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Finding the Optimal Sharpe Ratio in Continuous-Time Markets with and Without A Risk-Free Assets in Amman Stock Exchange

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Abstract:
The aim of this study is to find the optimal Sharpe ratio in the markets with the continuation of time with and without risk-free assets on the Amman Stock Exchange during the period (2008-2017). The study uses the method of overlapping periods to achieve continuous-time. The study uses the Excel program to find the optimal Sharpe ratios for the share through the cut-off model. The study finds that there are is 7 sub-periods of 40, i.e. 18 %, above the cut-off point with risk-free in continuous timing model .Three of the periods are ranked as good periods to invest with 42.9%, and four of the periods are ranked as very good periods to invest with 57.1%. The period number 24 (24-4-2015 to 17-1-2016) is the best period to invest in services and industrial sectors with a return of 94%. On the other hand, the cut-off point without risk free case, there are 7 sub-periods of 40 above the cut-off point in continuous timing model. Two of these periods are ranked as good periods to invest with 28.6%, and five of these periods are ranked as very good periods to invest with 71.4%. Period number 35 (23-8-2016 to 16-5-2017) is the best period to invest in services and industrial sectors with a return of 99%.

Keywords: *Optimal Sharpe Ratio, Continuous Timing, ASE, Cut-off Rate, Stock Valuation, Return and Risk.*

INTRODUCTION

Investment is the employment of funds on assets with the aim of earning income or capital appreciation. Every investment involves a return and risk. The possibility of variation in the actual return is known as investment risk. To make wise decisions in investment, there is a need for knowledge on security analysis and investment management. A rational investor aims at attaining maximum return with a given risk. In the traditional approach, investor's needs in terms of income and capital appreciation are evaluated and appropriate securities are selected to meet the needs of the investor. In the modern approach, Markowitz (1952) model is used in the selection of securities based on the risk and return analysis. Markowitz laid a foundation for quantifying risk and his contribution is popularly known as 'Modern Portfolio Theory'. He had provided analytical tools for analyzing and selecting optimal portfolio. He won Nobel Prize for this contribution to portfolio management in 1990. But, William Sharpe (1963) extended the work done by Markowitz. He considered market index while analyzing the portfolio. He simplified the amount and type of input data required to perform portfolio analysis. He made the numerous and complex computations easy which were essential to attain the optimal portfolio. He developed the Single Index Model (SIM) to make these computations easy and construct an optimal portfolio. In the Markowitz mean-variance portfolio theory, one can model the rate of returns on assets as a random variable. The goal is then to choose the portfolio weighting factors optimally. In the context of the Markowitz theory, an optimal set of weights is one in which the portfolio achieves an acceptable baseline expected rate of return with minimal

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volatility. Here, the variance of the rates of return of an instrument is taken as a surrogate for its volatility. The single-index model (SIM) is a simple asset pricing model to measure both the risk and the return of a stock. Sharpe (SIM) is commonly used in the finance industry. Today, fund managers use this model in portfolio analysis and construction. Investors also may reap the benefits of Sharpe's (SIM) as the number of companies traded in the stock exchanges is increasing year after year.

Theoretical Background and Literature review

Introduction

This chapter will introduce the theoretical and Institutional backgrounds of the study. It will presents the fundamentals of stock valuation, including (Gordon model, Financial Ratio) and technical valuation (Markowitz mean-variance, CAPM) and stock returns measure of Sharpe, Jensen and Treynor. In additional, it will presents some information's about the ASE as the empirical market of the study.

Assets Valuations

The starting point for the valuation of assets based on fundamentals is that the present value depends on future cash flows, and for example, the shares provide two types of cash flows: dividends and sale price at the end. (Ross et al. 1999). If the valuation refers to bonds, coupons are received and the actual projects are valued after discounting the cash flows of the taxes in the current value. By summarizing future cash flows, we obtain the discounted cash flow (DCF) model, which is the same regardless of the type of asset. The subjectivity of fundamental analysis is often crystallized when an investor realizes that he has only quality companies the portfolio. It is a natural tendency to analyze and choose only high-quality companies because markets, supply, and demand are defined by human behavior. The demand for quality stocks can be considered substantially high and of low quality. This can inflict a large gap between the actual values of the stocks. After all, stock selection is largely about timing and understanding the behavior of others in the markets.

Sharpe Ratio

In 1966, Sharpe studied 34 open mutual fund transactions between 1954 and 1963 (Sharpe, 1966). To do this, he calculated the average annual rate of return and the standard deviation of these rates of return for each fund (Sharpe, 1966). He confirmed the CAPM theory, explaining that funds with higher average return also obtain greater volatility. This relationship seems to be linear. In addition, it uses the same formula as Treynor's but replaces the Beta by a standard deviation. Therefore, Sharpe's ratio is quite similar to Treynor's ratio, but the meaning is different. In fact, the Treynor measure takes into account the systematic risk. Sharpe's ratio uses the general risk. A good definition of this measure is that the ratio "measures the reward to (total) volatility trade-off."(sharpe, 1964). The interpretation of Sharpe's measure is not complicated. In fact, the higher the ratio, the better the fund's performance. The measure can be negative if the return without risk is greater than the average annual yield

Jensen's Alpha

In 1968, Jensen published an important study entitled "The performance of mutual funds in the period 1945-1964". Analyzed the investment funds of the US and he compared them with a benchmark: the S & P 500. He also used the US Treasury. One year as a risk-free rate. At the beginning of the article, Jensen gave a definition of the performance of the portfolio. First, it is "the ability of the portfolio manager or security analyst to increase the return on the portfolio through the successful prediction of future share prices. (Jensen, 1968) and second, it is "the ability of the portfolio manager to minimize (through "efficient" diversification) the amount of "insurable risk" born by the holders of the portfolio." (Jensen, 1968) In addition, before explaining his model to analyze the performance of investment funds, Jensen described his five assumption . (Jensen, 1968).

Treynor's Ratio

In 1965, the fund industry of the United States was growing. However, there were few methods to

evaluate the financial performance of these funds. (Treynor, 1965) suggested that the value of an actively managed portfolio depends on the market trend. If the market is bullish, the value of the portfolio increases and if the market is bearish, the value of the portfolio decreases (Treynor, 1965)..

Amman Stock Exchange (ASE)

Industrial Sector:

Jordan's industrial sector continues to grow, phosphate and potash, chemicals and pharmaceuticals and textiles and clothing, all growth is experiencing in both net profit and volume in 2015, these segments have increased against the headwinds of the global economy and in a region directly affected by major geopolitical tensions, demonstrates the resilience of the sector and its resilience. The government, which sees the sector as vital to the long-term development plans of the kingdom, has also been actively helping manufacturers and heavy industry through incentives and promotional campaigns, support that seems to continue to strengthen. Meanwhile, the retail sector has grown steadily in recent years, its contribution to GDP to reach JD1.13 ($1.6bn) in 2015, compared to JD11.4bn ($15.5bn) last year, or about 10 % of total. The volume of trading in the industrial sector during the period (2008-2017) between (4,849,859,639-701,859,524) This indicates a decline in the volume of trading during the study period, which means that there is stagnation or decrease in the movements of selling and buying on the shares of this sector. The stock market capitalization during the period (2008-2017) is between (5,903,652,519- 3,530,527,171). The decline in the market capitalizations of the sector indicates the liquidation of companies or the decline in share returns. (http://www.cbj.gov.jo/)

2. Services Sector:

Services accounted for more than 66.3% of gross domestic product (GDP) in 2015. The sector employed nearly 78% of the labor force in 2013. The volume of trading in the Services sector during the period (2008-2017) between (9,624,900,004-1,202,107,859) This indicates a decline in the volume of trading during the study period, which means that there is stagnation or decrease in the movements of selling and buying on the shares of this sector. The stock market capitalization during the period (2008-2017) is between (15,464,230,211 -11,065,061,330). The decline in the market capitalizations of the sector indicates the liquidation of companies or the decline in share returns.(http://www.cbj.gov.jo/)

1.3. Financial Sector:

The financial services sector is one of the most robust and mature in Jordan, remaining resilient in the face of significant external volatility and retaining its role as a driver of economic growth in 2015. The banking sector, in particular, has been a major source of strength, with the Central Bank of Jordan (CBJ) maintaining a pro-growth monetary stance, following on from growth in deposits and profits at commercial banks in 2015. The volume of trading in the Financial sector during the period (2008-2017) between (5,371,087,896 -423,639,322) this indicates a decline in the volume of trading during the study period, which means that there is stagnation or decrease in the movements of selling and buying on the shares of this sector. The stock market capitalization during the period (2008-2017) is between (3,569,934,035-2,743,796,350). The decline in the market capitalizations of the sector indicates the liquidation of companies or the decline in share returns.(http://www.cbj.gov.jo/)

The following Table (3-1) presents the summary of the literature reviewed about in this chapter

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Table (3-1)
Summary of Literature Review

Authors (Years)	**Country and Period**	**Variables models**	**Results**
Sigmundsdóttir and Ren, 2012	USA 1992 to 2011	using Sharpe and downsize risk as a measurement	The two different investment strategies Suggest relatively different asset allocations. However, not surprisingly the historical results show that both the Sharpe ratio and the downside risk ratio are quite sensitive to sample data as they vary from period to period, implying that the forecasting ability of these optimal weights might be limited
Eling and Tibiletti, 2010	USA January 1995 to December 2004	the mean, standard deviation	Since goodness-of-fit tests illustrate that mutual funds and hedge funds returns can be better described by skew-normal distributions, we recommend considering the skew-normal Sharpe ratio as an alternative measure in performance evaluation.
Mora et al., 2010	Latin America 2001 to 2006	The first method uses a historical variance – covariance matrix and the second one employs a semi-variance – semi-covariance matrix. The third method consists of an exponentially weighted moving average and the fourth and last method applies resembling. From a practical point of view	This result is significant because less rebalancing can mean greater potential savings. The study further analyzes the performance of optimal portfolios as compared to equally weighted portfolios. The results of applying the Sharpe ratio in the out-of-sample period provided no evidence of statistically significant differences between optimal portfolios and equally weighted portfolios. However, some evidence is provided in favor of resembling as the returns obtained in the out-of-sample period showed stochastic dominance over the returns of the portfolios estimated using more traditional methodologies.
Fonseca, 2010	The performance of the European Stock (2001-2009)	Were calculated using a model combining the market model and an implicit long-term relation between the index prices Finally, time-varying (conditional) Sharpe ratios were calculated for each index.	These were used as the basis for a statistical comparison of the performance of the stock indexes of this group of countries, throughout different sub-periods corresponding to different conditions (of expansion and depression) in the stock markets.

Benson et al., 2008	Australian 1996–2005	time series of 120 monthly returns	Study find there is an increasing level of interest in performance measurement, especially amongst unsophisticated investors. While the academic literature is rich with sophisticated risk-adjusted performance metrics, the appeal of these techniques is limited amongst industry professionals and their clients.
Achour and Roy, 1984	Canadian 1971-1979	Using Treynor's measure suggest B similar conclusion. We then apply the signiscance tests recently recommended by 3oobson and Korkie (1981).	This result illustrates the necessity of performing adequate statistical significance tests whenever investment performance is being evaluated.
Authors (Years)	**Country and Period**	**Variables models**	**Results**
Mohith et al., 2017	Indian 2011 – 2015	Used the cut-off point was calculated based on the highest value and cut-off point should be used to calculate the proportion of money to be invested in each stock.	The study found would be helpful to investors for investing in media and entertainment sector.
Nandan and Srivastava, 2017	Indian 2010 - 2015	Computing weekly return of each security as well as market return.	The study found that maximum proportion of 9.6 percent should be invested in IndusInd Bank and Sun Pharmaceuticals and least .89 percent is to be invested in Axis Bank.
Kantar and Parhi 2017	Indian 1st January 2015 to 31 December 2015	Used in this paper Sharpe's Single Index Model is used, which basically selects assets on the basis of excess return to beta ratio to construct the optimum portfolio. Daily log return is calculated for each of the 50 stocks in order to smoothen the return.	Study found that only five out of 50 stocks were selected in the optimum portfolio. They were Maruti, Infratel, BPCL, Lupin and Hindustan Unilever each having a weight of 48 %, 6.7%, 19%, 16%, and 9.75% respectively.

Yao and Zeng, 2017	Shanghai Chine 2010 - 2015	we choose 44 stocks that have been staying in the component list during our sample period and found in the case with only risky assets, the global minimum variance is strictly larger than zero and the efficient frontier is a branch of a hyperbola in the standard derivation mean plane	The efficient frontier with only risky assets is no longer tangent to the one with both risky and risk-free assets; inclusion of a risk-free asset can strictly enhance the optimal Sharpe ratio.
Poornima and Remesh, 2016	India 2010-2015	Analyzing the collected data a "cut-off rate "can calculate. This cut–off rate is considered in the construction of optimal portfolio	This study found out that Ashok Leyland having highest return and Hyundai having lowest return. This paper identifies an optimal portfolio from the selected companies which serves as a guide to function in maximizing return
Shah, 2015	India 2000 – 2015	used Standard deviation, Expected return, Residual variance, Sharpe Model, Capital Asset Pricing Model (CAPM)	The study found the Sharpe Model, portfolio return 1.89% it means an investor is getting 1.89% of portfolio return by constructing a portfolio of BSE top 15 securities, and against it he is bearing 8.86% portfolio risk. And According to Sharpe model, portfolio return 1.89% it means an investor is getting 1.89% of portfolio return by constructing a portfolio of BSE top 15 securities, and against it he is bearing 8.86% portfolio risk.
Tumewu and Zakarias, 2015	Indonesia 2008 - 2012	used one-way ANOVA	This study find no difference between any of these three methods. Any of this method can be used by the investor to analyze the ratio of portfolio performance. As a recommendation, using these three methods simultaneously can provide better information for manager as part of investment management process.
Pinasthika and Surya, 2014	Indonesia 2007 – 2013	Price used for the data is the monthly-adjusted closing price of the stock, considering the dividend payment, stock split, and other company transactions during the period of observation.	The study found that additional risk-free asset lowers the risk significantly for both Markowitz and the index-tracking portfolios, with the index-tracking diversified portfolio has a lower risk than the benchmark index. The index-tracking portfolio also gives a higher beta than the Markowitz MV portfolio. This increase in beta depends on the index variance, in this case JKSE variance, and also the asset covariance matrix. During the back testing, the performance of both Markowitz MV

			portfolio and index-tracking portfolio do not track the index performance. However, the portfolios which use index-tracking method outperform the portfolios constructed using the Markowitz MV mode.
Nalini, 2014	India	using SIM	The results of the present study and such micro level studies have more utility value to the fund managers.
Gopalakrishna, 2014	India 2004-2008	By applying regression on the market return and excess security return it is found that IT index has a phenomenal amount of sensitiveness over S&P CNX Nifty	The study investigated that there are four aggressive stocks having beta coefficient of more than one. It is recommended that among the sample companies all the stocks are undervalued except one stock and thus the investors can pick these stocks to revise their portfolio.
Mandal, 2013	Bombay India 2001 - 2011	The proposed mechanism formulates a unique cut off rate and selects securities having 'excess-return to beta' ratio greater than or equals to the cut off rate.	The study find it is found that comparatively SIM gives an easy mechanism of constructing optimal portfolio of stocks for a rational investor by analyzing the reason behind the inclusion of securities in the portfolio with their respective weights. Actually, it simplifies the portfolio problems found in the Markowitz's model to a great extent.
Mandal, 2013	April 2001 to March 2011	Using the Sharpe's Single Index Model.	The study find the observed that as compared to the Markowitz's Mean-Variance Model, the Sharpe's Single Index model gives an easy mechanism of constructing an optimal portfolio of stocks for a rational investor by analyzing the reason behind the inclusion of securities in the portfolio with their respective weights and the construction of optimal portfolio is concerned, there is a considerable similarity between SIM and the Markowitz's model though, in reality, SIM requires lesser input than the input requirement of Markowitz's model to arrive at the risk and return of the optimal portfolio. Finally there is a significant difference between the total risk of the optimal portfolio calculated under two different mechanisms found in SIM and Markowitz's model respectively.
Kamal, 2012	Dhaka 2005 - 2009	The proposed method formulates a unique cut off point (cut off rate of	Percentage of an investment in each of the selected stocks is then decided on the basis of respective weights assigned to each stock depending on

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		return) and selects stocks having excess of their expected return over risk-free rate of return surpassing this cut-off point.	respective 'β' value, stock movement variance representing unsystematic risk, return on stock and risk free return vis-à-vis the cut off rate of return. Interestingly, most of the stocks selected turned out to be bank stocks. Again we went for single index model applied to same stocks those made to the optimum portfolio in ex ante stock price bubble scenario considering data for the period of January 2010 to June 2012. We found that all stocks failed to make the pass Single Index Model criteria i.e. excess return over beta must be higher than the risk free rate. Here for the period of 2010 to 2012, the risk free rate considered to be 11.5 % per annum (Treasury bill rate during 2012).
Debasish et al, 2012	India 2003 - 2012	Percentage of investment in each of selected stock is decided based on respective beta value, stock movement variance unsystematic risk, and return on stock risk free return.	Among the fourteen selected companies an optimal portfolio using Sharpe's Single Index Model constituted only three stocks. The proportion of investment to be made was also calculated using Single Index Model.
Bekhet and Matar, 2011	ASE 2000-2006	This study is based on the application of two elementary developed models namely; Markowitz and single-index	The results show that there is no significant difference between the two tested models, and that the numbers of stocks in the portfolios do not affect the result in the comparison of the two portfolio models
Momani (2008),	Jordan, (1996-2007)	The method that will be applied is the Simple Index Model	The result of the study was that the Arab bank was the only bank to be included in the optimal portfolio and is the largest bank in Jordan with respect to capital volume and number of branches inside and outside of Jordan. As for the rest of the banks, they were not eligible to be included in the optimal portfolio, but very close to be included. Also the result of the analysis was that a statistical indication did not exist between the location of the bank in the portfolio and the factors that were inspected in this study. Also, the correlation and correlation of coefficient were weak in all the previously mentioned variables which indicates the inefficiency of Amman's stock exchange in applying the model (EGP).

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This study was characterized by the previous studies as the only study that created the optimal Sharpe ratio for the shares, while the previous studies have dealt with finding the optimal Sharpe ratio for the portfolios as characterized by the cut-off model and a single index model instead of single index model and CAPM. The period 2008-2017, which witnessed the financial crisis of the mortgage and beyond and the crises of the Arab Spring, which was not dealt with in previous studies

Methodology and Data

Introduction

This chapter aims to presents the methodology used to test the research framework that talk about the find the optimal Sharpe ratio in continuous-time markets with and without a risk-free asset in Amman Stock Exchange. This chapter also discusses the data collection procedure, the operationalization and measurement of the variables, the sampling and the analytic procedure used in this research.

Data Sources

The data of this study comes from secondary sources, the base data taken from Amman stock exchange (ASE) which it has all annual reports for listed companies in Jordan, the researcher downloaded these reports for the period from 9th Oct. 2008 to 31th Dec. 2017. Also, risk-free data published by the Central Bank of Jordan (CBJ), to get information about finding the optimal Sharpe ratio in continuous-time markets with and without a risk-free assets in Amman Stock Exchange.

Other data comes from sources that are available in library of university, internet, books and articles.

Population and Sample

The population of this study includes companies that listed on Amman stock exchange (ASE). The sample of the study includes(67) industrial and services companies (2280 observation) during the period 9th Oct. 2008 to 31th Dec. 2017. This numbers (67 stocks) represents the final sample of the study, which satisfies the condition of data availability during the period of the study. The reason behind the choice of industrial sector is that the industrial sector operates globally. Also the industrial sector contributes about (25%) of Jordan GDP. The reason behind using the services sector is that it contributes about (60%) of Jordan GDP, which means this sectors have the largest contribution percentages to the GDP (Amman Chamber of Commerce, 2018).

Methods of the Analysis

The study sample includes daily closing prices of industrial and service companies which are (67) companies traded of (94) listed companies in the industrial and service sectors during the study period. The study conducted some treatments on the closing prices of shares such as taking logarithm. The annual risk free rate is obtained from the Central Bank of Jordan website. The study sample consists of (1350) observations (5/7/2012 – 31/12/2017) and is divided into (40) overlapping periods. The first period was from t_1 to t_{180} (5/7/2012 – 1/4/2013) and the second period from t_{31} to t_{210} (16/8/2012 – 14/5/2013). In other words, the study works on an equal increase to the poles of the period by (30) observations. The last period in the study is from t_{1171} to t_{1350} (4/4/2017 – 31/12/2017) For each estimation period, The study estimates the intercept, slope, expected return, error term and variance residual then calculate the cut-off point of optimal stock's returns. In order get a 40-period series, with equal number of days, the study starts its time-series continuously from 5/7/2012 onward. Therefore, the study excludes the previous period from (9/10/2008).**Summary** In this section, the study provides the methodology and data about optimal stock valuation. The following chapter presents and discusses the empirical result that has been conducted on the study.

Results

Introduction

This chapter aimed to obtain the research objective, regarding the optimal Sharpe ratio with and without a risk-free assets. Firstly, it will introduce summary of the data used in the analysis. Secondly, it will present the empirical results of finding the optimal Sharpe ratio with a risk-free security in a continuous-time market. Thirdly, it will present the empirical results of finding the optimal Sharpe ratio without a risk-free security, in a continuous-time market. Finally, this

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study results will be compared with previous literature to identify the effect of market condition (ASE) on the research application and analysis

Cut-Off Rate for Sharpe Ratio

In order to determine the optimal Sharpe ration, a cut-off point has to be determined. The study used equation (7) in chapter 4 to calculate the cut-off rate with risk-free and uses the equation (8) to calculate the cut-off rate without risk-free for Sharpe ratio. Table (5-2) provides the computations of the systematic and unsystematic risks for each stock in the sample.

Table (5-2)

Systematic and Unsystematic Risk of each Stock in the Sample

No.	Co. Code	(R_i)	(σ_i)	(σi^2)	(B_i)	$Bi*\sigma m$	($Bi^2*\sigma m^2$)	(σei^2)
1	ABMS	-0.00017	0.0170	0.00029	0.363	0.0024	0.000006	0.00028
2	JOHT	-0.00022	0.0199	0.00040	0.120	0.0008	0.000001	0.00040
3	JOEP	-0.00037	0.0155	0.00024	1.240	0.0082	0.000067	0.00017
4	AIHO	-0.00034	0.0178	0.00032	0.268	0.0018	0.000003	0.00031
5	IREL	0.00019	0.0226	0.00051	0.462	0.0031	0.000009	0.00050
6	SHIP	-0.00011	0.0181	0.00033	0.323	0.0021	0.000005	0.00032
7	PRES	-0.00163	0.0195	0.00038	0.458	0.0030	0.000009	0.00037
8	JDFS	0.00060	0.0163	0.00026	0.205	0.0014	0.000002	0.00026
9	JITC	-0.00042	0.0187	0.00035	0.319	0.0021	0.000004	0.00035
10	SITT	-0.00060	0.0203	0.00041	0.346	0.0023	0.000005	0.00041
11	MDTR	0.00008	0.0120	0.00014	0.347	0.0023	0.000005	0.00014
12	ZEIC	-0.00015	0.0184	0.00034	-0.060	-0.0004	0.000000	0.00034
13	AIEI	-0.00012	0.0159	0.00025	0.425	0.0028	0.000008	0.00025
14	JOTF	-0.00028	0.0135	0.00018	-0.004	0.0000	0.000000	0.00018
15	ZARA	-0.00062	0.0178	0.00032	0.311	0.0021	0.000004	0.00031
16	AIPC	-0.00003	0.0164	0.00027	0.106	0.0007	0.000000	0.00027
17	JETT	-0.00005	0.0141	0.00020	0.382	0.0025	0.000006	0.00019
18	SPTI	0.00008	0.0233	0.00054	0.781	0.0052	0.000027	0.00051
19	ALFA	-0.00019	0.0137	0.00019	0.193	0.0013	0.000002	0.00019
20	SIJC	-0.00114	0.0233	0.00054	0.319	0.0021	0.000004	0.00054
21	GEIG	-0.00004	0.0186	0.00035	0.394	0.0026	0.000007	0.00034
22	MALL	-0.00028	0.0148	0.00022	0.382	0.0025	0.000006	0.00021
23	JTEL	-0.00037	0.0151	0.00023	0.814	0.0054	0.000029	0.00020
24	CICO	0.00029	0.0238	0.00057	0.283	0.0019	0.000003	0.00056
25	NAQL	-0.00072	0.0241	0.00058	1.078	0.0071	0.000051	0.00053
26	JPTD	-0.00029	0.0071	0.00005	-0.027	-0.0002	0.000000	0.00005
27	RJAL	-0.00080	0.0260	0.00068	1.274	0.0084	0.000071	0.00061
28	BIND	-0.00044	0.0226	0.00051	0.274	0.0018	0.000003	0.00051
29	AIFE	0.00026	0.0142	0.00020	0.242	0.0016	0.000003	0.00020
30	PEDC	0.00030	0.0132	0.00017	0.019	0.0001	0.000000	0.00017

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31	PIEC	0.00008	0.0118	0.00014	0.019	0.0001	0.000000	0.00014
32	OFTC	-0.00020	0.0240	0.00057	1.021	0.0067	0.000046	0.00053
33	SECO	-0.00079	0.0608	0.00370	1.276	0.0084	0.000071	0.00363
34	NOTI	0.00047	0.0215	0.00046	0.319	0.0021	0.000004	0.00046
35	MSFT	-0.00040	0.0221	0.00049	0.901	0.0060	0.000035	0.00045
36	JPPC	0.00006	0.0230	0.00053	0.549	0.0036	0.000013	0.00052
37	JODA	0.00019	0.0138	0.00019	0.051	0.0003	0.000000	0.00019
38	AALU	0.00012	0.0190	0.00036	0.112	0.0007	0.000001	0.00036
39	ICAG	-0.00003	0.0216	0.00047	0.619	0.0041	0.000017	0.00045
40	ACDT	-0.00062	0.0195	0.00038	0.214	0.0014	0.000002	0.00038
41	NAST	0.00004	0.0305	0.00093	1.039	0.0069	0.000047	0.00088
42	JOPH	-0.00118	0.0214	0.00046	1.644	0.0109	0.000118	0.00034
43	JOPI	-0.00048	0.0227	0.00051	0.557	0.0037	0.000014	0.00050
44	ICMI	-0.00036	0.0239	0.00057	0.549	0.0036	0.000013	0.00056
45	JOIC	-0.00023	0.0152	0.00023	0.104	0.0007	0.000000	0.00023
46	GENI	-0.00034	0.0098	0.00010	-0.014	-0.0001	0.000000	0.00010
47	WIRE	-0.00065	0.0210	0.00044	0.977	0.0065	0.000042	0.00040
48	JOCM	-0.00074	0.0211	0.00045	0.942	0.0062	0.000039	0.00041
49	APOT	-0.00040	0.0209	0.00044	1.540	0.0102	0.000103	0.00033
50	UMIC	0.00017	0.0174	0.00030	0.686	0.0045	0.000021	0.00028
51	NATC	-0.00031	0.0149	0.00022	0.361	0.0024	0.000006	0.00022
52	JOIR	-0.00071	0.0330	0.00109	1.068	0.0071	0.000050	0.00104
53	ATCO	-0.00002	0.0235	0.00055	0.334	0.0022	0.000005	0.00055
54	RMCC	-0.00037	0.0159	0.00025	0.391	0.0026	0.000007	0.00025
55	JOST	-0.00089	0.0218	0.00047	1.481	0.0098	0.000096	0.00038
56	AEIN	-0.00042	0.0269	0.00072	1.041	0.0069	0.000047	0.00067
57	NATP	-0.00045	0.0232	0.00054	-0.021	-0.0001	0.000000	0.00054
58	INOH	-0.00069	0.0243	0.00059	0.693	0.0046	0.000021	0.00057
59	NATA	-0.00046	0.0209	0.00044	0.788	0.0052	0.000027	0.00041
60	AIFF	-0.00053	0.0201	0.00041	-0.107	-0.0007	0.000000	0.00040
61	NDAR	-0.00045	0.0367	0.00135	0.142	0.0009	0.000001	0.00135
62	ASPMM	-0.00023	0.0179	0.00032	0.470	0.0031	0.000010	0.00031
63	JVOI	-0.00025	0.0233	0.00054	0.162	0.0011	0.000001	0.00054
64	TRAV	-0.00055	0.0162	0.00026	0.131	0.0009	0.000001	0.00026
65	AQRM	-0.00031	0.0290	0.00084	1.076	0.0071	0.000050	0.00079
66	MBED	-0.00004	0.0145	0.00021	0.587	0.0039	0.000015	0.00020
67	JOPT	-0.00057	0.0199	0.00040	1.596	0.0105	0.000111	0.00029

- **R_i: Mean daily return**
- **σ_i: Standard deviation**
- **σi^2: Variance**
- **B_i: Beta**
- **$Bi^2 * \sigma m^2$: Systematic risk**
- **σei^2: Unsystematic risk**

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Table (5-4) Cut-Off Rate for Sharpe Ratio

No.	co. code	$\left[\frac{ri - Rf}{\sigma i}\right]$	$\frac{(ri - rf)\beta i}{\sigma ei^2}$	$\frac{\beta i^2}{\sigma ei^2}$	$\sum_{i=1}^{n} \frac{(ri - rf)\beta i}{\sigma ei^2}$	$\sum_{i=1}^{n} \frac{\beta i^2}{\sigma ei^2}$	Cut off (ci)
1	**JOTF**	**0.126**	**-0.00035**	**0.00012**	**-0.00035**	**0.00012**	**-0.00000002**
2	GENI	0.043	-0.00015	0.00002	-0.00050	0.00014	-0.00000002
3	NATP	0.034	-0.00224	0.00168	-0.00274	0.00183	-0.00000012
4	JPTD	0.021	-0.00009	0.00001	-0.00282	0.00183	-0.00000012
5	AIFF	0.007	-0.00064	0.00033	-0.00346	0.00216	-0.00000015
6	ZEIC	0.007	-0.00043	0.00035	-0.00390	0.00251	-0.00000017
7	PEDC	0.002	0.00002	0.00008	-0.00388	0.00260	-0.00000017
8	JGFS	0.002	0.00033	0.00026	-0.00355	0.00286	-0.00000015
9	NOTI	0.001	0.00026	0.00060	-0.00329	0.00346	-0.00000014
10	CICO	0.000	0.00003	0.00078	-0.00326	0.00424	-0.00000014
11	AIFE	0.000	0.00000	0.00029	-0.00326	0.00453	-0.00000014
12	UMIC	0.000	-0.00008	0.00023	-0.00334	0.00476	-0.00000015
13	IREL	0.000	-0.00016	0.00102	-0.00350	0.00578	-0.00000015
14	NAST	0.000	-0.00108	0.00427	-0.00458	0.01005	-0.00000020
15	SPTI	0.000	-0.00031	0.00084	-0.00489	0.01089	-0.00000021
16	JPPC	0.000	-0.00040	0.00099	-0.00529	0.01188	-0.00000023
17	APOT	0.000	-0.00115	0.00057	-0.00644	0.01245	-0.00000028
18	OFTC	0.000	-0.00326	0.02559	-0.00970	0.03804	-0.00000042
19	ICAG	0.000	-0.00072	0.00108	-0.01042	0.03912	-0.00000045
20	JOEP	-0.001	-0.00020	0.00005	-0.01062	0.03918	-0.00000046
21	MBED	-0.001	-0.00018	0.00011	-0.01080	0.03929	-0.00000047
22	JOPT	-0.001	-0.00113	0.00039	-0.01193	0.03968	-0.00000052
23	MDTR	-0.001	-0.00013	0.00010	-0.01206	0.03977	-0.00000053
24	AQRM	-0.001	-0.00081	0.00110	-0.01287	0.04088	-0.00000056
25	AEIN	-0.001	-0.00087	0.00086	-0.01374	0.04174	-0.00000060
26	MSFT	-0.001	-0.00675	0.00525	-0.02049	0.04699	-0.00000089
27	JTEL	-0.001	-0.00021	0.00006	-0.02070	0.04705	-0.00000090
28	JOST	-0.001	-0.00086	0.00028	-0.02156	0.04734	-0.00000094
29	GEIG	-0.001	-0.00052	0.00058	-0.02208	0.04791	-0.00000096
30	JETT	-0.001	-0.00035	0.00021	-0.02243	0.04813	-0.00000098
31	SECO	-0.001	-0.00091	0.00039	-0.02334	0.04852	-0.00000102
32	RJAL	-0.001	-0.00018	0.00010	-0.02352	0.04862	-0.00000103
33	ATCO	-0.001	-0.00034	0.00066	-0.02386	0.04928	-0.00000104
34	JOPH	-0.001	-0.00108	0.00026	-0.02494	0.04953	-0.00000109
35	AIEI	-0.001	-0.00018	0.00012	-0.02512	0.04965	-0.00000110
36	JOIR	-0.001	-0.00196	0.00210	-0.02709	0.05175	-0.00000118
37	NAQL	-0.001	-0.00277	0.00148	-0.02985	0.05322	-0.00000130
38	NATA	-0.001	-0.00083	0.00047	-0.03068	0.05369	-0.00000134

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39	WIRE	-0.001	-0.00081	0.00035	-0.03149	0.05405	-0.00000137
40	ASPMM	-0.001	-0.00041	0.00025	-0.03190	0.05430	-0.00000139
41	JOCM	-0.001	-0.00046	0.00019	-0.03237	0.05449	-0.00000141
42	ICMI	-0.001	-0.00102	0.00091	-0.03339	0.05540	-0.00000146
43	SHIP	-0.001	-0.00024	0.00021	-0.03363	0.05561	-0.00000147
44	ABMS	-0.001	-0.00022	0.00014	-0.03386	0.05575	-0.00000148
45	AALU	-0.001	-0.00023	0.00057	-0.03409	0.05632	-0.00000149
46	JOPI	-0.001	-0.00390	0.00263	-0.03799	0.05895	-0.00000166
47	INOH	-0.001	-0.00137	0.00082	-0.03935	0.05977	-0.00000172
48	MALL	-0.001	-0.00029	0.00011	-0.03964	0.05988	-0.00000173
49	JODA	-0.002	-0.00005	0.00011	-0.03969	0.05999	-0.00000173
50	NATC	-0.002	-0.00044	0.00017	-0.04013	0.06016	-0.00000175
51	RMCC	-0.002	-0.00073	0.00028	-0.04086	0.06044	-0.00000178
52	JITC	-0.002	-0.00023	0.00012	-0.04109	0.06055	-0.00000179
53	AIHO	-0.002	-0.00035	0.00018	-0.04143	0.06073	-0.00000181
54	ALFA	-0.002	-0.00034	0.00014	-0.04178	0.06088	-0.00000182
55	SITT	-0.003	-0.00093	0.00043	-0.04270	0.06131	-0.00000186
56	BIND	-0.003	-0.00053	0.00038	-0.04323	0.06169	-0.00000189
57	AIPC	-0.003	-0.00015	0.00013	-0.04338	0.06182	-0.00000189
58	ZARA	-0.003	-0.00049	0.00017	-0.04387	0.06200	-0.00000191
59	JDOI	-0.003	-0.00068	0.00072	-0.04455	0.06271	-0.00000194
60	JOHT	-0.004	-0.00047	0.00039	-0.04502	0.06310	-0.00000196
61	ACDT	-0.004	-0.00025	0.00011	-0.04527	0.06321	-0.00000197
62	PRES	-0.004	-0.00226	0.00044	-0.04753	0.06365	-0.00000207
63	SIJC	-0.004	-0.00141	0.00054	-0.04893	0.06419	-0.00000213
64	JOIC	-0.005	-0.00043	0.00020	-0.04937	0.06439	-0.00000215
65	NDAR	-0.005	-0.00123	0.00231	-0.05059	0.06670	-0.00000221
66	TRAV	-0.006	-0.00109	0.00035	-0.05169	0.06705	-0.00000225
67	PIEC	-0.010	-0.00034	0.00097	-0.05203	0.06802	-0.00000227

- $C_i = \frac{\sigma_m^2 \sum_{i=1}^{n} \frac{(ri-rf)\beta i}{\sigma ei^2}}{1+\sigma_m^2 \sum_{i=1}^{n} \frac{\beta i^2}{\sigma ei^2}}$

1 . Cut-Off Rate for Sharpe Ratio with Risk-Free Asset

In order to calculate the optimal Sharpe ratio with a risk-free asset, the study uses the data from the previous section to determine the cut-off rate and rank the stocks accordingly.

The study divided the sample period (2012-2017) into 40 periods. With (180) days. The first period starts in (5/7/2012) and ends in (1/4/2013), and so on, such that the last period starts in (4/4/2017) and ends in (31/12/2017).

In each sub period, the study computes the cut-off rate with a risk-free asset. Then, the study identifies the stocks above and below the cut-off rate in each sub-period.

Table (5-5) reports the cut-off rate with risk-free asset in continuous-time market, in each period.

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Table (5-5)
Number of Stocks Above\ Below the Optimal Sharpe Ratio with a Risk-Free during the 40 Sub-Periods

period range		**With Risk Free**						
From	To	**period**	**n**	**cut-off value**	**no. of firm above cut-off**	**%**	**no. of firm below cut-off**	**%**
05-07-2012	01-04-2013	1	67	0.000005	36	0.54	30	0.45
16-08-2012	14-05-2013	2	67	0.000002	30	0.45	36	0.54
02-10-2012	25-06-2013	3	67	0.000001	25	0.37	41	0.61
19-11-2012	06-08-2013	4	67	0.000000	26	0.39	40	0.60
03-01-2013	22-09-2013	5	67	0.000070	19	0.28	47	0.70
19-02-2013	10-11-2013	6	67	0.000001	15	0.22	51	0.76
02-04-2013	24-12-2013	7	67	0.000000	0	0.00	66	0.99
15-05-2013	09-02-2014	8	67	0.000010	22	0.33	44	0.66
26-06-2013	23-03-2014	9	67	0.000012	30	0.45	36	0.54
07-08-2013	05-05-2014	10	67	0.000008	26	0.39	40	0.60
23-09-2013	17-06-2014	11	67	0.000010	24	0.36	42	0.63
11-11-2013	04-08-2014	12	67	0.000023	45	0.67	21	0.31
26-12-2013	15-09-2014	13	67	0.000160	19	0.28	47	0.70
10-02-2014	30-10-2014	14	67	0.000002	13	0.19	53	0.79
24-03-2014	11-12-2014	15	67	0.000002	23	0.34	43	0.64
06-05-2014	29-01-2015	16	67	0.000033	31	0.46	35	0.52
18-06-2014	15-03-2015	17	67	0.000011	33	0.49	33	0.49
5-08-2014	26-04-2015	18	67	0.000008	19	0.28	47	0.70
16-09-2014	09-06-2015	19	67	0.000004	19	0.28	47	0.70
02-11-2014	23-07-2015	20	67	0.000006	24	0.36	42	0.63
14-12-2014	03-09-2015	21	67	0.000132	10	0.15	56	0.84
01-02-2015	21-10-2015	22	67	0.000000	9	0.13	57	0.85
16-03-2015	03-12-2015	23	67	0.000001	21	0.31	45	0.67
27-04-2015	17-01-2016	24	67	0.000004	63	0.94	3	0.04
10-06-2015	28-02-2016	25	67	0.000006	26	0.39	40	0.60
26-07-2015	10-04-2016	26	67	0.000003	17	0.25	49	0.73
06-09-2015	23-05-2016	27	67	0.000002	28	0.42	38	0.57
22-10-2015	07/11/2016	28	67	0.000001	22	0.33	44	0.66
06-12-2015	22-08-2016	29	67	0.000000	0	0.00	66	0.99
18-01-2016	12-10-2016	30	67	0.000041	24	0.36	42	0.63
29-02-2016	23-11-2016	31	67	0.000000	1	0.01	65	0.97
11-04-2016	09-01-2017	32	67	0.000007	50	0.75	16	0.24
24-05-2016	20-02-2017	33	67	0.000002	53	0.79	13	0.19
12-07-2016	03-04-2017	34	67	0.000013	44	0.66	22	0.33

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23-08-2016	16-05-2017	35	67	0.000001	18	0.27	48	0.72
13-10-2016	04-07-2017	36	67	0.000001	20	0.30	46	0.69
24-11-2016	16-08-2017	37	67	0.000001	50	0.75	16	0.24
10-01-2017	03-10-2017	38	67	0.000000	18	0.27	48	0.72
21-02-2017	14-11-2017	39	67	0.000000	24	0.36	42	0.63
04-04-2017	31-12-2017	40	67	0.000001	16	0.24	50	0.75

It can be seen from the Table that the sub-period no. (24) is the best period as there are 63 (27/4/2015 - 17/1/2016) of (67) stocks i.e. 94%, has achieved returns about the cut-off rate. Then the sub-period no. 33 (24/5/2016 - 20/2/2017) with 53 stocks above the cut-off rate. However, the sub-period no. 7 and 29 (2/4/2013-24/12/2013 and 6/12/2015-22/8/2016) are that worst periods in ASE, as all stock's returns are below the cut-off return. Then the sub-period no. 31 (29/2/2016 - 23/11/2016) with only 1 Stock above the cut-off rate. Figure (5-1) graphs there results

1. Comparison between the Results of Using Sharpe Ratio with and without Risk-Free Asset

Table (5-7) provide a comparison data for using the cut-off rate for Sharpe ratio with and without risk-free asset in a continuous-time markets.

Table (5-7)
Comparison between the Results of Using Sharpe Ratio with and without Risk-Free Asset

Period No.	No. of Stock above cut-off Rate with Risk-Free	No. of Stock above cut-off Rate without Risk-Free
1	36	64
2	30	34
3	25	28
4	26	26
5	19	21
6	15	0
7	0	30
8	22	32
9	30	30
10	26	26
11	24	26
12	45	31
13	19	25
14	13	9
15	23	29
16	31	32

17	33	38
18	19	29
19	19	64
20	24	0
21	10	10
22	9	19
23	21	24
24	63	31
25	26	25
26	17	30
27	28	28
28	22	27
29	0	24
30	24	22
31	1	10
32	50	59
33	53	53
34	44	33
35	18	66
36	20	23
37	50	24
38	18	22
39	24	24
40	16	17
Total	**993**	**1145**

Table (5-7) provide the numbers of stocks above cut-off point in both with and without risk-free. The result explain the optimal shape ratio without risk-free the best than Sharpe ratio with risk-free, because the stock achieve return in the periods without risk free more than periods with risk-free and the table explain the total stocks above cut-off point in the without risk-free more than with risk-free. **Summary** In this section, the study provides the empirical result of the study. The following chapter presents the Results and Recommendations of the study

Results and Recommendations

The Results

1. In the cut-off point with risk free case there is 7 sub-periods of 40 is above cut-off point in continuous timing model with percent of 17.5%, three of this periods is ranked as good
2. periods to invest with 42.9% and four of this periods is ranked as very good periods to invest with 57.1%, period number 24 (24-4-2015 to 17-1-2016) is the best period to invest in services and industrial sectors with percent of 94%.
3. In the cut-off point without risk free case there is 7 sub-periods of 40 is above cut-off point in continuous timing model with percent of 17.5%, two of this periods is ranked as good periods to invest with 28.6% and five of this periods is ranked as very good periods to invest with 71.4%, period number 35 (23-8-

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2016 to 16-5-2017) is the best period to invest in services and industrial sectors with percent of 99%.

Recommendations

1. The researcher recommends that to conduct such research on the financial sector and connect it with this study to can take a decision to invest in Amman stock exchange sectors.
2. The need to conduct studies on the same subject of the independent study but using investment portfolios
3. Studies should be conducted on the same topic as the independent study, but using Jensen and Treynor ratios.

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