ISSN- 2350-0530(O) ISSN- 2394-3629(P)
IF: 4.321 (CosmosImpactFactor), 2.532 (I2OR)

INTERNATIONAL JOURNAL OF RESEARCH – GRANTHAALAYAH
A knowledge Repository

Management

ARBITRAGE PRICING MODEL IN RELATION TO EFFICIENT MARKET HYPOTHESES

Bilal Razzaq [1], Sabra Noveen [2], Adeel Mustafa [3], Rabia Najaf *[4]
[1] Bahria University, Islamabad, PAKISTAN
[2] The University of Lahore, Lahore, PAKISTAN
[3] Foundation University, Islamabad, PAKISTAN
[*4] The University of Lahore, Islamabad Campus, PAKISTAN

DOI: https://doi.org/10.29121/granthaalayah.v4.i7.2016.2605

ABSTRACT

The purpose of this thesis is to distinguish between efficient and inefficient markets and check the validity and efficiency of Arbitrage Pricing Theory in these markets (United States and Hong Kong).

In order to distinguish between efficient and inefficient markets, Durbin Watson Autocorrelation tests were applied on 12 stock exchanges name EUROPE, HONG KONG, INDIA, TAIWAN, AMSTERDAM, MALAYSIA, UNITED STATES, CANADA, TOKYO, AUSTRALIA, AUSTRIA, and SWITZERLAND. Furthermore, the efficiency was further checked through comparison of the market and locally listed mutual funds. After the selection of Hong Kong and United States Stock Exchanges, 10 macroeconomic variables (Inflation, Short Term Interest Rate, Long Term Interest Rate, Exchange Rate, Money Supply, Gold Prices, Oil Prices, Industrial Production Index, Market Return and Unemployment Rate were tested upon so that the APT model could be constructed. Tests like Normality and Multi-co-linearity were performed. Principle Component Analysis was used to reduce the number of variables. After all the above mentioned tests 4 variables were chosen to represent the APT in both the Hong Kong and United States Stock Exchanges. Lastly OLS Regression was applied to study the effect of these macroeconomic variables on the stock prices.

The results showed that Hong Kong Stock Exchange was the most efficient while United States Stock Exchange fell in the inefficient category. The efficiency of APT was proven through the analysis of the value of R2. This value proved that when similar model of APT is applied in two different stock exchanges, the results would be more efficient in an efficient market like Hong Kong.

This is the first attempt at constructing an APT Model based on the economic conditions in one country and applying the same model in a highly efficient market; in order to relate the performance of APT with market efficiency.

ISSN- 2350-0530(O) ISSN- 2394-3629(P)
IF: 4.321 (CosmosImpactFactor), 2.532 (I2OR)

Keywords:
Arbitrage Pricing Theory, Efficient Market Hypothesis, Durbin-Watson Autocorrelation Test, Wald Wolfowitz Runs Test, Principal Component Analysis, Normality, Multicollinearity, OLS Regression.

Cite This Article: Bilal Razzaq, Sabra Noveen, Adeel Mustafa, and Rabia Najaf, "ARBITRAGE PRICING MODEL IN RELATION TO EFFICIENT MARKET HYPOTHESES" International Journal of Research – Granthaalayah, Vol. 4, No. 7 (2016): 137-149.

1. INTRODUCTION

Financial markets play a significant role in economic soundness and prosperity of a country. The initial studies that sparked the thought of linking economic growth with financial markets in developing countries were performed by Goldsmith (1969), Shaw & Mckinnon (1973). As financial system gets developed the information, transaction and monitoring costs decrease. This in turn promotes the identification and funding of sound business opportunities and investments, mobilizes reserves for active service, benchmarking of investment managers, hedging, risk diversification and facilitates the exchange of goods and services (Khan, Qayyum & Sheikh, 2005). The Efficient Market Hypothesis (EMH from hereafter) was further divided by Fama into 3 sub-categories. The Weak-Form EMH, which portrays that security prices incorporate all available information with respect to security markets (Abrosimova and Linowski, 2002). The Semi-Strong EMH encircles the Weak-Form EMH, as it also includes information such as, dividend yield, P/E ratios and P/BV ratio, D/P ratio and P/BV ratio etc. (Muir & Schipani, 2007). The first issue arises when the EMH assumes that all investors receiving the information perceive it in a similar manner, e.g. investor valuating the securities on the basis of growth while the other in search of undervalued opportunities would already have arrived at different inferences. Therefore it becomes increasingly difficult to figure out the true value of an asset in an efficient market (Malkiel, 2003). Some of the noteworthy anomalies are January effect, Price to Earnings ratio effect, small firm effect and over and under reaction to earnings. The most noticeable of these anomalies is the "Calendar Effect" also called "The January Effect". First surfaced in the early 1942 by Sydney D. Wachtel, when it was identified, that stock prices felt considerably in December and picked up in the first few days of January (Philpot & Peterson, 2011).

Behavioral Finance is another branch of Finance that causes stock prices to fluctuate. At times, decisions have to be made in the nick of time and the situation does not allow for investors to make intelligent decisions (Thaler, 1999).

In view of these efficient market hypotheses and arising stock market anomalies, number of asset pricing theories exist that attempt to evaluate securities. The most famous and commonly used asset pricing theory is Capital Asset Pricing Model (CAPM).

For the purpose of thesis I conducted efficiency tests on 12 stock exchanges in the world. These stock exchanges included Amsterdam, Europe, Hong Kong, India, Taiwan, Pakistan, Malaysia, United States, Indonesia, Canada, Tokyo, Australia, Austria and Switzerland. The efficiency of

ISSN- 2350-0530(O) ISSN- 2394-3629(P)
IF: 4.321 (CosmosImpactFactor), 2.532 (I2OR)

these stock markets was tested as per the methods outlined by Reilly and Brown in their book "Analysis of Investment & Management of Portfolios". The stock markets were tested in relation to the 3 forms of Efficient Market Hypothesis, weak, semi-strong and strong form. Durbin Watson Autocorrelation Test (DWT from here on) and Wald Wolfowtiz Runs Test were applied to check for weak form hypothesis. The DWT once applied to the monthly data of these stock exchanges Hong Kong, India, Taiwan, Pakistan, Amsterdam and Malaysia showed no auto correlation. Whereas US, Canada, Tokyo, Australia, Austria and Switzerland showed auto correlation. On the daily data DTW showed correlation for Switzerland, Europe, Indonesia and Pakistan. While on the daily data Australia, Hong Kong, Amsterdam, Switzerland and Austria did not show auto correlation. In the runs test Pakistan proved to be the most inefficient market while Hong Kong as the most efficient. The US and Europe stock exchanges produced mixed results. All of the stock exchanges were proven in efficient in regards to the strong form hypothesis as the results would show there exist mutual funds managers in every country that have beaten the market index. As the market contains all the risky assets and provides the best risk-adjusted return we can render the markets inefficient as mutual funds can out run the market. The semi-strong form efficiency test was conducted through event study. It was discovered that the markets quickly respond to the news of famous companies. While, if the popularity of the company is not as high, it took a while for the market and company's stock prices to incorporate the news. With the evidence presented above we have selected Pakistan as the most inefficient market, Hong Kong as the most efficient and US was chosen based on mixed results, representing the half way between efficient and inefficient.

2. LITERATURE REVIEW

APT acts as a substitute for CAPM and 3 factor model. They both project a linear relationship. The linear relationship exists between expected return of the asset and its covariance with other variables. These variables could be the market portfolio (in case of CAPM) or macroeconomic variables (in case of APT) and similarly for 3 factors model the market return, HML and SMB (Hubberman & Wang, 2005). Essentially arbitrage is taking advantage of an opportunity that entails no risk and no cost (Poitras, 2009). Various researchers have developed various rationales to justify the choice of variables selected for a particular study. Berry et al. (1988) provided a theoretical framework, which forms the prerequisites for a variable to qualify as a legitimate risk factor. Triznka (1986) stumbled upon 5 economic forces that have pervasive effects on stock returns. Similarly, in another study headed by Cho (1984) discovered that the number of variables with significant influence ranges from two to five. The characterization of developed and developing stock markets relies heavily upon, the depth of the market (measure of buy and sell requests that are open at different quotes) and the stability of these markets (Saeed, 2012). Studies in regards to macroeconomic factors and stock prices began in the 80's (Menike, 2006).Emerging market stock returns are usually higher than markets that are fully developed. Nishat and Shaheen (2004) examined the Karachi Stock Exchange Index to study the impact of macroeconomic forces. The data and the variables employed for the study was 1973-2004 and industrial production, consumer price index and money supply respectively.

In an extensive study by Chen et al. in 1986, he checked the validity of macroeconomic factors on returns, by comparing the expected outcome with actual outcome. Risk factor also becomes an important consideration in the valuation process (Markowitz, 1952-1956). The validity of

ISSN- 2350-0530(O) ISSN- 2394-3629(P)
IF: 4.321 (CosmosImpactFactor), 2.532 (I2OR)

APT was tested by Chen, Roll and Ross (CR&R, 1986) and it was discovered that many of the macroeconomic variables were helpful in explaining the variations in rates of returns.

APT model has also been applied on securities were the availability of sufficient information is an issue (Hunda & Lin, 1993).APT's authenticity in relation to economic conditions was initiated by Isako, Cauchie and Hoesli (2002). The study was conducted on 19 industrial sector portfolios, using monthly data from 1986-2002. It was revealed that stock returns are affected by both local and foreign economic conditions.

Mauri Paavola (2006) applied the APT model on Russian Equity market. Returns were calculated for 20 of the largest companies in equity stocks. 80% of the variance calculated on the data from 1999-2006 was mainly due to 5 macroeconomic forces, namely inflation, exchange rate, industrial production and money supply.

In a study conducted by Varela and Teker in 1998 applied APT across 1037 firms. Data employed was from Jan 1980 to Dec 1992. They concluded that the single factor model (CAPM) was inferior to all others. The study also confirmed that multifactor model and APT are superior as their error term is not priced by alternate model risk factors. The London Stock Exchange (LSE) was targeted by Guns and Cukor (2007) in regards to the APT. The independent variables to support the APT were uncertainty in Inflation, a residual error for industry portfolio, uncertainty in sectoral industrial production, unforeseen dividends, money supply, interest rate and exchange rate. The results came out in favor of the APT and it was concluded that these macroeconomic factors were all priced in relation to the London Stock Exchange stock prices.

The Indian Stock Exchange was made the target of this study conducted by Sarbapriya Ray and Shyampur Siddheswari in (2011). A multiple regression model was implemented on the data from 1990-2011. On top of that Granger Causality Test was also enacted to get an understanding of the causal relationship. Interest Rate, Industrial Production, Inflation, Foreign Direct Investment, Oil Price, Gold Price, GDP and Exchange Rate were the macroeconomic variables used for the study. The regression results indicated a negative significant relationship between Oil Price, Gold and stock prices. Exchange Rate, Inflation, Foreign Direct Investment and Wholesale Price Index projected non-significant results.

3. METHODOLOGY

Research approaches can be characterized under deductive or inductive research. Hypotheses are formulated in case of deductive research and research questions are formed for inductive reasoning. In this study we are testing the validity of APT in relation to EMH. This argument further validates the use of deductive approach for this study. We are primarily focusing on secondary data collected from January 2004 to December 2013. Following were research questions;

- To study the literature on asset pricing models, specifically the APT and market efficiency.
- Analyze different stock exchanges with respect to their efficiencies.
- Study the impact of linear relationship of macroeconomic variables on stock prices in these efficient markets as outlined by the APT.

ISSN- 2350-0530(O) ISSN- 2394-3629(P)
IF: 4.321 (CosmosImpactFactor), 2.532 (I2OR)

RESEARCH HYPOTHESIS

H_0 = The performance of APT is dependent upon the efficiency of the markets.
H_1 = The performance of APT is not dependent upon market efficiency.

Data for the period of Jan 2004-Dec2013 was collected from various websites. The data for DJIA companies and Hang Seng 50 Index companies was collected through www.YahooFinance.com and www.Bloomberg.com. Companies with less than 119 readings were eliminated from the statistical analysis, as uniformity was the goal. The data for economic variables posed a real challenge. The prices for Gold, Exchange Rates and Oil were readily available in the above mentioned websites. The Economic Indicators like the Inflation, Interest Rates, Money Supply, and Industrial Production were collected from Economic Survey Report for each year.

For efficient market, world-wide stock exchanges was collected as sample and characterized into **3 major portions**, first **Weak-Form Efficiency, Semi-Strong Form Efficiency and Strong-Form Efficiency**.The Weak-Form Efficiency is checked through the **Durbin-Watson Autocorrelation Test and Wald-Wolfowitz Runs**

$$d = \frac{\sum_{t=2}^{T}(e_t - e_{t-1})^2}{\sum_{t=1}^{T} e_t^2},$$

Where
T = number of observations
ei = yi − yˆi
yi = The observed value
ˆyi = Predicted values
d becomes smaller as the serial correlations increase. If the value of d = 2, no autocorrelation exists. Lower than and higher than 2 shows negative and positive autocorrelation respectively**Test** ("Analysis of Investments & Management of Portfolios" by Reilly & Brown, pp. 143, 2010).

The Wald Wolfowitz runs test is used to determine that elements of a particular sequence are not dependent upon each other

$$\sigma^2 = \frac{2\,N_+\,N_-\,(2\,N_+\,N_- - N)}{N^2\,(N-1)} = \frac{(\mu-1)(\mu-2)}{N-1}.$$

N+ = Number of positive occurrences
N- = Number of negative occurrences
N = Total number of observations (Nisar & Hanif, 2012).

4. RESULTS & DISCUSSIONS

To check the Strong-Form Efficiency comparison of **Market index vs. local mutual funds** was conducted. These mutual funds' returns were compared with respect to 1, 2, 3, 5, & 10 Year

ISSN- 2350-0530(O) ISSN- 2394-3629(P)
IF: 4.321 (CosmosImpactFactor), 2.532 (I2OR)

return. Acomparison was made on the basis of the listed mutual fund and local markets by using Sharpe Ratio, treynor ratio and Janson model.

Table 1:			
WALD WOLFOWITZ RUNS TEST			
Z SCORES			
	MONTHLY	**WEEKLY**	**DAILY**
AMSTERDAM	0.14	0.03	0.08
AUSTRALIA	-2.18	-1.01	1.56
AUSTRIA	-1.26	0.55	-1.81
CANADA	-2.03	0.67	1.03
EUROPE	-0.85	1.31	3.92
HONG KONG	1.38	0.46	1.28
INDIA	1.38	-1.95	-2.41
MALAYSIA	0.33	-0.96	-4.3
UNITED STATES	-0.29	1.15	2.86
SWITZERLAND	-1.52	0.74	0.08
TAIWAN	-0.15	0.33	-0.52
TOKYO	-0.52	-1.37	2.94
Source: Own Calculations.			

Table 1 shows the results of Wald Wolfowitz runs test. The runs test depicts if the stock returns are independent of each other or not. . All countries stock indices cleared the weekly runs test, as all the values fall with in +1.96 and -1.96 (The Acceptance Region). In the Daily column runs test was run on the daily returns of the respective indices. The test results show that Europe, India, Indonesia, Malaysia, United States and Tokyo have failed to fall in the acceptance region. The countries that have proved to be the most efficient in terms of randomness of data are Amsterdam, Austria, Hong Kong and Taiwan. Based on the runs test we can figure out which countries have random appearances in their returns or show some kind of autocorrelation.

Table 2:			
Durbin Watson Autocorrelation Test			
D Values			
	MONTHLY	**WEEKLY**	**DAILY**
AUSTRALIA	1.52	1.99	2.06
EUROPE	1.67	2.22	2.11
HONG KONG	1.85	1.99	2.05
INDIA	1.85	1.98	1.85
MALAYSIA	1.73	1.92	2.39
UNITED STATES	1.58	1.15	2.21
SWITZERLAND	1.43	2.4	1.98
TAIWAN	1.85	2.08	1.89

We have set the benchmark between 1.80 and 2.20. Only Hong Kong, India and Taiwan have fallen in the safe zone and show no autocorrelation while all the other countries have shown slight autocorrelation. While the weekly results showed completely the opposite to monthly

ISSN- 2350-0530(O) ISSN- 2394-3629(P)
IF: 4.321 (CosmosImpactFactor), 2.532 (I2OR)

returns. Only Europe, United States and Switzerland fell outside the acceptance zone thus showing autocorrelation in their weekly returns. In the daily returns again United States and Malaysia showed minute autocorrelation while all the other countries were within the acceptance region. The only country that has shown slight autocorrelation in all three categories of returns is the United States. Durbin Watson test also suggests that the alarming situation occurs below 1 and above 3. No country has shown alarmingly high positive or negative autocorrelation.

Below is the Table 3 that shows the results of Strong Form of Efficiency tested by comparing the market with the locally listed mutual funds. As we can see in the table 1,2,3,5 & 10 year returns are provided for the respective countries market returns and also the mutual funds returns. In case of the United States all three mutual fundshave beaten the US DJIA market in the aggregate 10 Yr. returns. Switzerland is the only country where I could only find one mutual fund that beat the Swiss Market Index in all categories of the returns. Similarly Malaysia and India have been overtaken by all three mutual funds in their aggregate returns.

Table 3 Source: Own Calculations		Market				Mutual Fund 1				Mutual Fund 2				Mutual Fund 3			
		Return	Sharpe	Jensen	Treyno	Return	Sharpe	Jensen	Treyno	Return	Sharpe	Jensen	Treyno	Return	Sharpe	Jensen	Treyno
	1-Yr	26.54%	3.09	0.26	0.26	26.62%	3.07	0.26	0.27	19.94%	2.10	0.23	0.22	25.69%	3.16	0.24	0.29
	2-Yr	19.85%	2.05	0.20	0.20	18.32%	2.22	0.16	0.23	11.81%	1.29	0.09	0.27	19.27%	2.34	0.16	0.24
United States	3- Yr	13.62%	1.11	0.13	0.13	13.17%	1.21	0.11	0.15	12.94%	1.60	0.05	0.42	13.56%	1.32	0.11	0.17
	5-Yr	15.65%	0.97	0.15	0.15	15.07%	1.16	0.12	0.19	11.94%	1.07	0.08	0.25	17.03%	1.12	0.14	0.19
	10-Yr	6.01%	0.29	0.04	0.04	11.52%	0.79	0.04	0.13	10.27%	0.69	0.03	0.15	9.52%	0.57	0.04	0.09
	1-Yr	46.96%	2.86	0.47	0.47	22.73%	1.33	0.29	0.36	45.91%	1.64	0.55	0.38	31.15%	1.67	0.38	0.38
	2-Yr	34.93%	1.84	0.35	0.35	13.84%	0.89	0.19	0.24	27.60%	1.24	0.26	0.37	19.86%	1.30	0.19	0.35
Japan	3- Yr	17.33%	0.91	0.17	0.17	9.15%	0.62	0.08	0.19	16.82%	0.81	0.13	0.23	10.81%	0.72	0.10	0.19
	5-Yr	14.27%	0.69	0.14	0.14	9.96%	0.59	0.08	0.18	17.28%	0.72	0.12	0.21	12.74%	0.76	0.09	0.21
	10-Yr	6.18%	0.22	0.04	0.04	7.62%	0.35	0.03	0.11	7.11%	0.24	0.04	0.07	5.14%	0.20	0.03	0.05
	1-Yr	11.40%	1.96	0.11	0.11	22.14%	2.72	-0.02	-0.55	15.21%	1.86	0.09	0.20	18.03%	1.68	0.07	0.33
	2-Yr	10.58%	0.87	0.10	0.10	19.26%	1.96	0.01	-9.72	9.43%	0.66	0.11	0.09	13.23%	0.87	0.10	0.13
Taiwan	3- Yr	-0.30%	-0.03	0.00	0.00	10.29%	0.72	0.01	1.33	2.55%	0.14	0.00	0.02	1.74%	0.09	0.00	0.02
	5-Yr	14.56%	0.72	0.14	0.14	23.46%	1.02	0.03	4.80	18.46%	0.74	0.16	0.16	21.16%	0.89	0.15	0.20
	10-Yr	5.10%	0.16	0.03	0.03	13.43%	0.46	0.02	0.35	13.49%	0.45	0.04	0.13	13.77%	0.45	0.04	0.14
	1-Yr	19.02%	1.88	0.19	0.19	20.65%	2.07	0.19	0.21	3.56%	0.08	0.34	0.02	0.75%	0.06	0.17	0.01
	2-Yr	16.69%	1.77	0.17	0.17	18.53%	2.03	0.16	0.19	-6.28%	-0.20	0.20	-0.05	0.84%	0.06	0.17	0.01
Switzerland	3- Yr	8.71%	0.77	0.09	0.09	10.21%	0.91	0.09	0.10	4.35%	0.14	0.05	0.07	0.96%	0.07	0.07	0.01
	5-Yr	8.70%	0.66	0.08	0.08	10.58%	0.81	0.08	0.10	3.69%	0.12	0.03	0.10	1.42%	0.09	0.08	0.01
	10-Yr	4.38%	0.20	0.03	0.03	5.92%	0.32	0.03	0.04	1.76%	0.00	0.01	0.00	0.87%	-0.08	0.02	-0.01
	1-Yr	10.32%	1.36	0.10	0.10	21.04%	0.94	0.18	0.12	11.39%	1.05	0.05	0.26	58.49%	5.30	0.07	3.02
	2-Yr	10.24%	1.34	0.10	0.10	18.81%	0.99	0.10	0.19	30.38%	1.02	0.11	0.34	25.98%	1.75	0.07	0.53
Malaysia	3- Yr	7.35%	0.74	0.07	0.07	15.90%	0.61	0.13	0.09	24.08%	0.95	0.08	0.29	16.89%	0.84	0.09	0.15
	5-Yr	15.81%	1.39	0.16	0.16	26.12%	1.00	0.21	0.19	25.54%	1.01	0.14	0.31	33.67%	1.43	0.19	0.30
	10-Yr	9.15%	0.55	0.07	0.07	19.31%	0.55	0.11	0.12	10.04%	0.29	0.07	0.09	21.18%	0.74	0.09	0.17
	1-Yr	3.67%	0.26	0.04	0.04	-16.0%	-0.65	-0.01	-1.13	5.06%	0.32	0.02	0.11	5.05%	0.32	0.02	0.11
	2-Yr	13.20%	0.76	0.13	0.13	27.13%	0.69	0.10	0.42	15.08%	0.96	0.08	0.26	15.97%	0.98	0.09	0.26
India	3- Yr	2.37%	0.11	0.02	0.02	6.81%	0.19	0.02	0.10	3.83%	0.22	0.01	0.08	1.25%	0.06	0.01	0.02
	5-Yr	11.83%	0.55	0.12	0.12	31.72%	0.68	0.12	0.37	19.89%	0.98	0.09	0.29	14.14%	0.59	0.09	0.18
	10-Yr	8.04%	0.28	0.06	0.06	40.10%	0.51	0.10	0.33	18.46%	0.71	0.06	0.22	10.49%	0.32	0.05	0.11

ISSN- 2350-0530(O) ISSN- 2394-3629(P)
IF: 4.321 (CosmosImpactFactor), 2.532 (I2OR)

Hong Kong	1-Yr	3.67%	0.26	0.04	0.04	9.07%	0.54	0.04	0.08	13.06%	1.04	0.02	0.32	44.20%	1.10	0.02	-0.93
	2-Yr	13.20%	0.76	0.13	0.13	21.68%	1.11	0.12	0.25	20.15%	1.63	0.06	0.57	22.62%	0.70	-0.01	-0.91
	3- Yr	2.37%	0.11	0.02	0.02	5.68%	0.23	0.03	0.05	8.51%	0.65	0.01	0.24	5.62%	0.19	0.01	0.52
	5-Yr	11.83%	0.55	0.12	0.12	29.84%	0.95	0.15	0.24	20.98%	1.09	0.07	0.40	17.40%	0.42	0.03	0.93
	10-Yr	8.04%	0.28	0.06	0.06	12.25%	0.36	0.07	0.10	4.96%	0.16	0.04	0.06	3.98%	0.06	0.02	0.08
Europe	1-Yr	17.42%	1.31	0.17	0.17	2.67%	1.84	0.01	0.35	7.83%	1.65	0.05	0.31	8.43%	1.78	0.05	0.33
	2-Yr	15.79%	1.09	0.16	0.16	3.75%	2.43	0.01	0.47	11.42%	2.05	0.05	0.45	12.03%	2.16	0.05	0.48
	3- Yr	5.05%	0.28	0.05	0.05	2.70%	1.40	0.00	0.80	4.81%	0.65	0.02	0.15	5.41%	0.74	0.02	0.17
	5-Yr	6.66%	0.33	0.06	0.06	2.53%	1.38	0.00	1.11	9.08%	1.23	0.02	0.33	9.68%	1.31	0.02	0.35
	10-Yr	2.42%	0.04	0.01	0.01	2.70%	0.57	0.00	-2.40	4.21%	0.30	0.00	0.07	4.81%	0.37	0.01	0.08
Canada	1-Yr	9.45%	1.18	0.09	0.09	42.41%	1.63	0.13	0.37	13.31%	1.84	0.08	0.17	26.86%	3.08	0.08	0.39
	2-Yr	6.90%	0.78	0.07	0.07	3.99%	0.13	0.09	0.03	9.75%	0.87	0.08	0.09	22.22%	2.09	0.07	0.24
	3- Yr	0.96%	0.08	0.01	0.01	-1.79%	-0.08	0.01	-0.02	2.16%	0.15	0.01	0.02	9.39%	0.67	0.02	0.09
	5-Yr	9.14%	0.70	0.09	0.09	19.66%	0.58	0.15	0.12	14.40%	0.96	0.06	0.26	18.07%	1.06	0.10	0.18
	10-Yr	5.69%	0.28	0.04	0.04	7.98%	0.18	0.06	0.04	3.78%	0.12	0.02	0.05	5.74%	0.21	0.04	0.04
Austria	1-Yr	6.79%	0.48	0.07	0.07	11.25%	0.35	0.12	0.06	12.15%	0.73	0.07	0.11	12.15%	0.73	0.07	0.11
	2-Yr	16.18%	1.01	0.16	0.16	38.48%	1.06	0.33	0.19	20.91%	1.07	0.18	0.18	20.91%	1.07	0.18	0.18
	3- Yr	-2.65%	-0.15	-0.03	-0.03	-1.54%	-0.04	-0.05	-0.01	1.28%	0.05	-0.03	0.01	1.28%	0.05	-0.03	0.01
	5-Yr	9.89%	0.44	0.10	0.10	24.48%	0.45	0.20	0.12	15.71%	0.50	0.13	0.12	15.71%	0.50	0.13	0.12
	10-Yr	6.85%	0.21	0.05	0.05	10.67%	0.20	0.08	0.06	9.60%	0.26	0.06	0.07	9.60%	0.26	0.06	0.07
Australia	1-Yr	14.53%	1.17	0.14	0.14	32.84%	1.51	0.21	0.23	29.71%	1.32	0.23	0.19	37.94%	1.74	0.19	0.32
	2-Yr	13.90%	1.21	0.14	0.14	30.12%	1.61	0.19	0.23	32.29%	1.72	0.19	0.24	26.04%	1.39	0.15	0.25
	3- Yr	4.03%	0.32	0.04	0.04	18.32%	0.99	0.06	0.15	20.83%	1.10	0.06	0.17	12.89%	0.67	0.05	0.12
	5-Yr	8.52%	0.61	0.08	0.08	23.01%	1.04	0.12	0.17	21.46%	0.97	0.11	0.17	12.45%	0.40	0.11	0.09
	10-Yr	5.87%	0.29	0.04	0.04	13.52%	0.58	0.04	0.13	14.24%	0.63	0.05	0.12	13.45%	0.37	0.04	0.14

Furthermore Sharpe, Jenson and Treynor ratios were calculated for all indices and mutual funds. The risk free rate posed a great challenge as the data for risk free rate (in our case 3-month treasury bill) for each country was not available. While researching in one of the articles written by Prof A.Q Khan and Sana Ikram in 2011 suggests that in reality no rate is risk free rate. The best proxy that can be used for risk free rate is the US 3-month Treasury bill. The above mentioned experiments were conducted on the following 10 United States Macroeconomic Variables.

Table 5:

	Infl	Gold	IPI	ST int	Oil	LT Int	Unemploy	DOW	EUR	M2
No. of values used	119	119	119	119	119	119	119	119	119	119
Range	0.031	0.235	0.058	4.175	0.617	0.506	0.12286	0.236	0.1408	0.483
Mean	0.002	0.01	9E-04	0.056	0.013	-0	0.0017	0.005	-0.0004	0.025
Kurtosis	8.8	0.229	8.128	18.78	1.899	3.153	0.50197	1.723	0.7267	-1.59
Skewness	-1.46	-0	-2.14	3.681	-0.61	-0.53	0.83272	-0.76	0.4174	0.114
variance	1E-05	0.002	6E-05	0.248	0.009	0.005	0.0007	0.002	0.0006	0.036
Std deviation	0.004	0.043	0.008	0.498	0.095	0.072	0.02644	0.039	0.024	0.19
KolmogorovSmirnov	0.134	0.04	0.144	0.311	0.075	0.075	0.20625	0.071	0.0667	0.234
P-Value	0.028	0.992	0.014	<0.0001	0.518	0.511	< 0.0001	0.584	0.664	<0.0001

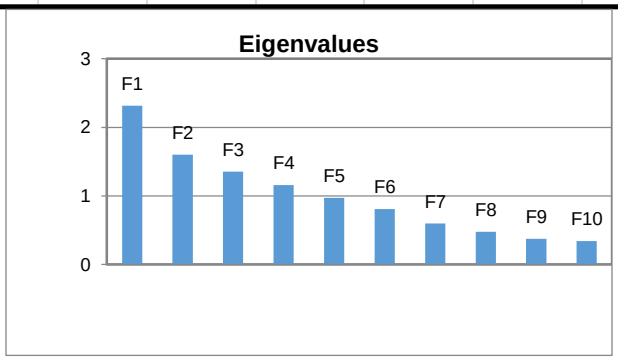
Table 5 shows the descriptive statistics of the 10 variables and Dow Jones Industrial Average (DJIA) can deviate by 3.9%. When the P-value of any given variable is less than the confidence interval we reject the null hypothesis that the sample resembles a normal population. From looking at the data above we can see that the P-Value for ST Int, Unemployment and Money Supply (M2) are below significance level of 0.01 while inflation and Industrial Production are below the significance level of 0.05. Thus in total 5 variables Short Term Interest Rate, Unemployment, Money Supply, Inflation and Industrial Production fail the Kolmogorov-Smirnov Test.

ISSN- 2350-0530(O) ISSN- 2394-3629(P)
IF: 4.321 (CosmosImpactFactor), 2.532 (I2OR)

PRINCIPAL COMPONENT ANALYSIS

Eigenvalues:

Table 8	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
Eigenvalue	2.315	1.601	1.355	1.159	0.972	0.808	0.597	0.476	0.375	0.342
% variance	23.148	16.013	13.545	11.589	9.721	8.078	5.971	4.764	3.747	3.423
Cumulative	23.148	39.161	52.707	64.296	74.017	82.095	88.066	92.830	96.577	100.000



There are a few ways to interpret Principal Component Analysis. First way is to select the factors with eigenvalue greater than 1. From table 8 we can conclude that PCA suggests that 4 factors should be used for this model to avoid Multicollinearity and Hetroskediscity.
Below is the table showing the Hong Kong descriptive statistics

Table 7:

	0001.HK	0002.HK	0004.HK	0012.HK	0013.HK	0016.HK	0019.HK	0023.HK	0066.HK	0083.HK
No. of values used	119	119	119	119	119	119	119	119	119	119
No. of values ignored	0	0	0	0	0	0	0	0	0	0
No. of min. val.	1	1	1	1	1	1	1	1	1	1
Minimum	-0.227	-0.166	-0.310	-0.284	-0.303	-0.271	-0.216	-0.371	-0.258	-0.385
Maximum	0.215	0.160	0.338	0.282	0.280	0.257	0.302	0.371	0.246	0.439
Range	0.442	0.326	0.648	0.566	0.583	0.528	0.518	0.742	0.504	0.824
Mean	0.010	0.007	0.015	0.007	0.009	0.008	0.009	0.010	0.011	0.016
Kurtosis	0.903	5.273	1.168	1.208	2.211	0.876	2.911	3.965	3.567	1.563
Skewness	-0.063	0.375	0.062	0.041	0.007	0.031	0.195	-0.211	0.401	0.401
Sample variance	0.006	0.002	0.010	0.008	0.007	0.008	0.005	0.009	0.004	0.015
Sample standard deviation	0.079	0.040	0.102	0.089	0.085	0.088	0.071	0.093	0.067	0.124
Kolmogorov-Smirnov Test	0.078	0.106	0.086	0.073	0.098	0.061	0.066	0.095	0.088	0.067
P-Value	0.475	0.139	0.342	0.563	0.206	0.764	0.677	0.241	0.323	0.667

Range defines the difference between the maximum reading and the minimum. This may also be interpreted as the maximum change that a variable has incurred over the last 10 years. Mean

ISSN- 2350-0530(O) ISSN- 2394-3629(P)
IF: 4.321 (CosmosImpactFactor), 2.532 (I2OR)

signifies the average of a company's return over the last 10 years. In terms of kurtosis none of the variables in the first table are close to zero. All positive readings for kurtosis indicate a Leptokurtic shape of the sample distribution.

Variable	R^2	F Test	Intercept	LT Int	^HIS	Exchange	GOLD
0001.HK:	0.757	< 0.0001	0.002	-0.002	1.093	0.987	-0.007
			0.548	0.944	< 0.0001	0.754	0.934
0002.HK	0.086	0.037	0.005	-0.017	0.105	7.201	0.169
			0.189	0.443	0.078	0.020	0.046
0003.HK	0.646	< 0.0001	0.003	-0.011	1.298	-0.549	0.203
			0.563	0.760	< 0.0001	0.911	0.133
0004.HK	0.646	< 0.0001	0.003	-0.011	1.298	-0.549	0.203
			0.563	0.760	< 0.0001	0.911	0.133
0012.HK	0.682	< 0.0001	-0.002	-0.006	1.194	7.799	0.121
			0.638	0.843	< 0.0001	0.057	0.278
0013.HK	0.626	< 0.0001	0.001	0.062	1.037	1.182	-0.017
			0.793	0.044	< 0.0001	0.779	0.885
0016.HK	0.665	< 0.0001	-0.002	-0.003	1.148	4.608	0.206
			0.642	0.907	< 0.0001	0.264	0.070
0019.HK	0.559	< 0.0001	0.002	0.026	0.846	6.164	0.098
			0.682	0.347	< 0.0001	0.107	0.350
0023.HK	0.620	< 0.0001	0.000	0.035	1.177	13.892	0.208
			0.943	0.292	< 0.0001	0.003	0.104
0066.HK	0.537	< 0.0001	0.003	-0.010	0.787	6.536	0.252
			0.495	0.719	< 0.0001	0.078	0.014
0083.HK	0.598	< 0.0001	0.003	-0.075	1.570	9.544	0.244
			0.689	0.106	< 0.0001	0.137	0.165
0101.HK	0.483	< 0.0001	0.007	-0.063	-0.063	1.036	1.284
			0.322	0.109	< 0.0001	0.813	0.505
0291.HK	0.505	< 0.0001	0.007	-0.048	1.125	13.297	-0.009
			0.325	0.226	< 0.0001	0.016	0.955
0293.HK	0.550	< 0.0001	0.000	0.034	0.951	7.459	-0.071
			0.966	0.279	< 0.0001	-0.019	0.552
0388.HK	0.646	< 0.0001	0.011	0.070	1.421	-15.479	0.303
			0.110	0.102	< 0.0001	0.010	0.063
0494.HK	0.238	< 0.0001	0.004	0.007	0.667	-8.450	0.139
			0.641	0.883	< 0.0001	0.208	0.449
0762.HK	0.259	< 0.0001	0.001	-0.063	0.696	-5.336	0.216
			0.901	0.175	< 0.0001	0.406	0.219
0836.HK	0.389	< 0.0001	0.022	-0.103	0.903	12.282	-0.681

ISSN- 2350-0530(O) ISSN- 2394-3629(P)
IF: 4.321 (CosmosImpactFactor), 2.532 (I2OR)

Table above is the regression for Hong Kong Stock Exchange. . The Independent variables are International Gold Prices in Honk Kong Dollars, Long Term Interest Rate, Exchange Rate with the US and Hang Seng 50 Index Return. The dependent variable is the monthly returns of Hang Seng 50 Index. The R^2 for Hong Kong Stock Exchange seems much more promising than The United States.%. The P-Value of F Test which is provided in the 2nd column suggests that except for 0006.HK and 0883.HK the model is insignificant. For these companies the percentage of variance explained in the stock price is 0.9% and 6.7%. For LT Int the significant negative impact was in the case of 0101.HK (-0.063) and significant positive impact in case of 0388.HK (0.070). Just like the United Stated the most important macroeconomic variable that represents the most variance in stock prices is Hang Seng 50 Index Return. The only company that had a significant negative impact was 0101.HK of -0.063. Rest all of the companies are positively correlated except for 0883.HK which had no significant impact from the Hang Seng 50 Index return. The beta for exchange rate ranged from -15.479 for 0388.HK to 22.378 for 0027.HK. The beta for Gold prices ranged from -0.681 for 0836.HK to 1.284 for 0101.HK.

5. CONCLUSION & RECOMMENDATIONS

10 variables were initially selected for the purpose of building the Arbitrage Pricing Model. These were Inflation, Gold Prices, Industrial Production Index, Short Term Interest Rates, Oil Prices, Long Term Interest Rates, Unemployment, Dow Jones Industrial Average, Exchange Rate (EUR) and Money Supply. Correlation matrix was applied to the 10 variables to avoid Multicollinearity. Furthermore, Principal Component Analysis was applied to reduce the number of variables to those that represented the most variance in the other variables. PCA suggested that 4 variables should be utilized from the 10 initially selected variables. The factor loadings from PCA showed that Gold Prices, Long Term Interest Rate, Dow Jones Industrial Index and Exchange Rate should represent the APT Model.

The Ordinary Least Square Regression (Saeed & Akhter, 2010) was applied to study the linear relationship between the independent and dependent variables. Similar model was applied on both Hong Kong and United States Stock Exchange Indices. For the United States 3/29 companies showed a value of R^2 more than 60%. And 3 out of the remaining 26 companies produce a variance above 50%. These results are not sufficient enough to generalize the APT model for the United States Stock Exchange. The Hong Kong Stock Exchange produced better results than the US. Hong Kong had one out of 40 companies with R^2 value above 70%, 11 companies were above 60% and 9 companies above 50%. These results though better than the US still not sufficient enough for the APT to become a valid predictor of stock returns.

From the above discussion we can conclude that APT was successful in explaining some of the variance in these markets. The most important point to note here is that as the efficiency of stock exchanges increase, APT's performance starts to get better. In case of United States the variance explained was not as high as variance explained by the Hong Kong Model. Thus we can conclude that Arbitrage Pricing Model is linked with market efficiency. This thesis also concludes that the existence of a perfectly efficient market is not possible. Even though Hong Kong Stock Exchange was picked as the proxy for efficient market, its efficiency is still questionable.

ISSN- 2350-0530(O) ISSN- 2394-3629(P)
IF: 4.321 (CosmosImpactFactor), 2.532 (I2OR)

My recommendation is that users of Arbitrage or any other pricing model, should first relate the asset pricing theory with market efficiency, in order to predict their effectiveness in a given market. Inefficient market failed to produce viable results. This is a sign that asset pricing theory such as APT may not be a successful predictor of stock returns.

6. *REFERENCES*

[1] *Ikram, S., & Khan, A. Q. (2011). Testing Strong Form Market Efficiency of Indian Capital Market: Performance Appraisal of Mutual Funds. International Journal of Business and Information Technology, 1(2).*

[2] *Hyde, S.J. (2007). The resposne of Industry stock returns to market, exchange rate and interest rate risks, Managerial Finance, pp. 693-709.*

[3] *Ihsan, H., Ahmad, E., Haq, M.I.U., and Sadia, H. (2007). Relationship of Economic and Financial Variables with Behaviors of Stock Returns, Journal of Economic Corporation, 28(2), 1-24.*

[4] *Iqbal, J., & Haider, A. (2005). Arbitrage pricing theory: evidence from an emerging stock market. Munich Personal RePEc Archive, 10(1), 123-139.*

[5] *Iqbal, Naeem, Khattak, Sajid Rehman, Khattak, M. Arif and Ullah, Innayat (2012). Testing the Arbitrage Pricing Theory on Karachi Stock Exchange, Interdisciplinary Journal of Contemporary Research in Business, 4(8).*

[6] *Iqbal, Javed, and Haider, Aziz (2005). Arbitrage Pricing Theory: Evidence From An Emerging Stock Market, Munich Personal RePEc Archive, 10(1), 123-139.*

[7] *Jaffe F. Jaffery, (Jul.1974), Special Information and Insider Trading, The Journal of Business, 47(3), pp. 410-428.*

[8] *Jaffe, J., & Randolph Westerfield, R. (2004). Corporate finance. Tata McGraw-Hill Education.*

[9] *Jagannathan, Ravi, Keiichi Kubota, and Hitoshi Takehara, (1998). Relationship between Labor-Income Risk and Average Return: Empirical Evidence from the Japanese Stock Market, Journal of Business, 3(71), 319-347.*

[10] *Jegadeesh, N., & Titman, S. (1993). Returns to buying winners and selling losers: Implications for stock market efficiency. The Journal of Finance, 48(1), 65-91.*

[11] *Javid, Attiya Yasmin, (2008a). Time Varying Risk Return Relationship: Evidence from listed Pakistani Firms, European Journal of Scientific Research, 22(1), 16-39.*

[12] *Jolliffe, I. T. (1972). Discarding variables in a principal component analysis. I: Artificial data. Applied statistics, 160-173.*

[13] *Jones, T. L., Fu, X., & Tang, T. (2008). Day-of-the-week effect in the seasoned equity offering discount. Managerial Finance, 35(1), 48-62.*

[14] *Joulion, P. (1991). Pacing of Exchange Rate Risk in the Stock Market, Journal of Financial and Quantitative Analysis, 26, 363–76.*

[15] *Karras, G., Lee, J. M., & Neuburger, H. (2007). Unlocking the sources of the apparent episodic stationarity of the P/E ratio: Impulses or propagation? Review of Accounting and Finance, 6(3), 339-348.*

[16] *Kaur, D., & Sahu, N. G. (2009). Correlation and causality between stock market and macroeconomic variables in India: an empirical study.*

ISSN- 2350-0530(O) ISSN- 2394-3629(P)
IF: 4.321 (CosmosImpactFactor), 2.532 (I2OR)

[17] *Khan, M. A., Qayyum, A., Sheikh, S. A., & Siddique, O. (2005). Financial Development and Economic Growth: The Case of Pakistan [with Comments].The Pakistan Development Review, 819-837.*
[18] *Khilji, N. M. (1993). The behavior of stock return in an emerging market: A case study of Pakistan. Pakistan Development Review, 32 (4), 593-604.*
[19] *Kim, H. J. (2008). Common factor analysis versus principal component analysis: choice for symptom cluster research. Asian Nursing Research, 2(1), 17-24.*
[20] *King, J. R., & Jackson, D. A. (1999). Variable selection in large environmental data sets using principal components analysis. Environmetrics, 10(1), 67-77.*
[21] *Lee, B. S. (1992), Causal Relations among Stock Returns, Interest Rates, Real Activity, and Inflation, The J. Finance, 47(4): 1591-1603.*
[22] *Lee, W. (1997). Market timing and short-term interest rates. Journal of Portfolio Management, 23 (3), 35-46.*
[23] *Adam, A. M., Tweneboah, G., (2007). Macroeconomic Factors and Stock Market Movement: Evidence from Ghana, School of Management, University of Leicester, UK.*
[24] *Adler and B. Domas. (1983). International Portfolio choice and Corporation: A Synthesis. Journal of Finance, 38, 925–984.*
[25] *Affleck-Graves, J. F. and Money, A. H. (1975). A Note on the Random Walk Model and South African Share Prices. The South African Journal of Economics, 43(3), 382-388.*
[26] *Aggarwal, R. (1981). Exchange rates and stock prices: A study of the US capital markets under floating exchange rates, Akron Business and Economic Review, 12, pp. 7-12.*
[27] *Ahmad Eatzaz and Badar-u-Zaman (1999). Volatility and Stock Return at Karachi Stock Exchange, Pakistan Economic and Social Review, 37(1), 25–37.*
[28] *Ahmed, M.A., Rehman, R.U., Raoof, A. (2010). Do interest rates, Exchange Rates effect Stock Returns? A Pakistani Perspective, International Research Journal of Finance and Economics, (50), pp. 146-150.*
[29] *Alam, M. M., & Uddin, M. G. S. (2009). Relationship between interest rate and stock price: empirical evidence from developed and developing countries, International journal of business and management, 4(3), P43.*
[30] *Ali, Imran, et al. "Causal relationship between macro-economic indicators and stock exchange prices in Pakistan." African Journal of Business Management4.3 (2010): 312-319.*