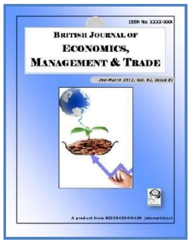

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A Preliminary Study of Stock Picking in the Construction Industry of Taiwan: Efficient Market Hypothesis Revisited

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Authors' contributions

This work was carried out in collaboration between the three authors. Both the authors wrote the paper, read it, and approved the final manuscript.

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ABSTRACT

One of the trading techniques that become popular among many traders is the technical analysis, which prospers through the first half of the 20th century. In recent years, this method is used less frequently and works only for less liquid securities. However, Aldridge (2009) finds that the technical analysis can still generate profitable trading signals based on intra-day data sampled at hourly intervals. In this study, we utilize VAR, Granger causality test and co integration test to construct models with sound theoretic basis and take the sample at daily intervals. In addition, we adopt an experimental design to exam these models and find supporting evidence for the technical analysis.
This study uses High wealth Construction in the Taiwan stock market as a sample case to compare the program trading profits when foreign institutional investors' (FINI) trading information is used and when domestic industrial information is used. The results show that co integration exists for High wealth Construction's stock. At the first stage (2007.1.2-2010.8.2), the profit is $29.3, which increases to $35.5 at the second stage (2007.1.2-2013.2.1). In addition, we show that utilizing domestic information, specifically, the historical price of Taiwan 50 and Huaku, rather than the securities lending information of FINI, investors are able to make higher profits. Therefore, this study provides evidence

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that the construction industry in Taiwan during the period August 2010 and January 2013 does not support the weak-form market efficiency.

Keywords: Construction Industry; programming trading; granger causality test; co-integration test.

1. INTRODUCTION

Since August 2010, several major events happened in the construction industry in Taiwan. On 24 June 2010, the Mayor of Taipei City proposed the Urban Renewal Plan, which however, was not implemented well. Up till November 2012, only one urban renewal application was approved. On 1 March 2011, the Taiwan government passed the Specifically Selected Goods and Services Tax (also known as the Luxury Tax) where property not lived in by the owner and sold within two years of purchase would be taxed 10-15%. The objective was to cool the property market. Moreover, from 1 August 2012, real estate transactions were required to be registered at real prices to promote the healthy development of the real estate market and increase the transparency of housing prices. Furthermore, in year 2012, there were dramatic changes in commercial real estate transactions. In the third quarter of 2012, the transaction volume reached the second highest level over the last five years. However, in the fourth quarter, as the Taiwan government restrained insurance companies from making real estate investment; for example, the returns on real estate investment by insurance companies cannot be lower than 2.875%. As insurance companies were the largest buyers in the real estate market, the transaction volume in the last quarter of 2012 reduced by 53% compared to the previous quarter.

Event studies are used to measure market efficiency and are used to back-test price data to determine the usefulness and reliability of trading strategies. We conduct our own event study to test whether or not Taiwan construction stock markets react efficiently to these four governmental actions announcements. However, owing to the limit of space, we split these event studies into Appendix 2 and focus on the test of weak form market efficiency in text.

The organization of the paper is as follows. The literature review is provided in Section 2. In Section 3, we discuss the methods used in this paper, including vector auto-regression (VAR), Granger Causality, co-integration test and program trading. Descriptions of the data and the results are provided in Section 4 and 5 respectively. A conclusion is provided in Section 6.

2. Literature Review

In 1900, French economist Bachelier [1] pioneered the idea that asset prices fluctuate randomly. He argues that the expected returns of investors will have zero net present value in an efficient market; in other words, this speculation is a fair game. Samulson [2] and Mandelbrot [3] then prove that the principle of fair game also applies to the efficient market hypothesis (EMH) with random walks theory. They find that if all the news is incorporated instantaneously in the price of a given security, the expected price of the security given the current information is always the current security price. This relationship is known as a martingale. Fama formally presented the efficient market hypothesis (EMH) in 1965. He suggests that the EMH is difficult to test [4]. However, the martingale-based tests for market efficiencies do exist. Shiller [5] adopts the S&P 500 data to exam the volatility of market prices which is much higher than the market price in theory. On the issue of market inefficiency and profit opportunities, Aldridge [6] concludes that while the price changes of two or more securities may be random when securities are considered individually, the price changes of a combination of these securities may be predictable, and vice versa.

The EMH proposed by Fama [4] suggests that there are three different levels of market efficiency. The first level is weak-form market efficiency, which tests if historical prices and returns can be used to predict future returns. If historical price information completely reflect in current prices, then investors will not be able to make abnormal returns based on past price information. The second level is semi-strong form market efficiency, which suggests that stock prices reflect all public information about the company's future prospects and do not reflect non-public information. Investors will not be able to make abnormal returns based on historical price information or by analyzing current public information. The third level is strong-form market efficiency, which suggests that stock prices have reflected all company-related information, including insider information. Investors will not be able to make abnormal returns even with insider information.

Several studies have tested the EMH. For example, Brock et al.[7] find significant predictability of the average movements in Dow Jones Industrial Average (DJIA) based on a set of simple technical trading rules. However, using some of the technical trading rules from Brock et al. [7], Curcio et al. [8] do not find profitable intraday returns in the Reuters foreign exchange market based on support and resistance rules. Therefore, Curcio et al. [8] conclude that the foreign exchange market is consistent with market efficiency. Gwilym and Sutcliffe [9] review 36 prior empirical studies on the interdependent relation between stock index futures, interest rate futures, spot stock price, and spot foreign exchange rate. They find that the price returns of financial tools have negative autocorrelation. The results suggest that these markets are not weak-form efficient. Similarly, Grieb and Reyes [10] find that the Mexican stock market does not support the random walk hypothesis (RWH). That is, investors can make profits by predicting stock price changes. However, the opposite result is found for the Brazilian market. Chang and Ting [11] find that the Taiwan stock market is consistent with the RWH based on monthly, quarterly and yearly data. Li and Xu [12] examine the market efficiency of the New Zealand stock market based on four sets of New Zealand stock indexes. They use the methods of co-integration and Granger causality and find that small companies are consistent with the semi-strong form market efficiency while the top 10 companies do not support the weak-form market efficiency. The top 30 and top 40 companies are consistent with weak-form market efficiency, but not the semi-strong form market efficiency.

There are several methods for deciding whether a market is efficient. Based on the method of co-integration, there are two opposing views. On the one hand, Hakkio and Rush [13] suggest that if two variables are co-integrated, in the long-run these two variables will have a common trend. Also, to meet the requirement of market efficiency, co-integration must exist in the futures and spot market. That is, based on the market efficiency, the futures prices will not be consistently above or below the spot prices. If co-integration does not exist between two variables, then in the long-run, these two set of prices will not converge, contradicting with the EMH. On the other hand, Granger [14] suggests that if co-integration exists between two variables, this means that the futures prices can be used to predict spot prices. That is, the spot market is led by the futures, thereby providing opportunities to make profits. Therefore, if co-integration exists between two variables, the market is inefficient. Hence, the objectives of this study are to test these two arguments using the optimal coefficients in program trading and to find steady investment strategies.

3. METHODS

3.1 Analytical Models

3.1.1 Vector auto-regression (VAR)

To ensure that all variables in the model have the causal relationship and to avoid the recognition problem when estimating traditional simultaneous structural equations, Sims [15] apply the vector auto-regression model in econometrics. All variables in the model are lagged variables of themselves. As all variables are endogenous variables, they can be used to predict a relevant time series system and how random events affect this system. In this study, the three variables in the model are y_{it}, y_{2t}, y_{3t}. Variable in time t is based on the variable in the prior time k and error term. y_{1t}, is the dependent (target industry) variable, y_{2t} and y_{3t} are independent (reference industry) variables. The following section 5.2 shows that y_{1t}, is D(B2542), and y_{2t} and y_{3t} are D(B50) and D(B2548) respectively. Therefore, the following shows VAR(1) (i.e., k = 1) as an example:

$$
\begin{aligned}
y_{it} &= m_1 + a_{11} y_{1,t-1} + a_{12} y_{2,t-1} + a_{13} y_{3,t-1} + \varepsilon_{1t} \\
y_{2t} &= m_2 + a_{21} y_{1,t-1} + a_{22} y_{2,t-1} + a_{23} y_{3,t-1} + \varepsilon_{2t} \quad \ldots\ldots\ldots\ldots\ldots\ldots (1) \\
y_{3t} &= m_3 + a_{31} y_{1,t-1} + a_{32} y_{2,t-1} + a_{33} y_{3,t-1} + \varepsilon_{3t}
\end{aligned}
$$

Where $E(\varepsilon_{it}) = 0, \forall i = 1,2,3; Var(\varepsilon_t) = E(\varepsilon_t \varepsilon_t^{'}) = \Sigma, \forall t, E(\varepsilon_{it}\varepsilon_{is}) = 0, \forall t \neq s, i = 1,2,3.$

The error term ε_{it} is white noise. The causality test, which is the focus of this study, impulse response function and forecast error variance decomposition can then be developed based on this model.

In order to understand the dynamic relationship between variables, this study further employs the variance decomposition function to find out which variables have stronger exogenous property. That is, the volatility of each endogenous variable is decomposed into random errors in separate equations, where higher contribution means that the variable is more important. The vector auto-regression model is:

$BX_t = \Gamma_0 + \Gamma_1 X_{t-1} + \Gamma_2 X_{t-2} + ... + \Gamma_p X_{t-p} + \varepsilon_t$ where B is the parameter matrix, $X_t,\ldots,X_{t-p}$ is the variable matrix, and $\Gamma_0,...,\Gamma_p$ is the parameter matrix. This can be transposed to: $X_t = A^{-1}\Gamma_0 + A^{-1}\varepsilon$. Therefore, $A = B - \Gamma_1 L - \Gamma_2 L^2 - ... - \Gamma_p L^p$ where L is a lagged factor and A is a matrix consisting of multiple lagged factors, which forms the Vector Moving Average (VMA) model, as shown below:

$$X_t = \alpha_0 + \varphi_0 \varepsilon_t + \varphi_1 \varepsilon_{t-1} + ... + \varphi_p \varepsilon_{t-p} + ... \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

where $\varphi_{\mathrm{p}} = (\varphi_{\mathrm{p,ij}})$ is a coefficient matrix with p=0,1,…, and impulse on y_j is caused by the functions $\varphi_{0,\mathrm{ij}}, \varphi_{1,\mathrm{ij}}, \ldots$

The variance decomposition model used in this study is as follows:

$$\mathrm{VC_{ij}(S)} = \frac{\sum_{p=0}^{s-1} (\varphi_{\mathrm{p,ij}})^2 \sigma_{\mathrm{ij}}}{\mathrm{Var(y_{it})}} = \frac{\sum_{p=0}^{s-1} (\varphi_{\mathrm{p,ij}})^2 \sigma_{\mathrm{jj}}}{\sum_{j=1}^{k} (\sum_{p=0}^{s-1} (\varphi_{\mathrm{p,ij}})^2 \sigma_{\mathrm{jj}})} \quad \text{(3)}$$

where $\varphi_{\mathrm{p,ij}}$ is the impulse response function. σ_{jj} is the standard deviation of the j^{th} component's white noise series. y_{it} is the i^{th} component's vector auto-regression (VAR). $VC_{ij}(S)$ is the variance contribution of the j^{th} component on the i^{th} component. This study then uses this method to decompose the impact of variables on the system and determine how this variation impacts on other variables in the system. Prior studies have adopted the Cholesky decomposition. However, the results from this method may vary if the order of the variables changes and there may be more than one solution. Therefore, this study avoids this problem by keeping the order of the variables consistent throughout the analysis. The simulation results are provided in the Appendix.

3.1.2 Granger causality

As the relationship between stock prices and securities lending by foreign institutional investors (FINI) is still inconclusive, the Granger [16,17] causality test can help understand how they are related. For example, we can examine if the correlation coefficients of the current y series and past values of the x series have causal relationship; that is, to observe the degree to which the past values of x can explain the present y. Specifically, if adding a lagged value of x or the correlation coefficient of x and y are statistically significant, then we can conclude that y is Granger caused by x.

If the series does not have a unit root, the causality test can be represented by the model below:

$$\begin{aligned} Y_{t1} &= \delta_0 + \sum_{i=1}^{m} \delta_i Y_{t1-i} + \sum_{i=1}^{m} \gamma_i Y_{t2-i} + \varepsilon_t \\ Y_{t2} &= \lambda_0 + \sum_{i=1}^{n} \lambda_i Y_{t2-i} + \sum_{i=1}^{n} \omega_i Y_{t1-i} + \nu_t \end{aligned} \quad \text{(4)}$$

where ε_t and ν_t in equation (4) are white noise error terms. m and n are the optimal lag periods based on SC's minimum value. The null hypothesis is that Y_2 has a Granger lead on Y_1. The alternative hypothesis is that Y_1 has a Granger lead on Y_2. If both γ and ω do not equal to 0, this means that there is bidirectional causality.

3.1.3 Co-integration Test

Engle and Granger [18] propose the two-stage testing for co-integration, and the method is as follows:

1. Use OLS to regress Y_t on X_t

$$Y_t = \alpha_0 + \alpha_1 X_t + \varepsilon_t \quad (5)$$

and use the residuals in the next stage.

$$\hat{\varepsilon}_t = Y_t - \hat{\beta}_0 - \hat{\beta}_1 X_t \quad (6)$$

2. Conduct a unit root test on residuals

$$\Delta \hat{\varepsilon}_t = \varphi \hat{\varepsilon}_{t-1} + \nu \quad (7)$$

The null hypothesis H_0 is that there is no co-integration; the alternative hypothesis H_1 is that there exists co-integration. The testing statistic is $\tau = \hat{\varphi} / Se(\hat{\varphi})$.

3.2 Experimental Design and Estimation Method

Based on the simulation results from program trading, this study conducts tests in two stages. In the first stage, which is between 2 January 2007 and 2 August 2010, we obtain the optimal simulation result. The optimal coefficient is then substituted in the second stage between 2 January 2007 and 1 February 2013. If investors are still able to make abnormal returns, this suggests that the market is inefficient.

Based on the design of program trading by Williams [19], we include two additional datasets apart from the stock prices in the construction industry (Data 1). These two dataset include domestic information and FINI information, and they are described as below:

1. Domestic information uses Taiwan 50 stock prices (Data 2) and Huaka stock prices (data 3) as the filters[1].
2. FINI information uses net spot value of FINI (Data 2) and net securities lending value of FINI (data 3) as the filters.

Using filters can effectively raise the trading profits. This study's estimation model is based on the following trading strategies

1. Long positions: (1) The RSI of data 1 rises and crosses the buying point of its RSI. (2) The RSI of data 2 rises and crosses the buying point of its RSI. (3) The RSI of data 3 rises and crosses the buying point of its RSI.
2. Short positions: (1) The RSI of data 1 falls and crosses the selling point of its RSI. (2) The RSI of data 2 falls and crosses the selling point of its RSI. (3) The RSI of data 3 falls and crosses the selling point of its RSI.

[1] According to Aldridge [20], we should choose markets that have large trading volumes, high volatilities or large price variations.

3. Closed position: When the RSI of data 2 falls below a certain high value, then the strategy is to sell the long position. On the other hand, when the RSI of data 2 rises above a certain low value, then the strategy is to do a short cover.

Apart from these basic settings, this study also uses the optimal program of MultiCharts program trading to conduct back-testing.[2]

4. DATA

The objective of this study is to analyze the investment strategies for the construction stocks. The first event that affects the construction industry, that is, the proposal of Urban Renewal Plan on 2 August 2010, is used as the cut-off date in program trading simulation to divide the sampling period into before-event period and after-event period. The daily data required for investment simulation in program trading are obtained from Taiwan Economic Journal. The daily data used include (1) daily trading prices of construction stocks, (2) daily trading prices of Taiwan 50 ETF, (3) net spot value of FINI, and (4) daily net securities lending value of FINI. Apart from the spot value and net securities lending value of FINI are I(0), the stock price index including intercept and trend are I(1). In order to proceed with co-integration test, we differentiate data 1 and data 2, which are stationary series of I(0), and therefore we can proceed with further testing.

5. RESULTS

5.1 Unit Root Test of VAR model

To ensure the validity of empirical results, we need to ensure that the series are stationary. Therefore, following the testing steps of VAR outlined in Chung, Chou and Sun [21], we choose the test for minimal AIC value. The results show that at level, besides the securities lending and spot value of FINI are I(0), the daily data of other stock indexes including Taiwan 50 are not stationary (Table 1). This also suggests the data has a fat tail and the series has autocorrelation. If after differentiating I(0), it becomes a stationary series; then, we can proceed with VAR testing.

Table 1. Unit root test of VAR model

Variable/Model	Intercept	Trend & intercept	None
0050(level)	-1.9379(0)	-1.9098(0)	-0.4057(0)
0050(differentiation)	-39.0260(0)*	-39.0162(0)*	-39.0385(0)*
2542(level)	-1.4501(0)	-1.9501(0)	-0.1967(0)
2542(differentiation)	-36.4605(0) *	-36.4539(0) *	-36.4680(0)*
2545(level)	-1.9944(1)	-2.0453 (1)	-0.5547(0)
2545(differentiation)	-34.1764(0)*	-34.1803(0)*	-34.1816(0)*
5522(level)	-1.9343(0)	-2.0356(0)	-0.5441(0)
5522(differentiation)	-37.3067(0)*	-37.2984(0)*	-37.3191(0)*
5531(level)	-1.7835(1)	-2.2504(1)	-1.2651(1)
5531(differentiation)	-36.2484(0) *	-36.2365 (0)*	-36.2541(0)*

[2]As High-wealth Construction had the largest impact on its stock price when the Urban Renewal Plan was proposed on 2 August 2010, this study uses High-wealth Construction as an example in the following analyses. In addition, Highwealth Construction has high market value and the stock price is above $20. The next year's EPS and operating income are predicted to be $8.8 and $20,727 million, respectively.

5534(level)	-2.3952(1)	-2.6205(1)*	-0.4501(1)*
5534(differentiation)	-33.1778(0)*	-33.1978(0)*	-33.1883(0)*
2547(level)	-2.3144(1)	-2.1846(1)	-1.2309(1)
2547(differentiation)	-34.1764(0) *	-34.1803(0) *	-34.1816(0)*
2536(level)	-2.5459(1)*	-2.6527(1)	-0.8177(1)
2536(differentiation)	-33.5559(0) *	-33.5451(0) *	-33.5664(0)*
2520(level)	-1.9809(1)	-2.2527(1)	-0.2860(1)
2520(differentiation)	-35.4421(0)*	-35.4309(0)*	-35.4508(0)*
2548(level)	-2.6481(1)**	-2.6374(1)	-0.5644(1)
2548(differentiation)	-34.9092(1)*	-34.8982 (0)*	-34.9206(0)*
finiloan(level)	-36.3483(0)*	-36.3364(0)*	-36.2858(0)*
finispot(level)	-19.1710(1)*	-19.1715(1)*	-19.1720(1)*

*Note: Coding for individual stocks are High-wealth Construction (2542), Huang Hsiang Construction (2545), Farglory (5522), Shining (5531), Chong Hong Construction (5534), Radium Life Tech (2547), Hung Poo (2536) and Kindom (2520). finiloan is the stock lending by FINI. finispot is the spot value of FINI. According to Mackinnon [22],*indicates significance at the 1% level and ** indicates significance at the 5% level. (0) means that AIC is at the minimum when the lag period is 0. This is evident in securities lending by FINI, spot value of FINI, High-wealth Construction (B2542), Taiwan 50 (B50), Huaku (B2548). AIC is also at the minimum in period 0 when the first differentiation and lagged period are executed on data.*

5.2 VAR Causality Test

The estimation results of VAR model are presented in Table 2. After differentiation, Taiwan 50 (B50) significantly leads the stock prices of Huaku (B2548) and High-wealth Construction (2542) by one period. After differentiation, the stock prices of Huaku (B2548) also lead Taiwan 50 (B50). Therefore, these three variables are included in the back-testing based on the optimization of program trading simulation.

Table 2. Estimation results of VAR model

	D(B2542)	D(B50)	D(B2548)
D(B2542(-1))	0.046298	0.018755	0.069828
	(0.03171)	(0.02110)	(0.05787)
	[1.45989]	[0.88881]	[1.20670]
D(B50(-1))	0.134190	0.040747	0.458016
	(0.04358)	(0.02900)	(0.07952)
	[3.07924]	[1.40524]	[5.75984]
D(B2548(-1))	-0.017928	-0.047918	0.018559
	(0.01714)	(0.01141)	(0.03128)
	[-1.04588]	[-4.20120]	[0.59334]
C	0.013254	-0.002585	0.004052
	(0.03012)	(0.02004)	(0.05497)
	[0.43998]	[-0.12895]	[0.07372]
Determinant resid covariance (dof adj.)		2.051727	
Determinant resid covariance		2.035529	
Log likelihood		-6992.085	
Akaike information criterion		9.240218	
Schwarz criterion		9.282359	

Note: same as Table 1.

5.3 Granger Causality Test

5.3.1 Granger Causality Test of High-wealth Construction, Taiwan 50 and Huaku

This section conducts Granger causality test of the daily spot net long/short value of securities investment trust, securities lending value by FINI and Taiwan Index Futures. The results show that after lagging one period and differentiating, Taiwan 50 (B50), Huaku (B2548), and High-wealth Construction (B2542) have unidirectional Granger causality relationship as shown in Table 3 and the Appendix. In other words, the stock price of Taiwan 50 is the Granger cause of High-wealth Construction. Similarly, W.I.S.E. Yuanta/P-shares CSI 300 ETF is the Granger cause of High-wealth Construction. Also, Taiwan 50 (A50A) and Huaku (2548) are Granger cause of each other. Therefore, in the next section, we will further include these three variables in the back-testing model using program trading to see if securities lending has any effect on the performance of securities investment trust.

Table 3. Granger causality test of Highwealth Construction, Taiwan 50 and Huaku

Null hypothesis	Sample size	F-statistics	Prob.
D(B50) does not Granger cause D(B2542)	1516	8.47764	0.0036
D(B2542) does not Granger cause D(B50)		1.38499	0.2394
D(B2548) does not Granger cause (B2542)	1516	0.08982	0.7644
D(B2542) does not Granger cause D(B2548)		7.14901	0.0076
D(B2548) does not Granger cause D(B50)	1516	18.2628	2.E-05
D(B50) does not Granger cause D(B2548)		39.0090	5.E-10

Note: same as Table 1.

5.3.2 Variance Decomposition Analysis

Based on the variance decomposition results, Taiwan 50 (A50A) has the largest impact from itself, and the contribution weighting is 99.27%. High-wealth Construction (B2542) also has great impact on Taiwan 50 (B50), with the contribution weighting of 26.57%. In addition, Huaku (B2548) is influenced by High-wealth Construction (B2542), with contribution weighting of 33.55%.

Table 4. Variance decomposition analysis of Highwealth Construction, Taiwan 50 and Huaku

Variance Decomposition of D(B2542):				
Period	S.E.	D(B2542)	D(B50)	D(B2548)
1	1.420973	100.0000	0.000000	0.000000
2	1.618045	99.14655	0.281557	0.571894
3	1.935223	99.30792	0.220956	0.471125
4	2.146205	99.25875	0.235167	0.506083
5	2.363133	99.27882	0.225806	0.495375
6	2.551087	99.27135	0.226899	0.501750
7	2.730641	99.27477	0.224428	0.500806
8	2.897138	99.27388	0.223832	0.502287
9	3.055422	99.27461	0.222808	0.502584
10	3.205530	99.27461	0.222203	0.503191

Variance Decomposition of D(B50):

Period	S.E.	D(B2542)	D(B50)	D(B2548)
1	0.902244	19.56054	80.43946	0.000000
2	0.959293	20.62342	78.91566	0.460925
3	1.093682	22.52644	70.94595	6.527608
4	1.178548	23.66911	68.67065	7.660233
5	1.271303	24.43230	66.51236	9.055343
6	1.351683	25.08734	65.00345	9.909211
7	1.430063	25.56259	63.75240	10.68502
8	1.503302	25.97067	62.76039	11.26894
9	1.573588	26.29504	61.93696	11.76800
10	1.640671	**26.57380**	**61.24619**	12.18001

Variance Decomposition of D(B2548):

Period	S.E.	D(B2542)	D(B50)	D(B2548)
1	2.447965	29.85460	13.43951	56.70589
2	2.842176	31.22371	24.66765	44.10864
3	3.342422	31.77608	32.06182	36.16210
4	3.704351	32.42272	35.45064	32.12663
5	4.062921	32.71971	37.85567	29.42462
6	4.380646	33.00658	39.56501	27.42841
7	4.681662	33.18296	40.87038	25.94667
8	4.962405	33.34035	41.87690	24.78275
9	5.228959	33.45695	42.68835	23.85470
10	5.482204	**33.55706**	**43.35107**	23.09186

Cholesky Ordering: D(B2542) D(B50) D(B2548)

5.4 Analysis Using Impulse Response Function

For each stock, the greatest impact on stock price comes from the stock itself. For example, the impact response of High-wealth Construction (B2542) is 0.9659 and Taiwan 50 (b50) is 0.3390. In addition, the High-wealth Construction (B2542) has a significant impact on Taiwan 50 (B50) and Huaku (B2548); the impact responses are 0.2533 and 0.9683 respectively. As shown in Fig. 5., most of the impulse responses are positive and the fluctuations slow down after the fourth period. On the other hand, the impulse response of High-wealth Construction (B2542) from Huaku (B2548) is negative (-0.1909). The impulse response of Huaku (B2548) from Taiwan 50 (B50) is the greatest (1.1649). These results have the same implication as the previous section.

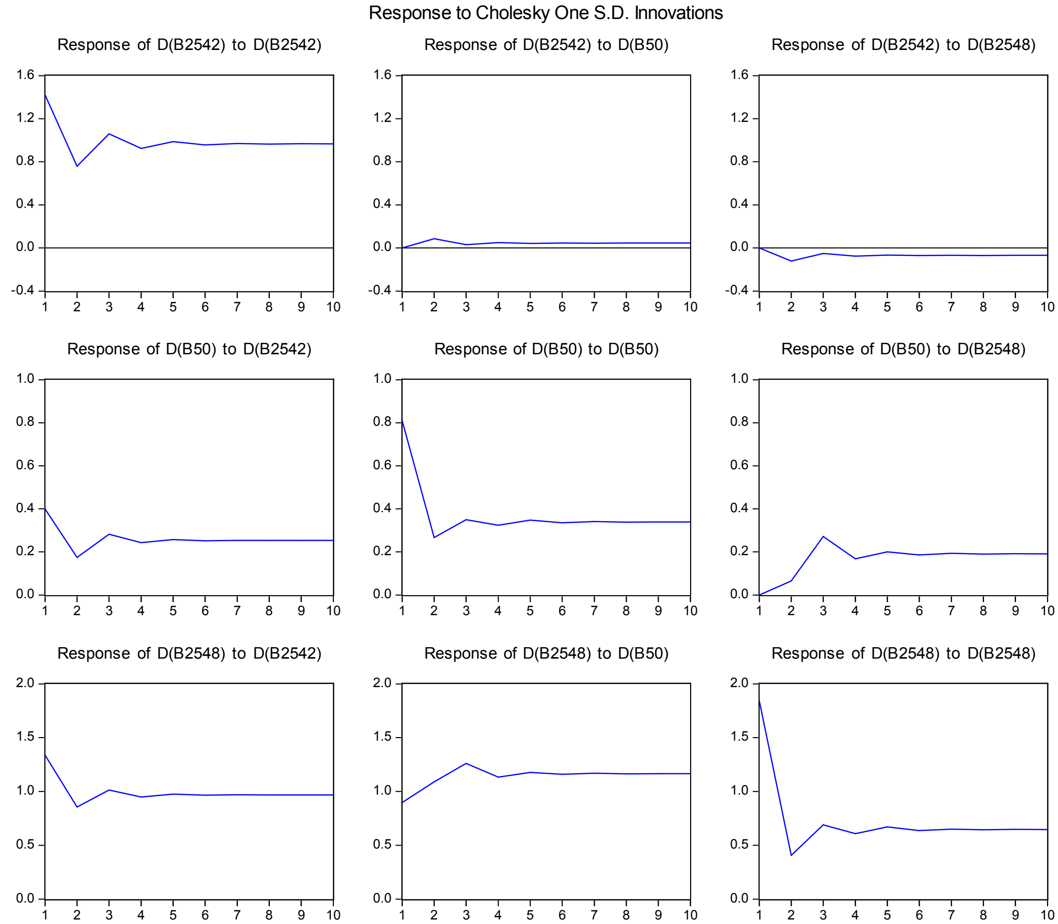

Fig. 5. The impulse response function of Highwealth Construction (B2542), Taiwan 50 and Huaku (B2548)

5.5 Co-integration Test

This study hypothesizes that the stock price indexes have intercepts and trends. Therefore, the OLS regression model (including intercepts and trends) of individual stocks is as follows: D(B2542)= C(1) +C(2)*D(B50) +C(3)*D(B2548). We conduct a two-stage co-integration test of Taiwan 50 D(B50) and Huaku (B2548) on High-wealth Construction (B2542) and the result is ADF=-38.0446 with stationary residuals. Therefore, we conclude that there exists co-integration (Table 5 and 6). The OLS results of other stocks are presented in Table 7. The ADF test (unreported) also shows that the residuals are a stationary series. Moreover, we find that the construction stocks do not have same stage co-integration; that is, the coefficients C(2) are all insignificant. Therefore, due to space limitation, these results are not reported.

Table 5. OLS regression results

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.012925	0.024402	0.529692	0.5964
C(2)	0.337057	0.034237	9.844783	0.0000
C(3)	0.249423	0.012324	20.23837	0.0000
R-squared	0.349559	Adjusted R-squared		0.348700
F-statistic	406.8256			

Table 6. Unit root test of residuals

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID01DB2542(-1)	-0.977688	0.025698	-38.04469	0.0000
C	-0.024537	0.048887	-0.501917	0.6158
@TREND(1001)	3.29E-05	5.58E-05	0.589728	0.5555
Akaike info criterion	2.737716	Schwarz criterion		2.748251

Table 7. OLS analysis of construction stocks

Variable/Coefficient	C(1)	C(2)	C(3)
D(B2542)	0.0129(0.5296)	0.3370(9.8447)	0.2494(20.2383)
D(B2545)	0.0036(0.0971)	0.4470 (8.3855)	0.4513(23.5161)
D(B5522)	0.0008(0.0221)	0.5333(9.9184)	0.4129(21.3343)
D(B5531)	-0.0271(-0.7333)	0.4065(7.8189)	0.3793(20.2717)
D(B5534)	0.0068(0.2102)	0.3790(8.2377)	0.5609(33.8644)
D(B2547)	-0.0131(-0.7311)	0.2259(8.9650)	0.2003(22.0855)
D(B2536)	-0.0053(-0.2420)	0.3121(1.9754)	0.2616(23.2291)
D(B2520)	0.0057(0.4914)	0.1872(11.3875)	0.1322(22.3443)

*Note: Coding for individual stocks are High-wealth Construction (2542), Huang Hsiang Construction (2545), Farglory (5522), Shining (5531), Chong Hong Construction (5534), Radium Life Tech (2547), Hung Poo (2536) and Kindom (2520). The analysis is based on the following model: D(individual stock code)= C(1) +C(2)*D(B50) +C(3)*D(B2548).*

5.6 Empirical Results of a Listed Construction Stock, High-wealth Construction

Based on the above model, this study simulates the investment of High-wealth Construction (B2542). The results show that between 2 January 2007 and 2 August 2010, the profit is $29.3, and between 2 January 2007 and 1 February 2013, the profit increases to $35.5. The stock price rises by 23% from $50 on 16 August 2010 to $61.5 on 1 February 2013. Using the program trading information of High-wealth Construction, the profit increases to 32%, showing that despite the volatility in stock markets, investors can profit from program trading (Fig. 6). The program trading simulation results of other major construction stocks are reported in Table 8.

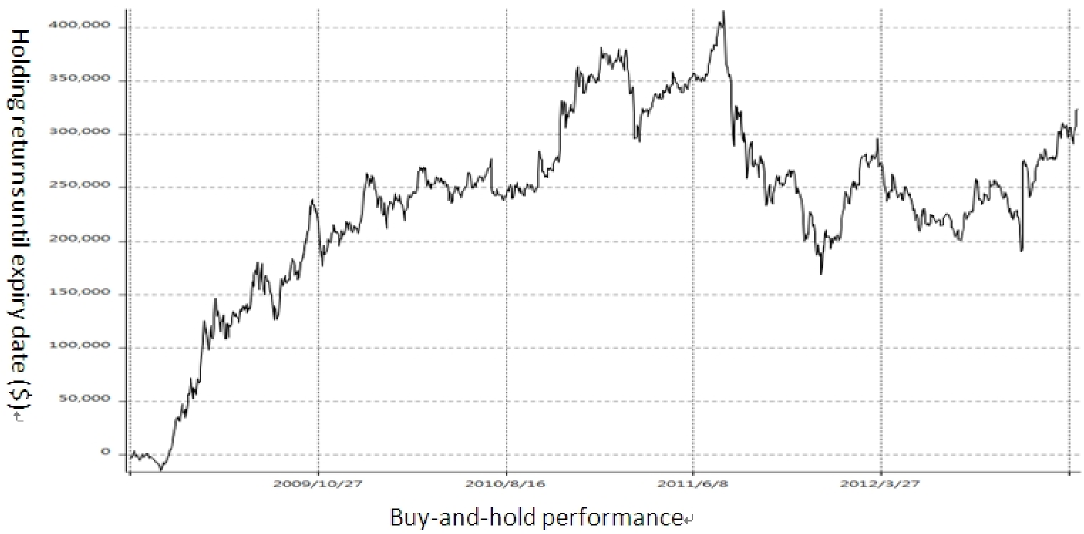

Fig. 6. Buy-and-hold performance of Highwealth Construction (2007.01.02-2013.02.01)

Table 8. Results of program trading simulation

	FINI information		Domestic information	
	(1)	(2)	(1)	(2)
5522	23.65	--	52.3	20.1
2542	32.5	38.1	29.3	35.5
2511	33.93	--	8.52	--
2545	72.25	--	18.1	--
2501	16.93	--	6.55	--
5534	99.59	109.79	42.7	43.4
2504	6.09	4.49	3.06	2.59
2547	7.1	4.4	8.1	10.8
5531	22.5	--	29.9	--
2536	38.15	37.05	26.5	27.95
2524	41.8	39.8	11.5	--

Note: (1) represents the program trading simulation for the period 2 Jan 2007 - 2 Aug 2010; (2) represents the program trading simulation for the period 2 Jan 2007 - 1 Feb 2013.

6. CONCLUSION

On 24 June 2010, the Taipei City Government announced a new urban renewal project, which aimed at renewing four to five-story apartment buildings and providing more incentives to construction companies and residents in order to persuade them to participate in the project. The announcement had led to rising stock prices in the construction industry in August and September of the same year. However, the protests by home owners in Shilin District on 28 March 2012 where the Taipei City Government evicted the owners of two buildings in Shilin District and demolished their homes to make way for an urban renewal project had caused the stock prices in the construction industry to fall again. The Luxury Tax and the requirement to register at real prices for real estate transactions had made the housing market to plumb further. All these events have made investment choices more difficult for investors.

Moreover, to encourage foreign institutional investors to participate in our financial market, the Taiwan Government relaxed the restrictions on short selling from the year 2007. Lan, Chien and Chen et al. [23] show that investors, who possess the securities lending information of FINI have informational advantage in particular when trading in the futures market. This study analyzes the Taiwan stock market between 2007 and 2013 using program trading technique. The results show that investors are not able to make consistent profits in the construction market based on the securities lending information of FINI. However, they have greater chances of making profits based on the historical prices of Taiwan 50 and Huaku. The findings suggest that our construction market does not meet the weak-form market efficiency during the period between August 2010 and January 2013.

Specifically, this study simulates the situation where High-wealth Construction can use the FINI trading information or Taiwan's industrial information to conduct program trading. The results show that using the domestic industrial information between 2 January 2007 and 2 August 2010, the trading profit is $29.3 and the profit increases to $35.5 when the simulation period extends to 1 February 2013. In contrast, the trading profit does not increase when FINI trading information is used. The evidence is consistent with Granger's [14] argument that investors are able to make profits in the long-run in markets that are co-integrated, and therefore, these markets are inefficient. Investors can also construct investment portfolios in co-integrated markets. Some individual stocks may be co-integrated but the profits do not increase. This phenomenon is consistent with Chan's [24] argument that co-integration is a sufficient condition but not a necessary condition. Moreover, even if price series are not co-integrated, in the short-run there are still many opportunities for the price to turn around. Therefore, traders can still make profits just like the sample companies, High-wealth Construction and Radium Life Tech Co., in this study. Overall, this study shows that the chances of making profits are lower when FINI trading information is used than when domestic industrial information is used. This means that investors are able to make abnormal returns if they select the industrial information carefully. Therefore, we do not find evidence consistent with the weak-form market efficiency in the construction industry during the sample period.

One limitation of this study is that due to time constraints and the limited number of sample companies in the construction industry, we are not able to do statistical testing or optimal back-testing simulations.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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APPENDIX 1

1. High-wealth Construction (2542)

Null Hypothesis:	Obs.	F-Statistic	Prob.
D(B50) does not Granger Cause D(B2542)	1516	8.47764	0.0036
D(B2542) does not Granger Cause D(B50)		1.38499	0.2394
D(B2548) does not Granger Cause D(B2542)	1516	0.08982	0.7644
D(B2542) does not Granger Cause D(B2548)		7.14901	0.0076
D(B2548) does not Granger Cause D(B50)	1516	18.2628	2.E-05
D(B50) does not Granger Cause D(B2548)		39.0090	5.E-10

2. Huang Hsiang Construction (2545)

Null Hypothesis:	Obs.	F-Statistic	Prob.
D(B50) does not Granger Cause D(B2545)	1516	20.0801	8.E-06
D(B2545) does not Granger Cause D(B50)		4.14314	0.0420
D(B2548) does not Granger Cause D(B2545)	1516	5.53770	0.0187
D(B2545) does not Granger Cause D(B2548)		4.37116	0.0367
D(B2548) does not Granger Cause D(B50)	1516	18.2628	2.E-05
D(B50) does not Granger Cause D(B2548)		39.0090	5.E-10

3. Farglory (5522)

Null Hypothesis:	Obs.	F-Statistic	Prob.
D(B50) does not Granger Cause D(B5522)	1516	23.8550	1.E-06
D(B5522) does not Granger Cause D(B50)		2.81695	0.0935
D(B2548) does not Granger Cause D(B5522)	1516	6.92878	0.0086
D(B5522) does not Granger Cause D(B2548)		1.33923	0.2474
D(B2548) does not Granger Cause D(B50)	1516	18.2628	2.E-05
D(B50) does not Granger Cause D(B2548)		39.0090	5.E-10

4. Shining (5531)

Null Hypothesis:	Obs.	F-Statistic	Prob.
D(B50) does not Granger Cause D(B5531)	1516	38.3530	8.E-10
D(B5531) does not Granger Cause D(B50)		10.7610	0.0011
D(B2548) does not Granger Cause D(B5531)	1516	6.40092	0.0115
D(B5531) does not Granger Cause D(B2548)		6.14451	0.0133
D(B2548) does not Granger Cause D(B50)	1516	18.2628	2.E-05
D(B50) does not Granger Cause D(B2548)		39.0090	5.E-10

5. Chong Hong Construction (5534)

Null Hypothesis:	Obs.	F-Statistic	Prob.
D(B50) does not Granger Cause D(B5534)	1516	23.5954	1.E-06
D(B5534) does not Granger Cause D(B50)		7.91216	0.0050
D(B2548) does not Granger Cause D(B5534)	1516	1.86377	0.1724
D(B5534) does not Granger Cause D(B2548)		9.92498	0.0017
D(B2548) does not Granger Cause D(B50)	1516	18.2628	2.E-05
D(B50) does not Granger Cause D(B2548)		39.0090	5.E-10

6. Radium Life Tech (2547)

Null Hypothesis:	Obs.	F-Statistic	Prob.
D(B50) does not Granger Cause D(B2547)	1516	8.54748	0.0035
D(B2547) does not Granger Cause D(B50)		11.8776	0.0006
D(B2548) does not Granger Cause D(B2547)	1516	0.06090	0.8051
D(B2547) does not Granger Cause D(B2548)		5.73216	0.0168
D(B2548) does not Granger Cause D(B50)	1516	18.2628	2.E-05
D(B50) does not Granger Cause D(B2548)		39.0090	5.E-10

7. Hung Poo (2536)

Null Hypothesis:	Obs.	F-Statistic	Prob.
D(B50) does not Granger Cause D(B2536)	1516	13.9182	0.0002
D(B2536) does not Granger Cause D(B50)		1.79477	0.1805
D(B2548) does not Granger Cause D(B2536)	1516	0.31163	0.5768
D(B2536) does not Granger Cause D(B2548)		24.2132	1.E-06
D(B2548) does not Granger Cause D(B50)	1516	18.2628	2.E-05
D(B50) does not Granger Cause D(B2548)		39.0090	5.E-10

8. Kindom (2520)

Null Hypothesis:	Obs.	F-Statistic	Prob.
D(B50) does not Granger Cause D(B2520)	1516	9.68183	0.0019
D(B2520) does not Granger Cause D(B50)		0.77678	0.3783
D(B2548) does not Granger Cause D(B2520)	1516	0.18016	0.6713
D(B2520) does not Granger Cause D(B2548)		3.94366	0.0472
D(B2548) does not Granger Cause D(B50)	1516	18.2628	2.E-05
D(B50) does not Granger Cause D(B2548)		39.0090	5.E-10

APPENDIX 2

A number of other tests of semi-strong form efficiency have been reported in the academic literature. If a capital market is relatively high degree of efficiency then one would expect that security prices would continuously reflect all available information. Meanwhile, if new information occurs randomly and security prices are a function of all available information, then one would expect that security prices would fluctuate randomly as randomly generated news is immersed in security prices.

Firstly, we need to locate an appropriate sampling of companies to study. These 41 construction stocks are defined by the classification of yahoo stock market and the daily trading prices are obtained from Taiwan Economic Journal. We establish a 61-day testing period for returns around the event dates, the event date plus 30 days before and 30 days after. We standardize event dates and compute returns for each stock during each of the days in the testing period.

Secondly, adopting the TWSE index as benchmark to determine normal returns for each of the securities for each date, we compute daily returns for the market index for each day in our 61-day testing period for each stock. One of our objectives is to determine whether any daily residual is statistically significantly different from zero. However, in some other instances, we might find that while no effect is found on the residual for any particular date, the effect might be realized over a period of days. We can compute cumulative average residuals to determine cumulative effects over time:

$$CAR_t = \sum_{i}^{t} AR_i.$$

If our hypotheses concerning each date t in our testing period were given as follows:

$$H_0 : CAR_t \le 0;\ H_A : CAR_t > 0,.$$

we would be able to reject the null hypothesis that $CAR_t \le 0$ with 95% confidence for any date in our event period as the empirical results showed below. Hence, we can conclude that the construction industry market did not fulfill the conditions of semi-strong form efficiency of market during this period.

Table 9. Cumulative Average Residuals of the Event of Governmental Actions

	20100802			20110301			20120801			20121119		
	CAR	statistics	prob.	CAR	statistics	prob.	CAR	statistics	prob.	CAR	statistics	prob.
-30	1.0201	3.3883	0.0007	-1.8026	-5.3787	0	-0.4994	-1.8385	0.066	-0.0699	-0.2621	0.7932
-29	1.5918	3.7281	0.0002	-3.1945	-6.732	0	0.5767	1.5071	0.1318	-0.0584	-0.1552	0.8766
-28	1.7095	3.2575	0.0011	-3.9069	-6.722	0	1.6387	3.5132	0.0004	0.1916	0.4174	0.6764
-27	1.8985	3.124	0.0018	-2.4805	-3.7007	0.0002	2.8503	5.3167	0	-0.0165	-0.0311	0.9752
-26	0.4033	0.5917	0.554	-3.8476	-5.1428	0	2.1861	3.6629	0.0002	-0.2202	-0.3729	0.7092
-25	-0.0353	-0.0472	0.9624	-3.4987	-4.2758	0	1.8405	2.8256	0.0047	-1.0012	-1.5514	0.1208
-24	0.4759	0.5874	0.5569	-5.7874	-6.558	0	2.2806	3.2518	0.0011	-1.1762	-1.6905	0.0909
-23	0.9843	1.1333	0.2571	-6.0598	-6.4319	0	1.2844	1.717	0.086	-1.0824	-1.4575	0.145
-22	1.549	1.6775	0.0935	-5.887	-5.8968	0	1.0657	1.3457	0.1784	-1.3337	-1.6953	0.09
-21	1.5267	1.566	0.1173	-5.9158	-5.6284	0	0.8916	1.0698	0.2847	-1.0674	-1.2885	0.1976
-20	0.6845	0.668	0.5041	-5.6908	-5.1671	0	0.8623	0.9881	0.3231	-1.4782	-1.7026	0.0886
-19	0.0253	0.0236	0.9812	-6.4994	-5.6551	0	1.0855	1.1925	0.233	-0.9903	-1.0928	0.2745
-18	0.6419	0.5743	0.5658	-6.6129	-5.5326	0	0.4644	0.4907	0.6236	-1.3401	-1.4218	0.1551
-17	-0.1308	-0.1126	0.9103	-7.1681	-5.7827	0	0.8027	0.8182	0.4133	-2.0748	-2.1222	0.0338
-16	-0.6611	-0.5492	0.5829	-7.8447	-6.1175	0	1.0585	1.0431	0.2969	-4.0876	-4.0387	0.0001
-15	-0.974	-0.7827	0.4338	-8.9834	-6.7867	0	0.8514	0.813	0.4162	-4.1004	-3.9236	0.0001
-14	-1.0487	-0.8167	0.4141	-8.634	-6.3314	0	1.6338	1.5143	0.13	-3.3406	-3.1024	0.0019
-13	-1.9305	-1.4595	0.1444	-6.9609	-4.9627	0	1.3384	1.2062	0.2278	-3.5593	-3.2136	0.0013
-12	-1.3626	-1.0019	0.3164	-6.161	-4.2758	0	1.0176	0.893	0.3718	-3.5456	-3.1169	0.0018
-11	-0.484	-0.3466	0.7289	-6.9042	-4.6694	0	0.9706	0.8306	0.4062	-2.4621	-2.1101	0.0349
-10	0.4076	0.2846	0.776	-7.4307	-4.9069	0	1.6915	1.4131	0.1576	-2.9653	-2.4807	0.0131
-9	-0.2829	-0.1928	0.8471	-8.1744	-5.2754	0	1.2599	1.0287	0.3036	-3.1654	-2.5877	0.0097
-8	-0.5002	-0.3332	0.739	-7.9374	-5.0113	0	1.1896	0.9502	0.342	-2.6216	-2.0962	0.0361
-7	0.3928	0.256	0.7979	-9.0402	-5.5888	0	1.2138	0.9492	0.3425	-2.4272	-1.9002	0.0574
-6	0.6437	0.4108	0.6812	-7.8135	-4.7335	0	1.3009	0.9969	0.3188	-2.0454	-1.5692	0.1166
-5	0.5532	0.3459	0.7294	-8.0031	-4.7551	0	1.8109	1.361	0.1735	-1.4293	-1.0753	0.2822
-4	0.747	0.4581	0.6469	-8.754	-5.1045	0	2.0701	1.527	0.1268	-1.5877	-1.172	0.2412
-3	2.3628	1.4223	0.1549	-8.8132	-5.0461	0	0.6538	0.4735	0.6358	-1.7229	-1.249	0.2117
-2	1.7951	1.0612	0.2886	-9.432	-5.3073	0	0.721	0.5131	0.6079	-1.6676	-1.188	0.2348
-1	2.1843	1.2689	0.2045	-13.0682	-7.2304	0	-0.0997	-0.0698	0.9444	-1.8032	-1.263	0.2066
+0	1.6984	0.9701	0.332	-14.3079	-7.7874	0	0.2025	0.1394	0.8892	-2.1003	-1.4473	0.1478
+1	2.329	1.3087	0.1907	-13.2448	-7.0962	0	0.5704	0.3864	0.6992	-2.9211	-1.9812	0.0476
+2	2.1148	1.1696	0.2421	-14.2546	-7.5214	0	0.301	0.2008	0.8409	-3.5348	-2.3609	0.0182
+3	2.4642	1.3422	0.1795	-17.5435	-9.1196	0	0.2952	0.194	0.8462	-3.6912	-2.4288	0.0151
+4	2.3763	1.2752	0.2022	-18.695	-9.5788	0	0.6996	0.4532	0.6504	-4.5913	-2.9761	0.0029
+5	2.1158	1.119	0.2631	-18.3713	-9.2816	0	0.7205	0.4601	0.6454	-4.829	-3.0852	0.002
+6	1.927	1.005	0.3149	-18.172	-9.0561	0	0.5102	0.3214	0.7479	-4.8647	-3.0656	0.0022
+7	2.2648	1.165	0.244	-15.7092	-7.725	0	0.3622	0.2251	0.8219	-4.8544	-3.0186	0.0025
+8	3.3116	1.6808	0.0928	-15.3448	-7.448	0	-0.2104	-0.1291	0.8973	-5.1447	-3.1577	0.0016
+9	4.2482	2.1285	0.0333	-18.219	-8.7316	0	0.0965	0.0585	0.9534	-5.3183	-3.2227	0.0013
+10	3.7228	1.8417	0.0655	-19.8903	-9.413	0	2.4089	1.4411	0.1495	-5.4586	-3.267	0.0011
+11	5.4576	2.6668	0.0077	-19.235	-8.9946	0	4.3245	2.556	0.0106	-5.2589	-3.1097	0.0019
+12	7.2532	3.5017	0.0005	-19.2966	-8.9178	0	4.0076	2.3408	0.0192	-5.3361	-3.1183	0.0018
+13	6.7822	3.2361	0.0012	-17.4799	-7.9854	0	3.3608	1.9404	0.0523	-3.8125	-2.2025	0.0276
+14	8.4471	3.9844	0.0001	-17.4124	-7.8649	0	4.1336	2.3597	0.0183	-4.7602	-2.7191	0.0065
+15	9.4467	4.406	0	-16.7862	-7.4987	0	5.2757	2.9785	0.0029	-4.9988	-2.8241	0.0047
+16	9.4174	4.3443	0	-16.5288	-7.3042	0	5.217	2.9136	0.0036	-5.2121	-2.913	0.0036
+17	8.0188	3.6587	0.0003	-16.3626	-7.1545	0	5.4844	3.0305	0.0024	-5.7976	-3.206	0.0013
+18	8.1299	3.6702	0.0002	-17.4267	-7.5411	0	6.269	3.428	0.0006	-5.4217	-2.967	0.003
+19	9.7857	4.3724	0	-18.0113	-7.7153	0	6.4555	3.4942	0.0005	-5.2623	-2.8508	0.0044
+20	9.2959	4.1118	0	-17.9427	-7.6097	0	6.5245	3.4964	0.0005	-4.674	-2.5068	0.0122
+21	8.6857	3.8038	0.0001	-18.0229	-7.5691	0	6.9444	3.6851	0.0002	-4.8705	-2.5869	0.0097
+22	11.2689	4.8875	0	-18.1613	-7.5542	0	7.7089	4.0514	0.0001	-4.9727	-2.6159	0.0089
+23	10.7377	4.6128	0	-17.0457	-7.0236	0	7.3973	3.8511	0.0001	-4.6199	-2.4076	0.0161
+24	8.4572	3.5989	0.0003	-18.2859	-7.4648	0	8.8825	4.5814	0	-4.7163	-2.435	0.0149
+25	7.6736	3.2354	0.0012	-17.2034	-6.959	0	8.8185	4.507	0	-4.8352	-2.4739	0.0134
+26	8.6829	3.6281	0.0003	-17.4529	-6.9971	0	9.0604	4.5892	0	-4.2095	-2.1347	0.0328
+27	8.6109	3.5663	0.0004	-16.6736	-6.6262	0	10.5747	5.3089	0	-3.1492	-1.583	0.1134
+28	7.9147	3.2495	0.0012	-15.9733	-6.2931	0	9.362	4.6595	0	-2.7879	-1.3894	0.1647
+29	7.3892	3.0078	0.0026	-15.8066	-6.1748	0	8.6333	4.2603	0	-2.9338	-1.4498	0.1471
+30	6.4644	2.6088	0.0091	-16.0491	-6.2173	0	8.3194	4.0711	0	-3.554	-1.7417	0.0816

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