Cultural Influence on Financial Record Clustering at Hong Kong Stock Exchange

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Abstract

This paper investigates the influence of Asian local culture on the number preferences of stock market participants at Hong Kong Stock Exchange. We conduct number clustering on calendar dates of trade over unique trade characteristics such as stock price, trade volume and trade frequencies. We highlight the use of days of the week as controls for lurking effects. We demonstrate the frequency distribution of price and shares are off the uniform distribution to imply that there are some stock related characteristics which are influenced by unique local culture. In turn, our logistic regression model indicates that the predictor variables that are under influence of Asian culture create clear evidence of date clustering for auspicious and inauspicious numbers in both solar and lunar calendar systems. We conclude that Asian culture and superstition appear to influence the number preference of market practitioners at the Hong Kong market during regular calendar dates.

Keywords: Numerical Clustering, Calendar Date Clustering, Cultural Influence on Clustering

I.   Introduction

A large amount of today's business transactions involves clustering of numbers which is based on superstitious beliefs from unique local culture. In this paper, we examine incidents of number clustering at Hong Kong Stock Exchange in terms of the impact of the Asian, more specifically Hong Kong cultural elements on the aspects of transaction records.

Numerical clustering is a trend that a given number is observed more frequently than others under specific conditions. We take a view that clustering results from market participants' preference about underlying value and they are influenced by unique local culture. We in fact observe that some numbers appear more frequently compared to the other numbers at Hong Kong market. While there have been studies on price clustering in the US and European asset markets and they have found a noticeable clustering evidence for round and even transaction numbers, there has been lack of study of examinations for the calendar dates in trading records which are influenced by local culture.

Underlying nature of Hong Kong local culture on numerical values is that each number in transaction records such as trade date, time, price and trade volumes have special meaning and significance to the market participants. Some numbers are recognized as lucky, productive, and well rounded to bring good fortune, and some numbers are translated in the opposite way. For example, numerical character 4 is notoriously known as unlucky number because it sounds like death in Chinese character pronunciation and the character 8 represents wealth, success and productiveness. The evidence on this type of cultural influence is found in many Asian countries and some prior works showed that the values in transaction records in Asian financial market are indeed influenced by this culture to generate preferred number clustering.

While the prior studies have focused more on clustering of ending digits of records, we extend the view to temporal terms to analyze the calendar date clustering that is influenced by asset prices, trade volumes and the trade frequencies controlling for the effect of days in the week using a dataset from Hong Kong stock markets.

For the time period, January 2007, of our dataset, Frequency distributions of ending price and trade volume in shares against ending digits of calendar dates (0 through 9) show that stock price and share clustering are prevalent. As expected, date value of 4 significantly reduces the magnitude of price and shares compared to other well-rounded (i.e., lucky) numbers such as 5, 6 and 8.
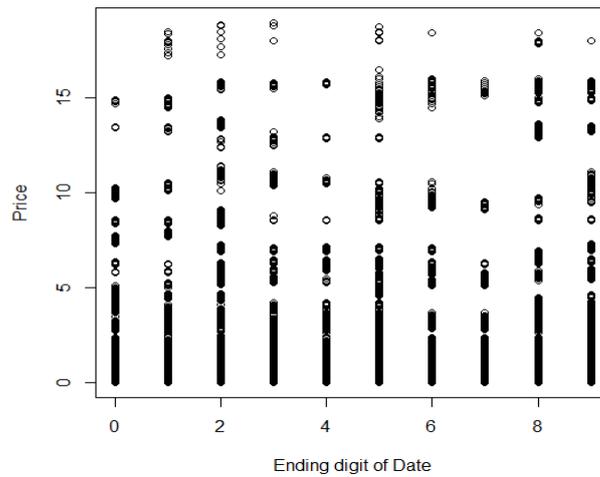

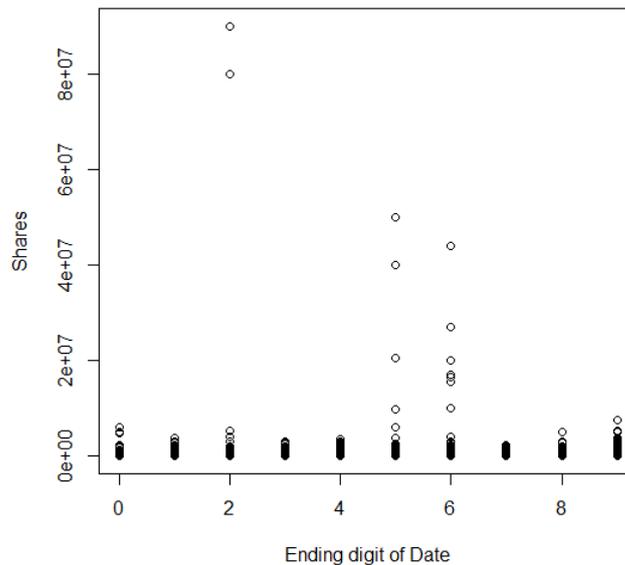**Figure 1.** Price against the ending digit of calendar dates

Figure 2. Trade volume (Shares) against the ending digit of calendar dates

Given that any numbers in transaction records can involve cultural implications, we highlight whether the day of the week (Monday through Friday) and the lunar calendar translation of dates factors help explain the impact of price and share on date clustering in the market. We conjecture that the date clustering for auspicious number such as 8 is

positively influenced by price, the trade volume in shares and trade frequencies. On the other hand, for a typical inauspicious number, 4, there should be significant reduction in those three factors. We further control for the day of the week effect so that unnecessary bias can be eliminated and the results can be significant. A similar pattern is expected in numeric translation of lunar calendar dates as the transaction operators in the market are dominated my Asian culture at Hong Kong.

Price clustering is observed in many studies. Niederhoffer (1965) found that the values of ending prices converges to whole numbers in New York Stock Exchange (NYSE) and Harris (1991) further argued that the convergence behavior is influenced by various market conditions. The fluctuating market conditions can be explained by the market participants' strategic behavior against uncertainty in the market.

Delving into the participants' behavior, according to Butler (1988), market participants' behavior tends to be biased by surrounding conditions. We note that this surrounding condition can involve unique local culture which dominates the geographical region where the market established. This nature of bias engenders preferences on specific numbers or clustering (Aitken et al., 1996 Grossman et al., 1997). This bias can be represented in the form of price or trading aspects in the clustering (Grossman et al., 1997; Harris, 1991 Hameed and Terry, 1998).

In our dataset for Hong Kong Stock Exchange, there is a clear evidence of local culture and biases on participants' valuation. Intuitively it is a market where the majority of participants are under influence of Asian culture which determines attractiveness and perception of numbers and, in turn, affects the selection of the numbers for transaction dates, times and days.

While a large portion of prior studies considered ending digits of prices as the main determinant of clustering (Donaldson and Kim 1993; Christie and Schultz 1994; Koedijk and Stork 1994; Gwilym et al. 1998; Kandel et al. 2001; Liu 2011), there has been a lack of study on the numerical representation of dates as well as days of the week effect (We assigned 1 through 5 for Monday through Friday as dummies). We also consider the lunar calendar based enumeration which reflects the local culture where our dataset is obtained.

Based on the heterogeneous numbers preference, we first hypothesize the distribution of prices and trade volumes in shares are not uniform. The following plots and Kolmogorov-Smirnov test results in section 3 confirms the arguments. By stating this, we mean that the price and share distribution is not just random occurring but they are influenced by surrounding cultural factors in the market.

H1. The frequency distribution of the prices and trade volume are not uniform.

Based on the assumption about the impact of local Asian culture on the value perception of market participants, it is obvious that people prefer auspicious numbers in dates. This will be even more prominent when they make decisions on high price item. They might tend to be more sensitive to auspicious (inauspicious) numbers in dates for higher share prices. We develop the following hypothesis

H2. As the share price increases (decreases), there will be more intense calendar date-clustering for auspicious (inauspicious) numbers.

A similar argument applies to the trade volumes in shares. We expect that people tend to be more sensitive to auspicious (inauspicious) numbers in dates for higher (lower) transaction volumes and give the following hypothesis

H3. The higher (lower) the trade volume is, the more intense (weak) date-clustering there will be for auspicious (inauspicious) numbers.
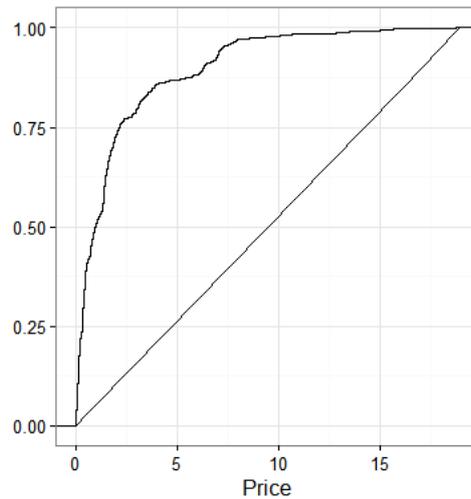
Figure 3. Cumulative distribution of Price against Uniform distribution
Kolmogorov-Smirnov test statistic is in section 3.
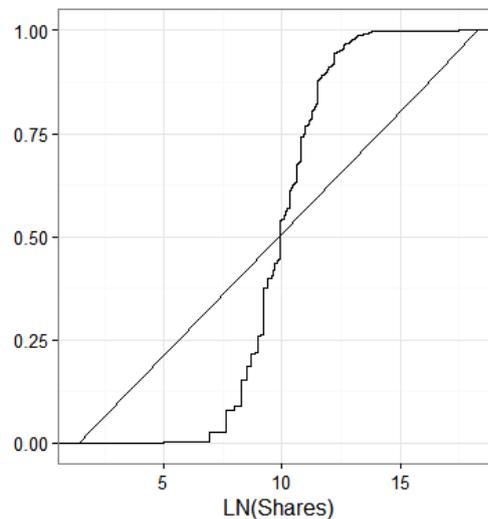
Figure 4. Cumulative distribution of trade volume, LN(Shares), against Uniform distribution
Kolmogorov-Smirnov test statistic is in section 3.

Another important aspect of a stock market is liquidity which can be represented by trade frequency. As this metric reflects the amount of information processed (Brown et al 2002) as well as the attempts of transaction for specific number preferences, it should affect our date clustering. We hypothesize that as transaction frequencies increase, there is higher date clustering.

   H4. When there is a high trade frequency for a given stock, there will be more intensive (positive/negative) date clustering (for auspicious/inauspicious numbers).

While prior studies considered the ending digit of prices and corresponding clustering, there has been lack of studies on the impact of calendar dates and days of the week. We assign numerical representations of days such as 1 for Mondays through 5 for Fridays and hypothesize that the clustering of day-metric is influenced by prices, trade volume and trade frequencies. In our research, the main dependent variables are auspicious (inauspicious) numbers in dates. We further control for the day of the week to eliminate any possible lurking bias. We also examine H2 through H4 for the date clustering on lunar calendar given that Hong Kong is under strong influence of Asian culture.

II.   Data

Our dataset includes 110,831 transaction records at Hong Kong Stock Exchange during the period of January 2007. We characterize the date clustering based on closing share prices of each day, trade volume and frequency as well as the numerical metrics of days, Monday through Friday. The sample included records during normal trade hours from 9 AM to 4 PM. To consider the beginning/ending digits of dates, we parsed those terms in separate variables and the time is also parsed to hour, minute and second components in different variables. The days are transformed to a numerical sequence such as Monday-1, Tuesday-2 ..., Friday-5 and the control dummies for the days are used in our regression models later. Considering the local cultural effects at Hong Kong, we exploited lunar calendar dates by extracting ending digits. Following table shows the detailed central tendencies and distribution patterns of the attributes in our data.

Table 1 Descriptive statistics

Variable	Description	mean	sd	median	min	max	skew	kurtosis
price	Ending price	1.99	2.68	1.00	0.00	18.98	2.39	6.72
shares	Number of shares traded	68538.31	561413.79	20000	4	90000000	118.21	16861.81
hour	Hour term in Time	12.34	2.10	12.00	9.00	16.00	0.16	-1.67
minute	Minute term in Time	30.43	17.73	31.00	0.00	59.00	-0.08	-1.21
second	Second term in Time	28.57	17.70	28.00	0.00	59.00	0.03	-1.24
date	Transaction date	17.94	8.89	18.00	2.00	31.00	-0.24	-1.09

dateFirst	First digit of date	2.44	1.88	2.00	1.00	9.00	2.12	4.31
dateLast	Ending digit of date	4.53	2.98	4.00	0.00	9.00	0.12	-1.25
day	Monday - Friday	2.92	1.38	3.00	1.00	5.00	0.11	-1.21
is1day	Monday dummy (1 if Monday 0 otherwise)	0.20	0.40	0.00	0.00	1.00	1.52	0.32
is2day	Tuesday dummy(1 if Tuesday 0 otherwise)	0.22	0.42	0.00	0.00	1.00	1.33	-0.22
is3day	Wednesday dummy(1 if Wednesday 0 otherwise)	0.23	0.42	0.00	0.00	1.00	1.30	-0.32
is4day	Thursday dummy(1 if Thursday 0 otherwise)	0.17	0.38	0.00	0.00	1.00	1.74	1.01
is5day	Friday dummy(1 if Friday 0 otherwise)	0.18	0.38	0.00	0.00	1.00	1.66	0.77
is4date	Ending digit of date 4 dummy	0.09	0.29	0.00	0.00	1.00	2.86	6.18
is8date	Ending digit of date 8 dummy	0.09	0.28	0.00	0.00	1.00	2.92	6.51
lis4date	Ending digit of lunar calendar date 4 dummy	0.14	0.34	0.00	0.00	1.00	2.13	2.54
lis8date	Ending digit of lunar calendar date 8 dummy	0.08	0.27	0.00	0.00	1.00	3.13	7.81

III.   Methods and Discussion

The dependent variables we use involve date values for auspicious/inauspicious numbers of the local culture of Hong Kong. Equation (1) and equation (2) respectively represent the intensity of clustering for 8 and 4. Independent variables include the three main market components (i.e., price, trade volume, and trade frequency) which represent the unique characteristic of daily trading for a given stock. Day dummy variables are used to control for the day of the week (Monday through Friday) effects. We consider the dominating local culture of Hong Kong in lunar calendric representation of number 8 and 4, which are regressed on the identical set of independent variables in equation (3) and equation (4).

$$is8date = \beta_0 + \beta_p \cdot price + \beta_s \cdot lnshares + \beta_1 \cdot liquidity + \beta_1 \cdot is1day + \beta_2 \cdot is2day + \beta_3 \cdot is3day + \beta_4 \cdot is4day \tag{1}$$

$$is4date = \beta_0 + \beta_p \cdot price + \beta_s \cdot lnshares + \beta_1 \cdot liquidity + \beta_1 \cdot is1day + \beta_2 \cdot is2day + \beta_3 \cdot is3day + \beta_4 \cdot is4day \tag{2}$$

$$lis8date = \beta_0 + \beta_p \cdot price + \beta_s \cdot lnshares + \beta_1 \cdot liquidity + \beta_1 \cdot is1day + \beta_2 \cdot is2day + \beta_3 \cdot is3day + \beta_4 \cdot is4day \tag{3}$$

$$lis4date = \beta_0 + \beta_p \cdot price + \beta_s \cdot lnshares + \beta_1 \cdot liquidity + \beta_1 \cdot is1day + \beta_2 \cdot is2day + \beta_3 \cdot is3day + \beta_4 \cdot is4day \tag{4}$$

A Kolmogorov-Smirnov test statistic, where the expected price and trade volume are based on the uniform distribution, is used to test the first hypothesis which states that the distribution of price and shares in our dataset will not be uniform because of the influence of dominating local Asian culture. The sample frequencies for the Hong Kong market are shown in Figure 1. Both price and LN(shares) strongly reject ($p < 0.0001$) the null hypothesis of a uniform distribution of the values.

Table 2 Kolmogorov-Smirnov test

One-sample Kolmogorov-Smirnov test data: *Price* D = 0.64839, p-value < 0.00001 alternative hypothesis: two-sided	One-sample Kolmogorov-Smirnov test data: *LN(Sahres)* D = 0.34118, p-value < 0.00001 alternative hypothesis: two-sided

Table 3, 4, 5 and 6 show regression models for each date clustering in H2 and H4. The dependent variables are all binary, representing the ending digit of a date is either auspicious/inauspicious. Table 5 and 6 are for lunar calendar based metrics. Clearly opposite patterns have been observed in date 4 and date 8 for both solar and lunar calendar date clustering. In Table3, Controlling for day (Monday through Friday) effects, the three transaction characteristics (i.e., price, trade volume, and trade frequencies) have all positive impacts on auspicious date.

We use deviances to measure goodness of fit of the models. The first measure, null deviance, shows how the predicted response deviates from the overall mean of given values in the dataset. Including the independent variables, there is a significant reduction in deviance with a loss of seven degrees of freedom. In addition, the Akaike Information Criterion (AIC) provides a method for assessing the adjusted goodness of fit, which is very close to the deviance reduction. As AIC statistic is used to test the

joint null hypothesis whether all of the model's coefficients except the intercept are significant, the overall impact of regressors supports H2 – H4.

Table 3 Logistic regression analysis for auspicious number in date

		Estimate	Std. Error	z
Dependent Variable = is8date			
Significance < 0.01 *** < 0.05 ** < 0.1 *			
β_0 : Intercept		-21.36	124.80	-0.17
β_p : price		0.08***	0.01	15.47
β_s : lnshares		0.05***	0.01	4.88
β_l : liquidity		0.00***	0.00	8.88
Days control (Multicollinearity considered)	β_1 : is1day	18.88	124.80	0.15
	β_2 : is2day	0.02	168.00	0.00
	β_3 : is3day	0.01	167.00	0.00
	β_4 : is4day	19.90	124.80	0.16
Null deviance: 65833 on 110830 degrees of freedom			
Residual deviance: 42495 on 110823 degrees of freedom			
AIC: 42511			

Now price, trade volume, and trade frequencies have all negative impacts on inauspicious date 4. As expected

Table 4 Logistic regression analysis for inauspicious number in date

		Estimate	Std. Error	z
Dependent Variable = is4date			
Significance < 0.01 *** < 0.05 ** < 0.1 *			
β_0 : Intercept		-20.04	125.20	-0.16
β_p : price		-0.03***	0.01	-5.95
β_s : lnshares		-0.03***	0.01	-3.51
β_l : liquidity		-0.00***	0.00	-9.24
Days controls (Multicollinearity considered)	β_1 : is1day	-0.01	173.30	0.00
	β_2 : is2day	-0.02	168.50	0.00
	β_3 : is3day	19.25	125.20	0.15
	β_4 : is4day	19.41	125.20	0.16
Null deviance: 67168 on 110830 degrees of freedom			
Residual deviance: 47084 on 110823 degrees of freedom			
AIC: 47100			

In Table 5 and Table 6, lunar calendar date 8 and 4 are regressed over independent variables of price, trade volume, and frequencies. Two dependent variables for auspicious/inauspicious number show obvious difference. Price, LN(Shares) and liquidity are all positively associated with the auspicious lunar calendar date implying that the local Asian culture and superstition influences the number preferences in trading.

Table 5 Project selection matrix rules

	Estimate	Std. Error	z
Dependent Variable = lis8date			
Significance < 0.01 *** < 0.05 ** < 0.1 *			
β_0 : Intercept	-1.85***	0.10	-18.17
β_p : price	0.01	0.01	1.41
β_s : lnshares	0.05***	0.01	5.43
β_l : liquidity	0.00**	0.00	2.99
Days controls (Multicol-linearity considered) β_1 : is1day	-19.29	119.90	-0.16
β_2 : is2day	-0.26***	0.02	-10.95
β_3 : is3day	-19.29	111.50	-0.17
β_4 : is4day	-19.29	128.30	-0.15
Null deviance: 61030 on 110830 degrees of freedom			
Residual deviance: 43900 on 110823 degrees of freedom			
AIC: 43916			

Similarly, on inauspicious lunar calendar date, the predictors (price, trade volume and frequencies) impose all negative impact. In general, the deviance reductions show reasonable goodness of fit but implication of price for lunar calendar date is weaker than Table 3 and Table 4. Some coefficients of the day dummy variables are significant and control for the lurking variables to maintain unbiasedness of the main regressors.

Table 6 Project selection matrix rules

	Estimate	Std. Error	Z
Dependent Variable =lis4date			
Significance < 0.01 *** < 0.05 ** < 0.1 *			
β_0 : Intercept	-0.64***	0.08	-8.01
β_p : price	-0.01	0.00	-1.57
β_s : lnshares	-0.07***	0.01	-8.73
β_l : liquidity	-0.00***	0.00	-14.62
Days controls (Multicollin earity considered) β_1 : is1day	0.87***	0.02	37.43
β_2 : is2day	-0.27***	0.03	-10.59
β_3 : is3day	-18.09	67.51	-0.27
β_4 : is4day	-18.09	77.65	-0.23
Null deviance: 87904 on 110830 degrees of freedom			
Residual deviance: 67843 on 110823 degrees of freedom			
AIC: 67859			

The results at Hong Kong Stock Exchange for solar and lunar calendar date clustering are consistent that clustering of auspicious number (8 in our analysis) increases with the level of the stock price, trade volume in shares and trade frequencies. On the other hand, the clustering for inauspicious number 4 declines with the three components. Controlling for the day of the week effect, a general preference in the market for the digit 8 and avoidance of 4 were detected across all trading activities. Reasons can be proposed as unique Asian local cultural influence at Hong Kong where the market has a relatively high proportion of local participants whose everyday transaction behavior are under influence of Asian culture.

IV.   Conclusions

To investigate the influence of unique local Asian culture on the number preferences of stock market participants at Hong Kong Stock Exchange, we conducted calendar date clustering over the trade characteristics such as stock price, trade volume and trade frequency. We first examined the frequency distribution of stock price and shares which are not uniformly distributed to imply that there are some stock related characteristics and that are influenced by unique local culture. In turn, our logistic regression model indicates, the local Asian culture influenced predictor variables create clear evidence of date clustering for auspicious and inauspicious numbers in solar and lunar calendar system. We further highlight the inclusion of day of the week effect which plays roles of estimation bias elimination. Asian culture and superstition appear to influence the number preferences of market practitioners at the Hong Kong market for both solar and lunar calendar systems.

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