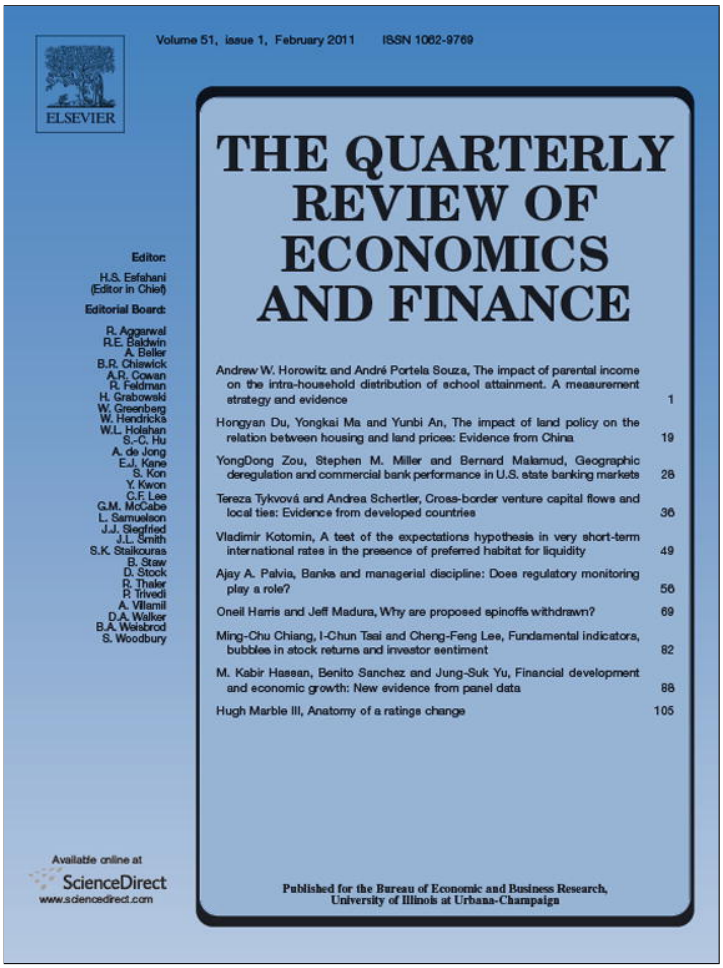

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Fundamental indicators, bubbles in stock returns and investor sentiment

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ABSTRACT

This paper uses the stock performance of construction companies in Taiwan to test whether there are bubbles. The panel data tests are employed to find whether the prices of construction company stocks reflect fundamental indicators and to detect the bubble-like behavior of the stock prices. A bubble indicator is constructed and its relationship with investor sentiment is also discussed. The empirical finding shows that sentiment of foreign investors was the most likely to be related to bubbles in the sample period. This evidence also provides the implication for policy enactment of government.

1. Introduction

Stock prices and fundamentals go hand in hand. When the former deviates substantially from the latter, investors often bear great losses from price adjustments, especially when there are bubbles in stock returns. If investors are able to identify unreasonable price movements before investments, risks in the stock market would be reduced. Besides, from an academic point of view, a better knowledge of the relationship between bubbles and investor behavior could provide suggestion for policy enactment to prevent bubbles before they occur.

As many fundamental and non-fundamental factors can move the stock prices, to decompose stock price or to discern which part of the stock price movement was resulted from herding or irrational investor behavior is difficult. To investigate such a hard but important issue, this paper uses the stock performance of construction companies in Taiwan as an example. As Taiwan is a small-scale emerging and developing country, housing market in Taiwan has always been highly volatile.[1] In such a heavily populated small island, any speculative trading in housing market can move the prices and result in large stock price adjustments in the same sector. Even though the business cycle of the housing market determines the stock price of construction companies in general, deviations from the fundamentals sometimes take place, and large price adjustments often occur accordingly. Sometimes these stock price adjustments in housing industry are larger than those in other industries or in other countries. As the housing industry in Taiwan experienced several cycle of bubbles and recession in the past, such a highly volatile market could serve as a good example to analyze the bubbles in stock prices.

Besides, though construction industry is one of a few sectors that are deeply affected by business cycle and fundamental factors, the indicators that measure the associated fundamental factor are

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[1] Taiwan's housing market has always been highly volatile, with obvious ups and downs. Historical price data shows several periods of bubbles and recessions; for example, Taiwan's house prices have experienced three major cycles from 1970 to the present. Prices approximately doubled in the first and second peaks during the early and late 1970s. The third occurred in the late 1980s, when housing prices soared, tripling in value. These high prices were far higher than an average household could afford, and lasted for a long time.

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rare to find. However, Architecture and Building Research Institute of Ministry of Interior in Taiwan develops the Real Estate Cycle Indicator (RECI)[2] which measures fundamentals related to the Taiwan housing industry. Utilizing the RECI as a proxy of fundamental factors, this paper can analyze the stock price movements in construction industry and discern they are herding-driven or fundamental-driven movements directly. These provide additional benefits of using Taiwan data. The goal of this paper is to study whether there are bubbles (i.e., price deviations from the fundamentals) in our sample period and analyzes the type of investor behavior that leads to these bubbles. The empirical findings will provide an insight to the relationships between fundamental indicators, bubbles in stock returns and investor sentiment in Taiwan market.

Although the bubbles issues are very important for the participants of asset markets, previous studies have rarely employed quantitative methods to examine bubbles. Mikhed and Zemčík (2009) proposed a new concept and measurement for bubble indicator. They apply panel data tests for unit roots and co-integration to measure whether asset prices are stable compared to the fundamentals. In the current paper, we take RECI for the housing market in Taiwan as the proxy of fundamental for stock prices of construction companies, and follow Mikhed and Zemčík (2009) to construct the bubble indicator based on stock performance.

As for investor behavior in the stock market, many researchers in market microstructure (such as Chordia & Subrahmanyam, 2004; Kraus & Stoll, 1972; Lakonishok, Shleifer, & Vishny, 1992; Sias, 1997; and Wermers, 1999) believe and prove that a buy-sell imbalance (BSI) signals trading needs. The BSI indicates investor needs and predicts dynamics of future trading needs and price. Thus, when a certain group of investors have a significant buy-sell imbalance, it can affect future returns based on autocorrelation of trading needs, and different investors can speculate information from other investors and mimic their actions. Kumar and Lee (2006) studied whether retail investors have common trading tendencies or sentiment and whether these significantly affect returns. By using the investor trading volume, they computed the buy-sell imbalance of stocks and portfolios as the sentiment for retail investors and showed that sentiment is a significant risk factor for stock returns. To analyze the type of investor behavior that leads to bubbles, this paper builds on the methodology proposed by Kumar and Lee (2006) and determines market sentiment for various types of construction company investors in Taiwan. Examining the relationships between bubbles in stock returns and investor behavior will provide the evidence that caused bubbles.

The paper is organized as follows: Section 2 illustrates the methodology used in this paper. Section 3 presents the data, and Section 4 discusses the empirical results. Section 5 concludes the paper.

2. The methodology

This paper investigates the relationship between the stock price of construction companies listed in Taiwan and the housing market index (RECI) to examine bubbles and to construct a bubble indicator. Following the methods of Mikhed and Zemčík (2009), this paper study whether there are bubbles by examining whether there are price deviations from the fundamentals (housing market index). And then we go on to analyze the type of investor behavior that leads to these bubbles. We briefly illustrate the methodologies constructing bubble indicator and investor sentiment in the following.

2.1. Bubble indicator

Previous studies have rarely employed quantitative methods to examine bubbles. Mikhed and Zemčík (2009) employed panel data tests for unit roots and cointegration to find out whether asset prices reflect fundamentals. Their work are based on the theoretical framework of Campbell and Shiller (1987), which proposed the stationarity between financial assets and their cash flows should be of the same order of integration and if they are both non-stationary in levels but stationary in first differences, the two series should be cointegrated. In this paper, the unit root test on the asset price and fundamental factors proposed by Mikhed and Zemčík (2009) are applied to examine whether the former deviates from the latter, in other words, whether a bubble has been formed. The unit root test can be divided into the following four scenarios:

- Scenario A: The asset price and the fundamentals are both stationary.
- Scenario B: The asset price is stationary but the fundamental is non-stationary.
- Scenario C: The asset price is non-stationary but the fundamental is stationary.
- Scenario D: The asset price and the fundamentals are both non-stationary.

Under Scenario A, there are no bubbles in asset prices so the bubble indicator is zero; Scenario B represents an incorrect model; in Scenario C, there are bubbles in asset prices, in this case, the bubble indicator equals to 1; in Scenario D, the asset price and the fundamentals need to be tested for cointegration and the p-value will be the bubble indicator. As the current paper use panel data, panel data tests for unit roots and co-integration are introduced briefly below.

In recent years, some studies have been devoted to develop panel-based unit root tests, for example, Levin, Lin, and Chu (2002), Breitung (2000), and Im, Pesaran, and Shin (2003). These papers have shown that panel unit root tests are more powerful than unit root tests applied to individual series because the information in the time series is enhanced by that contained in the cross-section data.

The panel unit root tests developed by Levin et al. (2002) and Breitung (2000) are similar to tests carried out on a single series, because they all assume that there is a common unit root process across the relevant cross-sections. The LLC and Breitung tests employ a null hypothesis of a unit root using the following basic Augmented Dickey Fuller (ADF) specification:

$$Y_{i,t} = \rho Y_{i,t-1} + \sum \phi_{ij} \Delta Y_{it-j} + X_{i,t}\gamma + e_{i,t}, \quad (1)$$

where $Y_{i,t}$ stands for the endogenous variable; $X_{i,t}$ indicates exogenous variables in the model, such as company fixed effects and individual time trends; and γ is the corresponding vector of coefficients. The symbol $e_{i,t}$ refers to the error terms that are assumed to be mutually independent disturbances. Notably, ρ is assumed to be identical across the cross sections, but the lag order for the difference terms across the sectors is allowed to vary. In contrast, the test proposed by Im et al. (2003) allows ρ to vary across cross-sections, that is, the ADF regressions can be modified as follows:

$$Y_{i,t} = \rho_i Y_{i,t-1} + \sum \phi_{ij} \Delta Y_{it-j} + X_{i,t}\gamma + e_{i,t}. \quad (2)$$

[2] Real Estate Cycle Indicator developed by Ministry of Interior is a composite index considers four aspects in housing market: investment, production, trading, and usage. The indexes used in each aspect are as followed: land traded index for investment, number of construction area licensing for production, standard price index of new housing for trading, and residential usage index for usage.

Table 1
Descriptive statistics.

Variable	Construction company stock price	Housing market index	Investment sentiment			
			Dealers	Trusts	Foreign investors	Retail investors
Mean	14.4586	10.5484	−0.0374	−0.0471	0.0306	−0.0001
Std. dev.	4.6739	2.1732	0.1107	0.1550	0.1353	0.0101
Skewness	0.6709	−0.5718	−0.8016	0.4900	0.2682	0.2257
Kurtosis	2.5556	2.2370	3.3539	3.7911	2.2427	3.1310

Note: business indicator for the housing market is housing market index using the Real Estate Cycle Indicator as a proxy. Investment sentiment is the BSI computed by Eq. (7). Since the numerator in Eq. (7) denotes the net long or short position of one type of traders on company i whereas the denominator represents the total of longs and shorts on the same company, BSI shows the behaviors of traders and their sentiment toward stock market. The positive BSI indicates the investor sentiment is increasing as the group of investors has a net demand for the company while the negative BSI indicates a decrease in the investor sentiment as the traders provide a net supply for the company.

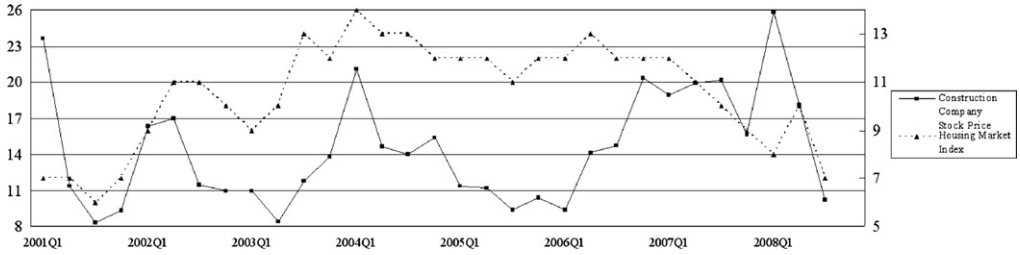

Fig. 1. Time series of construction company stock price and housing market index.

The less restrictive IPS statistic is based on averaging individual ADF unit root tests (t_i) according to

$$t_{\mathrm{IPS}} = \frac{\sqrt{N}(\bar{t} - E[t_i|\rho_i = 0])}{\sqrt{var[t_i|\rho_i = 0]}} \rightarrow N(0, 1), \tag{3}$$

where $\bar{t} = N^{-1}\sum_{i=1}^{N} t_i$.

This paper follows the procedure proposed by Mikhed and Zemčík (2009) by using the stock prices of construction companies and fundamental indicators to employ IPS unit root test. If the results show that the stock prices and fundamental indicators are both non-stationary, then this paper proceed to conduct the cointegration test.

This paper followed the Pedroni (1999, 2004) framework to test for cointegration. The cointegration regression used in this paper is given as follows:

$$Y_{i,t} = \alpha_i + \delta_i t + \beta_i X_{i,t} + \varepsilon_{i,t} \tag{4}$$

for

$$t = 1, 2, \ldots, T; i = 1, 2, \ldots, N,$$

where Y_i is the endogenous variable, and X_i is the regression variable. The letter T refers to the number of observations over time, N refers to the number of individual members in the panel, β_i is the slope coefficient, α_i is the member-specific intercept or fixed-effects parameter, and $\delta_i t$ refers to the deterministic time trends.

This formulation allows for the investigation of heterogeneous panels, in which heterogeneous slope coefficients, fixed effects, and individual specific deterministic trends are permitted. The term $\varepsilon_{i,t}$ shows the deviations from the long-term relationship between stock prices and fundamental indicators. If they are cointegrated, this term will be stationary. Stationarity can be achieved by establishing whether ρ_i in:

$$\varepsilon_{i,t} = \rho_i \varepsilon_{i,t-1} + \xi_{i,t} \tag{5}$$

is united. The null hypothesis is that $\rho_i = 1$. This implies that the null hypothesis is equivalent to testing the null of no cointegration for all i. If there is an autocorrelation effect in the term $\varepsilon_{i,t}$, we can modify the regression by adding the lagged terms of deviations:

$$\varepsilon_{i,t} = \rho_i \varepsilon_{i,t-1} + \sum_{k=1}^{K_i} \pi_{i,k} \Delta\varepsilon_{i,t-1} + \xi^*_{i,t} \tag{6}$$

Then the p-values of cointegration statistics are used to formulate a bubble indicator.

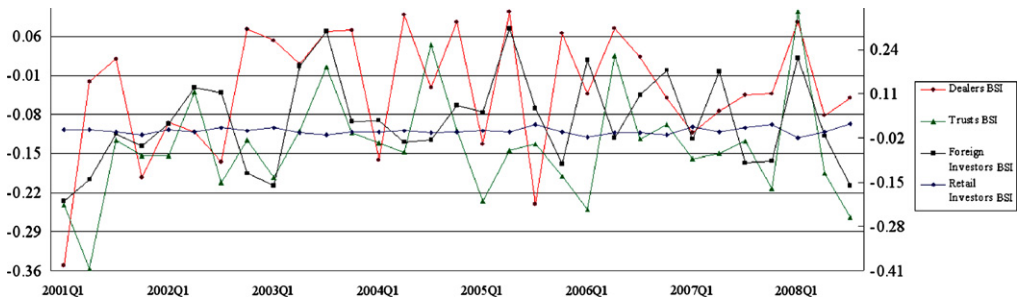

Fig. 2. Time series of investment sentiment.

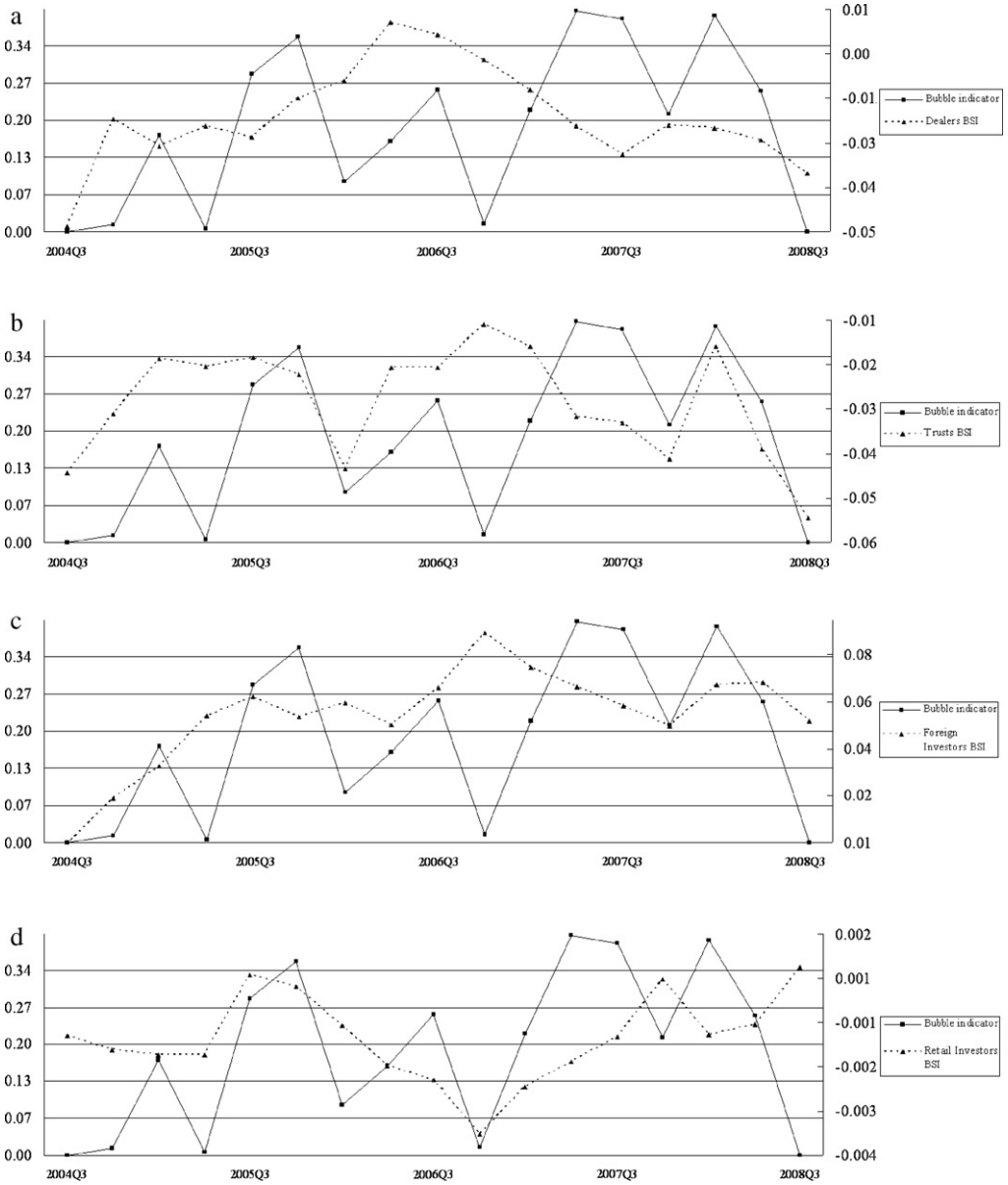

Fig. 3. Indicators of bubble and investor sentiment. *Note*: (a), (b), (c) and (d) are comparison of BSI verses bubble indicator of dealer, trusts, foreign investors and retail investors respectively. BSI is the investor sentiment indicator computed by Eq. (1). Bubble indicator is obtained from *p*-value of cointegration statistics in Eq. (5).

2.2. Investor sentiment

We then study which investor sentiment correlates with the bubble indicator. The way we construct investor sentiment is proposed by Kumar and Lee (2006); they used the buy-sell imbalance of various investors as the investors' sentiment indicator, which acts as a proxy for stock market sentiment in this paper.

First, we introduce how the investor sentiment indicator is constructed:

Let the investor sentiment indicator (BSI) of investors in company i in quarter t be

$$\mathrm{BSI}_{it} = \frac{\sum_{j=1}^{D_t}(\mathrm{VB}_{ijt} - \mathrm{VS}_{ijt})}{\sum_{j=1}^{D_t}(\mathrm{VB}_{ijt} + \mathrm{VS}_{ijt})} \tag{7}$$

where D_t is the trading days in quarter t; VB_{ijt} (VS_{ijt}) are the total long (short) position of such investors on company i in the jth day of quarter t. Since the numerator above shall be the total long or short position of investors of company i in quarter t, it shall be positive for a net long position and negative for a net short in that quarter. The denominator represents the total of longs and shorts, which must be positive. Hence, if BSI > 0, then this group of investors have a net demand for the company in that quarter; in other words, more investors have positive expectations for the market's future, and the investor sentiment is increasing. On the other hand, if BSI < 0, then such group of investors have a net supply for the company in that quarter; that is, more investors have negative expectations for the market's future, and investor sentiment is decreasing. Different types of investors may have different views on the market. We divide investors into four types: dealers, retail investors, foreign investors, and trusts; each has its own sentiment indicator.[3]

[3] There are four types of trader in Taiwan including retail investors and institutional investors such as dealers, trusts, and foreign investors. Dealers buy and sell securities on behalf of themselves. Investment trusts in Taiwan is an institution

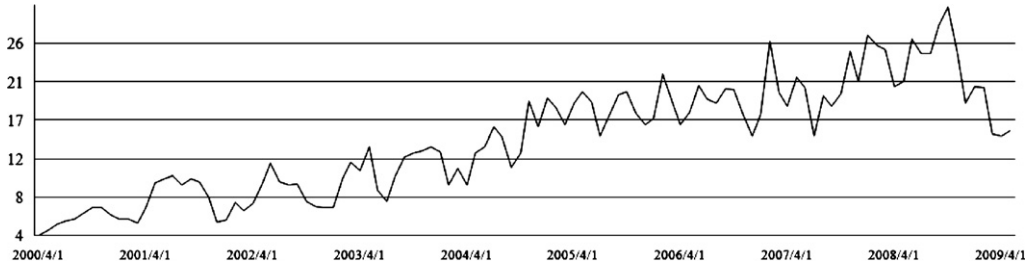

Fig. 4. Trading ratio of foreign investor: as percentage of total trading amount.

3. The data

The quarterly stock prices and daily total trading volumes of 28 construction companies listed on the Taiwan Stock Exchange are obtained from the Taiwan Economic Journal Database. The time span of data is from the first quarter of 2001 to the third quarter of 2008. As a proxy for the fundamentals of housing market in Taiwan, the Real Estate Cycle Indicator for the identical sample period are collected from the Architecture and Building Research Institute of the Ministry of the Interior in Taiwan. To construct quarterly investor sentiment of four types of investors, namely, dealers, retail investors, foreign investors and trusts, we employ the daily total trading volume on individual security to calculate the BSI using Eq. (7). Since the numerator in Eq. (7) denotes the net long or short position of one type of traders on company *i* whereas the denominator represents the total of longs and shorts on the same company, BSI shows the behaviors of traders and their sentiment toward stock market. In detailed, the positive BSI indicates the investor sentiment is increasing as this group of investors has a net demand for the company in that quarter. On the contrary, negative BSI shows a decrease in the investor sentiment as the traders provide a net supply for the company. The summary statistics for the stock price of construction companies, the housing market index, and investor sentiments are represented in Table 1.

As indicated in Table 1, foreign investors and retail investors, on average, had positive expectations for construction companies listed in Taiwan during the sample period for their average investor sentiment was positive. In contrast, dealers and trusts held negative expectations, as suggested by the negative average investor sentiment. The distinction of sentiment index among investors could be inspected in Fig. 2. Among the sentiment index estimators, that of the trusts is the minimum (−0.0471) indicating that the trusts had the largest short position among investors. Furthermore, the average business indicator for the industry (10.55) suggests that, on average, it was a relative bear market in housing industry. Differences among these four types of investors may result from different expectations for the industry, but how was the actual performance of the industry?

As depicted in Fig. 1, the time series of the average stock price of construction companies and the housing market index show consistent co-movements during the sample period, though deviations did occur from time to time. To examine whether stock prices reflected fundamentals and whether there were bubbles, a more rigorous method is applied in the next section for a further investigation (Fig. 2).

4. The empirical results

Table 2 shows the bubble indicators during the sample periods based on unit root and co-integration tests, as suggest by Mikhed and Zemčík (2009). Their work are based on the theoretical framework of Campbell and Shiller (1987), which proposed the stationarity between financial assets and their cash flows should be of the same order of integration and if they are both non-stationary in levels but stationary in first differences, the two series should be cointegrated. As mentioned early, by Mikhed and Zemčík (2009), the unit root test can be divided into the following four scenarios: Scenario A: The asset price and the fundamentals are both stationary; Scenario B: The asset price is stationary but the fundamental is non-stationary; Scenario C: The asset price is non-stationary but the fundamental is stationary; Scenario D: The asset price and the fundamentals are both non-stationary.

In Table 2, stock price series is stationary only in third quarter of 2008, so the bubble indicator is 0. This is a scenario in line with scenario A. Besides, the insignificant *p*-value of IPS test in other period cannot reject the null hypothesis of non-stationarity indicating that the stock price series are non-stationary. Therefore, the cointegration test between stock price series and the proxy variable of fundamentals are required for further investigation and the *p*-value

Table 2
Bubble indicator.

Date	Stock price-IPS	Cointegration	Bubble indicator
2004Q3	0.9938	0.0000	0.0000
2004Q4	0.9999	0.0135	0.0135
2005Q1	0.9307	0.1736	0.1736
2005Q2	0.6867	0.0063	0.0063
2005Q3	0.5721	0.2842	0.2842
2005Q4	0.5919	0.3513	0.3513
2006Q1	0.2787	0.0902	0.0902
2006Q2	0.9408	0.1622	0.1622
2006Q3	0.9664	0.2549	0.2549
2006Q4	1.0000	0.0140	0.0140
2007Q1	0.9939	0.2193	0.2193
2007Q2	0.9986	0.3989	0.3989
2007Q3	0.9996	0.3839	0.3839
2007Q4	0.2937	0.2125	0.2125
2008Q1	1.0000	0.3900	0.3900
2008Q2	0.9964	0.2528	0.2528
2008Q3	0.0014	0.3973	0.0000

Note: stock price-IPS is the test statistics proposed by Im et al. (2003) to test for a unit root. Following the framework of Mikhed and Zemčík (2009), the bubble indicators are obtained from *p*-values of IPS and those of panel cointegration which are estimated in the 10-year data windows and ended in a given year. Among the bubble indicator above, that in third quarter of 2008 is 0 because the stock price series is stationary in that period. The other bubble indicators are obtained from *p*-values of panel cointegration. If *p*-value in cointegration test is significant and the null hypothesis of no-cointegration between stock price and fundamentals is rejected, the bubble indicator would be small as stock price go with fundamentals. On the contrary, if *p*-value is large and null hypothesis cannot be rejected, the bubble indicator is large. In this circumstance, stock price movement deviate from the fundamentals and the existence of bubbles are probable.

that provides financial services as a financial intermediate or acts as the trustee to investing and managing fund, property on behalf of a beneficiary Foreign investors, including QFII and foreign natural persons, based on their experiences and abilities in investment trade actively and play important role in Taiwan's stock market. Stock market in Taiwan is known by its highly volatility, previous studies usually attributed this phenomenon to the higher trading ratio of retail investors.

Table 3
The correlation between investor sentiment and bubble indicator.

Bubble indicator			
Dealers	Trusts	Foreign investors	Retail investors
0.1039	0.2667	0.3935	0.1584

in cointegration test is the bubble indicator. If *p*-value in cointegration test is significant and the null hypothesis of no-cointegration is rejected, that is, two series are cointegrated, the bubble indicator would be small. Then stock price go with fundamentals and no bubbles exist. On the contrary, if *p*-value is large and null hypothesis cannot be rejected, the bubble indicator is large. In this circumstance, stock price movement deviate from the fundamentals and the existence of bubbles are probable.

Fig. 3 further shows the bubble indicator and market sentiment of various investors. There are interesting evidences of connection between the bubble indicator and investor sentiment. These evidences could be utilized to identify who is the investor that causes the bubbles. For example, the bubbles in 2004 and 2008 might mainly be related to the investor sentiment of trusts. In Fig. 3, it seems that in general, the sentiment of retail investors was the most likely to be related to bubbles in the sample period. If retail investors are pessimistic (a downturn in investor sentiment), bubbles are less likely to occur. Stock market in Taiwan is a retail-dominated market in which trading ratio of retail investors, approximately more than 70%, is far larger than those of other types of investors. Thus, it is not surprising to find the sentiment of retail investor is related to bubbles in Taiwan's stock market. However, based on the inference of financial behavior theory, the herding behavior of retail investors are usually resulting from following the trading of other institutional investors. Consequently, retail investors might not create bubbles solely, there might be other type of investor whose trading act as an indicator in market and bubbles emerged as retail investors following them.

To investigate the interaction between trading of investors, the correlations of investor sentiment of various types of investor and bubble indicator are summarized in Table 3. Surprisingly, sentiment of foreign investor instead of that of retail investor is the main factor that causes bubbles. Our explanation to these results is as followed. Like other emerging markets do, Taiwan's stock market attracts strong interest from foreign investors. Fig. 4 presents the trading ratios of foreign investor in Taiwan's stock market from 2000 to 2009. As we can see in Fig. 4, trading ratio of foreign investor get higher and higher and grows quite fast during these period. However, as a relative small market in capitalization, the massive flowing of foreign capital into market might create bubbles. Therefore, even construction industry that we studied is fairly domestic and is not expected to be highly impacted by foreign investors trading, herding behavior of retail investors that followed foreign investors' trading might lead to the indirect effect of creating bubbles. Therefore, if the government intends to somewhat deal with the bubbles in the market, it could determine whether to interfere based on trades by foreign investors.

5. Conclusion

This paper used construction company stocks in Taiwan as an example. We observed whether bubbles, i.e., stock price deviations from the fundamentals, existed during our sample period. We also studied which investor behavior caused the result. We selected the sample from Taiwan because the housing market in this country has been unpredictable in the past; as a result, returns of relevant stocks have been quite volatile. Though the business cycle of the housing market determines stock performance of construction companies in principle, there are still deviations from the fundamentals from time to time. Large price adjustments often occur eventually. Thus, this industry would be the ideal one to measure the relationship between stock bubbles and investor behavior.

Results show that bubbles in construction company stocks in Taiwan are highly related to the sentiment of foreign investors. Since previous studies found that the dominated retail investors in Taiwan were less rational and easy to follow the trading behavior of institutional investors. Their herding behaviors in stock market push up the stock price, and create bubbles in the market. This might be the explanation that sentiment of foreign investor, whose trading ratio is lower than that of retail investor, will have highest correlation with bubbles. The result showed that investors should select stocks that have fewer foreign and retail investors in the Taiwan stock market in order to avoid buying at the peak of bubbles.

Though this paper is based on stock performance of construction companies in Taiwan, the results also illustrate that the bubble indicator and investor sentiment can be used to test the rationality of other kinds of markets and investors. This approach can be used as a foundation for larger samples in the future.

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