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DO IMMIGRANTS HAVE LOWER PARTICIPATION RATES IN U.S. FINANCIAL MARKETS?

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ABSTRACT

This paper uses data from the National Longitudinal Survey to examine the differences in individual financial market participation among native-born and immigrant Americans. The results indicate that when compared with natives, immigrants are less likely to own financial assets. A decomposition analysis of financial asset ownership reveals that income gap along with differences in educational attainment as well as the wealth and risk tolerance are the biggest contributors to this disparity. Additionally, income, wealth, inheritance, and educational attainment are positive predictors of financial market participation. Age, income, net worth and number of years of stay in the United States are positively associated with increase in financial wealth of immigrants across time.

JEL: D14, G11, N30

KEYWORDS: Immigrants, Household finance, Investor behavior, Stock market participation

INTRODUCTION

The degree of economic integration of immigrants is an issue of importance for policy makers, researchers, and scholars of international economics. Financial market participation represents one key aspect of economic assimilation. Currently, 1 in every 9 Americans is an immigrant (Osili and Paulson, 2008). Recent studies on individual savings behavior have found that immigrants save less than native-born Americans (Amuedo-Dorantes and Pozo, 2002; Cobb-Clark and Hildebrand, 2006) and that immigrants are less likely to have checking or savings accounts (Osili and Paulson, 2008). Similar literature on Canadian immigrants has found that, although immigrants initially saved less than their Canadian-born counterparts; the disparity in savings declined with an immigrant's integration into Canadian society (Carroll, Rhee and Rhee, 1994).

There are many reasons to believe that the portfolio choices of immigrants will diverge from those of native-born residents. Many immigrants face income profiles that differ from native-born residents in terms of levels and earnings risk. The migration process itself leads immigrants to be a highly selected sample of individuals (Borjas, 1985). Similarly, there may be a cultural basis to the differences in investment participation between immigrants and Native-born Americans (Carroll, Rhee and Rhee, 1999). In addition, the prospect of remigration may further alter immigrants' incentives for financial investments (Amuedo-Dorantes and Pozo, 2001; Dustmann, 1997).

Given the demographic and socioeconomic changes taking place in American society, further research is necessary to gain greater insight into the individual financial market participation of immigrants. Investment decision making requires accessibility to stock markets and the ability to synthesize available financial information, on the part of the immigrant investors. Furthermore, having knowledge of the differences in investment preferences of immigrants and natives can pave the way for future policies and programs aimed at reducing the gap in asset ownership and wealth accumulation, which may currently exist. This study examines the differences in financial market participation between immigrants and native-born Americans, and estimates the factors that may affect preferences for financial asset ownership using the National Longitudinal Survey of youth 1979(NLSY79) data set. The remainder of this paper is organized as follows: in the next section a review of literature is provided. This is then followed by a methodology section that provides a detailed account of the empirical models and the data used in this study. Next, the empirical results are examined. Finally, the paper closes with a discussion of some key findings and concluding comments.

LITERATURE REVIEW

Immigrant Assimilation

Recent studies on individual savings behavior indicate that immigrants have lower wealth accumulation than native-born Americans (Cobb-Clark and Hildebrand, 2006), and immigrants are less likely to have checking or savings accounts (Osili and Paulson, 2008). Amuedo-Dorantes and Pozo (2002) found in their study that immigrants had lower precautionary savings than the native-born Americans. Borjas (1985, 1994) found that immigrant Americans initially faced an income disparity upon arrival, but this income difference reduced with the immigrants' number of years of stay in the country. From their research on Canadian immigrants, Carroll et al. (1994) found that initially, immigrants saved less than native-born Canadians; however, this gap reduced as immigrants assimilated economically over time. Results from another Canadian study showed that immigrants were financially less informed than their Canadian-born counterparts (Morissette and Zhang, 2004). Carroll et al. (1999) found that U.S. immigrants increased their wealth between 1980 and 1990 at a much faster rate than the U.S.-born households. The researchers also found that recent immigrants initially consumed more and saved less than natives, but this difference was reduced as their economic participation and access to investments grew over a period of approximately 25 to 30 years. An early study by Chiswick (1978) indicated that immigrant income rose over time as their labor market experience increased. Wage inequalities compared to native-born American households disappeared after immigrants had been in the United States 10 to 15 years. Saxenian (2002) however found in her study that highly skilled immigrants were more likely to own start up businesses and create wealth in the economy. There is also evidence from past studies that immigrants displayed a home country bias when diversifying their portfolio of investments (Amadi and Bergin, 2006).

According to the Pagano and Jappelli (1993) study, lending institutions were more likely to charge higher interest rates to the immigrant borrowers. Drew (2002) found that the median value of a first-time home purchased by immigrant Americans was approximately 50 percent higher than the value of a home for native-born first-time home buyers. According to the author, this resulted in larger payments and heavier cost burden for immigrant first-time home buyers, as compared to native-born home buyers. Another research also found that immigrants were hesitant to borrow from financial institutions and instead preferred borrowing through the non-traditional channels such as relatives or friends (Rhine and Toussaint-Comeau, 1999). Newberger et al. (2004) found that lack of access to conventional credit also constrained the ability of immigrants to start up new businesses.

Financial Market Participation

Haliassos and Bertaut (1995) found in their research that approximately 75% of households in the U.S. did not own financial assets. Findings from another recent study indicate that although household income and net worth increased considerably between 1998 and 2001, this growth in income and net worth was greater for households with higher than median income (Aizcorbe, Kennickell and Moore, 2003). Another significant finding of this study was that financial market participation among households, through investments in stocks, mutual funds, and retirement plans, increased substantially between 1998 and 2001. Chapman, Dow, and Hariharan (2005) found that households responded to changes in stock market prices by shifting their investments between financial asset-based and non-financial asset-based assets. Choudhury (2001) found that minorities engaged in lower financial market participation than white households. Past studies also indicate that the level of financial asset ownership increases with an increase in the level of education (Wang and Hanna, 1997). The Wang and Hanna study also found that investment allocation in financial assets increased with income.

Cortes, Herbert, Wilson and Clay (2007) showed that immigrant homeownership increased with age, income, level of education and net worth. Interestingly, another study found that immigrants were 60% more likely than native-born investors to exit from of the financial markets (Osili and Paulson, 2008). Newberger, Rhine and Chiu (2004) used data from the Survey of Income and Program Participation (SIPP) to show that nearly 32% of the immigrants did not hold transactional accounts. Rhine and Green (2006) found that lower educational attainment, lower income and cultural differences reduced the likelihood of holding bank accounts among immigrants.

METHODLOGY

Hypotheses

Past research indicates that most households need to own some financial assets for wealth accumulation over time (Choudhury, 2001; Campbell and Viceira, 2003). Additionally, investors are constrained in their investment decisions by educational attainment, income, and risk tolerance (Carroll et al., 1994; Wang and Hanna, 1997). Immigrant asset ownership increased with age, income, level of education and net worth (Cortes et al., 2007). The following is a description of the three hypotheses that were explored in this study:

Hypothesis 1: Immigrants have lower financial market participation than native-born Americans when controlling for other socioeconomic, financial, and demographic characteristics.

Hypothesis 2: Individual financial market participation increases with income, educational attainment and risk tolerance after controlling for other factors.

Hypothesis 3: Financial wealth of immigrants increases across time with their age, income, educational attainment and number of years of stay in the United States after controlling for other socioeconomic and demographic characteristics.

Financial market participation= f (immigrant, age, marital status, gender, race, family size, children, educational attainment, income, networth, inheritance, risk tolerance)

Δ financial wealth of immigrants = f (age, marital status, gender, race, family size, children, educational attainment, income, networth, risk tolerance, years of stay in the United States)

Data and Sample

This study uses a comprehensive data set containing economic, social, demographic, and behavioral characteristics derived from the National Longitudinal Survey of Youth 1979 (NLSY79), a nationally representative panel data set comprised of 12,686 respondents managed by the Center for Human Resource Research at the Ohio State University. The 1979 wave began with a national survey of individuals born between 1957 and 1964. NLSY79 has surveyed the same households between 1979 and 2004 during 21 waves of this panel. Zagorsky (1999), found that the wealth and investment data contained in the NLSY data set correlates well with the wealth data in other major national databases, such as the Survey of Consumer Finance (SCF), Panel Study of Income Dynamics (PSID), and Survey of Income and Program Participation (SIPP). The sample includes 796 immigrants, who were born abroad to non-U.S. citizens before 1979. Data from the years 2004 and 1994 were chosen for this study because of the detailed investment information available in this most recent 2004 wave and because the 2004-1994 period represents phase where these households have entered the wealth formation years of their life cycle.

Variables

The dependent variable for the first part of this study is financial asset ownership, a binary variable coded as "1" if the individual owns stocks or mutual funds or "0" if otherwise. For this study, the self-reported information from 2004 is used. In the second part of this study, dependent variable is the change in financial wealth between 1994 and 2004. This variable constructed by taking the log of the difference in value of stocks, bonds and mutual funds held between 2004 and 1994.

The independent variable of interest in this study is coded as "1" if an immigrant or "0" if not. Other control variables consist of demographic, financial, and socioeconomic characteristics. Age and age square are included because age is a significant predictor of financial asset holdings and investment participation (Ameriks, Caplin and Leahy, 2007). Prior research has shown that whites are more likely than minorities to hold high-risk and high-return assets (Keister, 2000; Wang and Hanna, 1997). Hence, in order to control for this demographic difference, race is included as a control variable. Past studies indicate differences in risk tolerance between native-born and immigrant Americans (Amuedo-Dorantes and Pozo, 2002; Barsky, et al., 1997). To control for this difference, risk tolerance is included in the model. The risk tolerance variable is created using responses to questions from the 1993 wave of the NLSY data set that address respondents' attitude towards risk. The risk variable coincides with those created by Lusardi (1998) from the HRS data set and Amuedo-Dorantes and Pozo (2002) from the NLSY data set. Education, marital status, having children, and gender are also controlled because of their association with wealth and retirement plan participation in prior literature (Springstead and Wilson, 2000; Yuh and DeVaney, 1996; Zagorsky, 2005). Past studies indicate that income, inheritance, and wealth are associated with asset ownership and savings (Amuedo-Dorantes and Pozo, 2002; Menchik and Jianakoplos, 1997; Osili and Paulson, 2008). In order to control for this, income, inheritance, and wealth are included among the control variables for this study. Additional control variables used in the second part of this study are the log values of income and net worth in 1994, and educational attainment in 1994. Immigrants' number of years of stay in the United States is also included in the model for the second part of this study.

Analysis

Descriptive Statistics: A descriptive statistical analysis is performed initially to examine the demographic composition, educational attainment, income, and investment preferences of natives and immigrants. The demographic characteristics include age, family size, gender, marital status, children, and race. Investment preferences include homeownership, stockownership, mutual fund investments, bonds, and having money in bank accounts.

Financial Asset Ownership: The first part of this study examines the determinants of financial market participation and whether immigrants differ significantly from native-born Americans in their preference for financial asset ownership. The probit estimation technique is used for calculating the coefficients of the hypothesized variables. These estimates are then applied to calculate the marginal effects for the independent as well as other control variables.

Decomposition of Financial Asset Ownership

While part of the differences in preference for financial asset ownership across native-born households and immigrants may be due to differences in characteristics. Another part can also be attributed to differences in coefficients. This paper follows closely the Fairlie (2005) procedure to decompose the differences into the two components. The Fairlie method is an extension of the Blinder-Oaxaca decomposition method (Blinder, 1973; Oaxaca, 1973). Using the Oaxaca and Ransom (1994) study, the difference in financial asset ownership for immigrants versus native-born Americans can be stated as:

$$Y^{NB} - Y^{I} = \left[\sum_{i=1}^{N^{NB}} \frac{F(X_i^{NB} \beta^{NB})}{N^{NB}} - \sum_{i=1}^{N^{I}} \frac{F(X_i^{I} \beta^{NB})}{N^{I}} \right] + \left[\sum_{i=1}^{N^{I}} \frac{F(X_i^{I} \beta^{NB})}{N^{I}} - \sum_{i=1}^{N^{I}} \frac{F(X_i^{I} \beta^{I})}{N^{I}} \right] \qquad (1)$$

Y^{NB}-Y^{I} represents the difference in financial asset ownership for native-born and immigrant households. F is the cumulative distribution function and n represents the sample size in different groups. X^{NB} and X^{I} are row vectors of average value for individual characteristics of native-born and immigrant Americans, respectively. β^{NB} and β^{I} are vector coefficient estimates. The first term in the equation, therefore, corresponds to part of the difference in financial asset ownership that is attributed to differences in characteristics, and the second term represents the differences in behavior treatment. The contribution of each variable to the gap is equal to the change in average predicted probability by replacing the immigrant distribution with the native distribution of that variable while holding the distribution of other variables constant. Alternatively, the difference in the probabilities of financial asset ownership can be decomposed as:

$$Y^{NB} - Y^{I} = \left[\sum_{i=1}^{N^{NB}} \frac{F(X_i^{NB} \beta^{I})}{N^{NB}} - \sum_{i=1}^{N^{I}} \frac{F(X_i^{I} \beta^{I})}{N^{I}} \right] + \left[\sum_{i=1}^{N^{NB}} \frac{F(X_i^{NB} \beta^{NB})}{N^{NB}} - \sum_{i=1}^{N^{NB}} \frac{F(X_i^{NB} \beta^{I})}{N^{NB}} \right] \qquad (2)$$

In equation 1, native-born coefficients are used as weights for the first term, and immigrant characteristics are used as weights in the second term. In equation 2, immigrant coefficients are used as weights for the first term, and native-born characteristics are used as weights in the second term. The procedure requires one-to-one matching of observations from immigrant and native-born respondents. Since the number of native-born respondents is greater than the number of immigrants, random subsamples of native-born respondents are needed. To better approximate the entire native-born sample while controlling for selection bias due to sample differences between immigrant and native-born groups, the sampling process is repeated 1,000 times, and the mean of the computed statistics estimated from alternative weights is then calculated. As suggested by prior studies (Oaxaca and Ransom, 1994; Leppel, 2007), both sets of estimates for immigrant and native-born respondents are used along with the overall sample. Therefore, the decomposition analysis is conducted using the overall, native-born and immigrant samples. Using coefficients from the probit analyses, the decomposition results demonstrate the relative contribution to differences in financial asset ownership that can be attributed to various demographic and socioeconomic factors that are controlled for in this study.

Change in Immigrants' Financial Wealth (1994-2004)

The second part of this study examines the determinants of increase in financial wealth of immigrants between 1994 and 2004. This period is chosen because it represents the primary wealth formation phase in the life cycle of respondents included in the NLSY79 cohort. An ordinary least squares (OLS) regression is used for estimating the predictors of immigrants' financial wealth accumulation. Also, as suggested in Wooldridge (2006), robust standard errors are used to control for heteroskedasticity.

RESULTS

Descriptive Statistics

Table 1 shows demographic characteristics, socioeconomic composition, and investment participation rates of natives and immigrants. The mean household income for natives ($64,626) is higher than that of immigrants ($61,087). Although immigrants have a slightly lower participation rate in homeownership (35.1%) as opposed to that of the native-born sample population (35.4%), the disparity is much greater for financial asset holdings, such as stocks, mutual funds, and bonds, and for having bank accounts. In this study, 11.3% of immigrants own stocks compared to 16.4% of native-born Americans. Also, immigrants have a lower participation rate in mutual fund ownership (8.1%) compared to natives (13.6%). Immigrants have a larger average family size (3.4) compared to natives (3.1). Moreover, the educational attainment of native-born Americans is much higher than that of the immigrants.

Table 1: Descriptive Statistics

Variables	All	Native	Immigrant
Sociodemographic Factors			
Age	42.8	42.8	43.1
Family Size	3.1	3.1	3.4
Household Income	$64,384	$64,626	$61,087
Male	48.0%	48.0%	48.0%
Married	36.0%	35.0%	37.0%
Race			
White	49.1%	51.1%	32.8%
Black	24.8%	26.5%	13.4%
Hispanic	12.1%	9.9%	38.7%
Asian	2.7%	1.2%	9.1%
Native American	5.3%	5.3%	0.0%
Others	6.0%	6.0%	6.0%
Educational Attainment			
< High School	12.0%	9.9%	23.7%
High School Grad	44.7%	44.9%	38.7%
Some College	24.3%	24.9%	23.3%
College Graduate	12.0%	12.5%	8.3%
Graduate Education	7.0%	7.8%	4.0%
Years in US			
25-29 years			24.8%
30-34 years			27.3%
35-39 years			23.8%
40-44 years			19.5%
45-47 years			4.6%
Investment Participation			
Homeowner	35.3%	35.4%	35.1%
Have Bank Accounts	76.2%	77.0%	72.1%
Have Govt. Bonds	11.2%	11.3%	8.4%
Have Stocks	16.3%	16.4%	11.3%
Have Mutual Funds	13.5%	13.6%	8.1%

This table shows the summary statistics from the data. Percentage distribution of the socio-demographic, education and investment related characteristics are provided for the overall sample in the first column, and the native-born and immigrant samples in the other two columns. Mean values of age, family size and income are also shown for the overall, native-born only and immigrant only samples

Determinants of Financial Asset Ownership

Results from Table 2 show that immigrants are less likely than natives to own financial assets. This is consistent with past studies, which found that immigrants have lower participation rates in investment asset ownership than natives (Cobb-Clarke and Hildebrand, 2006; Osili and Paulson, 2008). Also, consistent with past studies, this research finds that income, risk tolerance and net worth are positive predictors of financial asset ownership (Gutter, Fox and Montalto, 1999). The results of this study also indicate that the probability of financial asset ownership increases with family size, educational attainment, being married, and for those who receive inheritance. These results support the findings from previous research on household investment participation and asset holdings (Bertaut, 1998). Estimates from this model also indicate that those who have children are less likely to own financial assets. This result is also consistent with past findings (Keister, 2000). Among other estimates, black and hispanic investors are less likely to own financial assets when compared with the control group of whites. This finding also agrees with findings from past research (Gutter et al., 1999; Wang and Hanna, 1997).

Table 2: Probit of Financial Asset Ownership

Variables	Coefficient	Marginal Effects	Significance
Immigrant	-0.282	-0.056	***
Age	0.084	0.019	
Age square	-0.001	-0.000	
Married	0.062	0.014	**
Male	0.004	0.001	
Black	-0.201	-0.042	***
Hispanic	-0.240	-0.052	***
Asian	0.390	0.111	
Family size	0.064	0.015	***
Children	-0.292	-0.075	***
College & up	0.179	0.044	***
Log Income	0.328	0.078	***
Log Net worth	0.209	0.050	***
Risk Tolerance	0.123	0.034	**
Inherit	0.305	0.082	***
Constant	-5.661		***
Observations	4495		
Pseudo R-squared	0.1564		

*This table shows the probit estimation of financial asset ownership. The first column shows the coefficients, the second column shows the marginal effects and the final column shows the level of significance of the relationship. *, **, and *** indicate significance at 10, 5 and 1 percent levels respectively.*

Decomposition Analysis of Financial Asset Ownership

The results of the decomposition analysis for financial asset ownership in Table 3 show that approximately 60% to 65% of the difference in financial asset ownership between immigrant and native-born respondents can be explained by a difference in characteristics, while the remaining 35% to 40% is due to differences in behavior and treatment. The largest portion of this gap is due to income disparity. Income difference accounts for approximately 25% to 37% of the financial asset ownership disparity in this study. Among other factors, net worth (14.7% to 15.6%), risk tolerance (3.4% to 7.8%), educational attainment (8.6% to 12.4%), and receiving inheritance (2.8% to 4.4%) contribute to greater financial asset ownership among native-born Americans compared to immigrants. Having children (2.7% to 3.7%) and age (1.3% to 2.3%) also favor native-born financial asset ownership. Among immigrants, family size (7.4% to 8%) and being Asian (2.1% to 3.7%) support financial asset ownership. The results of this analysis show that the estimations from all three sample coefficients exhibit reasonably consistent estimation.

Table 3: Decomposition Analysis of Stockownership

	Full Sample	Immigrant	Native-born
Native-born Ownership Rate	0.1996	0.1996	0.1996
Immigrant Ownership Rate	0.1358	0.1358	0.1358
Immigrant/Native gap	0.0638	0.0638	0.0638
Contribution from Differences in:			
Age	0.0008	0.0015	0.0009
St.Error	0.0007	0.0024	0.0007
Percentage	1.3%	2.3%	1.4%
Married	0.0002	0.0000	0.0002
St.Error	0.0008	0.0023	0.0008
Percentage	0.4%	0.0%	0.4%
Male	0.0000	0.0000	0.0000
St.Error	0.0003	0.0014	0.0004
Percentage	0.0%	0.0%	0.0%
White	0.0002	0.0002	0.0002
St.Error	0.0004	0.0012	0.0004
Percentage	0.3%	0.3%	0.3%
Hispanic	0.0030	0.0020	0.0030
St.Error	0.0019	0.0055	0.0019
Percentage	4.7%	3.2%	4.7%
Asian	-0.0013	-0.0023	-0.0013
St.Error	0.0033	0.0035	0.0033
Percentage	-2.1%	-3.7%	-2.1%
Family size	-0.0047	-0.0051	-0.0048
St.Error	0.0018	0.0063	0.0018
Percentage	-7.4%	-8.0%	-7.5%
Children	0.0023	0.0017	0.0024
St.Error	0.0010	0.0039	0.0010
Percentage	3.6%	2.7%	3.7%
College & Up	0.0055	0.0079	0.0055
St.Error	0.0015	0.0063	0.0015
Percentage	8.6%	12.4%	8.7%
Inheritance	0.0018	0.0028	0.0018
St.Error	0.0011	0.0058	0.0011
Percentage	2.8%	4.4%	2.8%
Risk Tolerance	0.0048	0.0022	0.0049
St.Error	0.0010	0.0029	0.0010
Percentage	7.5%	3.4%	7.8%
Log Income	0.0160	0.0237	0.0160
St.Error	0.0052	0.0032	0.0052
Percentage	25.1%	37.1%	25.0%
Log NW	0.0095	0.0099	0.0094
St.Error	0.0012	0.0047	0.0011
Percentage	14.9%	15.6%	14.7%
All included variables	0.0380	0.0415	0.0381
	59.2%	64.8%	59.5%

This table shows the decomposition analysis of financial asset ownership. The first column shows the variables, the second column shows decomposition for the full sample, the third column shows the estimates drawn from the immigrant only sample and the last column shows the estimates drawn from the native-born only sample.

Predictors of Financial Asset Accumulation among Immigrants

The predictors of change in financial wealth of immigrants between 1994 and 2004 are estimated in table 4. The results of the ordinary least squares regression show that age square, being married and men are positively associated with increase in value of financial assets during 1994-2004. These results are consistent with recent findings on household investment behavior from the Ameriks et al. (2007) study. Results also show that when compared with the reference group of white immigrants, the hispanics experienced a lower increase in their financial wealth between 1994 and 2004. Having children was also negatively associated with increase in financial equity during the period. However, completion of college or higher in 1994, income and net worth in 1994 and risk tolerance are positive predictors of increase in financial wealth among immigrants during this period. These results are in concordance with similar findings in the general population of American households in a number of past studies (Springstead and Wilson, 2000; Yuh and DeVaney, 1996; Zagorsky, 2005). Consistent with previous studies on immigrant economic assimilation (Chiswick, 1978; Borjas, 1985; Carroll et al. 1999), this research also finds that immigrants' number of years of stay in the United States is positively associated with increase in the value of their financial assets.

Table 4: Predictors of Financial Asset Accumulation (1994-2004) Among Immigrants

Variables	Coefficient	Robust Standard Error	Significance
Age	-0.003	0.007	
Age square	0.005	0.003	*
Married	0.042	0.012	**
Male	0.015	0.009	*
Black	-0.022	0.024	
Hispanic	-0.041	0.017	**
Asian	0.019	0.046	
Family size	0.004	0.005	
Children	-0.062	0.012	***
College or higher	0.059	0.011	***
Log Income	0.036	0.007	***
Log Net worth	0.021	0.003	***
Risk Tolerance	0.011	0.005	**
Years of stay	0.042	0.017	**
Constant	13.401	0.146	***
R square	0.221		

*This table shows the OLS estimation of the change in financial wealth from 1994-2004 for the immigrants. The first column shows the variables, the second column shows the estimated coefficients, the third column shows the standard errors and the final column shows the level of significance of the relationship. *, **, and *** indicate significance at 10, 5 and 1 percent levels respectively.*

DISCUSSION

This paper adds to existing literature on the economic participation of immigrants by focusing on the investment behavior of U.S. immigrants and comparing them with native-born American citizens. The evidence from the probit analysis of financial asset market participation demonstrates that immigrants are less likely to own financial assets than natives. Even though it is common knowledge that risky asset participation, such as financial asset ownership, is important for wealth accumulation and must be an integral part of the personal financial planning process (Altonji and Doraszelski, 2005), immigrant households continue to avoid the financial asset markets. This can be attributed to the existing lack of access to and lower investment opportunities for immigrants (Dustmann, 1997).

A large portion of the disparity in financial asset ownership among immigrant and native-born Americans can be explained through the differences in income, wealth and risk tolerance. The lower financial market participation of immigrants seen in this study may also offer some explanation for the lower wealth accumulation of immigrants found in earlier studies (Amuedo-Dorantes and Pozo, 2002; Carroll et al., 1994).

The results also show that wealthier immigrants with higher educational attainment and higher income increased their financial wealth during the 1994 and 2004 period. While risk tolerance was a factor, the immigrants' number of years of stay in the United States was positively associated with this change. These results tend to suggest that immigrants' financial wealth increases with the increase in their human capital and as they gradually integrate into the American society over a period of time.

CONCLUSION

This paper used data from NLSY79 to investigate differences in preference for financial asset ownership among immigrants and natives and the predictors of immigrants' financial asset accumulation across time. This data set included respondents between the ages of 37 and 49, thus comprising a cohort in the wealth accumulation phase of the life cycle. A lower rate of financial market participation may possibly result from the slow rate of economic assimilation by immigrants, which perhaps causes inadequate saving for their retirement. As ownership of financial assets, has been shown to be an important factor in the wealth accumulation process (Altonji and Doraszelski, 2005; Campbell and Viceira, 2003), a continued disparity in financial asset ownership may perpetuate the existing native-immigrant economic gap. Although findings from previous studies on immigration indicate that immigrants are able to integrate completely into society in about 10 to 15 years (Chiswick, 1978; Shamsuddin and DeVoretz, 1998), this study was comprised of immigrants who have been in the United States for much longer periods; however, as evidenced by the results, such disparities persist. Given this scenario, it will be important for future scholars and immigration policy makers to develop strategies that can help improve immigrants' access to market participation. The results of this study show that immigrants with higher income and educational attainment increased the value of their financial assets during the 1994-2004 period.

One possible reason for the low financial asset ownership of immigrants when compared with the native-born Americans is their lack of financial education. In the future, policy makers should place greater emphasis on creating better financial awareness among immigrants in order to facilitate their investment market participation and quicker economic assimilation into society. Also in the future, similar research, including immigrants' country of origin, can be conducted to study in greater detail whether nativity differences contribute to the differences in economic participation and the asset ownership decisions made by immigrants.

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BANK FAILURE: EVIDENCE FROM THE COLOMBIAN FINANCIAL CRISIS

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ABSTRACT

Bank-specific determinants of bank failure during the financial crisis in Colombia are identified and studied using duration analysis. The process of failure of banks and related financial institutions during that period can be explained by differences in financial health and prudence across institutions. The capitalization ratio is the most significant indicator explaining bank failure. Increases in this ratio lead to a reduction in the hazard rate of failure at any given moment in time. This ratio exhibits a non-linear component. At lower levels of capitalization small differences in capitalization are associated with larger differences in failure rates. Our results thus provide empirical support for existing regulatory practice. Other important variables explaining bank failure dynamics are the bank´s size and profitability.

JEL: C41; E4; E58; G21; G23; G38

KEYWORDS: Financial institutions, bankruptcy, liquidation, capitalization, supervision, duration hazard function.

INTRODUCTION

During the late 1990s and early 2000s, Colombia´s financial system experienced a period of financial stress, characterized by the failure of many banks and other financial institutions, as well as by severe deterioration of the whole system´s financial health. The capitalization ratio of the system fell dramatically, as did profitability and liquidity. As a consequence of the crisis, the number of institutions[1], dropped from 110 in June 1998, to only 57 in December 2001, after failures, mergers and acquisitions. Total assets of the financial system experienced a real contraction of more than 20 percent during the same period, making that episode of financial stress the deepest financial crisis experienced by the country in the last century.

This paper uses duration models to characterize the failure rates of financial institutions in Colombia and to identify key financial variables associated with these failure rates. Using an unusually informative data set and a duration model with partial likelihood estimation, we show that the process financial institutions failure during the financial crisis is significantly affected by differences in financial health and prudence existing across institutions. Our specification tests show that the proportional hazard specification is appropriate for our sample. Popular parametric specifications of the baseline hazard are unsatisfactory.

We focus on the capitalization variable and identify a nonlinear effect. As might be expected, increasing the capitalization ratio decreases the probability of default at a decreasing rate. Although capitalization is sometimes one of several significant variables, previous studies have not identified this nonlinearity, possibly due to the relative lack of data information in datasets with few failures. The data set used here is unusually rich, in two senses: First, survival is measured on a monthly scale, which helps identify more precisely the moment of failure of financial institutions. Most of the previous studies use quarterly data, which is the frequency in which financial institutions report their balances to the supervisors in many countries. Second, due to Colombia´s financial crisis, there are enough failures to identify and measure significant effects of financial variables. We expect that our qualitative results are likely to be applicable to modern banking systems generally, though we would hesitate to extrapolate numerical values of coefficients outside of our application.

Regarding the literature on the financial crisis of Colombia, this paper contributes by providing microeconomic evidence on the main variables determining bank failure. It also provides a model that can be used as an early warning tool and an alternative to the costly on-site visits made by supervisors to institutions considered at risk. It also provides the supervisors a basic guideline about which financial variables are important to follow during moments of stress.

Section 2 briefly describes what happened during the episode of financial crisis in Colombia. Section 3 is a literature review section. Section 4 presents the description of the data. Section 5 presents the techniques used to construct a model for the failure of financial institutions. Section 6 presents the results of the estimation as well as empirical tests to check the validity of the model. Section 7 presents some empirical evidence using time-varying regressors. Finally, section 8 presents conclusions.

THE FINANCIAL CRISIS IN COLOMBIA

During the 1980s, Colombia´s financial system was subject to elevated reserve requirements and forced investments and to strong constraints on foreign investment. There were as well on the types of operations that intermediaries could do and on interest rates[2]. Additionally, a process of bank nationalization was held during that decade. In contrast, at the beginning of the 1990s, a program of financial liberalization was implemented. The process was supported by the laws 45 of 1990 and 9 of 1991, which eased the conditions for the entrance of foreign investment to Colombia, promoted more competition in the financial system, and gave financial institutions more liberty in the management of financial operations and interest rates (Banco de la República, 2002).

As a result, the ratio of intermediated assets (loans plus bonds) to GDP increased from 31 percent in 1990 to 47 percent in 1996. The number of financial institutions increased significantly, the participation of the assets of foreign banks in the total assets of the system increased, and most of the government-owned financial institutions were privatized.

As a consequence of the growth in the financial system and of the economic expansion that took place during the first half of the 1990s, between 1991 and 1997 Colombia registered a credit boom without precedent. The ratio of loans to GDP and the price of assets (financial and real) grew steadily, as did the number of intermediaries. But, as is often the case when quick expansion of credit follows financial liberalization[3], the quality of loans of financial institutions decreased, and this degradation of loan quality elevated the financial fragility of the economy[4].

Between 1998 and 1999 a sudden capital reversion occurred, followed by a steep fall in the terms of trade, which led to a reduction in the aggregate level of expenditure. This has been identified as the main cause of both the financial crisis and the economic recession experienced in Colombia recently (Villar et al ,2005). Internal demand fell, especially during 1999, as well as output, while interest rates increased to historically high levels. However, as Parra and Salazar (2000) argue, monetary policy also played a role in increasing the vulnerability of the system, when in June 1998, the Central Bank while defending the exchange rate band added extra pressure on interest rates. The average interest rate on ninety-day *Certificados de Deposito a Termino* (CDT´s)[5] increased more that 500 basis points in one month, while the average interest rate on loans increased almost 1000 basis points in the same period of time. From that moment on, a sharp deterioration of the financial health of the intermediaries began. Loan quality decreased - i.e., the rate of non-performing loans to total loans for the system increased from 7.9% in June 1998 to 16% by the end of 1999-, and the losses of financial institutions, which had very low levels of provisions, led to a reduction of capital and a worsening of capitalization. The reduction in the capitalization ratio was common for all the institutions but was asymmetric, doing more damage to those that had low capitalization levels before the crisis. Most of those institutions were liquidated, either forced by the Superintendencia Bancaria (hereafter Superbancaria, the financial system´s supervisor) or voluntarily. Others merged, or were absorbed by other financial institutions.

The liquidation process of financial institutions is regulated by the *Estatuto Orgánico del Sistema Financiero* (Suberbancaria, 2006). The decision to liquidate an institution is taken to protect the depositors and the financial stability of the system. When a decision to liquidate is taken by the Superbancaria, it becomes effective immediately. The legal representative of the institution and the general public are informed about the decision and the Superbancaria takes control of the institution. The Superbancaria then chooses a liquidator who is in charge of liquidating the assets of the bank and repaying the depositors and other creditors of the failed institution.

The period of financial stress generated a reduction in the size of the financial intermediation industry of Colombia and a change in the asset composition of the financial system. In terms of size, the ratio of intermediated assets to GDP fell to 38 percent in 2000. In terms of asset composition, the percentage of loans in the assets of banks fell; in their place, more securities were acquired. Financial institutions became more conservative in their lending policies, in order to maintain higher capitalization levels. Similarly, the ratio of provisions to loans of surviving institutions grew steadily. As a consequence, concentration of the .nancial system increased, mainly due to the processes of liquidation and mergers and acquisitions of institutions that took place during the period of stress.

LITERATURE REVIEW

The literature on the financial crisis of Colombia has concentrated on explaining its causes and consequences. See Arias et al (1999), Arbeláez et al. (2003), Carrasquilla and Zárate (2002), Parra and Salazar (2000), Uribe and Vargas (2002), Urrutia (1999) and Villar et al (2005). A sudden capital reversion at the end of the 1990s after a long period of capital inflows has been identified as the main cause of both the financial crisis and the economic recession experienced in Colombia recently (Villar et al ,2005).

The sudden capital reversion of the Colombian economy was not an isolated one; many countries in the region experienced similar episodes at the time. This fact has been studied in empirical papers related to the literature on contagion[6]. See, for instance, Edwards (2000). Stiglitz (1999), as well as other authors, argues that the important increase in capital mobility experienced during the 1990s led to an increase in the vulnerability of emerging countries to speculative attacks. Other authors, for example Calvo (2000), have pointed out that the vulnerability to contagion is closely related to the credibility in a country´s exchange rate system. Probably both types of arguments are valid for explaining the episodes of financial distress occurring in Latin American economies during the 1990s.

There have been no micro-level studies of the role of specific financial variables in determining failure and time to failure of banks during the recent financial crisis in Colombia. This paper uses duration models to characterize the failure rates of financial institutions in Colombia and to identify key financial variables associated with these failure rates. Duration models use hazard functions rather than densities to specify the distribution of observables (and thus the likelihood function). For the method, see Kiefer (1988) and Lancaster (1990). Although early economic applications of hazard functions or duration analysis were in labor economics, they have been applied to bank failures. Lane et al (1986), Weelock and Wilson (1995), and Whalen (1991), use duration models to explain bank failure in the United States.

Other studies have used duration models to explain time to failure after particular episodes of financial stress in under-developed countries. For example, Gonzalez-Hermosillo et al (1996) use them to explain bank failure after the Mexican crisis of 1994, and Carree (2003) does a hazard rate analysis of Russian commercial banks in the period 1994-1997.

There are theoretical as well as practical reasons to consider that the capitalization ratio plays a special role for financial institutions. The literature on capital crunch shows that, under capital regulations, this ratio is important for financial institutions when they are making decisions on portfolio composition. See Peek and Rosengren (1995), Estrella et al (2000), and Van den Heuvel (2004). In the practical world, following the Basel accord (Basel Committee on Banking Supervision, 2004), financial institutions and supervisors now follow closely the capital ratio of the institutions they regulate and impose minimum requirements. Thus, capitalization plays a special role for financial institutions in determining their overall financial health and thus the degree of trouble that they might experience in episodes of financial stress.

DESCRIPTION OF THE DATA

In June 1998 there were 110 institutions in the financial system of Colombia, excluding financial cooperatives and special public financial institutions. From those institutions considered here as the financial system, 39 were commercial banks, 43 were financial companies, and the remaining 28 were financial companies specialized in commercial leasing. Three and a half years later, the financial system comprised only 57 institutions: 27 commercial banks, 19 financial companies, and 11 financial companies specializing in commercial leasing.

Although there are some differences between commercial banks and financial companies, due to liability composition[7] and size, in practical terms both types of institutions serve very similar purposes and compete in the issuance of loans and deposits. However, financial companies that specialize in commercial leasing are quite different, because they have different purposes than the other intermediaries previously mentioned, and their activities and portfolio composition are also very different. Therefore, for the purpose of this paper, data are collected only from commercial banks and financial companies.

Since we are interested in explaining time to failure during the financial crisis, the period of observation is the 42 months between June 1998, when the crisis began, and December 2001, when the system began to recover. The frequency of the data is monthly, and all banks are in the same fiscal year. Financial data as of June 1998 was collected for each of the financial institutions considered for the empirical analysis[8]. Following previous studies and theoretical expectations, the following financial ratios were considered in the explanation of time to failure: capitalization (CAP), defined as the ratio of equity to assets; management efficiency (EFF), approximated by the ratio of operating expenses to average annual assets; profitability of assets (PROF), given by the ratio of annualized profits to average annual assets; loan participation (LOAN), given by total loans over total assets; loan composition (COMP), defined as the ratio of commercial loans to total loans; and, a market based variable (SIZE), defined as the assets of the institution divided by a common number to scale the variable appropriately. These financial indicators are proxies of the variables traditionally considered in the literature. The variables COMP and LOAN can be interpreted as portfolio characteristics potentially related to volatility.

This paper emphasizes the special role played by the capitalization ratio, identifying a non-linear impact of this ratio on time to bank failure in Colombia. To account for a non-linear component of capitalization, a variable called CAPL was included. This variable results from the multiplication of (CAP-C) by an indicator function that takes the value 1 if CAP is less or equal to C and 0 otherwise.

We experimented with different values of C. Our purpose here is to approximate a nonlinearity of unknown functional form with a simple approximation. As it turns out, the data are informative enough to identify a significant nonlinearity, but not informative enough to tie down its functional form precisely. The data set used to construct the variables consists of information in the balance sheets that financial institutions have to report to the Superbancaria. Table 1 shows a summary of the indicators for both groups of intermediaries in June 1998.

Table 1: Summary of the Financial Ratios Used in the Empirical Analysis

Banks	Percentile			Others	Percentile			Overall	Percentile		
	25	50	75		25	50	75		25	50	75
CAP	8.7	12.8	15.4	CAP	13.3	18.1	29.0	CAP	11.4	14.4	21.0
EFF	3.1	3.9	5.1	EFF	1.5	2.5	3.6	EFF	2.3	3.3	4.4
PROF	-0.3	0.6	0.9	PROF	-1.2	0.08	0.9	PROF	-0.7	0.3	0.9
LOAN	58.4	66.3	77.5	LOAN	58.5	67.5	73.2	LOAN	58.5	67.3	75.2
COMP	26.7	70.2	81.1	COMP	23.1	63.3	99.4	COMP	24.9	67.5	91.0
SIZE	432.2	980.1	2452.8	SIZE	36.4	110.1	275.5	SIZE	103.2	299.9	1196.1

In percentage for all variables, except SIZE, measured in millions of Colombian pesos.

Looking at medians, financial companies appear to be more capitalized than banks, and to be smaller, more efficient and less profitable also. However, there are large variations within each type of institution. Note also that medians of asset and loan composition are similar for banks and financial companies; in this sense, the latter can be considered as small banks. Most correlations between the variables were small and in no case did one exceed 0.51 in absolute value.

Regarding failure, from the group of banks 12 failures were observed between June 1998 and December 2001, representing a failure rate of 31 percent; meanwhile, 16 institutions of the group of non-banks failed during the same period, representing a failure rate of 37 percent[9]. Overall, there are 82 institutions in the sample, of which 28 failed. Failure rates of both groups of intermediaries appear similar. In the next section tests are done to show that both groups have the same survivor function.

DURATION MODELS TO STUDY BANK FAILURE

We use a duration or hazard function model to study the time to failure of financial institutions. This approach generalizes the more common binary response (logit or probit) approach by modeling not only the occurrence of failure but the time to failure - allowing finer measurement of the effect of different variables on failure. Thus, duration models applied to this problem can provide answers to questions that are relevant for both financial supervisors and financial institutions, such as: after the occurrence of a negative shock, what is the probability that a bank fails in the following months, given it has survived up to that moment? Or, what is the predicted time to failure for a bank of some given characteristics? A model capable of answering those questions at low cost can be very useful as an early warning model, to identify potential vulnerabilities of the financial system, and could be used by supervisors as an alternative to the costly site visits that they make periodically to financial institutions considered at risk.

Most of the papers that apply these models to explain time to bank failure use the semiparametric proportional hazards model of Cox (1972); an exception is the work of Carree (2003), who uses several parametric models to explain bank failure in Russia. The proportional hazards model is the most frequently used, because it does not make assumptions about the particular functional form of the baseline hazard, and because estimated hazard functions of bank failure in many cases are non-monotonic, thus reducing the number of parametric models that can be used.

SURVIVOR FUNCTIONS AND HAZARD FUNCTIONS

In duration models, the dependent variable is duration, the time that takes a system to change from one state to another. In the case of bank failure, duration is the time that it takes for a bank to fail after the occurrence of a negative shock that affects the financial system.

In theory, duration T is a non-negative, continuous random variable. However, in practice, duration is usually represented by an integer number of months, for example. When T can take a large number of integer values, it is conventional to model duration as being continuous (Davidson and MacKinnon, 2004).

Duration can be represented by its density function $f(t)$ or its cumulative distribution function $F(t)$, where $F(t) = \Pr(T \leq t)$, for a given t. The survival function, which is an alternative way of representing duration, is given by $S(t) = 1 - F(t) = \Pr(T > t)$. In words, the survival function represents the probability that the duration of an event is larger than a given t. Now, the probability that a state ends between period t and $t + \Delta t$, given that it has lasted up to time t, is given by

$$\Pr(t < T \leq t + \Delta t \,|\, T > t) = \frac{F(t+\Delta t) - F(t)}{S(t)} \tag{1}$$

This is the conditional probability that the state ends in a short time after t, provided it has reached time t. For example, in the case of bank failure it is the probability that a bank changes of state from operating to not operating (i.e. fails) in a short time after time t, conditional on the fact that the bank was still operating at time t.

The hazard function $\lambda(t)$, which is another way of characterizing the distribution of T, results from considering the limit when $\Delta t \to 0$ of equation (1). This function gives the instantaneous probability rate that a change of state occurs, given that it has not happened up to moment t. The cumulative hazard function $\Lambda(t)$ is the integral of the hazard function. The relation between the hazard function, the cumulative hazard function and the survival function is given by equation (2)

$$\Lambda(t) = \int_{u=0}^{t} \lambda(u)du = -\log[S(t)] \tag{2}$$

Some empirical studies use parametric models for duration. Commonly used distributions are the exponential, the Weibull and the Gompertz. The exponential implies a constant hazard while the Weibull admits decreasing or increasing hazards. The Gompertz distribution allows non-monotonic hazard rates, but is not particularly flexible. Further, the baseline hazard in our formulation reflects changes in macroeconomic conditions common to all the institutions. There is no reason to think these will correspond to a monotonic hazard, and indeed we find evidence it does not.

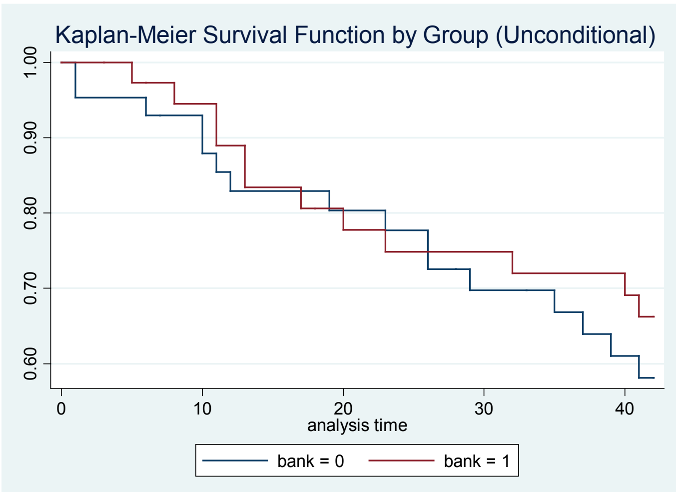
We begin by estimating the unconditional (raw: no covariates) survivor function, using the Kaplan-Meier non-parametric estimator, which takes into account censored data. Suppose that bank failure is observed at different moments in time, $t_1, t_2, ..., t_m$, and that d_i banks fail at time t_i[10]. For $t \geq t_i$,

$$\hat{S}(t) = \prod_{t_i \leq t} [1 - \frac{d_i}{N_i}] \tag{3}$$

where N_i represents the total number of banks that were still operating at time t_i.

The failure pattern of banks and of other financial institutions during the financial crisis of Colombia was similar in terms of percentage of institutions failing. That suggests that the survival functions of both groups might be similar. Figure 1 shows the estimated survival function for both groups of intermediaries.

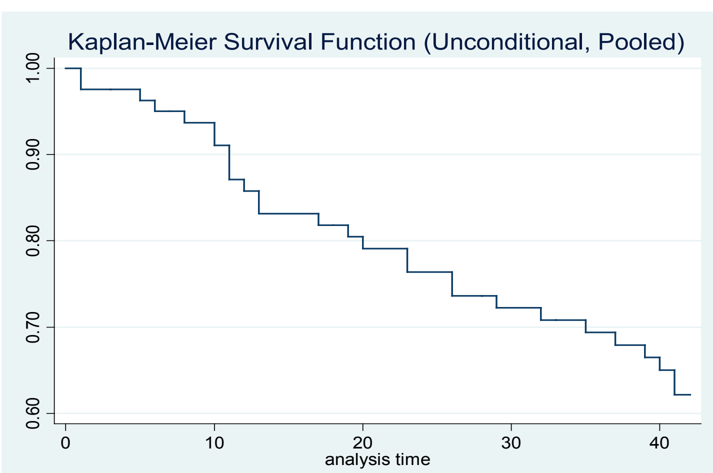
Figure 1: Estimated Survival Function by Group (Unconditional)



This figure shows failure patterns of banks and other financial institutions during the Columbia financial crisis. The measure is the Kaplan-Meier Survival Function Unconditional

These look similar. In order to corroborate that intuition, tests of equality of the survival functions were done. Table 2 shows the results of these tests. Note that these tests are crude and exploratory because they do not condition on the bank- specific financial variables. Nevertheless, they give us some confidence that pooling is appropriate, because, as can be observed from Table 2, there is no evidence to reject the null hypothesis of equality of the survival functions of both groups. Therefore, in the rest of the paper we treat all the institutions as one group. The Kaplan-Meier survival function for the whole group of institutions is shown in Figure 2.

Figure 2: Survival Function (Unconditional, Pooled)



This figure shows failure patterns of banks and other financial institutions during the Columbia financial crisis. The measure is the Kaplan-Meier Survival Function Unconditional Pooled

Table 2: Test for Equality of the Survivor Functions

Test	χ^2 (1)	Prob > χ^2
Log-rank	0.45	0.5039
Wilcoxon	0.41	0.5238

Ho: Both groups have equal survivor functions

In order to estimate the hazard function, it is first required to obtain an estimation of the cumulative hazard function. The Nelson-Aalen non-parametric estimator is natural for this purpose. Equation (4) shows how to compute this estimator. For $t \geq t_i$

$$\hat{\Lambda}(t) = \sum_{t_i \leq t} \frac{d_i}{N_i} \tag{4}$$

The hazard function can be estimated as a kernel-smoothed representation of the
estimated hazard contributions[11] $\Delta\hat{\Lambda}(t_i) = \hat{\Lambda}(t_i) - \hat{\Lambda}(t_{i-1})$, as

$$\hat{\lambda}(t) = \frac{1}{b}\sum_{i=1}^{D} K\left(\frac{t-t_i}{b}\right)\hat{\Lambda}(t_i) \tag{5}$$

where $K(\ )$ represents the kernel function, b is the bandwidth, and the summation is over the total number of failures D that is observed (Klein and Moeschberger, 2003).

Figure 3 shows the estimated smoothed-hazard function for the group of financial institutions. Note how the hazard rate of failure is clearly non-monotonic. Initially it increases sharply up to approximately month 10, then decreases up to month 25, then increases a little and finally decreases from month 30 on. This behavior of the baseline hazard reflects events applying to all institutions, like changes in macroeconomic conditions during the time of the study. Of particular importance, there was a change in the exchange rate regime in September 1999, from a crawling-peg system to a free floating system.

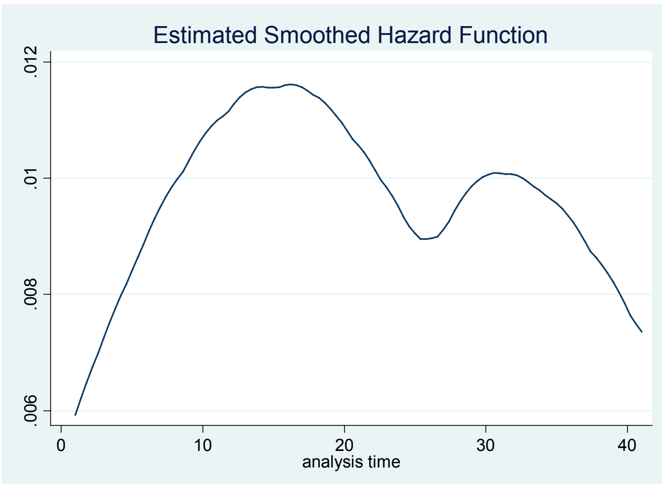
The form of the estimated hazard function shows that the most commonly used parametric models for the distribution of duration do not seem to be appropriate for modeling the baseline hazard of bank failure in Colombia during the period of financial stress.

PROPORTIONAL HAZARDS

Our objective is to understand how bank-specific variables affected the conditional probability of failure and time to failure after the shocks that initiated the financial crisis. In ordinary regression models, explanatory variables affect the dependent variable by moving its mean around. However, in duration models it is not straightforward to see how explanatory variables affect duration and the interpretation of the coefficients in these types of models depends on the particular specification of the model. But there are two widely used special cases in which the coefficients can be given a partial derivative interpretation: the proportional hazards model and the accelerated lifetime model (Kiefer, 1988).

Following the previous literature on the application of duration models to bank failure and building on the above analysis indicating that conventional candidates for parametric models are inappropriate, this paper estimates a proportional hazards model in which no parametric form is assumed for the baseline hazard function. As shown below using a specification test, this assumption seems to be appropriate for the problem of interest.

Figure 3: Estimated Smoothed Hazard Function



This table shows the estimated Smoothed Hazard Function.

Under the proportional hazards specification the hazard rate can be written as

$$\lambda(t, X, \beta, \lambda_0) = \phi(X, \beta)\lambda_0(t) \quad (6)$$

where λ_0 is the baseline hazard. Note that the effect of time on the hazard rate is captured completely through the baseline hazard. One common specification for the function ϕ, which is followed in this paper, is $\phi(X, \beta) = \exp(X'\beta)$, where X is a vector of covariates and β is the corresponding vector of parameters to be estimated. Under this specification

$$\frac{\partial \log[\lambda(\ )]}{\partial x_k} = \beta_k \quad (7)$$

for all k. Therefore, the coefficients can be interpreted as the constant, proportional effect of the corresponding covariate on the conditional probability of completing a spell. In the particular case of bank failure, completing a spell is associated with the moment in which a bank is liquidated.

ESTIMATION TECHNIQUE

In the case of specifications which model the baseline hazard explicitly by making use of a particular parametric model, estimation can be done by the method of maximum likelihood. When the baseline hazard is not explicitly modeled, the conventional estimation method is partial likelihood estimation, developed by Cox (1972). The key point of the method is the observation that the ratio of the hazards (6) for any two individuals i and j depends on the covariates, but does not depend on duration:

$$\frac{\lambda(t, X_i, \beta, \lambda_0)}{\lambda(t, X_j, \beta, \lambda_0)} = \frac{\exp(X_i'\beta)}{\exp(X_j'\beta)} \tag{8}$$

Suppose there are n observations and there is no censoring. If there are no ties, durations can be ordered from the shortest to the longest, $t_1 < t_2 < ... < t_n$. Note that the index denotes both the observation and the moment of time in which the duration for that particular observation ends. The contribution to the partial likelihood function of any observation j is given by

$$\frac{\exp(X_j'\beta)}{\sum_{i=j}^{n} \exp(X_i'\beta)} \tag{9}$$

the ratio of the hazard of the individual whose spell ended at duration t_j to the sum of the hazards of the individual whose spells were still in progress at the instant before t_j. The likelihood can then be written as

$$L(\beta) = \prod_{j=1}^{n} \frac{\exp(X_j'\beta)}{\sum_{i=j}^{n} \exp(X_i'\beta)} \tag{10}$$

Thus, the log-likelihood function is

$$\ell(\beta) = \sum_{j=1}^{n} \left[X_j'\beta - \log \sum_{i=j}^{n} \exp(X_i'\beta) \right] \tag{11}$$

By maximizing equation (11) with respect to β, estimators of the unknown parameter values are obtained. The intuition behind partial likelihood estimation is that without knowing the baseline hazard only the order of durations provides information about the unknown coefficients.

When there is censoring, the censored spells will contribute to the log-likelihood function by entering only in the denominator of the uncensored observations. Censored observations will not enter the numerator of the log-likelihood function at all.

Ties in durations can be handled by several different methods. In this paper, ties are handled by applying the Breslow method. In continuous time ties are not expected. Nevertheless, given that the moment of failure in practical applications is aggregated into groups (here months), ties are possible, and in fact they occur. Suppose we have 4 individuals a_1, a_2, a_3, a_4, in the risk pool and in a certain moment a_1 and a_2 fail. The Breslow method says that, given it is unknown which of the failures preceded the other, the largest risk pool will be used for both failures. In other words, this method assumes that a_1 failed from the risk pool a_1, a_2, a_3, a_4, and a_2 also failed from the risk pool a_1, a_2, a_3, a_4. The Breslow method is an approximation of the exact marginal likelihood, and is used when there are not many ties at a given point in time.

ESTIMATION RESULTS

The model was estimated using the partial likelihood method. Results are presented in Table 3, which shows the values of the estimated coefficients and their standard errors. One first important conclusion from Table 3 is that the null hypothesis that none of the indicators included in the model is important in explaining the behavior of duration is clearly rejected. This provides evidence that supports the idea that failure of financial institutions during the period of financial stress can be explained by differences in financial health and prudence existing across institutions. Given our focus on capitalization and the differences observed in the median values of this ratio for banks and financial companies, we included a slope dummy (DCAP) to test whether the effect of this variable on the hazard rate differs between the two types of institutions. The "t" statistic, for the test of the hypothesis that the effect of this interaction variable is zero, is 0.21. This is not a surprising value under the null; the probability under the null of seeing this or a higher value is 0.83. Thus, we focus discussion on the constrained estimates in the last 2 columns of Table 3.

Regarding the role played by individual indicators, it can be seen that the single most significant financial ratio in explaining the inter-institution variability in the hazard rate is the capitalization ratio. The sign of the coefficient is negative, implying that an increase in the capitalization ratio for a given bank results in a reduction of its probability of failing at every moment of time, everything else constant. This is the expected result, consistent with previous studies and verifying the importance to both the institutions and their supervisors of following the evolution of this ratio over time. More important and novel is the finding that the variable CAPL affects the hazard rate significantly and with the expected negative sign[12]. This provides evidence in favor of a non-linear effect of the capitalization ratio on the probability of failure. Therefore, improvements in this ratio are more important for poorly capitalized banks than for banks with better capitalization levels. This result can be explained intuitively. It can be expected that there is a capitalization level over which a bank no longer benefits from a further increase, and, on the contrary, could lose profitable lending opportunities. The estimated coefficients for CAP and CAPL imply that a one percentage point increase in the capitalization ratio will lead to a 6.0 percent reduction of the instantaneous probability of failure for a well-capitalized bank (capitalization greater than C; for these specific numbers C=10.2%. Very similar results hold for a range of values of C), while it will lead to a 25.3 percent reduction in the same probability for a poorly capitalized bank (capitalization less than C), everything else being constant. Note that this direct interpretation of the coefficient compares a percentage point change with a percentage change. Given these coefficient estimates, a one percent increase in capitalization from the cutoff value of 10.2 percent will reduce the sample average per period failure rate from 0.81 percent to 0.76 percent, while a one percent decrease in capitalization will increase the rate to 1.02%[13].

Table 3: Partial Likelihood Estimation Results

	Unconstrained model		Constrained model	
Variable	Coefficient	Std. Err.	Coefficient	Std. Err.
CAP	-.0595*	.0302	-.0596*	.0302
CAPL	-.2057*	.1141	-.1933*	.0975
EFF	-.1684	.2096	-.1434	.1738
PROF	-.1696	.1256	-.1572	.1108
LOAN	-.0128	.0151	-.0128	.0152
COMP	.0067	.0097	.0078	.0083
SIZE	-.0011*	.0005	-.0011*	.0005
DCAP	.0077	.0366		
Log-likelihood	-97.81		-97.83	
LR χ^2 (d.f.)	25.45 (8)		25.41 (7)	
Prob > χ^2	0.0013		0.0006	

**5% level of significance*

Another important variable in explaining the hazard rate is bank´s size (SIZE). The sign is negative, indicating that, other things being equal, increases in this variable decrease the risk of failure of a bank. This effect is the expected one, as it seems reasonable to assume that large institutions are less exposed to risk because they can diversify their assets more, because they can achieve economies of scale, or because they likely have been in business longer. Profitability (PROF) is also important and its coefficient is negative, as expected, although its significance is lower.

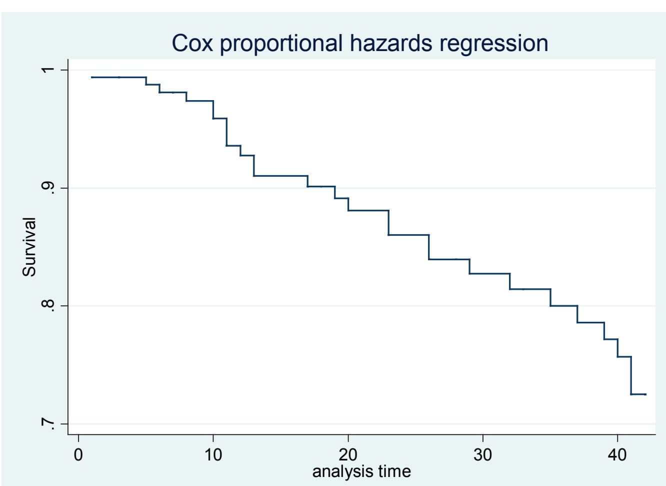
As a robustness test for the results shown above, changes to the specification of the model were done by excluding variables and by including new ones. In all the different specifications, the signs of CAP and CAPL remained unchanged, and the values of the coefficients were stable. The same holds for regressions done exlcuding outlyers with very high and low capitalization levels.

The interpretation of the results presented in Table 3 relies on the proportional hazards assumption. Therefore, it is important to test whether this assumption is a sensible one in the context studied here. This can be done formally using the Schoenfeld´s residuals test. The proportional hazards factorization implies that the effect of the covariates on the hazard function is constant over time. Testing the hypothesis that the effects of the covariates do not vary over time is equivalent to testing for a zero slope in a generalized linear regression of the residuals on time. The null hypothesis of the test is that the slope is zero. A rejection of the null hypothesis indicates that the proportional hazards assumption is unsuitable.

It is a conventional practice to do a test of each covariate as well as a global test. Most absolute "t"´s were small, and the joint test statistic, a $\chi^2(7)$ random variable, takes the value 9.53, not a surprising value under the null that all the coefficients are zero. This provides evidence that the proportional hazards assumption is adequate in the context of the model of bank failure.

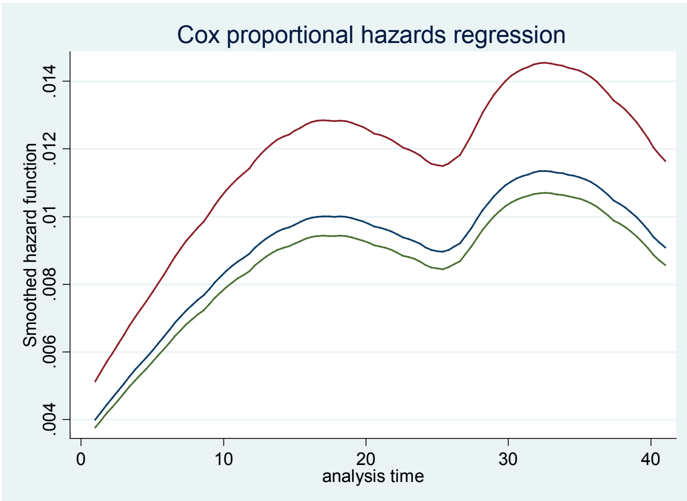
Figure 4 shows the estimated survival function evaluated at the mean values of all the predictors. Of course, this lines up well with the raw survivor function plotted in Figure 2. Figure 5 shows the estimated hazard functions evaluated with the value of capital one percentage point below the break value, at the break value, and one percentage point above. The other predictors are held constant at their means. Figure 5 gives striking summary evidence on the importance of capitalization on the likelihood of default in a period of financial stress.

Figure 4: Cox Proportional Hazards Regression



This figure shows the Cox proportional hazards regression

Figure 5: Cox Proportional Hazard Regression



This figure shows the Cox proportional hazard regression based on the Smoothed hazard function.

TIME VARYING REGRESSORS

The model estimated in the previous section is useful for banks and supervisors, because the probability that a bank fails in a certain future period can be calculated using only financial data on the bank that is currently available. Tests of the proportional hazards assumption showed that the specification considered previously is adequate. As a further description of the failure process, from a somewhat different point of view, we consider a regression model with time varying covariates. The specification is retained, but now monthly observations on each regressor from June 1998 to December 2001 are used.

Table 4 shows the results of the regression done by partial likelihood estimation, using time varying covariates. The signs of the coefficients of the variables remain unchanged. Some changes are observed regarding the significance levels of the variables. Particularly, the significance of capitalization is reduced, while profitability gains significance. The chi-squared statistic, twice the difference in loglikelihood values, for the test of the joint hypothesis that the effect of CAP and CAPL is zero, is 3.78. On two degrees of freedom, the probability under the null of seeing this or a higher value is 0.15.

When combined with the previous results, we conclude that, when considering a bank´s viability into the future, current capitalization is the key financial variable. When considering immediate risk, current profitability is also important. Perhaps both variables are important indicators of financial health, but profitability is more idiosyncratic and has a more immediate effect, while capitalization is a less noisy indicator of financial health. Thus, profitability at a point in time reflects "shocks" specific to that period, while capitalization is less affected by single-period shocks. Profitability looses significance in the longer run, probably because current profitability is not a good forecast of future profitability, while capitalization, affected by accumulated profits, is less temporally variable.

CONCLUSIONS

This paper identifies the main bank-specific determinants of time to failure during the financial crisis in Colombia. Using an unusually informative data set and a duration model with partial likelihood estimation, we show that the process of failure of financial institutions during that period is significantly affected by differences in financial health and prudence existing across institutions. Our specification tests show that the proportional hazard specification is appropriate for our sample, while popular parametric specifications of the baseline hazard are unsatisfactory.

When looking ahead, the capitalization ratio is the most significant of the relevant indicators that explain bank failure. Increases in this ratio lead to a reduction in the hazard rate of failure at any given moment in time. This ratio exhibits a non-linear component, implying that the impact of increases in this variable is more important for less capitalized banks. This result, which appears to be intuitive and appealing, agrees with the literature on capital crunch that suggests that banks´ capital is crucial for real decisions taken by banks, such as portfolio choices. Related previous studies have found capitalization to be a significant variable explaining the conditional probability of failure; however, none identifies a nonlinear component. Other important variables explaining bank failure dynamics are a bank´s size and profitability.

When using time-varying covariates, profitability gains significance as a short-run indicator of instantaneous failure. This result indicates that profitability is an important indicator of within-period feasibility of the bank, while capitalization is a less noisy indicator of financial health.

Table 4: Time Varying Regressors

	Unconstrained model		Constrained model	
Variable	Coefficient	Std. Err.	Coefficient	Std. Err.
CAP	-0.0045	0.0149		
CAPL	-0.0286	0.0229		
EFF	-0.0064	0.0524	-0.0006	0.0516
PROF	-0.0433*	0.0210	-0.686*	0.0147
LOAN	-0.0222	0.0126	-0.0151	0.0101
COMP	0.0003	0.0070	0.0027	0.0068
SIZE	-0.0007*	0.0003	-0.0009*	0.0004
Log-likelihood	-93.59		-95.48	
LR χ^2 (d.f.)	42.74 (7)		38.96 (5)	
Prob > χ^2	0.0000		0.0000	

**5% level of significance*

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ENDNOTES

1. The financial system here includes commercial banks, financial companies, and financial companies specialized in commercial leasing. Financial cooperatives and special public financial institutions are not included here.
1. These were requirements imposed by the Superintendencia Bancaria, which at the time of the crisis was the regulator of the financial system in Colombia.
2. For example, Carree (2003) argues that the process of bank liquidation that occurred in Russia during the period 1995-1998 (the Central Bank of Russia withdrew about 1000 bank licenses during that period) can be explained by the period of easing in financial regulation policies that took place during the early 1990s.
3. During the ascendant part of the cycle, the fragilities of the financial system were not very visible. Most of the financial intermediaries obtained high profitability levels that arose from the higher levels of risk undertaken by them, as well as by low levels of provisions. When the downturn began, financial fragility became evident as loans deteriorated, deteriorating the financial system´s capital.
4. Mainly time deposits issued by financial institutions to finance their positions in assets.

   There are many different definitions of contagion in the literature. Kaminsky and Reinhart (1999), for example, define contagion as a situation in which the knowledge that there is a crisis occurring elsewhere increases the probability of a domestic crisis, everything else being constant.
5. Other authors, such as Edwards (2000) argue that a better definition of contagion is a situation in which the extent to which a shock is transmitted among countries is higher than what was expected ex-ante.
6. The main difference can be found in demand deposits: while commercial banks can issue checking accounts, financial companies cannot. Nevertheless, financial companies can issue saving deposits and time deposits. Another difference is the required amount of initial capital: the minimum required capital to constitute a bank is almost three times as big as that needed to constitute a financial company. Nevertheless, initial capital requirements are small vis-à-vis the size of the intermediaries once they are operating.
7. For an extension reported in Section 6, we collect monthly data on each of the financial variables.
8. In this paper, failure is considered as the event in which an institution is liquidated, either by the decision of the regulator (forced failure) or by the decision of the institution´s managers ("voluntary" failure). The moment in which the bank fails is defined as the month in which the institution is liquidated formally; that is, the moment at which the institution stops reporting its balances to the Superbancaria. Even when this is not a exact measure of the moment in which a bank fails, it appears to be the best possible approximation, and the fact that the balance sheets of financial institutions are reported on a monthly frequency, rather than a quarterly frequency as in other countries makes this measure more accurate. Institutions that merged or were acquired are not considered as a failure here.
9. Note that in continuous time there should be no ties in time of failure among banks. Nevertheless, in practice ties are observed.

10. The kernel-smoothed estimator of $\lambda(t)$ is a weighted average of these "crude" estimates over event times close to t. How close the events are is determined by b, the bandwidth, so that events lying in the interval [t-b, t+b] are included in the weighted average. The kernel function determines the weights given to points at a distance from t. Here we use the Epanechnikov kernel
11. Table 4 reports the results setting the value of C equal to 10.2 percent. Nevertheless, these results remain valid for values of C in the range from 10 to 11 percent.
12. A one percent change in the capitalization ratio is rather large and is not frequently observed in a short period for a nancial institution. Therefore, the numerical interpretation of the coe¢ cients here should be considered as a reference only.

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DISCLAIMER

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THE NONLINEAR IMPACT OF GLOBALIZATION ON CORRUPTION

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ABSTRACT

Some researchers have argued that globalization has increased the opportunity for corrupt practices, while others state that globalization has lead to a decrease in corruption as countries wishing to join the global economy must comply with international anti-corruption rules and regulations. This study empirically explores this paradox using the Corruption Perceptions Index (CPI) and the Konjunkturforschungsstelle (KOF) globalization Index. The results suggest that a nonlinear relationship exists between globalization and corruption. Specifically, the results of this study suggest that the effect of globalization on corruption is dependent on the level of globalization with the highest corruption levels realized at moderate or transitioning levels of globalization.

JEL: F0, D73

KEYWORDS: globalization, corruption, KOF globalization index

INTRODUCTION

Globalization is multifaceted and involves the interaction beyond national borders, among businesses, services and governments. Recent technological progress has largely overcome distances while ideas and people have become more mobile. Nations are more interconnected and dependence among them has grown. Freidman (2005) affirmed that globalization is not a passing trend, describing it as an overarching umbrella under which most, if not all, countries and international systems currently operate. Further, Freidman (2005) notes that globalization has shaped foreign relations and affected domestic politics, culture, and the development of economic and social systems worldwide. Nevertheless, globalization has not been without controversy, especially regarding labor issues, environmental concerns and general social inequalities. Despite the arguments made against globalization, since the 1970s, the world has become increasingly economically, socially, and politically globalized (KOF Press Release, 2008) and, as Sung and Chu (2003) state, countries can no longer afford not to participate in the global economy as economic development is often a casualty of economic isolation.

An important outcome of globalization and the establishment of cross-country relationships has been the greater attention paid to the manner in which countries conduct their economic, social and political affairs. This focus has brought to light corrupt business and political practices prevalent within many cultures and societies. Indentified at all levels of society, corruption affects both rich and poor nations. Tanzi (1998) defines corrupt practices as activities that are illegal, unethical, and dishonest business practices carried out by a bureaucracy, or by political leadership. Van Klaveren (1989) notes that corruption includes bribery among public officials and Klitgaard (1988) states that corruption can also occur as commercial bribery between two private parties. Further, much research has considered the causes and consequences of corruption. Specifically, Mauro (1995), Gastanga et al. (1998), Wei (1999), and Zhao et al. (2003), among others find that corruption distorts public policy and disrupts international trade and investment. Macrae (1982), Alam (1995), and Ades and Di Tella (1997 and 1999) state that corruption weakens good government, leads to the misallocation and inefficient use of resources, harms private sector development, distorts the rule of law, and weakens the institutions that are necessary for economic growth. The increases in globalization, however, have lead international organizations to call for anti-corruption policies and more transparency in trade and transactions and existing research clearly suggests a link between corruption and globalization, which Holm and Sorenson (1995) define as the intensification of economic, social and political interaction across national boundaries.

Specifically, Gould (1991), Eisner (1995), and Jreisat (1997) argue that globalization has increased the opportunity for corrupt practices as the resulting trade relationships have put government officials and businesses into situations that foster corruption and Leiken (1997) and Elliott (1997) note that globalization has made the detection of corrupt practices more difficult. Alternatively, Williams and Beare (1999) and Sung and Chu (2003) state that globalization should act to decrease corruption as countries wishing to join the global economy must comply with the anti-corrupt policies of the World Trade Organization (WTO) and the International Monetary Fund (IMF), among other supranational entities. Thus, the research on globalization and corruption differs, as some argue a positive relationship and others a negative one.

If globalization can have positive and negative influences on corruption, past research assuming a linear relationship has allowed these two effects to compete with each other such that the estimated effect of globalization on corruption has a downward bias. The primary objective of this study is to resolve this paradox by relaxing the assumption that the relationship between globalization and corruption is linear. Specifically, it is hypothesized that globalization can have varying effects on country corruption levels, which are dependent on the country's level of globalization. To date, no prior study has considered the possibility of a nonlinear relationship, which can have important policy implications, especially for countries transitioning into the global economy.

The organization of the remainder of the paper is as follows. In Literature Review section that immediately follows, a more detailed discussion of the possible nonlinear relationship between corruption and globalization in addition to a description of the data measures used to proxy these two variables are provided. The next section, Data and Methodology, discusses the control variables and their data measures as well as the descriptive statistics on all data used in this study. A discussion of the regression analyses and the results follow in the Results section of the paper. Finally, the Concluding Comments section offers a summary of the research findings.

LITERATURE REVIEW

Corruption and Globalization: A Nonlinear Relationship

Researchers have argued that globalization and the growing openness among countries increases corruption by creating relationships that encourage corrupt practices in an attempt to stay competitive in an aggressive world of trade, commerce, ideas, service and information. Compounding this issue, Leiken (1997) and Elliott (1997) note, that globalization has made the detection of corrupt practices more difficult given the extensive use of electronic commerce and offshore financial centers. Glynn et al. (1997) state that rapid economic globalization causes corruption to spillover and permeate the global economy and Tornell and Lane (1998) find that the opportunities for corruption are greater as export shares of raw materials increase. Further, Williams and Beare (1999) note that there is much agreement that globalization has provided the impetus and opportunity for corrupt practices and has contributed to the growth and spread of corruption.

Alternatively, other researchers make the opposing argument that globalization reduces corruption levels. Specifically, Akhter (2004) states that with greater integration of trade and investments, domestic and international constituents will exert pressure on institutions to become more accountable and transparent, thus reducing the opportunities for corrupt behavior. Sung and Chu (2003) note that powerful supranational organizations have made a concerted effort to reduce corruption by requiring countries that want to participate in the world economy to establish cross-border regulations and standards that include fiscal transparency, monetary policy, data dissemination, corporate governance, and accounting supervision. In a review of the IMF, OECD and World Bank policy statements, Williams and Beare (1999) summarize that these institutions have a clear desire for global economic governance and this hinges on two main principles of access and accountability. Thus, as Sung and Chu (2003) state, it is not involvement in the global economy that lowers corruption *per se*, but rather the participation in the global economy requires the regulation and oversight of the supranational institutions, which have clear anti-corruption targets and goals. In regard to empirical evidence, Ades and Di Tella (1997 and 1999), Brunetti and Weder (1998), Treisman (2000), and Herzfeld and Weiss (2003) find a negative relationship between openness, or percentage of imports, and corruption levels. Further, Golden (2002) provides evidence that as Italy became more globalized and integrated into the global economy, it experienced a decrease in corruption levels.

Clearly, the existing research suggests that globalization can have positive and negative effects on corruption levels. To date, however, empirical studies such as Shabbir and Anwar (2007) and Sung and Chu (2003), assume a linear relationship between corruption and globalization and, in doing so, they have not allowed for the possibility that globalization can have varying effects on corruption levels dependent on a country's level of globalization. In this study, it is hypothesized that a nonlinear or inverted U-shaped relationship exists between corruption and globalization. Specifically, it is argued that at lower levels of globalization, countries are not as regulated nor as well integrated into the global economy and, as these countries engage in the globalization process, their corruption levels initially increase. Newly formed trade relationships create opportunities for corrupt practices and emerging nations may be more likely to engage in corrupt practices in an effort to plunge ahead in the increasingly competitive global environment. Nevertheless, as countries continue to integrate into the world economy, they must comply with the anti-corruption policies of the supranational entities that require more transparency and accountability. If such an inverted U-shaped relationship exists between corruption and globalization, corruption levels reach their peak or threshold as countries transition from low to moderate levels of globalization and countries above and below the threshold level experience lower levels of corruption. If support for this relationship is found, many important policy implications for countries transitioning into the global community can be drawn. Using cross-country data and controlling for other factors known to affect country corruption levels, this study empirically tests this theory using regression analysis.

<u>Measuring Corruption and Globalization</u>

This study uses the Corruption Perception Index (CPI) created by Transparency International (2008) to proxy corruption. Transparency International defines corruption as the misuse of entrusted power for private gain and designed the CPI to measure the degree to which officials and politicians are believed to accept bribes, or illicit payments in public procurement, embezzle public funds, or commit offences. The CPI is a perceptual measure of corruption and is the most comprehensive quantitative indicator of cross-country corruption available. Despite some limitations noted by Husted (1999), the CPI has been used in a number of studies such as Treisman (2000), Davis and Ruhe (2003), Park (2003), Pelligrini and Gerlagh (2006), and Del Monte and Papagni (2007), among many others. Further, as Serra (2006) and Lancaster and Montinola (1997) state, no index or measure of corruption is perfect; however, the CPI is robust unlike other measures of corruption that are based on individual sources, such as Business International, International Country Risk Guide, World Bank index, and the World Competitiveness Report. The CPI is based on a continuous scale from 1 to 10 with 1 representing the highest perceived levels of corruption and 10 the least. As an example, in 2008, Denmark, New Zealand and Sweden each received a CPI score of 9.3, indicating that these three countries experience the lowest levels of corruption, while Somalia, Myanmar and Iraq received CPI scores of 1.0, 1.3 and 1.3, respectively, suggesting some of the greatest levels of corruption.

The Konjunkturforschungsstelle (KOF) index of globalization is used to proxy the degree to which a country is globalized. Following Clark (2000), Norris (2000) and Keohane and Nye (2000), the KOF defines globalization as "…the process of creating networks of connections among actors at multi-continental distances, mediated through a variety of flows including people, information and ideas, capital and goods" (KOF Report, 2008). The KOF conceptualizes globalization as a process that integrates economies, cultures and technologies and governance that erodes national boundaries and creates interdependent relationships (KOF Report, 2008). The KOF index is a broad measure of globalization as it considers a country's economic, social and political level of globalization. In reference to economic globalization, the KOF measures trade, foreign direct investment flows and stocks, tariff rates, and capital account restrictions, among other factors. The social dimension of globalization takes into consideration data on personal contact such as outgoing telephone traffic, international tourism and percentage of foreign population, as well as data on information flows and cultural proximity such as percentage of internet users, cable televisions, and radios and trade in books, and the per capita number of McDonald's restaurants and Ikea stores. Political globalization, the third dimension of the KOF index, accounts for the number of foreign embassies in a country as well as country membership in international organizations and participation in U.N. Security Council missions.

The KOF index of globalization is a weighted average of the three dimensions of globalization (economic, social and political) and ranges from 1 to 100 such that higher values indicate a greater degree of globalization. This measure has been used in many studies such as Dreher and Gaston (2007), Koster (2007), Tsai (2007), and Shabbir and Anwar (2007) to proxy the degree to which a country is globalized. In 2005, Austria, Sweden and Switzerland received some of the highest KOF index scores of 92.09, 91.38, 90.02, respectively, suggesting that these countries are highly globalized in comparison to Burundi and Myanmar, which received the lowest KOF index values of 22.41 and 27.4, respectively.

DATA AND METHODOLOGY

In order to examine the relationship between the corruption and globalization, it is necessary to control for the other socio-economic and institutional variables that past research has shown to affect a country's corruption levels. The following section summarizes these factors and includes a discussion of the data measures used to proxy the controls.

Democracy

As Seldadyo and de Haan (2006) state, there is a consensus that democracy serves to reduce corruption as political liberty imposes transparency and provides a system of checks and balances within a country's political structure. Persson and Tabellini (2003) and Kunicova and Rose-Ackerman (2005) also note that societies are better able to monitor and legally restrict politicians from engaging in corrupt behavior in democratic environments in which there is political participation and competition and constraints on the chief executive. Although there is much theoretical support for a negative relationship between corruption and democracy, the empirical results are mixed. Specifically, Ades and Di Tella (1999), Fisman and Gatti (2002), and Shabbir and Anwar (2007) fail to find a significant relationship between democracy and corruption, while Andvig et al. (2000), Braun and Di Tella (2004), Suphacahlasai (2005), Kunicova and Rose-Ackerman (2005), Lederman et al. (2005), and Goel and Nelson (2005) provide evidence of a negative relationship between democracy and corruption.

To measure the degree of democracy afforded to countries, the unweighted average of Political (PR) and Civil Liberties (CL) constructed by Freedom House (2005). As noted by Freedom House, political rights and civil liberties, while inextricably linked, consider different measures of democracy. Political rights largely refer to the freedom to organize in political parties or groupings, the existence of party competition, and the existence and fairness of elections. Alternatively, civil liberties refer to the freedoms afforded to the media, the right to open and free discussions, the freedom of assembly and religious expression, the protection from political terror, and the prevalence of the rule of law. Based on survey results of experts, both indices are on a seven-point scale from one, most free, to seven, least free. Since both political rights and civil liberties measure important facets of democracy, an average of the two values is used for each country such that countries with lower average combined rating of political and civil rights (PRCL) represent higher levels of democratic freedom. Researchers such as Barro (1999) and Emerson (2006) often use this measure to proxy democracy and it correlates highly with other measures of democracy such as the Polity data series.

Economic Freedom

Frechette (2001), Knack and Azfar (2003), and Seldadyo and de Haan (2006) note that limited economic freedoms such as restrictions of foreign trade, foreign investment, and capital markets stimulate corruption as the presence of these restrictions provide opportunities for bribery and other corrupt practices. Broadman and Recanatini (2000, 2002) also show that corruption is more widespread in restrictive economic environments where firms face significant barriers to entry and exit. Goel and Nelson (2005), Kunicova and Rose-Ackerman (2005), Lederman et al. (2005), and Shabbir and Anwar (2007) among others provide empirical evidence that economic freedom is negatively related to corruption.

The 2005 Heritage Foundation's Index of Economic Freedom (EFI) is used to proxy economic freedom, which researchers such as Baliamoune-Lutz (2003), Goel and Nelson (2005), and Quazi (2007) among many others use as a measure of the economic freedoms afforded to a country. The EFI considers 50 economic freedom variables that are divided into ten categories; trade policy, fiscal burden of government, government intervention in the economy, monetary policy, capital flows and foreign investment, banking and finance, wages and prices, property rights, regulation, and informal market activity. In calculating the EFI, each of the ten categories receives a score, and the average of these scores provide an overall economic freedom score between 0 and 100 such that higher scores represent more economically free countries.

Diversity

Collier (1998) finds that cultural and ethnic heterogeneity tends to hamper nation building and growth, while Mauro (1995) finds a negative correlation between ethno-linguistic fractionalization and political stability, bureaucratic efficiency, institutional efficiency, and corruption. Many researchers such as Shleifer and Vishny (1993), La Porta et al. (1998), Treisman (2000), Lederman et al. (2005), and Suphacahlasai (2005) provide evidence that corruption is lower in more ethnically and linguistically homogeneous societies.

While there is a consensus that higher corruption levels are associated with more ethnically and linguistically diverse societies, the research provides mixed results regarding the effect of religious diversity on corruption levels. Specifically, Treisman (2000), Herzfeld and Weiss (2003), and Chang and Golden (2004) find a negative relationship between corruption levels and the share of a population having affiliation with a particular religion, while La Porta et al (1998) and Paldam (2001) report a positive relationship, and Shabbir and Anwar (2007) fail to find a significant relationship between religious diversity and corruption.

Using the Fractionalization Index created by Alesina et al. (2003), this study controls for the ethnic, linguistic and religious diversity within a country. To create the index for each type of diversity, Alesina et al. (2003) employs the Herfindahl index methodology and the index represents the probability that two randomly selected individuals from a population belong to different groups. A measure close to zero implies a less diverse, or more homogenized society, and a value closer to one suggests the opposite.

Economic Development

As Seldadyo and de Haan (2006) state, income is the most commonly used factor to explain corruption levels and there is a strong consensus in the literature that wealthier countries tend to have lower levels of corruption. Studies such as Braun and Di Tella (2004), Chang-Golden (2004), Brown et al. (2005), Kunicova-R.Ackerman (2005), Lederman et al. (2005), and Shabbir and Anwar (2007) among many others offer empirical evidence of the negative relationship between wealth and corruption levels. Further, Treisman (2000) and Paldam (1999) find that the most significant determinant of corruption is economic development, which is typically measured in real GDP per capita.

Following these studies, economic development is controlled for in this study using the 2005 GDP per capita (measured in constant 2000 U.S. dollars), which is available from the World Bank. GDP per capita is a widely accepted measure of economic development and is commonly employed in analyses that control for differences in income and standard of living across countries.

Descriptive Statistics

To test the hypothesized nonlinear relationship between country corruption levels and globalization using a regression analysis, this study employs data from a sample of 113 countries. Table 1 provides a summary of the data used in this analysis as well as the descriptive statistics for each variable. *CPI* represents 2008 data and the control variables are lagged as their affect on *CPI* cannot be expected to occur immediately. Specifically, *Global*, *PRCL*, *EFI* and *LnGDP* per capita represent 2005 data and *E*, *L*, and *R* represent 2003 data, which are the most recent data available for this measure of diversity.

Table 1: Variable Summary and Descriptive Statistics

Variable	Proxy (Name, Year Reported)	Mean	Standard Deviation	*n*
Corruption	Corruption Perception Index (CPI, 2008)	4.57	2.21	113
Globalization	KOF Index of Globalization (Global, 2005)	59.81	15.88	113
Democracy	Freedom House (PRCL, 2005)	2.75	1.73	113
Economic Freedom	Index of Economic Freedom (EFI, 2005)	61.67	9.50	113
Ethnic Diversity	Ethnic Fractionalization Index (E, 2003)	0.45	0.26	113
Linguistic Diversity	Linguistic Fractionalization Index (L, 2003)	0.38	0.29	113
Religious Diversity	Religious Fractionalization Index (R, 2003)	0.44	0.24	113
Economic Development†	GDP per capita (LnGDPPC, 2005)	8.07	1.61	113

†A series of scatter plots and preliminary regression analyses indicated that the relationship between CPI and GDP per capita is best described as linear in the log of GDP per capita. The proxy for corruption is the Transparency International's CPI data that measures the perceived level of corruption within a country. The KOF Globalization Index measures a country's level of economic, social and political level of globalization. The remaining variables are control variables. Specifically, the average of the Political Rights and Civil Liberties indices provided by Freedom House proxy country-level democracy and Heritage Foundation's Index of Economic Freedom measures the degree to which a country enjoys economic freedoms. The Fractionalization Indices created by Alesina et al. (2003) measures ethnic, linguistic and religious diversity. Finally, GDP per capita, which is available from the World Bank proxies the level of economic development.

Table 2 provides the correlation matrix for all of the variables. The Jacque-Bera test was used to test the normality of each of the variables, and at 95% confidence *CPI*, *PRCL*, *E*, *L* and *R* were all found to be non-normal. Given that one of the assumptions for the Pearson measure of correlation is normality, the

Spearman rank correlation is used to measure the correlation with these variables and the Pearson measure is used only between pairs of variables found to be normal (*Global*, *EFI* and *LnGDP* per capita).

Table 2: Correlation Matrix

	CPI	Global	PRCL	EFI	E	L	R	LnGDPPC
CPI	1							
Global	0.77***	1						
PRCL	-0.73***	-0.66***	1					
EFI	0.83***	0.62***	-0.68***	1				
E	-0.53***	-0.58***	0.48***	-0.36***	1			
L	-0.36***	-0.40***	0.33***	-0.30***	0.68***	1		
R	-0.02	-0.09***	0.04	0.12	0.29***	0.32***	1	
LnGDPPC	0.86***	0.82***	-0.65***	0.73***	-0.59***	-0.47***	-0.10	1

*This table presents the estimated correlation coefficients between corruption, globalization and the remaining control variables. ***, ** and * indicate significance at the 1, 5 and 10 percent levels, respectively.*

As seen in Table 2, *CPI* is positively and significantly correlated with *Global, EFI*, and *LnGDP* per capita, which suggests that countries with lower levels of corruption tend to be more globalized and enjoy greater levels economic freedom and development, as lower levels of corruption are associated with higher *CPI* values. Further, *CPI* is negatively and significantly correlated with *PRCL*, *E*, *L*, and *R*, indicating that countries with lower levels of corruption tend to be more democratic and more ethnically, linguistically, and religiously homogeneous.

RESULTS

Two separate regression models are estimated to test the possible nonlinear relationship between corruption and globalization. The first regression, Model 1, is a regression of control variables and *Global* on *CPI*, is defined as:

$$CPI = \beta_o + \beta_1 Global + \beta_2 PRCL + \beta_3 EFI + \beta_4 E + \beta_5 L + \beta_6 R + \beta_7 LnGDPPC + \varepsilon \tag{1}$$

As shown in Table 3, the regression results provide support for Model 1 with an Adjusted R^2 of 0.83 and a significant *F* at the 99% significance level. Further, White's (1980) general test for heteroscedasticity provides evidence that the residuals are homoscedastic. In reference to the coefficient estimates, with the exception of *PRCL* and *R*, all of the control variables are significant. Given the mixed results in past research regarding the relationships between democracy and corruption as well as religious diversity and corruption, the insignificant results are not surprising. Of the significant variables, all variables have the expected sign with the exception of *L*. The positive coefficient on *L* indicates that linguistically diverse countries tend to have lower corruption levels, while previous research suggests that ethnic and linguistic diversity should both serve to increase corruption levels. Nevertheless, linguistic diversity does have beneficial effects as a more linguistically diverse population can yield a more talented human capital pool that can work to reduce corruption.

Table 3: Regression Results Model 1: Dependent Variable: CPI

	Coefficient Estimate	Std Err	t Stat	
Intercept	6.72843	0.89747	-7.50**	<.0001
Global	0.03193	0.01002	3.19**	0.0019
PRCL	-0.06044	0.06659	-0.91	0.3662
EFI	0.10459	0.01482	7.06**	<.0001
E	1.17141	0.51986	-2.25*	0.0263
L	1.07891	0.41614	2.59*	0.0109
R	0.00531	0.39581	0.01	0.9893
LnGDPPC	0.39843	0.11641	3.42**	0.0009

Adj. $R^2 = 0.8359$ *F stat = 82.50*** *This table presented the results from Regression Model.*
(1) $CPI = \beta_o + \beta_1 Global + \beta_2 PRCL + \beta_3 EFI + \beta_4 E + \beta_5 L + \beta_6 R + \beta_7 LnGDPPC + \varepsilon$ *. ***, ** and * indicate significance at the 1, 5 and 10 percent levels, respectively.*

Interestingly, the sign on *Global* is positive, which suggests that globalization has an overall negative, linear effect on corruption. In other words, when a linear relationship is assumed between globalization and corruption and other factors known to effect corruption are controlled for, the effect of globalization on corruption is negative, implying that the effects of the anti-corruption policies of the supranationals outweigh the increased opportunities for corruption that are provided through globalization. This overall negative effect of globalization on corruption has also been found in Sung and Chu (2003) and Shabbir and Anwar (2007). Given the support for the baseline model, a second regression (Model 2) that includes $Global^2$ as an explanatory variable, is defined as:

$$CPI = \beta_o + \beta_1 Global + \beta_2 Global^2 + \beta_3 PRCL + \beta_4 EFI + \beta_5 E + \beta_6 L + \beta_7 R + \beta_8 LnGDPPC + \varepsilon \quad (2)$$

A partial *F* test indicates that $Global^2$ adds explanatory power to the model, and, as shown in Table 4, the Adjusted R^2 increases to 0.86. Further, White's (1980) general test for heteroscedasticity provides evidence that the residuals are homoscedastic and, in reference to the control variables, there are no significant changes between Model 1 and 2. Most importantly, the sign on *Global* changes from positive to negative and the coefficient on $Global^2$ is positive and both coefficients are significant. These results establish the existence of a nonlinear relationship between country corruption levels and the degree of globalization, even after controlling for other factors known to affect corruption. Specifically, these results suggest that as countries begin to globalize their corruption levels initially increase as the newly formed trade relationships create new opportunities for corrupt practices; however, as countries continue integrate into the world economy, they face increased regulation by the anti-corruption policies of the supranationals, forcing their corruption levels to fall. Thus, the highest corruption levels are realized at a moderate or transitioning level of globalization.

To explore this finding further, the estimated *CPI* values are calculated using the estimated regression results and evaluating all of the independent variables at their means with the exception of *Global.* Figure 1 illustrates the estimated values of *CPI* against the *Global* values included in the data set.

By taking the first derivative of the estimated regression equation with respect to *Global* and solving the first order condition, the result is that countries with *Global* values of approximately 52.94 are estimated to have the lowest *CPI* values, or highest estimated corruption levels, holding economic development, economic and democratic freedoms, and diversity levels constant. Examples of countries with *Global* values close to this transitioning break point are Paraguay (51.37), Pakistan (51.79), Columbia (52.66), and Ghana (53.35), which have low *CPI* values of 2.4, 2.5, 3.8, and 3.9, respectively, suggesting relatively higher corruption levels. At the low end of the globalization scale, Botswana and Barbados are examples of countries with relatively low *Global* values of 43.06 and 46.68, respectively that also have higher *CPI* values of 5.9 and 7, indicating lower corruption levels. While these countries are more closed and enjoy lower corruption levels, countries such as Belgium, Austria, and Sweden are highly globalized with *Global* values of 92.09, 91.38, and 90.02, respectively, and also enjoy lower corruption levels with high *CPI* values of 7.3, 8.1, and 9.3, respectively.

Table 4: Regression Results Model 2: Dependent Variable: CPI

	Coefficient Estimate	Std Err	*t* Stat	
Intercept	-1.35582	1.38433	-0.98	0.3297
Global	-0.15459	0.03988	-3.88**	0.0002
Global²	0.00146	0.00030428	4.80**	<.0001
PRCL	-0.06028	0.06053	-1.00	0.3217
EFI	0.10136	0.01349	7.52**	<.0001
E	-1.25552	0.47288	-2.66**	0.0092
L	0.86690	0.38084	2.28*	0.0249
R	-0.00390	0.35980	-0.01	0.9914
LnGDPPC	0.46173	0.10663	4.33**	<.0001

Adj. R^2 *= 0.8644* *F stat = 90.25*** *This table presented the results from Regression Model (2)* $CPI = \beta_o + \beta_1 Global + \beta_2 Global^2 + \beta_3 PRCL + \beta_4 EFI + \beta_5 E + \beta_6 L + \beta_7 R + \beta_8 LnGDPPC + \varepsilon$. ****, ** and * indicate significance at the 1, 5 and 10 percent levels, respectively.*

Figure 1: Estimated CPI and Globalization

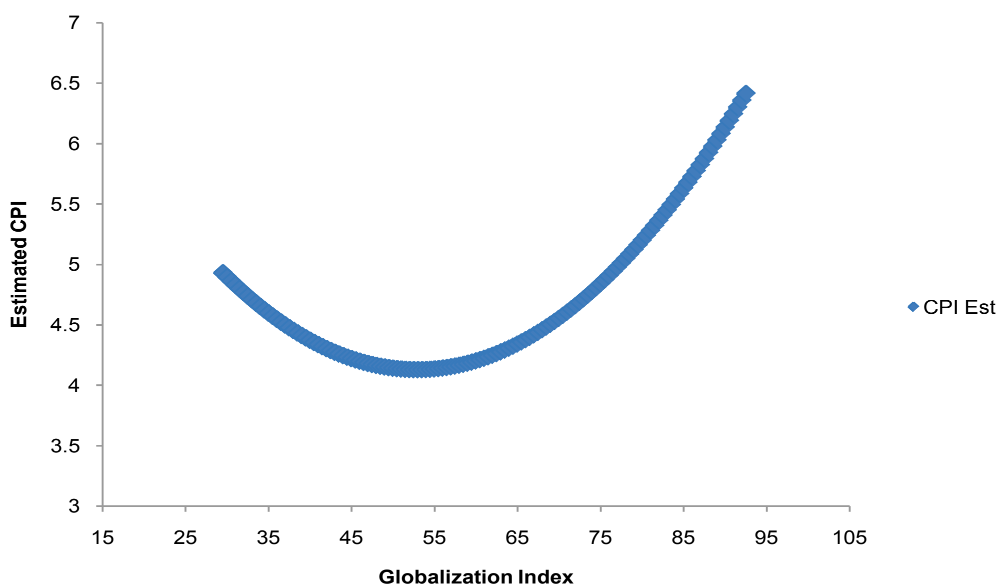

Figure 1 presents the estimated CPI values against the *Global* values included in the data set. The estimated CPI values are calculated using the results from Regression Model (2): $CPI = \beta_o + \beta_1 Global + \beta_2 Global^2 + \beta_3 PRCL + \beta_4 EFI + \beta_5 E + \beta_6 L + \beta_7 R + \beta_8 LnGDPPC + \varepsilon$

It is important to note, however, that a country with a *Global* value of approximately 52.94 will not necessarily have a low *CPI* score and countries with exceptionally low or high *Global* values will not necessarily have a high *CPI* score, as the other control variables also play an important role in determining a country's corruption levels. For example, Mauritius has a *Global* value of 52.35 and a more moderate *CPI* value of 5.5, but it also enjoys a relatively higher level of economic development and freedom compared to other transitioning countries mentioned above. Further, on the lower end of the globalization scale, Guinea-Bissau has a *Global* value of 33.11 and a low *CPI* value of 1.9, but it also has a considerably lower level of economic development and freedom relative to many other countries with similar *Global* values. Thus, when assessing a country's corruption level, it is important to take into consideration all factors that influence corruption levels in addition to its level of globalization. Overall, the results of this study strongly suggest that the relationship between globalization and corruption is nonlinear such that the effect of globalization on corruption levels is dependent on the level of globalization, and thus offers an explanation to the paradoxical relationship described in the existing literature.

CONCLUDING COMMENTS

Globalization has brought a greater attention to the manner in which countries conduct their economic and governmental affairs and the degree of corruption inherent in a country's economic and political systems. Past research has noted that with globalization there are increased opportunities for corrupt practices; however, there are also strong anti-corruption policies and regulations that countries must adhere to if they want to become active participants in the world economy. To date, research has assumed a direct, linear relationship between the two, forcing the positive and negative effects of globalization on corruption to compete with each other. This study is relaxes this linear assumption and allows for the effects of globalization on corruption to vary depending on the level of globalization. By identifying a significant nonlinear relationship between globalization and corruption, the major contribution of this study resolves the paradox presented in past research. Specifically, the findings suggest that globalization has a positive and negative effect on corruption, which depends on the globalization level of the country.

The results of this analysis such that the highest corruption levels are realized at moderate or transitioning levels of globalization, even after controlling for other factors known to affect corruption levels. Theoretically, at lower levels of globalization, there less opportunity for corrupt practices, but as countries become more globalized, the newly formed trade relationships create new opportunities for corruption. The urge for emerging economies such as China and Russia to catch up and compete in the global arena may encourage illicit and illegal transactions. Nevertheless, as countries continue integrate into the world economy, they face increased regulation by the anti-corruption policies and the act of becoming more globalized exposes the market inefficiencies in transactions and forces corruption levels to fall.

It is important to note that countries transitioning into the global economy will not necessarily have high corruption levels as the other factors such as economic and democratic freedoms, economic development and diversity affect a country's corruption levels. Nevertheless, this study's main finding has important implications for policy makers. Specifically, leaders and policy makers of countries that are beginning the globalization process need to be aware of the increased opportunities for corrupt practices in newly formed relationships and take action to reduce the incentives for corrupt behaviors. Further, these leaders should also recognize that while the supranational entities have strong anti-corruption policies in place, in the early stages of globalization, the results of this study suggest that these policies are not strong enough to prevent increases in corrupt practices. In summary, corruption is a global problem that will take the concerted efforts of all countries, policy makers and leaders to curtail it and the results of this study suggest that countries transitioning into the global community face the greatest concerns for corrupt practices.

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CAN STOCK PRICE MOMENTUM BE EXPLAINED BY ANCHORING?

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ABSTRACT

Using German stock data from 1980 to 2008, this study tests whether stock price momentum can be explained by anchoring – a specific form of non-rational behavior. Three different empirical tests indicate that anchoring is the driver of the 52-week high strategy which is long in stocks with a price at or close to their one year high price and short in stocks with a price far from their 52-week high. With sorting and regression approaches, it is further shown that the 52-week high strategy itself largely dominates the momentum strategy and that the distance of a stock's price to its 52-week high price is a better predictor of future returns than the momentum criterion.

JEL: G12, G14

INTRODUCTION

While most researchers agree on the existence of the momentum effect, no consensus has been reached why momentum portfolios are profitable. Supporters of the risk-based explanation view the excess returns of momentum strategies as rational compensation for risk. Researchers of the behavioral finance field, however, explain its profits with a deviation of prices from their fundamental values due to a non-rational behavior of at least some investors. Based on the behavioral approach, the momentum effect represents a serious challenge to the Efficient Market Hypothesis (EMH), which is not the case according to the risk-based explanations. The potential consequences of the momentum phenomenon on the EMH make the search for its driver an important field of research.

This work can be assigned to the behavioral field and tests whether anchoring, a specific form of non-rational behavior, can explain the momentum effect. It builds on the work of George and Hwang (2004). They hypothesize that momentum can be largely explained by a strategy that is long in stocks with a price at or near their 52-week high price (the highest price of the stock in the past one year) and is short in stocks with a price far from their 52-week high. The profitability of the 52-week high strategy is assumed to be explained by "anchoring", a type of irrational behavior which states that people use a reference point when forming estimates.

We examine the idea of George and Hwang (2004) and test whether anchoring can explain (indirectly through the 52-week high strategy) the momentum effect. Hence, the null hypothesis states that momentum cannot be explained by anchoring. In order to test our null, we need to examine whether first, the 52-week high strategy dominates the momentum strategy and second, whether anchoring qualifies as explanation for the 52-week high profits. The focus of this paper lies in the exploration of the second relation. Therefore, three different types of tests are proposed. To our knowledge, this study is the first that tests the link between this behavioral pattern and the 52-week high. The first test examines the 52-week high strategy at industry level. According to the anchoring hypothesis, the industry-52-week high strategy should not dominate the 52-week high since the one year high price of an industry is not publicly available and hence does not qualify as a potential reference point. We further test whether a strategy with a ranking criterion that employs the highest price of a stock over a period longer or shorter than one year is more profitable than the 52-week high. The highest price of a stock over most intervals is not published. Therefore, this measure is not easily accessible to investors and cannot be used as reference point. Thirdly, the profitability of the 52-week high strategy is measured during the dot-com bubble. A couple of papers document irrational behavior such as overreaction or herding as the cause for its emergence. When subjects herd or overreact, they do not suffer from the anchoring bias at the same time. This implies that people should not anchor during the dot-com bubble and hence, the 52-week high strategy is expected to be unprofitable during this period if it is caused by anchoring. Our main finding is that anchoring cannot be rejected as driver of the 52-week high strategy.

We also go further than George and Hwang (2004) by testing the relationship between momentum and the 52-week high. On the one hand, the link between the two strategies is explored more broadly. First, the profitability of both strategies is compared for different ranking and holding periods. This is important as it is not sufficient to compare the 52-week high to only one or two momentum strategies (e.g. the (6/1/6) strategy) in order to document the dominance of the 52-week high. Second, we look at the profitability of both strategies at industry level and find that they generate returns of similar magnitude. The similar profitability of them for industry portfolios further indicates a close relation between momentum and the 52-week high. On the other hand, the link between the two strategies is tested with two sorting and one regression approaches as all methods have strengths but also face substantial drawbacks.

The third contribution of this paper is to present some insights into the momentum literature for non-U.S. data. As most studies examine U.S. stocks, it is important to use a different sample in order to exclude data mining as explanation for the momentum effect. This work shows that the momentum effect still exists after 2001, which is doubted by Henker et al (2006), and Hwang and Rubesam (2007). We therefore support the view of Dimson et al. (2008) that the non-profitability of the momentum strategy after 2001 is only limited to the U.S. sample. Our data sample also allows a closer look at the momentum effect in Germany. Stock price momentum is profitable for the German market. This is shown by using the common methodology of Jegadeesh and Titman (1993). Furthermore, it documents that the industry momentum strategy is profitable. Yet, its returns are in opposite to the U.S. not as large as those of momentum strategies at individual stock level. Finally, this paper presents evidence that the 52-week high strategy of George and Hwang (2004) is also profitable outside the U.S for the total sample, but that it does not work during the dot-com bubble between October 1998 and February 2000.

The remainder of the paper is organized as follows. After a brief review of the literature, the data and the methodology used in the study are presented. Subsequently, the profitability of momentum and 52-week high strategies for German stocks is documented. The dominance of the 52-week high is examined in the fourth section. Then in the following section, we present anchoring and provide three tests whether the 52-week high is driven by this behavioral phenomenon. Section six reports robustness tests and in the last section, we summarize the results and make concluding remarks.

LITERATURE REVIEW

Our study builds on the work of George and Hwang (2004). They hypothesize that momentum can be explained by a strategy that uses the nearness of a stock's price to its 52-week high price as a ranking criterion. Stocks that are close to or near their 52-week high price are included in the winner portfolio while stocks with a price far from the highest price within the last one year are assigned to the loser portfolio. George and Hwang assume that the profitability of the 52-week high strategy is caused by "anchoring", a specific form of irrational behavior that describes the way people make estimations. Tversky and Kahneman (1974) argue that subjects focus too much on a reference point when forming estimates. Applying the anchoring phenomenon to the 52-week high strategy, investors estimate the impact of news on the stock price and therefore use the 52-week high price of a stock as reference point – an easily "accessible piece of information" (George and Hwang (2004)) as it is published in nearly all newspapers reporting on stocks.

If good news has pushed a stock to or close to its 52-week high price, investors are not prepared to bid the price higher even if the information warrants it. Since the information is not completely incorporated in the stock price at once, the price subsequently increases which results in continuation. Similarly, when bad news has pushed the stock price to a level far from its 52-week high, investors are also unwilling to sell the stock for a price as low as it should be based on the bad news. Subsequently, the news is incorporated in the stock price, which results in a decrease. Hence, investors are unwilling to immediately revise their beliefs. This unwillingness is largest for stocks close to or far from the 52-week high. For stocks that are traded neither close to nor far from their 52-week high, news is faster incorporated into the stock price which does not result in any observable predictability.

In order to examine whether anchoring qualifies as explanation for the momentum effect, it is important to examine the relation between the momentum strategy and the 52-week high strategy but also to test whether the 52-week high strategy is driven by anchoring. The examination of the second link is important as it indicates whether any evidence is found in momentum against the EMH. Without clear indication for investors' non-rationality driving the 52-week high, the relation between momentum and the 52-week high only states that one strategy is explained by another although the drivers of both are unknown and could also be linked to risk factors.

DATA AND METHODOLOGY

Our sample includes all listed stocks on German exchanges that were traded during the period January 1980 and March 2008, a total of 339 months. For each stock and each month, the price (adjusted for subsequent capital actions), the market value, the 52-week high price and the 52-week low price are obtained from Datastream. The intraday high price of each stock is collected on a daily basis. To mitigate microstructure effects that are associated with low-priced and illiquid stocks, only stocks with a price larger than one Euro and a market value above 50 Mio. Euro are considered for the ranking in month t. On average, the number of stocks available is 750 per month. Our sample includes both surviving and non-surviving stocks and does not suffer from a survivorship bias.

Portfolios for all strategies are constructed as in Jegadeesh and Titman (1993). At the end of each month, all traded stocks are ranked in ascending order based on the strategy's respective ranking criterion. The top 30 percent of stocks are assigned to the winner portfolio, the bottom 30 percent to the loser portfolio and the rest to a portfolio that is referred to as the middle one. These portfolios are equally weighted and not rebalanced during the holding period. To be precise, this implies that stocks are only perfectly equal-weighted at the date of the portfolio formation. As the portfolios are not rebalanced during the holding period, stocks with a price increase get a larger fraction in the portfolio, while stocks with a negative return during the holding period get a smaller weight. The investment strategy is self-financing, buys winner stocks, and sells loser stocks. Hence, the strategy profits are computed as the arithmetic difference (WML) between the returns of the winner portfolio (r_w) and the returns of the loser portfolio (r_l):

$$\text{WML} = r_w - r_l \tag{1}$$

To abstract from potential microstructure effects and the bid/ask bounce, we skip one month between the ranking and holding period which is common in the momentum literature. If a stock is delisted during the holding period, we follow Forner (2003) and assume that the remaining proceeds are equally invested in the remaining stocks. Consistent with Jegadeesh and Titman (1993), monthly portfolio returns are calculated on an overlapping holding period basis. Compared to non-overlapping returns, this method increases the power of the statistical tests and provides cleaner results as the bid-ask bounce effects are reduced (Moskowitz and Grinblatt (1999)). Hence, measuring returns on an overlapping period basis implies that the monthly average profits to K strategies (with K equals to the length of the holding period in months) are reported, each beginning one month apart. For example, at the beginning of month t, the winner portfolio with a holding period of 3 months consists of three sub-portfolios: one formed at the beginning of $t-3$, one built in $t-2$ and one started in $t-1$. At the beginning of month $t+1$, the monthly return is measured for the subportfolios constructed in $t-2$, $t-1$ and t, while the portfolio formed in $t-3$ is replaced by the one built in t.

We also conduct an experimental analysis to test whether subjects do in fact suffer from the anchoring bias. Therefore, 105 undergraduate students take part in this test and have to estimate a percentage number. Without their knowledge, students are subdivided into three groups. This is done by giving different information to the participants, which they might employ when estimating the percentage. In order to ensure that the results are not biased by a group dynamic, we make sure that a participant's estimation is not influenced by her neighbor firstly by leaving enough space between the subjects and secondly by ensuring that the information are not the same for students sitting next to each other. Furthermore, as the test is anonymous and as we do not offer payoffs for accuracy, the risk that decisions are made based on other criteria than the own estimate is quite small.

MOMENTUM AND THE 52 WEEK HIGH STRATEGY

Formally, the main difference between the momentum strategy and the 52-week high strategy is the ranking criterion. According to the momentum strategy, stocks are ranked based on their past buy-and hold performance. The 30 percent of stocks that performed best during the ranking period is attributed to the winner portfolio while the 30 percent of stocks with the worst buy-and-hold returns is assigned to the loser portfolio. The notation $(J/S/K)$ applies to the momentum strategies and indicates a ranking period of J months, a skip period of S months and a holding period of K months.

In Panel A of Table 1, average monthly momentum returns are reported for different ranking and holding periods. Winner and loser profits are returns in excess of the Datastream Germany Price Index. Table 1 documents that momentum strategies yield substantial and mainly highly significant profits over the sample period 1980 to 2008. Stocks that were winners over the previous 3 to 12 months continue to outperform past loser stocks over the next 3 to 12 months. All examined momentum strategies yield positive returns. For 12 out of 16 strategies, returns are significant on the 10% level, for 10 strategies on the 5% level and for 4 out of 16 strategies, momentum profits are significant on the 1% level. The highest monthly returns are generated by the (9/1/3) and the (6/1/6) portfolios. At first glance, the momentum profits in Table 1 seem rather low in comparison to the study of Jegadeesh and Titman (1993) reporting an average monthly return of about 1% for U.S. stocks. Yet, this results from the examination of the return differences between the top and bottom tercile while Jegadeesh and Titman (1993) focus on the top and bottom decile. The 30% and 70% breakpoints are chosen for two reasons: First, we use German data. Compared to the number of stocks traded in the U.S., our sample is much smaller which implies that winner and loser portfolios contain fewer stocks. This disadvantage can be reduced by including a larger fraction of stocks in the portfolios. And secondly, in opposite to Jegadeesh and Titman (1993) who are interested in presenting evidence for the existence of the momentum effect, we focus on the *driver* of this phenomenon and therefore, we can put less emphasize on the tails of the distribution. Some papers point out that the momentum effect has disappeared in the post-2000 era (Henker et al (2006), Hwang and Rubesam (2007)). Yet, our results show that this is not the case for momentum in Germany. Between January 1 2000 and March 1 2008, the (6/1/6) momentum portfolios generate an average monthly return of 0.60% (not in the tables). This finding is consistent with Dimson et al. (2008) examining UK stocks and reporting an average monthly profit of 0.86% for momentum portfolios after 2000. Hence, our results indicate that it is premature to pronounce the disappearance of momentum.

Table 1: Profits to Momentum and 52-week High Strategies

Ranking Period (in months)		Holding Period (in months) 3	6	9	12
	Panel A: Average Monthly Returns				
3	Winner	0.0016	0.0019	0.0021	0.0023
	Loser	-0.0006	-0.0013	-0.0016	-0.0010
	Winner-Loser	0.0022	0.0032*	0.0038**	0.0032**
		(1.05)	(1.83)	(2.52)	(2.33)
6	Winner	0.0032	0.0034	0.0031	0.0023
	Loser	-0.0018	-0.0022	-0.0019	-0.0011
	Winner-Loser	0.0049**	0.0056***	0.0050***	0.0034**
		(2.02)	(2.75)	(2.86)	(2.20)
9	Winner	0.0038	0.0034	0.0023	0.0016
	Loser	-0.0024	-0.0019	-0.0014	-0.0005
	Winner-Loser	0.0062***	0.0053***	0.0037**	0.0021
		(2.72)	(2.68)	(2.05)	(1.25)
12	Winner	0.0030	0.0025	0.0019	0.0014
	Loser	-0.0012	-0.0011	0.0002	0.0008
	Winner-Loser	0.0042*	0.0036**	0.0018	0.0006
		(1.95)	(2.07)	(0.92)	(0.32)
	Panel B: Average Monthly 52-week High Returns				
	Winner	0.0036	0.0033	0.0029	0.0024
	Loser	-0.0022	-0.0025	-0.0021	-0.0015
	Winner-Loser	0.0059**	0.0058**	0.0050**	0.0039*
		(2.12)	(2.24)	(2.08)	(1.74)

*This table reports the average monthly portfolio returns in excess of the Datastream Germany Price Index average return from February 1981 through March 2008, for momentum strategies (Panel A) and 52-week high strategies (Panel B). The winner (loser) portfolios on the momentum strategy are the equally weighted portfolios of the 30 percent of stocks with the highest (lowest) return over the ranking period. The winner (loser) portfolios of the 52-week high strategy are the equally weighted portfolios of the 30 percent of stocks with the highest (lowest) quotient of the current price to the 52-week high. For the ranking, all German stocks on Datastream with a price larger than one Euro and a market value above 50 Million Euro are considered; t-statistics (two-tailed) are reported in parentheses. *;**;*** are the significance levels on the 10%, 5% and 1% level.*

The ranking criterion of the 52-week high strategy is the distance of a stock's current price to its 52-week high (PHR^{52}: Price-52-week high ratio). Formally, let $P_{i,t-1}$ be the price of stock i at the first day of month $t-1$ and $H_{i,t-1}^{52}$ stock i's highest price during the one year period ending at the first day of month $t-1$.

$$PHR_{i,t-1}^{52} = \frac{P_{i,t-1}}{H_{i,t-1}^{52}} \quad (2)$$

By construction, PHR^{52} takes positive values but cannot be larger than one. The 30 percent of stocks with a price closest to their 52-week high (stocks with the largest PHR^{52}) are attributed to the winner portfolio and the 30 of stocks with a price furthest from their 52-week high (stocks with the smallest PHR^{52} values) are assigned to the loser portfolio. Panel B of Table 1 shows the average monthly returns of the 52-week high strategy for different holding periods. Stocks with a price close to the 52-week high significantly outperform stocks with a price far from the 52-week high over all four examined investment periods. The profits to the 52-week high strategy are approximately as high as the top momentum strategy for each investment period.

Momentum and 52-week high returns might be influenced by the turn-of-the-year effect: Stocks with a poor performance strongly rebound at the beginning of a new year. According to Roll (1983), Griffiths and White (1993) and Ferris et al. (2001), this anomaly is due to tax loss selling: In order to realize tax loss benefits, investors sell loser stocks at the end of the year. This leads to lower prices at year-end for loser stocks. At the beginning of the following year, the selling pressure vanishes and the prices of the loser stocks recover. In order to examine momentum and 52-week high profits when the turn-of-the-year effect is excluded, we report the returns for both strategies in non-January months in Table 2. Compared to the results in Table 1, loser portfolio returns are substantially lower for both, the momentum and the 52-week high strategy. This is consistent with the turn-of-the-year effect, which states that loser stocks perform well at the beginning of the year. The exclusion of January returns does also lead to lower profits in the winner portfolios. This is not unusual when the turn-of-the-year effect is excluded (see George and Hwang, 2004). Yet, the decrease of loser returns is larger compared to the decrease of the winner profits which leads to slightly higher average monthly returns for momentum and 52-week high strategies.

Table 2: Profits to Momentum and 52-week High Strategies in Months except January

Ranking Period (in months)		Holding Period (in months) 3	6	9	12
	Panel A: Average Monthly Returns				
3	Winner	0.0006	0.0008	0.0010	0.0006
	Loser	-0.0026	-0.0032	-0.0033	-0.0026
	Winner-Loser	0.0032	0.0040**	0.0043***	0.0032***
		(1.58)	(2.37)	(3.08)	(2.70)
6	Winner	0.0022	0.0023	0.0018	0.0011
	Loser	-0.0036	-0.0039	-0.0034	-0.0025
	Winner-Loser	0.0058**	0.0062***	0.0053***	0.0036**
		(2.45)	(3.13)	(3.10)	(2.34)
9	Winner	0.0026	0.0021	0.0010	0.0004
	Loser	-0.0040	-0.0034	-0.0028	-0.0018
	Winner-Loser	0.0066***	0.0054***	0.0038**	0.0022
		(3.01)	(2.76)	(2.06)	(1.23)
12	Winner	0.0017	0.0012	0.0006	0.0002
	Loser	-0.0026	-0.0021	-0.0012	-0.0006
	Winner-Loser	0.0043**	0.0033*	0.0018	0.0007
		(1.98)	(1.85)	(0.90)	(0.38)
	Panel B: Average Monthly 52-week High Returns				
	Winner	0.0029	0.0025	0.0022	0.0017
	Loser	-0.0044	-0.0046	-0.0041	-0.0034
	Winner-Loser	0.0073***	0.0071***	0.0062***	0.0051**
		(2.80)	(2.91)	(2.75)	(2.34)

*This table reports the average monthly portfolio returns in excess of the Datastream Germany Price Index average return from February 1981 through March 2008, for momentum strategies (Panel A) and 52-week high strategies (Panel B) excluding returns in Januaries. The winner (loser) portfolios on the momentum strategy are the equally weighted portfolios of the 30 percent of stocks with the highest (lowest) return over the ranking period. The winner (loser) portfolios of the 52-week high strategy are the equally weighted portfolios of the 30 percent of stocks with the highest (lowest) quotient of the current price to the 52-week high. For the ranking, all German stocks on Datastream with a price larger than one Euro and a market value above 50 Million Euro are considered; t-statistics (two-tailed) are reported in parentheses. *;**;*** are the significance levels on the 10%, 5% and 1% level.*

Our sample period includes the dot-com bubble around the year 2000. In order to ensure that our findings are not driven by this short period, we exclude all months between October 1 1998 and March 1 2000 during which the speculative bubble has grown. March 1 was chosen as the ending date since the German equivalent to the Nasdaq Composite, the NEMAX50, peaked at the beginning of March 2000. The choice of a beginning date is less clear for the dot-com bubble. We decide for October 1 1998 since the NEMAX50 increased by only 1.3% within 6 months before that date and rose by 17% from October 1 1998 to November 1 1998, by 43% until January 1 1999 and by 359% to March 1 2000. Table 3 reports the average monthly momentum and 52-week high returns for all months except for those during the dot-com bubble period. Most momentum returns and all 52-week high profits are higher when the dot-com bubble period is excluded. As in Table 1, the most profitable momentum strategy and the 52-week high yield returns that are approximately similar for each holding period. During the dot-com bubble, neither the momentum nor the 52-week high strategies performed well. Between October 1998 and March 2000, 13 out of 16 momentum strategies yield negative returns and only two have a slightly positive average monthly return. The four 52-week high strategies perform even worse and generate with -0.8% to -1.3% (not reported in the tables) substantially negative average monthly profits. Hence, momentum and 52-week high strategies seem to be profitable between 1981 and 2008. The profits are not due to the turn-of-the year effect or due to the dot-com bubble period.

Table 3: Profits to Momentum and 52-week High Strategies outside the Dot-com-Bubble Period

Ranking Period (in months)		Holding Period (in months) 3	6	9	12
	Panel A: Average Monthly Returns				
3	Winner	0.0015	0.0016	0.0020	0.0017
	Loser	-0.0008	-0.0017	-0.0019	-0.0013
	Winner-Loser	0.0023	0.0033**	0.0039**	0.0031**
		(1.05)	(1.79)	(2.48)	(2.51)
6	Winner	0.0027	0.0032	0.0030	0.0026
	Loser	-0.0020	-0.0024	-0.0020	-0.0012
	Winner-Loser	0.0048**	0.0057***	0.0051***	0.0038**
		(1.87)	(2.63)	(2.86)	(2.40)
9	Winner	0.0037	0.0033	0.0029	0.0022
	Loser	-0.0024	-0.0020	-0.0012	-0.0003
	Winner-Loser	0.0062***	0.0054***	0.0041**	0.0025
		(2.60)	(2.69)	(2.20)	(1.49)
12	Winner	0.0035	0.0031	0.0027	0.0022
	Loser	-0.0008	-0.0008	0.0004	-0.0010
	Winner-Loser	0.0043**	0.0040**	0.0023	0.0012
		(2.06)	(2.44)	(1.27)	(0.74)
	Panel B: Average Monthly 52-week High Returns				
	Winner	0.0040	0.0040	0.0036	0.0031
	Loser	-0.0018	-0.0028	-0.0031	-0.0016
	Winner-Loser	0.0066**	0.0067**	0.0058**	0.0047**
		(2.36)	(2.50)	(2.45)	(2.16)

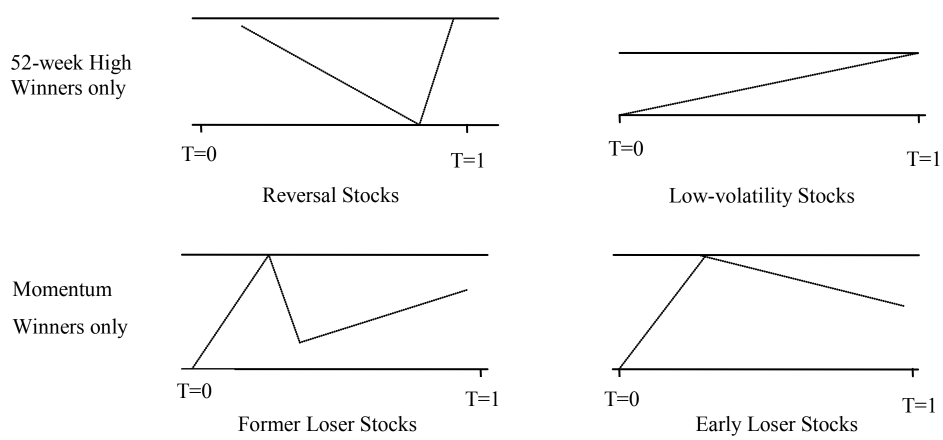
*This table reports the average monthly portfolio returns in excess of the Datastream Germany Price Index average return from February 1981 through March 2008, for momentum strategies (Panel A) and 52-week high strategies (Panel B) excluding the period of the dot-com bubble from October 1st 1998 to March 1st 2000. The winner (loser) portfolios on the momentum strategy are the equally weighted portfolios of the 30 percent of stocks with the highest (lowest) return over the ranking period. The winner (loser) portfolios of the 52-week high strategy are the equally weighted portfolios of the 30 percent of stocks with the highest (lowest) quotient of the current price to the 52-week high. For the ranking, all German stocks on Datastream with a price larger than one Euro and a market value above 50 Million Euro are considered; t-statistics (two-tailed) are reported in parentheses. *;**;*** are the significance levels on the 10%, 5% and 1% level.*

The 52-week High and the Momentum Strategy with a Ranking Period of 12 Months

Momentum strategies with a ranking period of 12 months cover a ranking period which is as long as that of the 52-week high strategies (momentum focuses on the past 12 months performance while the 52-week high uses the highest price over the past one year in its ranking measure). Despite of the identical length of the ranking period, momentum strategies are substantially less profitable for all examined holding periods (see Table 1 – Table 3). This leads to the question, which stocks are included in the winner (loser) portfolio according to the 52-week high criterion but are not in the winner (loser) portfolio based on the 12 months momentum measure and the other way round.

The first line in Figure 1 illustrates two types of stocks that are in the winner portfolio of the 52-week high strategy but not in that of the momentum strategy. In the second line of Figure 1, two types of stocks are illustrated which are in the momentum winner portfolio but not in the 52-week high winner portfolio. Each graphic shows the stock price from $T = 0$ to $T = 1$. This time horizon is defined as 12 months. The top horizontal line represents the 52-week high between $T = 0$ and $T = 1$, while the bottom horizontal line shows the lowest price within this interval. The first graphic illustrates “Reversal Stocks” which lose value at the beginning but recover and are near or close to the 52-week high in $T = 1$. As the buy-and-hold return between $T = 0$ and $T = 1$ is small, these stocks are not winners according to the momentum criterion. "Low-volatility Stocks" are also 52-week high but not momentum winners. For this type of stocks, the distance between their 52-week high and low is small. In the second line of Figure 1, the price pattern of stocks that are only momentum winners is illustrated. "Former Loser Stocks" suffer from great loses at the beginning and stabilize on a certain level (or slightly recover). They are only momentum winner stocks as the return between $T = 0$ and $T = 1$ is large but do not belong to the 52-week high winners as the stocks trade far from their 52-week high. In the bottom left graphic, the price pattern of "Early Loser Stocks" which yield high returns at the beginning of the period but have a poor performance at the end. As the 52-week high strategy is substantially more profitable than the $(12/1/x)$ momentum strategy, either stocks that are only considered winner stocks by the 52-week high strategy perform well or stocks that are only momentum winners underperform. Hence, either "Reversal Stocks" or "Low-volatility Stocks" have a good performance in the holding periods or "Former Loser Stocks" or "Early Loser Stocks" must perform poorly. Symmetric conclusions can be drawn for loser stocks.

Figure 1: Types of Stocks Responsible for the Difference between the (12/1/x) Momentum and the 52-week High Strategy Performance



The figure shows types of stocks that are 52-week high winners but not momentum winners (H1 and H2) and types of stocks that are included in the winner portfolio by the momentum criterion but not by the 52-week high measure (M1 and M2). Each graphic illustrates the stock's price pattern from $T = 0$ to $T = 1$. This time span between $T = 0$ to $T = 1$ is defined as 12 months. The top horizontal line represents the 52-week high between $T = 0$ and $T = 1$ while the bottom horizontal line shows the lowest price within this interval.

This brief illustration has two interesting implications. First, it theoretically shows that there are types of stocks, which are only considered as winners by one criterion. These types could make the difference in the performance between the 52-week high and the $(12/1/x)$ momentum strategy. Secondly, these four graphics show that the $(12/1/x)$ momentum is slower in identifying future winner stocks: Since it is less profitable than the 52-week high, stocks that are only momentum winners are expected to have a bad or at least modest performance while stocks that are only 52-week high winners are assumed to perform well. "Reversal Stocks" and "Low-volatility Stocks" are assigned to the 52-week high winner portfolio in $T = 1$. Due to their excepted performance, they will also be included in the momentum winner portfolios to a later date. Hence, the 52-week high strategy seems to earlier invest in a future winner stock than the momentum strategy. A similar pattern can be observed for the "Former Loser Stocks" and "Early Loser Stocks". While the 52-week high does not include those stocks in the winner portfolio in $T = 1$, the momentum criterion does. Finally, after $T = 1$, after a bad or modest performance of those stocks, the momentum measure does also refuse to call these stocks winners. Hence again, while the poor performance of these stocks is identified by 52-week high in $T = 1$, the $(12/1/x)$ momentum measure is much slower. In summary, these four types of stocks indicate that the 52-week high is faster in identifying winner stocks than the momentum strategy with a ranking period of 12 months.

COMPARISON BETWEEN THE MOMENTUM AND THE 52 WEEK HIGH STRATEGY

In Table 1-3, the profitability of momentum strategies with different ranking and holding periods are compared to the returns of 52-week high strategies with different holding periods. Measuring the performance of both strategies over a variety of ranking and holding periods is important in order to completely examine their relationship. For example, it is not sufficient to compare only the (6/1/6) momentum strategy with the 52-week high strategy, since it is not necessarily the most profitable momentum strategy (Rouwenhorst (1998), Forner and Marhuenda (2003), Doukas and McKnight (2005), Agyei-Ampomah (2007)). This section examines whether stock price momentum and the 52-week high are independent or whether one ranking criterion dominates the other. Therefore, with the sorting and the regression approach, two different methods are employed. The sorting approach attributes stocks to different portfolios based on both the 52-week high and the momentum criterion. This method can further be subdivided in a conditional sort and a two-way sort. Based on the conditional sort, stocks are first sorted and collected in different portfolios according to one strategy. Then within the portfolios, stocks are further ranked on the criterion of the second strategy. The two-way method ranks stocks *independently* based on the first and on the second ranking criterion and forms portfolios based on the independent rank of both strategies. For example, winners according to one ranking criterion are subdivided into different portfolios based on the second independent sort. A big advantage of the sorting approach is that this methodology offers a simple and intuitive insight in the relationship between two strategies, as stocks are included in different portfolios of which the returns can be easily compared and interpreted. A potential problem, however, is the unevenly balanced number of stocks within the portfolios. For example, there are more stocks ranked as winners by both criteria than stocks that are momentum winners and at the same time losers based on the 52-week high. A further disadvantage is the construction of test statistics, which is less clear for the sorting approach compared to other methods (Nijman et al. (2004)). Beside sorts, strategies can also be compared by regressions. They allow the incorporation of other effects in addition to the momentum and the 52-week high effects. For example, firm size can be controlled for, as a relationship between firm size and momentum returns is documented in some studies (Rouwenhorst (1998), Hong (2000)). Moreover, the construction of regressions and the interpretation of the obtained results seem to be well understood. Yet, a drawback of regressions is the functional form they impose on the relationship between the exogenous and the endogenous variables (Fama and French (2008)). This form might be incorrect and therefore lead to wrong conclusions. In order to ensure that our results are not driven by the drawbacks of the employed method, we use both approaches to test the relationship between the momentum and the 52-week high strategy.

As a first sorting method, a conditional sort is conducted: Stocks are assigned to different portfolios based on one ranking measure. Then within the portfolios, stocks are further sorted according to the criterion of the second strategy. This test identifies whether the 52-week high strategy still has explanatory power conditional on the momentum ranking, and vice versa. For consideration of space, we only report the results of the comparison between the most profitable momentum strategy and the 52-week high over a holding period of six months (Table 4). Other periods produce similar results. In Panel A of Table 4, stocks are first classified into winner, middle and loser portfolios according to the momentum criterion (the past six-month performance), then each of the three portfolios is further subdivided into winner, middle and loser portfolios based on the 52-week high rankings. Panel B documents the results when stocks are first classified based on the 52-week high performance measure and then sorted according to the momentum criterion within the three portfolios. As above, the top 30% of stocks is assigned to the winner portfolio, the bottom 30% is included in the loser portfolio while the rest (40%) is collected in the middle portfolio. The ranking criterion for the momentum strategy is the past return of a stock during $t-7$ and $t-2$ and PHR^{52} for the 52-week high strategy. Panel B shows that the (6/1/6) momentum strategy loses its profitability within the 52-week high winner and loser groups. The returns to momentum W-L portfolios are small at 0.28 percent or less and not significant. Excluding the dot-com bubble period (column 2) or the turn-of-the-year effect (column 3) or both (column 4) does not increase momentum profits within the 52-week high winner and loser groups. In opposite, the 52-week high strategy still is profitable after controlling for momentum. This is at least true for non-January returns and outside the dot-com bubble where the 52-week high measure yields large and significant profits (0.38% – 0.56% on average per month). The returns to the 52-week high strategy within the winner and loser momentum portfolio are almost two times higher than the profits to the (6/1/6) momentum strategy within the 52-week high winner and loser groups outside the dot-com period. The dominance of the 52-week high over momentum becomes even more obvious when both the dot-com period and January returns are excluded (column 4). Importantly, for non-January returns or outside the dot-com bubble, the 52-week high strategy remains also profitable within the middle momentum portfolio (with a monthly return of between 0.38% and 0.48%). According to the momentum strategy, these stocks do not have extremely high or extremely low future returns. Hence, if the momentum measure is a powerful predictor of future returns, forming subgroups within the middle portfolios based on the 52-week high criterion should not lead to profits. In contrary, the (6/1/6) momentum measure does not produce large and significant returns within the middle group of the 52-week high. Over the total sample period, however, the dominance of the 52-week high over momentum is less obvious. Although the momentum criterion does not generate significant returns within the 52-week high groups, this is also not the case for the 52-week high measure within the momentum portfolios. As the findings in Table 4 indicate, either this might be due to the turn-of-the-year effect which distorts the results related to the relationship between the 52-week high and the (6/1/6) momentum strategy or it could be influenced by the dot-com bubble period. During this phase, the 52-week high portfolios underperform the momentum ones although both strategies are not profitable.

The relationship between the 52-week high and the momentum strategy is further tested using a two-way sort. Based on the momentum criterion, all stocks are divided into three portfolios (M1, M2, M3). The top 30% of the stocks are included in portfolio M1. Independently from this sort, stocks are arranged in three portfolios (H1, H2, H3) based on the 52-week high criterion, with the 30% of stocks closest to the 52-week high included in portfolio H1. Hence, the portfolio M1H1 consists of stocks that are in the winner portfolio according to both the momentum and the 52-week high ranking criterion. As above, the test is conducted for the relationship between the (6/1/6) momentum and the 52-week high with a holding period of six months (Table 5).

The two-way sort confirms the findings of the conditional sort. Table 5 indicates that the 52-week high dominates the (6/1/6) momentum strategy when the turn-of-the-year effect or the dot-com bubble effect is excluded (Panel B-D). This can be observed in the positive H1-H3 returns that are large and mostly significant. They indicate whether stocks with a price close to the 52-week high outperform stocks with a price far from their one year high within the same momentum portfolio. In opposite, the M1-M3 portfolio returns are small and not significant. They document whether stocks with a good 6-month performance outperform stocks with a poor 6-month return within the same 52-week high portfolio. Hence, the 52-week high strategy seems to dominate the (6/1/6) momentum strategy at least outside the dot-com bubble period or in non-January returns. The results of the two-way sort for the strategies with other holding periods leads to similar conclusions (not reported).

Table 4: Comparison between the (6/1/6) Momentum and the 52-week High Strategy – Conditional Sort

Panel A					
Portfolios Classified by the Momentum	**Portfolios Classified by the 52-Week High**	**Ave. Monthly Return**	**Ex.10/98-2/00**	**Ex. January**	**Ex. Jan. and ex. 10/98-2/00**
Winner	Winner	0.0042	0.0040	0.0032	0.0038
	Loser	0.0016	0.0001	-0.0006	-0.0013
	Winner-Loser	0.0027	0.0040	0.0038	0.0051
		(1.47)	(2.55)**	(2.27)**	(3.10)***
Middle	Winner	0.0008	0.0019	0.0003	0.0018
	Loser	-0.0019	-0.0019	-0.0035	-0.0030
	Winner-Loser	0.0028	0.0038	0.0039	0.0048
		(1.42)	(2.09)**	(2.08)**	(2.57)**
Loser	Winner	-0.0019	-0.0008	-0.0020	-0.0011
	Loser	-0.0043	-0.0051	-0.0077	-0.0082
	Winner-Loser	0.0025	0.0043	0.0056	0.0071
		(0.76)	(2.11)**	(2.22)**	(2.81)**

Panel B					
Portfolios Classified by the 52-Week High	**Portfolios Classified by the Momentum**	**Ave. Monthly Return**	**Ex. 10/98-2/00**	**Ex. January**	**Ex. Jan. and ex10/98-2/00**
Winner	Winner	0.0046	0.0040	0.0032	0.0030
	Loser	0.0020	0.0018	0.0003	-0.0014
	Winner-Loser	0.0026	0.0022	0.0029	0.0016
		(1.58)	(1.37)	(1.74)*	(1.07)
Middle	Winner	0.0017	0.0011	0.0004	-0.0003
	Loser	-0.0010	-0.0005	-0.0014	-0.0011
	Winner-Loser	0.0028	0.0016	0.0019	0.0007
		(1.54)	(1.20)	(1.39)	(0.56)
Loser	Winner	-0.0008	-0.0022	-0.0039	-0.0051
	Loser	-0.0031	-0.0044	-0.0067	-0.0077
	Winner-Loser	0.0024	0.0022	0.0028	0.0026
		(1.30)	(1.20)	(1.67)*	(1.54)

*The table reports the average monthly returns of portfolios that are formed according to the (6/1/6) momentum and to the 52-week high strategy with a 6-month holding period from February 1981 through March 2008. In Panel A, stocks are first sorted on the (6/1/6) momentum ranking criterion and subsequently within the three portfolios based on the 52-week high criterion. In Panel B, stocks are sorted according to the 52-week high measure and then based on the momentum criterion. In column three, the average monthly portfolio returns are reported for the total sample period, in column four for the total period except for the dot-com bubble period between October 1998 and February 2000. Column five reports non-January returns and the last column non-January returns outside the dot-com bubble. The t-statistics are in parentheses. *;**;*** are the significance levels on the 10%, 5% and 1% level.*

As a third method to examine the relationship between the momentum and the 52-week high strategy, Fama-MacBeth (1973) style cross-sectional regressions similar to those in George and Hwang (2004) are conducted. As above, we compare the (6/1/6) momentum strategy to the 52-week high with a holding period of six month length. Dummy variables that indicate whether a stock is included in the winner or loser portfolios by a strategy are regressed on the month t return of stock i. In order to control for firm size, the market capitalization of firm i is taken as explanatory variable with a lag. With the return of stock i in $t-1$ as explanatory variable, a second control variable is employed to isolate the bid-ask bounce impact on the coefficient estimates. Hence, the coefficients of the dummy variables help us to measure the return of one strategy in isolation from the second one and in control of size and the bid-ask bounce. As mentioned above, overlapping portfolios are employed to examine a strategy's profitability. Consequently, as we examine the 52-week high and the momentum strategy for a holding period of six months, the winner and loser portfolios of both strategies in month t consist of six sub-portfolios formed in $t-j$ (with $j = 2, \dots 7$) respectively.

Table 5: Comparison between the (6/1/6) Momentum and the 52-week High Strategy – Two-way Sort

	52-week High Strategy				
(6/1/6) Momentum Strategy	H1	H2	H3	H1-H3	t-stat
	Panel A: Raw Returns				
M1	0.0033	0.0015	0.0001	0.0033	(1.10)
M2	0.0003	-0.0012	-0.0035	0.0039	(1.50)
M3	0.0001	-0.0012	-0.0042	0.0043	(1.26)
M1-M3	0.0032	0.0027	0.0043	-0.0011	
t-stat	(1.56)	(1.51)	(1.94)*		
	Panel B: Ex Dot-com Bubble				
M1	0.0042	0.0016	-0.0013	0.0055	(1.95)*
M2	0.0017	0.0000	-0.0032	0.0049	(1.84)*
M3	0.0012	-0.0001	-0.0041	0.0053	(1.49)
M1-M3	0.0030	0.0017	0.0028	0.0002	
t-stat	(1.27)	(0.91)	(1.28)		
	Panel C: Ex Jan				
M1	0.0027	0.0004	-0.0029	0.0055	(1.98)**
M2	0.0003	-0.0005	-0.0041	0.0045	(1.78)*
M3	0.0000	-0.0007	-0.0048	0.0048	(1.35)
M1-M3	0.0027	0.0011	0.0020	0.0007	
t-stat	(1.02)	(0.70)	(0.85)		
	Panel D: Ex. Jan and ex. Dot-com Bubble				
M1	0.0035	0.0006	-0.0034	0.0069	(2.45)**
M2	0.0015	0.0000	-0.0038	0.0053	(2.08)**
M3	0.0011	0.0000	-0.0055	0.0066	(1.82)*
M1-M3	0.0024	0.0006	0.0020	0.0004	
t-stat	(1.13)	(0.65)	(1.26)		

The table reports the average monthly returns of portfolios that are formed according to the (6/1/6) *momentum and the 52-week high strategy with a 6-month holding period from February 1981 through March 2008. Panel A reports the average monthly returns over the total sample period. Panel B documents average monthly returns when the dot-com bubble period is excluded, whereas Panel C reports average returns for non-January months. In Panel D, the average monthly non-January profits outside the dot-com bubble are documented. The t-statistics are in parentheses. *;**;*** are the significance levels on the 10%, 5% and 1% level.*

We estimate for each j the following regression in order to examine the relationship between the winner and loser portfolios formed in $t-j$ and the return in month t:

$$
\begin{aligned}
R_{i,t} &= \alpha_{0t}^{j} + \alpha_{1t}^{j}\, size_{i,t-1} + \alpha_{2t}^{j}\, R_{i,t-1} + \alpha_{3t}^{j}\, mw_{i,t-j} + \alpha_{4t}^{j}\, ml_{i,t-j} \\
&= +\alpha_{5t}^{j}\, hw_{i,t-j} + \alpha_{6t}^{j}\, hl_{i,t-j} + \epsilon_{it}, \qquad (3)
\end{aligned}
$$

where $R_{i,t}$ is the return and $size_{i,t}$ the market value of stock i in month t. The momentum strategy is considered in the regression by two dummy variables, $mw_{i,t-j}$ and $lw_{i,t-j}$. If in month $t-j$, stock i is ranked in the top (bottom) 30% based on the momentum ranking criterion, $mw_{i,t-j}$ $(lw_{i,t-j})$ is one and zero otherwise. The ranking criterion of momentum is stock i's buy-and-hold return between $t-j-6$ and $t-j$. The dummy variables $hw_{i,t-j}$ and $hl_{i,t-j}$ represent the 52-week high strategy: if in month $t-j$ stock i is among the top (bottom) 30% according to the 52-week high ranking measure, $hw_{i,t-j}$ ($hl_{i,t-j}$) takes one and zero otherwise. The ranking criterion of the 52-week high is the ratio of stock i's price in $t-1$ and its highest price between $t-j-12$ and $t-j$. The intercept α_{0t}^{j} can be interpreted as the monthly return of a portfolio that has hedged out the size effect, the bid-ask bounce, the momentum and the 52-week high effect (Fama (1976)). The dummy variable coefficients α_{3t}^{j} for example can be viewed as the return in excess of α_{0t}^{j} that is obtained by taking a long position in the (6/1/6) momentum winner portfolio in isolation of all other effects. In order to get the total monthly return of the pure winner or pure loser portfolios, the averages of the coefficients from the six independent regressions for each $j = 2, \ldots, 7$ are calculated: $1/6 \sum_{j=2}^{7} \alpha_3^j$, …, $1/6 \sum_{j=2}^{7} \alpha_6^j$.

Table 6: Comparison between the (6/1/6) Momentum and the 52-week High Strategy – Regression

	All Months	Ex Dot-com Bubble	Ex Jan
α_i	0.94	0.81	0.81
	(3.65)***	(3.12)***	(3.05)***
$size_{i,t-1}$	-0.02	-0.05	-0.04
	(-0.80)	(-0.76)	(-0.94)
$R_{i,t-1}$	-1.03	-1.04	-1.03
	(-3.96)***	(-3.34)***	(-3.74)***
$mw_{i,t-j}$	0.24	0.25	0.22
	(2.49)***	(2.59)***	(2.30)**
$ml_{i,t-j}$	-0.13	-0.10	-0.13
	(-1.67)*	(-1.70)*	(-1.69)*
$hw_{i,t-j}$	0.17	0.24	0.20
	(1.82)*	(2.10)**	(2.15)**
$hl_{i,t-j}$	-0.24	-0.23	-0.34
	(-1.70)*	(-1.71)*	(-2.05)**
$mw_{i,t-j} - ml_{i,t-j}$	0.37	0.34	0.35
	(2.34)***	(2.28)**	(2.20)**
$hw_{i,t-j} - hl_{i,t-j}$	0.40	0.48	0.55
	(2.16)**	(2.38)**	(2.30)**

The table reports the time-series average of the averaged coefficients obtained from six cross-sectional regressions (j=2, 7) which are estimated for each month between February 1981 and March 2008. The regressions for the (6/1/6) *momentum strategy and the 52-week high with a 6-month holding period are conducted as described in Equation (3). The time-series t-statistics are documented in parentheses. The first column reports the results for all months, the second column shows the findings for all months except for those during the dot-com bubble period from October 1998 to February 2000 and the last column reports the returns for non-January months. *;**;*** are the significance levels on the 10%, 5% and 1% level.*

Table 6 reports the time-series averages of the total monthly returns and the associated t-statistics. In the bottom of the table, the difference between the winner and loser dummies for the momentum (the 52-week high strategy) represents the average monthly return from a zero-cost portfolio that is long in the momentum (52-week high) winners and short in the momentum (52-week high) losers. The regression results support the general conclusions of the sorting approach. When the dot-com bubble period is excluded, the dominance of the 52-week high strategy is obvious. A self-financing 52-week high strategy yields 0.48%, which is much larger than the momentum return of 0.34%. A similar pattern is present when January returns are excluded. Using raw returns, the dominance is less clear and the difference in the 52-week high dummy variables is with 0.40% only weakly larger than the difference in the momentum dummy variables with 0.37%.

So far, the results indicate that the momentum and the 52-week high strategy generate similar returns, but that the 52-week high dominates momentum – at least when it is controlled for the dot-com bubble effect or the turn-of-the-year effect. Yet, this is not enough to reject the hypothesis that momentum is not driven by the anchoring phenomenon. The cause for the profitability of the 52-week high strategy (and hence of momentum) could also be a risk factor not yet detected or another behavioral heuristic than anchoring.

ANCHORING AS EXPLANATION FOR THE 52-WEEK HIGH PROFITS

Evidence for Anchoring

A potential explanation for the profitability of the 52-week high strategy is "anchoring" (George and Hwang, 2004). Anchoring refers to the method how people make estimations. Tversky and Kahneman (1974) argue that people form estimates by starting from an initial value and then adjusting to the final guess. Anchoring states that this adjustment is not sufficient and that subjects focus too much on the initial value (or reference point). Hence, anchoring can be defined as the insufficient adjustment of people's estimate from the starting value to the final guess. To examine this behavior, we carry out an experimental analysis similar to one of Tversky and Kahneman (1974). We ask 105 undergraduate students to estimate the fraction of the area in Germany that is used for agriculture. We decide for this question based on two criteria: First, its answer should be unknown to the subjects so that they in fact have to guess the correct percentage and secondly it should be easily understandable for the participants in order to avoid misunderstandings. In the test, the participants have to answer two questions. In the first one, they are asked to estimate whether the fraction is smaller or larger than a specific number, which is given to them and which varies across the students. The specific number represents the initial value and is 20% for the first group, 50% for the second and 70% for the third group. In the second question, they have to estimate the percentage. In order to ensure that the results are not biased by a group dynamic, we make sure that a student's estimation is not influenced by her neighbor by first leaving enough space between the subjects and secondly by not giving the same initial value to students sitting next to each other. Furthermore, as the test is anonymous and as we do not offer payoffs for accuracy, the risk that decisions are made based on other criteria than the own estimate is quite small.

The core finding of the test is that the arbitrarily numbers have a substantial effect on the estimates. The median estimate for the group that obtains 20% as percentage number is 31% while it is 47% for the group with an initial value of 50%. Participants that have to evaluate whether the percentage is smaller or larger than 70% have a median estimate of 56%. When the estimates are compared pair wise between the groups, the differences are highly significant with a p-value below 0.01.

The Industry-52-week High Strategy

As documented, momentum strategies are profitable for individual stocks. There is also some evidence that the momentum effect is present at industry level (Moskowitz and Grinblatt, 1999, Nijman et al., 2004). Strategies that buy the top industries and sell the bottom industries based on the past returns over the ranking period generate significant monthly profits. Since momentum and the 52-week high strategies seem to be related, it is worth to examine whether the 52-week high strategy is also profitable at industry level. This test is that powerful as it tests both relationships, that between the momentum and the 52-week high strategy and that between the 52-week high strategy and anchoring. Evidence for both relationships is obtained by comparing the returns of the momentum and the 52-week high strategy at individual stock level and at industry level. Four potential findings with different interpretations are possible: First, the industry-52-week high strategy dominates and explains the profitability of the 52-week high strategy at individual stock level. This finding presents clear evidence against the anchoring hypothesis, which states that traders evaluate the impact on news based on a reference point. It implies that the reference point is a piece of information that is readily available to traders. This is true for the 52-week high of an individual stock as it is reported in nearly all newspapers publishing stock prices. However, this is not the case for the 52-week high of an industry. This piece of information is not available and needs to be calculated manually. Therefore, the 52-week high price of an industry cannot be considered as an easily obtainable piece of information. Consequently, the industry-52-week high strategy should not be substantially profitable or at least not dominate the 52-week high strategy of individual stocks if anchoring explains its profitability.

Secondly, the 52-week high strategy is not profitable at industry level. This could imply that the 52-week high is not able to explain momentum as it has not the capability to explain its profitability in industry portfolios. Yet, it could also indicate that momentum and industry momentum are independent phenomena with different drivers (due to their similar ranking criterion, this interpretation seems rather unrealistic). Furthermore, this second potential finding does not represent any evidence against anchoring being the driver of the 52-week high as the nearness to the 52-week high price of an industry is (at least) not a better predictor of future returns than the 52-week high price of individual stocks which is an easily available piece of information.

Third, the profits to the industry-52-week high strategy are not larger than those to the 52-week high but different in magnitude compared to the industry momentum returns. As above, since the industry-52-week high does not dominate the 52-week high, this finding does not present evidence against anchoring as the driver of the 52-week high. It also implies that there is a close link between the 52-week high and the momentum strategy, as the profits of the strategies are similar both at individual stock level and in industry portfolios.

Fourth, the profits to the industry-52-week high strategy are not larger than those of the 52-week high but similar to the industry momentum profits. As in the third potential finding, this does not contradict the anchoring idea. Concerning the link between momentum and the 52-week high, the finding points on a close relation between the two strategies as their profits are similar both at individual stock and at industry level.

Only the fourth potential finding presents support for the hypothesis that anchoring explains the stock price momentum. All other potential findings are either at odds with anchoring being the driver of the 52-week high or present evidence against a close relationship between the 52-week high and the momentum strategy. The construction of the industry-52-week high strategy resembles that of the 52-week high for individual stocks. Yet, since for an industry, neither a price nor a 52-week high exist, we calculate the price-52-week high ratio (PHR) for each industry. Therefore, the weighted price of all n_j stocks belonging to industry j at the beginning of month $t-1$ is divided by the weighted 52-week high of all n_j stocks (the highest price of a stock over one year ending at the beginning of month $t-1$). Within industry j, the n_j stocks are weighted based on the factor $\omega_{i,t-1}$. If stocks are value-weighted within the industries, it represents the fraction of stock i's market value in $t-1$ to the total market value of industry j in $t-1$. If however, stocks are equal-weighted within an industry, $\omega_{i,t-1}$ is equal to one divided by n_j:

$$PHR^{52}_{j,t-1} = \frac{\sum_{i=1}^{n_j} \omega_{i,t-1} P_{i,t-1}}{\sum_{i=1}^{n_j} \omega_{i,t-1} H^{52}_{i,t-1}} \quad (4)$$

By construction, the PHR measure can take positive values not larger than 1: if all stocks of industry j trade exactly on their 52-week high, PHR is one, if industry j's stocks have a price that is extremely far from their one year high, PHR takes a value close to zero. The strategy is long in stocks that belong to the 30% of industries with the highest PHR value and short in stocks that belong to 30% of industries with the lowest PHR measure. The portfolios are held over a holding period of six months. Between the ranking time and the holding period, a skip period of one month is included.

In order to examine the industry-52-week high strategy, we classify stocks into one of 20 industries according to the FTSE Economic and Industrial sector criterion of Datastream. We decide for this industry measure for three reasons. First, Moskowitz and Grinblatt (1999) also classify stocks into 20 industry categories when examining industry momentum. Secondly, dividing stocks into more than 20 industry groups would imply a smaller number of stocks per industry. This would increase the risk that results are driven by idiosyncratic effects due to lack of diversification. A broader measure in opposite would reduce the number of industries that is included in the winner and loser portfolios. To ensure that the industry portfolios are well diversified and have only negligible firm-specific risk, we reduce our sample period to the interval between March 1988 and March 2008. This is necessary since the industry-52-week high strategy has stricter requirements on data availability than the momentum and the 52-week high strategies as a sufficient number of stocks is necessary for *each* industry to ensure diversification. Since the number of stocks is small for some industries between 1980 and 1988, we ignore this period in the subsequent research. Additionally, each month, only industry that contain 15 stocks or more are considered. Table 7 gives a description of the industry portfolios and a summary on them. There are some differences in the average monthly returns of industry portfolios when stocks are value- and equal-weighted within an industry. Therefore, the following tests are computed for both value-weighted and equal-weighted industry portfolios.

Table 7: Description of Industries, March 1988 – March 2008

Industry	**Value-weighted**		**Equal-weighted**		**Avg. % of Market Cap.**	**Avg. No. of Stocks**	**Average PHR**
	Mean	**St. Dev.**	**Mean**	**St. Dev.**			
Automobiles & Parts	0.15	3.15	0.12	2.66	3.98%	30.76	0.92
Banks	0.50	2.74	0.17	1.70	17.01%	83.16	0.90
Basic Resources	0.61	3.52	0.44	2.86	2.47%	52.47	0.94
Chemicals	0.21	2.41	0.33	1.91	3.37%	29.27	0.95
Construct. & Material	0.24	2.67	0.06	2.47	0.85%	35.25	0.95
Financial Services	0.64	3.44	0.21	2.62	5.87%	48.92	0.93
Food & Beverage	0.66	2.07	0.21	1.50	0.69%	38.74	0.94
Healthcare	0.73	2.63	0.67	2.74	8.80%	72.20	0.93
Ind. Goods & Services	0.50	3.11	0.17	2.43	8.09%	154.26	0.92
Insurance	0.23	2.99	0.06	2.48	5.36%	49.84	0.93
Media	0.18	3.79	0.17	4.01	4.19%	37.86	0.89
Oil & Gas	0.65	2.74	0.43	2.85	3.63%	30.69	0.89
Pers & Household Goods	0.34	2.42	0.03	2.07	4.51%	57.49	0.92
Real Estate	0.58	2.64	0.18	2.09	0.95%	34.12	0.95
Retail	0.27	2.67	0.11	2.64	3.25%	46.58	0.92
Technology	0.72	5.02	0.44	4.36	8.43%	139.70	0.89
Telecommunications	0.50	3.53	0.20	3.54	12.21%	33.75	0.90
Travel & Leisure	0.24	2.89	0.13	2.36	1.71%	28.10	0.91
Utilities	0.52	1.82	0.24	1.79	4.63%	31.57	0.95

The table represents summary statistics for 19 out of 20 industries. "Other" is excluded, as it does not contain more than two stocks in most months. The first columns represent the average returns in excess of the Datastream Germany Price Index and the standard deviations of value weighted industry portfolios, while the second ones show the mean and standard deviation of equally weighted industry portfolios. Also reported are the average percentages of total market capitalization, the average number of stocks assigned to each industry and the average PHR (value-weighted) for each industry over the sample period.

Table 8 reports the profits to the industry-52-week high and to the industry momentum strategy. Panel A documents the profits to the strategies if stocks are value-weighted within an industry and Panel B if stocks are equal-weighted within an industry. The industry-52-week high strategy generates significantly positive returns both when stocks are value-weighted and equal-weighted within an industry. The strategy remains profitable after the exclusion of the turn-of-the-year effect (line 4 in Panel A and B) and/or of the dot-com bubble (line 6 in Panel A and B). However, compared to the 52-week high strategy for individual stocks, the industry-52-week high is substantially less profitable. The 52-week high with a holding period of six months yields a monthly profit of 0.59% for the total sample, 0.75% for the period except the dot-com bubble and 0.80% for non-January returns between March 1 1988 and March 1 2008 (not reported in the tables). The industry-52-week high portfolios generate substantially lower returns with an average profit of 0.32% for the total sample, 0.44% for the non-dot-com bubble period and 0.44% for non-January months (when stocks are value-weighting within industries). To be very precise, we also compare the 52-week high strategy to the industry-52-week high strategy when stocks are equal-weighted within the total winner and loser portfolios (line 8). This ensures that only the ranking criteria of the respective strategies and not the employed portfolio weighting method are compared. But even by giving them the same weight within the winner and loser portfolios, the industry-52-week high strategy is still not as profitable as the 52-week high strategy. Furthermore, industry momentum does not outperfom the industry-52-week high strategy. Both yield similar profits during the total sample period. For equal-weighted industry portfolios, the difference is 0.03%, for value-weighted portfolios it is only 0.02%. The difference in the profitability is larger if the dot-com bubble period or the turn-of-the-year effect is excluded, but still below 0.10%.

Table 8: Profitability of Industry Strategies

	Wi	Lo	Wi-Lo	t-stat
	Panel A: Value-weighting			
Industry Momentum (6/1/6)	0.0058	0.0024	0.0034	(1.73)*
Industry-52-Week High	0.0051	0.0019	0.0032	(1.67)*
Industry Momentum (6/1/6) ex. Jan	0.0053	0.0016	0.0038	(1.83)*
Industry-52-Week High ex. Jan	0.0048	0.0004	0.0044	(2.17)**
Industry Momentum (6/1/6) ex. 10/98-2/00	0.0062	0.0028	0.0036	(1.81)*
Industry-52-Week High ex. 10/98-2/00	0.0058	0.0013	0.0044	(2.10)**
	Panel B: Equal-weighting			
Industry Momentum (6/1/6)	0.0039	-0.0004	0.0043	(2.27)**
Industry-52-Week High	0.0033	-0.0007	0.0040	(1.72)*
Industry Momentum (6/1/6) ex. Jan	0.003	-0.0024	0.0053	(2.51)**
Industry-52-Week High ex. Jan	0.0029	-0.0025	0.0054	(2.52)**
Industry Momentum (6/1/6) ex. 10/98-2/00	0.0032	-0.0011	0.0044	(2.17)**
Industry-52-Week High ex. 10/98-2/00	0.0030	-0.0025	0.0054	(2.57)***
Ind. Mom. (6/1/6) (Equal-weighted portfolios)	0.0038	0.0007	0.0033	(1.75)*
Ind. 52-week High (Equal-weighted portfolios)	0.0038	0.0005	0.0034	(1.72)*

*This table reports the average monthly portfolio returns from March 1 1988 to March 1 2008, for industry momentum and industry-52-week high strategies. In Panel A, stocks are value-weighted within an industry while stocks are equal-weighted within an industry in Panel B. For the ranking, all German stocks on Datastream with a price larger than 1 Euro and a market value above 50 Million Euro are considered; t-statistics (two-tailed) are reported in parentheses. *;**;*** are the significance levels on the 10%, 5% and 1% level.*

In summary, the momentum and the 52-week high strategy seem to be linked closely together. Both, at individual stock level and across industry portfolios, the returns to the strategies are of similar magnitude. Furthermore, since the industry-52-week high does not dominate the 52-week high strategy for individual stocks, we cannot reject the hypothesis that the 52-week high (and hence momentum) can be explained by anchoring. Moreover, we do not find any evidence that industry momentum can explain the profitability of individual momentum which is documented in Moskowitz and Grinblatt (1999) for the U.S. market. In Table 8, the industry momentum portfolios yield substantially lower returns than individual momentum portfolios. This finding is consistent with Nijman et al. (2004) documenting that industry momentum plays only a minor role in explaining the individual momentum effect for European stocks.

<u>The x-month High Strategy</u>

As a second test for anchoring as explanation for the 52-week high and hence for momentum profits, we examine whether the predictive power of the PHR_i^{52} ranking criterion is improved when we replace the 52-week High price by the x-month high price. We define the x-month high price as the highest price of a stock over the past x months. This test allows us to examine two implications of our core hypothesis. First, it is tested whether the 52-week high is indeed driven by the described behavioral phenomenon. While many newspapers publish the 52-week high price, this is not the case for most x-month high prices of a stock. As this information is not easily available to traders, they should not be able to use it as a reference point against which they evaluate the impact of news. Therefore, according to the anchoring hypothesis, strategies should not dominate the 52-week high strategy that rank stocks based on their nearness to an x-month high, which is not widely published. If however, an x-month high strategy dominates the 52-week high, anchoring would not be the right explanation for the 52-week high (and momentum) profits. Secondly, this test can also be used to examine whether the 52-week high price is the reference point used by traders that suffer from the anchoring bias. For example, some newspapers do also publish the 1-month high or the 3-month high of a stock. If the 1-month high strategy or the 3-month high strategy dominates the 52-week high, anchoring cannot be rejected although the 52-week high price might not be the correct reference point. The x-month high strategy is constructed similarly to the 52-week high strategy except for denominator. It is represented by $H_{i,t-1}^{x}$, the highest price of stock i over a period of x month length that ends at the beginning of month $t-1$:

$$PHR_i^x = \frac{P_{i,t-1}}{H_{i,t-1}^x}. \quad (5)$$

$H_{i,t-1}^x$ is constructed by using daily data and measuring the maximum intraday high price for stock i during the x-month period.

Table 9 documents the profitability of x-month high strategies during the total sample (column A), for all months except January (column B) and for all months except during the dot-com bubble. The 52-week high strategy dominates all x-month high strategies. This strongly supports the anchoring hypothesis since the biggest difference between most x-month high prices and the 52-week high price is the availability of the information. Therefore, the 52-week high qualifies as reference point while most x-month high measures do not. Beside the 52-week high, strategies that employ the highest price of a stock over a period close to one year yield the highest returns. Figure 2 illustrates this pattern and shows the monthly average returns of the x-month high strategies graphically. It documents that profits are inverted u-shaped. The closer (further) the length of the period over which the highest price of a stock is measured with respect to the one year high, the smaller (larger) is the difference between the monthly returns. This is not surprising, as with a high probability, the maximum price of a stock over a period close to one year is identical to the 52-week high price. For example, the 1-month high is only equal to the 52-week high if the highest price over the past year is reached within the previous month. In opposite, the chance that the 52-week high and the 9-month high are identical is larger as they have 9 months in common.

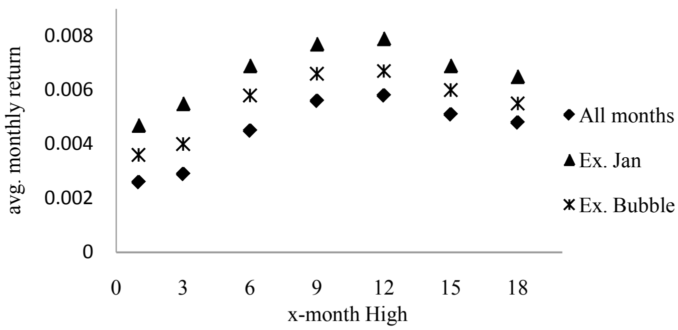
Table 9: Profitability of the x-month High Strategy

	All Months			**ex Jan.**			**ex Dot-com Bubble**		
	Wi	Lo	Wi-Lo	Wi	Lo	Wi-Lo	Wi	Lo	Wi-Lo
1-month High Strategy	0.001	-	0.0026 (1.48)	0.001	-	0.0047** (2.45)	0.001	-	0.0036** (1.94)
3-month High Strategy	0.001	-	0.0029 (1.14)	0.001	-	0.0055** (1.91)	0.001	-	0.0040 (1.55)
6-month High Strategy	0.002	-	0.0045 (1.58)	0.002	-	0.0069** (2.44)	0.002	-	0.0058** (1.95)
9-month High Strategy	0.003	-	0.0056** (2.07)	0.003	-	0.0077*** (2.91)	0.002	-	0.0066** (2.43)
52-week High Strategy	0.003	-	0.0058** (2.24)	0.002	-	0.0079*** (3.08)	0.004	-	0.0067** (2.50)
15-month High	0.002	-	0.0051* (1.94)	0.001	-	0.0069*** (2.70)	0.002	-	0.0060** (2.24)
18-month High	0.002	-	0.0048* (1.90)	0.002	-	0.0065*** (2.64)	0.002	-	0.0055** (1.82)

*This table reports the average monthly portfolio returns in excess of the Datastream Germany Price Index average return- The sample period is from February 1981 through March 2008 for all x-month high strategies except for the 15-month and 18-month high, which start in May 1980 and August 1980 respectively. For the ranking, all German stocks on Datastream with a price larger than one Euro and a market value above 50 Million Euro are considered; t-statistics (two-tailed) are reported in parentheses. *;**;*** are the significance levels on the 10%, 5% and 1% level.*

Furthermore, given that anchoring explains the 52-week high profits, other x-month high prices do not qualify as potential reference points used by traders. Beside the 52-week high prices, some newspapers do also publish the 1-month high prices or the 3-month high prices. However, strategies that use these pieces of information in their ranking criterion are less profitable than the 52-week high and they are not substantially more profitable than other x-month high strategies. In summary, these findings support anchoring as the explanation for the profits of the 52-week high (and the momentum) strategy and secondly present evidence for the 52-week high as the reference point used by investors.

Figure 2: Monthly Profits to the x-month High Strategy



The graph illustrates the average monthly returns of different x-month high strategies. On the x-axis, the number of months is shown over which the highest price for each stock is measured and on the y-axis, the average monthly return is documented. For each x-month high strategy, the average return for the total period, the average return for all months except January and for the total period except the dot-com bubble period is illustrated.

The Profitability of the 52-week High Strategy during the Dot-com Bubble

As a third test for anchoring being the driver of the 52-week high, we measure the profitability of the 52-week high strategy during the emergence of the dot-com bubble. There is a vast of literature, which documents that bubbles are caused by irrational behavior of subjects, for example herding - the tendency of subjects of being influenced by others (see, e.g. Hirshleifer and Hong Teoh (2003) for an overview) or overreaction (e.g. Scheinkman and Xiong, 2003, Hong et al., 2006). This argumentation implies that subjects change their behavior during a bubble. When herding or overreacting to private news, people form their estimates about future stock price based on other criteria than a reference point. This implies that the 52-week high strategy should not be profitable during the dot-com phase if anchoring is in fact its driver.

As mentioned above, we define October 1, 1998 as beginning and March 1, 2000 as ending date of the dot-com bubble. During that period, the 52-week high portfolios generate substantially negative returns for all examined holding periods (between -0.80% and -1.30% per month on average). Hence, while the 52-week high ranking criterion seems to work well in predicting future stock returns outside the dot-com bubble. This is not the case within this time period. The difference in the profitability of the 52-week high in and outside the dot-com bubble indicates that the driver of this strategy disappeared during the time. One explanation could be the behavior of investors: while they normally use the 52-week high as orientation in evaluating news and suffer from anchoring, they form their estimations about future stock prices based on other criteria during the bubble (e.g. herding). This might be viewed as evidence that the 52-week high is driven by people’s non-rational behavior.

The 52-week Low Price – An Alternative Anchor?

Beside the 52-week high price, investors could also use the 52-week low price of a stock as a reference point as this information is also easily available. The 52-week low reports the lowest price of a stock within the past 52 weeks. Therefore, we also examine a strategy based on the 52-week low and examine a strategy that buys 30% of stocks of which the price is furthest away from their 52-week low and sells 30% of stocks with a price closest to the 52-week low. This strategy is substantially less profitable than the 52-week high. For a holding period of six months, the 52-week low portfolios generate an average monthly return of 0.39 (t-statistic: 2.46). The profitability of the strategy is not surprising as it partly replicates the 52-week high strategy: The 52-week low portfolios are long in stocks with a price far from the 52-week low and short in stocks with a price close to the 52-week low. Stocks that are far from the 52-week low are often those that are close to their 52-week high and stocks that are close to their 52-week low are often those with a price far from the 52-week high. This can also be observed in the data. Over the total sample period, 46.7% (47.0%) of stocks in the winner (loser) portfolio based on the 52-week high criterion are also in the winner (loser) portfolio based on the 52-week low criterion. Hence, the 52-week low strategy is partially long in stocks that are close to the 52-week high and partially short in stocks with a price far from the 52-week high. This replication is incomplete as the 52-week high strategy generates a monthly return that is about 49% higher than the 52-week low strategy. If each strategy is only allowed to include stocks that are not considered in the same portfolio by the other strategy, the 52-week high strategy yields higher returns than the 52-week low. We come to this conclusion as the 52-week low strategy yields lower returns than the 52-week high although the number of stocks that are considered winners or losers commonly by both strategies is large. If we do not allow 52-week high winners and losers to be included into the winner and loser portfolios of the 52-week low strategy, the latter strategy loses its profitability and generates an insignificant average monthly return of 0.14% (t-stat 0.56). Hence, the 52-week low profits seem to be driven by the 52-week high criterion.

ROBUSTNESS TESTS

To ensure that our findings are not influenced by illiquid stocks, we recalculate momentum and 52-week high returns and only considers stocks for the ranking that are traded continuously in all six months before the ranking date. This approach goes back to Forner and Marhuenda (2003). Table 10 reports the results for the (6/1/6) momentum and the 52-week high strategy with a holding period of six months. It shows that the profits to the strategies are only slightly different under this assumption. Hence, our requirements for stocks to be included in the sample (stocks with a market value larger than 50 million Euro and a price above one Euro) seem to be sufficient.

To further limit the risk of obtaining biased results due to data mining, we follow August et al. (2000) and Göppl and Schütz (1992) and only include those stocks that are traded in at least 50 percent of all months of the sample period. This limitation also does not alter our results and conclusions (not reported in the tables).

Table 10: The Strategies' Profitability for Highly Liquid Stocks

	Stocks traded continuously			**All Stocks**		
	Wi	Lo	Wi-Lo	Wi	Lo	Wi-Lo
Mom (6/1/6)	0.0030	-0.0024	0.0053***	0.0034	-0.0022	0.0056***
			(2.89)			(2.75)
52-week High	0.0029	-0.0023	0.0052***	0.0033	-0.0025	0.0058**
			(3.63)			(2.24)
Mom (6/1/6) ex Jan.	0.0019	-0.0039	0.0058***	0.0023	-0.0039	0.0062***
			(3.28)			(3.13)
52-week High ex Jan.	0.0026	-0.0047	0.0073***	0.0025	-0.0046	0.0071***
			(3.95)			(2.91)
Mom (6/1/6) ex Dot-com Bubble	0.0040	-0.0015	0.0054***	0.0032	-0.0024	0.0057***
			(3.68)			(2.63)
52-week High ex Dot-com Bubble	0.0037	-0.0019	0.0056***	0.0040	-0.0028	0.0067**
			(3.87)			(2.50)

This table reports the average monthly portfolio returns in excess of the Datastream Germany Price Index average return from February 1981 through March 2008, for the (6/1/6) *momentum strategy and for the 52-week high strategy. In the left column, monthly returns for strategies are reported when only stocks are considered for ranking with a price larger than one Euro, a market value above 50 million Euro and which are traded continuously in all six months before the ranking date. In the right columns, stocks are considered with a price larger than one Euro and a market value above 50 Million Euro for the ranking. The data contains all German stocks on Datastream; t-statistics (two-tailed) are reported in parentheses. *;**;*** are the significance levels on the 10%, 5% and 1% level.*

In order to ensure that the dot-com bubble period does not heavily influence our results, we report monthly returns for all months except those during October 1998 and February 2000. Another way to control for this short episode in finance history is to measure profits of momentum and 52-week high strategies when technology and telecommunication stocks are excluded from the sample. These stocks are most heavily influenced by the emergence and the collapse of the dot-com bubble. Yet, the exclusion does not alter our findings: the (6/1/6) momentum strategy generates an average monthly return of 0.53%, which is only slightly smaller than 0.56% for all stocks; the profitability of the 52-week high strategy is (with 0.57%) almost identical compared to 0.58% for all stocks.

The last robustness check relates to stocks delisted during the holding period. As in Forner (2003), this study assumes that the proceeds of the delisted stocks are at once equally invested in the remaining stocks. To ensure that this does not influence the results we use the procedure of Agyei-Ampomah (2003) and assume a return of zero if a stock is delisted. Yet, as the percentage of stocks that are delisted during each ranking period is small (results available upon request), this assumption does not change our results.

SUMMARY AND CONCLUSIONS

This work relates to the behavioral finance literature and tests the hypothesis whether momentum can be explained by anchoring – a behavioral heuristic documented by Kahneman et al. (1982) which states that subjects focus too much on a reference point when forming estimates. We survey this behavior in an experimental study similar to that in Kahneman (1982) and ask 105 undergraduate students to estimate a quantity (e.g. the part of the area in Germany that is used for agriculture) in relation to a randomly chosen number. Subjects with a higher (lower) starting number have on average a higher (lower) estimate.

In order to test whether momentum can be explained by anchoring, we examine if momentum is dominated by George and Hwang (2004)'s 52-week high strategy and whether anchoring explains the 52-week high profits. Especially the second relationship is important. It decides whether both strategies represent a serious challenge to the Efficiency Market Hypothesis (EMH). If the impact of non-rational behavior on stock prices can be credibly documented, the assumption of full rationality is violated – a key assumption of the EMH. Up to our knowledge, we are the first to test empirically whether anchoring qualifies as the driver of the 52-week high strategy. With three different tests, we find support for the 52-week high price of a stock being used as a reference point by investors against which they evaluate the impact of news on the stock price.

Moreover, this work examines the link between momentum and the 52-week high and cannot reject the hypothesis that momentum is not dominated by the 52-week high. To show this, we use two sorting and one regression approach. This is important, as all tests face some weaknesses and a dominant method to compare the two strategies does not exist. Further evidence for a close relationship between the 52-week high and momentum is found as the two strategies yield similar returns on both individual stock level and in industry portfolios.

Beside our core findings, this paper also provides some interesting insights for non-U.S. stock data. Using German data, we show that the momentum effect is still present after 2001, which is doubted by some papers. Momentum is also profitable at industry level although, in opposite to the U.S market, the average monthly return of industry momentum is substantially smaller than the individual momentum profits. We also document that the 52-week high strategy is profitable in another market than the U.S. and largely dominates momentum.

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THEORETICAL AND NUMERICAL VALUATION OF CALLABLE BONDS

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ABSTRACT

This paper studies the value of a callable bond and the bond issuer's optimal financial decision regarding whether to continue the investment on the market or call the bond. Assume the market investment return follows a stochastic model, the value of contract is formulated as a partial differential equation system embedded with a free boundary, defining the level of market return rate at which it is optimal for the issuer to call the bond. A fundamental solution of the partial differential equation is derived, and used to formulate the value of the bond. A bisection scheme is implemented to solve the problem numerically.

JEL: D4, D46 G14, G15

KEYWORDS: Callable Bonds, optimal financial decision, stochastic model

INTRODUCTION

A callable bond is a bond that can be redeemed by the bond issuer prior to its maturity under certain conditions by paying off all the borrowing balance to the bond holders. Naturally the issuer shall invest the raised capital into market, expecting the return on the investment be higher than the amount he has to pay to the bond holder. A company will rationally choose to call a bond if it is paying a higher coupon while earning a lower return from market. Here we consider a callable bond with a duration $T > 0$ and a fixed coupon rate $c > 0$, where the issuer is allowed to call (redeem the bond) prematurely by paying off the borrowing at any time $d < T$. We assume the bond is fully amortized, i.e., the issuer pays an equal coupon payment $m > 0$ for each unit time period throughout the duration of the bond. This is in contrast to other types of bonds, say, zero-coupon bond, for instance, where the issuer does not pay back any amount of borrowing until the contract expires. The amortized callable bond is popular in practice mainly because payments are distributed into equal installments over the duration of the bond, which makes it possible for the issuer to make relatively smooth financial planning and avoid "payment shock". Denote by $P(d)$ the outstanding borrowing balance owed by the bond issuer to the bond holder at time d. If the coupon rate is zero, then $P(d)$ will linearly decrease in time from d=0 to $d = T$. However, this is unlikely the case in real economy since it would imply that the bond issuer uses for free the money borrowed from the bond buyers. The usual situation is $c > 0$, which means that bond issuer pays more, in sum of all the coupons, than its initial borrowing $P(0)$. For example, company A raised \$1,000,000 as of today by issuing a 20-year callable bond with a fixed coupon rate c = 5%. Then the company needs to pay a coupon of $m = 7.91 \times 104$ \$/year to the bond holders. We would like to remark that in practice, a corporate bond sometimes only specifies m, $P(0)$, and T, leaving c as an embedded implicit term of the contract. For this reason, c is sometimes referred as the implied coupon rate or implied interest rate.

Now suppose the bond issuer has raised $P(0)$ dollars of capital at $d = 0$ and for each unit time period, he pays a coupon of m dollars back to the bond holder, and if he decides to call at time d, he must pay off the borrowing balance of P(d) dollars. Then the valuation of bond is of interests to both the bond issuer and the holder. On one hand, the holder or a third party investor may want to know the fair value of such a bond. For investment banks or security companies which hold large portfolio of such bonds, the value of these bonds may have significant impact on their credit ratings and asset performance. And in situations like company merge or liquidation, the valuation of these bonds often becomes necessary, as required by statutory accounting principles. On the other hand, from the bond issuer's point of view, he expects to wisely use the capital such that the investment return is higher, on average, than the bond coupons he has to pay. In reality, the issuer may have many ways to use the capital. Here for simplicity, we consider his overall return from all possible market investment, the return rate of which follows certain stochastic process. The optimal decision at any given time, from the bond issuer's point of view, depends on how much return can be earned if an equal amount of capital *P(d)* be invested in the market. Intuitively, the issuer should not choose to call unless the overall investment return rate is expected to be very low for certain amount of time. Hence, the issuer must, at every moment while the contract is in effect, monitor the market investment return and decide whether it is of his best interest to call immediately.

The paper is organized as follows. In Section 2 we provide a review of related literature. In Section 3 we introduce the model of the underlying rate of return for the option and the partial differential equation governing the value of the bond. In section 3, we formulate the integral equation representation of the value of the bond with a free boundary incorporated. In section 4, we apply the Fourier transform to derive the Green's function used in our integral formulation of the solution. In section 5, we implement a bisection scheme to solve the problem iteratively and present some specific numerical examples. In section 6, we present some concluding remarks on our approach and possible future directions.

LITERATURE REVIEW

A seminal work of bond valuation can be traced back to Merton (1974), where the equity of a firm is treated as an option on its assets, and the value of a pure discount bond of a firm is analyzed under the assumption that the asset value of the firm follows geometric Brownian motion. Because of the important role played by callable bonds in real economy, related problems have been studied by considerable literatures. Black and Cox (1976) extend the theoretical framework of Merton (1974) to the situation where the value of a firm "follows a diffusion process with instantaneous variance proportional to the square of the value". Geske (1977) provides a compound option approach for valuing debt of a firm where the debt is restricted to be a single issue of discrete coupon debt and the firm is assumed dividend free. With these assumptions, Geske shows that the value of the corporate debt can be computed as the difference between the total value of the firm and the value of the equity. These earlier works share a common limitation by assuming market interest rate as constant. In an attempt to address the interest rate effect on the value of bonds as well as other interest rate options, Hull and White (1990) propose to value these options using a class of market data consistent spot rate models. Specifically, they present two one-sate variable models and show that the differences between the European style bond prices computed for these two models are small under certain assumptions. In the sequential, Hull and White (1993) propose a general procedure to construct interest rate models for fitting a given set of initial market data. They also provide a computing framework involving the construction of a trinomial tree for the short rate, working back through which the value of bond can be obtained. Aiming to generalize the framework for term structure models, Heath, Jarrow and Morton (1992) directly impose a stochastic structure on the evolution of forward interest rate curve. The model, based on the theory of arbitrage asset pricing, is proposed for valuing the interest rate options, including corporate bonds, when lacking the information of market price of risk. One shortcoming of this model is that it poses more computational difficulties in implementation. In recent development, reduced form method is introduced to study the bond valuation problems where when default is allowed. According to Duffie and Singleton (1999), a defaultable bond can be valued by discounting its payment streams at a default adjusted interest rate through a risk neutral measure.

We would like to remark that the problems of pricing defautable or callable bonds, like many other option valuation problems, typically do not have closed form solutions, thus a great deal of efforts have been made to find numerical solutions as well as approximated analytical solutions. For instance, a numerical partial differential equation scheme is implemented by Brennan and Schwartz (1977), a binomial lattice model was applied by Li et al. (1995), a Monte Carlo simulation approach is proposed by Kind and Wilde (2003), and a finite difference method is recently tried by Breton and Ben-Ameur (2005). A quasi-closed form approximation formula is obtained by Tourruco et al. (2007) for a zero coupon bond under the Black-Karasinski model. One notices (see Buttler (1995), for instance) that usual numerical techniques such as finite difference or binomial method typically provide poor accuracy and stability, which are mainly caused by the complexity of the free boundary conditions. Monte Carlo simulation is easy to implement, but is not quite efficient for pricing callable bonds with its drawback of low convergence. More detailed critiques of these these methods can be found in Jiang (2005). To rectify such numerical shortcomings, an integral equation approach has been recently proposed by Chen and Chadam (2007) and Xie (2008) for American option pricing and related problems. The main idea is to formulate the value of the option under review as an appropriate integral form, on basis of which one can derive an efficient algorithm to solve the problem iteratively. The same idea is applied in this work. We first derive an integral representation of the bond value in terms of market return rate *x* at time *t,* then use it to design a bisection algorithm to iteratively solve for the optimal early call boundary. Then the bond value is recovered by numerical integral algorithm.

THE MODEL AND THE PROBLEM FORMULATION

In this work we assume that the return rate that the bond issuer can earn from market investment follows the Vasicek (1977) model, where the market return rate *r* is treated as a Markov process, governed by the stochastic differential equation

$$dr_t = k(\theta - r_t)dt + \sigma dW_t \qquad (1)$$

where W_t is the standard Brownian process. The Vasicek model is composed of one deterministic term and one random term. The deterministic term (also "the drift term") is chosen to produce the so called "mean-reverting" property. And the random term is to model the volatility caused by (possibly infinite) unpredictable factors. Using integrating factor method, as explained in Jiang (2005), for instance, one can solve the stochastic differential equation and get the explicit (stochastic) solution for the return rate at any time $t > d$.

$$r_t = \theta + e^{-k(t-d)}(r_d - \theta) + \sigma\int_d^t e^{-k(t-d-u)}dW_u$$

We are interested in the value of the callable bond at any given time and the corresponding return rate. For mathematical convenience, instead of using real time *d*, we introduce $t := T - d$. Financially t is the time to expiry of the bond contract (hereafter simply referred as the "time"). Let *V(x, t)* be the bond value at time *t* and the corresponding return rate *x*. Standard theory of mathematical tells us that *V(x, t)*, when the bond is not optimal to call, must satisfy the Black-Sholes type partial differential equation (hereafter referred as "PDE")

$$\frac{\partial V}{\partial t} - \frac{\sigma^2}{2}\frac{\partial^2 V}{\partial x^2} - k(\theta - x)\frac{\partial V}{\partial x} + xV = m. \qquad (2)$$

When it is optimal to call at certain time *t, V(x, t)* becomes *P(t)*. Let *h(t)* be the unknown optimal return level for the issuer to exercise the call, then we have

$$V(x, t) = P(t) \quad \text{for } x <= h(t), \tag{3}$$

and this automatically gives

$$V(x, 0) = 0. \tag{4}$$

It is also apparent that

$$V_x(x, t) = 0 \text{ for } x < h(t). \tag{5}$$

Since $V(x, t)$ is assumed at least twice differentiable in x, we know that

$$V_x(x,t) = 0 \qquad \text{for } \ x = h(t). \tag{6}$$

By a trivial free of arbitrage argument, one can show the

$$h(0) = c, \tag{7}$$

i.e., the optimal call boundary must starts at c as we look backward from the expiry date. Mathematically (2)-(7) constitute a free boundary problem we need to solve, where the free boundary $x = h(t),$ defining the optimal level of return rate at which the bond is to be called, separates the right half t-x plane into two regions. For the continuation region where $x > h(t),$ the bond contract is in effect and the value of the bond is governed by (2). For the early exercise region where $x < h(t),$ the bond is called and the bond holder gets back the borrowing balance of $P(t).$ Because it is the issuer, rather than the holder, has the choice to act in response to the market, the value of the contract is always less or equal than the loan balance. Thus the free boundary is where the value of the bond first reaches value of $P(t),$ i.e., it is optimal for the issuer to call the bond if and only if that value of the bond reaches $P(t)$ for the first time. To solve the free boundary problem (2)-(7), we first derive the fundamental solution of (2), then use it to formulate the solution $V(x, t).$

MATHEMATICAL MOTIVATION

When handling a free boundary PDE system, it is often tempting to investigate if we can find the solution for the homogeneous PDE without boundary conditions. If this can be done, then the solution to the system can be formulated in terms of integral equations with boundary conditions incorporated. Without loss of generality, we assume $m = 1$. Define

$$L(V) := \frac{\sigma^2}{2}\frac{\partial^2 V}{\partial x^2} + k(\theta - x)\frac{\partial V}{\partial r} - xV, \tag{8}$$

We see that, according to (2.5) and (2.6) ,

$$\frac{\partial V}{\partial t} - L(V) = F(x,t), \qquad \forall x \in \mathbb{R}, \ t > 0 \tag{9}$$

Where

$$F(x,t) = \begin{cases} 1, & for \quad x > h(t), \ t > 0 \\ \dfrac{x}{c} + (1 - \dfrac{x}{c})e^{-ct}, & for \quad x \le h(t), \ t > 0 \end{cases}$$

If we can find the solution, say *G(r,y,t,τ)* to the PDE defined in (8), then, by the Green's identity, we would be able to write the solution as

$$V(x,t) = \int_0^t \int_{-\infty}^{\infty} F(y,\tau) G(x,y,t,\tau) d\,dy\tau. \tag{10}$$

And then the following manipulations can be made to find the integral identities on which a numerical iteration scheme can be designed.

$$\begin{aligned} V &= \int_0^t \int_{-\infty}^{h(\tau)} \left(\frac{y}{c} + (1-\frac{y}{c})\right) e^{-c\tau} G(r,y,t,\tau) dy d\tau + \int_0^t \int_{h(\tau)}^{\infty} G(r,y,t,\tau) dy d\tau \\ &= \int_0^t \int_{-\infty}^{\infty} \left(\frac{y}{c} + (1-\frac{y}{c})\right) e^{-c\tau} G(r,y,t,\tau) dy d\tau \\ &\quad - \int_0^t \int_{h(\tau)}^{\infty} G(r,y,t,\tau)(1-\frac{y}{c})(e^{-c\tau}-1) dy d\tau \end{aligned}$$

Denote

$$I = \int_{-\infty}^{\infty} \left(\frac{y}{c} + (1-\frac{y}{c})\right) e^{-c\tau} G(x,y,t,\tau) dy$$

We are going to show that $I = P(t)$. To this end we do not evaluate I directly. Instead, we integrate the differential form of G with respect to y over the whole x-space. Let $s = t — \tau$. Because G, by the nature of being the fundamental solution to the PDE in (8), satisfies

$$G_s - \frac{\sigma^2}{2} G_{yy} + [k(\theta - y)G]_y + yG = 0 \tag{11}$$

and G decays exponentially in y, as will become apparent after we derive its explicit formula, we can apply integral by parts to integrate (11) with respect to y in the whole x-space, thus have

$$\frac{d}{ds}\int_R G dy = -\int_R yG dy$$

Then

$$\begin{aligned} I &= e^{-c\tau} \int_R G dy + \frac{1-e^{-c\tau}}{c} \int yG dy \\ &= e^{-c\tau} \int_R G dy - \frac{1-e^{-c\tau}}{c} \frac{d}{ds} \int G dy \\ &= -\frac{1}{c}\frac{d}{ds}\{(1-e^{-c\tau})\int_R G dy\} \end{aligned}$$

Now, using the fact that $\int_R G dy = 1, \quad \tau = t$, we get

$$\int_0^t I d\tau = \int_0 -\frac{1}{c}\frac{d}{ds}\{(1-e^{-c\tau})\int_R G dy\} = \frac{1}{c}(1-e^{-ct}) \equiv \mathrm{P}(t).$$

Let

$$U(x,t) = \int_0^t \int_{h(\tau)}^{\infty} G(r,y,t,\tau)(1-\frac{y}{c})(e^{-c\tau}-1)dyd\tau, \tag{12}$$

we get

$$V(x,t) = P(t) - U(x, t) \tag{13}$$

And now it is straightforward to translate the boundary conditions (3-6) of *V(x, t)* into boundary conditions of *U(x, t),* i.e., when *x = h(t),*

$$U(x, t) = 0, \tag{14}$$

$$U_x(x,t) = 0. \tag{15}$$

So far the analysis is carried out as if the solution were known. The following section is dedicated to finding the fundamental solution *G* using the Fourier Transform method.

DERIVATION OF THE FUNDAMENTAL SOLUTION

Let *G* be the fundamental solution associated with (8). For every *(x, t)* fixed,
Define the Fourier transform in the *x* variable by:

$$F[G(r,y,t,\tau)] = \int_{-\infty}^{\infty} G(r,y,t,\tau)e^{-i\lambda r}d\,r = \hat{G}(\lambda,y,t,\tau),$$

we have

$$\begin{cases} \dfrac{\partial \hat{G}}{\partial \tau} + \dfrac{\sigma^2}{2}\dfrac{\partial^2 G}{\partial y^2} - k(\theta - y)\dfrac{\partial G}{\partial y} + (k-y)\hat{G} = 0, \quad \text{for} \quad \tau < t, \; y \in \square \\ \hat{G}(\lambda, y, t, t-) = e^{-i\lambda y} \end{cases} \tag{16}$$

We postulate that admits a solution of the form

$$\hat{G}(r,y,t,t-) = e^{A(t,\tau,\lambda)+yB(t,\tau,\lambda)}. \tag{17}$$

with *A(t, T, λ)* and *B(t,T, λ)* to be determined shortly. Substituting (17) back into the partial differential equation in (16), we get

$$\begin{cases} A' + \frac{\sigma^2}{2}B^2 - k\theta B + k = 0 \\ B' + kB - 1 = 0 \\ A(t,t,\lambda) = 0 \\ B(t,t,\lambda) = -i\lambda \end{cases} \tag{18}$$

Using the method of separation of variables to solve the second differential equation in (18), we get

$$B = (-\frac{1}{k} - i\lambda)e^{k(t-\tau)} + \frac{1}{k} \tag{19}$$

Substitute (19) into the first differential equation in (18), we have

$$\begin{aligned} A &= -\int_\tau^t k\theta B ds + \int_\tau^t \frac{\sigma^2}{2}B^2 ds + \int_\tau^t k ds \\ &= -k\theta\int_\tau^t [(-\frac{1}{k} - i\lambda)e^{k(t-s)} + \frac{1}{k}]ds + \frac{\sigma^2}{2}\int_\tau^t [(-\frac{1}{k} - i\lambda)e^{k(t-s)} + \frac{1}{k}]^2 ds + k(t-\tau) \\ &= \theta\int_\tau^t [(1+i\lambda k)e^{k(t-s)} - 1]ds + \frac{\sigma^2}{2k^2}\int_\tau^t [(1+i\lambda k)e^{k(t-s)} - 1]^2 ds + k(t-\tau) \end{aligned}$$

Next, we want to collect terms for $A + yB$ according to the powers of λ. For this purpose, we write

$$\begin{aligned} A + yB &= \theta\int_\tau^t [(1+i\lambda k)e^{k(t-s)} - 1]ds \\ &\quad + \frac{\sigma^2}{2k^2}\int_\tau^t [(1+i\lambda k)e^{k(t-s)} - 1]^2 ds + k(t-\tau) - y[(\frac{1}{k} + i\lambda)e^{k(t-\tau)} - \frac{1}{k}] \\ &= -\alpha_2\lambda^2 + \alpha_1 i\lambda + \alpha_0\lambda \end{aligned}$$

A tedious but straightforward computation will lead to exact expressions of $\alpha_0, \alpha_1,$ and α_2 as functions in *y, t* and τ. But the integral form expressions of $\alpha_0, \alpha_1,$ and α_2 are good enough for computational purposes. Now we can apply the inverse of Fourier transform to derive the desired the solution

$$\begin{aligned} G(r,y,t,\tau) &= \frac{1}{2\pi}\int_{-\infty}^{\infty} \hat{G}(r,y,t,\tau)e^{i\lambda r}d\lambda \\ &= \frac{1}{2\pi}\int_{-\infty}^{\infty} e^{-\alpha_2\lambda^2 + \alpha_1 i\lambda + \alpha_0\lambda}e^{i\lambda r}d\lambda \\ &= \frac{1}{\sqrt{4\pi\alpha_2}}e^{\alpha_0 - \frac{(\alpha_1 + r)^2}{4\alpha_2}} \end{aligned}$$

It is easy to verify that *G(x, y, t, τ)* is exponentially decaying in *y* for *x, t, τ* fixed, and the spatial integral with respect to y is always equal to 1 for fixed tau at t. Now the expression for $U_r\,(r, t)$ involves a double integral over an infinite domain, sometimes it is beneficial to reduce the double integral to a single one. This is because that the inside integral of U can be evaluated by, say, change of variables. Since the computation is tedious and such a further simplification is not necessary in finding numerical solutions, we omit these further computations.

NUMERICAL EXAMPLE AND DISCUSSION

Here we present some numerical examples obtained from our method. Our numerical algorithm is based on the free boundary condition defined in (14), where the integral representation of $U(x,\ t)$ is given by (12). Recall that $h(t)$ is defined as the level of return rate x at which $V(x,\ t)$ reaches $P(t)$ for the first time, or equivalently, $U(x, t)$ decreases to 0 for the first time. Start from $h(0) = c$ and $U(x, 0) = 0$, for each $t > 0$ fixed, we apply bisection scheme to find h(t), then use the integral representation (12) to recover $U(x, t)$, and use (13) to recover $V(x, t)$. To implement the bisection scheme, we start with the two initial guesses of $h(t)$. If they are too high compared to the true value of $h(t)$, we somehow shift downward the next guess; if too low, we somehow shift upward the next guess; if one is above and the other is below the true value, we take the average to update the guess. For a given bond with duration T and coupon rate c, assuming the model parameters are known, we partition the time [0, T] into N evenly spaced subintervals with $dt = T/N$. Define $t = (t_0,\ t_1,\ \dots,\ t_N)$, a time vector with $t_n = n dt,\ n = 0,\ \dots N$. For a prescribed error tolerance level, say, Tole=10^{-8}, we implement our algorithm as follows.

(1) $h(t_0) = c$, which is known from (7).

(2) Suppose we have found $h(t_1),\ h(t_2),\ \dots, h(t_{n-1})$, we apply a bisection scheme to find $h(t_n)$:

(a) Take reasonable two initial guesses of $h(t_n)$, say $h^1\ (t_n)$ and $h^2\ (t_n)$. We assume $h^1(t_n) > h^2(t_n)$; if not, simply switch index 1 and 2.

(b) Apply numerical integration method, say Simpson quadrature, for instance, to evaluate the integral in (12), with $h(\tau)$ being interpolated by $(t_0,h(t_0))$, $(t_1,\ h(t_1))$, …, $(t_n,\ h^i(t_n))$, and get $U(h^i(t_n),\ t_n)$ accordingly for $i = 1,\ 2,$ respectively.

(c) If $U(h^1(t_n),t_n) > 0$ and $U(h^2(t_n),t_n) > 0$, then we set

$$h^3(t_n) = h^2(t_n) - [h^1(t_n) - h^2(t_n)].$$

(d) If $U(h^1(t_n),t_n) < 0$ and $U(h^2(t_n),t_n) < 0$, then we set

$h^3(t_n) = h^1(t_n) + [h^1(t_n) - h^2(t_n)]$;

$h^2(t_n) = h^1(t_n)$.

(e) If $U(h^1(t_n),t_n) > 0$ and $U(h^2(t_n),t_n) < 0$, then we set

$h^3(t_n) = [\,h^1(t_n) + h^2(t_n)]/2$; 2

(i) If $U(h^3(t_n), t_n) > 0$, set

$$h^2(t_n) = h^2(t_n).$$

(ii) Otherwise, set

$$h^2(t_n) = h^1(t_n).$$

(f) If $|U(h^3(t_n), t_n)|$ <Tole, iteration ends. If not, use $h^2(t_n)$ and $h^3(t_n)$ as two updated initial guesses, repeat steps (a) through (f) to find $h^4(t_n)$. Repeat such an iteration until an index k is reached such that $|U(h^k(t_n), t_k)| <$ Tole.

(3) Once $h(t_n)$'s have been found for $n = 0, 1, \ldots, N$, $V(x, t_n)$ can be recovered by (13) for arbitrary given x using numerical integration quadratures.

For the iteration to converge faster, it is better to start with one initial guess above and the other below the true value of $h(t_n)$. Our numerical experiments show that the choices of c and $-c$ are good enough for most cases. Also to increase the accuracy of the numerical solution, one can increase N, the number of grids for partitioning the time interval [0, T]. For typical parameters with $T < 30$, our numerical simulations show that $N = 4096$ is large enough for achieving a solution with relative error less than 10^{-6}, where relative error is defined as the difference of numerical values of $h(T)$'s achieved with different N's.

As an example, consider a 5-year bond as of today with coupon payment $m = 1$ (dollars per year), and coupon rate $c = 0.08$. And the corresponding borrowing balance is $P(t) = 4.1210$ (dollars). Assume the parameter values appearing in (2.1) are $\theta = 0.04$, $k = 0.2$, $a = 0.01$, we implement our numerical method and get the bond value as of today V as a function of current market return rate x. The "$c = 0.08$" column in Table 1 is the output of V (in dollars) of such a bond for $x = 0.01, 0.02, \ldots, 0.12$. Indeed one can see that V increases as x decreases, when other variables and parameters fixed. To make optimal financial decision, the bond issuer needs to apply the algorithm to compute V and compare it with P. If the the current market return rate $x = 0.10$, say, then $V = 4.0419$ (dollars). Since $V(0.10, 5) = 4.0419 < 4.1210 = P(5)$, the issuer should not call the bond. Financially it means that cost of fund raising through issuance of bond is inexpensive enough that the issuer can benefit by investing $P(5)$ amount of capital to earn a relatively higher market return. On the other hand, if $x = 0.07$, then $V(0.07, 5) = P(5) = 4.1210$, and the issuer should call the bond. Financially it means that the cost of fund raising through issuance of bond is so expensive that it is a wise decision for the issuer to close the deal. And as time changes, the issuer shall obtain the updated return rate x, redo the computation, and make updated comparison. For similar bonds with coupon rate $c = 0.02, 0.04, 0.06$, one can similarly compute V for $x = 0.01, 0.02, \ldots, 0.12$. The results are presented in Table 1. Keeping other variables and parameters unchanged, one can run the program again for $t = 10$ and $t = 20$, for instance, and the outputs are tabulated in Table 2 and 3.

CONCLUSION AND DISCUSSION

Assuming the return rate of market investment follows the Vasicek model, we formulated and numerically solved a callable bond valuation problem. An exact solution of the governing PDE is obtained and used to derive the representation of the contract value. A bisection algorithm is implemented and validated to solve the problem numerically. Numerical simulations show that our algorithm is fast and stable.

Table 1: Numerical Computation of Bond Price *V(x,t)*

x	*c* = 0.02	*c* = 0.04	*c* = 0.06	*c* = 0.08
0.0100	4.7493	4.5317	4.3197	4.1210
0.0200	4.6890	4.5317	4.3197	4.1210
0.0300	4.6120	4.5317	4.3197	4.1210
0.0400	4.5321	4.5016	4.3197	4.1210
0.0500	4.4527	4.4405	4.3197	4.1210
0.0600	4.3746	4.3697	4.3083	4.1210
0.0700	4.2981	4.2962	4.2652	4.1210
0.0800	4.2232	4.2226	4.2068	4.1167
0.0900	4. 1500	4.1500	4. 1418	4.0877
0.1000	4.0783	4.0786	4.0744	4.0419
0.1100	4.0083	4.0087	4.0065	3.9871
0.1200	3.9398	3.9403	3.9390	3.9276

Table 1 presents a numerical computation of bond price V(x,t) at different market interest rate x and coupon rate c. Here the duration of bond is t=5, and the values for the model parameters are θ =0.04, k=0.2, σ = 0.01

Table 2: Numerical Computation of Bond Price *V(x,t), t =10*

x	*c* = 0.02	*c* = 0.04	*c* = 0.06	*c* = 0.08
0.0100	8.9075	8.2420	7.5198	6.8834
0.0200	8.6942	8.2420	7.5198	6.8834
0.0300	8.4704	8.2334	7.5198	6.8834
0.0400	8.2482	8.1254	7.5198	6.8834
0.0500	8.0310	7.9614	7.5198	6.8834
0.0600	7.8197	7.7778	7.4902	6.8834
0.0700	7.6147	7.5885	7.3944	6.8834
0.0800	7.4160	7.3991	7.2643	6.8747
0.0900	7.2235	7.2124	7.1167	6.8197
0.1000	7.0370	7.0297	6.9607	6.7312
0.1100	6.8564	6.8515	6.8011	6.6221
0.1200	6.6814	6.6782	6.6411	6.5003

Table 2 presents a numerical computation of bond price V(x,t) at different market interest rate x and coupon rate c. Here the duration of bond is t=10, and the values for the model parameters are θ =0.04, k=0.2, σ = 0.01

In addition to its mathematical robustness, the algorithm can be a useful tool for portfolio management purposes. Practitioners who wish to create maximum yield using borrowed capital should be able to apply our program to monitor the market condition and decide when it is optimal to liquidate its investment. While the method is designed for valuing the callable bond with market interest following the Vasicek model, we feel it can be extended to similar problems where market interest follows other mean-revering models. One limitation of our current work is the assumption that the issuer must settle the balance in whole amount if he decides to call the bond. As a future research direction, we would like to study the optimal prepayment strategy for the issuer if partial payments are allowed.

Table 3: Numerical Computation of Bond Price *V(x,t), t =20*

x	***c* = 0.02**	***c* = 0.04**	***c* = 0.06**	***c* = 0.08**
0.0100	15.3493	13.7668	11.6468	9.9763
0.0200	14.8234	13.7668	11.6468	9.9763
0.0300	14.3136	13.6967	11.6468	9.9763
0.0400	13.8221	13.4209	11.6468	9.9763
0.0500	13.3491	13.0641	11.6468	9.9763
0.0600	12.8943	12.6801	11.5902	9.9763
0.0700	12.4572	12.2900	11.4223	9.9763
0.0800	12.0370	11.9030	11.1944	9.9627
0.0900	11.6331	11.5236	10.9341	9.8784
0.1000	11.2450	11.1541	10.6568	9.7416
0.1100	10.8719	10.7957	10.3714	9.5712
0.1200	10.5133	10.4488	10.0837	9.3790

Table 3 presents a numerical computation of bond price V(x,t) at different market interest rate x and coupon rate c. Here the duration of bond is t=20, and the values for the model parameters are θ =0.04, k=0.2, σ = 0.01

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THE HAZARDS OF PROPPING UP: BUBBLES AND CHAOS

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ABSTRACT

In the current environment of financial distress, many governments are likely to soon become major holders of financial assets, but the policy debate focuses only on the likelihood and extent of short-term market stabilization. This paper shows that government intervention and propping up are likely to lead to long-term bubbles and even wildly chaotic behavior. The discontinuities occur when the committed capital reaches a critical amount that depends on just two parameters: the market impact of trading and the target exposure percentage.

JEL: G28; G11; G12; G13

KEYWORDS: Government Policy and Regulation financial distress, market stabilization

INTRODUCTION

Globally, governments appear to be quickly becoming holders of enormous quantities of financial securities. The main goals are to calm the markets, increase liquidity, and raise prices. While the details are still unresolved, the vast majority of financial economists seem to support some sort of intervention. But the government's buying power, whether or not it leads to a short-term stabilization of prices, can in certain circumstances described by this paper lead to a long-term bubble, or even chaos.

Consider a financial institution that faces mark-to-market losses on its large position of illiquid financial instruments. It can "prop up," or make additional market transactions that are small relative to its overall portfolio but, because of the illiquidity, have a large effect on the market price and therefore on the value of its entire portfolio. In this way, the institution can appear to generate large profits from its existing position at a remarkably small cost.

This paper presents a model of such mark-to-market propping up for a stylized financial entity aiming to hold a position in thinly traded derivatives with an exposure in fixed proportion to its capital. The prices resulting from the entity's transactions show variety and complexity, ranging from traditional bubbles, to discontinuous gaps, to smooth hills, to infinite growth.

Funds often allocate a certain portion of their capital to a particular investment class. Whether it is a pension fund allocating half of its capital to bonds, a mutual fund allocating one-third of its capital to growth stocks, or a sovereign wealth fund allocating twenty percent of its capital to a particular currency, it is common to find fixed percentage targets for entire classes of securities, with the percentage changing relatively rarely.

Consider an example of a hedge fund that trades only volatility swaps, which pay off the difference between the realized volatility of an underlying asset and the initial strike, multiplied by the notional of the swap, called the vega notional. Suppose a $100 million hedge fund, which seeks to always be long 10 percent of its capital in vega notional, is indeed long $10 million worth of vega notional. It trades in fixed maturities of, let us suppose, five years. After one year has elapsed, the mark-to-market profit of the hedge fund is equal to the product of $10 million and the difference between the weighted average of the realized volatility for the first year and the implied volatility of the remaining four years. Because one-fifth of the position has expired, the remaining vega notional is now only $8 million. If the fund wants to maintain a 10% exposure to volatility, it needs to purchase some more volatility swaps.

But what if the market implied volatility is no longer cheap? Could it still make sense for the fund to purchase the swap? Yes, it could, if the fund is big enough to cause a market impact by its trading. Suppose that by purchasing $2 million of new five-year vega, the hedge fund causes all implied volatilities to rise by one volatility point above fair value. Then assuming the fund does no more trades, in five years it will lose $2 million on its last trade. In the meantime, however, it will have caused a mark-to-market profit of $8 million, because its old volatility swaps would have been marked to the higher value too. Over the next four years, it will lose all of that $8 million as well, since at the end, the realized volatility will be the fair value, and the marks at the end of the first year will be deemed, in hindsight, to be too high. The rest of this paper contains a literature review, the formal model definitions and dynamics, and an exploration and discussion of the simulations, followed by a conclusion.

LITERATURE REVIEW

The literature on bubbles is perhaps the oldest class of financial research. Aristotle wrote of Thales who created a bubble in olive presses by cornering the market and selling at its peak. Isaac Newton lost twenty thousand pounds in the South Sea bubble, famously complaining that he can "calculate the motions of heavenly bodies, but not the madness of people." These two early examples still represent the two primary modern approaches to understanding bubbles.

Explanations of Thales-like bubbles assume relatively rational investors. Blanchard and Watson (1982) show that bubbles can be consistent with rationality. Jarrow (1992) finds bubbles can form if certain large traders can manipulate markets. Abreu and Brunnermeier (2003) find bubbles can persist because of a synchronization problem between rational investors in timing their exits.

Explanations of South Sea-like bubbles assume the existence of noise traders, combined with limits on arbitrageurs. Shleifer and Summers (1990) show how even rational investors can predict bigger fools in the future and so push bubbles further in the hope that they will be able to get out before it bursts. Many psychological biases seem able to drive noise trader behavior. Scheinkman and Xiong (2003) show that overconfidence leads to bubbles. Greenwood and Nagel (2008) find that the recent tech bubble was driven by younger investors. Barberis, Shleifer, and Vishny (1998) show that naïve extrapolation and a conservatism bias lead to consistently predictable return patterns. This paper does not assume a particular psychological bias for the financial entities. On the contrary, the entities act rationally given their constraints.

Indeed, regardless of whether market participants are rational or not, experimental markets reliably replicate bubbles in laboratory conditions. Porter and Smith (2003) review 72 such experiments and find that markets with a well-defined expected fundamental dividend value exhibit bubbles, which diminish with experience, and which seem to depend on investor uncertainty about the behavior of other traders rather than uncertainty about the fundamental value itself. Hirota and Sunder (2007) suggest alternatively that short horizons and computational difficulty are to blame.

It is possible to generate bubbles and crashes through explicit models of agent behavior. For example, Corcos, Eckmann, Malaspinas, Malevergne, and Sornette (2008) introduce a deterministic, infinite-agent model in which agents change from bullish to bearish depending on the mood of their friends. This model is able to generate a wide range of behavior from chaotic to super-exponentially growing bubbles followed by crashes to quasi-periodic behavior. Wolfram (2002) describes a very simple idealized model of a market based on all entities repeatedly changing their mind depending on the decisions made by their two nearest neighbors in the prior period. In a similar vein, Maymin (2008a) proposes the minimal model of complexity of financial security prices, requiring only a single investor trading a single asset, yet still generating bubbles, crashes, and complexity.

Relative to such agent-based models, the dynamics presented here do not depend on complexity arising from simple trading rules or changes in attitudes or beliefs, but rather focus on the results of the fixed portfolio allocation decisions of a single financial entity or group of financial entities.

Furthermore, agent-based rules are typically applied to asset markets such as stocks or bonds, eschewing the more complicated derivatives markets, whereas the model presented here applies most easily to derivatives with fixed maturity dates and random realizations rather than perpetuities like stocks or fixed coupons like bonds.

Indeed, research linking bubbles and derivatives is rare and often only an indirect link based on bubbles in the underlying asset. For example, Cox and Hobson (2005) show that option pricing in the presence of an underlying bubble violates put-call parity among other things. In contrast, this paper describes bubbles formed directly in derivative markets by the market participants.

Similarly, financial research on chaos such as Hsieh (1991) has focused on the dynamics of the underlying asset processes, not on the chaos potentially caused directly through trading in markets for the derivatives themselves.

MODEL DEFINITIONS AND DYNAMICS

Definition 1: A *standard maturity* derivative security is one that is typically traded in the market for a fixed maturity of a particular number of years.

The most obvious examples are credit default swaps, where new swaps tend to trade at five-year maturities and old swaps have maturities less than five-years. Volatility and variance swaps can typically be traded for any maturity but one-year and two-year maturities are common as well. Sometimes such swaps tend to expire on particular days such as to coincide with the expiration of a futures contract, so the maturity is a constant when rounded to the nearest year.

Definition 2: A *decomposable* derivative security is one whose payoff can be expressed as:

$$\sum_{t=0}^{T-\Delta t} \frac{N\Delta t}{T}\left(R_{t;t+\Delta t} - K\right)$$

where the derivative security has initial strike K and notional N and which pays off $N\left(R_{0;T} - K\right)$ at maturity T, with $R_{A;B}$ representing the realized value of the period from A to B.

In other words, a decomposable derivative security is a sequence of forward-starting derivatives each with maturities Δt. A typical example of such a security is a variance swap.

Definition 3: A *linear market impact model* for a family of derivative securities with a flat term structure adjusts all future implied values by the same amount for a given amount of notional traded. In particular, for a variance swap, $\sigma' = \sigma + \lambda V$, where σ' is the new implied level, σ is the old implied level, V is the amount of variance swap notional purchased (a negative amount if sold), and λ is the impact.

In other words, and simplifying to the language of volatility swaps, if you buy $10 million of vega, and if we assume as we will later that $\lambda = 0.05$, then you will have increased the remaining implied volatility by half of a volatility point. If it had been a flat 20% implied volatility term structure, it will now be a flat 20.50% implied volatility term structure.

Definition 4: A *constant exposure* fund is one that seeks to maintain an exposure to a standard maturity derivative equal to a fixed proportion of its capital at every period.

A fund that aims to be 60% invested in equities and 40% in bonds is a constant exposure fund if one regards stocks as derivatives whose standard maturity is infinity and bonds as a derivative whose standard maturity is 30 years. As the bond values accrete down, such a fund needs to purchase more new bonds to satisfy its exposure requirement.

A fund that aims to maintain a 10% exposure to volatility will rebalance its volatility exposure every period to ensure that any profit it has earned is used to support new and larger positions and any losses it has incurred will result in a sale of new positions to offset the exposure of its existing positions.

With these definitions, we can derive the evolution dynamics of a hedge fund's capital.

Theorem 1: A constant exposure fund (or group of funds acting as one) with a target constant proportional exposure of κ to a decomposable derivative security that trades in the market with a standard maturity of T years, having a linear market impact model that increases the implied mark of all derivative securities by λ for each unit of exposure purchased, will, at time $t + \Delta t$, have capital $C_{t+\Delta t}$, average maturity $M_{t+\Delta t}$, and implied mark $\sigma_{t+\Delta t}$ given jointly by:

$$C_{t+\Delta t} = C_t + \frac{C_t \kappa \Delta t \left(R_{t;t+\Delta t} - \sigma_{t+\Delta t} + C_t \kappa \lambda \frac{(M_t - \Delta t)}{M_t} \right)}{M_t - C_t \kappa^2 \lambda (M_t - \Delta t)}$$

$$M_{t+\Delta t} = \frac{M_t T \Delta t \left[\kappa \left(\sigma_t - R_{t;t+\Delta t} \right) - 1 \right] - (M_t - \Delta t)^2 \left(M_t - C_t \kappa^2 \lambda (M_t - \Delta t) \right)}{C_t \kappa^2 \lambda (M_t - \Delta t)^2 - M_t \left(M_t - \kappa \Delta t \left(\sigma_t - R_{t;t+\Delta t} \right) \right)}$$

$$\sigma_{t+\Delta t} = \frac{\sigma_t M_t + C_t \kappa \lambda \left(\Delta t - \kappa \sigma_t M_t + \kappa \Delta t R_{t;t+\Delta t} \right)}{C_t \kappa^2 \lambda (M_t - \Delta t) - M_t}$$

where $R_{t;t+\Delta t}$ is the realized portion of the derivative for the period from time t to time $t + \Delta t$ and C_0 is the fund's initial starting capital.

Proof of Theorem 1: The proof follows from solving the following equations, which themselves follow directly from the assumptions and the definition of profit as the sum of the realized profit plus the implied profit:

$V_t = \kappa C_t$	"Vega" definition
$\tilde{V}_t = V_t \frac{M_t - \Delta t}{M_t}$	"Aged vega"
$V_{t+\Delta t} = V_t + \kappa \Pi_{t;t+\Delta t}$	New vega
$\sigma_{t+\Delta t} = \sigma_t + \lambda \left(V_{t+\Delta t} - \tilde{V}_t \right)$	Market impact
$\Pi_{t;t+\Delta t} = \frac{V_t}{M_t} \left(R_{t;t+\Delta t} - \sigma_t \right) \Delta t + \tilde{V}_t (\sigma_{t+\Delta t} - \sigma_t)$	Profit for this period

$$M_{t+\Delta t} = \frac{\tilde{V}_t(M_t - \Delta t) + (V_{t+\Delta t} - \tilde{V}_t)T}{V_{t+\Delta t}}$$ Average maturity

$$C_{t+\Delta t} = C_t + \Pi_{t;t+\Delta t}$$ Definition of profit

Substituting the definitions of $\sigma_{t+\Delta t}$, $\widetilde{V}_t$, and $V_{t+\Delta t}$ from the earlier equations into the one for profit, we get:

$$\Pi_{t;t+\Delta t} = \frac{V_t}{M_t}(R_{t;t+\Delta t} - \sigma_t)\Delta t + \widetilde{V}_t(\sigma_{t+\Delta t} - \sigma_t)$$

$$= \frac{V_t}{M_t}(R_{t;t+\Delta t} - \sigma_t)\Delta t + \tilde{V}_t\lambda(V_{t+\Delta t} - \tilde{V}_t)$$

$$= \frac{V_t}{M_t}(R_{t;t+\Delta t} - \sigma_t)\Delta t + \tilde{V}_t\lambda(V_t + \kappa\Pi_{t;t+\Delta t} - \tilde{V}_t)$$

$$= \frac{V_t}{M_t}(R_{t;t+\Delta t} - \sigma_t)\Delta t + V_t\frac{M_t - \Delta t}{M_t}\lambda\left(V_t + \kappa\Pi_{t;t+\Delta t} - V_t\frac{M_t - \Delta t}{M_t}\right)$$

Collecting terms gives the solution for $\Pi_{t;t+\Delta t}$ from which all others flow:

$$\left(1 - V_t\frac{M_t - \Delta t}{M_t}\lambda\kappa\right)\Pi_{t;t+\Delta t} = \frac{V_t}{M_t}(R_{t;t+\Delta t} - \sigma_t)\Delta t + V_t^2\frac{M_t - \Delta t}{M_t}\lambda\frac{\Delta t}{M_t}$$

The "vega" definition in the proof represents the following. If the fund has \$100 million and is targeting a 10% exposure to volatility, then the amount of vega it is carrying is \$10 million. This follows from the definition of a constant exposure fund.

The "aged vega" is the amount of vega remaining after a period of time Δt has elapsed. By decomposability, the progress of time has essentially expired the first Δt of the total M_t maturity of the decomposable derivative security. Hence the remaining exposure is just the fraction of the remaining maturity as applied to the initial exposure to the derivatives.

The profit for any period is composed of two parts: the realized profit on the portion of the decomposable derivative that has essentially matured, and the implied profit on the portion of the decomposable derivative that remains. The portion that has matured is $\frac{V_t}{M_t}\Delta t$ and the portion that remains is the "aged vega."

The average remaining maturity is a weighted average of the maturity that remained, weighted by the aged vega, and the standard maturity of the derivative, weighted by the new vega, or the additional amount of vega required to be purchased to maintain the constant-exposure assumption. Since the new capital is simply the sum of the old capital and the profits, the new vega must be the same constant proportion κ of the new capital. Since the old vega was that same proportion of the old capital, the new vega can be expressed as the sum of the old vega plus a proportion κ of the profits.

Note the discontinuities that can result when the coefficient of the left hand side of the equation for $\Pi_{t;t+\Delta t}$ is near zero:

$$V_t = \frac{M_t}{M_t - \Delta t}\frac{1}{\lambda\kappa}$$

$$C_t = \frac{M_t}{M_t - \Delta t}\frac{1}{\lambda\kappa^2}$$

$$C_t \approx \frac{1}{\lambda\kappa^2}$$

where the last approximation follows by noting that M_t is approximately the same as $M_t - \Delta t$.

Denote by $C_t^* = 1/(\lambda\kappa^2)$ this critical value of capital.

The evolution of capital follows a quadratic fractional transformation. In particular, its quadratic form is determined as the product of two affine ones. Cambini, Crouzeix, and Martein (2002) show that such a transformation is pseudoconvex in certain circumstances. The evolution of the capital can also be re-written as follows.

$$C_{t+\Delta t} = C_t + \frac{C_t\kappa\Delta t\left(R_{t;t+\Delta t} - \sigma_{t+\Delta t} + C_t\kappa\lambda\frac{(M_t-\Delta t)}{M_t}\right)}{M_t - C_t\kappa^2\lambda(M_t - \Delta t)}$$

$$= \frac{C_t\kappa\Delta t\left(R_{t;t+\Delta t} - \sigma_{t+\Delta t} + C_t\kappa\lambda\frac{(M_t-\Delta t)}{M_t}\right) + C_t\left(M_t - C_t\kappa^2\lambda(M_t - \Delta t)\right)}{M_t - C_t\kappa^2\lambda(M_t - \Delta t)}$$

$$= \frac{C_t\kappa\Delta t\left(R_{t;t+\Delta t} - \sigma_{t+\Delta t}\right) + C_t^2\kappa^2\lambda\frac{M_t-\Delta t}{M_t} + C_tM_t - C_t^2\kappa^2\lambda(M_t - \Delta t)}{M_t - C_t\kappa^2\lambda(M_t - \Delta t)}$$

$$= \frac{C_t\left(\kappa\Delta t\left(R_{t;t+\Delta t} - \sigma_{t+\Delta t}\right) + M_t\right) + C_t^2\kappa^2\lambda(M_t - \Delta t)\left(\frac{\Delta t}{M_t} - 1\right)}{M_t - C_t\kappa^2\lambda(M_t - \Delta t)}$$

Though this model is expressed in terms of derivatives and assumes a constant exposure, it is representative of a wider class of possible models that result in hedge funds buying small amounts of some securities for poor future arbitrage returns to achieve larger current mark-to-market returns.

SIMULATIONS AND DISCUSSION

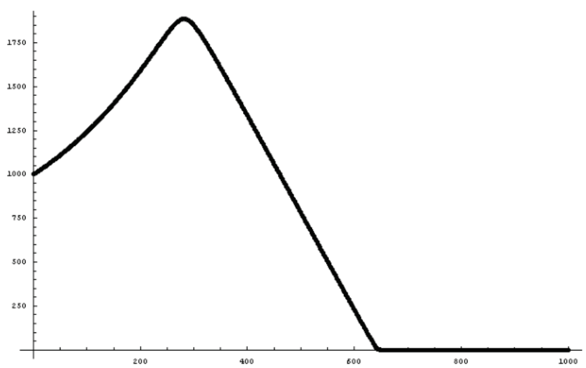
Let us consider a particular numerical example of this model. Suppose we are looking at an amalgamation of a group of hedge funds totaling C_0 = \$1 billion in capital, and that this capital is targeting κ = 10% of its capital as exposure to variance swaps. Hence, initially it has \$100 of vega exposure.

(I use the term "vega notional" for convenience. The exact terminology would be "variance swap notional" and both the realized and implied marks would be in variance terms, not volatility, but the discussion flows easier if the terminology is that of volatility swaps. An alternative way of reading this is to assume that volatility swaps are decomposable.)

Suppose finally that the default maturity of new swaps is 5 years and that a $1 million purchase of new swaps increases all implieds by $\lambda = 0.05$ volatility points per $1 million. The particular numbers do not matter since similar results follow at some point so long as $\lambda > 0$ and $\kappa > 0$. Nevertheless, these numbers do represent ballpark estimates of reality. An online demonstration allows interaction and exploration of this model (Maymin, 2008b).

Figure 1 shows the evolution of the capital over time, where for convenience the capital, vega, and λ are all expressed in millions. This figure shows the prototypical evolution of capital under the model. Capital initially increases as the fund purchases more of the derivative both to replace its expiring exposure and to generate current mark-to-market profits at the expense of future arbitrage losses until the realized losses from expiring exposure gets so large that the fund is forced to sell and liquidate. The figure shows a gentle, smooth bubble.

Figure 1: Simulated Evolution of Capital Starting with Initial Capital of $1 billion



This figure represents the evolution, in time steps of 1/100's of a year, of the capital of a hedge fund that invests 10% of its initial $1 billion in variance swaps that have a default maturity of 5 years and experience market impact equal to 0.05 variance points per $1 million notional trade. The initial implied is 20% and the realized is constant at 20%. The capital peaks above $1.75 billion after about three years (300 time steps), and then decreases rapidly until bankruptcy around year 6 (600 time steps).

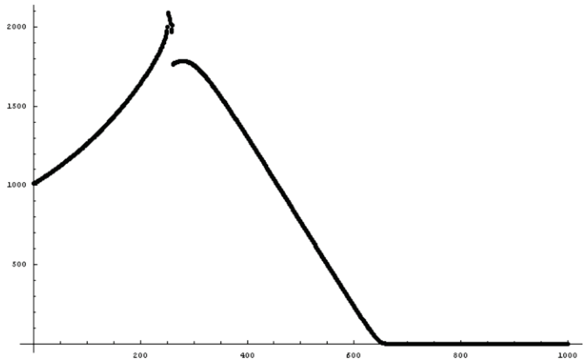
Discontinuities

Recall the critical value of capital $C_t^* = \frac{1}{\lambda\kappa^2}$ at which discontinuities can occur and note that the critical value occurs when $C_t^* = \frac{1}{0.05/\$1{,}000{,}000\,(0.1)^2}$ = $2 billion. The capital never reaches the critical value and so the evolution remains smooth. But if the initial capital were just one percent higher and started out at C_0 = $1.01 billion, then its evolution would experience several discontinuities, including a big gap down after around two and a half years. See Figure 2.

Not all evolutions are necessarily bubbles either. If the initial capital were just two million dollars higher, a mere 0.20% higher than the previous example, so that C_0 = $1.012 billion, then the capital of the hedge fund would continue to grow without bound. See Figure 3.

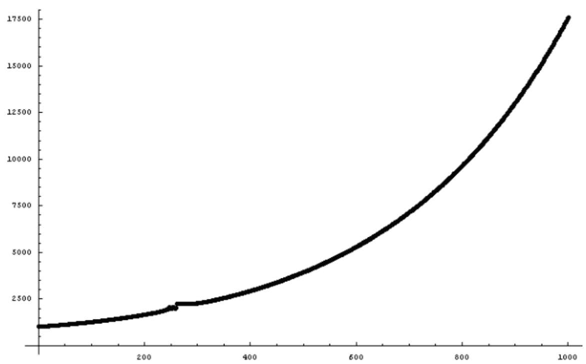
Additionally, it is not necessarily the case that there will only be one bubble. If we start from our base case and simply make the initial implied volatility 17% instead of 20%, so that the volatility appears to be 3% cheap to start, then the profits rise quickly, form a discontinuity, drop by approximately 75%, then start a new, slower, and more continuous bubble. See Figure 4.

Figure 2: Simulated Evolution of Capital Starting with Initial Capital of $1.01 billion



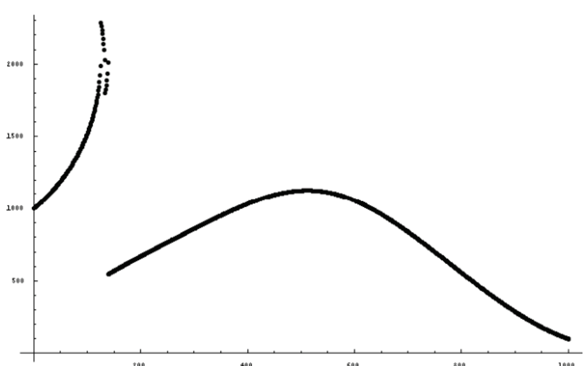
This figure represents the evolution, in time steps of 1/100's of a year, of the capital of a hedge fund that invests 10% of its initial $1.01 billion in variance swaps that have a default maturity of 5 years and experience market impact equal to 0.05 variance points per $1 million notional trade. The initial implied is 20% and the realized is constant at 20%. The capital peaks above $2 billion after about two and a half years (250 time steps), and then gaps down and decreases until bankruptcy around year 6 (600 time steps).

Figure 3: Simulated Evolution of Capital Starting with Initial Capital of $1.012 billion



This figure represents the evolution, in time steps of 1/100's of a year, of the capital of a hedge fund that invests 10% of its initial $1.012 billion in variance swaps that have a default maturity of 5 years and experience market impact equal to 0.05 variance points per $1 million notional trade. The initial implied is 20% and the realized is constant at 20%. The capital continues to increase indefinitely, reaching more than $17.5

Figure 4: Simulated Evolution of Capital Starting with Initial Implied Volatility of 17%



This figure represents the evolution, in time steps of 1/100's of a year, of the capital of a hedge fund that invests 10% of its initial $1 billion in variance swaps that have a default maturity of 5 years and experience market impact equal to 0.05 variance points per $1 million notional trade. The initial implied is 17% and the realized is constant at 20%. The capital peaks at nearly $2.5 billion after about one and a half years (150 time steps), and then gaps down to about $500 million in capital. From there, it follows a smooth bubble back up to about $1 billion in year five (500 time steps) and decreases gradually towards bankruptcy.

Because the evolution around the critical value is so fragile, different discontinuities can result from even slight changes to the time step or other parameters.

Possible Extensions

The model can easily be extended to allow for alternative representations of market impact. For example, instead of a linear market impact model, we could use one whose impact is measured by the square root of the traded vega. However, that removes neither the jumps nor the possibility of infinite wealth, and apart from changing the exact times of bubbles and jumps, it does not aid in the intuition behind the model.

Similarly, the model can be extended to allow the market impact to dissipate over time, or to affect the realized portion as well as the implied portion. Indeed, there is good reason to assume that an increase in the implied will spill over into the realized simply because of the hedge fund's increased hedging activity. As more hedge funds buy volatility, volatility tends to dampen under their hedging. As more hedge funds sell volatility, volatility tends to increase under their hedging. Still, these enhancements to the model simply mitigate the effect over time but do not remove the fundamental discontinuities.

The model assumptions of direct decomposability and constant exposure may be relaxed. For example, mortgage-backed securities are not typically decomposable, but they do experience time decay in a non-linear way. Funds also may have a range of exposure they are willing to bear. The pure linearity of decomposition here is just a convenient approximation to the aging process of virtually all non-perpetual securities.

Similarly, though the illustrative example presented here was of a hedge fund trading volatility, the model applies equally well to a group or sector of hedge funds, or pension funds, or sovereign wealth funds, where allocations as a percentage of capital can be sticky even when the individual entities may not be because the risk of the entire securities held by those kinds of entities may be a fixed percentage, even though the individual entities allocate it different among themselves. As an example, by some anecdotal estimates, about 80 percent of the convertible bonds that were issued in the late 1990s and early 2000s were held by hedge funds; even if no particular hedge fund tried to hold a fixed proportion, the market was such that the overall amount held by hedge funds in total remained approximately constant.

CONCLUSION

What are the potential long term effects of consistently propping up? I present a model of financial entities seeking to maintain a constant exposure to decaying securities that engage in propping up and I find that they can generate a bubble. In most cases, the bubble can be a smooth runup followed by a smooth dropdown, but around certain critical capital values, discontinuities can result. Furthermore, the critical capital value depends only on two parameters: the market impact of trading new derivatives, and the proportional target exposure.

The implications for investors are that realized lower market volatility in such markets may be a temporary illusion hiding the possibility of a chaotic crash, and that the amount of capital committed to the strategies can provide valuable information to the extent the critical values can be calculated.

With the current environment of global government intervention into private markets, whether by purchasing outright equity stakes or establishing a portfolio of bad assets, the long-term consequences may not be adequately addressed or even considered. This is, after all, an "emergency" situation. But the proposed cure may be worse than the disease, and if the level of governmental intervention reaches the critical value, defined above as a function of the market impact and the allocation percentage, it is essentially unpredictable what may result.

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BIOGRAPHY

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HOW DOES THE CANADIAN STOCK MARKET REACT TO THE FED'S POLICY?

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Nahid Kalbasi Anaraki, Islamic Azad University, Science and Research Branch, Tehran

ABSTRACT

This study examines how the Canadian stock market reacts to the Fed's policy. Although many research studies have measured the bilateral correlation among national stock markets, rarely have they investigated this correlation within a Free Trade Zone (FTZ). We use a Vector Error Correction Model (VECM) accounting for monetary and exchange rate policies to measure the long-term elasticity of Toronto Stock Exchange (TSE) not only to the Fed's policy, through the movements of Federal Fund Rate (FFR), but also to the parity value of the Canadian-U.S. dollar exchange rate. The estimated results suggest that TSE is sensitive to both FFR, and the conversion rate of the US-Canadian dollar. The variance decomposition technique helps us to determine the main factors contributing to the movements of TSE. We also use multivariate dynamic forecasts to predict TSE.

JEL: G1

KEYWORDS: Stock market integrity, financial turmoil, North America Free Trade Agreement (NAFTA), Federal Fund Rate (FFR), Vector Error Correction Model (VECM), Toronto Stock Exchange (TSE).

INTRODUCTION

The last two decades have witnessed rapid international capital mobility in the form of investment and intra-regional trade because of increasing interaction among the world economies. The co-movements of the world's national equity markets have long been a popular research topic in the finance literature. Indeed, the integration of global stock markets has important policy implications for trade, exchange rate and monetary policies. Although the co-movements of the world's major stock markets have been studied extensively, the co-movements of stock markets within a Free Trade Zone (FTZ) or a monetary union have rarely received sufficient attention.

As the Canadian-U.S. stock markets' integration seems to have been intensified due to higher amount of trade within NAFTA, we try to investigate the correlation between these two stock markets, using a Vector Error Correction Model (VECM). Since many Canadians remain concerned as to whether the U.S. financial turmoil could spill over into Canada's stock market, this paper tries to address this question by measuring the long-term elasticity of TSE to the U.S. stock market indices, the exchange rate behavior and the Fed's policy changing the FFR. The rest of the paper is organized as follows. In the next section we introduce a brief history of NAFTA. Then we review the literature on the relationship of stock market, exchange rates and monetary variables. In Section III we briefly review the Canadian stock market. While Section IV deals with methodology and data description, Section V is allocated to empirical results. Finally Section VI raps up and concludes.

LITERATURE REVIEW

North America Free Trade Agreement (NAFTA)

Greater integration of the Canadian, Mexican and the U.S. markets has been one of the key developments in North America since the implementation of the Canada-U.S. Free Trade Agreement (CUSTA) in 1989 and its successor accord, the North American Free Trade Agreement (NAFTA), signed on December 17, 1992. This agreement between the U.S., Canada and Mexico created the world's biggest single market by eliminating all trade and investment barriers among these countries. Taking effect on January 1, 1994, NAFTA immediately lifted tariffs on the majority of goods produced by the three nations. The United States has the largest economy of these three; the U.S. GDP is more than 10 times greater than both Canada and Mexico and has the largest growth rate. Therefore, it is expected that the U.S. monetary policy largely affects the two other economies.

Trade relations among Canada, Mexico and the United States have broadened substantially since NAFTA's implementation, though the extent to which this expansion is a direct result of the deal is controversial. According to official data, the overall value of intra-North American trade has more than tripled since the implementation of NAFTA. Canada and the United States are the largest markets for one another's goods. Total cross-border trade has increased almost fivefold since 1980—when a series of Canadian-U.S. tariff reduction agreements began—and now amounts to almost USD $500 billion annually. The integration of the two economies has blossomed Canadians' concerns about becoming overwhelmed by the U.S. financial turmoil. Indeed, the same fears that have driven down the U.S. stock market, have also taken their toll on stocks of America's trading partners. Although Canadians have greatly benefited from NAFTA, this integration may also threaten Canada due to sharply weakened U.S. dollar. Since the contagion from the U.S. stock market turmoil may spill over to Canada's economy, we use a VECM model, to test the hypothesis whether the TSE is sensitive to the Fed's policy, changing FFR, to the parity of the US-Canadian dollar exchange rate, and to the U.S. stock market behavior.

Studying the co-movements of national stock markets has long been a popular research topic in finance (see Makridakis & Wheelwright, 1974; Joy et al., 1976; Hilliard, 1979; Maldonaldo & Saunders, 1981; Phillipatos et al., 1983). The relationship among various stock markets is a hot topic and has both micro and macroeconomic policy implications. Early studies by Ripley (1973), Lessard (1976) and Hilliard (1979) generally find low correlations among stock markets, which validate the benefits of diversifications in international portfolio management. However, after the U.S. stock market crash in October 1987, the trend was reversed. Lee and Kim (1994), among others, find that national stock markets became more interrelated after the crash. Applying a VAR and impulse response function analysis Jeon and Von-Furstenberg (1990), among others, find a stronger co-movement among international stock markets. Similar studies suggest that after the Asian financial crisis in 1998, stock markets became more integrated, showing evidence for the co-movement of the U.S. and other world equity markets (see Eun & Shim, 1989). Cheung and Ng (1992) find that the U.S. stock market plays a dominant role for the Tokyo stock market from January 1985 through December 1989. However, not all the research studies support the integration among stock markets. Koop (1994) uses a Bayesian method to conclude that there are no common stochastic trends in stock prices across selected countries. Forbes and Rigobon (2002) claim that currency crisis lead to lower integration among stock markets.

Some recent studies have investigated the co-movements of national stock markets in a given geographical region. For example, Firedman and Shachmurove (1997) and Meric and Meric (1997) show that the correlation between the European stock markets has been decreasing during the time. Hashimoto and Ito (2004) analyze the co-movement of the exchange rates and the stock prices from the viewpoint of contagion among the eight countries in South East Asia during the period of Asian crisis, 1997–1999. In their study, contagion is defined among not only the exchange rates and stock prices separately but also between an exchange rate and a stock price of the same country or different countries. Their results prove contagion between the exchange rate and stock price of the same country or different countries during the crisis period; stock prices are found to be higher under influence of exchange rates and stock prices of other countries.

Aggarwal and Kyaw (2005) examine the integration of the three participating equity markets before and after NAFTA based on daily, weekly and monthly data. As expected, unit root tests for the overall period 1988–2001 and the two subperiods 1988–1993 (pre-NAFTA), and 1994-2001 (post-NAFTA) indicate that equity prices are cointegrated only for the post NAFTA period. Chen, Lobo and Wong (2005) examine the bilateral relations between three pairs of stock markets, namely India-U.S., India-China, and China-U.S. They use a Fractionally Integrated Vector Error Correction Model (FIVEC) to examine the cointegration among the three markets. By augmenting the FIVECM with a multivariate GARCH, they study the first and second moment spillover effects. Their results suggest that all three pairs of stock markets are fractionally co-integrated and that the U.S. stock has hegemony relative to two other markets. Meric, Goldberg, Dunne and Meric (2005) use the correlation analysis to study the time-varying correlation patterns between pairs of NAFTA stock. The Granger causality test is used to examine the predictability and the weak-form efficiency of each stock market's returns. Their results suggest that all three NAFTA stock markets are of weak-form efficient; that is, the past returns of none of the three stock markets can be used to predict its future returns.

Gluster, Ratner and Meric (2007) study the co-movements of the weekly index returns of the Egyptian, Israeli, Jordanian, Turkish, the U.K. and the U.S. stock markets from September 9, 1996, to September 11, 2006. They use the Principal Component Analysis (PCA) technique to study the co-movements among the U.S. stock market and the Middle East stock markets. Their results indicate that there is a very low correlation among the Egyptian, Israeli, Jordanian and Turkish stock markets. The rolling correlation analysis suggests that the most volatile correlation can be found between the Turkish and the U.S. stock markets, and the least volatile correlation appears between the Egyptian and the U.S. stock markets.
As it was sketched here, the influence of the U.S. economy and its stock market on the global stock markets is pervasive and well documented in the literature. Indeed, the dominant role of the U.S. dollar in the international monetary system has intensified the hegemony of the U.S. stock market on the international markets.

CANADA'S STOCK MARKET

The existence of stock exchanges in Canada can be traced back to early 1870s. The Montreal Stock Exchange—now known as the Montreal Exchange or ME—was the first to incorporate in 1874, while the Toronto Stock Exchange (TSE) was founded in 1878. By 1999, four main stock exchanges were operating in Canada—the ME, the TSE, the Alberta Stock Exchange (ASE), and the Vancouver Stock Exchange (VSE). The TSE has gradually established itself as Canada's principal market for equity trades, and in 1998, its share in the equity trading reached almost 90%. In March 1999, these four main stock exchanges announced an agreement to restructure the Canadian markets into areas of specialization. The agreement was implemented at the end of 1999 and early 2000. As a result, the trading of senior equities was consolidated on the TSE; derivatives were transferred to the ME, ASE and the VSE, after merging to become the Canadian Venture Exchange (CDNX), which specialized in trading junior securities. The rationale behind the restructuring was a desire to strengthen the overall competitiveness of the Canadian market transactions by reducing fragmentation. At the time, this was seen as especially critical, given the increasing globalization of markets and the growing competition between traditional stock exchanges and new trading mechanisms. However, the TSE is by far, the largest exchange in Canada, and therefore we use TSE as the representative index for the Canadian stock market.

DATA AND METHODOLOGY

Hypothesis

Though the co-movements of the national stock markets in different regions and within NAFTA have already been studied, researchers have generally emphasized on techniques, rather than delving into macroeconomic, monetary, and exchange rate policies. To address this deficiency we include all the related monetary and exchange rate variables in a VECM to test the hypothesis whether there is a contagion between these two stock markets. Indeed, the aim of this paper is twofold. First we investigate how TSE reacts not only to the Fed's policy—changing FFR—but also to the exchange rate movements between the two currencies, and to the U.S. stock market behavior. Second, we try to forecast the TSE level based on a multivariate dynamic forecast technique.

Data Description

We use monthly data from January 1996 through April 2008. The data on the U.S. monetary and macroeconomic variables come from Federal Reserve Bank of St Louis and the Federal Reserve System. The data on the Canadian monetary variables are from Bank of Canada, and the monthly data for TSE come from Canada's National Statistical Agency.The list of variables is shown in the following Table.

Table 1: List of Variables Used in the Model

Abbreviation	Name of Variable
USM2	US Money Supply
FFR	Federal Fund Rate
USGDP	US Gross Domestic Product
USCPI	US Consumer price Index
CGDP	Canada's Gross Domestic Product
EXCH	US dollar parity versus the Canadian dollar
NASDAQ	US Nasdaq Industrial Index
DJ	Dow Jones Index
CINT	Canadian Interest Rate
TSE	Toronto Stock Exchange Index

This table introduces the list of variables that will be used in the Vector error Correction Models in the next sections. The data are used in a monthly basis and pertains to January 1996 through April 2008.

The descriptive statistics of these variables are presented in Table 2. The first step is to test for the non-stationary of the involved series. We implement Augmented Dickey Fuller (ADF) unit root to test whether the series are stationary. The results contained in Table 3 suggest that all the variables in the logarithm forms are I (1) in accordance with the findings in the literature.

Table 2: Descriptive Statistics

Statistics	Mean	Median	No	Std Dev.	Skewness	Kurtosis
USM2	5481.537	5500.300	149	1197.66	0.087	1.74
USGDP	10629.93	10333.30	147	1912.77	0.28	1.96
USCPI	180.57	178.80	149	16.82	0.30	1.96
FFR	4.00	4.80	149	1.76	-0.53	1.76
NASDAQ	2101.32	2027.13	149	708.49	1.27	5.14
EXCH	1.35	1.38	149	0.17	-0.58	2.27
CINT	3.87	4.07	144	1.13	-0.02	1.68
CGDP	282320.40	285303.00	147	32407	-0.193	2.03
TSE	8651.31	7772.70	149	2593	0.749	2.48

This table introduces the descriptive statistics for the data including the mean, median, number of observations, Standard deviation, skewness and kurtosis. As it is shown the exchange rate has the lowest standard deviation.

Table 3: Unit Root Tests (Augmented Dickey Fuller ADF test)

Variables	No. of Lagged Differences	Test Statistic	5% Critical Value	1% Critical Value
USM2	2	-0.622	-2.881	-3.476
USGDP	4	-0.356	-2.881	-3.477
USCPI	2	1.486	-2.881	-3.476
FFR	1	-1.192	-2.881	-3.476
NASDAQ	0	-2.109	-2.881	-3.476
EXCH	2	-1.158	-3.441	-4.023
CINT	2	-2.084	-2.881	-3.477
TSE	1	-0.979	-2.881	-3.475

This table introduces the augmented Dickey Fuller Test for the variables used in the study. As it is shown all the variables in the logarithm forms are I (1) at 99% significance level in accordance with the findings in the literature.

Methodology

To investigate the long-term relationship between the two stock markets, we employ a first difference specification of a VECM model. This specification helps us examine the long-term elasticities of TSE with respect to USM2, FFR, NASDAQ, (or Dow Jones), the exchange rate and the Canadian interest rate. The ordering of the variables in our VECM model is as follows:

$$\begin{bmatrix} TSE \\ USM2 \\ FFR \\ NASDAQ \\ EXCH \\ CINT \end{bmatrix}$$

Finally, we use the variance decomposition technique to examine how the TSE responds to FFR shocks, to changes in the parity value of the US-Canadian dollar exchange rate, and to the movements of NASADAQ and Dow Jones. The monetary transmission mechanism suggests that FFR is negatively correlated with TSE, since when FFR drops, the cost of borrowing decreases, investment increases and the NASDAQ moves up, subsequently. As the two stock markets are positively correlated, a fall in FFR will also lead to higher TSE. On the other hand, it is expected that the US-Canadian dollar exchange be negatively correlated with TSE. Indeed, with a weaker dollar the U.S. exports increases, the U.S. GDP and investment moves up, leading to higher NASDAQ and TSE, highlighting a negative correlation among the exchange rate and TSE.

EMPIRICAL RESULTS

Using the first order difference of a VECM for the period January 1996 through April 2008, we implement both Dow Jones and NASDAQ as representative indices for the US stock market. The estimated results with inclusion of Dow Jones, as shown in Table 4, suggest that all variables are statistically significant and with the expected signs. The long-term elasticity of the TSE with respect to FFR is almost -0.7% and statistically significant. In other words, a 1% standard deviation in FFR decreases TSE by 0.7%. The elasticity of TSE to Dow Jones amounts to 0.4%, highlighting the relatively strong correlation of the two stock markets, as expected in theory. The results also suggest that the long-term elasticity of TSE to exchange rate parity amounts to 0.66%, exceeding its elasticity to DJ, underlining the importance of parity value on TSE movements.

The variance decomposition technique for a period of 24 months, based on the mentioned VECM, as shown in Table 5 indicates that after the Canadian interest rate, TSE is mainly affected by FFR and USM2; almost 1% of the variance of the TSE, after a year, is attributable to the FFR. Though the

Canadian interest rate contribution in explaining the Canadian stock market is stable during the time, the role of FFR increases from 0.2% in the second month to 1% at the end of the first year.

Table 4: Vector Error Correction Estimates (with Dow Jones)

List of Variables	CointEq1
TSE	1
USM2	-0.48
	(-2.99)
FFR	0.69
	(6.04)
DJ	-0.41
	(-3.19)
EXCH	0.66
	(3.43)
CINT	0.89
	(6.04)
Log Likelihood	1664.98
Akaike information Criteria	-27.05
Schwarz Criteria	-25.77

This Table presents the results on the estimation of the Vector Error Correction Model with inclusion of Dow Jones. The Akaike and Schwartz criteria indicate that at least one co-integration equation exists among the variables. Note the Numbers in parentheses are t statistics

Table 5: Variance Decomposition of LOG (TSE)

Period	S.E.	LOG(TSE)	LOG(USM2)	LOG(FFR)	LOG(EXCH)	LOG(DJ)	LOG(CINT)
1	0.045755	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.070433	99.17656	0.366601	0.224346	0.081366	0.014747	0.136380
3	0.089081	98.27206	0.593998	0.483813	0.112551	0.071361	0.466214
4	0.104414	97.55542	0.741906	0.667252	0.109550	0.126112	0.799758
5	0.117697	97.07162	0.835648	0.780836	0.099031	0.163781	1.049080
6	0.129599	96.76614	0.895711	0.848759	0.089354	0.187003	1.213036
7	0.140497	96.57367	0.935641	0.890334	0.081978	0.201121	1.317257
8	0.150617	96.44667	0.963647	0.917519	0.076627	0.210135	1.385405
9	0.160106	96.35654	0.984454	0.936880	0.072737	0.216394	1.432991
10	0.169069	96.28778	1.000703	0.951773	0.069819	0.221131	1.468790
11	0.177582	96.23239	1.013874	0.963857	0.067536	0.224948	1.497401
12	0.185706	96.18622	1.024821	0.973968	0.065675	0.228140	1.521179
13	0.193489	96.14700	1.034079	0.982571	0.064113	0.230861	1.541381
14	0.200970	96.11328	1.042007	0.989967	0.062776	0.233204	1.558764
15	0.208183	96.08405	1.048866	0.996377	0.061618	0.235238	1.573849
16	0.215154	96.05851	1.054854	1.001975	0.060604	0.237016	1.587037
17	0.221906	96.03603	1.060124	1.006901	0.059710	0.238580	1.598650
18	0.228459	96.01610	1.064798	1.011268	0.058917	0.239967	1.608947
19	0.234829	95.99831	1.068971	1.015167	0.058209	0.241205	1.618138
20	0.241030	95.98233	1.072719	1.018668	0.057573	0.242317	1.626393
21	0.247076	95.96790	1.076105	1.021831	0.056998	0.243321	1.633849
22	0.252978	95.95479	1.079179	1.024701	0.056477	0.244233	1.640617
23	0.258745	95.94285	1.081981	1.027319	0.056001	0.245064	1.646788
24	0.264386	95.93191	1.084547	1.029716	0.055566	0.245825	1.652439

This table provides the variance decomposition of TSE with respect to US money supply, Federal Fund Rate, Exchange rate, Dow Jones and Canadian interest rate.

We repeat the estimation of VECM with inclusion of NASDAQ, rather than Dow Jones. The estimated results as presented in Table 6 suggest that the long-term elasticity of the TSE with respect to NASDAQ is almost 0.2, indicating higher correlation of TSE with DJ. However, the long term elasticity of TSE to FFR and to exchange rate amounts to 0.50 and 0.78, respectively, indicating the importance of Fed's policy and the parity value in TSE movements. The variance decomposition technique as presented in Table 7 suggests that the contribution of FFR to TSE movements increases from 0.6 percent in the second month to 2.3 percent at the end of the period. Using a multivariate dynamic technique, we forecast the levels of TSE in the logarithm form, assuming that FFR moves according to its past six months' behavior. The results presented in Appendix 1, closely captures the movements of TSE.

Table 6: Vector Error Correction Estimates (with NASDAQ)

List of Variables	CointEq1
TSE	1
USM2	-0.580
	(-4.29)
FFR	0.505
	(5.48)
Nasdaq	-0.20
	(-4.17)
EXCH	0.78
	(4.69)
CINT	0.79
	(6.98)
Log Likelihood	1605.60
Akaike information Criteria	-26.06
Schwarz Criteria	-24.77

This Table presents the results on the estimation of the Vector Error Correction Model with inclusion of NASDAQ Industrial Index. The Akaike and Schwartz criteria indicate that at least one co-integration equation exists among the variables. Note. Numbers in parentheses are t statistics.

Table 7: Variance Decomposition of LOG (TSE)

Period	S.E.	LOG(TSE)	LOG(USM2)	LOG(FFR)	LOG(EXCH)	LOG(NASDAQ)	LOG(CINT)
1	0.044980	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.069002	98.45666	0.438483	0.612118	0.166846	0.061794	0.264095
3	0.087390	96.77198	0.735177	1.167265	0.239697	0.224240	0.861646
4	0.102584	95.52036	0.916536	1.530485	0.247834	0.342066	1.442717
5	0.115796	94.69147	1.031679	1.757224	0.236149	0.412777	1.870700
6	0.127643	94.15553	1.107414	1.901585	0.222257	0.455435	2.157778
7	0.138482	93.80245	1.159202	1.997188	0.210632	0.482621	2.347906
8	0.148535	93.55983	1.196194	2.063699	0.201726	0.501130	2.477418
9	0.157952	93.38416	1.223820	2.112454	0.195016	0.514576	2.569971
10	0.166841	93.25029	1.245296	2.149947	0.189892	0.524899	2.639672
11	0.175281	93.14383	1.262553	2.179924	0.185871	0.533169	2.694654
12	0.183334	93.05640	1.276780	2.204603	0.182620	0.539993	2.739603
13	0.191048	92.98294	1.288743	2.225355	0.179921	0.545744	2.777298
14	0.198462	92.92019	1.298954	2.243080	0.177632	0.550662	2.809480
15	0.205609	92.86593	1.307775	2.258403	0.175661	0.554917	2.837311
16	0.212516	92.81855	1.315474	2.271780	0.173941	0.558633	2.861621
17	0.219205	92.77683	1.322249	2.283558	0.172428	0.561904	2.883032
18	0.225696	92.73982	1.328258	2.294003	0.171085	0.564806	2.902028
19	0.232006	92.70678	1.333623	2.303329	0.169886	0.567396	2.918990
20	0.238149	92.67710	1.338441	2.311706	0.168808	0.569723	2.934226
21	0.244137	92.65029	1.342793	2.319270	0.167835	0.571824	2.947987
22	0.249981	92.62596	1.346742	2.326136	0.166952	0.573731	2.960475
23	0.255692	92.60379	1.350342	2.332395	0.166147	0.575469	2.971859
24	0.261278	92.58349	1.353638	2.338124	0.165410	0.577061	2.982281

This table provides the variance decomposition of TSE with respect to US money supply, Federal Fund Rate, Exchange rate, NASDAQ Industrial Index and Canadian interest rate.

CONCLUSION

This paper employs a VECM for the period January 1999 to April 2008 to measure the long-term elasticity of TSE to FFR shocks, the US-Canadian dollar exchange rate and the U.S. stock market indices; Dow Jones and NASDAQ. The estimated results suggest that TSE has a higher correlation with Dow Jones, compared with NASDAQ. The results also indicate that TSE is significantly elastic to FFR, highlighting the importance of Fed's policy for Canadian stock market. The results also suggest that the elasticity of TSE to exchange rate is almost -0.66%, emphasizing the importance of the parity value on TSE; as expected in theory.Using a multivariate dynamic technique, we forecast the TSE, assuming that the FFR moves according to its past six months' behavior. The results closely capture the movements of the TSE. In sum, the results have important policy implications for the Canadian policymakers to avert the US shocks on their stock market.

APPENDIX

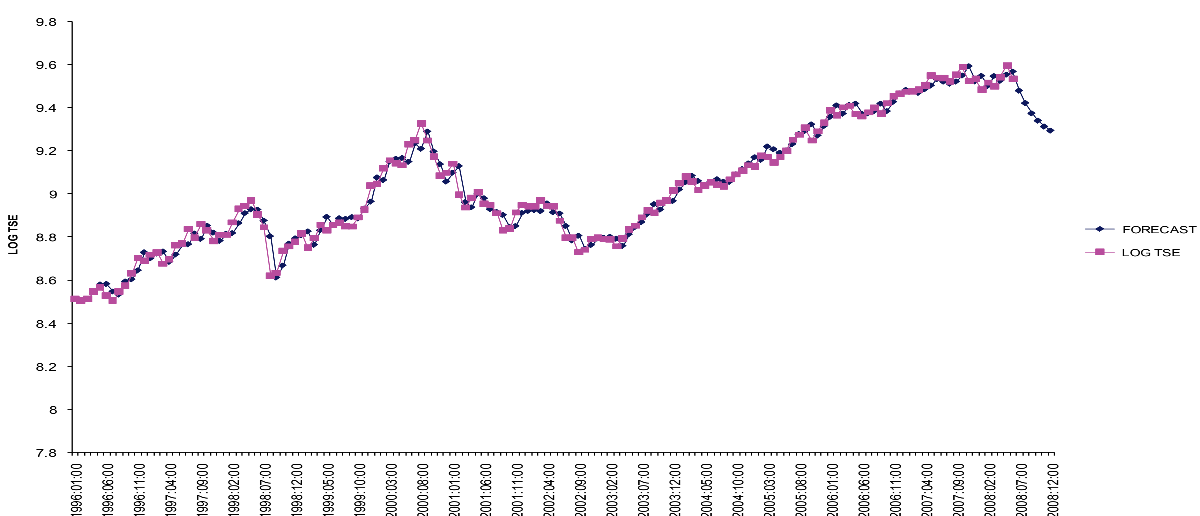
Appendix 1: Multivariate Dynamic Forecasts for the Level of LTSE

145 observations from 1996M5 to 2008M5. Order of VAR = 4, chosen r =1. List of variables included in the cointegrating vector: LTSE, LEXCH, LDJ, LCINT , LFFR

Observation	Actual	Prediction	Error
2008M6	*NONE*	9.5345	*NONE*
2008M7	*NONE*	9.4784	*NONE*
2008M8	*NONE*	9.4206	*NONE*
2008M9	*NONE*	9.3728	*NONE*
2008M10	*NONE*	9.339	*NONE*
2008M11	*NONE*	9.3115	*NONE*
2008M12	*NONE*	9.2928	*NONE*

		Estimated Period	Forecast Period
		1996M5 to 2008M5	2008M6 t0 2008M5
Mean		0.000	*NONE*
Mean	Absolute	. 033725	*NONE*
Mean	Sum Squares	0.001979	*NONE*
Root	Mean Sum Squares	0.044484	*NONE*

Figure1: Multivariate Dynamic Forecasts for the Level of TSE in Logarithm Form



This figure shows that how the logarithm of Toronto Stock Exchange (TSE) will move during the next month

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THE RELATIONSHIP BETWEEN CORPORATE GOVERNANCE AND THE PERFORMANCE OF PALESTINIAN FIRMS: AN EMPIRICAL STUDY

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ABSTRACT

This paper investigates the relationship between performance and corporate governance in Palestine. Firm performance is measured by Tobin's Q, whereas corporate governance is determined based on the level of ownership concentration. Prior research in developed economies provides evidence that ownership concentration has a significant impact on firm performance, while evidence in emerging economies is inconclusive. However, in Palestine there is no prior empirical research on this relationship. This paper reports the results of an empirical study of a sample of firms listed at Palestine Securities Exchange during the period (2003-2006). The sample of the study consists of (16) firms, which represent around 50% of all listed firms.

The paper reports a series of regressions that account for different specifications of firm valuation and ownership concentration. The results indicate that ownership concentration has a good explanatory power of market value change as measured by Tobin's q for years 2003 and 2006 but not for years 2004 and 2005. This paper provides some evidence, although not decisive, that ownership concentration is negatively related to firm value. This evidence invites further research in this area before deciding on the need for ownership de- concentration in Palestinian firms.

JEL: G30, G34, L25

KEY WORDS: Corporate Governance, Ownership Concentration, Financial Performance, Tobin's Q, Market Value and Book Value

INTRODUCTION

The relationship between Corporate Governance (CG) and performance has received considerable attention in the financial economics literature in recent years. One of the key pillars of CG is the level of Ownership Concentration (OC). Conceptually, it has been argued that the more the firm's ownership is concentrated; the poorer its performance will be [(Jensen and Meckling, 1976):(Demsetz, & Villalonga, 2001). Studies have documented conclusive evidence on this relationship in developed economies [(Holderness et al, 1999, Demsetz and Villalonga (2001,) Agrawal, and Sahiba (2004)]. However, literature in emerging economies supports the notion that family control creates strong incentives that have potentially competing influences on the manner in, and extent to, which internal corporate governance mechanisms are utilized. A notable feature of this literature is its failure to reach a consensus regarding the nature of this relationship. Studies of this issue have reported conflicting results due to a number of reasons including measurement of variables, sample period, estimating technique and degree of success to account for the endogeneity of a firm's ownership structure {see for example, (Claessens et al., 2000), and Xu and Wang, (1999)}.

Expectedly, no prior studies have addressed this issue in Palestine, due to the very young experience with capital markets and portfolio investment. This paper examines the relationship between OC and performance of the firms listed at Palestine Securities Exchange (PSE), which are mostly characterized as family-owned and managed businesses. Unlike most emerging markets; the PSE established in 1997; is still relatively small and dull with no more than (34) listed firms, and suffers from some informational inefficiency, high volatility and poor governance (Abdelkarim, 2007). This study seeks to add empirical evidence to the very limited conceptual insights regarding this relationship in the Palestinian context, and explores to what extent this evidence is consistent with that found in other countries.

The primary objective of the study is to examine the relationship between the degree of ownership concentration and performance of selected sample of firms listed at the PSE. In specific, this paper addresses the following research question: To what extent the degree of OC explains the change in market value of firms listed at the PSE?

The results of the study support the hypothesis that less OC improves corporate performance. These results call for a need to change the level of OC in firms listed at the PSE, which should come in the context of improving the quality of corporate governance and culture as whole. This change would only be possible when the Palestinian Government replaces the two extremely old and diverse Corporate Laws, which are still in effect in the Palestinian Territories. One law was enacted in the West Bank in 1964 and the other was enacted in the Gaza Strip in 1929, accompanied with a unified modern Corporate Law that responds to good governance principles and practices. Results should also encourage the Palestine Capital Market Authority to accelerate the process of drafting a Corporate Governance Code.

The remainder of this paper is organized as follows: Section 2 reviews the previous studies that examine the relationship between ownership structure and corporate performance, including research that has been conducted in other countries of this world. Section 3 presents the methodology and data, utilized in this study including the model specifications in order to test the hypotheses. Section 4 describes and discusses the results of testing the hypotheses. Section 5 summarizes the results and draws some conclusions.

LITERATURE REVIEW

Prior research indicates that corporate governance has a significant impact on firm performance. Theory suggests that improving performance and creating value can be achieved by paying greater attention to ownership structure and concentration (Jensen and Meckling, 1976). In this context, the effect of ownership distribution on firm performance and valuation has been the focus of extensive analysis in developed economies. In particular, Shleifer and Vishny (1986, 1997) have identified many potential benefits of de-concentrated ownership, including superior performance and higher firm value. Berle and Means (1982) argue that given the interests of management and shareholders are not generally aligned, corporate resources are not used efficiently in maximizing corporate profit. Therefore, they suggest that the relationship between ownership concentration and performance should be a positive one. However, Demsetz (1985) argues it is unreasonable to suppose that diffused ownership destroys profit maximization as a guide to resource allocation.

A common approach to empirical studies in this field is to focus on the impact of ownership on firm value. This line has often been taken in developed economies (see, for example, Demsetz and Lehn, 1985; D'Souza and Megginson, 1999). The approach has also been used in transitional economies (see Claessens *et al*., 1997, in the Czech Republic) and in the study of enterprises in China (see, for example, Xu and Wang, 1999; Chen and Gong, 2000; Gul and Zhao, 2000).

The literature documents a linear relationship between degree of ownership concentration and ex-post firm performance measures (Demsetz and Lehn, 1985). Many studies conducted in the developed countries, like the US and Europe, documents a linear relationship between ownership concentration and firm performance (see for example Xu and Wang, 1999; Chen and Gong, 2000; Gul and Zhao, 2000). Claessens *et al.* (1997) finds a similar linear relationship in their study of reforms in the Czech Republic.

On the other hand, the literature identifies a non-linear relationship when examining the correlation between firm value and insider ownership in emerging economies (Morck *et al*., 1988; Wruck, 1989; Hermalin and Weisbach, 1991).

Gharaybeh, Batayneh, and Salameh, (1997)) was the first and only study which examine the relationship between a firm's ownership structure and its performance in the case of Amman Financial Market (AFM). They found the presence of a stronger correlation between stock returns of family controlled firms across all sectors compared to stocks that belong to uncontrolled firms. In addition, they found that unsystematic risk for different firms controlled by one family was very high. Despite the conceptual and empirical support for the endogenously of ownership structure, many studies have failed to consider this when estimating the effect of ownership structure on performance [(Morck, Shleifer & Vishny 1988; McConnell & Servaes 1990); And Demsetz and Villalonga (2001)].

The measure of firm performance and value creation that this paper focuses on is Tobin's *Q*. In theory, the *Q* ratio identifies the juxtaposition of the marginal efficiency of capital and the financial cost of capital (Tobin, 1978). Typically, in the finance and accounting literature, *Q* is taken as a proxy for marginal *Q*. In essence, the ratio gauges the marginal efficiency of capital compared to the financial cost of capital. The approach captures whether the value of a firm as an operational business is greater than the cost of the assets required to generate its cash flow, at that point in time. It is measured as a ratio of the market value of a company's debt and equity to the current replacement cost of its assets. Thus, Tobin's *Q* is positively related to investors' perceptions of managerial quality. A *Q*-ratio greater than one suggests that the firm is creating value greater than the cost of the assets utilized to produce its cash flow. This suggests investors are willing to pay a premium over the value of the firm's assets in anticipation of good future prospects under the present management. Conversely, a *Q* below one implies that investors are discounting the value of the firm's assets (Lang *et al*., 1991; Lang and Stulz, 1994). Hence, Tobin's *Q* has been widely embraced as a measure of firm performance in the finance and accounting literature (see, for example; Morck *et al.*; Hermalin and Weisbach, 1991; Zingales, 1994; McConnell and Servaes, 1995; Claessens *et al.*, 1997; Claessens *et al*., 2000).

<u>The Palestinian Context-Macroeconomic Overview</u>

Thirty years of occupation in the West Bank and Gaza (WBG) has left a heavily distorted economy in a state that is almost completely dependent on the Israeli economy. While other countries in the region have grown and industrialized, the Palestinian economy retains the hallmarks of a less developed economy. The size of the average industrial enterprise is about four workers, no larger than it was in 1927 (Roy, 1999). While, the share of agriculture in GDP has declined, services and the public sector have been expanding rapidly, driven by donor funding and remittances from the export of labor. The share of industry remains low at around 12-13 percent. In contrast, in Jordan, for example, the industrial sector accounts for nearly 30 percent of GDP. It was hoped that with limited autonomy arising from the Oslo Accords of September 1993, the Palestinian private sector would take off. Free of the constraints imposed by military occupation, Palestinian entrepreneurs would rapidly invest and the thriving economy would attract foreign investment. Unfortunately, this did not materialize and the economy has suffered even more since Oslo.

Following the signing of the Paris Protocol in 1994, growth in the West Bank and Gaza in the latter half of the 1990s was moderate. Real per capita GDP grew approximately 3% on average from 1994-1999 with much of the growth concentrated in construction and commerce sectors. Unemployment rates declined significantly from nearly 28% in 1996 to approximately 11% in 1999. At the same time, high levels of remittances from Israeli employment, restricted trade relations, and high levels of donor aid inflow contributed to a declining competitiveness in the tradable food and services. This decline resulted from higher costs of production, particularly domestic labor. High production costs also contributed in part to limited growth in private investment, representing approximately 15% of GDP in 1999 (World Bank, 2003).

Prior to the outbreak of the Intifada in September 2000, trade between the WBG and Israel had effectively become internal, reflecting a customs union regime, and the majority of Palestinian workers were employed by Israeli firms. Roughly, 85% of Palestinian foreign trade was with and through Israel, and Israeli firms account for roughly one fourth of Palestinian employment. The last six years of escalated conflict in the WBG have left the Palestinian economy mired in crisis. Israeli military and security measures, increased during the six years of the Intifada, have imposed major costs on the WBG economy, heavily undercutting its current and future developmental prospects. The closures regime—i.e. the multi-faceted system of restrictions on the movement of goods and people both within the WBG and through Israel to the rest of the world—along with construction of the separation barrier have fragmented the WBG economic space, and further reduced the WBG's productive potential. Such adversities have contributed to significant declines in trade, employment and investment resulting into a decline in per capita income of 48% and in high rates of unemployment and poverty.

The economic crisis has become worse subsequent to the 2006 public elections. Decisions by the Government of Israel to suspend the transfer of clearance revenues collected on behalf of the Palestinian Authority (PA) and by foreign donors to cease budget support for PA following the public elections held in January 2006 have provoked an unprecedented fiscal crisis for the PA government. Consequently, threatening to undermine public institutions and authority. International political difficulties and increasing domestic friction drove the already fragile economic recovery of 2004-2005 into a tailspin. Although hard data are scarce, real GDP is estimated to have fallen within a range of 5 to 10 percent in 2006, less than it initially had been feared, but still leaving average real per capita GDP at almost 40 percent below its 1999 level, and unemployment and poverty at totally unprecedented rates (40% and 65% respectively) (PCBS, 2007). Stronger-than-expected official and private inflows have helped prevent a much sharper decline in incomes and consumption in 2006, thus cushioning the overall contraction.

More troubling than the negative growth rates over the past few years is the changing composition of the economy, as GDP is being increasingly driven by government and private consumption from remittances and donor aid, while investment has fallen to exceedingly low levels, leaving little productive base for a self-sustaining economy. Furthermore, WBG faces an expanding labor force and a shrinking private sector. Thus, the public sector has become the only alternative for jobs. With few options at its disposal, and despite an unsustainable wage bill, the PA has resorted to absorbing workers as a way to alleviate poverty. As a result, public sector employment has grown by 60% since 1999 and by 2006 stood at about 157,800 (World Bank, September 2007). Thus, while the public sector has expanded, the economy's productive capability has begun to hollow out making it increasingly donor dependent.

In addition, unpredictability of border crossings and checkpoints has prevented Palestinian businesses from importing inputs and exporting products in a timely and planned manner. As a result, the pace of capital flight has reached an all-time high in the last two years with almost no foreign direct investment and most local capital being kept abroad or invested in real estate or short term trading activities. The IMF estimated that already-low private investment declined by over 15% between 2006 and 2007.

The Palestinian Context-Business Environment

Modest improvements in the macro-economy in the 1990s were roughly consistent with a generally more favorable business environment for firms. In particular, there were important achievements in improving access to infrastructure and finance during the 1990s. Relative to other countries in the Arab region, such as Egypt, which continue to maintain high levels of direct intervention by the public sector in economic activity, the West Bank and Gaza have traditionally maintained a business environment more conductive to private enterprise. This is reflected in part by a 2000 World Bank Business Environment (WBES) firm survey conducted just prior to the outbreak of the second Intifada in September 2000. Among the top five constraints identified by firms in the WBES were (1) high levels of policy instability and uncertainty; (2) corruption; (3) inflation; (4) the exchange rate; and (5) taxes and regulations. This represented a tentative shift from concerns recorded in the previous 1996 survey, which identified infrastructure and access to finance as being among the more significant obstacles and likely reflects much of the progress in infrastructure investment and improvement in the general economy following a relative period of prosperity in the mid 1990s. In particular, there was a reduction of corporate income tax rates from 38 to 20% and the enactment of the investment promotion law[1]. These results are roughly consistent with the perceptions of foreign investors. A recent FIAS survey of investors identified two main areas for concern: a weak economic legal and regulatory environment and the unclear role of the PA in economic activity and a perception of corruption. Also, the economy's structural dependence on the Israeli economy, costly security and transit procedures, and relatively high market wages, have contributed in part to high cost structure firms. In addition, private firms have insufficient capacity to ensure high uniform products quality, and conformity with best practices. However, perceived obstacles in doing business in the WBG have changed since September 2000.

The Investment Climate Assessment (ICA) of the World Bank in 2006 reveals that shrinking market access and the lack of free movement are the main constraints to growth for Palestinian enterprises. Relative to other countries in the region, the Palestinian investment climate is good, petty corruption is low, the bureaucracy is relatively efficient and financial markets are well developed. Despite this, Palestinian enterprises have not invested enough to maintain their international competitiveness. Managers know they need to invest and have access to the necessary resources. However, they are unwilling to do so unless they are assured secure and predictable access to both domestic and international markets.
Unfortunately, the growing settlements and movement restrictions imposed by Israeli authorities since 2001 overshadow all other positive elements of the investment climate. The restrictions close-off markets raise transaction costs and prevent producers from guaranteeing delivery dates. The closures also serve to keep firms small and prevent them from attaining minimum efficient scale. The percentage of WBG enterprises selling within the territories has fallen by half since 2000. More importantly, markets in the West Bank appear to be shrinking because of movement restrictions imposed to protect Israeli settlements. In 2000, nearly 60 percent of firms made a significant share of their sales outside of their home city; by 2006, this had fallen to around 40 percent. The most difficult issue to overcome is the uncertainty caused by the movement restrictions. For example, the survey reveals that on average it takes around 22 days to clear imports for companies in the West Bank. However, the longest time averages nearly 43 days. On-time delivery is a requirement in the modern export market, but Palestinian producers can never be sure, when their cargo will move. Consequently, to a large degree, they are frozen out of the high value export market.

The Palestinian Context-The Private Sector

The Palestinian Private sector is unique in more than one important aspect. It is mostly dominated by small and medium family enterprises, with poor performance and governance. The number of relatively huge corporations is still low. Traditionally, the private sector has played an important role in the development of the Palestinian economy, particularly with the respect to employment. Prior to the onset of the Intifada in September 2000, there were approximately 80,355 private establishments in the WBG, with the majority located in Ramallah, Hebron and Gaza. Average firm size has been less than four persons, with gross average capitalization levels of US $10,000[2]. In addition, there were an estimated

80,000 micro enterprises, represented mainly by family business activities largely involved in trading, small-scale manufacturing, services and agriculture. The majority of firms have traditionally been concentrated in services (retail, hotels, restaurants, business services) and industry (food and beverage, metal fabrication, textiles\ garments and furniture) and private employment is nearly 70% of the domestic labor force in the West Bank and more than 65% in Gaza. The entry and growth of new firms in the West Bank and Gaza has been relatively dynamic with nearly 17% of firms sampled for the WBES in 2000, established over the period 1997-1999. Most new firms were small, medium sized, and nearly half were engaged in export activities, relative to the total sample of firms. Registration of new companies rose over 50% to 831 in 1999, with nearly 80% of new private limited companies registered in the West Bank (UNSCO, 2000). There was also a surge in the registration of foreign companies with 11 companies registered in 1999 relative to 4 in 1998.

Investment has fallen to precariously low levels, over the 2001-2006 endangering the prospects for long-term growth. Public investment to maintain or add infrastructure has nearly ceased, and in the last two years, almost all government funds have been used to pay salaries and cover operating costs. Total private investment, which was approximately, $1.3 billion in 1999, was unlikely to exceed $100 million in 2002. It is estimated that of the $305 million damage to physical assets, roughly 52% are private sector assets (World Bank, 2003). In total real private GDP has declined by almost 29% by 2003 from its 1999 level and already-low private investment is estimated by the IMF to have fallen by over 15% between 2005 and 2006. In addition, the market value of companies listed on the Palestine Securities Exchange had dropped by more than 40% by the end of 2004, but it started to rise in 2005 to reach unprecedented level of $3,500 million by the end of that same year (increase by 200% from the level of 2000). However, the beginning of 2006 Palestine Stock Exchange, like other Arab markets, has been going through a severe price correction process, led so far to a loss of around 60% of its capitalization value.

A recent World Bank Investment Climate Assessment (2006) found that less than a quarter of private sector firms made any investments in 2005/2006 and that manufacturing equipments were on average over 10 years old. Managers had access to finance, but were operating at less than 60% capacity, and saw few opportunities for investment under the current closure regime. Gross capital formation in the private sector fell by over 60% between 1999 and 2005 (See Table 1). The lack of investment in public infrastructure and private firms is eliminating any residue of the Palestinian productive base, making the economy more aid-dependent. When conditions improve, large investments will be needed just to rehabilitate assets let alone create new wealth.

Moreover, the unpredictability of the border openings has prevented firms from importing inputs and exporting products in a planned and profitable way. In response, enterprises have closed and large amounts of financial and human capital have fled. The pace of capital flight reached an all-time high in the last two years. Investors have always been wary of investing in WB&G, with almost no foreign direct investment in the past few years and most local capital is kept abroad or invested in real estate or short term trading activities. Now local entrepreneurs are closing existing operations and moving them to neighboring countries. This capital and the entrepreneurial and technical talent that go with it are irreplaceable and unlikely to return unless conditions dramatically improve.

<u>The Financial System</u>

The Palestinian private businesses do not have many adequate financing options, neither in amount nor in variety. The financial system cannot be characterized as sound, functioning or efficient. To the contrary, the financial intermediation through the banking industry is too low as reflected in the credit to deposits ratio. This ratio is on average below 30%, while it goes beyond 70% in neighboring countries as well as in OECD countries. Furthermore, more than two thirds of banking credits extended to private businesses have been either in the form of short-term loans or overdrafts, while long–term financing is almost none existent. That explains why the capital structure of almost all Palestinian corporations is geared heavily towards equity financing, with extremely low indebtedness (Abdelkarim, 2007).

The establishment of Palestine Securities Exchange (PSE) in 1997 has provided public shareholdings with new opportunities for long – term financing, at a time when banks exercised and conservative credit policies [Abdelkarim (1995), and Sabri (2003)]. In February 2005 the Palestinian Capital Market Authority (PCMA), was established in accordance with to the Securities Law number 12 for year 2004. The PCMA is the sole legal entity that is responsible for monitoring the trading activities at the PSE as well as for organizing the conduct of the listed companies and the brokerage member firms.

The PSE performance has developed over years. However, it is still performing under its potential and still invites considerable reforms. Governance, disclosure and efficiency are issues still of concern to policy makers and investors. Another issue of importance and relevance to the performance of the PSE is the high degree of ownership concentration in the Palestinian corporations traded. It is widely perceived that this phenomenon has been negatively affecting the fair pricing of stocks; consequently, impairing confidence in the PSE as a whole. This explains why the PSE continues to lack sufficient depth and liquidity. Opening up corporate ownership is expected to attract foreign portfolio investments and in turn improves quality of governance. Table 1 below provides key indicators on the performance of the PSE over the most recent five years.

Table 1: Some Indicators on the PSE Performance for a Number of Recent Years

Years / **Indicators**	**2003**	**2004**	**2005**	**2006**	**2007**
Market Capitalization (Millions $)	650.47	1096.52	4456.18	1891.51	2437.156
Listed Companies	24	26	28	31	35
Shares Traded (Millions $)	40.35	103.64	369.567	125.55	274.33
Trading Value (Millions $)	58.33	200.56	2096.16	1047.1	816.98
Turnover	0.76	1.66	6.44	1.44	3.095
Market Value to GDP (Millions $)	0.150	0.248	0.93	0.387	0.493
Value Traded to GDP (Millions $)	0.0134	0.045	0.441	0.214	0.165
GDP (Millions $)	4325.4	4415.3	4750	4892.1	4941.021

Sources: Arab Monetary Fund (AMF) bulletin, several issues, and PSE Public Relation Department Publications.

METHODOLOGY AND DATA

Hypothesis: Based on the theory and empirical evidence on the relationship between ownership concentration and firms' performance, the null hypothesis of this study is formed as follows:

> *H01: There is a statistically insignificant relationship between degrees of ownership concentration and firm performance as measured by Tobin's Q.*

Research Model: This paper examines data relating to 16 selected firms listed at the (PSE) for the years (2003-2006). The selection of these years was motivated by the availability of trading data over the test period. This paper follows the tradition of empirical work in corporate governance by examining the performance of the firm in the form of regression analysis. Performance (in this case, measured by Tobin's *Q*) is the dependent variable in the model, and corporate governance measured in terms of OC is the independent variable together with other control variables that have theoretical validity

The hypothesis of the study is tested by the following regression model:

Q = α + β1*SALES* + β2*DEBT* + β3*GR* + β4*OC* + β Dv(x1) + β Dv(x2)+ β Dv(X3) + β Dv(X4)+ β Cash Flow + β Debit 1+ e

Definition of Variables of the Model

Dependent Variable-Performance: Performance is measured as Tobin's Q by dividing the sum of the market value by book value, as follows:

$$Q = \frac{Market\ Value\ of\ the\ Firm}{The\ Book\ Value\ of\ the\ Total\ Asset} \quad (1)$$

Where, the market value= Number of outstanding shares at the end of the year multiplied by its price on that date.

Independent Variable Ownership Concentration: Ownership concentration measured by the sum of the voting rights held by the five largest shareholders.

Control Variable: We use a group of control variables in this study to avoid the bias of the main independent variable. The following are explanations of those variables:

Sales: Measures the size effect of firms and will be taken as the natural logarithm of annual sales revenue in billion US dollar.

Debt: The financial leverage is taken as the debt/asset ratio, which equals the book value of debt divided by the value of total assets.

Debt 1: alternative measure of leverage, Calculated by total debt / equity.

Net Income Growth: Growth of net income. Growth is computed as the difference between income for period t and t - 1 over t - 1.

Cash Flow: is an alternative measure used instead of the net income growth. This measure is identified as the net cash flow shown in the cash flow statement.

Dummy variables for each test year are as follows:

Dv(X1) = 1 if the year 2003, 0 otherwise.

Dv(X2) = 1 if the year 2004, 0 otherwise.

Dv(X3) = 1 if the year 2005, 0 otherwise.

Dv(X4) = 1 if the year 2006, 0 otherwise.

RESULT

Descriptive Statistics

Prior to running the regressions, a descriptive statistics and a bivariate correlation analysis of the dependent and independent variables were conducted. Table (2) presents descriptive statistics for model variables.

Table 2: Descriptive Statistics of the Variables during the Test Period (2003-2006)

Variables	Mean	Std. Deviation	N
Q	1.5001481	1.64506285	64
OC	.5359640	.18729082	64
x1	.2500	.43644	64
x2	.2500000	.43643578	64
x3	.2500000	.43643578	64
x4	.2500000	.43643578	64
SALES	6.2848657	1.60558269	64
Debt	1.6288665	9.17180014	64
Gr	.6209953	2.22551262	64
Cash	1.3271734E+07	3.60949582E+07	64
Debt1	1.2053082	2.17696034	64

The results, reported in Table (3), indicate that the correlation between independent and dependent variables. As we can see, there is a significant negative correlation between ownership concentration and performance as measured by Tobin's Q with (0.314) degree for among the tested period. This negative correlation can be explained by the regression result later in this paper, so we can say that the negative correlation is due to the concentration of ownership, which leads to a negative effect on firms' market value. The matrix of correlation indicates also the results of correlation between the other variables, Q correlates negatively with debt to assets ratio by (-0. 232), but it is not significant; on the other hand, it correlates positively and significantly with sales (0.336), while correlation is about (-.127) between debt and income. We see also that the Q correlates negatively with debt to equity ratio by (-.153) degree, positively with net cash flow by (0.226).

Overall, we can argue that the matrix shown in Table (3) for variables, including the dummy variables and the new one, indicates a serious correlation between independent and dependent variables especially between sales and market value of the firm, and the correlation shown between market value and ownership concentration.

Regression Results

To achieve our objectives we run a single regression for the four years using dummy variables X1=1 if the year 2003, 0 otherwise. X2=1 if the year 2004, 0 otherwise. X3=1 if the year 2005, 0 otherwise. X4 =1 if the year 2006, 0 otherwise. To test the hypothesis of this study we used three models of regression:

First model: included Q as dependent variable, ownership concentration, net cash flow, debit to equity ratio, sales and four dummy variables represent the years of the study as independent variables.

Second model: included Q as dependent variable, ownership concentration, debt to assets ratio, sales, net income growth and the dummy variables as independent variables.

Third model: included Q as dependent variables, ownership concentration, debt to equity ratio, debit to assets ratio, net income growth, net cash flow, and the dummy variables as independent.

Table 3: Correlation Matrix for the Variables during the Test Period

Variables	OC	Q	Debt1	SALES	Cash	Gr	Debt	x1	x2	x3	x4
OC	1	-.314	-.069	-.152	-.167	-.025	-.232	.024	.075	-.123	.024
Sig. (2-tailed)		.011*	.588	.230	.187	.845	.065	.850	.557	.333	.850
Q		1	-.153	.336	.226	.019	-.133	-.341-**	.257*	.257*	-.173
Sig. (2-tailed)			.227	.007*	.073	.884	.293	.006*	.040**	.040**	.171
Debt 1			1	-.001	-.109	-.127	.236	.038	.000	-.132	.093
Sig. (2-tailed)				.995	.390	.318	.060	.766	.997	.300	.463
Sales				1	.229	.079	.020	-.205	.019	.173	.013
Sig. (2-tailed)					.069	.536	.876	.105	.880	.172	.921
Cash flow					1	-.082	-.054	-.139	.062	.064	.013
Sig. (2-tailed)						.518	.675	.275	.629	.617	.917
GR						1	-.034	-.166	-.001	.168	-.001
Sig. (2-tailed)							.788	.189	.996	.185	.996
Debt							1	.259	-.086	-.086	-.086
Sig. (2-tailed)								.039**	.498	.499	.498
X1								1	-.333	-.333-**	-.333-**
Sig. (2-tailed)									.007*	.007*	.007*
X2									1	-.333-**	-.333-**
Sig. (2-tailed)										.007*	.007*
X3										1	-.333-**
Sig. (2-tailed)											.007*
X4											1
Sig. (2-tailed)											

*This table includes the matrix correlation between the dependent variable, namely market value of the firm as measured by Tobin's Q, and the independent variables: ownership concentration (OC), Debt to assets ratio (Debt), sales, net cash flow, Debt to equity ratio (Debt 1), and dummy variables: X1 =1 If year 2003, 0 otherwise. X2 =1 if year 2004, 0 otherwise. X3 =1 if year 2005, 0 otherwise. X4 =1 if year 2006, 0 otherwise.** and * indicate correlation (2-tailed) significance at the 0.05 and 0.01 levels respectively.*

Results of the first model in Table (4), shown the adjusted R2 for the regression is (0.288). In this case, we could say there is a significant relationship between the dependent and independent variables, according to the F value and the level of significance that appears in the table (4) which was (0.00). Therefore, we can argue that the independent variables could explain the change in market value of firms listed at Palestine Stock Exchange, due to the level of explanatory power of the adjusted R2 and the level of significance.

Thus, we must reject the null hypotheses and argue that there is a statically significant negative relationship between ownership concentration and performance of the Palestinian firms. A possible explanation for this; is that the typical listed firm in Palestine's stock market is highly concentrated. The market, therefore, negatively responds to this ownership concentration and lowers the value of the firms that has a high level of concentration, as the expectation is that the top five shareholders will control the vast majority of firms.

Based on the above discussion, we can draw the relationship between the market value and dependent variables as follows:

$$Q = 1.951 - 2.380\ OC + 0.218\ Sales - 1.251\ X1 \quad (2)$$

Table 4: Regression Results of the First Model

Dependent	β	Sig
Q		
Intercept	1.951	0.842
OC	-2.380	0.017*
CF	0.00003	0.532
Sales	0.218	0.064**
Debit 1	- 0.097	0.241
X1	-1.251	0.017*
X2	0.292	0.560
X4	-0.916	0.072
Adjusted R2	0.288	
F	4.647	0.000

*This table includes the regression results of the first model, which includes market value of the firm measured by Tobin's Q as dependent variables, and a number of independent variables: ownership concentration (OC), sales, net cash flow (CF), Debt to equity ratio (Debt 1), dummy variables X1 =1 If year 2003, 0 otherwise. X2 =1 if year 2004, 0 otherwise. X3 =1 if year 2005, 0 otherwise. X4 =1 if year 2006, 0 otherwise. ** and * indicate (2-tailed) significance at the 0.10 and 0.05 levels respectively.*

In addition, Table (5) shows the regression result for the second model. As we see the adjusted R2 for the regression of the second is (0.288), the explanatory power of this model is very close to that one that appears in the first model. In this case, we could say that there is relationship between the dependent and independent variables according to the **F** value and the level of significance that appear in table (5), which is (sig, 0.00**)**. However, it should be noted that the adjusted R2 is weak under the three models but it is significant; therefore, we can say that the independent variables could explain the market value of the firms listed at Palestine Stock Exchange, due to the explanatory power of the adjusted R2 and the level of significance.Thus, we must reject the Hypothesis of the irrelevance of ownership concentration. A possible explanation for this is that the typical listed firm in Palestine stock market is highly concentrated.

Table 5: Regression Results of the Second Model

Dependent	*β*	Sig
Q		
Intercept	2.248	0.031
OC	-2.670	0.009*
Sales	0.239	0.04*
Debit	- 0.026	0.212
GR	-0.050	0.540
X1	-1.48	0.005*
X3	-0.239	0.634
X4	-1.236	0.013*
Adjusted R2	0.288	
F	4.647	0.000

*The above table (6) includes the regression results of the second model. Dependent variable market value of the firm as measured by Tobin's Q, and the independent variables: ownership concentration (OC), sales, growth in net income (GR), Debt to assets ratio (Debt), dummy variables X1 =1 If year 2003, 0 otherwise. X2 =1 if year 2004, 0 otherwise. X3 =1 if year 2005, 0 otherwise. X4 =1 if year 2006, 0 otherwise. ** and * indicate (2-tailed) significance at the 0.10 and 0.05 levels respectively.*

Based on the above discussion, we can draw the relationship between the market value and dependent variables according to the second model as follows:

$$Q = 2.248 - 2.670\ OC + 0.239\ Sales - 1.48\ X1 - 1.236\ x4 \quad (3)$$

Table 6: Regression Results of the Third Model

Dependent Q	β	Sig
Intercept	2.080	0.048
OC	-2.622	0.011*
Sales	0.228	0.055**
Debt	- 0.02	0.343
GR	-0.054	0.511
Cash Flow	0.00000025	0.630
Debt 1	-0.087	0.314
X1	-1.204	0.028*
X2	0.272	0.591
X4	-0.946	0.066**
Adjusted R2	0.28	
F	3.728	0.001*

*The above table (6) includes the regression results of the third model. Dependent variable market value of the firm as measured by Tobin's (Q), and the independent variables: ownership concentration (OC), sales, Debt to assets ratio (Debt), growth in net income (GR), net cash flow (CF), Debt to equity ratio (Debt 1), dummy variables X1 =1 If year 2003, 0 otherwise. X2 =1 if year 2004, 0 otherwise. X3 =1 if year 2005, 0 otherwise. X4 =1 if year 2006, 0 otherwise. ** and * indicate (2-tailed) significance at the 0.10 and 0.05 levels respectively.*

In Table (6), the dependent variable [market value (Q)] was tested in the regressions using the third model in which we used the all variables. Results of the regressions for this model, have added little value. As shown in Table 6, we can argue that the relationship is clear between the dependent and independent variables, negatively with ownership concentration with **(-2.622),** which is significant at 0.05.

Thus, according to results that appear in the three models, if we take the result of F test, which is no less than (3.728) with a significant level of (0.001), we can say that the model can represent the relationship between the independent variables and dependent. Therefore, it is possible to reject Hypothesis 1 – the irrelevance of Ownership Concentration- and say there is a statistically significant relationship between the independent variables specially debts ratio and ownership concentration and the market value of firms listed at Palestine stock exchange.

Thus, we can represent the relationship as follows:

$$Q = 2.080 - 2.622\ OC - 0.228\ Sales - 1.204\ X1 - 0.946\ X4. \quad (4)$$

The impact of ownership structure is examined in the regressions using a legal person's shares. High levels of ownership concentration might be thought of as impinging upon the efficient operation of a firm and hence lead to poor performance as measured by *Q*. Ownership Concentration, on the other hand, it could also be regarded as a form of potential support for the firm in adverse situations, implying greater protection of shareholder value.

Furthermore, we run another regression by using the growth in net income as a dependent variable and firm value, as measured by Tobin's Q, as an independent variable; at the same time, we run it with the other independent variables. The results of this regression did not add any meaningful information to the study; thus, we omitted these results.

The level of ownership of shares by owners has a negative relationship with performance as measured by Tobin's *Q*. This is an interesting finding, as previous studies have tended to be inconclusive on a year-by year basis, or with different specifications of performance. It appears that the market has greater regard for ownership concentration, rather than sales, income growth, net cash flow, debt to assets ratio, and debt to equity ratio. The evidence therefore does not support Hypothesis 1. The structure of share ownership has explanatory power.

Net income growth has been negative in our study but insignificant. In previous studies, researchers have consistently identified growth in income as having explanatory power in the regressions (see, for example, Gul and Zhao, 2000). However, our findings fail to identify any significance in the coefficients of income growth, or net cash flow.

The coefficient for the independent variable SALE, used as a measure of size, are positive and significant at the 5 per cent level for regression in the three models.

The coefficient for the independent variable DEBT (1), debt, indicates a negative statistical insignificance at the 5 per cent or 10 per cent level in the three models. Negative relationships are consistent with conventional theory, which supports the concern that investors will have concerning high levels of debt. While a number of clear results have been obtained from this study, it is also recognized that the explanatory power of the regression according to R2 may be relating to certain variables provide unclear guidance. Future research could incorporate alternative specifications of performance, other variables with potential explanatory power, and tests for nonlinear effects and utilize a larger sample size.

In summary the overall results reported in this paper rejects the null hypothesis that there is a statistically insignificant relationship between ownership concentration and performance of sample firms measured by Tobin's Q.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

This research incorporates recent data on Palestinian listed firms by studying the impact of ownership concentration and firm performance. The findings indicate that better explanatory power is available in model three; suggesting evidence of a process of maturity in the PSE and a need to be cautious in interpreting utilized data.

Our findings suggest that ownership concentration, without consideration of the structure of the shareholdings, explains firm performance. The (OC) was negatively related to the performance of firms listed at PSE. These results invite further research of the relationship between OC and firm market value. They may also imply that the issue of corporate governance in Palestinian firms deserves more serious attention. Further research in this area may include the relationship between OC and firm performance; however, by using different measures of OC such as structure of shareholdings or structure of Board (executive vs. nonexecutive). Besides, other measures of firm performance may be used instead of Tobin's Q such as Earnings Per Share and Risk Adjusted Rate of Return.

Recommendations

Due to the findings above, one can interpret these results and recommend the following:

The negative relation between the performance and ownership concentration is an interesting and expected result in the Palestinian situation; it supports the change in ownership structure and requires a lower percentage of stock holdings by a few people.

These findings support the need for ownership de-concentration for Palestinian firms listed at the Palestine Securities Exchange (PSE). It is known that high ownership concentration is one of the main impediments to good corporate governance. Thus, there is a need for Palestinian firms to reduce OC, which in turn would enhance Corporate Governance. However, this strategic change requires strong will, positive attitude and good management, so that adverse effects of that change will be minimized.

END NOTES

1 For a more complete discussion see David Sewell (2001) Government and the Business Environment in the West Bank and Gaza, MENA Working Paper Series No.23.
2 See the Palestinian Central Bureau of Statistics, Bernard O'Sullivan (2000) SME Sector Study. Prepared for the IFC, and UNSCO (2000) Special report on the Palestinian Economy.

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THE EFFECT OF CAPITAL STRUCTURE ON PROFITABILITY: AN EMPIRICAL ANALYSIS OF LISTED FIRMS IN NIGERIA

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ABSTRACT

This study investigates the influence of the capital structure on profitability of quoted companies in Nigeria. The study used secondary data from 1990 to 2004 collected from the selected Annual Report and Accounts of 50 non-financial quoted companies, and Fact Books published by the Nigerian Stock Exchange. The Pooled Ordinary Least Squares (OLS) model, Fixed Effect Model (FEM) and Random Effect Model (REM) were used in the analysis. The results indicate that profitability present a positive correlation with short-term debt and equity and an inverse correlation with long-term debt. Furthermore, the results show a negative association between the ratio of total debt to total assets and profitability. The result suggests that firms in Nigeria depend on external financing. In the Nigerian case, a high proportion (60%) of the debt is represented in short-term debt. The study suggests that companies should implement an effective and efficient credit policy, which will improve the performance level of the turnover and growth. Finally, the top echelon of company management should take interest in the issue of capital structure and constantly monitor its form and adaptability.

JEL: G32

KEYWORDS: Pooled Ordinary Least Squares, Fixed Effect Model, Random Effect Model, capital structure, profitability

INTRODUCTION

The corporate sector in the country is characterized by a large number of firms operating in a largely deregulated and increasingly competitive environment. Since 1987, financial liberalization has changed the operating environment of firms, by giving more flexibility to the Nigerian financial manager in choosing the capital structure of the firm.

The problem of how firms choose and adjust their strategic mix of securities has called for a great deal of attention and debate among corporate financial literature. The interest is due to the fact that the mix of funds (Leverage ratio) affects the cost and availability of capital and thus, firm's investment decisions. At the outset of such debate among other issues, is the question of the relevance of firm's strategic financing decisions for its own valuation. It requires that managers identify ways of funding new investment. Company financing decisions involve a wide range of policy issues.

Planning capital structure involves, to a great extent, the consideration of shareholders interest and other groups. Initially, at the time of its promotion, a company will have to plan its capital structure and subsequently, whenever funds have to be raised to finance investment, a capital structure decision is involved (Salawu, 2007). It is clear that capital structure is a significant management decision as it greatly influences the owner's equity return, his risks as well as the market value of the shares. It is therefore incumbent on the management of a company to develop an appropriate capital structure, which is most suitable to the company's operation.

Thus, financing policy, capital structure and firm ownership are all strongly linked in explaining how economic agents form and modify their asset-acquisition behaviour through firms and capital markets, and thereby influence the ratio of their income and returns to asset holdings, whether in the form of direct remuneration, capital gains or dividend. A better understanding of the issues at hand requires a look at the concept of capital structure and its effect on firm profitability. With relatively little evidence available on the effect of capital structure on the profitability of the listed companies in Nigeria. This study attempts to examine the effect of capital structure on profitability of non-financial quoted firms in Nigeria in the context of the country's ongoing economic reforms.

The rest of the paper contains four sections. Section 2 provides literature review. Section 3 dealt with research methods while Section four presents the results. Concluding remarks follow in Section 5.

LITERATURE ON CAPITAL STRUCTURE AND PROFITABILITY

Most of the empirical evidence on capital structure comes from studies of the determinants of corporate debt ratios e.g. Titma and Wessels (1988), Rajan and Zingales (1995), Graham (1996) and studies of issuing firms' debt vs. equity financing choice (e.g. Marsh (1982), Jalilvand and Harris (1984), Bayless and Chaplisky (1990), Mackie – Mason (1990), Jung, Kim and Stulz (1996). These studies have successfully identified firm characteristics such as size, R and D intensity, market-to-book ratio of assets, stock returns, asset tangibility, profitability and the marginal tax rate as important determinants of corporate financing choices. The effects associated with profitability and market-to-book ratio has been found to be especially important.

Modigliani and Miller (1958 and 1963) demonstrate that in a frictionless world, financial leverage is unrelated to firm value, but in a world with tax – deductible interest payments, firm value and capital structure are positively related. Other researchers have added imperfections, such as bankruptcy costs (Baxter, 1967; Stiglitz, 1972; Kraus and Litzenberger, 1973; and Kim, 1978), agency costs (Jensen and Mechling, 1976), and gains from leverage – induced tax shields (De Angdo ad Masulis, 1980), to the analysis and have maintained that an optional capital structure may exist. Empirical work by Bradley, Jarrell and Kim (1984), Long and Malitz (1985) and Titman and Wessells (1988) largely supports bankruptcy costs or agency costs as partial determinants of leverage and of optimal capital structure. Miller (1977) added personal taxes to the analysis and demonstrated that optimal debt usage occurs on a macro – level, but it does not exist at the firm level. Interest deductibility at the firm level is offset at the investor level.

Fama and French (2002) agree that the negative effects of profitability on leverage is consistent with the pecking order model, but also find that there is an offsetting response of leverage to changes in earnings, implying that the profitability effects are in part due to transitory changes in leverage rather than changes in the target.

Bancel and Mittoo (2002) in their study survey managers of firms in seventeen European countries on their capital structure choice and its determinants. Their preliminary analysis of the survey shows some interesting findings. Financial flexibility, credit rating and tax advantage of debt are the most important factors influencing the debt policy while the earnings per share dilution is the most important concern in issuing equity Evidence also supports that the level of interest rate and the share price are important considerations in selecting the timing of the debt and equity issues respectively. Finally, hedging considerations are the primary factors influencing the selection of the maturity of debt or when raising capital abroad.

Hovakimian, Hovakimian and Tehranian (2003) have successfully identified firm characteristics such as size, R and D intensity, market-to-book ratio of assets, stock returns, asset tangibility, profitability, and the marginal tax rate as important determinants of corporate financing choices. It was reported that high market-to-book firms have low target debt ratios. On the other hand, consistent with market timing, high stock returns increase the probability of equity issuance, but have no effect on target leverage.

Drobetz and Fix (2003) tested the leverage predictions of the trade-off and pecking order models using Swiss data. According to them, the race between the trade-off theory and the pecking order theory is undecided; in fact, on many issues there is no conflict. In their study, firms with more investment opportunities apply less leverage, which supports both the trade-off model and a complex version of the pecking order model. Confirming the pecking order model but contradicting the trade-off model, more profitable firms use less leverage. Leverage is also closely related to tangibility of assets and the volatility of a firm's earnings. They also find that Swiss firms tend to maintain target leverage ratios.

Modigliani and Miller (1963) argue that, due to the tax deductability of interest payments, companies may prefer debt to equity. This presupposes that highly profitable companies tend to have high level of debt. However, De Angelo and Masulis (1980) argue that interest tax shields may be unimportant to companies with other tax shields, such as depreciation.

In the trade-off theory, agency costs, taxes, and bankruptcy costs push more profitable firms toward higher book leverage. In the first place, expected bankruptcy costs decline when profitability increases. Second, the deductability of corporate interest payments induces more profitable firms to finance with debt. In a trade-off theory framework, when firms are profitable, they prefer debt to benefit from the tax shield. In addition, if past profitability is a good proxy for future profitability, profitable firms can borrow more, as the likelihood of paying back the loans is greater. In the agency models of Jensen and Meckhing (1976), Easterbook (1984), and Jesen (1986), higher leverage helps to control agency problems by forcing managers to pay out more of the firm's excess cash.

In sharp contrast, Myers and Majhif (1984) argued that as a result of asymmetric information (pecking order hypothesis), companies prefer internal sources of finance. In other words, higher profitability companies tend to have lower debt levels and higher retained earnings. Thus, a pecking order is established, whereby companies with high levels of profits tend to finance investments with retained earnings rather than by the raising of debt finance. Accordingly, the pecking-order model predicts a negative relationship between book leverage and profitability.

Again, the empirical evidence on the issue is mixed. For instance, Toy et. al., (1974); Kester (1986); Titman and Wessels (1988); Harris and Raviv (1991); Bennett and Donnelly (1993); Rajan and Zingales (1995), and Michaeles et. al. (1999); Booth et al. (2001); Bervan and Danbolt (2001) all find gearing to be negatively related to the level of profitability (supporting the pecking-order theory), while Jensen, Solberg and Zorn (1992) find a positive one (supporting the trade-off theory).

However, corporate studies in Nigeria have been clustered around estimation of corporate cost of capital (Akintola, Bello and Adedipe, 1983; Inanga, 1987 and Adelegan, 2001), determinants of dividend policy (Inanga, 1975,) and financing decision (Salami, 2000 and Adenikinju, 2001). Salawu, (2007) examined the considerable factors in deciding on the appropriate amount of equity and debt in the Nigerian banking industry, and the factors influencing banks' capital structure. His study revealed that ownership structure and management control, growth and opportunity, profitability, issuing cost, and tax economics associated with debt are the major factors influencing bank's capital structure.

DATA AND METHODOLOGY

The study uses data of 50 non-financial companies listed on the Nigerian Stock Exchange for the period from 1990 to 2004. The companies with missing data and newly quoted companies were excluded from the study. The study also excludes the financial and securities sector companies, as their financial characteristics and use of leverage are substantially different from other companies. In addition, the balance sheets of the firms in the financial sector (banks, insurance companies, and investments trust) have a significantly different structure from those of non-financial firms; therefore, financial firms were excluded from the sample. The secondary data for the study consist of selected variables from the financial statements of sampled firms.

The estimation model uses panel data. Panel data econometric techniques were employed for the study. The Pooled Ordinary Least Squares (OLS) model, Fixed Effect Model and Random Effect Model were used in the analysis, which covered the data from 1990 to 2004. The estimation equation is as follow:

PROF = f (LEV1, LEV2, LEV3, PL)

Where:

PROF = Profitability

LEV1 = Total liabilities ratio

LEV2 = Long-term liabilities ratio

LEV3 = Short-term liabilities ratio

PL = Participation of Equity

Profitability is defined as earnings before interest and tax to the book value of total assets. Independent variables include total liabilities ratio, long-term debt ratio, short-term debt ratio and participation of equity. Total liabilities ratio refers to the total debt divided by total assets (LEV1), while long-term debt ratio is the ratio of long-term debt divided by total assets (LEV2). Short-term debt ratio (LEV3) is calculated as short-term debt divided by total assets. The equity (PL) is defined as the ratio of net assets to total debts.

RESULT AND DISCUSSION

The choice among the ideal proportion of debt and equity can affect the value of the company, as much as the return rate can. This section reveals the analysis of the influence of the capital structure of Nigerian companies regarding the factor profitability. The results of the analysis of the regression estimated to evaluate the influence of the capital structure on the profitability are shown in Tables 1 and 2.

Table 1: Descriptive Statistics of Profitability and Capital Structure

VARIABLE	OBS.	MEAN	MEDIAN	STD. DEV.	MINIMUM	MAXIMUM
PROF	722	-0.3858	0.2030	12.781	-266.00	28.127
LEV I	722	0.6572	0.6352	0.3695	0.0081	6.300
LEV 2	722	0.0829	0.0359	0.3733	0.0000	9.769
LEV 3	722	0.6003	0.5592	0.4879	0.0081	9.4938
PL	722	0.8389	0.5706	1.7048	-0.7441	41.6078

The data in Table 1 present the average indicators. The return rate (PROF) measured by the earning after interest and tax divided by net assets gives negative values, that is, -0.3858. This indicates that the companies showed poor performance in the analyzed period. The total liabilities (LEV1) on average amount to about 65.72%. If total liabilities are split into long-term liabilities (repayable in more than one year) and short-term liabilities (repayable in less than one year), the figures 8.29% and 60% respectively, show that debt financing for firms in Nigeria corresponds mainly to a short-term nature.

The participation of equity in the financing of the companies measured by equity on total debts (PL) presents average of 0.8388 and standard deviation of 1.7047. The results suggest a certain uniformity of that capital source, that is, an elevated number of companies falls back mainly upon equity as a financing form. The values are quite high, that is, justified by the low long-term debt level.

Table 2: Regression Model Estimates: Profitability and Capital Structure Dependent Variable, Profitability (PROF)

Variable	OLS	Fixed Effect Result	Random Effect Result
Constant	0.3604 (0.3257)	0.5300 (0.4368)	0.3602 (0.3266)
LEV1	-1.2783 (-0.6701)	-2.0299 (-0.9604)	-1.2797 (-0.6734)
LEV2	0.0746 (0.0582)	-0.1346 (-0.1014)	0.0739 (0.0579)
LEV3	0.0409 (0.0291)	0.1739 (0.1169)	0.0411 (0.0293)
PL	0.0754 (0.2562)	0.0043 (1.2506)	0.0765 (0.2610)
Adjusted R^2	0.0016	0.0775	-0.004
F – statistic	0.289 (0.885)	1.059 (0.365)	0.291 (0.884)
D-Watson Stat	2.0	2.0	2.2
Hausman Test	-	-	9.753 (0.0448)
Cross-section included	50	50	50
Number of observations	722	722	722

*Profitability (PROF) refers to earning after interest and tax/ net assets; long-term debt (LEV1) is defined as total debts/total assets, long-term debts (LEV2) refer to the ratio of long-term debts/total assets. Short-term debts (LEV3) is the current liabilities divided by total assets. The equity (PL) is defined as the ratio of net assets to total debts. Numbers in parentheses appearing below the coefficients are t-values. *, ** and *** indicates coefficient is significant at the 1, 5 and 10 percent levels respectively. However, from the table above none of the variables are significance.*

Tables 2 present the results of the pooled OLS, fixed effects and random effects estimations for total debts (LEV1), long-term debts (LEV2) and short-term debts (LEV3). Moreover, the outcome of the Hausman's specification test in the study rejects the hypothesis regarding the absence of correlation between the individual unobservable effects and the explanatory variables and, therefore, the choice should be the fixed effects. The Hausman test indicates that the fixed effect model should be used.

The LEV1 (total debts) has a negative sign of –1.2783, -2.0299 and –1.2797 under the three estimation techniques. The results indicate that the return rate (profitability) is inversely proportional to the debt. In other words, the larger the total debt, the lower is the profitability. This result is in conformity with the conclusions of Booth et al (2001), Fama and French (1998), Graham (2000) and miller (1977).

The short-term debts (LEV3) presented a positive sign with highest coefficient of 0.1739 under fixed effect model. This suggests that short-term debt is a common practice among the most profitable companies. This is due to the instability of the Nigerian economy, which necessitates the need of short-term funds to provide the necessary working capitals—which are the type of resources supposedly offered with relative abundance and easiness by financial institutions. The participation of equity (PL) in the capital structure is positively correlated with profitability.

CONCLUSION

This study investigates the relationship between capital structure and profitability of quoted companies on the Nigerian Stock Exchange during a fifteen years period. The result reveals that profitability has experienced a downward trend in growth with the average growth rate standing at a negative 38.58%. The disparity in profitability ranged from 28% maximum value for some firms to a loss of over 266% (minimum value) for others. This presents a great disparity between firms in profitability.

Moreover, the impact of capital structure on the profitability is not significant, but there is positive relationship between profitability and short-term debt. The result suggests that firms in Nigeria depend on external financing. In the Nigerian case, a high proportion (60%) of the debt is represented in short-term debt. The participation of equity (PL) in the capital structure is positively correlated with profitability.

More importantly, the result indicates that the Nigerian companies are using long-term debt in a extremely conservative way. This may be due to the high interest rates practiced at the Nigerian Financial Market, the instability of the exchange rate politics and remaining atmosphere of uncertainty of the economy. These factors convey operational and financial risks that hinder the managerial planning and inhibit the adoption of more sophisticated debt policy.

Thus, the results from this study have important implications for financial stability as higher ratios of short-term debt to total debt makes the corporate sector highly vulnerable to changes in economic conditions and may increase the economy wide impact of a financial crisis. Therefore, the following recommendation will assist the financial managers. One, the management should strive to identify the optimal capital structure of the firm and also maintain it since it represents the point where the market value of the firm is maximized. Two, the companies should implement an effective and efficient credit policy, which will improve the performance level of the turnover and growth. Finally, the top echelon of company management should take interest in the issue of capital structure and constantly monitor its form and adaptability.

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BIOGRAPHY

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THE USE OF TERM STRUCTURE INFORMATION IN THE HEDGING OF JAPANESE GOVERNMENT BONDS

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ABSTRACT

This paper employs the Kalman filter to explore the impact of term structure variables in the hedging of Japanese Government Bonds (JGBs) with treasury futures. The term structure factors (level parameter β_0, slope parameter β_1, and curvature parameter, β_2) are based on Nelson and Siegel (1987) model. The out-of-sample hedging performance is also provided by moving window technology. The empirical results show the existence of significant relationships among the term structure factors, the earlier hedge ratio, and the optimal hedge ratio. However, the time-varying hedge ratio (which includes the term structure variables from the information set) did not provide good out-of-sample hedging effectiveness. Nevertheless, the out-of-sample results did demonstrate that the performance of the time-varying hedge ratio with term structure variables is better than a hedge ratio with a naive hedge or OLS model in the 7–10-year Japanese Government Bond index.

JEL: G12, G15, G32

INTRODUCTION

The so-called 'term structure of interest rates' (TSIR), which is also known as the yield curve, shows the expected yield from zero-coupon government bonds under a given default risk. For many large financial institutions, information derived from the TSIR has played an important role in the valuation and hedging of interest-rate-dependent instruments. Moreover, the shape of the TSIR provides a good predictive indicator of future economic activity, with consequent implications for estimations of GDP and inflation rates (Estrella and Mishkin, 1998; Estrella and Hardouvelis, 1991) Investors can, therefore, make judgments on the future impact of financial and economic activities by observing changes in the TSIR, and can thus adjust their investment and hedging strategies.

Because the spot price of bonds is a function of interest rates and the movement of the yield curve is not parallel within different maturities, Litterman and Scheinkman (1991) decomposed the curve of the TSIR into three phases: level, slope, and curvature. Diebold and Li (2006) used β_0, β_1 and β_2 in the Nelson and Siegel (1987) model to designate these three phases, which they interpreted as the long-term, short-term, and middle-term phases in the interest rate. In addition, apart from these three phases, the factor τ from the Nelson and Siegel (1987) model governs the exponential decay rate. When the value of τ is small, slow decay is produced and there is a better fit with the yield curve at long maturities; conversely, when the value of τ is large, rapid decay is produced and there is a better fit with the yield curve at short maturities. Moreover, as Dolan (1999) and Diebold et al. (2006) have pointed out, the Nelson and Siegel (1987) model is well suited to describing the dynamic process of the TSIR and providing good forecasts.

To promote bond portfolio performance, bond investment managers obviously wish to manage interest rate risks efficiently, and they need to understand the dynamic process of the TSIR. In this regard, Markowitz (1991) decomposed portfolio risk into: (i) system risk; and (ii) non-system risk. According to this view, bond investment managers can eliminate non-system risk by diversification of investment;

however, the hedge function of futures contracts or other derivatives can diversify the system risk in the bond portfolio. Management of the interest risk with futures contracts has become an important issue in bond portfolio management.

The Tokyo Stock Exchange (TSE) has offered trading on 10-year Japanese Government Bond (JGB) Futures contracts since October 1985. The trading volume of these contracts has boomed, and the JGB Futures market is now regarded as one of the most active in the Asian financial system. These futures bonds are popular because they can be used to transfer risk and thus provide bond investors with a hedge against interest rate risks. In these circumstances, the determination of the optimal hedge ratio becomes a crucial issue in the hedge strategy of investors; however, their ability to do this effectively has been inhibited by the fact that most empirical studies of these issues have focused only on the question of stock portfolio hedge. The present paper addresses this gap in the literature by analysing the hedge function of interest rate futures in the JGB market.

Because the duration of a bond portfolio is fundamentally a function of interest rates, it is reasonable to assume that the returns of a bond portfolio will fluctuate with movements in the yield curve. In accordance with the approach adopted by Fink et al. (2005), the present study investigates the performance of an optimal hedge ratio using moving window technology based on the Kalman filter; however, the approach of Fink et al. (2005) extended here through a more accurate estimation of the yield curve factors. In this regard, Dolan (1999) pointed out that the parameters of the yield curve, estimated using the Nelson and Siegel (1987) model, could be predicted; indeed, Dolan (1999) presented forecasts of how the level, slope, and curve could have significant effects on bond portfolio performance. The main contribution of the present work is to combine the yield curve factors of the JGB, using the Nelson and Siegel (1987) model, with the Kalman filter to generate the optimal hedge ratio.

The remainder of this paper is organised as follows. In the next section, we discuss the relevant literature. The next section introduces the estimation of yield curve factors, and the calculation of the time-varying optimal hedge ratio, using the Kalman filter. The third section proceeds to an empirical analysis - describing: (i) the detailed data; (ii) the estimation of the model of yield curve and the Kalman filter; and (iii) the in-sample and out-of-sample performance of a number of hedges. The final section presents the conclusion.

LITERATURE REVIEW

Estimating Term Structure of Interest Rates

Many methods exist to estimate the yield curves. Generally speaking, there are two distinct approaches to estimate the term structure of interest rates: the equilibrium models and the empirical models**.** The equilibrium models are formalized by defining state variables characterizing the state of the economy (relevant to the determination of the term structure) which are driven by these random processes and are related in some way to the prices of bonds. It then uses no-arbitrage arguments to infer the dynamics of the term structure. Examples of this include Vasicek (1977), Dothan (1978), Brennan and Schwartz (1979), Cox Ingersoll and Ross (CIR, 1985) and Duffie and Kan (1996). Unfortunately, in terms of the expedient assumptions about the nature of the stochastic process driving interest rates, the term structure of interest rates derived by those models could only exist theoretically in an efficient market and do not conform well to the observed data on bond yields and prices.

In contrast to equilibrium models, the empirical models focusing on obtaining a continuing yield curve from cross-sectional coupon bond data based on curve fitting techniques are able to describe a richer variety of yield patterns in reality. The resulting term structure estimated from the statistical techniques can be directly put into interest rate models, such as the Ho and Lee (1986), the Heath et al. (1992) and Hull and White (1990) models, for pricing interest rate contingent claims. Since a coupon bond can be considered as a portfolio of discount bonds with maturities dates consistent with the coupon dates, the discount bond prices thus can be extracted from actual coupon bond prices by statistical techniques. Examples of this approach include McCulloch (1971, 1975), Schaefer (1981), Vasicek and Fong (1982) and Steely (1991). The major advantage of the empirical models is able to characterize a plenty variety of reasonable yield curve patterns which are consistent with real market yield curves. Furthermore, among the empirical models, the Nelson and Siegel (1987) model is most suited to the ultimate purpose of determining the optimal hedge ratio. There are three main superior features of the Nelson and Siegel (1987) model. First, it has only three major parameters, and which can be well used to explain the meaning of the yield curve shape in real market condition; Second, it has been proved to be good at fitting yield curves (Willner, 1996; Dolan, 1999; Diebold and Li, 2006; Diebold et al., 2006); Finally, each parameter derived from the Nelson and Siegel (1987) model can separately present the level, slope and curvature changes, which are three significant contributions of varied yield curve shape.

<u>Revolution of Hedge Ratios Estimation</u>

Traditionally, hedge ratios have been estimated by regression analysis. However, Myers (1991) has argued that this method of estimating hedge ratios encounters two problems: (I) the estimated value of hedge ratios using this methodology does not involve all relevant information; and (ii) the hedge ratio derived by this method is not time-dependent because the covariance matrix of spot and futures prices will not change with time. As a result, the assumption of a fixed covariance matrix could induce investors to take unacceptable risks with futures.

To resolve these difficulties in the traditional model, Engle (1982) provided the autoregressive conditional heteroscedasticity (ARCH) model, which predicts the conditional variance by taking a weighted average of past errors. In this model, recent information has more influence on the error term than information from the distant past. This ARCH model was extended in the Generalized ARCH model (known as the GARCH model), which was developed by Bollerslev (1986). The GARCH model assumes that variance is a weighted average between previous variance and error terms. An even more generalized model has been proposed by Engle et al. (1988), who took into consideration the feedback relationship between spots and futures. All of these ARCH-type models represent a significant advance on previously used methods because they all assume that hedge ratios are time-variant, and many studies have used them to estimate time-varying hedge ratios (Baillie and Myers, 1991; Kroner and Sultan, 1993; Koutmos, 2001; Rossi and Zucca, 2002). In order to avoid the difficulty of deciding the initial value of the GARCH model, Fink et al. (2005) utilised the Kalman filter to estimate a time-varying optimal hedge ratio.

As noted above, the traditional assumption that hedge ratios are time-invariant is not sustainable; rather, it is necessary to describe the dynamic relationship between yield-curve factors and hedge ratios. To incorporate information on the level, slope, and curvature of the yield curve into the estimation of a time-varying optimal hedge ratio, the present study utilises the Kalman filter, which avoids the difficulty of deciding the initial value of the GARCH model.

METHODOLOGY: CHOOSING A MODEL OF YIELD CURVE AND KALMAN FILTER

The parsimonious model of the yield curve used in this paper is that built by Nelson and Siegel (1987). Willner (1996) contended that this model is a useful method for approximating the sensitivity of a bond portfolio to yield-curve level, slope, and curvature. In a similar vein, Diebold and Li (2006) and Diebold et al. (2006) argued that the well-known Nelson-Siegel (1987) model is well suited to approximating

yield-curve dynamics and providing good predictions. The model is used in the present study to estimate the level, slope, and curvature of the yield curve with Japanese government coupon bonds.
The theoretical price of a coupon bond is equal to the sum of the present value of the future coupon and the principal payments according to the following relationship:

$$\hat{B}_i = \sum_{j=1}^{M_i} C(t_{i,j}) \exp\{-t_{i,j} R(t_{i,j})\}, \tag{1}$$

where:

$\hat{B}_i$ is the i_{th} theoretical price of coupon bond;
M_i is the maturity of the i_{th} bond;
$C(t_{i,j})$ is the cash flow of the i_{th} bond at time t_j; and
$R(t_{i,j})$ is the spot rate at time t_j in the i_{th} bond.

Nelson and Siegel (1987) chose a function for the forward rate curve that can be transferred by integrating process to spot rate curve as follows:

$$R(t_{i,j}) = \beta_0 + \beta_1\left(\frac{\tau}{t_{i,j}}\right)\left[1-\exp\left(\frac{-t_{i,j}}{\tau}\right)\right] + \beta_2\left(\frac{\tau}{t_{i,j}}\right)\left[1-\exp\left(\frac{-t_{i,j}}{\tau}\right)\left(\frac{t_{i,j}}{\tau}+1\right)\right] \tag{2}$$

Where
β_0, β_1, β_2 and τ are the parameters for a maturity of t years.
The Nelson and Siegel (1987) model implies an intuitive explanation of the parameters: (i) the value of β_0, which is regarded as a long-term interest rate, is represented by the level of the curve; (ii) the value of β_1, which is regarded as a short-term interest rate, is represented by the slope of the curve; (iii) the value of β_2, which is regarded as a medium-term interest rate, is represented by the curvature of the curve; and (iv) the parameter τ, which governs the exponential decay rate at which the short-term and medium-term factors decay to zero.

To generate these parameters of the yield curve, we added the function of spot rate into the theoretical price of the coupon bond function (1) as follows:

$$\begin{aligned}\hat{B}_i &= \sum_{j=1}^{z_i} C(t_{i,j}) \exp((-t)(R(t))) \\ &= \sum_{j=1}^{z_i} C(t_{i.j}) \exp\left((-t_{i,j}) \times \left(\beta_0 + \beta_1 (\frac{\tau}{t_{i,j}})\left[1-\exp(\frac{-t_{i,j}}{\tau})\right] + \beta_2 (\frac{\tau}{t_{i,j}})\left[1-\exp(\frac{-t_{i,j}}{\tau})(\frac{t_{i,j}}{\tau}+1)\right]\right)\right)\end{aligned} \tag{3}$$

The parameters can then be estimated by minimising the difference between the actual and theoretical bond price; that is:

$$Q = \frac{1}{n}\sum_{i=1}^{n}\left[(B_i - \hat{B}_i)\right]^2 \tag{4}$$

where n is the number of bonds.

Because the objective function is nonlinear, the Newton method can be used to approximate the parameters of the Nelson and Siegel (1987) model. One advantage of this method is that τ cannot assume to be a constant; rather, it varies with other parameters. In this regard it should be noted that Diebold and Li (2006) estimated the Nelson and Siegel (1987) model with a constant value of the τ, but

Hurn et al. (2005) argued that the curve from the Nelson and Siegel (1987) model is sensitive to the scale parameter τ, which cannot be fixed. Applying the Newton method to the Nelson and Siegel (1987) model for each day generates a time series of estimates of parameters, which can then be placed as yield-curve factors in the Kalman filter model to estimate the optimal hedge ratio.

The GARCH-based estimation method for time-varying hedge ratios requires the imposition of inequality restrictions on model parameters and the use of a wide range of starting values (Fackler and McNew, 1994; Harris and Shen, 2003). To overcome these negative features of the GARCH method, the present study utilised a Kalman filter to construct a state space specification to estimate the optimal hedge ratio. A state space representation of the relationship between spot and futures return is given by the following system of equations:

$$\begin{aligned} \Delta S_t &= \Delta f_t v_t + \mu_t \\ v_t &= \alpha + \lambda v_{t-1} + \gamma_1 \beta_0 + \gamma_2 \beta_1 + \gamma_3 \beta_2 + \zeta_t \\ \mu_t &\sim N\left(0, \sigma_\mu^2\right) \\ \zeta_t &\sim N\left(0, \sigma_\zeta^2\right) \end{aligned} \tag{5}$$

where

ΔS_t is the log return of the bond index at time t;

Δf_t is the log return of the 10-year JGB futures contracts employed in the hedge portfolio at time t; and

v_t, the optimal hedge ratio at time t, determines the value of futures contracts purchased or sold to the underlying security.

In the state equation, λ measures the persistence of the optimal hedge ratio. Other coefficients that interpret the effect of the yield-curve shape are:

γ_1, which represents the level effect of the yield curve;

γ_2, which represents the slope effect of the yield curve;

γ_3, which represents the curvature effect of the yield curve.

The both error terms μ_t and ζ_t are assumed to follow a normal distribution and are independent of each other.

The Kalman filter procedure takes into account the serially correlated and heteroscedastic disturbance in the relationship between changes in the spot return and changes in the futures return. In addition, the Kalman filter is a recursive algorithm for sequentially updating the time-varying hedge ratios (given new information during the time series). For instance, consider a dataset that includes T observations with the former state vector $\lambda_{1|0}$ defined as the optimal hedge ratio at time one (which is estimated at time zero). In these circumstances, the later state variable $P_{1|0}$ represents the covariance matrix of the conditional distribution of the state vector $\lambda_{1|0}$ (given information available at time zero). Given that the information parameters λ 、 γ_1 、 γ_2 、 γ_3 、 σ_μ^2, and σ_ζ^2 are assumed to be known, the one-step ahead predictor of state terms $\lambda_{1|0}$ and $P_{1|0}$ can be expressed as:

$$\hat{v}_{t|t} = \hat{v}_{t|t-1} + \left(P_{t|t-1}\right)^2 \left(\Delta f_t\right)^2 F_t^{-1}\left(\Delta S_t - \lambda \hat{v}_{t|t-1}\right) \tag{6}$$

$$P_{t|t} = P_{t|t-1} - \left(P_{t|t-1}\right)^2 \left(\Delta f_t\right)^2 F_t^{-1} \tag{7}$$

$$F_t = (\Delta f_t)^2 P_{t|t-1} + \sigma_\mu^2 \tag{8}$$

Therefore, the optimal hedge ratio λ is predicted one step ahead in the following way:

$$\hat{v}_{t+1|t} = (\lambda - K_t \Delta f_t)\hat{v}_{t|t-1} + K_t \Delta S_t + (\alpha + \gamma_1 \beta_0 + \gamma_2 \beta_1 + \gamma_3 \beta_2) \tag{9}$$

$$K_t = \lambda P_{t|t-1} \Delta f_t F_t^{-1} \tag{10}$$

$$P_{t+1} = \lambda^2 \left\{ P_{t|t-1} - (P_{t|t-1})^2 \lambda^2 F_t^{-1} \right\} + \sigma_\zeta^2 \tag{11}$$

To complete the Kalman filter, the unknown elements of the system matrices must be replaced by their estimates. Given the assumption of the normality of μ_t and ζ_t, the parameters of the system equations can be estimated by formulating the log likelihood function as follows:

$$\log L = -\frac{T}{2}\log(2\pi) - \frac{1}{2}\sum_{t=1}^{T}\log|F_t| - \frac{1}{2}\sum_{t=1}^{T}\frac{\theta_t^2}{F_t} \quad , \theta_t = \Delta S_t - \Delta f_t \hat{v}_{t|t-1} \tag{12}$$

Data

The data used in the empirical study referred to daily 10-year JGB nearby Futures contracts traded on the Tokyo Security Exchange (TSE). The 10-year JGB nearby Futures contracts settlement prices were obtained from Datastream. The daily JGB price index was calculated by JP Morgan and collected from Datastream. The data transferred to the daily log return covered the period from 30 May 2002 to 18 April 2007. The total number of time-series observations in the data set was 1275. For estimating the JGB yield curve, the daily JGB price was plotted. This consisted of 179 observations (on average) per day from 30 May 2002 to 18 April 2007. A Newton method was used to extract these yield-curve factors embedded in the Nelson and Siegel (1987) model.

EMPIRICAL RESULTS

From these data, it was possible to derive the parameters and variables as described in the previous section. Table 1 provides some descriptive statistics of these time-series parameters and variables. The left column of the table shows the means, mediums, maximums, minimums, and standard deviations. Among the yield-curve factors:

(1) the mean of daily β_0 was 0.0327, which shows that the long-term interest rate level tended to 3.27%;
(2) the mean of daily β_1 was -0.0336, which represents the positive slope of the yield curve on average;
(3) the mean of daily β_2 was 0.0036, which shows that the slope of the yield curve was not only positive, but also had a hump in the JGB market.

In addition, the maximum β_2 and the minimum β_2 were not all larger than zero, which shows that the shapes of the yield curves in the JGB market involved different patterns. Therefore, the risk of yield-curve changes should be taken into account in interest risk management.

Table 1 also shows the statistics of the JGB spot and futures log return. The average log return of the JGB spot (–0.0017%) was less than that of the JGB futures (–0.0032%). Similarly, the standard deviation of spot log return (0.1453%) was also lower than that of the futures log return(0.2414%), which implies that the volatility of the futures market was greater than that of the spot market.

Table 1: Descriptive Statistics for Yield Curve Factors, Spot and Futures Returns

	β_0	β_1	β_2	**JGB_Spot**	**JGB_Futures**
Mean	0.0327	(0.0336)	0.0036	-0.0017%	-0.0032%
Median	0.0296	(0.0320)	0.0038	0.0000%	0.0000%
Maximum	0.0671	(0.0141)	2.1192	0.7086%	1.0525%
Minimum	0.0034	(0.0526)	(0.1376)	-0.8620%	-1.7891%
Std. Dev.	0.0123	0.0079	0.0866	0.1453%	0.2414%

The parameters β_0 , β_1 and β_2 are the yield curve factors embedded in the Nelson and Siegel model. The daily returns of JGB price index and futures settlement price are transferred to log returns.

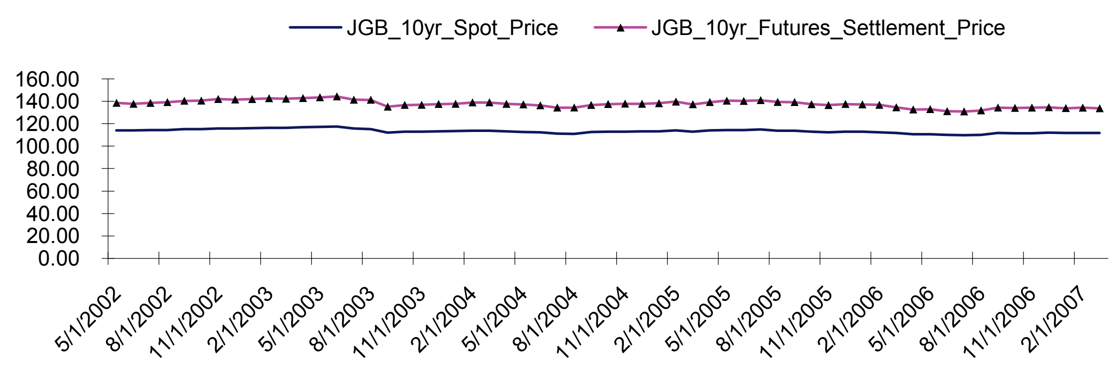
Pearson correlation analysis was employed to investigate the yield-fitting ability of the Nelson and Siegel (1987) model and the degree of relationship between the JGB spot and futures returns (as shown in Table 2). The correlation coefficient between the 10-year JGB price index and 10-year JGB futures settlement price was quite high (98.189%), which implies that the 10-year JGB price index return was more strongly correlated to the 10-year JGB futures return. This relationship is also clear from Figure 1. The strong correlation between these factors indicates that the JGB 10-year futures could provide a good hedge function for the JGB 10-year price index.

Table 2: Correlation of JGB Spot and Futures Price with JGB Yield and NS Yield

	10yr JGB_Spot Index Price	**10yr JGB_Futures Settlement Price**	**10yr JGB_Yield**	**10yr JGB_NS_Yield**
10yr JGB_Spot Index price	1	0.98189	-0.92197	-0.90868
10yr JGB_Futures Settlement Price	0.98189	1	-0.89346	-0.89210
10yr JGB_Yield	-0.92197	-0.89346	1	0.95757
10yr JGB_NS_Yield	-0.90868	-0.89210	0.95757	1

10-year JGB futures settlement price was quite high (98.189%), which implies that the 10-year JGB price index return was more strongly correlated to the 10-year JGB futures return.

Figure 1: The Price of 10 Year JGB versus the Settlement Price of 10 Year JGB Futures

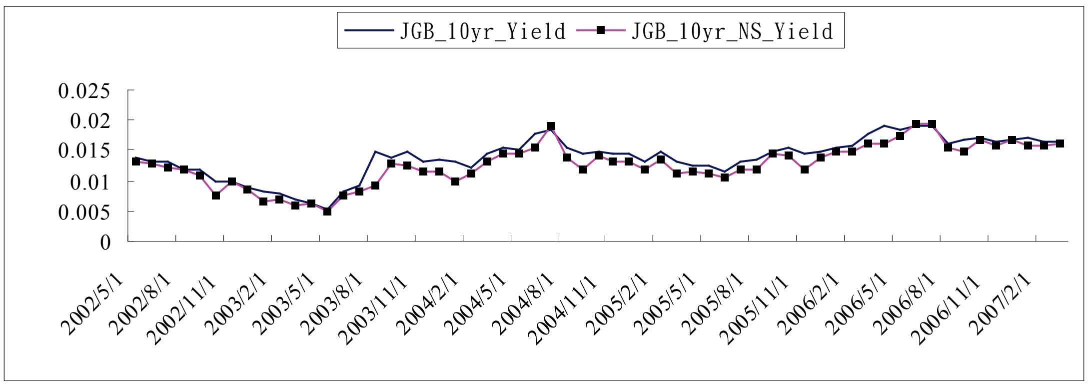


The strong correlation between these factors indicates that the JGB 10-year futures could provide a good hedge function for the JGB 10-year price index.

As shown in Table 2, the correlation coefficient between the 10-year JGB yield and the 10-year JGB price index was negative (–92.197%). Table 2 also presents the correlation between the 10-year JGB yield and the 10-year JGB futures settlement price (–89.346%). The negative relationship between the JGB yield and price is in accordance with the intuitive perception of bond pricing.

Finally, both Table 2 and Figure 2 show that the 10-year JGB yield estimated by Nelson and Siegel (1987) had a correlation of 95.757% with the actual 10-year JGB yield, which suggests that the Nelson and Siegel (1987) model could fit the 10-year JGB yield well. For this reason, the parameters of the model should involve some information to explain the variety of the 10-year JGB yield.

Figure 2: The Yield of 10 Year JGB versus the NS Yield of 10 Year JGB



Nelson and Siegel (1987) model could fit the 10-year JGB yield. Thus, the parameters of the model should involve some information to explain the variety of the 10-year JGB yield.

Effect of TSIR Factors on the Hedge Ratio

To compare the influence of different parameters on the determination of hedge ratio, a number of constrained alternatives are specified. Table 3 shows results of a Kalman filter for unrestricted and restricted models. The following observations can be made.

First, it is apparent that the persistence parameter λ was significantly positive in all models, which implies that the movement of the hedge ratio displayed persistency. Secondly, the level coefficient γ_1 (2.1324) in model 1 was significantly positive with respect to the hedge ratio. This phenomenon might be due to investors increasing their hedge position as the level of interest rate increases. Thirdly, the slope coefficient γ_2 (2.3873) in model 1 was significantly positive with respect to the hedge ratio, which implies that the difference between the short-term and long-term interest rates pushed investors to increase their hedge position. Finally, the curvature coefficient γ_3 (0.0499) was not significant. These findings demonstrate that the early hedge ratio and the level and slope of the yield curve affect the next optimal hedge ratio.

To gain a better understanding of the distribution of each parameter from the empirical model, different constraints of the parameters are shown as models 2 to 8 in Table 3. The following observations can be made.
Model 2 was estimated with a constraint of γ_3=0. The persistent coefficient λ (0.1316) of model 2 remained significantly positive. The yield-curve coefficients γ_1 (2.0956) and γ_2 (2.3896) also had a

significant influence on the optimal hedge ratio. Model 3 shows an alternative restriction, in which γ_2=0. The coefficients λ and γ_1 were significantly positive. Model 4 imposed a constraint of γ_1=0. The coefficient λ remained significantly positive. Two constraints were imposed to compare the contribution of each parameter in models 5 to 7. The coefficient λ was still significantly positive in these three models, but only γ_1 was significantly positive in model 5. These models returned similar results to those of previous models. As shown in models 1 to 7, it is apparent that the coefficients λ and γ_1 were important parameters for explaining the hedge ratio.

Finally, model 8 had a constraint of λ=0 (which enabled consideration of the effect of the yield-curve factor without the coefficient λ). The coefficients γ_1 and γ_2 were still significantly positive with respect to the hedge ratio, which implies that the level and slope factors provide additional information of importance in explaining the determination of the optimal hedge ratio.

Table 3: Results of Kalman Filter for Unrestricted and Restricted Model

	Model 1 (not restricted)	Model 2 (γ_3=0)	Model 3 (γ_2=0)	Model 4 (γ_1=0)	Model 5 (γ_3=0) (γ_2=0)	Model 6 (γ_3=0) (γ_1=0)	Model 7 (γ_2=0) (γ_1=0)	Model 8 (λ=0)
λ	0.1312*** (0.0006)	0.1316*** (0.0006)	0.1383*** (0.0002)	0.1380*** (0.0002)	0.1340*** (0.0002)	0.1394*** (0.0002)	0.1398*** (0.0002)	
γ_1	2.1324** (0.0110)	2.0956** (0.0126)	1.1054* (0.0572)		1.0506*** (0.0701)			2.4291*** (0.0065)
γ_2	2.3873** (0.0384)	2.3896** (0.0379)		0.3173 (0.6920)		0.3422 (0.6672)		2.8098** (0.0215)
γ_3	0.0499 (0.4338)		0.0407 (0.5709)	0.0233 (0.7745)			0.0245 (0.7624)	0.0624 (0.3153)
σ_μ	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
σ_ζ	0.1622	0.1624	0.1634	0.1645	0.1633	0.1644	0.1643	0.1670
Log likelihood	8286.8470	8286.5490	8284.3550	8282.4010	8284.1580	8282.3360	8282.3160	8284.7400

This table provides parameter estimates in the following model:

$$\Delta S_t = \Delta f_t \nu_t + \mu_t$$
$$\nu_t = \alpha + \lambda \nu_{t-1} + \gamma_1 \beta_0 + \gamma_2 \beta_1 + \gamma_3 \beta_2 + \zeta_t$$
$$\mu_t \sim N(0, \sigma_\mu^2)$$
$$\zeta_t \sim N(0, \sigma_\zeta^2)$$

The ΔS_t is log returns of the JGB price index at time t. The variable Δf_t is the log returns of the JGB futures settlement price, that it can structure the hedge portfolio. The term structure factors β_0, β_1 and β_2, form Nelson and Siegel model, show level movement, slope change, and curvature shift separately. The ν_t presents the appropriate hedge ratio at time t, and the coefficient λ is parameter of persistence to determine the appropriate hedge ratio. Finally, the coefficients γ_1, γ_2, and 、γ_3 demonstrate the effect of term structure factor on hedge ratio. The sample period is daily between May 30, 2002 and April 18, 2007 with 1275 empirical data. Model 1 through model 8 exhibit various restrictions of parameters.

The Wald test was used to examine the null hypothesis implied in Table 3. The results are shown in Table 4. Model 2 demonstrated an insignificant coefficient (γ_3), as expected. The findings for models 3, 4, and 8 could not lead to a rejection of their null hypotheses, which indicates that, the coefficients, γ_1, γ_2 and λ, all involve rich information in deciding the next hedge ratio. In contrast, the results from models 5, 6, and 7 provide grounds for rejecting their null hypotheses. Model 8 also rejects the null hypothesis, which supports the contention that coefficient λ has a significant relationship with the hedge ratio.

Table 4: WALD Test

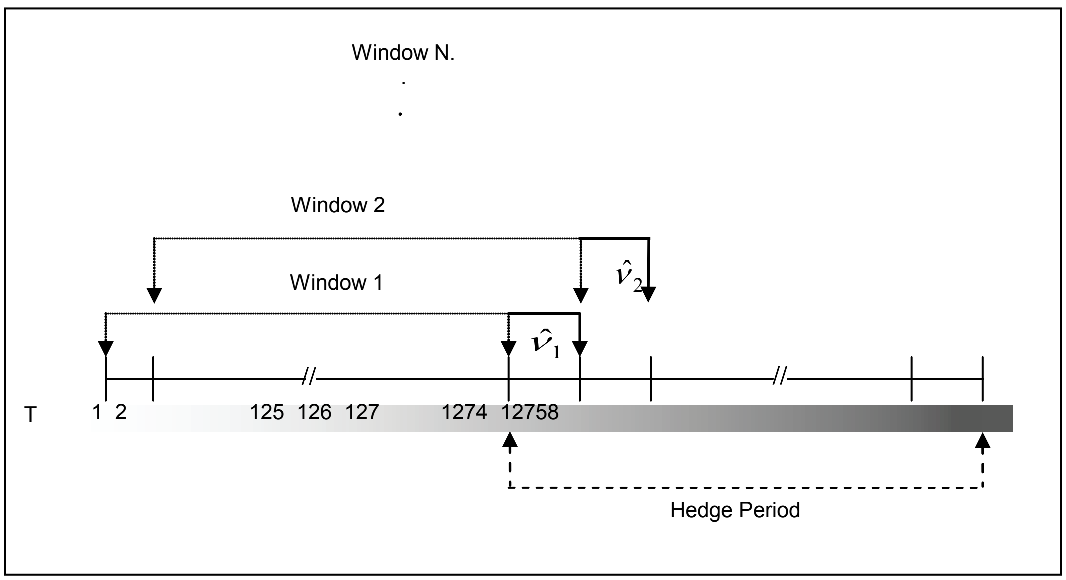
	Model 2 (γ_3=0)	Model 3 (γ_2=0)	Model 4 (γ_1=0)	Model 5 (γ_3=0) (γ_2=0)	Model 6 (γ_3=0) (γ_1=0)	Model 7 (γ_2=0) (γ_1=0)	Model 8 (λ=0)
Chi-square	0.6101 (0.4348)	4.3229** (0.0376)	6.4667** (0.0110)	4.7847* (0.0914)	7.0372** (0.0296)	6.5890** (0.0371)	11.8578*** (0.0006)

The equation in parenthesis exhibits hypothesis.
**** indicates significant at the 1%. ** indicates significant at the 5%. * indicates significant at the 10%.*

Results of Out-of–Sample Performance

To examine the performance of one-step-ahead hedge portfolios, the optimal hedge ratios (based on models 1 to 8) were estimated, beginning from the first period, proceeding to 125 days, and concluding with the end period day (as shown in Figure 3).

Figure 3: Out of Sample Hedge for Moving Window Estimation



The hedge portfolio consisted of a long position on the JGB 10-year price index and a short position on the JGB 10-year futures, which multiplied by the one-step-ahead optimal hedge ratio ($\nu_{t+1|t}$). Table 5 shows the standard deviation of returns of the simulated hedge portfolios when various restrictions were imposed.

A comparison of the various models shows that model 9 (OLS method) had a greater standard deviation (0.0084) than the other models. This result demonstrates that the yield-curve factors and persistence factor can provide additional explanatory power to decrease the standard deviation of the hedge portfolio.

Table 5: Out of Sample Result for Standard Deviation of Hedge Position

	Model 1 (no restricted)	Model 2 (γ_3=0)	Model 3 (γ_2=0)	Model 4 (γ_1=0)	Model 5 (γ_3=0) (γ_2=0)	Model 6 (γ_3=0) (γ_1=0)	Model 7 (γ_2=0) (γ_1=0)	Model 8 (λ=0)	Model 9 OLS
Standard Deviation of Hedge Position	0.0050	0.0051	0.0054	0.0054	0.0056	0.0058	0.0053	0.0052	0.0084

The estimation, used in model 1 through model 9 within 125 daily data, is set to forecast the hedge ratio on next day, so we can construct a hedge portfolio. With this procedure of estimation, we can get 1149 hedge portfolio returns and standard deviation between the 126th day and 1275th day.

Table 6 presents a methodology suggested by Ederington (1979) for testing hedge effectiveness, as follows:

$$h_e = 1 - \frac{\sigma^2_{hedge}}{\sigma^2_{unhedge}} \qquad (13)$$

where:

σ^2_{hedge} is the variance of the hedged portfolio; and

$\sigma^2_{unhedge}$ is the variance of the unhedged portfolio.

As the value of h_e trends to higher levels, the hedged portfolio becomes more effective.

As shown in Table 6, it is apparent that all models had impressive out-out-sample hedge effectiveness (up to 90%). This result demonstrates that the JGB futures market could provide an excellent environment for hedge investments. This is likely to be due to the high dependence between the spot and futures prices and the high liquidity of market trading.

Table 6: Out of Sample Result for Hedge Efficiency

	Restriction	Hedge Efficiency
Model 1	No restricted	97.1874%
Model 2	(γ_3=0)	97.0002%
Model 3	(γ_2=0)	96.6053%
Model 4	(γ_1=0)	96.6546%
Model 5	(γ_3=0) (γ_2=0)	96.3564%
Model 6	(γ_3=0) (γ_1=0)	96.0964%
Model 7	(γ_2=0) (γ_1=0)	96.7635%
Model 8	(λ=0)	96.8751%
Model 9	OLS	91.8141%
Model 10	v_t =1	95.8989%

The estimation, used in model 1 through model 9 within 125 daily data, is set to forecast the hedge ratio on next day, so we can construct a hedge portfolio. With this procedure of estimation, we can get 1149 hedge portfolio returns and standard deviation to calculate the hedge efficiency between the 126th day and 1275th day. The model 10 has taken the estimation with Perfect Hedge Method, or called Naive Hedge, which means the hedger can buy and sell the same amount of futures contract in contrast to his holding spot position.

It should be noted that the models that involved the yield-curve factors produced greater hedge effectiveness. This was especially apparent in models 1 and 2, which exhibited the greatest hedge effectiveness. This result shows that the models that include information about the level and slope factors provide significantly greater benefits. In addition, our empirical results are quite different with Fink et al. (2005), which indicate that both the level of interest rates and the slope of the yield curve are unimportant variables in determining the empirically optimal hedge ratio between mortgage-backed securities and Treasury futures contracts.

To summarise the results of out-of-sample testing, it has been demonstrated that the yield-curve information (such as level and slope factors) can improve the determination of the optimal hedge ratio and thus improve the effectiveness of the hedge. The persistence factor, λ, is also an important factor in determining the optimal hedge ratio.

CONCLUSION

The present study has incorporated factors from Nelson and Siegel (1987) with a Kalman filter approach to investigate hedge effectiveness between Japanese Government Bond (JGB) spot and futures. The study has demonstrated statistically significant effects from the persistent, level, and slope factors from an in-sample test. An analysis of out-of-sample predicted performance has demonstrated that the use of yield-curve information (such as persistence, level and slope factors) in determining the optimal hedge ratio can improve the effectiveness of the hedge. The findings also contribute to the literature by revealing that the term structure information need to be accounted for directly in the hedging of the government bonds with interest rates futures contracts.

Fink, et al. (2006) find that both the level of interest rates and the slope of the yield curve are unimportant variables in determining the empirically optimal hedge ratio between MBS and Treasury futures contract. On the contrary, this article concludes the yield-curve information, intuition suggests them to be relevant determinants, should play a significant role in the determination of the time-varying hedge ratio between Treasury bonds and Treasury futures. Since the chief source of basis risk comes from the prepayment of mortgages underlying the MBS, the basis risk in Treasury futures and its underlying asset is much lower than that of Treasury futures and MBS. Thus, it seems reasonable that our empirical findings could be generalised to other government bond markets. Furthermore, this paper compares the hedging effectiveness in hedging 10-year bonds with a Kalman filter approach. Also, our JGB futures contracts are based on Japanese government bonds with a term to maturity of 10 years. Thus, the improvement in hedge effectiveness based on yield-curve information will be limited when we choose the 7-year or the 5-year cash bonds as hedging objects.

More research should be done to assess the bond features: Is the type of issuer important when comparing the hedging effectiveness with a Kalman filter approach? What is the difference between the developed and developing bond market? How should the liquidity risk affect the hedging effectiveness？ How should the optimal hedge ratio be measured. Answers to these questions will contribute the literature in helping the computation of a more reliable hedge ratio between Treasury bonds and Treasury futures.

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HERDING MOMENTUM EFFECT AND FEEDBACK TRADING OF QUALIFIED FOREIGN INSTITUTIONAL INVESTORS IN THE TAIWAN STOCK MARKET

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ABSTRACT

This study extends the herding measures proposed by Warmers (1999), Lakonishok, Shleifer and Vishny (1992) and Borensztein and Gaston (2003) for stocks overbought and oversold by institutional investors as well as the information content related to institutional herding proposed by Nofsinger and Sias (1999). Our analysis further develops a herding measure related to the overbought herding measure, oversold herding measure, and overbought–oversold in dollar ratio for Qualified Foreign Institutional Investors (QFIIs) in the Taiwan stock market. Our results show that the short-term overbought herding measure and the mid-to-long-term oversold in dollar ratio by QFIIs are associated with herding effects resulting from positive feedback trading among QFIIs. The short-to mid-term overbought in dollar ratio by QFIIs is associated with clear herding effects, primarily resulting from the price-impact of herding. The results of this study contribute to the literature on herding measured by the buying number and dollar amounts of institutional investor. The results are also to be integrated with a series of research studies regarding reactions to information on securities markets.

JEL: G11, G14, G21, C21.

KEYWORDS: herding, feedback trading, cascading, momentum, QFIIs.

INTRODUCTION

Qualified Foreign Institutional Investors (QFIIs) have invested in the Taiwan securities market following its initial opening in 1991.Since this time, the regulator of the Taiwan securities market has pursued a gradual opening-up policy to attract the attention of QFIIs. QFIIs, with larger scale and better investment capabilities than other foreign investor groups, tend to be more rational than general investors, and place greater emphasis on long-term strategies in comparison with domestic institutional investors in Taiwan. Their numbers and the weight of their trading dollar amounts are greater than those of other institutional investors, which causes their overbought and oversold to have a significant influence on the Taiwan stock market. Previous studies (e.g., Shiu and Liau, 2005) demonstrated that the overbuying and overselling activities of QFIIs affect the movement of the weighted stock price index, thereby becoming a reference for the investment decisions of other investors.

The difference among the benchmarks for overbought and oversold by foreign investors represents different information regarding trading volume, numbers, and dollar amounts; most previous studies tend to measure overbought and oversold by institutional investors based on the change in share ownership (Nofsingaer and Sias, 1999; Cai, Kaul and Zheng, 2000; Sias, Starks, and Titman, 2002). In contrast, Jones and Winters (1999) proposed that the number of institutional investors in a particular stock reflects new entrants and thus the possibility of additional analysis; they argued that the number of institutional investors in a stock captures the breadth of ownership and analyst coverage. Nevertheless, the LSV index proposed by Lakonishok, Shleifer and Vishny (1992), measured as the buy-and-sell numbers of mutual funds for each individual stock, fails to divide the buying and selling direction and is therefore unable to capture the interaction between the movement of buying or selling direction of institutional investors.

Wermers (1999) modified and improved the measuring index of Lakonishok et al. (1992) to a buying and selling conditional herding measure. Furthermore, Borensztein and Gaston (2003) proposed that when the trading of a particular stock is frequent and primarily flows in one direction, the direction with fewer trades might have the greater dollar amount. In detail, the overbought–oversold index based on the number of foreign investors joining or withdrawing represents the average overbought–oversold willingness of all foreign investors, whereas the overbought–oversold in dollar ratio based on the trading dollar amount of foreign investors implies a corresponding addition or withdrawing of capital.

The work of Wermers (1999), Borensztein and Gaston (2003) on the measure of overbought–oversold behavior by institutional investors, in conjunction with the study of Nofsinger and Sias (1999) on herding, feedback trading, and related issues have extended the dimensions of herding research. The integration of these two studies might well improve analyses of the related issues of herding by QFIIs in emerging markets such as Taiwan. Thus, this study combines the herding definition by Nofsinger and Sias (1999) and the herding measures of the buying number by Wermers (1999) and dollar amounts by Borensztein and Gaston (2003) to be applicable to the Taiwan stock market. Moreover, we want to clarify that QFIIs' herding effect in Taiwan mainly results from their feedback trading or the price-impact of herding.

LITERATURE REVIEW

Nofsingaer and Sias (1999), Cai, Kaul and Zheng (2000), Sias, Starks, and Titman (2002) documented a strong positive relation between changes in institutional ownership and returns measured over the same period. Moreover, we want to explore the relation between the herding measured by the buying number and dollar amounts of institutional investors and the corresponding returns. Additionally, Chakravarty (2001), Dennis and Weston (2000), and Sias, Starks, and Titman (2002) conclude that the relation between changes in institutional ownership and returns measured over the same period results primarily from price effects associated with institutional trading. However, previous studies by Grinblatt, Titman, and Wermers (1995), Wermers (1999, 2000), Nofsingaer and Sias (1999), and Sias, Starks and Titman (2002) have demonstrated the feedback trading of institutional investors. Thus, we want to further clarify the causal direction between the institutional herding measures and the corresponding returns in the different herding intervals. We also want to separately explore whether the feedback trading and the price-impact of institutional herding exist in the different herding intervals.

Hence, this study focuses on the following four topics. First, stocks are sorted separately based on the buy herding measure ($BHM_{i,t}$) and sell herding measure ($SHM_{i,t}$) by QFIIs; this identifies those overbought and oversold stocks with larger herding values. We also sort the stocks based on dollar ratio ($DR_{i,t}$) by QFIIs and identify stocks with overbought and oversold of $DR_{i,t}$ by QFIIs to obtain a more accurate observation. We then extend Nofsinger and Sias's (1999) work to separately examine the relationship between abnormal returns on securities and the overbought-oversold herding indexes of QFIIs to evaluate the importance of their herding behaviors. Second, we use the econometric causality test to confirm the causal directions of feedback trading and herding impacting price measured by the overbought–oversold herding indices of QFIIs. Third, we perform a significant examination of previous abnormal returns on the overbought–oversold herding indices of QFIIs and previous overbought–oversold herding indexes for QFIIs on those in the current phase to verify the existence of feedback trading and cascades by QFIIs. Finally, to verify the managerial implications of QFII's herding for investment decisions, we perform a significant examination of the influence of the overbought–oversold herding indices for QFIIs on subsequent abnormal returns.

The remainder of this article is organized as follows. Section 3 discusses research methods that include the econometric causality test between abnormal returns of securities and the overbought–oversold herding indexes by QFIIs and testing of the herding effect. Section 4 considers the herding effect, feedback trading, cascading, and the price impact of herding due to overbought–oversold herding indexes for QFIIs. Section 5 concludes this paper.

RESEARCH DESIGN AND METHOD

In this section we discuss the research design and methodology used in the paper. We begin by discussing the data utilized in the empirical tests. Next we discuss how herding behavior and abnormal returns are measured. Finally, we discuss impact of herding on stock price.

Data

The data analyzed in this study are the monthly individual stock returns of companies listed on TSEC (Taiwan Stock Exchange Corporation), weighted stock index returns, and the buying and selling numbers and dollar amounts for QFIIs between January 2002 and December 2007. There are 45,421 observations that were computed by the numbers of stocks listed in each month from 2002-2007 in our data. These data were further transformed into abnormal returns for individual stocks, overbought herding measure, oversold herding measure, and overbought–oversold in dollar ratio by QFIIs. Because no data exist for the buying and selling numbers and dollar amounts of QFIIs prior to 2002, it is impossible to transform relevant herding measures. Data are sourced from the Taiwan Economic Journal Data Bank. Returns on individual stocks are calculated for each month, while QFII's trading numbers and dollar amounts are derived from each trading day and accumulate until the end of each month. If the net trading accumulation of a particular stock by one of the QFIIs in a month is positive (negative), then that QFIIs is counted towards the buying (selling) numbers. To create sufficient restraints to formulate a meaningful QFII's herding calculation, this study follows the definition provided by Borensztein and Gaston (2003) in herding measures, which calculates only the overbought and oversold herding measures for individual shares of QFII's trading numbers that exceed five per month and calculates only the overbought–oversold in dollar ratio for individual shares of QFIIs for which the incoming or outgoing dollar amounts exceeded 3% of the total dollar amount to improve the credibility of the sample data.

Measure of Herding by QFII and Abnormal Returns

With regard to quantifying the herding degree of trading numbers among QFIIs, this study primarily cites indices of Wermers (1999) buy herding measure ($BHM_{i,t}$) and sell herding measure ($SHM_{i,t}$) to divide the shares into two categories: the buy herding measure that is greater than the expectation ratio of the buying number by QFIIs and the sell herding measure that is lower than that for any given month(s). The two categories of stocks are further sorted to select stock with greater herding values (the overbought herding measure and the oversold herding measure) according to the values of two separate indexes. The positioning and meaning of the herding measures described in this study are used to explore whether QFIIs move in the same direction more often than any individual QFII would expect if they independently and randomly traded. This article makes use of the buy and sell herding measures of Wermers (1999), vesting the directional characteristics of QFII's herding movement. Because the two herding measures can clearly indicate the existence of a "mutual" phenomenon of movement in the same direction among QFIIs, they can capture differences in the change in share ownership by QFIIs; this is known as the "reversely balancing" phenomenon, where the increase is matched by a reduction in share ownership by other investors. Moreover, when $BHM_{i,t}$ ($SHM_{i,t}$) is significantly greater than 0, the trading in stock *i* by QFIIs over a given period of *t* month(s) has a herding tendency towards the buyer (seller) relative to the average trading on all stocks; when the $BHM_{i,t}$ ($SHM_{i,t}$) increases, the measure for the degree of buying (selling) herding among QFIIs becomes more pronounced. The buy herding measure $BHM_{i,t}$ and sell herding measure $SHM_{i,t}$ expanded in this study are explained as follows:

$$BHM_{i,t} = HM_{i,t} / p_{i,t} > E[p_{i,t}] , \quad (1)$$

$$SHM_{i,t} = HM_{i,t} / p_{i,t} < E[p_{i,t}] , \quad (2)$$

$$HM_{i,t} = |p_{i,t} - E[p_{i,t}]| - E|p_{i,t} - E[p_{i,t}]| \quad (3)$$

$$p_{i,t} = \frac{B_{i,t}}{B_{i,t} + S_{i,t}} , \quad (4)$$

where $p_{i,t}$ is the proportion of all QFIIs trading stock *i* over *t* month(s) that are buyers, and $E[p_{i,t}]$ is the expected proportion of all QFIIs who are buyers over *t* month(s) in all traded stocks. An adjusting factor $E|p_{i,t} - E[p_{i,t}]|$ is then subtracted to allow for random variation around the expected value of $\left|\frac{B_{i,t}}{B_{i,t} + S_{i,t}} - E[p_{i,t}]\right|$ under the null hypothesis of no herding by QFIIs. Since $B_{i,t}$ follows a binomial distribution with probability $E[p_{i,t}]$ of success, $E|p_{i,t} - E[p_{i,t}]|$ is easily calculated given $E[p_{i,t}]$ and the number of QFIIs active in that stock over the given *t* month(s).

$$E|p_{i,t} - E[p_{i,t}]| = \sum_{k=0}^{n_{i,t}} \left[\left| \frac{k}{n_{i,t}} - E[p_{i,t}] \right| * C_k^{n_{i,t}} (E[p_{i,t}])^k (1 - E[p_{i,t}])^{n_{i,t}-k} \right] \quad (5)$$

Among them, $n_{i,t}$: the total trading numbers ($B_{i,t} + S_{i,t}$) of QFIIs active in given *t* month(s) on *i* stock. $C_k^{n_{i,t}}$: All the possible associative numbers of selecting k objects from n objects. Such a factor can adjust the difference caused by trading numbers. The factor will be close to 0 significantly greater than 0) if QFII's trading numbers increase (decrease) on any one stock *i*; however, given that Borensztein and Gaston (2003) consider that traded numbers of stocks are frequent and focused in one direction, there may be a greater traded dollar amount in the direction with less trade. The result of the dollar ratio of Lakonishok et al. (1992), which is one measure of excess demand, may be different from those of the buy or sell herding measures of Wermers (1999). In the event of arranging the stocks traded by QFIIs in given month(s) according to the size of the ratio, the stocks with a greater order can be considered as overbought stocks in dollar amounts by QFIIs in given month(s); in contrast, the stocks with a smaller order can be designated as stocks that are oversold in that group. As such, this article considers the measure of dollar ratio traded by QFIIs to be an additional institutional herding index used to obtain more complete information. We define the operation of the dollar ratio as follows:

$$DR_{it} = \frac{Inflow_{it} - Outflow_{it}}{Inflow_{it} + Outflow_{it}} \quad (6)$$

Among them, the inflow (outflow) is the dollar value where QFIIs increase (decrease) their holdings in stock *i* during a given *t* month(s).

In general, if $BHM_{i,t}$ ($DR_{i,t}$) is sorted into a greater positive value, it means that share *i* during *t* month(s) is categorized by the numbers (dollar amount) as a stock that is consistently overbought, or positive herding among QFIIs. In contrast, if $SHM_{i,t}$ ($DR_{i,t}$) is sorted as a greater positive value (negative value), it means that share *i* during *t* month(s) is categorized by the numbers (dollar amount) as a stock consistently oversold, or negative herding. The abnormal return of individual stock *i* for a given *t* month(s) is initially calculated based on a capital asset pricing model:

$$r_i^a = \left(r_{i,t1} - r_{f,t1}\right) - \beta_i \left(r_{m,t1} - r_{f,t1}\right) \qquad t1 = -11, \ldots, 0 \tag{7}$$

$r_{i,t1}$ is the monthly return for individual stock i in this month and past eleven months; $r_{f,t1}$ is the risk-free rate in this month and past eleven months, which is the interest rate for a one-month term deposit offered by Taiwan First Bank; $r_{m,t1}$ is the change ratio of net value of TAIEX in this month and past eleven months.

This study employs the buy-and-hold method to calculate equally weighted buy-and-hold abnormal returns of stocks in overbought and oversold portfolios for each formation period during the test period. The average monthly buy-and-hold abnormal return at point T for a holding of k month(s) for each portfolio ($BR_{T,K}$ and $SR_{T,K}$) is then computed as follows:

$$BR_{T,k} = \left[\prod_{t=1}^{k} [1 + \frac{1}{B_T} \sum_{i=1}^{B_T} (r_{iB,T+t}^a)] - 1 \right] / k \tag{8}$$

$$SR_{T,k} = \left[\prod_{t=1}^{k} [1 + \frac{1}{S_T} \sum_{i=1}^{S_T} (r_{iS,T+t}^a)] - 1 \right] / k \tag{9}$$

B_T : Share number of overbought portfolio; S_T : share number of oversold portfolio;
$r_{iB,T+t}^a$ is the abnormal return of stock *i* of the overbought portfolio at T + *t*; $r_{iS,T+t}^a$ is the abnormal return of stock *i* of the oversold portfolio at T + *t*.

QFII's Herding Effect, Feedback Trading and Herding Impacting Price

This study extends the definition of the relative importance of institutional herding proposed by Nofsinger and Sias (1999), which in this study is termed the herding effect. If a positive (negative) relationship exists between the herding value of stocks with the overbought (oversold) herding measure by QFIIs and stock returns of the same interval, there is a buying (selling) force in the numbers among QFIIs. On the contrary, there is a buying (selling) force in the numbers among QFIIs. For the same reason, if a positive relationship exists between the herding value of the stocks with the overbought (oversold) in dollar ratio by QFIIs and stock returns of the same interval, there is a dollar increase (decrease) force by QFIIs in the given stocks. In contrast, there is a dollar increase (decrease) force exerted by QFIIs on the given stocks.

The research design of this article separately sorts the stocks of all listed companies into three (five) portfolios based on the degree of the buy and sell herding measures (in dollar ratio) for QFIIs to select stocks that are overbought–oversold.[3] If testing reveals the same (opposite) directional movement between the herding values of stocks with the overbought (oversold) herding measure or overbought–oversold in dollar ratio and abnormal returns for the same interval, we infer the existence of a herding effect among QFIIs. It may reflect the fact that stocks with the overbought-oversold herding indices of QFIIs reach a greater level on positive feedback trading. Alternatively, it may be because stocks with the overbought-oversold herding indices of QFIIs have a greater positive effect on the price. Thus, this study uses the widely accepted Granger causality test (Granger, 1969) to explore whether herding effects on the number and dollar amounts by QFIIs result from their positive feedback trading or the price-impact of their herding. Subsequently, we explore whether there are evidently positive or negative feedback trading and cascading in the number and dollar amounts traded by QFIIs. Finally, we evaluate whether other investors can positively or negatively follow the stocks of overbought/oversold herding measure and overbought/oversold in dollar ratio by QFIIs and for how long they should be followed to obtain optimal performance.

In addition, this study revises the cross-sectional weighted regressions of Jones and Winters (1999) by including QFIIs' overbought (oversold) herding measure (or dollar ratio) and abnormal returns to strengthen the examination of QFIIs' herding effect, feedback trading, cascading, and herding price impact. Equations (10-1) and (10-2) are the cross-sectional weighted regressions for testing QFIIs' herding effect.

$$R^a_{0-t} = \alpha_0 + \alpha_1 BHM^+_{0-t} + \alpha_2 SHM^+_{0-t} \tag{10-1}$$

$$R^a_{0-t} = \beta_0 + \beta_1 DR_{0-t} \tag{10-2}$$

R^a_{0-t} is the abnormal return in herding t month(s). BHM^+_{0-t} (SHM^+_{0-t}) is the overbought (oversold) herding measure among QFIIs in herding t month(s), and DR_{0-t} is the dollar ratio among QFIIs in herding t month(s).

Equations (11-1), (11-2), and (11-3) are the cross-sectional weighted regressions for testing QFIIs' feedback trading and cascading.

$$BHM^+_{0-t} = \alpha_0 + \alpha_1 BHM^+_{-t1-0} + \alpha_2 SHM^+_{-t1-0} + \alpha_3 R^a_{-t1-0} \tag{11-1}$$

$$SHM^+_{0-t} = \beta_0 + \beta_1 BHM^+_{-t1-0} + \beta_2 SHM^+_{-t1-0} + \beta_3 R^a_{-t1-0} \tag{11-2}$$

$$DR_{0-t} = \gamma_0 + \gamma_1 DR_{-t1-0} + R^a_{-t1-0} \tag{11-3}$$

R^a_{-t1-0} is the abnormal returns for pre-herding *t1* month(s). BHM^+_{-t1-0} (SHM^+_{-t1-0}) is pre-herding *t1*-month(s) overbought (oversold) herding measure among QFIIs, and DR_{-t1-0} is the pre-herding *t1* month(s) dollar ratio of QFIIs.

Equations (12-1) and (12-2) are the cross-sectional weighted regressions for testing the price impact of QFII's herding.

$$R^a_{t-t2} = \alpha_0 + \alpha_1 BHM^+_{0-t} + \alpha_2 SHM^+_{0-t} \tag{12-1}$$

$$R^a_{t-t2} = \beta_0 + \beta_1 DR^+_{0-t} + \beta_2 DR^-_{0-t} \tag{12-2}$$

R^a_{t-t2} is post-herding t2-month(s) abnormal return(s). BHM^+_{0-t} (SHM^+_{0-t}) is the overbought (oversold) herding measure among QFIIs in herding t month(s), and DR^+_{0-t} (DR^-_{0-t}) is the overbought (oversold) dollar ratio of QFIIs in herding t month(s).

In summary, the test of the existence of a herding effect on QFII's numbers or dollar amounts is equal to the tests of the existence of a clearly positive (negative) relation between the mean herding value of stocks with the overbought herding measure BHM^+_{0-t} (oversold herding measure SHM^+_{0-t}) or overbought–oversold in dollar ratio DR^+_{0-t}, DR^-_{0-t} of QFIIs and abnormal returns of securities in the same interval R^a_{0-t}. If feedback trading exists among QFIIs, the previous abnormal returns R^a_{-t1-0} will clearly and positively (negatively) affect BHM^+_{0-t} (SHM^+_{0-t}) or DR^+_{0-t}, DR^-_{0-t} of QFIIs. If the herding among

QFIIs positively drives prices, BHM^{+}_{0-t} (SHM^{+}_{0-t}) or $DR^{+}_{0-t}, DR^{-}_{0-t}$ of QFIIs will clearly and positively (negatively) affect abnormal returns for the next period R^{a}_{t-t2} ; otherwise, there exists herding among QFIIs that negatively drives prices.

EMPIRICAL RESULTS

This section presents the empirical results. This section is organized as follows. First, the herding effect is discussed. Next we examine results that distinguish between feedback trading and the price impact of herding. The following section examines feedback trading and cascading. The final part of this section examines momentum and contrarian effects on herding measures.

The Herding Effect

Panels B1 and B2 in Table 1 report the time-series averages of the cross-sectional mean abnormal returns measured by the BHM^{+}_{0-t} and SHM^{+}_{0-t} and $DR^{+}_{0-t}, DR^{-}_{0-t}$ by QFIIs, respectively, over one, two, three, and six herding month(s). The T statistics are based on the standard errors used by Fama-MacBeeth (1973) (the time-series standard errors of each monthly cross-sectional mean). The empirical results clearly reveal that regardless of how many months the herding lasts, clearly positive relations are present between the BHM^{+}_{0-t} or SHM^{+}_{0-t} by QFIIs and R^{a}_{0-t} over the herding month(s), and that these numbers are all statistically significant. For the overbought herding measure over one, two, three and six months by QFIIs, the average abnormal returns of firms with the greatest herding degree should be 4.917%, 3.263%, 2.570%, and 2.099%, respectively; for the oversold herding measure over the same interval, the average abnormal returns of firms with the greatest herding degree should be 1.804%, 1.392%, 1.713%, and 1.824%, respectively. That is, the buying force in the numbers among QFIIs is more important than the selling force. The reason for this is either that positive feedback trading of stocks with the BHM^{+}_{0-t} (SHM^{+}_{0-t}) by QFIIs reaches (cannot reach) a greater degree or that the stocks with their BHM^{+}_{0-t} (SHM^{+}_{0-t}) positively (cannot positively) affect price to a greater extent. Moreover, there exists a significantly positive relationship between $DR^{+}_{0-t}, DR^{-}_{0-t}$ by QFIIs and R^{a}_{0-t} over the herding month(s).

For the overbought in dollar ratio over one, two, three and six months by QFIIs, the average abnormal returns of firms with the smallest herding degree should be –3.217%, –1.802%, –1.144%, and –2.031%, respectively, whereas the average abnormal returns of firms with the greatest herding degree should be 4.490%, 2.294%, 1.767%, and 1.268%, respectively. The dollar increase and decrease force exerted by QFIIs in the given stocks are all important. The reason could be that the positive feedback trading by stocks overbought /oversold in dollar ratio by QFIIs reaches a greater extent or that the stocks overbought/oversold in dollar ratio positively affect the price to a greater degree. In addition, Panels C1 and C2 in Table 1 show the results of regressing the average R^{a}_{0-t} over herding month(s) on the BHM^{+}_{0-t} , SHM^{+}_{0-t} and DR_{0-t} by QFIIs. The α_1 and α_2 coefficients on the BHM^{+}_{0-t} and SHM^{+}_{0-t} are significantly positive, revealing that stocks with greater average abnormal returns experience a greater overbought herding measure and oversold herding measure by QFIIs. The positive β_1 coefficient for the DR_{0-t} by QFIIs shows that the stocks with greater average abnormal returns experience a greater dollar ratio by QFIIs. On the basis of regression, however, we are still unable to determine whether the overbought herding measure, oversold herding measure, and overbought/oversold in dollar ratio by QFIIs are due to or caused by the average abnormal returns; rather, further testing is required to determine whether feedback trading or herding impacting price on these herding measures by QFIIs has a greater impact.

Table 1: The Herding abnormal Returns of BHM^{+}_{0-t}, SHM^{+}_{0-t}, DR^{+}_{0-t}, and DR^{-}_{0-t} by QFIIs

	BHM^{+}_{0-1}	SHM^{+}_{0-1}	BHM^{+}_{0-2}	SHM^{+}_{0-2}	BHM^{+}_{0-3}	SHM^{+}_{0-3}	BHM^{+}_{0-6}	SHM^{+}_{0-6}
Panel A1: The BHM^{+}_{0-t} and SHM^{+}_{0-t} of stocks Traded by QFII								
HM_{0-t} t=1,2,3,6	0.148	0.155	0.121	0.125	0.113	0.111	0.095	0.104
Panel B1: Herding Monthly Abnormal Returns (in percent)								
t=1,2,3,6	4.917	1.084	3.263	1.392	2.570	1.713	2.099	1.824
t-value	(10.71***)	(6.51***)	(12.34***)	(12.21***)	(11.66***)	(15.51***)	(11.30***)	(10.73***)

Panel C1: Regressing Herding Returns on the BHM^{+}_{0-1} and $SHM^{+}_{t=1}$ of Stocks Traded by QFII

	α_0	α_1	α_2	F-statistic	R^2
t=0 to 1	0.614	8.353	5.887	0.830	0.048
t-value	(0.849)	(5.756***)	(1.820*)		

	DR^{+}_{0-1}	DR^{-}_{0-1}	F-statistic	DR^{+}_{0-2}	DR^{-}_{0-2}	F-statistic
Panel A_2: The DR^{+}_{t} and DR^{-}_{t} of stocks Traded by QFII						
DR_{0-t} t=1,2	0.658	-0.721	10.158***	0.758	-0.655	6.850***
Panel B_2: Herding Monthly Abnormal Returns (in percent)						
t=1,2	4.490	-3.217	18.204***	2.294	-1.802	9.521***
t-value	(7.25***)	(-6.31***)		(6.42***)	(-4.73***)	

	DR^{+}_{0-3}	DR^{-}_{0-3}	F-statistic	DR^{+}_{0-6}	DR^{-}_{0-6}	F-statistic
Panel A3: The DR^{+}_{0-t} and DR^{-}_{0-t} of stocks Traded by QFII						
DR_{0-t} t=3,6	0.674	-0.611	7.734***	0.617	-0.658	8.052***
Panel B3: Herding Monthly Abnormal Returns (in percent)						
t=3,6	1.767	-1.144	9.215***	1.268	-2.031	11.325***
t-value	(7.45***)	(-3.93***)		(6.22***)	(-8.62***)	

Panel C2: Regressing Herding Returns on the DR_{0-1} of Stocks Traded by QFII

	β_0	β_1	F-statistic	R^2
t=0 to 1	0.962	8.244	1.488	0.042
t-value	(1.52)	(11.09***)		

Each one (two, three, or six) herding month (months), all listed firms are sorted into three portfolios based on the "buy herding measure," $BHM_{0-t=1,2,3,\,or\,6}$, "sell herding measure," $SHM_{0-t=1,2,3,\,or\,6}$ of individual stocks traded by QFIIs separately. In same herding interval, all listed firms are sorted into five portfolios based on the "dollar ratio", $DR_{0-t=1,2,3,\,or\,6}$ of individual stocks traded by QFIIs. Panel A_1 and B_1 are the time-series average of the monthly cross-sectional mean of the overbought and oversold herding measure by QFIIs (BHM^{+}_{0-t} and SHM^{+}_{0-t}) and the corresponding abnormal returns for the portfolio of the biggest average in BHM_{0-t} and SHM_{0-t}. Panel A_2 and B_2 are time-series average of the monthly cross-sectional mean of the overbought and oversold in dollar ratio (DR^{+}_{0-t} and DR^{-}_{0-t}) by QFIIs and the corresponding abnormal returns for the portfolio of the biggest and smallest average in DR_{0-t}. The regression models of Panel C_1 and C_2 are presented as below: $R^{a}_{0-1}=\alpha_0+\alpha_1 BHM^{+}_{0-1}+\alpha_2 SHM^{+}_{0-1}$ and $R^{a}_{0-1}=\beta_0+\beta_1 DR_{0-1}$. R is the mean abnormal return in the herding month t(=1). BHM^{+}_{0-1} (SHM^{+}_{0-1}) is the monthly cross-sectional mean of the overbought (oversold) herding measure traded by QFII in the herding month (t=1). DR_{0-1} is the monthly cross-sectional mean of the dollar ratio traded by QFII in the herding month (t=1). The F-statistic is based on the null hypothesis that the time-series averages of cross-sectional means do not differ across the portfolios of the overbought and oversold in dollar ratio (DR^{+}_{0-t} and DR^{-}_{0-t}).

Distinguishing Feedback Trading from Price Impacting of Herding

We employ the Granger causality test to assess the relation between the average herding values of the BHM^{+}_{0-t}, SHM^{+}_{0-t}, or DR^{+}_{0-t}, DR^{-}_{0-t} and the corresponding average R^{a}_{0-t}. First, we separately perform an ADF test on the origin or post-difference series of the average herding values of the stocks under each herding measure and interval and the corresponding average abnormal returns to ensure that these series are stationary or transform the series to stationary. The testing reveals that the ADF statistics in most of these variable sequences do not exist in the unit root after taking the difference. Thereafter, this study uses these stationary variables to conduct the Granger causality test. With regard to the lag period, this study uses the shorter of the lag periods chosen by AIC and SBIC to perform an examination of the model. The analytical results in Table 2 show that one or two lags will minimize the values of the information criteria under each herding measure and interval. Thus, we use the optimal one or two lags to evaluate the degree of causation between the average herding values and the corresponding average abnormal returns.

In Panel A of Table 2, under the null hypothesis that the corresponding average R^{a}_{0-1} (average herding value BHM^{+}_{0-1}) of the one-month overbought herding measure by QFIIs will not affect the average herding value BHM^{+}_{0-1} (average R^{a}_{0-1}), the p-value of the F statistic is smaller than 0.1% (5%), demonstrating a mutual causation between BHM^{+}_{0-1} and the corresponding R^{a}_{0-1}, in which the effect of the feedback trading of R^{a}_{0-1} on BHM^{+}_{0-1} is especially clear. The p-values of the remaining F statistics in Panel A, however, do not reach the 10% significance level, indicating a lack of causation between the average herding values BHM^{+}_{0-t} by QFIIs in other intervals and the corresponding average R^{a}_{0-t}. In addition, the corresponding p-values for all F statistics in Panel B consistently fail to reach the 10% significance level, indicating a lack of mutual causation between the average herding values of the short- to long-term SHM^{+}_{0-t} by QFIIs and the corresponding average R^{a}_{0-t}.

In Panel C, under the null hypothesis where the average herding values of the DR^{+}_{0-1}, DR^{+}_{0-2}, and DR^{+}_{0-3} (DR^{+}_{0-6}) by QFIIs do not affect the corresponding average R^{a}_{0-1}, R^{a}_{0-2}, and R^{a}_{0-3} (R^{a}_{0-6}), the p-values of the F statistics are less than 5% or 10% (greater than 10%). This reveals a causation of the price impact of QFII's herding where DR^{+}_{0-1}, DR^{+}_{0-2}, and DR^{+}_{0-3} (DR^{+}_{0-6}) have (do not have) an significant impact on the corresponding average R^{a}_{0-1}, R^{a}_{0-2}, and R^{a}_{0-3} (R^{a}_{0-6}). In Panel D, however, under the null hypothesis in which the average R^{a}_{0-2} and R^{a}_{0-6} (R^{a}_{0-1} and R^{a}_{0-3}) of the oversold in dollar ratio over do not affect the corresponding average herding values of the DR^{-}_{0-2} and DR^{-}_{0-6} (DR^{-}_{0-1} and DR^{-}_{0-3}) by QFIIs, the p-values of the F statistics are less (greater) than 10%. This indicates a causation of feedback trading where R^{a}_{0-2} and R^{a}_{0-6} have a clear impact on the corresponding DR^{-}_{0-2} and DR^{-}_{0-6}, while there exists no significant correlation between DR^{-}_{0-1} and R^{a}_{0-1} or between DR^{-}_{0-3} and R^{a}_{0-3}.

For the Taiwan stock market, our results reveal that the herding effect between BHM^{+}_{0-1} by QFIIs and the corresponding average R^{a}_{0-1} primarily results from their positive feedback trading. There is no causation between the average herding values of the short-, mid-, and long-term SHM^{+}_{0-t} and the corresponding average R^{a}_{0-t}; this is consistent with the reduced importance of the selling force in numbers among QFIIs and the non-existence of the herding effect. Moreover, the herding effects between DR^{+}_{0-1}, DR^{+}_{0-2}, and DR^{+}_{0-3} by QFIIs and the corresponding average R^{a}_{0-1}, R^{a}_{0-2}, and R^{a}_{0-3} are primarily caused by the effect of their overbought in dollar ratio on abnormal returns. We found, however, that the herding effects between DR^{-}_{0-2} and DR^{-}_{0-6} by QFIIs and the corresponding average R^{a}_{0-2} and R^{a}_{0-6} are caused primarily by their positive feedback trading. More importantly, the above results clearly show that in the Taiwan stock market, positive feedback trading by QFIIs is more pronounced for stocks of the short-term overbought herding measure and longer-term oversold in dollar ratio by QFIIs, whereas the price impact of QFII's herding is clearly evident for stocks of the short-mid-term overbought in dollar ratio.

Feedback Trading and Cascading

The results shown in Panels A1-A4 in Table 3 show that QFIIs prefer to overbuy stocks that have had clearly positive abnormal returns in the pre-herding one, two, three, and six months; however, they prefer to oversell stocks that have had more pronounced positive abnormal returns in all of the pre-herding periods. QFIIs consistently focus on positive feedback trading of stocks with their overbought herding measure, while they focus on negative feedback trading of stocks with their oversold herding measure. In addition, the results in Panels B1-B4 of Table 3 show that QFIIs strongly prefer to overbuy (oversell) the stocks that have had significantly positive (negative) average returns in the pre-herding period. This indicates that positive feedback trading with the overbought/oversold in dollar ratio is more significant. Based on the three-month overbought (oversold) herding measure, QFIIs tend to overbuy (oversell) the stocks in the pre-herding one, two, three, and six months where the average abnormal returns attain 1.703% (2.201%), 1.444% (2.054%), 1.138% (2.034%), and 1.158% (1.969%), respectively. Based on the one-month overbought (oversold) in dollar ratio, QFIIs tend to overbuy (oversell) stocks where the average abnormal returns in the pre-herding one, two, three, and six months attain 1.794% (–0.538%), 1.246% (–0.655%), 0.402% (–0.360%), and –0.124% (–0.747%), respectively. The results of overbought herding measure and overbought in dollar ratio both indicate that the shorter the observation period prior to trading, the larger the required average abnormal returns for which QFIIs overbuy; nevertheless, negative (positive) feedback trading of stocks with QFII's SHM^{+}_{0-3} (DR^{-}_{0-6}) is the most obvious.

The results in Panels C1 and C2 of Table 3 reveal that in terms of BHM^{+}_{0-1}, SHM^{+}_{0-1}, and DR^{+}_{0-1}, DR^{-}_{0-1}, QFIIs prefer to overbuy (oversell) the stocks which they have overbought (oversold) the previous month. Most importantly, QFII's cascades are obvious regardless of their numbers or dollar amount. Panes D1 and D2 in Table 3 show the results of regressing QFII's BHM^{+}_{0-1} (SHM^{+}_{0-1}) simultaneously on BHM^{+}_{-1-0}, SHM^{+}_{-1-0}, and R^{a}_{-1-0}. The significantly positive $\alpha_1(\beta_2)$ coefficient of BHM^{+}_{-1-0} (SHM^{+}_{-1-0}) is greater than the significantly negative $\alpha_2(\beta_1)$ coefficient of SHM^{+}_{-1-0} (BHM^{+}_{-1-0}), implying that at least for herding over one month, QFIIs tend toward to cascade on the numbers. In addition, the analytical results in Panel D3 by simultaneously regressing QFII's one-month DR_{0-1} on the previous one-month DR_{-1-0} and R^{a}_{-1-0} reveal that the coefficient γ_1 of DR_{-1-0} is a clearly positive value, meaning that QFIIs clearly prefer to cascade on the dollar amount. Furthermore, the insignificant coefficient of R^{a}_{-1-0} reveals that, corresponding to the weakness of feedback trading by QFIIs, the impact of QFII's cascades on the numbers and dollar amount is significantly greater. The analytical results are inconsistent with the findings of Jones and Winters (1999), who stated that institutional investors would more evidently undertake positive feedback trading than cascades, but the results are consistent with those of Lu, Wong and Fang (2007), exploring the feedback trading and cascades of the three major institutional investors in the Taiwan stock market based on share ownership adjustment of institutional investors. The analytical results of this study reflect learning and imitation among foreign institutional investors.

Table 2: Causation between BHM^+_{0-t}, SHM^+_{0-t}, DR^+_{0-t} or DR^-_{0-t} and Abnormal Returns

Null Hypothesis	Lag Period	AIC/SBIC	F-statistic	p-value
Panel A: Examine if There Is a Granger Cause Relationship between R^a_{0-t} and BHM^+_{0-t} by QFII				
R^a_{0-1} does not Granger Cause BHM^+_{0-1}	2	AIC: 1.854	9.5010	0.0007***
BHM^+_{0-1} does not Granger Cause R^a_{0-1}		SBIC: 2.308	3.4924	0.0443**
R^a_{0-2} does not Granger Cause BHM^+_{0-2}	2	AIC: 1.021	0.0337	0.9669
BHM^+_{0-2} does not Granger Cause R^a_{0-2}		SBIC: 1.479	0.1711	0.8436
R^a_{0-3} does not Granger Cause BHM^+_{0-3}	1	AIC: 0.162	0.5851	0.4505
BHM^+_{0-3} does not Granger Cause R^a_{0-3}		SBIC: 0.437	1.2058	0.2812
R^a_{0-6} does not Granger Cause BHM^+_{0-6}	1	AIC: -2.187	0.8999	0.3515
BHM^+_{0-6} does not Granger Cause R^a_{0-6}		SBIC: -1.905	0.0074	0.9322
Panel B: Examine if There Is a Granger Cause Relationship between R^a_{0-t} and SHM^+_{0-t} by QFII				
Null Hypothesis	Lag Period	AIC/SBIC	F-statistic	p-value
R^a_{0-1} does not Granger Cause SHM^+_{0-1}	1	AIC: 1.967	0.4952	0.4867
SHM^+_{0-1} does not Granger Cause R^a_{0-1}		SBIC: 2.233	1.6275	0.2112
R^a_{0-2} does not Granger Cause SHM^+_{0-2}	1	AIC: 0.067	0.2401	0.6276
SHM^+_{0-2} does not Granger Cause R^a_{0-2}		SBIC: 0.336	0.0816	0.7770
R^a_{0-3} does not Granger Cause SHM^+_{0-3}	1	AIC: 0.128	0.2165	0.6452
SHM^+_{0-3} does not Granger Cause R^a_{0-3}		SBIC: 0.403	0.3809	0.5419
R^a_{0-6} does not Granger Cause SHM^+_{0-6}	1	AIC: -1.859	0.0185	0.8930
SHM^+_{0-6} does not Granger Cause R^a_{0-6}		SBIC: -1.576	0.3868	0.5394
Panel C: Examine if There Is a Granger Cause Relationship between R^a_{0-t} and DR^+_{0-t} by QFII				
Null Hypothesis	Lag Period	AIC/SBIC	F-statistic	p-value
R^a_{0-1} does not Granger Cause DR^+_{0-1}	1	AIC: 5.647	0.7655	0.3881
DR^+_{0-1} does not Granger Cause R^a_{0-1}		SBIC: 5.913	6.9464	0.0128**
R^a_{0-2} does not Granger Cause DR^+_{0-2}	2	AIC: 4.062	1.5727	0.2259
DR^+_{0-2} does not Granger Cause R^a_{0-2}		SBIC: 4.334	2.8451	0.0756*
R^a_{0-3} does not Granger Cause DR^+_{0-3}	1	AIC: 2.647	0.6267	0.4350
DR^+_{0-3} does not Granger Cause R^a_{0-3}		SBIC: 2.921	6.4281	0.0169**
R^a_{0-6} does not Granger Cause DR^+_{0-6}	1	AIC: 1.424	0.0008	0.9780
DR^+_{0-6} does not Granger Cause R^a_{0-6}		SBIC: 1.706	0.9886	0.3293
Panel D: Examine if There Is a Granger Cause Relationship between R^a_{0-t} and DR^-_{0-t} by QFII				
Null Hypothesis	Lag Period	AIC/SBIC	F-statistic	p-value
R^a_{0-1} does not Granger Cause DR^-_{0-1}	1	SBIC: 7.085	0.1857	0.6695
DR^-_{0-1} does not Granger Cause R^a_{0-1}			1.4040	0.2451
R^a_{0-2} does not Granger Cause DR^-_{0-2}	1	SBIC: 5.144	3.0027	0.0934*
DR^-_{0-2} does not Granger Cause R^a_{0-2}			0.5711	0.4557
R^a_{0-3} does not Granger Cause DR^-_{0-3}	1	AIC: 3.405	0.3324	0.5687
DR^-_{0-3} does not Granger Cause R^a_{0-3}		SBIC: 3.681	0.5988	0.4453
R^a_{0-6} does not Granger Cause DR^-_{0-6}	1	AIC: 1.640	3.6798	0.0661*
DR^-_{0-6} does not Granger Cause R^a_{0-6}		SBIC: 1.923	0.3587	0.5544

In Panel A, B, C and D, this study uses the Granger (1969) causality test to identify the causation between the cross-sectional mean of overbought herding measure, oversold herding measure or overbought and oversold in dollar ratio of QFIIs and the cross-sectional mean of abnormal returns in the same herding months separately. Testing if the average $BHM^+_{,t}$ of QFIIs Granger-Cause the average abnormal return, the complete model is $R^a_t = \sum_{j=1}^{p} d_{21,j} BHM^+_{t-j} + \sum_{j=1}^{p} d_{22,j} R^a_{t-j} + \gamma_{2,t}$, and the reduced model is when H_0: $d_{21,1}=d_{21,2}=\ldots\ldots\ldots d_{21,p}=0$. Also, testing if the average abnormal return Granger-Cause the average $BHM^+_{,t}$ of QFIIs, the complete model is $BHM^+_t = \sum_{j=1}^{p} d_{11,j} BHM_{t-j} + \sum_{j=1}^{p} d_{12,j} R^a_{t-j} + \gamma_{1,t}$, and the reduced model is when H_0: $d_{12,1}=d_{12,2}=\ldots\ldots=d_{12,p}=0$. ***, **, and * statistically significant at the 1, 5, and 10 percent levels, respectively.

Table 3: Feedback Trading and Cascading of BHM^{+}_{0-t}, SHM^{+}_{0-t}, DR^{+}_{0-t}, and DR^{-}_{0-t} by QFIIs.

Panel A_1: Pre—Herding 1 Month (SHM^{+}_{0-1} and BHM^{+}_{0-1}) Abnormal Return (in percent)		
Total Period:	SHM^{+}_{0-1}	BHM^{+}_{0-1}
−1 to 0	1.172	1.543
t-value	(6.714***)	(4.365***)
−2 to 0	0.984	1.191
t-value	(6.376***)	(4.926***)
−3 to 0	1.329	0.766
t-value	(13.010***)	(3.397***)
−6 to 0	1.288	0.593
t-value	(17.529***)	(3.255***)
Panel A_2: Pre—Herding 2 Months (SHM^{+}_{0-2} and BHM^{+}_{0-2}) Abnormal Return (in percent)		
Total Period:	SHM^{+}_{0-2}	BHM^{+}_{0-2}
−1 to 0	2.055	1.131
t-value	(8.650***)	(3.926***)
−2 to 0	2.037	0.808
t-value	(10.545***)	(4.089***)
−3 to 0	1.920	0.826
t-value	(11.817***)	(4.700***)
−6 to 0	1.755	1.020
t-value	(14.783***)	(4.918***)
Panel A_3: Pre—Herding 3 Months (SHM^{+}_{0-3} and BHM^{+}_{0-3}) Abnormal Return (in percent)		
Total Period:	SHM^{+}_{0-3}	BHM^{+}_{0-3}
−1 to 0	2.201	1.703
t-value	(8.252***)	(5.561***)
−2 to 0	2.054	1.444
t-value	(10.372***)	(6.399***)
−3 to 0	2.034	1.138
t-value	(14.122***)	(6.206***)
−6 to 0	1.969	1.158
t-value	(17.859***)	(5.703***)
Panel A_4: Pre—Herding 6 Months (SHM^{+}_{0-6} and BHM^{+}_{0-6}) Abnormal Return (in percent)		
Total Period:	SHM^{+}_{0-6}	BHM^{+}_{0-6}
−1 to 0	1.655	1.496
t-value	(9.093***)	(5.149***)
−2 to 0	1.710	1.139
t-value	(12.684***)	(5.139***)
−3 to 0	1.932	1.010
t-value	(14.753***)	(4.819***)
−6 to 0	1.800	1.240
t-value	(13.110***)	(6.123***)

Table 3: Feedback Trading and Cascading of $BHM_{0\text{-}t}$, $SHM_{0\text{-}t}$, $DR^{+}_{0\text{-}t}$, $DR^{-}_{0\text{-}t}$ by QFIIs (Continued).

Panel B1: Pre—Herding 1 Month (DR^{+}_{0-1} and DR^{-}_{0-1}) Abnormal Return (in percent)

Total Period:	DR^{-}_{0-1}	Decile 3	DR^{+}_{0-1}	F-statistic
−1 to 0 t-value	-0.538 (-0.873)	1.521 (2.198**)	1.794 (2.626**)	18.083***
−2 to 0 t-value	-0.655 (-1.577)	0.283 (0.744)	1.246 (2.600**)	12.514***
−3 to 0 t-value	-0.360 (-1.012)	-0.232 (-0.918)	0.402 (1.109)	4.100**
−6 to 0 t-value	-0.747 (-3.147***)	-0.027 (-0.124)	-0.124 (-0.540)	3.236

Panel B₂: Pre—Herding 2 Months (DR^{+}_{0-2} and DR^{-}_{0-2}) Abnormal Return (in percent)

Total Period:	DR^{-}_{0-2}	Decile 3	DR^{+}_{0-2}	F-statistic
−1 to 0 t-value	0.069 (0.120)	1.156 (2.530**)	1.440 (2.626**)	7.002***
−2 to 0 t-value	0.031 (0.066)	1.267 (2.959***)	0.407 (0.863)	3.881*
−3 to 0 t-value	0.186 (0.422)	0.859 (2.275**)	0.255 (0.602)	2.030
−6 to 0 t-value	0.169 (0.682)	0.285 (1.935*)	0.579 (2.097**)	2.956

Panel B₃: Pre—Herding 3 Months (DR^{+}_{0-3} and DR^{-}_{0-3}) Abnormal Return (in percent)

Total Period:	DR^{-}_{0-3}	Decile 3	DR^{+}_{0-3}	F-statistic
−1 to 0 t-value	-0.079 (-0.174)	3.247 (5.297***)	0.608 (1.459)	2.986
−2 to 0 t-value	-0.161 (-0.417)	1.384 (4.627***)	0.813 (2.484**)	3.908*
−3 to 0 t-value	-0.055 (-0.147)	0.794 (3.195***)	0.913 (3.586***)	5.827**
−6 to 0 t-value	0.144 (0.610)	0.609 (2.945***)	0.425 (2.597**)	2.005

Panel B₄: Pre—Herding 6 Months (DR^{+}_{0-6} and DR^{-}_{0-6}) Abnormal Return (in percent)

Total Period:	DR^{-}_{0-6}	Decile 3	DR^{+}_{0-6}	F-statistic
−1 to 0 t-value	-1.588 (-2.334**)	1.873 (4.345***)	1.079 (2.341**)	9.164***
−2 to 0 t-value	-1.297 (-2.969***)	1.498 (4.211***)	0.352 (1.072)	5.123**
−3 to 0 t-value	-0.957 (-2.854***)	1.213 (4.947***)	0.373 (1.410)	2.770
−6 to 0 t-value	-0.765 (-4.000***)	1.253 (5.957***)	0.326 (1.554)	2.854

Table 3: Feedback Trading and Cascading of BHM_{0-t}, SHM_{0-t}, DR^{+}_{0-t}, DR^{-}_{0-t} by QFIIs (Continued).

Panel C1: The BHM^{+}_{-t1-0} and SHM^{+}_{-t1-0} before the BHM^{+}_{0-1} and SHM^{+}_{0-1} of stocks Traded by QFIIs (in percent)

	SHM^{+}_{0-1}	BHM^{+}_{0-1}
-1 to 0 t-value	0.064 (8.428***)	0.038 (10.321***)
-2 to 0 t-value	0.030 (5.756***)	0.030 (9.900***)
-3 to 0 t-value	0.026 (7.019***)	0.031 (13.933***)
-6 to 0 t-value	0.019 (3.215***)	0.028 (11.215***)

Panel C₂: The DR^{+}_{-t1-0} and DR^{-}_{-t1-0} before the DR^{+}_{0-1} and DR^{-}_{0-1} of Stocks Traded by QFIIs (in percent)

	DR^{-}_{0-1}	Decile 3	DR^{+}_{0-1}	F-statistic
-1 to 0 t-value	-0.170 (-6.073***)	0.042 (0.148)	0.054 (2.026**)	6.958***
-2 to 0 t-value	-0.018 (-0.739)	0.044 (0.192)	0.091 (3.519***)	8.123***
-3 to 0 t-value	-0.033 (-1.680*)	0.127 (1.504)	0.114 (4.402***)	9.235***
-6 to 0 t-value	-0.007 (-0.429)	0.014 (0.123)	-0.019 (-1.207)	2.751

Panel D₁: Regressing the BHM^{+}_{0-1} of Stocks Traded by QFIIs on BHM^{+}_{-t1-0}, SHM^{+}_{-t1-0}, and R^{a}_{-t1-0}

	α_0	α_1	α_2	α_3	F-statistic	R^2
-1 to 0 t-value	0.035 (3.397***)	0.301 (14.695***)	-0.290 (-13.053***)	-0.001 (-0.979)	0.963	0.085

Panel D₂: Regressing the SHM^{+}_{0-1} of Stocks Traded by QFII on BHM^{+}_{-t1-0}, SHM^{+}_{-t1-0}, and R^{a}_{-t1-0}

	β_0	β_1	β_2	β_3	F-statistic	R^2
-1 to 0 t-value	0.046 (3.72***)	-0.119 (-9.408***)	0.199 (15.207***)	0.001 (0.552)	1.199	0.104

Panel D₃: Regressing the DR_{0-1} of Stocks Traded by QFIIs on DR_{-t1-0} and R^{a}_{-t1-0}

	γ_0	γ_1	γ_2	F-statistic	R^2
-1 to 0 t-value	-0.001 (-0.226)	0.179 (11.153***)	-0.006 (-0.759)	1.432	0.082

The division method of the portfolios, the test statistics and the choice of the sample period are the same as Table I. In panel A and B, the periods-t1 to 0 (t1= one, two, three and six) indicate the periods between the first, second, third, and sixth month before the herding month to the herding month, respectively. Panel A_1, A_2, A_3 and A_4 report the results of feedback trading in the "overbought herding measure" BHM^{+}_{0-t} and "oversold herding measure" SHM^{+}_{0-t} of individual stocks traded by QFIIs each one (two, three, or six) herding month (months) separately. Panel B_1, B_2, B_3 and B_4 report the results of feedback trading in the overbought and oversold in dollar ratio (DR^{+}_{0-t} and DR^{-}_{0-t}) of individual stocks traded by QFIIs in the same herding interval separately. Panel C_1 and C_2 report the results of cascading in BHM^{+}_{0-t}, SHM^{+}_{0-t}, DR^{+}_{0-t} and DR^{-}_{0-t} by QFIIs in the same herding interval respectively. Panel D_1, D_2 and D_3 are the regression models of cascading and feedback trading in BHM^{+}_{0-t}, SHM^{+}_{0-t} and DR_{0-t}, represented as

$BHM^{+}_{0-1} = \alpha_0 + \alpha_1 BHM^{+}_{-t1-0} + \alpha_2 SHM^{+}_{-t1-0} + \alpha_3 R^{a}_{-t1-0}$, $SHM^{+}_{0-1} = \beta_0 + \beta_1 BHM^{+}_{-t1-0} + \beta_2 SHM^{+}_{-t1-0} + \beta_3 R^{a}_{-t1-0}$ *and*

$DR_{0-1} = \gamma_0 + \gamma_1 DR_{-t1-0} + \gamma_2 R^{a}_{-t1-0}$. ****, **, and * statistically significant at the 1, 5, and 10 percent levels, respectively.*

MOMENTUM AND CONTRARIAN EFFECTS ON HERDING MEASURES

The results in Panels A1, A2, A3, and A4 of Table 4 reveal that with the exception that overreaction of returns exists in those stocks with the BHM^{+}_{0-1} by QFIIs, the stocks with the BHM^{+}_{0-2} , BHM^{+}_{0-3} , and BHM^{+}_{0-6} show an underreaction of returns. These are positive, but the positive abnormal returns begin to reverse after the stocks have been held for six months or so. Overreaction consistently and obviously exists in those stocks with their oversold herding measure. Moreover, the results in Panels B1, B2, B3, and B4 of Table 4 demonstrate that while the post-herding abnormal returns of stocks with the $DR^{+}_{0-1}, DR^{-}_{0-1}$ by QFIIs represent the contrarian effect, those of stocks with their $DR^{+}_{0-2}, DR^{-}_{0-2}$, $DR^{+}_{0-3}, DR^{-}_{0-3}$, $DR^{+}_{0-6}, DR^{-}_{0-6}$ present obvious evidence of the momentum effect. Similar results were obtained in Panels C1, C2, C3, and C4 of Table 4. It is appropriate for other investors to buy the stocks with the BHM^{+}_{0-2} , BHM^{+}_{0-3} by QFIIs and to hold these stocks for three and two months respectively; the average abnormal returns will reach approximately 0.373% and 0.467%. It is also appropriate for other investors to sell those stocks with the BHM^{+}_{0-1} by QFIIs for six months, as the average abnormal returns will amount to approximately 0.527%. If other investors buy the stocks oversold by QFIIs on the numbers and hold for one month, however, the average abnormal returns will reach approximately 2.132%. Our results of the overbought and oversold herding measures by QFIIs are inconsistent with the results obtained by Wermers (1999). This demonstrates that the returns on stocks with the oversold herding measure are superior to those for stocks with overbought herding measure. The first reason is collective overselling among QFIIs in the Taiwan stock market so as to subsequently buy at low prices or anticipate large-scale changes in stock ownership. The second reason is that QFIIs go on arbitrage or hedge in the futures or options markets, ensuring that those stocks oversold by QFIIs in the numbers in the spot market are unable to reach relatively high prices and provide significantly greater abnormal returns in subsequent months.

It is appropriate for other investors to buy those stocks with the DR^{+}_{02} , DR^{+}_{03} , and DR^{+}_{06} by QFIIs and to hold them for one month; the average abnormal returns will reach approximately 1.504%, 1.236%, and 2.240%, respectively. It is also appropriate for other investors to sell those stocks with the DR^{+}_{01} by QFIIs and to last for six months; the average abnormal returns will reach approximately 0.729%. If other investors buy the stocks with the DR^{-}_{01} by QFIIs and hold for one month, the average abnormal returns will be maximized, reaching approximately 1.443%. If other investors sell the stocks oversold by QFIIs on the dollar amount over two and three (six) months and last for six (three) months, however, the average abnormal returns will reach approximately 0.998% and 0.475% (1.019%), respectively. The direction of the oversold in dollar ratio that drives prices positively is the opposite to that of the oversold herding measure that drives prices negatively. The reason may be that the stocks oversold by QFIIs on the dollar amount at the mid-to-long-term continuously and significantly exist in the rational herding behaviors of selling at a high price; such herding behaviors tend to generate a momentum effect.

The results in Panel C1 of Table 4 show that for selling (buying) stocks with the BHM^{+}_{01} (SHM^{+}_{01}) by QFIIs and lasting for six (two) months rather than one (one) month, the BHM^{+}_{01} (SHM^{+}_{01}) has a stronger negative impact on post-herding abnormal returns. The results in Panel C2, however, indicate that for buying the stocks with the BHM^{+}_{03} (SHM^{+}_{03}) by QFIIs and holding for two (one) months rather than one or six (two or six) months, the BHM^{+}_{03} (SHM^{+}_{03}) has a stronger positive (negative) impact on post-herding abnormal returns. The results in Panel C3 show that for selling (buying) stocks with the DR^{+}_{01} (DR^{-}_{01}) by QFIIs and lasting for six (one) months rather than one (six) month,

Table 4: Momentum Effects of QFIIs

Panel A_1: Post—Herding 1 Month (SHM^{+}_{0-1} and BHM^{+}_{0-1}) Abnormal Return (in percent)		
	SHM^{+}_{0-1}	BHM^{+}_{0-1}
1 to 2 t-value	2.083 (11.088***)	-0.294 (-1.070)
1 to 3 t-value	1.389 (10.668***)	-0.488 (-2.179**)
1 to 4 t-value	0.919 (6.787***)	-0.357 (-2.057**)
1 to 7 t-value	1.301 (14.688***)	-0.527 (-5.033***)
Panel A_2: Post—Herding 2 Months (SHM^{+}_{0-2} and BHM^{+}_{0-2}) Abnormal Return (in percent)		
	SHM^{+}_{0-2}	BHM^{+}_{0-2}
2 to 3 t-value	2.044 (12.630***)	0.133 (0.573)
2 to 4 t-value	1.221 (6.261***)	0.114 (0.638)
2 to 5 t-value	1.090 (6.375***)	0.373 (2.405**)
2 to 8 t-value	1.292 (4.921***)	-0.079 (-0.064)
Panel A_3: Post—Herding 3 Months (SHM^{+}_{0-3} and BHM^{+}_{0-3}) Abnormal Return (in percent)		
	SHM^{+}_{0-3}	BHM^{+}_{0-3}
3 to 4 t-value	2.210 (15.130***)	0.446 (1.723*)
3 to 5 t-value	0.979 (4.620***)	0.467 (2.818***)
3 to 6 t-value	1.249 (6.717***)	0.346 (2.435**)
3 to 9 t-value	1.239 (4.029***)	-0.167 (-1.679*)
Panel A_4: Post—Herding 6 Months (SHM^{+}_{0-6} and BHM^{+}_{0-6}) Abnormal Return (in percent)		
	SHM^{+}_{0-6}	BHM^{+}_{0-6}
6 to 7 t-value	2.191 (15.774***)	0.368 (1.340)
6 to 8 t-value	1.919 (7.519***)	0.252 (1.300)
6 to 9 t-value	2.011 (10.751***)	0.190 (1.060)
6 to 12 t-value	2.139 (5.880***)	-0.124 (-0.913)

Table 4: Momentum Effects of QFIIs (Continued)

Panel B_1: Post—Herding 1 Month (DR^{+}_{0-1} and DR^{-}_{0-1}) Abnormal Return (in percent)				
	DR^{-}_{0-1}	Decile 3	DR^{+}_{0-1}	F-statistic
1 to 2 t-value	1.443 (1.707*)	0.694 (1.079)	-0.209 (-0.371)	10.821***
1 to 3 t-value	0.490 (1.038)	-0.080 (-0.206)	-0.246 (-0.624)	6.281**
1 to 4 t-value	0.013 (0.058)	-0.425 (-1.332)	-0.487 (-1.752*)	3.937*
1 to 7 t-value	-0.220 (-1.614)	-0.419 (-2.543**)	-0.729 (-5.74***)	1.009
Panel B_2: Post—Herding 2 Months (DR^{+}_{0-2} and DR^{-}_{0-2}) Abnormal Return (in percent)				
	DR^{-}_{0-2}	Decile 3	DR^{+}_{0-2}	F-statistic
2 to 3 t-value	0.538 (0.898)	0.967 (1.905*)	1.504 (2.722***)	7.934***
2 to 4 t-value	-0.323 (-0.723)	0.411 (1.029)	0.622 (1.473)	5.438**
2 to 5 t-value	-0.771 (-2.163**)	0.213 (0.695)	0.815 (2.543**)	6.465**
2 to 8 t-value	-0.998 (-4.227***)	0.650 (4.769***)	1.121 (4.70***)	8.990***
Panel B_3: Post—Herding 3 Months (DR^{+}_{0-3} and DR^{-}_{0-3}) Abnormal Return (in percent)				
	DR^{-}_{0-3}	Decile 3	DR^{+}_{0-3}	F-statistic
3 to 4 t-value	0.036 (0.089)	1.215 (2.594**)	1.236 (2.632**)	3.890*
3 to 5 t-value	0.421 (1.172)	0.811 (2.101**)	0.776 (2.633**)	3.857*
3 to 6 t-value	0.067 (0.198)	0.521 (1.911*)	0.522 (2.310**)	3.872*
3 to 9 t-value	-0.475 (-2.608***)	1.176 (5.999***)	0.072 (0.602)	3.001
Panel B_4: Post—Herding 6 Months (DR^{+}_{0-6} and DR^{-}_{0-6}) Abnormal Return (in percent)				
	DR^{-}_{0-6}	Decile 3	DR^{+}_{0-6}	F-statistic
6 to 7 t-value	0.094 (0.183)	-0.181 (-0.457)	2.240 (5.214***)	6.232**
6 to 8 t-value	-0.725 (-2.135**)	-0.510 (-2.001**)	1.554 (5.295***)	5.548**
6 to 9 t-value	-1.019 (-3.556***)	-0.529 (-2.358**)	1.466 (5.780***)	7.246***
6 to 12 t-value	-0.678 (-2.826***)	-0.429 (-2.239**)	0.952 (7.114***)	5.850**

Table 4: Momentum Effects of QFIIs (Continued)

Panel C_1: Regressing Post—Herding Return on the 1-month Herding Measure by QFII (in percent)					
	α_0	α_1	α_2	F-statistic	R^2
1 to 2 t-value	2.014 (2.982***)	-0.991 (-1.020)	3.884 (4.763***)	1.752	0.079
1 to 3 t-value	1.058 (1.706*)	-1.760 (-1.682*)	2.105 (1.957*)	1.658	0.058
1 to 7 t-value	1.102 (1.599)	-1.982 (-1.750*)	2.034 (1.679*)	1.596	0.046
Panel C_2: Regressing Post—Herding Return on the 3-months Herding Measure by QFII (in percent)					
	α_0	α_1	α_2	F-statistic	R^2
3 to 4 t-value	1.785 (1.905*)	2.126 (2.008**)	5.218 (3.935***)	3.853	0.083
3 to 5 t-value	1.983 (2.034**)	2.997 (2.758***)	2.235 (2.125**)	2.752	0.067
3 to 9 t-value	2.004 (1.986**)	1.650 (1.670*)	3.812 (2.980***)	3.847	0.075
Panel C_3: Regressing Post—Herding Return on the 1-month Dollar Ratio by QFII (in percent)					
	β_0	β_1	β_2	F-statistic	R^2
1 to 2 t-value	3.128 (3.254***)	-1.028 (-1.199)	2.132 (1.988**)	3.958	0.095
1 to 7 t-value	4.051 (2.250**)	2.005 (-1.890*)	-0.518 (-1.09)	3.870	0.087
Panel C_4: Regressing Post—Herding Return on the 6-months Dollar Ratio by QFII (in percent)					
	β_0	β_1	β_2	F-statistic	R^2
6 to 7 t-value	2.435 (2.537**)	4.227 (5.438***)	0.125 (0.170)	5.809	0.112
6 to 9 t-value	2.065 (1.704*)	2.673 (3.745***)	-1.989 (-3.012***)	6.700	0.296

Panel A_1, A_2, A_3 and A_4 report the momentum effects in the "overbought herding measure" BHM^{+}_{0-t} "oversold herding measure" SHM^{+}_{0-t} of individual stocks traded by QFIIs each one (two, three, or six) herding month(s) separately. Panel B_1, B_2, B_3 and B_4 report the momentum effects in the "overbought and oversold in dollar ratio" (DR^{+}_{0-t} and DR^{-}_{0-t}) of individual stocks in the same herding interval respectively. The periods t= one to two (t = one to three), for example, indicate holding or continuing one (two months) after BHM^{+}_{0-1}, SHM^{+}_{0-1}, DR^{+}_{0-1} or DR^{-}_{0-1} of individual stocks traded by QFIIs. Panel C_1, C_2, C_3 and C_4 report the respective results of regressing post-herding mean abnormal return on BHM^{+}_{0-t}, SHM^{+}_{0-t} or DR^{+}_{0-t}, DR^{-}_{0-t} of QFII. Illustrate the regression models of Panel C as below.

Panel C_1: $R^{a}_{1-2} = \alpha_0+\alpha_1 BHM^{+}_{0-1} + \alpha_2 SHM^{+}_{0-1}$

$R^{a}_{1-3} = \alpha_0+\alpha_1 BHM^{+}_{0-1} + \alpha_2 SHM^{+}_{0-1}$

$R^{a}_{1-7} = \alpha_0+\alpha_1 BHM^{+}_{0-1} + \alpha_2 SHM^{+}_{0-1}$

Panel C_2: $R^{a}_{3-4} = \alpha_0+\alpha_1 BHM^{+}_{0-3} + \alpha_2 SHM^{+}_{,0-3}$

$R^{a}_{3-5} = \alpha_0+\alpha_1 BHM^{+}_{0-3} + \alpha_2 SHM^{+}_{,0-3}$

$R^{a}_{3-9} = \alpha_0+\alpha_1 BHM^{+}_{0-3} + \alpha_2 SHM^{+}_{,0-3}$

Panel C_3: $R^{a}_{1-2} = \beta_0+\beta_1 DR^{+}_{0-1} + \beta_2 DR^{-}_{0-1}$

$R^{a}_{1-7} = \beta_0+\beta_1 DR^{+}_{0-1} + \beta_2 DR^{-}_{0-1}$

Panel C_4: $R^{a}_{6-7} = \beta_0+\beta_1 DR^{+}_{0-6} + \beta_2 DR^{-}_{0-6}$

$R^{a}_{6-9} = \beta_0+\beta_1 DR^{+}_{0-6} + \beta_2 DR^{-}_{0-6}$

***, **, and * statistically significant at the 1, 5, and 10 percent levels, respectively.

The overbought / oversold in dollar ratio has a stronger negative impact on post-herding abnormal returns. The results in Panel C4, however, show that or buying (selling) stocks with the DR^{+}_{06} (DR^{-}_{06}) by QFIIs and lasting for one (three) months rather than three (one) months, the overbought / oversold in dollar ratio has a stronger positive impact on post-herding abnormal returns. The analytical results presented in Panels C in Table 4 are largely consistent with those of Panels A and B. Furthermore, the above conclusion is inconsistent with the results of the US stock market undertaken by de Long *et al* (1990). Our results indicate that positive feedback trading by QFIIs in the Taiwan stock market leads to an overreaction, not just when they ignore fundamentals and create systemic pricing errors. For the one-month overbought herding measure or overbought / oversold in dollar ratio by QFIIs, positive feedback trading and overreaction of abnormal returns exist simultaneously. Most importantly, this implies a market inefficiency in the Taiwan stock market for the overbought herding measure, oversold herding measure, and overbought / oversold in dollar ratio by QFIIs; this positively or negatively drives post-herding returns.

CONCLUSION

This study employs the overbought-oversold indices of the buy herding measure and sell herding measure raised by Wermers (1999), and the overbought–oversold indices of dollar-ratio raised by Lakonishok et al. (1992) and Borensztein and Gaston (2003). This requires them to be indexed to measure herding behaviors by QFIIs in the Taiwan stock market in order to extend the study of Nofsinger and Sias (1999) and provide a clear operational definition for the herding effect, feedback trading, cascading, and herding impacting price by QFIIs. The econometric causality test is also invoked to determine whether the herding effect caused by QFIIs overbought–oversold in the Taiwan equity market primarily results from feedback trading or herding impacting price. We confirm the statistical causality direction between the herding behaviors on the numbers or dollar amount by QFIIs and abnormal returns, indicating a connection between the series of studies on feedback trading and momentum strategies in the securities market and related studies on herding behaviors of the numbers and dollar amount by institutional investors.

Empirical investigations reveal an obvious herding effect in the short-term overbought herding measure and longer-term oversold in dollar ratio by QFIIs in the Taiwan securities market. This results primarily from positive feedback trading by QFIIs; however, none of the oversold herding intervals of QFIIs show a herding effect. Moreover, there exits an obvious herding effect in the short- to mid-term overbought in dollar ratio, which results from the momentum effect of abnormal returns caused by QFII's herding. The impact of cascading on the numbers and dollar amount by QFIIs is greater than that of the feedback trading.

This study also demonstrates that except where portfolios with the one-month overbought herding measure by QFIIs drive post-herding abnormal returns in reverse, the stocks with the overbought herding measure over two, three, and six months will positively drive in post-herding abnormal returns. Nevertheless, the oversold herding measure of QFIIs will drive reverse post-herding abnormal returns to positive returns. Our results present that stocks institutional investors selling outperform those they buying in the number traded by QFIIs, which disagrees with the conclusions of U.S. proposed by Wermers (1999). Moreover, stocks with the one-month overbought (oversold) in dollar ratio by QFIIs present a contrarian effect, whereas stocks with the overbought (oversold) in dollar ratio over two, three- and six months display a significant momentum effect. More importantly, empirical results that the overbought herding measure, oversold herding measure, and overbought–oversold in dollar ratio by QFIIs clearly drive returns indicate that the Taiwan equity market is not an efficient market. Investors who positively or reversely follow the signals derived from the numbers and dollar amount of QFIIs in establishing securities portfolios and maintaining proper continuing periods are likely to obtain abnormal returns.

This paper helps in establishing the herding measures of the overbought herding measure, oversold herding measure, and overbought–oversold in dollar ratio to be used in measuring the herding of QFIIs in the Taiwan securities market. It is also revealed that the statistical causality direction between the herding behaviors on the numbers or dollar amounts among QFIIs and the corresponding abnormal returns. Our results confirm that the herding effect of short-term overbought herding measure and longer-term oversold in dollar ratio by QFIIs is mainly a result of positive feedback trading among QFIIs, whereas the herding effect of the short- to mid-term overbought in dollar ratio by QFIIs is primarily the result of "momentum persistence of abnormal returns." Results of this study contribute to studies of herding effect measured by the numbers and dollar amounts of institutional investors; these studies will be integrated with a series of studies on reactions to information on the securities market.

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END NOTES

1. The maximum individual investment for QFIIs investing in the equity market has been adjusted upward from US$50 million in 1991 to US$3 billion in 2001. The number of QFIIs has increased from 227 in 2001 to 536 in 2007. The ratio of trading dollar amounts by all foreign investors to the total trading volume increased from 5.9% in 2001 to 14.9% in June, 2007. These data were provided by the Taiwan Stock Exchange Corporation.
2. Although the number of institutional investors does not directly measure analyst coverage, Arable, A., Carvel, S. and Strobe, P. (1983) pointed out that the number of institutional investors in any one stock is strongly correlated with the number of analysts covering that stock. This is logical because sell-side analysts follow stocks as a service to institutional clients.
3. [3] The number of listed companies in the Taiwan stock market differs from those in the American stock market, and they are divided into no more than five portfolios. As the number of companies listed on the NYSE and NASDAQ stock markets approaches 3000, authors in America prefer to divide them into 10 groups. On the other hand, if we divide these companies into fewer portfolios, the differences among different portfolios may be insignificant.
4. [4] Because parts of the herding measures and the corresponding abnormal returns are negative, we are unable to directly extract the natural logarithm for them; instead, we use the difference or original series in conducting a subsequent ADF test. If these series do not have any unit root before the difference, they are maintained as the original series; otherwise, they are transformed into difference types to ensure the stability of the variable series.

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CORPORATE DISCLOSURES AFTER THE SEPTEMBER 11 TERRORIST ATTACKS

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ABSTRACT

We examine the actions that insurance firms take immediately after the September 11 attacks to reduce information asymmetries. We find that voluntary disclosure behavior is positively related to the magnitude of the September 11-related loss. Conditioning for the loss, disclosure behavior also systematically varies with firm leverage. However, these disclosures do not seem to impact the bid-ask spreads of the disclosing firms, perhaps because of the higher levels of uncertainty related to the extreme nature of the attacks. The study sheds light on the reactions of management during crisis events and the effect (or lack thereof) of such actions on firms' information environment.

JEL: G14, G22, M40

KEYWORDS: Corporate disclosure, terrorist attacks, bid-ask spread, crisis management

INTRODUCTION

On the morning of September 11, 2001, terrorists used airplanes to crash into and destroy the World Trade Center buildings in New York City. This terrorist attack (hereafter 9/11) was a huge, unprecedented event in world history, and impacted both U.S. and global economies and markets (e.g., Chen and Siems, 2004). For insurance companies, it represented the largest catastrophic event in U.S. history, representing $40-70 billion in insurance losses (e.g., Park, 2008; Doherty et al., 2003). Because of the unprecedented magnitude of property loss and potential open-ended liability losses, estimates about the magnitude of the losses provided by insurers tended to have wide boundaries and were subject to large margins of error. This increased information asymmetries between managers and market participants, which therefore increased the cost of potentially much-needed external capital.

The main goal of the current study is to examine how managers reacted to this change in information asymmetries. Specifically, given that insurance firms experience an exogenous shock that increases information asymmetries, how do managers change their disclosure practices to mitigate them? A large body of research in the accounting literature suggests that managers have different types of disclosure mechanisms at their disposal (e.g., Healy and Palepu, 2001); we examine one particular type of disclosure mechanism: press releases.

We examine the disclosure practices of the 105 firms in the insurance industry during the September 11 attacks. Overall, we find that firms with larger 9/11-related losses make a higher level of disclosures. We also find that conditioning on the level of losses, firms' disclosure behavior systematically varies with the level of leverage. This suggests that the relation between losses and disclosures in this crisis context systematically varies with leverage. Lastly, we find that these disclosures have little impact on the average bid-ask spreads upon market opening on September 17.

We contribute to the literature in two ways. First, extant studies in the insurance/risk literature examine the stock price behavior of insurance firms following 9/11, assuming that information asymmetries related to insurance losses play a major role in such behavior. However, none of these studies examine managers' attempts at resolving such information asymmetries. Explicitly examining managers' disclosures helps fill this gap, showing how managers disclose in moments of crisis. Second, several studies in the accounting literature examine voluntary disclosure behavior of managers experiencing firm-specific events (e.g., earnings surprises). However, we are not aware of any studies that consider exogenous events that are outside the manager's control, particularly significant crisis events like 9/11. The behavior we document therefore sheds light on how managers may respond to future crisis events.

BACKGROUND AND LITERATURE REVIEW

The terrorist attacks on September 11, 2001 have been documented in several extant studies (e.g., Hogarth, 2002; Cummins and Lewis, 2003; Doherty et al., 2003; Park, 2008). The attacks were unprecedented, unanticipated, and had an enormous impact on the psychology of the nation and the world. The event also had many economic repercussions. Many studies have examined 9/11's adverse effect on various aspects of the stock market. The studies are interesting because they examine how market participants react in a crisis situation with a high degree of uncertainty (e.g., Glaser and Weber, 2005). The most immediate and salient effect of 9/11 was the closing of the New York Stock Exchange for six days. On Monday, September 17, trading resumed. The Wall Street Journal reports that trading on that day was marked by panic and selling: "the day's trading was skewed by panic selling… selling was heavy and deep" (Wall Street Journal, C1, September 18, 2001). The Dow Jones Industrial Average closed down 7.3%, the largest one-day point decline in U.S. history.

Glaser and Weber (2005) find that, overall, investor's estimates of expected returns were higher after 9/11, suggesting investors' belief in mean reversion. Estimates of expected volatility were also higher. Furthermore, differences in opinion about expected returns were lower, but differences in opinion about expected volatility remained the same. Industry-specific studies have concentrated mostly on the insurance and airline industries. Studies such as Hogarth (2002), Cummins and Lewis (2003), Doherty et al. (2003), and Park (2008) find that the event had a significant impact on the market capitalization of insurance companies, representing the most severe short-term stock price decline in the industry's history. However, there was a price reversal in the short-term over the next few weeks. Park (2008) finds that these price reversals are robust after controlling for post-9/11 changes in systematic risk, as well as the changes in idiosyncratic risk (that could generate correlated parameter estimation risk).

HYPOTHESIS DEVELOPMENT

The impact of 9/11 on insurance companies is complex. Cummins and Lewis (2003) conclude that the insurance markets were in disequilibrium from the significant unexpected loss shocks arising from the event. These shocks were attributable to several factors. Insurance companies faced large, unexpected losses (i.e., claims, payouts). Moreover, because U.S.-based terrorism losses were unanticipated by the insurance companies, very little or no premium was ever collected (i.e., no revenues to balance against the losses). Even if losses were to be borne by international reinsurers, domestic insurers were still exposed to losses due to deductibles and policy limits, as well as participation in domestic reinsurance pools. Lastly, collectability of claims from reinsurers was also in question. Overall, the 9/11 terrorist attacks were an unanticipated event with little precedence, and caused significant potential open-ended liability losses that were very difficult to accurately estimate, and had the potential to take many years or decades to run off. Indeed, the attacks revealed new information about the frequency and severity of insured losses, thus increasing probability distributions related to such losses; these new uncertainties could not necessarily be diversified away. Thus, loss estimates given by insurers tended to have wide boundaries and were subject to large margins of error. This forced investors to reevaluate the future cash flows of insurance companies due to the new terrorism risk.

This sudden increase in the magnitude and nature of uncertainty dramatically increased information asymmetries between managers and market participants. This increase in information asymmetries in turn increased the demand for transparency, and therefore the demand for voluntary disclosures from management. The accounting literature has documented the effect of increased demand on the voluntary disclosure patterns of managers (e.g., Healy and Palepu, 2001). Consistent with this, Park (2008) provides anecdotal evidence that some firms attempted to resolve information asymmetries by announcing their net loss estimates before the markets reopened on September 17. The above discussion suggests the following empirical prediction: *H1*: Firms with relatively higher 9/11-related losses make more voluntary disclosures in the period following 9/11.

SAMPLE, DATA, AND SAMPLE SELECTION

Our sample selection starts with all firms in the life insurance (SIC code 6311), accident and health insurance (6321), and fire/marine & casualty insurance (6331) industries during the September 11 attacks (see Park, 2008). The initial sample includes 119 firms from the quarterly Compustat and daily CRSP tapes. To mitigate survivorship bias, we include the research files, as well. We exclude 14 firms due to insufficient accounting or stock price data. Our final sample includes 105 firms.

Voluntary disclosure data is collected from Factiva. We search for press releases made in the period immediately following the September 11 attacks (i.e., 9/11/2001 to 12/31/2001) made via PR Newswire and BusinessWire. Similar to prior studies that hand-collect press releases (e.g., Miller, 2002), we assume that our disclosures are representative of the firm's overall corporate disclosure practice. To the extent that it is not (e.g., conference calls), this may add noise or bias to our inferences; however, several prior empirical studies find that firms' disclosure practices tend to be complementary (i.e., not substitutes). We read each press release for discussion about the 9/11 attacks. We ignore press releases that do not mention the 9/11 attacks. Our main disclosure metric is a simple count of the 9/11-related disclosures that we collect. We collect 9/11-related losses data from these press releases—as well as from earnings announcement press releases where 9/11 related losses are explicitly discussed. To the extent that firms experience 9/11-related losses but do not explicitly discuss them in either a voluntary disclosure or in the earnings announcement press release, our reported loss measure is potentially biased.

Table 1 provides descriptive statistics for the firms in our sample. The mean (median) 9/11-related loss (LOSS) is $30.355 million ($0 million). The highest LOSS reported is $440 million (untabulated). However, comparing the loss relative to prior-period total assets (LOSST) suggests that the losses were not proportionately large. For instance, the 90th percentile LOSST is 0.005, suggesting that losses were only 0.5% of total assets. On average, firms made 0.6 voluntary disclosures (VOL_DISCL) that explicitly mentioned the 9/11 attacks. The median firm made no VOL_DISCL, while the 90th percentile firm made one VOL_DISCL. The most "talkative" firm made six VOL_DISCL (untabulated). One interesting finding is that 44% of our firms make 9/11-related disclosures. This is interesting because only 35% of the firms actually report 9/11-related losses (untabulated). The discrepancy arises from firms that make disclosures about the 9/11 attacks to merely state that they had no exposure to the event. This is an interesting aspect of voluntary disclosure activity that suggests firms signal in attempt to create a separating equilibrium. That is, given the extreme crisis event that we are examining, some firms make disclosures simply to state that there is no news to report. This further illustrates the non-linearity in the disclosure patterns of firms. Untabulated Pearson correlations reveal that the magnitude of the loss (LOSST) is positively correlated with voluntary disclosures (VOL_DISCL), with a correlation coefficient of 0.455 (p=0.000).

The mean (median) market value (MV) is $4562 ($570) million, suggesting that the sample skewed towards larger firms. Lastly, we find that earnings (NI) and earnings changes (DNI) are negative, and are statistically different from those of the prior quarter. Quarterly returns (QRET) are positive, but are statistically lower than in the prior quarter.

Table 1: Descriptive Statistics

	EVENT QUARTER						PRIOR QTR	DIFFERENCE
	MEAN	10%	25%	50%	75%	90%	MEAN	T-STAT
LOSS	30.355	0	0	0	3	95	-	-
LOSST	0.003	0	0	0	0.001	0.005	-	-
NI	-0.002	-0.015	-0.004	0.001	0.004	0.009	0.002	-2.72
DNI	-0.007	-0.064	-0.007	-0.002	0.000	0.002	-0.002	-2.81
QRET	0.034	-0.322	-0.143	0.023	0.116	0.229	0.106	-3.15
VOL_DISCL	0.600	0	0	0	1	1	-	-
MV	4562	17	99	570	2373	8847	5072	-0.19
LEV	0.048	0.000	0.016	0.039	0.066	0.103	0.050	-0.32
MTB	1.196	0.351	0.721	1.060	1.600	2.010	1.319	-1.30

This table presents descriptive statistics for the 105 publicly-traded insurance firms in our sample.

EMPIRICAL RESULTS

In Table 2, we present results from estimating a probit model, where our main dependent variable is the number of 9/11-related voluntary disclosures. The main independent variable is LOSST, the magnitude of 9/11-related losses, scaled by beginning total assets. Control variables include LEV, leverage (defined as beginning [total liabilities / total assets]), MV (lagged firm size), MTB (lagged market-to-book), and BAS (lagged average bid-ask spread). The model is as follows: $VOL\_DISCL = b_0 + b_1\, LOSST + b_2\, LEV + b_3\, MV + b_4\, MTB + b_5\, BAS + e$. In the first model, we estimate a preliminary model that does not include LEV.

Table 2: Disclosures and September-11 Losses

	LOSST	LEV	MV	MTB	BAS
COEFFICIENT	46.36		0.20	-0.37	0.88
CHI-SQUARE	15.82		5.13	1.68	0.01
P-VALUE	0.000		0.024	0.195	0.930
COEFFICIENT	47.06	1.92	0.22	-0.42	1.25
CHI-SQUARE	16.11	1.06	5.93	2.13	0.02
P-VALUE	0.000	0.304	0.015	0.145	0.901

This table presents results from a probit model estimation of the number of voluntary disclosures regressed on the level of 9/11 losses: $VOL\_DISCL = b_0 + b_1\, LOSST + b_2\, LEV + b_3\, MV + b_4\, MTB + b_5\, BAS + e$.

The coefficient on 9/11-related losses (LOSST) is significantly positive (47.06, p=0.000), suggesting that larger losses are related to higher levels of disclosures. Next, in Table 3, we also consider the interaction of LOSST with LEV. Capacity constraint models suggest that firms with a stronger need for external capital may also exhibit a greater need to reduce information asymmetries. This suggests that, among insurance firms that experience a 9/11-related loss, those with relatively worse capital positions—that are in higher need for external capital—are more likely to increase voluntary disclosures to mitigate information asymmetries (e.g., Healy et al., 1999). Consistent with this prediction, we find that the coefficient on the LOSST*LEV interaction term is significantly positive (444.49, p=0.021), suggesting that the relation between disclosures and 9/11 losses systematically varies with firm leverage. That is, it is the firms with losses and relatively higher leverage that are more susceptible to capital shortages arising from payouts/claims. Therefore, it is these firms that are most likely to make disclosures in an attempt to lower the cost of capital. In the second model, we interact LOSST with a decile-ranked transformation of LEV; this ensures that our results are not due to distributional properties of LEV. Results are qualitatively similar. Specifically, the LOSST interaction with ranked LEV is significantly positive (9.72, p=0.037). Untabulated results also reveal that a similar decile-ranking of LOSST does not change any of the results.

Table 3: Disclosures and September-11 Losses, Interactions with Leverage

	LOSST	LEV	LOSST*LEV	MV	MTB	BAS
COEFFICIENT	36.93	1.57	444.49	0.21	-0.40	1.64
CHI-SQUARE	6.30	0.68	1.29	5.37	1.92	0.03
P-VALUE	0.012	0.411	0.021	0.256	0.166	0.870
COEFFICIENT	29.53	-0.01	9.72	0.20	-0.42	-0.79
CHI-SQUARE	3.90	0.03	4.34	4.55	2.09	0.01
P-VALUE	0.048	0.864	0.037	0.033	0.149	0.937

This table presents results from a probit model estimation of the number of voluntary disclosures regressed on the level of 9/11 losses: $VOL\_DISCL = b_0 + b_1 LOSST + b_2 LEV + b_3 LOSST*LEV + b_4 MV + b_5 MTB + b_6 BAS + e$.

One unique aspect of the September 11 attacks is the fact that the markets were closed by fiat for four trading days (Tuesday 9/11 to Friday 9/14), and only reopened on Monday, September 17. We find that many firms make voluntary disclosures in the period prior to the 9/17 market opening—perhaps as an attempt to reduce information asymmetries upon market opening. To test this possibility, we examine the relation between bid-ask spreads and voluntary disclosures.

In Table 4, we present results from estimating an OLS model, where the main dependent variable is the average bid-ask spread over the 9/17-9/19 window. The main independent variable is VOL-DISCL, the number of voluntary disclosures made in the pre-9/17 (a subset of the disclosures used in Table 1 tests). Control variables include LOSST (the magnitude of 9/11-related losses, scaled by beginning total assets), MV (lagged firm size), MTB (lagged market-to-book), and SPREAD (prior quarter's average bid-ask spread). The model is as follows: $BAS = b_0 + b_1 VOL\_DISCL + b_2 LOSST + b_3 MV + b_4 MTB + b_5 BAS_{t-1} + e$.

Table 4: Bid-ask Spreads and Disclosures

	INTERCEPT	LOSST	VOLDISCL	MV	MTB	SPREAD	Adj-R2
COEFFICIENT	0.004	0.178	-0.000	-0.005	0.003	1.367	0.376
T-STATISTIC	0.323	0.559	-0.094	-2.259	0.409	6.094	
COEFFICIENT	0.004	0.013	-0.002	-0.005	0.003	1.372	0.399
T-STATISTIC	0.306	1.995	-0.499	-2.545	0.496	6.251	

This table presents results from an OLS model estimation of the average bid-ask spread during the 9/17-9/19/2001 period regressed on the number of voluntary disclosures made before market opening on 9/17/2001: $BAS = b_0 + b_1 VOL\_DISCL + b_2 LOSST + b_3 MV + b_4 MTB + b_5 BAS_{t-1} + e$.

The coefficient on VOL-DISCL is negative, but not statistically significant (-0.000, t=-0.094), suggesting that pre-9/17 disclosures do not have an impact on the bid-ask spreads. Nor does the magnitude of the loss (LOSST) have an effect on bid-ask spreads. However, in our second model, we find that when we replace LOSST with a simple dummy variable for the existence of a loss, the coefficient for this dummy variable is significantly positive (0.013, t=1.995), suggesting that the existence of a loss increases bid-ask spreads, though the magnitudes do not necessarily do so; this specification does not change the insignificance of the VOL-DISCL coefficient. In untabulated results, we find that the interaction of LOSST with LEV is statistically insignificant. Consistent with prior literature, our results show that the most significant predictors of the immediate bid-ask spread are market value (MV) and prior-quarter's bid-ask spread (BAS). However, results overall should be interpreted with caution because the bid-ask spread is not driven by solely information asymmetry, but other components such as the adverse selection component, as well (Krinsky and Lee, 1996).

SUMMARY AND DISCUSSION

We examine the voluntary disclosure behavior of firms in the insurance industry in the period immediately following a major crisis event; namely, the September 11 terrorist attacks. Of the 105 firms in our sample, 35% of them report losses explicitly related to the attacks. However, a larger number of firms (44%) make 9/11-related disclosures. The discrepancy arises from many firms having no insurance exposure to the attacks making disclosures of the "non-event" to their financial position. This is consistent with these unaffected firms making their disclosures or signaling to separate themselves from other firms, lest they be pooled together with those firms that do experience a loss from the event. Of those that incur insurance losses, firms with larger losses make a higher level of disclosures. Moreover, the interaction of 9/11-related losses and leverage are positively related to disclosures. Lastly, we find some weak evidence that the existence (though not magnitude) of a 9/11-related loss increases information asymmetries (i.e., bid-ask spread) in the immediate three-day period of market open (9/17-9/19/2001). However, making voluntary disclosures before the market opens on 9/17 does not seem to have an effect on bid-ask spreads.

Some of the evidence we provide is ex post not too surprising. For instance, perhaps it is not surprising to learn that voluntary disclosures were higher for firms that exhibited greater losses. In addition, though we were initially surprised at the non-trivial number of firms that disclosed their "non-event" status, the result is quite normal given the "lemons problem" discussed in Akerlof's (1970) seminal study. Other findings are a bit more surprising. For instance, our finding that firms with higher losses and higher leverage make relatively more disclosures is perhaps surprising to some readers because the magnitude of the losses as a share of total assets is not particularly significant (the mean loss 0.3% of total assets; the 90^{th} percentile loss 0.5% of total assets). Further, it is not clear whether losses of similar magnitude for a non-crisis event like the 9/11 attacks would elicit similar behavior from management—it is difficult to imagine many scenarios where firms voluntarily disclose their "non-exposure" to other events that represent a mean 0.3% loss. Thus, the behavior we document is not meant to be extended to other "typical" scenarios. However, we do believe that the study may have some external validity in other crisis events, where market psychology may play a more significant role (e.g., Hurricane Katrina, the current mortgage-related financial crisis). Lastly, given the significant information asymmetries that the attacks created, it is perhaps surprising that firms' voluntary disclosures did not have an impact on the immediate bid-ask spreads of these firms. One interpretation of this non-result is that, though managers tried to reduce the information asymmetries via their disclosures, it seems that this was not reflected in bid-ask spreads because of the (irrational) fear that existed in the aftermath of the 9/11 attacks.

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