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Daily U.S. Federal Funds Rate and Pacific Rim Stock Markets

Daniel W.W. Cheung
Department of Finance
The Chinese University of Hong Kong

Abstract

This study uses Sims-type vector autoregression technique to examine the impact of daily U.S. federal funds rate on six major Pacific Rim stock exchanges during the period 1990 to 1995 and a sub-period of 1994 to capture the change in U.S. monetary policy. Empirical results show that when the U.S. was targeting the federal funds rate in 1994, the variations in U.S. federal funds rate much better explain the variations of stock returns in Australia and Hong Kong. These results further suggest that a long time series data set may have the risk of encountering different policy regime during the period of study.

1. Introduction

The federal funds rate is often regarded as the indicator of the U.S. monetary policy. Bernanke and Blinder (1992) have demonstrated that the federal funds is a good indicator of monetary policy and that innovations in the funds rate forecast real variables well. Thorbecke and Alami (1992) have shown that the funds rate is a priced factor in the arbitrage pricing (APT) model and that unexpected increases (decreases) in the funds rate lower (raise) stock prices. This finding indicates that market participants believe that monetary policy is a state variable that affect economic activity. These empirical results support the Bernanke and Blinder's findings that monetary policy, working through the funds rate, influences real economic activity.

Use simple vector autoregressions, Balke and Emery (1994) found that before 1980 the correlations between the federal funds rate and other important macroeconomic variables are consistent with a traditional monetary policy interpretation of the federal funds rate. However, after 1982 the relationships between funds rate and other macroeconomic variables change sharply. Most important, the relationships between the funds rate and other macroeconomic variables observed during the 1980s are not consistent with a traditional monetary policy view of funds rate as they were before 1980. These results strongly support the view that the funds rate is a time-varying variable. In fact, Griffiths and Winters (1995) have shown that there is predictable changes in the variance of funds rate on a daily and intraday basis.

On the other extreme, Garfinkel and Thornton (1995) argued that the federal funds rate is no better an indicator of monetary policy than other short-term interest rates, such as the over-night repurchases and three-month T-bill rates. By supporting the notion that markets are efficient, the results suggest that the information contained in over-night repurchase and three-months T-bill rates and rate spreads concerns economic

fundamentals. Thus, the funds rate might not contain any information regarding the movements in share prices.

The objective of this paper is to examine the daily impact of funds rate to Pacific Rim stock markets during the period 1990-1995. In particular, the U.S. monetary policy in 1994 was formulated against a background of rapid economic expansion and rising resource utilization but generally modest aggregate price increases. The Federal Open Market Committee (FOMC) increased reserve pressures at 5 of 8 meetings and once between meetings, resulting in a cumulative increase of 2.5 percentage points in the federal funds rate. Corresponding to this monetary policy changes, our empirical results also show that the daily funds rate have significant impact on Australia and Hong Kong stock returns in 1994 sub-sample. However, for the whole sample period, namely 1990-1995, we found no correlations between daily federal funds rate and Pacific Rim stock returns. Our results further suggest that a long-time series data set may have the risk of encountering different policy regime during the period of study. Thus empirical results might be biased because of structural breaks in an exogenous environmental variables.

This paper is organized in the following fashion. Methodology is discussed in section 2. The empirical results are presented and discussed in section 3. Concluding remarks are made in section 4.

2. Methodology

To examine the trend of the U.S. federal funds rate, daily data on funds rate from 1990 to 1995 were collected. Table 1 presents the summary statistics for the U.S. federal funds rate from 1990 to 1995. The table clearly indicate that the funds rate was highly volatile in 1994 (i.e., the coefficient of variation is the highest among all the years). In addition, the correlation matrix in Table 2 indicates that there was a sharp difference between funds rate in 1994 and the other years. Most important, the funds rate in 1994 is negatively correlated with the rest of the years. This supports the notion that the Federal Reserve began targeting the funds rate to control inflation as the objective of its monetary policy.

The main purpose of this study is to examine the impact of daily federal funds rate on Pacific Rim stock returns during the sample period of 1990 to 1995, and the sub-sample period of 1994. Vector autoregressions (VAR) modelling are used to investigate the impact of federal funds rate to Pacific Rim stock returns. Daily stock returns of six Pacific Rim market indices are used in the study. These indices are the All-ordinary Index for Australia, the Hang Seng Index for Hong Kong, the Nikkei 500 for Japan, the Composite Index for South Korea, the All Share Index for Singapore, and Weighted Index for Taiwan. All stock market indices and the U.S. federal funds rate were extracted from *Datastream International*. Stock indices returns were converted into U.S. dollars at prevailing spot rates. Since the U.S. is in a different zone from the Pacific Rim countries, the Pacific Rim stock returns observations were lagged one-day.

The vector autoregressions (VAR) model proposed by Sims (1980) is the conventional unconstrained VAR model. The so called Sims-type VAR model treats all variables in the system symmetrically by serially including each on the right-hand side of

every equation and by assuming the same lag length for all variables in each equation. The Sims-type model used in this study is

$$\mathbf{X}_t = A(L)\mathbf{X}_t + \mathbf{c} + \varepsilon_t$$

where

$$A(L) = A_1L + A_2L^2 + \ldots\ldots\ldots\ldots + A_pL^p \text{ and}$$

$\mathbf{X}_t$ is a (7 x 1) vector of the following endogenous variables: The U.S. federal funds rate (FFR), and the stock returns of Australia (R_{AUS}), Hong Kong (R_{HKG}), Japan (R_{JPN}), South Korea (K_{KOR}), Singapore (R_{SING}), and Taiwan (R_{TWN}), respectively. A(L) is a an (7 x 7) matrix of polynomials in the backward-shift operator L, $\mathbf{c}$ is vector of constants and ε_t is an (7 x1) vector of error terms with the following properties:

$$E(\varepsilon_t) = 0,$$
$$E(\varepsilon_t\varepsilon_t') = \Sigma,$$
$$E(\varepsilon_t\varepsilon_s') = 0 \text{ for } t \neq s.$$

In terms of the time series literature, vector autoregressions provide a fairly unrestricted approximation to the reduced from of an unknown structural system of simultaneous equations. A VAR model therefore serve as a flexible approximation to the reduced form of any member of a wide variety of simultaneous structural models. To some extent, the reduced forms of traditional simultaneous equation models are special cases of the VAR model. Lupoletti and Webb (1986) and Litterman (1986) have argued that VAR can produce forecasts that are at least competitive with large-scale structural models in spite of the VAR's parsimonious structure.

3. Empirical Results

The first step in specifying a VAR model is to check for stationarity in all the variables in the system. (Kang, 1981, 1985, & 1989). An appropriate transformation of the variables may be needed in order to get a stationary series. In the present study, stationarity is checked by performing Dickey-Fuller (DF), Augmented Dickey-Fuller (ADF), and Phillips-Perron (PP) tests of unit roots for all the variables. The advantage of using Phillips-Perron unit roots tests is that they allow for heteroscedasticity and non-normality. The unit roots tests for stationarity in tables 3 and 4 show that growth rate of funds rate and all stock returns series are negative with 5 percent level of significance. Thus no further transformation of the series was needed to achieve stationarity, before using the VAR models. In addition, since all variables in the VAR system are integrated with order 0 (i.e., I(0)), there is no co-integration exists among all the variables, and the application of error correction model (ECM) is not needed in this study.

Table 5 presents the F-statistics for the group significance of U.S. funds rate for forecasting Pacific Rim stock returns. For the entire sample period, the F-statistics indicate that U.S. federal funds rate had no significant impact upon the stock returns in the Pacific Rim stock markets. In contrast, the F-statistics for 1994 show that the funds rate had significant effect on the stock returns of Australia and Hong Kong. These results indicate that the U.S. federal funds rate Granger-caused in mean to the stock returns of Australia and Hong Kong in 1994. The Q-statistic for each equation of the VAR model show that the error terms are white noise components. Therefore, the Granger-causal

relations between U.S. funds rate and stock returns of Australia and Hong Kong are statistically valid.

The variance decompositions (VDCs) results are presented in table 6. For a twenty-day horizon of forecasted variance, the forecasting power of U.S. federal funds rate had increased significantly from the entire sample period to the 1994 sub-period These results tend to support the claim that the changes of U.S. monetary policy by targeting the funds rate in 1994 had significant impact on the Pacific Rim stock markets, especially those countries have strong economic relationships with the U.S.

4. Concluding Remarks

During 1994, the U.S. Federal Reserve raised the federal funds 6 times. The significant switch of the U.S. monetary policy in 1994 tends to support the notion that the financial markets are more integrated. Particularly, previous empirical studies have found a strong linkage between the federal funds rate and U.S. stock returns. Several studies have documented that after the October 1987 crash the variations of U.S. stock returns explain more of the variations in major Pacific Rim stock market returns. Thus the transmission mechanism is from changes in U.S. monetary policy to the U.S. stock returns and then to Pacific Rim stock returns.

This study uses the VAR methodology to examine the impact of daily U.S. federal funds rate on six major Pacific Rim stock markets during 1990 to 1995 and 1994 alone. The rationale for examining the sub-period 1994 is mainly to capture the change in U.S. monetary policy. The empirical results suggest that for the entire sample period (i.e., 1990 to 1995), U.S. funds rate had no impact on the Pacific Rim stock returns. However, a stronger empirical relationship existed between U.S. funds rate and stock returns in Australia and Hong Kong in 1994 sub-period. To sum up, the monetary developments in the U.S. can have significant impact on Pacific Rim stock returns. Especially those Pacific Rim countries which have strong economic link with the U.S.

Table 1
Summary Statistics of Daily U.S. Federal Funds Rate

Year	1990	1991	1992	1993	1994	1995
Average	8.07%	5.63%	3.45%	2.99%	4.18%	5.81%
Standard Deviation	0.47	0.91	0.54	0.19	0.81	0.24
Coefficient Variation	0.06	0.16	0.16	0.07	0.19	0.04

Table 2

The Five Year Correlation Matrix of Daily U.S. Federal Funds Rate

	1991	1992	1993	1994	1995
1990	0.31	0.22	0.50	-0.42	0.11
1991		0.35	0.13	-0.64	0.08
1992			0.05	-0.56	0.06
1993				-0.04	0.05
1994					-0.11

Table 3

Dickey-Fuller (DF) and Augmented Dickey-Fuller (ADF) for Unit Root

	DF	ADF(5 lags)	DF	ADF(5 lags)
Variables	**1990-1995**		**1994**	
FFR	-53.67	-23.10	-25.06	-10.27
R_{AUS}	-41.56	-16.75	-13.17	-6.58
R_{HKG}	-38.73	-17.30	-14.40	-6.71
R_{JPN}	-40.79	-16.79	-14.79	-7.76
R_{KOR}	-41.92	-16.81	-15.62	-7.40
R_{SING}	-35.20	-15.70	-11.93	-6.42
R_{TWN}	-39.09	-16.57	-14.52	-6.37

All negatively significant at 1% level

Table 4
Phillips-Perron (PP) Tests for Unit Root

Variables	PP (no lag)	PP(5 lags)	PP (no lag)	PP(5 lags)
	1990-1995		**1994**	
FFR	-53.70	-62.69	-23.49	-29.08
R_{AUS}	-41.58	-41.68	-13.22	-13.09
R_{HKG}	-38.75	-38.80	-14.45	-14.48
R_{JPN}	-40.81	-40.81	-14.85	-14.82
R_{KOR}	-41.94	-41.98	-15.68	-15.69
R_{SING}	-35.22	-35.16	-11.97	-11.95
R_{TWN}	-39.11	-39.18	-14.59	-14.63

All negatively significant at 1% level

Table 5
F-Statistics and Marginal Significance Levels of U.S. Daily Federal Funds Rate for Forecasting in Asian-Pacific Returns
Time Period: 1990-1995 [**1994**]

Variables	F-Statistics	p-value
R_{AUS}	0.75[**3.44***]	0.58[**0.05**]
R_{HKG}	0.29[**2.14****]	0.92[**0.06**]
R_{JPN}	1.82[**0.39**]	0.11[**0.85**]
R_{KOR}	0.69[**0.58**]	0.63[**0.72**]
R_{SING}	0.21[**0.82**]	0.96[**0.54**]
R_{TAI}	0.25[**1.01**]	0.94[**0.41**]

*: Significant at 5% level.
**: Significant at 10% level.
Notes: Five lags of each variable are used for the above F-test.

Table 6
Variance Decompositions of Forecasted Variables
Time Period: 1990-1995 [**1994**]

Forecasted Variables	FFR	
R_{AUS}	0.36	[**5.75**]
	(0.007)	(**0.008**)
R_{HKG}	0.13	[**3.16**]
	(0.014)	(**0.018**)
R_{JPN}	0.66	[**2.04**]
	(0.015)	(**0.011**)
R_{KOR}	0.43	[**2.10**]
	(0.014)	(**0.010**)
R_{SING}	0.13	[**1.48**]
	(0.009)	(**0.106**)
R_{TAI}	0.14	[**3.32**]
	(0.023)	(**0.016**)

Notes: Entries are the percentage of the variance of the forecasted variable accounted for by variation in the column variable (FFR) at a 20-day horizon. Estimates are based on VAR with five lags of each variable. Standard errors are in the parentheses.

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