WEEKEND EFFECT ON HIBOR: TEST OF A STRUCTURAL CHANGE

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INTRODUCTION

Seasonality has been one of the popular issues in the finance literature. Fama (1965) is one of the earlier researchers who reported seasonality in stock markets. Using the US data, Fama found that the variance on Monday is greater than that for other days. Cross (1973) also showed that negative Monday returns exist in the US stock market. French (1980), Keim and Stambaugh (1984), and Cornell (1985) provided recent evidences on seasonality on stock markets. They showed that the mean stock return on Monday is significantly negative while that on Friday is significantly positive. Although this anomaly is first found in the U. S. stock market, empirical evidences also exist for other stock markets (Jaffe and Westerfield, 1985). Besides numerous research on daily stock returns, Rogalski (1984) found that the Weekend effect is valid only from February to December and the negative Monday effect occurs from Friday close to Monday open. Harris (1986) further examined the seasonality using intraday data of NYSE stocks. He found that the negative Monday returns is attributed by non-trading period as well as by the beginning session of Monday morning.

The identification of anomalies in the stocks markets leads to the studies of the seasonality in other markets. Gay and Kim (1987) and Phillips-Patrick (1988) found a similar day-of-the-week effect in stock index futures markets as reported in the stock market studies. Saunders and Urich (1988) examined the weekly variations in the Federal funds market and showed that a Weekend effect also exists in the interest rate market.

Although evidences on Weekend effect found from various markets are numerous, studies on Weekend effect in interbank money market are rare. Interbank rates are the market prices of funds which represents the cost of funding for institutional investors. They can also be regarded as the risk-free rates when there are no government T-bills exist in the market. Under a fixed exchange rate regime, interbank rate has a further role, namely, as a monetary tool to manage the required exchange rate in the market. Hence, it is interesting to test the hypothesis of a structural change in the interbank market under different exchange rate regimes.

In the Hong Kong interbank market, the most common maturities are overnight, 1-month, 2-month, 3-month, and 6-month. Tang (1993) studied the seasonality in the Hong Kong Interbank Offer Rates (HIBORs) before and after the

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launching of the official linked exchange rate system in October 1983. He found that seasonality of HIBORs are very different before and after the introduction of the exchange rate system. However, Tang (1993) did not formally test whether there exists a structural change in HIBORs and his definition of return (logarithmic interbank rate relatives) may not be appropriate as the bank rate is already a return. Hence, this paper, using a more appropriate definition of return and a longer sample period than Tang's (1993) data, examines the Weekend effect on HIBORs and formally test the hypothesis of no structural change in HIBOR between pre-linked and post-linked rate periods.

This paper is organised as follows: Section 2 describes the data and research methodology; Section 3 presents the empirical results and discussions; and Section 4 concludes the paper.

DATA AND METHODOLOGY

DATA

The daily closing rates of five different HIBORs, the overnight (ON), 1-month (1M), 2-month (2M), 3-month (3M), and 6-month (6M) are collected form the Hang Seng Bank Services Ltd. The sample period covers January 1980 to September 1991 (data of overnight HIBOR starts from April 1980). The whole sample period is divided into two sub-periods, the pre-linked rate period (January 1980 to September 1983) and the post-linked rate period (January 1984 to September 1991). Data from October to December 1983 is excluded from analysis to avoid the possible chaos in the early implementation of the linked rate system. Since HIBOR is already a percentage return, the change in returns is defined as $CR_t = R_t - R_{t-1}$ and $R_t = \ln(1 + H_t)$, where H_t is the closing rate of HIBOR at time t.

TESTING METHODOLOGIES

The 'Monday Effect' is tested by the following regression model:

$$CR_t = a + \sum_{i=1} b_i D_i + e_t \qquad (1)$$

where CR_t is the change in returns on day t and D_i's are dummy variables for Tuesday, Wednesday, Thursday, and Friday. The b_i's represent the difference in mean change in returns between Monday and other weekdays. The error term (e_t) is assumed to be identically and independently distributed with mean zero.

The hypothesis of an equal mean change in returns across all days of the week is further tested by the standard F-test (ANOVA) and a non-parametric test, Kruskal-Wallis test. Bartlett's homogeneity test of equal variance is employed to

test the hypothesis of equal variance of change in returns across all weekdays. The test criterion is as follows (Snedecor and Cochran, 1976):

$$M = (\Sigma v_i) * \ln s^2 - \Sigma (v_i * \ln s_i^2)$$

$$C = 1 + \{1/[3(a - 1)]\} * (\Sigma\ 1/v_i - 1/\Sigma\ v_i)$$

where $s^2 = \Sigma (v_i * s_i^2)/ \Sigma\ v_i$

s_i^2 is an estimate of the ^{2} from sample i

a = the number of samples

v_i = the degree of freedom of sample i

then, the quantity M/C is distributed approximately as a Chi-square distribution with a degree of freedom equal to (a - 1). In our case, as we have five weekdays in a week, the degree of freedom is four.

The hypothesis of no structural change in HIBOR between pre-linked and post-linked rate periods is tested by the following regression model:

$$CR_t = a + \sum_{i=1}^{4} b_i D_i + cK + \sum_{i=1}^{4} d_i E_i + e_t \qquad (2)$$

where both D_i's and E_i's are dummy variables of all weekdays except Monday in the pre-linked and post-linked periods respectively. All D_i's are zero in the post-linked periods while all E_i's are zero in the pre-linked period. K is a dummy variable which equals to zero in the pre-linked period and one in the post-linked period.

EMPIRICAL RESULTS.

Table 1 presents the means and standard deviations of the five different HIBORs by weekday in both pre-linked and post-linked periods. Almost all mean changes in returns are negative but not significantly different from zero. In the pre-linked period, only the overnight HIBOR shows no significant mean change in returns on all weekdays. However, in the post-linked period, all HIBORs except the overnight HIBOR have no significant mean change in returns on all weekdays. Among those significant mean changes, a positive Monday and a negative Thursday mean changes are found in the pre-linked period (1M, 2M, 3M HIBORs). However, a significantly negative mean change is found both on Monday and Thursday in the post-linked period (ON HIBOR). The results suggest that a 'Monday Effect' exists in the overnight HIBOR in the post-linked period and in all HIBORs except the ON HIBOR in the pre-linked period. This result is confirmed by a regression model with dummy variables (equation 2).

Table 1: Summary Statistics of HIBORs by Weekdays

		Pre-linked Period			Post-linked Period		
	WD	N	Mean	S.D.	N	Mean	S.D.
ON	Mon	153	-0.00151	2.29320	347	-0.50056**	2.65650
	Tue	156	-0.19514	1.88130	355	0.10729	2.33440
	Wed	171	-0.15172	2.11320	382	0.17544	2.23460
	Thu	172	0.03713	1.83770	382	-0.21684*	2.16260
	Fri	169	0.07282	1.89930	374	0.28078	2.85450
	All	821	-0.04619	2.00600	1840	-0.02522	2.47270
1M	Mon	163	0.11268**	0.45005	347	-0.01910	0.49563
	Tue	167	0.00915	0.31526	355	-0.00855	0.34121
	Wed	182	-0.02851	0.32710	382	-0.00093	0.27205
	Thu	185	-0.06673*	0.36829	382	-0.01894	0.28112
	Fri	181	-0.03295	0.32085	374	0.02042	0.29593
	All	878	-0.00411	0.36275	1840	-0.00535	0.29219
2M	Mon	163	0.07491*	0.41439	347	-0.01377	0.41933
	Tue	167	0.01161	0.27290	355	-0.00341	0.27630
	Wed	182	-0.02655	0.28287	382	-0.00900	0.22682
	Thu	185	-0.05925*	0.30165	382	-0.01339	0.23901
	Fri	181	-0.01009	0.27039	374	0.01256	0.27203
	All	878	-0.00395	0.31367	1840	-0.00523	0.34397
3M	Mon	163	0.07874*	0.37756	347	-0.00511	0.37535
	Tue	167	-0.00412	0.25927	355	-0.01347	0.27182
	Wed	182	-0.03230	0.25693	382	-0.00031	0.21386
	Thu	185	-0.02538	0.27709	382	-0.01418	0.20654
	Fri	181	-0.03717	0.26111	374	0.00888	0.26169
	All	878	-0.00587	0.29076	1840	-0.00476	0.27020
6M	Mon	163	0.03986	0.34214	346	-0.00084	0.29010
	Tue	167	0.03581*	0.22327	353	0.00078	0.23952
	Wed	182	-0.03302*	0.22424	381	-0.00476	0.22775
	Thu	185	-0.02119	0.24579	382	-0.01621	0.21559
	Fri	181	-0.01822	0.21579	374	0.00140	0.16673
	All	878	-0.00085	0.25416	1836	-0.00408	0.23003

Notes:
N = number of observations
Mean = mean change in returns
S.D. = standard deviation
WD = weekday
** - significant at the 1% level
* - significant at the 5% level

Table 2 presents the results from a direct test of the 'Monday Effect'. In the pre-linked period, the hypothesis of equal coefficients of all dummy variables is rejected at the 5% level for all HIBORs except the overnight HIBOR. A positive 'Monday Effect' is found because the t-values of the dummy variables are all significantly positive at the 5% level, showing that the mean change in returns on Monday is larger than that on the other weekdays for all HIBORs except the overnight HIBOR. However, in the post-linked period, the reserve occurs. Only the overnight HIBOR can reject the hypothesis that all coefficients of dummy variables are equal. T values of dummy variables show that mean change in

returns on Monday is significantly smaller than that on the other weekdays except Thursday. Hence, a negative 'Monday Effect' is found, but only in the overnight HIBOR.

Table 2: Results of Regression Equation with Dummy Variables

$$CR_t = a + \sum_{i=1}^{4} b_i D_i + e_t$$

		Pre-linked Period			Post-linked Period		
		Estimated Value	Prob>|T|	F-value Prob>F	Estimated Value	Prob>|T|	F-value Prob>F
ON	a	-0.00151	0.9926	0.5740	-0.49140	0.0002*	5.9850
	b1	-0.19360	0.3970	0.6816	0.59440	0.0014*	0.0001*
	b2	-0.15020	0.5017		0.66350	0.0003*	
	b3	0.03860	0.8626		0.27450	0.1328	
	b4	0.07430	0.7402		0.77220	0.0001*	
1M	a	0.11430	0.0001*	6.3840	-0.01970	0.2879	0.8480
	b1	-0.10770	0.0075*	0.0001*	0.01090	0.6749	0.4949
	b2	-0.13610	0.0006*		0.01890	0.4600	
	b3	-0.18730	0.0001*		0.00074	0.9769	
	b4	-0.14830	0.0002*		0.04010	0.1186	
2M	a	0.07980	0.0017*	4.7420	-0.01490	0.3447	0.5320
	b1	-0.06800	0.0571*	0.0009*	0.01160	0.5998	0.7121
	b2	-0.10480	0.0028*		0.00600	0.7825	
	b3	-0.14670	0.0001*		0.00147	0.9459	
	b4	-0.08550	0.0149*		0.02740	0.2090	
3M	a	0.08000	0.0006*	4.3760	-0.00827	0.5674	0.4660
	b1	-0.08540	0.0095*	0.0017*	-0.00372	0.8550	0.7610
	b2	-0.10890	0.0007*		0.00826	0.6790	
	b3	-0.11110	0.0006*		-0.00591	0.7672	
	b4	-0.11370	0.0004*		0.01710	0.3927	
6M	a	0.04180	0.0435*	3.2740	-0.00084	0.9459	0.3760
	b1	-0.00485	0.8675	0.0112*	0.00162	0.9260	0.8262
	b2	-0.07370	0.0097*		-0.00392	0.8185	
	b3	-0.06840	0.0163*		-0.01540	0.3683	
	b4	-0.06390	0.0254*		0.00224	0.8961	

Note : F-Value = Test of all coefficients of dummy variables jointly equal to zero
* - significant at the 5% level

Using the standard ANOVA and Kruskal-Wallis test, the results on the day-of-the-week effect is further confirmed. The empirical results are presented in Table 3. All HIBORs except the overnight HIBOR reject the hypothesis of equal mean change in returns in the pre-linked period while only the overnight

HIBOR can reject the same hypothesis in the post-linked period. Both parametric and non-parametric tests provide the same conclusion. Hence, non-normality in the data series will not affect the presence of the 'Monday Effect' in the Hong Kong interbank market. This result supports the findings of Tang (1993) who used a shorter sample period.

Results presented in Table 3 clearly show that properties of HIBOR with different maturities are very different in the pre-linked and post-linked periods. In order to formally test the hypothesis of a structural change in HIBOR, Chow's test is employed. The results are presented in Table 4. Empirical results show that the hypothesis that mean change in returns are the same in both pre-linked and post-linked periods is rejected at the 5% level for all HIBORs except the 6-month HIBOR. The results suggest that a change in exchange rate regime causes a structural change in the interbank rates, particularly for rates with shorter maturities.

Table 3: Results of ANOVA and Kruskal-Wallis Tests on Equality of Mean Change in Returns Across Weekdays

	Pre-linked Period				Post-linked Period			
	F-Value		Chi-sq		F-Value		Chi-sq	
	L	H	Prob>F	Pr>Chi-sq	L	H	Prob>F	Pr>Chi-sq
ON	2	5	0.5740	6.2217	1	5	6.1640	24.4000
			0.6816	0.1832			0.0001*	0.0001*
1M	4	1	6.2980	21.9720	1	5	0.8360	2.3435
			0.0001*	0.0002*			0.5025	0.6729
2M	4	1	4.4380	15.2010	1	5	0.5140	1.4204
			0.0015*	0.0043*			0.7256	0.8406
3M	5	1	4.6370	16.4370	4	5	0.4720	2.2995
			0.0010*	0.0025*			0.7564	0.6809
6M	3	1	3.1820	10.1030	4	5	0.3760	7.0467
			0.0131*	0.0387*			0.8262	0.1334

Notes: F-Value = F Test of all mean change in returns are equal
Chi-sq = Kruskal-Wallis Test of all mean change in returns are equal
L = Weekday with the lowest mean change in returns
H = Weekday with the highest mean change in returns
1 = Monday, 2 = Tuesday, ..., 5 = Friday.
* - significant at the 5% level

A study on the volatility across the HIBORs (see Table 1) show that all HIBORs have the greatest variance on Monday in both periods except the overnight HIBOR in the post-linked period. The reason is probably due to the fact that the money market is closed for two days during the weekend which implies higher risk involved for investors. Furthermore, the standard deviation decreases with an increase in the maturity of the interbank rate. This case is applied to both pre-linked and post-linked periods and is particularly obvious when the maturity

is changed from overnight to 1-month. The results show that cost of extremely short term funds is more sensitive to changes in the market.

Table 4: Results of Chow Test on Equality Between Pre-linked and Post-linked Periods

$$CR_t = a + \sum_{i=1}^{4} b_i D_i + cK + \sum_{i=1}^{4} d_i E_i + e_t$$

Estimated Value	HIBOR ON	1M	2M	3M	6M
a	-0.5006	-0.0191	-0.0138	-0.0051	-0.0008
Prob>|T|	0.0001*	0.3078	0.3903	0.7307	0.9476
b1	0.6078	0.0105	0.0104	-0.0084	0.0016
Prob>|T|	0.0006*	0.6887	0.6458	0.6886	0.9283
b2	0.6760	0.0182	0.0048	0.0048	-0.0039
Prob>|T|	0.0001*	0.4825	0.8293	0.8149	0.8241
b3	0.2837	0.0002	0.0004	-0.0091	-0.0154
Prob>|T|	0.1006	0.9951	0.9863	0.6580	0.3837
b4	0.7813	0.0395	0.0263	0.0140	0.0022
Prob>|T|	0.0001*	0.1286	0.2369	0.4971	0.8994
c	0.4990	0.1318	0.0887	0.0839	0.0407
Prob>|T|	0.0274*	0.0001*	0.0018*	0.0014*	0.0717
d1	-0.8015	-0.1141	-0.0737	-0.0745	-0.0057
Prob>|T|	0.0118*	0.0143*	0.0647	0.0435*	0.8583
d2	-0.8262	-0.1594	-0.1062	-0.1158	-0.0690
Prob>|T|	0.0080*	0.0005*	0.0066*	0.0014*	0.0269*
d3	-0.2451	-0.1796	-0.1345	-0.0951	-0.0457
Prob>|T|	0.4311	0.0001*	0.0006*	0.0085*	0.1413
d4	-0.7070	-0.1852	-0.1113	-0.1299	-0.0603
Prob>|T|	0.0238*	0.0001*	0.0045*	0.0003*	0.0533
F-Value[a]	2.2735	4.4191	2.8281	3.1179	1.6664
Prob>F	0.0449*	0.0005*	0.0149*	0.0082*	0.1393

Notes: * - significant at the 5% level
a - a joint test on the hypothesis that mean changes are the same in pre-linked and post-linked periods

The hypothesis of equal variance of change in returns across all weekdays is tested by Bartlett's homogeneity test of variance. The results are presented in Table 5. The hypothesis of equal variance across all weekdays is rejected at the 5% level in all HIBORs in both periods. Hence, empirical results show that the day-of-the-week effect exists in the volatility of the Hong Kong interbank market. The results further show that the seasonality in volatility is more clear in the post-linked period as the Chi-square statistics is larger than that in the pre-linked period.

Comparing the standard deviations of different HIBORs between pre-linked and post-linked periods show that HIBOR is more volatile in the post-linked period only for the overnight HIBOR. For all other HIBORs, standard deviations are similar and in some cases, the values are smaller in the post-linked period. The

results are different from that of Tang (1993) who found that all HIBORs are more volatile in the post-linked period. The differences may be due to the different definitions of return used in the analysis. Our results show that under a fixed exchange rate system, volatilities in foreign exchange is transferred to the interbank market but only restricted to rates with extremely short maturity. However, the impact on the volatility of HIBOR with longer maturities is limited.

Table 5: Bartlett's Test of Equal Variance Across Weekdays

Pre-linked Period:

HIBOR	Weekday with the Highest Variance	Lowest Variance	Chi-sq
ON	1	4	11.6310 *
2M	1	5	47.8350 **
3M	1	3	40.4183 **
6M	1	5	54.8472 **

Post-linked Period:

HIBOR	Weekday with the Highest Variance	Lowest Variance	Chi-sq
ON	5	4	42.7568 **
1M	1	3	198.6054 **
2M	1	3	191.3103 **
3M	1	4	177.5159 **
6M	1	5	111.1804 **

Notes: Chi-sq = Chi-square test statistics for Bartlett's test of equal variances across all weekdays
** - significant at the 1% level
* - significant at the 5% level
1 = Monday, 2 = Tuesday, ..., 5 = Friday.

Interbank rates indicate the cost of funds to institutional investors and is a monetary tool to manage the required exchange rate under a fixed exchange rate regime. Hence, this paper examines the Weekend effect on five interbank rates with different maturities (overnight, 1-month, 2-month, 3-month, and 6-month) in the Hong Kong market. Because of a change in the exchange rate regime in October 1983, the whole sample period is divided into pre-linked (flexible exchange rate regime) and post-linked (fixed exchange rate regime) periods and the hypothesis of no structural change in HIBOR between the two periods is tested. The hypothesis of equal mean change in returns and of equal variance across all weekdays are also tested for both periods.

Empirical results show that a positive 'Monday Effect' exists in the pre-linked period for all HIBORs except the overnight HIBOR. However, in the post-linked

period, a negative 'Monday Effect' exists only in the overnight HIBOR. Results from Chow's test indicate that there is a structural change in all HIBORs except the 6-month HIBOR, indicating that a change in the exchange rate regime has a great impact on the properties of interbank rates. The hypothesis of equal variance across all weekdays is rejected in both periods and the overnight HIBOR is the most volatile. Empirical results further show that the overnight HIBOR is more volatile in the post-linked period, supporting the argument that volatility in foreign exchange is transferred to the interbank market under fixed exchange rate regime.

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