.077	2.943	-3.464	0.785
ERM	-0.021	0.000	5.310	-6.650	1.389	0.022	0.080	2.930	-3.430	0.791
SMB	0.036	0.070	2.900	-4.570	0.729	-0.005	-0.010	1.620	-1.520	0.457
HML	0.065	0.060	3.360	-4.930	0.836	0.018	0.010	1.390	-1.360	0.307

Introduced in 1986, the Lehman Brothers MBS index covers the agency residential MBS (RMBS). As the investor base for Commercial MBS (CMBS) broadened in the late 1990s, Lehman Brothers introduced the investment-grade and high-yield CMBS indices in January 1999. Since the Lehman RMBS index is strictly investment-grade, We also use the home-equity Asset-backed Securities (HE ABS) index to serve as a proxy for the non-conforming or subprime residential mortgages that have been packaged into home equity ABS.

In November 2008, the Lehman Brother fixed income indices were rebranded to Barcap fixed income indices (see Barclays Capital (2008)). Both daily and monthly data from January 2000 to January 2008 on the total returns of RMBS, HE ABS, investment-grade CMBS, high-yield CMBS indices were obtained from the Barclays Capital (see Xu and Fung (2005) and Xu (2007) for detailed discussions on the Lehman residential and commercial MBS indices).

Table 2.**Daily Correlations**

Panel A. Full Sample Period from January 2000 to January 2008

	TRM	TRMH	TRMC	TRE	TRA		TRM	TRMH	TRMC	TRE	TRA
TRM	1.000	0.958	0.844	0.671	0.707	TRM(-1)	0.120	0.096	0.132	0.093	0.098
TRMH	0.958	1.000	0.659	0.594	0.630	TRMH(-1)	0.139	0.113	0.149	0.110	0.115
TRMC	0.844	0.659	1.000	0.658	0.686	TRMC(-1)	0.058	0.042	0.070	0.039	0.042
TRE	0.671	0.594	0.658	1.000	0.998	TRE(-1)	0.042	0.024	0.060	0.079	0.079
TRA	0.707	0.630	0.686	0.998	1.000	TRA(-1)	0.048	0.030	0.067	0.082	0.082
RMBS_T	0.037	0.060	-0.016	-0.008	-0.005	RMBS_T(-1)	0.039	0.048	0.018	0.021	0.023
ABHE_T	-0.022	-0.003	-0.056	-0.079	-0.077	ABHE_T(-1)	0.036	0.035	0.035	0.029	0.031
CMI_T	-0.024	-0.007	-0.051	-0.068	-0.067	CMI_T(-1)	0.032	0.041	0.010	0.009	0.011
CMH_T	-0.021	-0.005	-0.048	-0.087	-0.084	CMH_T(-1)	0.076	0.072	0.068	0.018	0.023
RMBS_Y	-0.003	-0.002	-0.006	-0.004	-0.004	RMBS_Y(-1)	0.000	0.002	-0.006	-0.004	-0.004
ABHE_Y	-0.013	-0.005	-0.026	-0.020	-0.019	ABHE_Y(-1)	-0.008	-0.001	-0.022	-0.020	-0.019
CMI_Y	-0.004	-0.002	-0.010	-0.007	-0.006	CMI_Y(-1)	0.000	0.002	-0.007	-0.004	-0.004
CMH_Y	0.026	0.031	0.009	-0.018	-0.014	CMH_Y(-1)	0.030	0.035	0.012	-0.020	-0.016
CPI_Y	0.011	0.012	0.003	-0.004	-0.003	CPI_Y(-1)	0.013	0.015	0.004	-0.006	-0.005
CPH_Y	0.060	0.060	0.043	0.006	0.010	CPH_Y(-1)	0.062	0.063	0.045	0.004	0.008
HMYSP	-0.020	-0.006	-0.039	-0.031	-0.030	HMYSP(-1)	-0.015	-0.003	-0.032	-0.031	-0.030
CMYSP	0.042	0.046	0.026	-0.017	-0.012	CMYSP(-1)	0.043	0.048	0.026	-0.022	-0.017
CPYSP	0.074	0.074	0.056	0.011	0.016	CPYSP(-1)	0.076	0.075	0.058	0.009	0.014
SPTR	0.438	0.385	0.439	0.513	0.522	SPTR(-1)	0.045	0.035	0.052	0.012	0.015
ERM	0.450	0.394	0.451	0.522	0.531	ERM(-1)	0.043	0.035	0.047	0.011	0.013
SMB	0.209	0.178	0.217	0.175	0.182	SMB(-1)	0.011	0.010	0.004	0.019	0.019
HML	-0.022	-0.027	-0.008	-0.058	-0.058	HML(-1)	-0.031	-0.034	-0.022	0.021	0.019

Examination of the descriptive statistics from Table 1 reveals that return behavior of MREITs is dramatically different from that of the MBS. As shown in Panel A, mean daily returns on all MREITs, residential MREITs, and commercial MREITs are 0.059%, 0.062%, and 0.057%, respectively. However, the mean daily returns on RMBS, HE ABS, investment-grade CMBS, and high-yield CMBS are only 0.025%, 0.015%, 0.027% and 0.046%, respectively. On other hand, the standard deviations of the residential and commercial mortgage REITs indices are 1.432% and 1.469%, while the standard deviations of RMBS and investment-grade CMBS indices are only 0.191% and 0.293%. We further split the sample into first half (Jan. 2000 to Dec. 2003) and second half (Jan. 2004 to Jan. 2008). The descriptive statistics in Panel B of Table 1 show high positive mean returns for the MREITs in the first half and negative mean returns in the second half, while the MBS indices deliver positive mean returns in both periods. Standard deviations of MREITs are much higher than those of MBS indices in both periods.

Table 2. (Continued)**Daily Correlations**

Panel B. First Half (January 2000- December 2003)

	TRM	TRMH	TRMC	TRE	TRA		TRM	TRMH	TRMC	TRE	TRA
TRM	1.000	0.949	0.766	0.523	0.557	TRM(-1)	0.183	0.169	0.150	0.137	0.145
TRMH	0.949	1.000	0.531	0.477	0.510	TRMH(-1)	0.169	0.149	0.149	0.134	0.141
TRMC	0.766	0.531	1.000	0.445	0.471	TRMC(-1)	0.145	0.144	0.104	0.099	0.105
TRE	0.523	0.477	0.445	1.000	0.999	TRE(-1)	0.129	0.109	0.119	0.151	0.154
TRA	0.557	0.510	0.471	0.999	1.000	TRA(-1)	0.136	0.115	0.125	0.155	0.159
RMBS_T	-0.087	-0.075	-0.088	-0.148	-0.148	RMBS_T(-1)	0.022	0.049	-0.026	-0.032	-0.030
ABHE_T	-0.126	-0.110	-0.123	-0.227	-0.227	ABHE_T(-1)	0.033	0.042	0.008	0.007	0.009
CMI_T	-0.133	-0.116	-0.129	-0.213	-0.213	CMI_T(-1)	0.020	0.032	-0.001	-0.005	-0.004
CMH_T	-0.097	-0.088	-0.091	-0.177	-0.175	CMH_T(-1)	-0.021	-0.013	-0.025	-0.003	-0.004
RMBS_Y	-0.028	-0.020	-0.038	0.002	-0.001	RMBS_Y(-1)	-0.030	-0.023	-0.039	-0.002	-0.005
ABHE_Y	-0.031	-0.019	-0.048	-0.007	-0.010	ABHE_Y(-1)	-0.029	-0.019	-0.043	-0.006	-0.008
CMI_Y	-0.027	-0.018	-0.040	-0.001	-0.004	CMI_Y(-1)	-0.027	-0.019	-0.037	0.001	-0.002
CMH_Y	-0.018	-0.013	-0.026	0.006	0.004	CMH_Y(-1)	-0.019	-0.016	-0.024	0.007	0.005
CPI_Y	-0.027	-0.014	-0.044	-0.009	-0.011	CPI_Y(-1)	-0.026	-0.016	-0.040	-0.010	-0.013
CPH_Y	-0.011	0.015	-0.055	-0.030	-0.030	CPH_Y(-1)	-0.010	0.016	-0.054	-0.038	-0.039
HMYSP	-0.032	-0.014	-0.058	-0.022	-0.023	HMYSP(-1)	-0.023	-0.009	-0.043	-0.013	-0.014
CMYSP	0.038	0.023	0.057	0.014	0.017	CMYSP(-1)	0.034	0.020	0.051	0.011	0.013
CPYSP	0.012	0.035	-0.032	-0.032	-0.031	CPYSP(-1)	0.012	0.038	-0.035	-0.043	-0.041
SPTR	0.405	0.359	0.371	0.530	0.539	SPTR(-1)	0.118	0.096	0.129	0.036	0.042
ERM	0.410	0.363	0.377	0.534	0.543	ERM(-1)	0.113	0.093	0.120	0.027	0.033
SMB	0.082	0.077	0.061	0.010	0.014	SMB(-1)	-0.058	-0.051	-0.058	-0.034	-0.037
HML	-0.098	-0.093	-0.080	-0.158	-0.160	HML(-1)	-0.067	-0.055	-0.080	0.032	0.029

Table 2 performs correlation analysis between MREIT and MBS indices. The contemporaneous correlation is only 0.060 between the residential MREIT and RMBS return indices, and -0.051 between the commercial MREIT and CMBS return indices. In order to see whether this low correlation is due to delayed response, we check for the correlations between the total returns on MREIT indices and the previous day's MBS indices. The lag 1 correlation is only 0.048 between the residential MREIT and RMBS indices, and 0.010 between the commercial MREIT and CMBS indices. In addition, the low correlation between MREITs and MBS is robust for the residential or commercial markets, using the investment-grade or high-yield indices, and for the first-half or second-half of the sample periods.

Another interesting observation from Table 2 is the high contemporaneous correlation between MREITs and stock market systematic factors. The return on MREITs has a 0.450 and 0.209 correlation with the stock market excess return and the stock market size factor, much higher than its correlation with the MBS market

return. This correlation is strong in the first half and even stronger in the second half. As for the correlation between MREITs and the corporate credit spread (yield spread between high-yield and investment-grade corporate bonds), it is very low (0.012) in the first half but much higher (0.061) in the second half.

Table 2. (Continued)

Daily Correlations

Panel C. Second Half (January 2004- January 2008)

	TRM	TRMH	TRMC	TRE	TRA		TRM	TRMH	TRMC	TRE	TRA
TRM	1.000	0.963	0.874	0.728	0.765	TRM(-1)	0.088	0.057	0.118	0.075	0.079
TRMH	0.963	1.000	0.714	0.645	0.683	TRMH(-1)	0.121	0.090	0.145	0.100	0.104
TRMC	0.874	0.714	1.000	0.737	0.765	TRMC(-1)	0.017	-0.008	0.050	0.016	0.018
TRE	0.728	0.645	0.737	1.000	0.998	TRE(-1)	0.007	-0.012	0.036	0.053	0.052
TRA	0.765	0.683	0.765	0.998	1.000	TRA(-1)	0.013	-0.008	0.043	0.055	0.054
RMBS_T	0.123	0.162	0.029	0.080	0.085	RMBS_T(-1)	0.049	0.046	0.046	0.057	0.058
ABHE_T	-0.002	0.022	-0.046	-0.048	-0.046	ABHE_T(-1)	0.034	0.030	0.039	0.035	0.036
CMI_T	0.060	0.089	0.000	0.035	0.037	CMI_T(-1)	0.039	0.048	0.013	0.021	0.024
CMH_T	0.027	0.055	-0.025	-0.037	-0.032	CMH_T(-1)	0.144	0.136	0.132	0.032	0.041
RMBS_Y	-0.062	-0.057	-0.058	-0.039	-0.041	RMBS_Y(-1)	-0.044	-0.035	-0.051	-0.029	-0.030
ABHE_Y	-0.014	-0.005	-0.026	-0.038	-0.036	ABHE_Y(-1)	-0.006	0.004	-0.022	-0.038	-0.036
CMI_Y	-0.042	-0.037	-0.043	-0.034	-0.035	CMI_Y(-1)	-0.029	-0.022	-0.035	-0.026	-0.026
CMH_Y	-0.006	0.010	-0.032	-0.047	-0.044	CMH_Y(-1)	0.004	0.021	-0.025	-0.047	-0.043
CPI_Y	-0.035	-0.030	-0.036	-0.027	-0.028	CPI_Y(-1)	-0.025	-0.017	-0.034	-0.024	-0.024
CPH_Y	0.020	0.035	-0.011	-0.004	-0.001	CPH_Y(-1)	0.043	0.053	0.016	0.020	0.023
HMYSP	0.011	0.020	-0.007	-0.030	-0.027	HMYSP(-1)	0.013	0.022	-0.005	-0.035	-0.031
CMYSP	0.018	0.033	-0.011	-0.034	-0.030	CMYSP(-1)	0.021	0.036	-0.008	-0.038	-0.034
CPYSP	0.061	0.077	0.024	0.024	0.027	CPYSP(-1)	0.082	0.088	0.056	0.051	0.055
SPTR	0.595	0.506	0.637	0.650	0.661	SPTR(-1)	-0.022	-0.031	-0.014	-0.008	-0.008
ERM	0.616	0.525	0.658	0.666	0.678	ERM(-1)	-0.020	-0.027	-0.016	-0.002	-0.003
SMB	0.376	0.315	0.411	0.368	0.378	SMB(-1)	0.076	0.074	0.060	0.072	0.075
HML	0.085	0.073	0.098	0.054	0.059	HML(-1)	0.002	-0.025	0.051	0.016	0.015

Note: See Panel A of Table 1 for the variable definitions. Variable Name (-1) stands for the lag one of the variable.

To further examine the relationship between MREITs and MBS, we also include the Fama-French three factors (i.e., the stock market excess return, size factor, and book to market value factor), the corporate credit spread, and lag squared return on MREITs (volatility proxy) in the regressions analysis. Table 3 presents the regression results for four different models: model 1 is a simple regression of MREITs return on the MBS return; model 2 is a regression of MREITs return on the Fama-French three factors (stock market excess return, size factor, and book to market value factor); model 3 is based on the MBS return and the Fama-French three factors; model 4 is based on the MBS return, the Fama-French three factors, the corporate credit spread, and lag squared return on

MREITs. Panels A, B, C present the regression analysis for the full sample period, first half and second half, respectively.

Table 3.

Regression Estimates for Daily Returns on Mortgage REITs

Panel A. Full Sample Period from January 2000 to January 2008

Variable	Variable Definition	Model 1		Model 2		Model 3		Model 4	
C	Intercept	0.001	<i>(1.80)</i>	0.0003	(0.45)	0.0006	(-0.27)	-0.002	<i>(-4.35)</i>
RMBS_T	Total Return on MBS Index	0.253	(1.33)			0.713	<i>(4.36)</i>	0.718	<i>(4.42)</i>
ERM	Excess Return on the Stock Market			0.786	<i>(20.40)</i>	0.799	<i>(20.40)</i>	0.821	<i>(24.26)</i>
SMB	Small minus Big Stock Return			0.924	<i>(15.19)</i>	0.914	<i>(14.97)</i>	0.947	<i>(17.26)</i>
HML	High minus Low Book-to-market Stock Return			0.605	<i>(12.40)</i>	0.611	<i>(12.57)</i>	0.624	<i>(12.89)</i>
CPYSP	Corporate Bond Credit Spread							0.052	<i>(4.12)</i>
TRM21	Lag 1 Squared Total Return on Mortgage REITs							1.469	<i>(1.76)</i>
F-test		2.65		360.42		278.19		199.09	
Adjusted R ²		0.082%		34.679%		35.483%		37.147%	

Panel B. First Half (January 2000- December 2003)

Variable	Variable Definition	Model 1		Model 2		Model 3		Model 4	
C	Intercept	0.002	<i>(5.09)</i>	0.001	<i>(3.71)</i>	0.001	<i>(3.54)</i>	0.000	(-0.38)
RMBS_T	Total Return on MBS Index	-0.454	<i>(-2.87)</i>			0.077	(0.51)	0.113	(0.75)
ERM	Excess Return on the Stock Market			0.546	<i>(12.25)</i>	0.547	<i>(11.90)</i>	0.572	<i>(15.16)</i>
SMB	Small minus Big Stock Return			0.600	<i>(8.64)</i>	0.598	<i>(8.48)</i>	0.643	<i>(10.64)</i>
HML	High minus Low Book-to-market Stock Return			0.373	<i>(6.33)</i>	0.373	<i>(6.29)</i>	0.406	<i>(7.04)</i>
CPYSP	Corporate Bond Credit Spread							0.021	(0.92)
TRM21	Lag 1 Squared Total Return on Mortgage REITs							2.753	<i>(1.65)</i>
F-test		7.78		128.52		94.74		68.24	
Adjusted R ²		0.677%		27.630%		27.370%		28.952%	

Panel C. Second Half (January 2004- January 2008)

Variable	Variable Definition	Model 1		Model 2		Model 3		Model 4	
C	Intercept	-0.001	(-1.08)	-0.001	<i>(-1.80)</i>	-0.001	<i>(-2.48)</i>	-0.006	<i>(-2.95)</i>
RMBS_T	Total Return on MBS Index	1.058	<i>(3.11)</i>			1.280	<i>(5.12)</i>	1.233	<i>(4.98)</i>
ERM	Excess Return on the Stock Market			1.118	<i>(14.49)</i>	1.134	<i>(14.80)</i>	1.137	<i>(15.43)</i>
SMB	Small minus Big Stock Return			0.908	<i>(6.21)</i>	0.802	<i>(5.69)</i>	0.830	<i>(5.99)</i>
HML	High minus Low Book-to-market Stock Return			0.586	<i>(5.11)</i>	0.581	<i>(5.22)</i>	0.585	<i>(5.43)</i>
CPYSP	Corporate Bond Credit Spread							0.169	<i>(2.21)</i>
TRM21	Lag 1 Squared Total Return on Mortgage REITs							1.220	(1.32)
F-test		15.59		255.46		205.93		141.74	
Adjusted R ²		1.409%		42.614%		44.556%		45.291%	

The t-statistics in parentheses are computed using White's heteroskedasticity-consistent variance-covariance estimator. **Bold** -- Significant at 5%; **Bold and Italic** -- Significant at 10%

Table 4.**Regression Estimates for Daily Returns on Residential Mortgage REITs vs. Commercial Mortgage REITs**

Panel A. Residential Mortgage REITs

Variable	Variable Definition	Model 1		Model 2		Model 3		Model 4	
C	Intercept	0.001	(1.64)	0.000	(0.65)	0.000	(-0.07)	-0.003	(-4.13)
RMBS_T	Total Return on Residential MBS Index	0.440	(2.01)			0.876	(4.25)	0.880	(4.28)
ERM	Excess Return on the Stock Market			0.731	(16.90)	0.746	(17.03)	0.770	(19.73)
SMB	Small minus Big Stock Return			0.838	(12.02)	0.824	(11.80)	0.856	(13.28)
HML	High minus Low Book-to-market Stock Return			0.545	(9.17)	0.553	(9.33)	0.567	(9.52)
CPYSP	Corporate Bond Credit Spread							0.056	(3.94)
TRMH21	Lag 1 Squared Return on Residential Mortgage REITs							1.468	(2.15)
F-test		6.92		233.48		184.27		158.47	
Adjusted R ²		0.293%		25.580%		26.686%		28.136%	

Panel B. Commercial Mortgage REITs

Variable	Variable Definition	Model 1		Model 2		Model 3		Model 4	
C	Intercept	0.001	(1.89)	0.000	(0.65)	0.000	(0.04)	0.000	(-0.41)
CMI_T	Total Return on Investment-grade CMBS Index	-0.259	(-2.06)			0.890	(20.23)	0.311	(3.05)
ERM	Excess Return on the Stock Market			0.731	(16.90)	1.082	(15.11)	0.909	(20.08)
SMB	Small minus Big Stock Return			0.838	(12.02)	0.708	(13.70)	1.081	(15.07)
HML	High minus Low Book-to-market Stock Return			0.545	(9.17)	0.000	(0.04)	0.709	(13.75)
CPYSP	Corporate Bond Credit Spread							0.311	(3.05)
TRMC21	Lag 1 Squared Return on Commercial Mortgage REITs							0.000	(-0.41)
F-test		5.40		395.13		298.10		245.81	
Adjusted R ²		0.218%		36.818%		37.109%		37.838%	

The t-statistics in parentheses are computed using White's heteroskedasticity-consistent variance-covariance estimator. **Bold** -- Significant at 5%; **Bold and Italic** -- Significant at 10%

The most striking result from Panel A of Table 3 is that the MBS return is statistically insignificant and it only explains 0.08% of the variation in MREITs return (see model 1). Panels B and C show that model 1's R² is 0.68% in first half and 1.41% in the second half, confirming the low explanatory power of MBS return for the MREIT return. In comparison, the Fama-French stock market three

factors are highly significant and explain 34.68% of the variation in MREITs return (see model 2). All three Fama-French three factors are positive and highly significant. With the inclusion of both MBS return and Fama-French stock market three factors, the MBS return variable is also positive and statistically significant (see model 3). However, model 3's adjusted R2 is only slightly higher than that of model 2. With the addition of the corporate credit spread and lag MREITs return volatility, the adjusted R2 of model 4 only improved by less than 2%. These two additional variables are positive and statistically significant for the full sample period. The corporate credit spread variable has a stronger significance in the second half while the lag MREITs return volatility variable is more significant in the first half.

Table 4 examines the relationship between home MREITs and RMBS returns in Panel A and the relationship between commercial MREITs and CMBS returns in Panel B. Consistent with the results from Table 3, the MBS return in the residential and commercial markets both show an extremely low explanatory power for the return on home MREITs and commercial MREITs (see model 1), and stock market factors show much higher explanatory power for the MREITs return (see model 2). Although the MBS return becomes significant in model 3, its incremental explanatory power is very low. The corporate bond credit spread appears to be significant in model 4 for both groups, while only the lagged return volatility is significant for the residential MREITs.

Table 5.
The Top Ten Most Volatile Days of REITs (January 2000 to January 2008)

	Mortgage REITs		Residential Mortgage REITs		Commercial Mortgage REITs		Equity REITs	
	Date	Return	Date	Return	Date	Return	Date	Return
1st Biggest % Loss	20070814	-12.90%	20070814	-12.90%	20070803	-11.00%	20071211	-5.58%
2nd Biggest % Loss	20040412	-8.69%	20070305	-8.14%	20070731	-9.61%	20071126	-5.21%
3rd Biggest % Loss	20070731	-8.58%	20040412	-8.69%	20040412	-8.85%	20040412	-4.99%
4th Biggest % Loss	20070305	-8.14%	20070731	-8.58%	20070801	-7.76%	20040406	-4.15%
5th Biggest % Loss	20070313	-6.57%	20010702	-4.89%	20020701	-7.51%	20071101	-3.89%
5th Biggest % Gain	20070808	5.52%	20020726	5.62%	20020726	5.95%	20071113	2.02%
4th Biggest % Gain	20070918	5.56%	20070918	5.56%	20070816	6.18%	20071128	4.53%
3rd Biggest % Gain	20020726	5.62%	20080122	5.35%	20070817	9.20%	20070808	5.52%
2nd Biggest % Gain	20070816	7.84%	20070816	7.84%	20070808	9.88%	20020729	4.08%
1st Biggest % Gain	20070817	9.23%	20070817	9.23%	20080123	10.65%	20080123	4.61%

Table 6.**The Top Ten Most Volatile Days of MBS (January 2000 to January 2008)**

	Agency Residential MBS Index		Home Equity ABS Index		Investment-grade CMBS Index		High-yield CMBS Index	
	Date	Return	Date	Return	Date	Return	Date	Return
1st Biggest % Loss	20000512	-1.97%	20071130	-7.80%	20011115	-1.32%	20070730	-7.66%
2nd Biggest % Loss	20080124	-0.82%	20080131	-5.70%	20040402	-1.23%	20030508	-5.90%
3rd Biggest % Loss	20030813	-0.75%	20070830	-2.60%	20011205	-1.21%	20070806	-3.53%
4th Biggest % Loss	20040507	-0.73%	20071228	-2.52%	20030813	-1.17%	20071026	-3.14%
5th Biggest % Loss	20070920	-0.71%	20080124	-1.06%	20010103	-1.03%	20071127	-2.30%
5th Biggest % Gain	20070907	0.71%	20010102	0.61%	20040305	0.98%	20020823	1.36%
4th Biggest % Gain	20000720	0.72%	20040806	0.65%	20010104	0.99%	20020913	1.44%
3rd Biggest % Gain	20071126	0.78%	20080102	0.66%	20040806	1.07%	20050506	1.85%
2nd Biggest % Gain	20040615	0.93%	20080122	0.95%	20010102	1.20%	20040617	4.86%
1st Biggest % Gain	20000511	1.58%	20071126	0.99%	20071126	1.32%	20030507	6.61%

To further examine the robustness of our results, we rank the daily total return on MREITs index and tabulate the 5 days with biggest % loss and 5 days with biggest gain in Table 5. The mortgage REITs have experienced huge swings in daily return, ranging from a daily loss of -12.90% on August 14, 2007 to a daily gain of 9.23% on August 17, 2007. Interestingly, eight of the ten most volatile days from January 2000 to January 2008 occurred in 2007 during the subprime crisis. In Table 6, we rank the MBS total return index and tabulate the 5 days with biggest % loss and 5 days with biggest % gain. The MBS return is much more stable, especially for the agency residential MBS return and the investment-grade CMBS return. The home equity ABS return and the high-yield CMBS return are much more volatile, but their volatilities are still much less than the return volatility on MREITs.

Since the above empirical results are based on daily data, one might be wondering whether the MREITs return would track the MBS return more closely on a monthly basis. In Table 7, we present the descriptive statistics in Panel A, the correlation statistics in Panel B, the most volatile months for MREITs in Panel C, the most volatile months for MBS return in Panel D, and the regression estimates in Panel E. Panel A shows that the mean and volatility of monthly MREIT returns are also dramatically different from those of the related MBS indices. Panel B displays the monthly correlations between the total returns on mortgage REITs and MBS indices, showing greater comovement relative to the daily correlations from Table 2. However, similar to the daily case, the monthly

correlation between mortgage REITs and MBS indices are still much lower than that between mortgage REITs and stock indices. Panels C and D present the top ten most volatile months of mortgage REITs and MBS, respectively. As for the ranking of the most volatile months, April 2004 and July 2007 topped the worst performing months for mortgage REITs, with a total return of -23.74% and -22.11%, respectively. The two worst performing months for residential MBS and commercial MBS both occurred in March 2007 and April 2004, with a decline that is much smaller than that of the mortgage REITs.

Table 7.

Re-examination using Monthly Data (January 2000 to January 2008)

Panel A. Monthly Descriptive Statistics (in %)

Monthly Descriptive Statistics	Full Sample Period (Jan. 2000-Jan. 2008)					First Half (Jan. 2000-Dec. 2003)			Second Half (Jan. 2004- Jan. 2008)		
	Mean	Median	Max	Min	Std. Dev.	Mean	Median	Std. Dev.	Mean	Median	Std. Dev.
TRM	1.329	2.278	14.170	-23.737	6.275	3.264	3.697	4.585	-0.527	1.106	7.114
TRMH	1.354	2.066	18.514	-22.940	6.646	3.152	3.594	5.347	-0.370	0.665	7.336
TRMC	1.335	2.475	13.833	-28.077	6.813	3.413	3.541	4.972	-0.658	1.392	7.739
TRE	1.377	1.888	8.740	-14.581	4.339	1.588	1.928	3.418	1.174	1.848	5.098
TRA	1.338	2.111	8.498	-15.264	4.287	1.657	2.068	3.351	1.032	2.193	5.041
RMBS_T	0.527	0.664	2.138	-1.873	0.781	0.628	0.710	0.818	0.428	0.493	0.738
ABHE_T	0.316	0.432	1.899	-5.556	1.063	0.632	0.674	0.703	0.006	0.199	1.256
CML_T	0.574	0.669	3.443	-4.464	1.344	0.872	1.032	1.542	0.283	0.327	1.053
CMH_T	0.956	0.970	5.816	-5.807	1.967	1.198	1.186	2.024	0.719	0.880	1.901
RMBS_Y	5.708	5.568	7.883	3.717	0.893	6.034	6.054	1.120	5.389	5.447	0.395
ABHE_Y	5.309	5.298	8.834	2.817	1.435	5.384	5.226	1.617	5.236	5.428	1.245
CML_Y	5.377	5.335	8.101	3.449	1.102	5.704	5.714	1.377	5.057	5.236	0.602
CMH_Y	12.198	11.850	15.159	9.844	1.285	12.785	13.014	0.981	11.622	11.431	1.295
CPLY	5.776	5.661	8.271	4.039	1.051	6.249	6.277	1.225	5.313	5.483	0.544
CPHY	9.891	8.828	14.584	6.757	2.371	11.860	12.419	1.771	7.962	7.933	0.706
HMYSP	-0.399	-0.456	3.901	-2.067	0.895	-0.650	-0.604	0.606	-0.154	-0.093	1.057
CMYSP	6.820	6.577	9.355	5.376	0.906	7.082	7.267	0.518	6.565	6.152	1.115
CPYSP	4.115	3.483	8.212	1.614	1.770	5.611	5.674	1.254	2.649	2.611	0.541
SPTR	0.206	0.740	9.783	-10.868	3.996	-0.226	-0.423	5.168	0.620	1.245	2.376
ERM	-0.006	0.770	8.180	-10.760	4.227	-0.494	-0.165	5.389	0.472	0.920	2.614
SMB	0.417	0.050	22.180	-16.700	4.293	0.931	0.950	5.701	-0.088	-0.230	2.122
HML	0.884	0.540	13.800	-12.800	3.801	1.388	1.420	5.104	0.391	0.280	1.696

Note: See Panel A of Table 1 for the variable definitions.

Regression analysis based on monthly data is shown in Panel E of Table 7. The results are largely consistent with those from the daily analysis. Results from Model 1M show that the return on MBS index is insignificant and it fails to explain

the variation in the return on the mortgage REITs, for either the residential or commercial groups. Results from Model 2M demonstrate that the Fama-French stock market factors (i.e., the stock market excess return, size factor, and book to market value factor) are significant drivers of the returns on MREITs and explain the largest proportion of the variation in the return on mortgage REITs. Additional variables such as the MBS return (in models 3M and 4M) and the corporate bond credit spread (in model 4M) are statistically significant but add little explanatory power to those contributed by the Fama-French three factors.

Table 7.(Continued)**Re-examination using Monthly Data (January 2000 to January 2008)**

Panel B. Monthly Correlations

	TRM	TRMH	TRMC	TRE	TRA		TRM	TRMH	TRMC	TRE	TRA
TRM	1.000	0.963	0.867	0.495	0.556	TRM(-1)	0.204	0.199	0.171	-0.069	-0.043
TRMH	0.963	1.000	0.706	0.379	0.441	TRMH(-1)	0.203	0.195	0.176	-0.095	-0.067
TRMC	0.867	0.706	1.000	0.613	0.661	TRMC(-1)	0.149	0.153	0.111	-0.018	-0.002
TRE	0.495	0.379	0.613	1.000	0.997	TRE(-1)	0.150	0.160	0.089	-0.052	-0.036
TRA	0.556	0.441	0.661	0.997	1.000	TRA(-1)	0.165	0.174	0.105	-0.054	-0.037
RMBS_T	0.136	0.167	0.037	-0.013	-0.002	RMBS_T(-1)	0.080	0.050	0.133	0.053	0.062
ABHE_T	0.177	0.149	0.187	0.249	0.247	ABHE_T(-1)	-0.007	-0.038	0.065	0.076	0.072
CMI_T	0.153	0.156	0.109	0.031	0.041	CMI_T(-1)	0.047	0.025	0.092	-0.023	-0.012
CMH_T	0.228	0.188	0.250	0.055	0.072	CMH_T(-1)	0.029	0.024	0.048	-0.026	-0.019
RMBS_Y	0.005	0.001	0.000	0.018	0.017	RMBS_Y(-1)	0.057	0.062	0.021	0.019	0.022
ABHE_Y	-0.065	-0.032	-0.121	-0.116	-0.114	ABHE_Y(-1)	-0.005	0.029	-0.077	-0.078	-0.074
CMI_Y	-0.008	0.002	-0.038	-0.022	-0.022	CMI_Y(-1)	0.047	0.057	0.003	0.000	0.003
CMH_Y	0.098	0.136	-0.004	-0.112	-0.095	CMH_Y(-1)	0.180	0.206	0.081	-0.090	-0.067
CPI_Y	0.026	0.035	-0.008	-0.047	-0.042	CPI_Y(-1)	0.092	0.102	0.044	-0.012	-0.004
CPH_Y	0.176	0.195	0.100	-0.083	-0.064	CPH_Y(-1)	0.264	0.271	0.196	-0.006	0.017
HMYSP	-0.107	-0.051	-0.192	-0.200	-0.197	HMYSP(-1)	-0.072	-0.018	-0.159	-0.158	-0.155
CMYSP	0.146	0.187	0.040	-0.131	-0.107	CMYSP(-1)	0.196	0.220	0.111	-0.127	-0.099
CPYSP	0.221	0.240	0.139	-0.084	-0.060	CPYSP(-1)	0.299	0.302	0.236	-0.001	0.025
SPTR	0.252	0.182	0.327	0.329	0.333	SPTR(-1)	0.101	0.074	0.133	0.206	0.210
ERM	0.273	0.212	0.335	0.345	0.349	ERM(-1)	0.101	0.065	0.145	0.167	0.171
SMB	0.190	0.207	0.145	0.171	0.179	SMB(-1)	0.070	0.029	0.102	-0.036	-0.031
HML	0.120	0.051	0.219	0.127	0.134	HML(-1)	0.007	0.064	-0.083	-0.018	-0.018

Note: See Panel A of Table 1 for the variable definitions. The Variable Name (-1) stands for the lag one of the variable.

Table 7.(Continued)**Re-examination using Monthly Data (January 2000 to January 2008)**

Panel C. The Top Ten Most Volatile Months of REITs (January 2000 to January 2008)

	Mortgage REITs		Residential Mortgage REITs		Commercial Mortgage REITs		Equity REITs	
	Month	Return	Month	Return	Month	Return	Month	Return
1st Biggest % Loss	200404	-23.74%	200404	-22.94%	200707	-28.08%	200404	-14.58%
2nd Biggest % Loss	200707	-22.11%	200707	-18.24%	200404	-25.15%	200711	-9.07%
3rd Biggest % Loss	200708	-12.38%	200708	-17.50%	200706	-10.92%	200706	-9.07%
4th Biggest % Loss	200702	-11.43%	200702	-12.34%	200711	-10.25%	200501	-8.40%
5th Biggest % Loss	200508	-10.62%	200508	-11.91%	200207	-9.92%	200707	-7.80%
5th Biggest % Gain	200212	8.94%	200204	10.67%	200408	10.41%	200507	7.14%
4th Biggest % Gain	200204	10.32%	200801	10.70%	200208	10.68%	200601	7.31%
3rd Biggest % Gain	200112	10.78%	200112	11.02%	200307	10.93%	200408	7.94%
2nd Biggest % Gain	200304	11.19%	200104	12.74%	200003	12.09%	200701	8.42%
1st Biggest % Gain	200101	14.17%	200101	18.51%	200304	13.83%	200007	8.74%

Panel D. The Top Ten Most Volatile Months of MBS (January 2000 to January 2008)

	Agency Residential MBS Index		Home Equity ABS Index		Investment-grade CMBS Index		High-yield CMBS Index	
	Month	Return	Month	Return	Month	Return	Month	Return
1st Biggest % Loss	200307	-1.87%	200711	-5.56%	200307	-4.46%	200707	-5.81%
2nd Biggest % Loss	200404	-1.78%	200712	-3.35%	200404	-3.24%	200307	-4.79%
3rd Biggest % Loss	200203	-1.06%	200801	-3.29%	200203	-1.89%	200404	-3.00%
4th Biggest % Loss	200111	-0.92%	200404	-1.70%	200111	-1.76%	200708	-2.71%
5th Biggest % Loss	200001	-0.87%	200708	-1.61%	200801	-1.71%	200203	-1.96%
5th Biggest % Gain	200711	1.74%	200101	1.51%	200204	2.80%	200505	4.39%
4th Biggest % Gain	200107	1.78%	200204	1.60%	200006	2.82%	200408	4.57%
3rd Biggest % Gain	200801	1.85%	200109	1.73%	200212	2.84%	200208	4.75%
2nd Biggest % Gain	200204	1.89%	200107	1.82%	200305	3.03%	200209	5.65%
1st Biggest % Gain	200006	2.14%	200012	1.90%	200309	3.44%	200406	5.82%

Table 7.(Continued)**Re-examination using Monthly Data (January 2000 to January 2008)**

Panel E. Regression Estimates on Monthly Total Returns of Mortgage REITs

Variable	Variable Definition	Model 1M		Model 2M		Model 3M		Model 4M	
I. Dependent Variable: Mortgage REITs									
C	Intercept	0.007	(0.73)	0.003	(0.47)	-0.008	(-0.84)	-0.041	(-2.56)
RMBS_T	Total Return on MBS Index	1.102	(0.94)			2.033	(2.10)	<i>1.711</i>	<i>(1.79)</i>
ERM	Excess Return on the Stock Market			0.627	(3.64)	0.736	(4.27)	0.792	(4.51)
SMB	Small minus Big Stock Return			0.521	(3.11)	0.529	(3.29)	0.580	(3.78)
HML	High minus Low Book-to-market Stock Return			0.852	(3.66)	0.897	(4.00)	0.845	(3.95)
CPYSP	Corporate Bond Credit Spread							0.903	(2.94)
TRM21	Lag 1 Squared Total Return on Mortgage REITs							-0.277	(-0.25)
Adjusted R ² / F-test		1.837% / 1.76		21.312% / 6.17		27.278% / 9.91		33.456% / 8.88	
II. Dependent Variable: Residential Mortgage REITs									
C	Intercept	0.006	(0.58)	0.006	(0.69)	-0.007	(-0.73)	-0.044	(-2.66)
RMBS_T	Total Return on Residential MBS Index	1.438	(1.24)			2.214	(2.20)	<i>1.931</i>	<i>(1.89)</i>
ERM	Excess Return on the Stock Market			0.474	(2.52)	0.593	(3.21)	0.651	(3.48)
SMB	Small minus Big Stock Return			0.510	(2.81)	0.519	(2.88)	0.602	(3.55)
HML	High minus Low Book-to-market Stock Return			0.657	(2.69)	0.706	(3.07)	0.648	(2.94)
CPYSP	Corporate Bond Credit Spread							0.956	(2.77)
TRMH21	Lag 1 Squared Total Return on Residential Mortgage REITs							0.109	(0.09)
Adjusted R ² / F-test		2.789% / 2.70		15.161% / 5.48		17.863% / 6.17		24.462% / 6.07	
III. Dependent Variable: Commercial Mortgage REITs									
C	Intercept	0.010	(1.07)	0.000	(-0.03)	-0.006	(-0.72)	-0.036	(-2.31)
CMI_T	Total Return on Investment-grade CMBS Index	0.552	(0.73)			1.035	(1.55)	0.784	(1.20)
ERM	Excess Return on the Stock Market			0.912	(5.57)	0.995	(5.64)	1.054	(5.64)
SMB	Small minus Big Stock Return			0.583	(3.37)	0.576	(3.62)	0.585	(3.44)
HML	High minus Low Book-to-market Stock Return			1.236	(5.27)	1.240	(5.59)	1.231	(5.42)
CPYSP	Corporate Bond Credit Spread							0.757	(2.42)
TRMC21	Lag 1 Squared Total Return on Commercial Mortgage REITs							0.151	(0.42)
Adjusted R ² / F-test		0.136%/1.13		37.508% / 20.00		40.922% (17.45)		43.188% / 12.91	

The t-statistics in parentheses are computed using White's heteroskedasticity-consistent variance-covariance estimator. **Bold** -- Significant at 5%; **Bold and Italic** -- Significant at 10%

3. Conclusions and Implications

Although mortgage REITs are investing in mortgages and/or MBS, this study shows that returns on MREITs and the underlying MBS market indices exhibit

completely different return and risk characteristics. In addition, MREITs are much more strongly driven by the stock market systematic factors than the underlying MBS market factors. The results are remarkably robust using either daily or monthly data, full sample or subsample data, and residential or commercial MREITs data. At first glance, these results seem to indicate that the markets for MREITs are inefficient in reflecting the underlying MBS market performance. However, we believe that further research is needed to address this puzzle about the disconnection between the returns on MREITs and the underlying MBS market.

MREITs, like all real estate investment trusts, are publically traded stocks. The features associated with stocks, such as margin trading, short selling and intraday quoting, make the MREITs much more liquid than the over-the-counter traded MBS and more sensitive to stock market volatility and changes in investor sentiment. An interesting question to ask, is whether such sensitivity is justified by the underlying asset value and if not, whether the presence of such inefficiency leads to any profitable arbitrage opportunity.

In addition, the Barcap MBS indices used in this study may not fully reflect the performance of each mortgage REIT's underlying mortgage and/or MBS portfolio. The Barcap residential MBS index only covers agency residential MBS, and the Barcap home equity ABS index only includes investment-grade home equity ABS.

Finally, many MREITs might be holding more whole loans than the securitized mortgages in the form of RMBS or CMBS. If the monthly net asset value (NAV) of individual MREITs is made available, future research should directly test the efficiency of the MREIT market using the monthly closing price on MREITs and their respective NAVs.

References

- Ambrose, Brent W., Michael J. Highfield, and Peter D. Linneman, 2005, "Real Estate and Economies of Scale: The Case of REITs," *Real Estate Economics*, 33(2), 323-330.
- Barclays Capital. December 2008. *The Benchmark in Fixed Income: Barclays Capital Indices. Rebranding the Unified Barclays Capital Indices.*

- Capozza, Dennis R., and Paul J. Seguin, 2000, "Debt, Agency, and Management Contracts in REITs: The External Advisor Puzzle," *Journal of Real Estate Finance and Economics*, 20(2), 91-116.
- Capozza, Dennis R., and Paul J. Seguin, 2003, "Insider Ownership, Risk Sharing and Tobin's q-Ratios: Evidence from REITs," *Real Estate Economics*, 31(3): 367-404.
- Chui, Andy C. W., Sheridan Titman, and K C John Wei, 2003, "The Cross Section of Expected REIT Returns," *Real Estate Economics*, 31(3), 451-479.
- Clayton, Jim, and Greg MacKinnon, 2001, "The Time-varying Nature of the Link between REIT, Real Estate and Financial Asset Returns," *Journal of Real Estate Portfolio Management*, 7(1), 43-54.
- Clayton, Jim, and Greg MacKinnon, 2003, "The Relative Importance of Stock, Bond and Real Estate Factors in Explaining REIT Returns," *Journal of Real Estate Finance and Economics*, 27(1), 39-60.
- Cotter, John, and Simon Stevenson, 2006, "Multivariate Modeling of Daily REIT Volatility," *Journal of Real Estate Finance and Economics*, 32(3), 305-325.
- Engle, R.F., 1982, "Autoregressive Conditional Heteroskedasticity with Estimates of the Variance of U. K. Inflation," *Econometrica*, 50, 987-1008.
- Glascok, John L., Chiuling Lu, and Raymond W. So, 2000, "Further Evidence on the Integration of REIT, Bond, and Stock Returns," *Journal of Real Estate Finance and Economics*, 20(2), 177-194.
- Hartzell, Jay C., Libo Sun, and Sheridan Titman, 2006, "The Effect of Corporate Governance on Investment: Evidence from Real Estate Investment Trusts," *Real Estate Economics*, 34(3), 343-371.
- He, Ling T., 1998, "Cointegration and Price Discovery between Equity and mortgage REITs," *Journal of Real Estate Research*, 16(3), 327-338.
- Jirasakuldech, Benjamas, and John R Knight, 2005, "Efficiency in the Market for REITs: Further Evidence," *Journal of Real Estate Portfolio Management*, 11(2), 123-131.
- Lee, Ming-Long, and Kevin C.H. Chiang, 2004, "Substitutability between Equity REITs and Mortgage REITs," *Journal of Real Estate Research*, 26 (1), 95-113.

- Liu, C.H., and J. Mei, 1992, "The Predictability of Returns on Equity REITs and Their Comovement with Other Assets," *Journal of Real Estate Finance and Economics*, 5, 401-418.
- Najand, Mohammad, Crystal Yan Lin, and Elizabeth Fitzgerald, 2006, "The Conditional CAPM and Time Varying Risk Premium for Equity REITs," *Journal of Real Estate Portfolio Management*, 12(2), 167-175.
- Okunev, John, Patrick J Wilson, 1997, "Using Nonlinear Tests to Examine Integration between Real Estate and Stock Markets," *Real Estate Economics*, 25(3), 487-503.
- Oppenheimer, Peter, and Terry V. Grissom, 1998, "Frequency Space Correlation between REITs and Capital Market Indices," *Journal of Real Estate Research*, 16(3), 291-309.
- Ott, Steven H., Timothy J Riddiough, and Ha-Chin Yi, 2005, "Finance, Investment and Investment Performance: Evidence from the REIT Sector," *Real Estate Economics*, 33(1), 203-235.
- Peterson, James D., and Cheng-Ho Hsieh. 1997. "Do Common Risk Factors in the Returns on Stocks and Bonds Explain Returns on REITs," *Real Estate Economics*, 25(2), 321-345.
- Stevenson, Simon, 2002, "An Examination of Volatility Spillovers in REIT Return," *Journal of Real Estate Portfolio Management*, 8(3), 229-238.
- Theodossiou, P. and U. Lee, 1993, "Mean and Volatility Spillover across Major National Markets: Further Empirical Evidence," *Journal of Financial Research*, 16, 337-350.
- Waggle, Doug, and Pankaj Agrawal, 2006, "The Stock-REIT Relationship and Optimal Asset Allocations," *Journal of Real Estate Portfolio Management*, 12(3), 209-221.
- Waggle, Doug, and Gisung Moon, 2006, "Mean-variance Analysis with REITs in Mixed Asset Portfolios; The Return Interval and the Time Period Used for the Estimation of Inputs," *Managerial Finance*, 32(12), 955-968.
- Xu, Xiaoqing Eleanor, and Hung-Gay Fung, 2005, "What Moves the Mortgage-backed Securities Market?" *Real Estate Economics* 33(2): 397-426.

Xu, Xiaoqing Eleanor, September 2007, "What Drives the Return on CMBS?"
Journal of Portfolio Management, 145-158.

Acknowledgement: The author thanks Sherwood Kuo of Barcalys Capital for providing data on the Barcap MBS indices, Stephen Harrison of FTSE for providing data on the NAREIT REIT indices, the Institute for International Business at Seton Hall University for generous financial support, and James Clayton of the Pension Real Estate Association, Bradford Case of NAREIT, and seminar participants at the 2008 American Real Estate Society Annual Meetings for valuable comments and suggestions.

IRABF *Editorial Policy*

The *International Review of Accounting, Banking and Finance*(IRABF) is interested in publishing papers that provide significant contributions to knowledge in all areas of applied finance, accounting, international finance and banking practices, with the exception of extremely narrow papers addressed to small specialist audiences. In addition, international perspectives on such topics are particularly welcome.

Date of publication:

Spring, Summer, Fall, Winter

Information for authors:

1. Manuscript submissions and all correspondence relating to the contents of the Journal should be sent to editors (see www.irabf.org for details on the submission process).
2. All submitted manuscripts must be original work and must not be under consideration for publication at another journal. All manuscripts must be typed one-sided in double space throughout with ample margins. The title page should contain the title of the manuscript, names of all authors and their affiliations, contact author and his/her correspondence address as well as e-mail address. An abstract of no more than 150 words should be included after the title page.
3. All sections should be numbered in Arabic numbers, and subsections should be numbered 1.1, 1.2, etc.
4. All tables and Figures should be able to stand-alone. Number tables and equations with Arabic numbers, and figures with Roman numerals. Each tables and figures should be presented on a separate page.
5. In manuscripts with mathematical proofs the authors should submit with manuscripts separate statements on the full mathematical workings that lead to the conclusions. These are required for the appraisal of the manuscripts. Any ancillary material available from the author on request should be enclosed for the referees.
6. References to other work should also be incorporated in a separate list of references typed double-spaced. Do not list any references not cited in the text. These references should be listed alphabetically with name of author, title, and date of publication, in the following forms as appropriate:

References:

Chan, Kam C., 2001. A citation-based ranking of journals in finance: some new results, *Journal of Financial Education*, 27, 36-52.

Roll, Richard, 1978. Ambiguity when performance is measured by the securities market line, *Journal of Finance* 33, 1051-70.

Items in the list of references should be referred to either in the text or in footnotes by naming the author and date. For example: Head and Shoup (1969).

7. All submissions should follow standard APA style (5th Edition).

Copyright and Photocopying @ 2010 IRABF. All rights reserved.

