WALIA journal 30(S3): 27-32, 2014
Available online at www.Waliaj.com
ISSN 1026-3861

Comparison of efficiency the Kalman Filter method with the conditional CAPM method to estimates of Beta (β) in Stock Exchange of Isfahan

Hossein Ostadi*, Somayeh Dabiri

Department of Economic, Dehaghan Branch, Islamic Azad University, Isfahan, Iran

Abstract: Risk is one of the effective factors on return financial assets; therefore, all investors should deal with the evaluation amount of Portfoy sensitivity of their financial assets on risk. An asset systematic risk or share basket has known with beta hypotheses. In this research, the attempt is on estimation of beta in the best way and it is presupposed that beta is not fixed and is dynamic and it is following the regression models. Filter Kalman method is the method that it works as return way. This research deals with the comparison of Filter Kalman method with conditional CAMP for estimating beta and with comparing the amounts has obtained from both method, efficiency of each has been found in each Beta estimate. For this purpose by using information from 20 companies has been accepted in the Isfahan exchange market in monthly period of 2010 until February 2013 has been dealt with to estimate the pattern has been offered by using Eviews software. The results show that estimated Filter Kalman has less error to compare with conditional CAMP in estimating the beta and has suitable efficiency.

Key words: *Efficiency; Filter Kalman method; Conditional CAMP method for estimating beta; Isfahan stock exchange*

1. Introduction

The prediction prices of the capital assets and pricing them from long time ago has been one of the interesting issue for investors and researchers in finance matter. In fact, the investors have been interested to predict the price and return of capital assets and financial with using the special methods. One of the most effective developments in the field of financial literature and prediction the price of financial assets occurred with introducing evaluation capital assets model (CAMP) by Sharp and others. Although, CAMP as a starting model considered as one of the most important developments in the field of financial literature, but numerous assumptions and unreal model in explaining CAMP, forces financial researchers to introduce more complementing model based on the main idea of CAMP. The existence of efficient financial markets in the countries of developed economy has led to the formation varied tools. These tools generally are included in the money market or capital market; they are different from each other in actuating the nature and they create a wide range of return rate. For example buying some of these assets are required risk and buying some others has no any risk, and people are inclined to these tools based on their acceptance of the amount of risk. On the other hand, these tools are constantly exchanging in second market that this issue has affected the rate of financial tools or on the other words; it has been formed related economic behavior. In fact the price and return rate of these assets are determined in the market and many factors like macroeconomic condition, the situation of international markets and even political factors and International links might be affected on the price of these tools. Filter Kalman is the way that has been introduced by a person named Kalman in the year 1960 and today it has different usage in different field and it works in time series econometric branch for calculating invisible components of the models. This method that works in return way starts with giving an initial amount for variable condition and for the average of its corresponding squares error and with using of the Colman's equations counts one of the amount of condition and use from this amount for next estimation amount. This trend will continue to the extent that state variable has calculated in all period and the amount of error reaches to a minimum. In this research, return without risk has expanded in the space of state which contains of pricing capital assets model and one of the accidental step models and or auto regression, and also unknown parameters estimate with maximum likelihood method and the amount of state variable estimates with Filter Kalman method. This study attempts to evaluate the efficiency of pricing capital conditional assets in the Isfahan exchange. Therefore, a sample of available shares in the Isfahan exchange chose and it has been evaluated based on efficiency of conditional CAMP model. In addition, it is attempted to compare the result of this model with the result of the Filter Kalman's model.

2. Literature investigation

2.1. Model CAMP

* Corresponding Author.

The CAMP is the most applicable model for choosing Portfoy which offers a collection of predictions about expected return of equilibrium capital assets. This model 12 years after the Markoytz model expanded by Sharp (1964), Linter (1965), and Masin (1966) simultaneously and independently. After introducing the CAMP model by sharp and et-al, numerous studies was performed about testing this model and development its concepts. Although, presented model by Sharp, Linter and Masin is one of the pioneer models the field of financial literature during recent 3 decades, but due to existence limitations in the use of the model and some results and evidence gained in financial markets, this model uses less as a model for predicted return financial assets. Therefore, the different models have been introduced in order to develop and correct the results of the CAMP model. One of the most important derived models of the CAMP model can be pointed out the CAMP condition model that based on that the quantities of Beta and individual return shares and shares of its Portfoys was provided to condition and particular characteristics of market this is why this model could be justified for undesirable results of traditional CAMP model. The first step about the employing this model did by *Huang and Hueng (2008)*. They tried to offer the reason for the existence of a weak link between Beta and return in the New York stock market. They concluded that it is necessary to review the statistical approach used in order to assess link between Beta and return, because of only the reason that real return and not expect return in this group of tests examines. They checked out the link between risk and return in different conditions of upward and downward market and they established a conditional valuation capital asset model. They expanded a kind of conditional link between the return and Beta and based on that, the link between return and Beta is different based on being positive or negative for extra return (risk spent). In the period of when the extra return is positive (upward market), in that case link between risk and return will be positive and in the period of when extra return of market is negative (downward market), in that case a negative link will be between risk and return.

2.2. Filter Kalman

Filter Kalman is used in space state model. This logarithmic are cursive solution being up to date or updating the described system in space state. This Filter is possible to use in both stationary data and non-stationary data. This solution uses from the available data for optimizing previous data. Filter Kalman is also a way that uses mathematical models for correcting the model directly instead of using all previous data for gaining next data and correcting the model. This method solves state equations and measurement equations for obtaining unobserved states in optimization way and simultaneously. In other words, this method uses all observed variables that contains $X_{1,}X_{2,}X_3$ ...xt for gaining θi with least error. This act is called Filtering if I is equal to T and in the case of i>T, it is called prediction and finally, in the case of i<T, it is called smoothing (Goodarzi, 2008).

In fact filtering act is done at first in a way that from the information related to each period for calculating unobserved variables in that period and then prediction is done. In this case, with using of results from the data of Filtering process, future amount of state variable will count and smoothing act will do at the end. In this level, state variable will achieve with using calculated data in all filtering and forecasting process.

This section has dealt with the Filter Kalman process for estimating state variable in different time. This action is done from the equations that provide possibility of optimization state variable estimation in the condition that there is new observation. For this purpose, the introduced space state in above pose again and in order to complete the topic it is assumed that in addition of vector state variable, there is another vector that consists of explanation variables as known zt with size of (k*1) that its coefficient is comprised of a matrix parameters known as A' with the size of (r*k). Based on this we will have:

$$X_t = A'z_t + h'\theta_i + n_t \quad (1)$$

$$\theta_{t+1} = G_t\theta_i + w_t \quad (2)$$

To start it is assumed the observation is available until the t-1 period and the amount of parameters A, H, Gand the amount of variance – covariance related to n and w are specified. Also $\hat{\theta}_{t\_1}$ is a good estimation (minimum mean square error estimator) of θ_{t_1} and Mean Square error (MSE) matrix related to $\hat{\theta}_{t\_1}$ that has shown with sample of P_{t-1}, has been calculated. In this case the equations of Filter Kalman first level known as prediction level is as below:

$$\hat{\theta}\text{t t-1} = G_t\hat{\theta}\text{t-1} \quad (3)$$

$$P_t\text{t-1} = G_tP_{t-1}G' + w_t \quad (4)$$

In fact at this level, the new amount $\hat{\theta}$ means t/t-1 $\hat{\theta}$ has been estimated and the amount of relevant MSE will calculate. Now the new amount of statevector is available. So, θ_t estimation optimize in a way that consists new observations. This action will do in the level of prediction stage that its equations are as below.

$$\hat{\theta}\text{t} = \hat{\theta}\text{t-1} + K_te_t \quad (5)$$

$$P_t = P_t\text{t-1} - K_th'_tP_t\text{t-1} \quad (6)$$

$$e_t = X_t - A'z_t - h'_t\hat{\theta}\text{t t-1} \quad (7)$$

$$K_t = P_t\text{t-1}\,h_t\,[h'_tP_t\text{t-1}\,h_t + \sigma_n^2]^{-1} \quad (10)$$

In the equations above e_t prediction error and k_t Kalman gain matrix are called. This trend of Filter Kalman continues in return way and all observations related to state vector has estimated. The method has been mentioned, designs for space of state that is manuscript in terms of parameters and in the case of non-linear parameters, extended Filter Kalman method is used. It should be noted that to start the process of return filter Kalman, it needs the initial amount for state vector and its MSE that can be guessed based on experimental works and or it measures with other methods like a calculated mathematical hope vector state (Chetfild, 2004).

3. Data of the model

The data has been used in this model are the data related to Isfahan stock exchange from March 2010 until February 2013 which in total 20 stock exchange companies create 480monthly data. For $R_m$variable, the price index and liquidity return is used and for R_i variable, Portfolio consisting of reported companies in table is used. This Portfolio has been made based on Markoytz Portfolio theory (Markoytz, 1991) and optimal weight method. The criteria of selection mentioned companies is the number of their more transaction to compare with other companies in the Isfahan stock exchange market which this issue (high number of transactions) caused the relative increase in the amount of their information and the increasing quality of the data has been used and such an increase in power of liquidity of related shares and as a result, decrease the liquidity risk.

It should be noted that the data related to companies return with the use of price, divided profit and increase of each company asset has been calculated with the formula in below:

$$R_{it} = \frac{D_t + P_t(1+\alpha+\beta) - (P_{t-1} + C\alpha)}{P_{t-1} + C\alpha}$$

They are defined as follow: R_{it} is company return,$D_t$is divided profit,P_t is the price in the period t, P_{t-1} is the price in period of t-1, α is the percent of increase in capital from the place of asset and cash given, β is the percent of increase in capital from the place of save, accumulated amount has been paid by investor for increase the capital from the place of liquid given (Raee, 2004).

4. The results of conditional CAMP model

Table 1 shows the result of analysis of conditional CAMP model for the model related to data of Isfahan stock exchange.

Table 1: The result of analysis of conditional CAMP model

variable	coefficient	T-statistics	Possible of significant
intercept	1.0542	0.9956	0.1215
γ_1	3.2541	3.546	0.0023
γ_2	0.01924	6.324	0.001

The results of estimation show that there is a positive and significant link between return and risk in stock exchange companies.

4.1. Estimated parameters of the model, Chosen optimal model and Estimated State Variable

With considering the initial quantities, equation along with each of the equations have been estimated in order to find out optimal model. The table (2) shows the quantities AIC, SIC, HQ related to each of the models. In this table the phrases RW(0), RW(1), AR(1) and AR(2), indicates accidental state step equation without intercept, accidental step with intercept, auto regression first level, auto regression second level. In the table (3) also the estimated parameters along with its probabilities have been brought.

Accidental step models with intercept and auto regression first level are out of significant variance. Therefore, these two models have been put aside without considering the other criteria. Now, there is a competition between the two models RW (0) and AR(1) that from the point of criteria AIC, both models are same, but accidental step model without intercept has considerable superiority based on criteria BIC and HQ. It should be mentioned that the Akaeek criteria paid more attention to better estimation of the model and Shoartz criteria put simplification in the first priority and Henan-Queen criteria is also between these two criteria.Dueto the proximity of the criteria of choosing the pattern related to these two models and lack of previous knowledge of R_f behavior, to evaluate them and selecting optimal model, we will consider the quantities of estimated state variable based on these two criteria and we will compare their behavior. Therefore final space state is as follow:

$$E(R_{it}) = \alpha + \beta_i E(R_{mt}) + (1-\beta_i)R_{ft} + z_t z_t \sim N(0,\sigma_z^2)$$

$$R_{ft} = a_1 + b_1 R_{ft-1} + w_t w_t \sim N(0,\sigma_w^2)$$

The statistical Z in table 3 shows that all parameters except α and a_1 are against zero significantly and or on the other word, zero hypotheses is rejected based on the parameters of the model are zero. The parameters α and a_1 are as follow intercept observation equation and state equation that still keep in the model based on caution. After estimating the model with maximum likelihood method, it looks necessary to study the quantities of slop of the likelihood subordinate in the quantities of estimated parameters, because as it is mentioned, maximization process likelihood subordinate with optimal model goes in amount that maximization process faces to the error possibly and repetition process oriented before approaching to the maximum point. Therefore, the situation of slop of the likelihood subordinate in estimated parameters has been brought in Table 2.

Table 2: situation of slop of the likelihood subordinate

Parameters	total	average	Newton Dir
α	0/00048	5/20E-6	1/34E-6
β	9/66E-5	7/90E-7	−1/88E-6
σ_z^2	-4/54E-5	-4/20E-7	-5/43-6
a_1	-0/0041	-1/68E-5	-3/20E-7
b_1	-0/00011	-3/60E-6	-8/30E-6
σ_w^2	7/11E-7	6/81E-9	/31E-56

Second Column in the table above is the total slope of the likelihood subordinate to return different quantities of parameters and third Column is their average. But the desired values is the fourth Column in table 2 that shows the slop of the subordinate in region of estimated parameters which in the situation of maximum likelihood subordinate, these quantities should be close to zero. According to fourth column in the table above, slop of the likelihood subordinate in the region of estimated parameters goes to zero.

Then, the estimation of space state parameters and its related topics for different years estimates with Filter Kalman method.

Table 3: estimation of Filter Kalman method

Space state	parameter	Parameters amount	Statistical Z	Probability
Space stateRW(0)	α	0.03	0.47	0.54
	β	0.53	6.15	0.001
		0.0073	-21.10	0.001
		-5.32	-6.07	0.001
Space stateRW(1)	α	0.02	1.14	0.27
	β	0.5	5.35	0.001
		0.52	-52.01	0.001
	α_1	-0/005	-1.32	0.12
Space stateAR(1)	α	-0.007	-0.08	0.76
	β	-0.003	4.70	0.001
		0.0015	-20.23	0.001
	α_1	0.005	0.28	0.52
	b_1	0.74	2.58	0.001
		0.0008	-4.32	0.001
Space stateAR(2)		-0.01	-0.56	0.31
		0.63	7.48	0.001
		-6.01	-30.22	0.001
	α_2	0.15	0.77	0.48
	b_2	0.75	10.61	0.001
	c_2	-0.77	-10.32	0.001

On this basis and considering all the conditions and the criteria, AR(1) model, the behavior of non-risk return estimates better than the other models and it chooses as optimal model. Therefore, final space state is as below:

$$E(R_{it}) = \alpha + \beta_i E(R_{mt}) + (1 - \beta_i) R_{ft} + z_t \quad z_t \sim N(0, \sigma_z^2)$$

$$R_{ft} = a_1 + b_1 R_{ft-1} + w_t \quad w_t \sim N(0, \sigma_w^2)$$

4.2. The test statistics

First of all before estimating the pattern, Filter Kalman method has been dealt with the study of stationary of research variable. Calculated return without risk is stationary in level.

Table 4: Dickey –Fuller test

	Dickey-Fuller test	Probability
R_f	−2 .61	0 .033
R_p	−9 .42	0.001
R_m	−7 .80	0.001

One of the other statistical which considers in space state models is the calculation of this link that is equal to (σ_w/σ_z), gains with knowing the quantities of σ_z and σ_w. With using of the quantities of these two variables which has calculated in space state, the link of signal to noyz estimates 0/220 which is bigger than zero.

Now, we can estimate the CAMP model once with the assumption of absence of $R_f$and again with inserting the calculated$R_f$with OLS method and then compare the results and the mentioned equation shows the result of estimation of these two models. The quantity of Beta in both equations is approximately same, but the main difference is the amount of determine factor that its amount increase with inserting return without risk to model. The equation in below, shows related regression to return without risk that estimates with simultaneous equation system method.

$$R_{pt} = \alpha_1 + \beta_1 R_{mt} + \varepsilon_{1t}$$
$$R_{pt} = \alpha_2 + \beta_2 R_{mt} + (1 - \beta_2) R_{ft} + \varepsilon_{2t}$$
$$R_{ft} = \omega + \emptyset R_{ft-1} + \varepsilon_{3t}$$

Table 5: The results of estimating the equations system

Equations	*Statistical/Parameter*	*Statistical/parameters amount*	*t-Stat*
First equation	α_1	*0.032*	*-2.04*
	β_1	*0.55*	*6.18*
		0.34	*Determine factor of first pattern*
	DW	*1.82*	*Watson camera*
Second equation	α_2	*-0.003*	*-1.85*
	β_2	*0.54*	*5.18*
		0.56	*Determine factor of second pattern*
	DW	*2.32*	*Watson camera*
Third equation	ω	*0.007*	*2.67*
	∅	*0.832*	*14.27*
		0.689	*Determine factor of third pattern*
	DW	*2.01*	*Watson camera*

4.3. Comparison of two methods

With using of absolute valueof predicted risk and reality amount, table in below has been brought quantities of difference of predicted and calculated real risk by using both the Mean Average Errors (MAE) and so the Root Mean Square Errors (RMSE) (Table 6).

Table 6: Comparison of methods

Filter Kalman Model	CAPM Model	
110.9	125.5	RMSE
12.96	29.25	MAE

Due to the fact that the less amount of each of these criteria is more suitable and it expresses the compliance of most of the data of the model with the reality, therefore, based on both statistical, the most suitable models of predicting risk with regard to have less error in Filter Kalman model are as follow:

1. Filter Kalman model
2. Conditional CAMP model

5. Conclusions and recommendations

One of the factors that have a lot effect on capital asset returns is risk. Therefore, all investors should deal with the measurement sensitivity of Portfoy of their capital asset on risk. Systematic risk is known as an asset or shares basket with the Beta coefficient. In this research the attempt is on finding the best way to estimate Beta and the assumption is that Beta is not fixed but is dynamic and it follows the auto regression model. In this study, both Filter Kalman and CAMP methods use to estimate Beta and with comparison of obtained quantities from both methods, the efficiency of each was found in Beta estimation. For this purpose, 20 accepted companies in Isfahan Stock Exchange during months of 1389 to 1392 were investigated. The results of analyzing the CAMP model showed a condition for the model related to Isfahan stock exchange data that there is a significant and positive link between return and risk in stock exchange companies. Then it was paid to estimate the Filter Kalman model. Therefore, with considering all conditions and criteria, AR (1) model estimates the behavior of return without risk better than the other models and it chooses as an optimal model. Then, for comparing both methods with using of difference absolute value of predicted risk and reality of both methods Mean Average Errors(MAE) and so the Root Mean Square Errors (RMSE) with regard to the fact that much less than any one of these criteria is more desirable and more consistent indicator of the model with reality. Therefore filter model Colman, according to both statistics is the most appropriate model of predicted risk with regard to at least of Errors.

With regard to the results above it can be noticed on two completely applicable suggestions:

1-with regard to the results and by considering the link between return and risk in both Filter Kalman and CAMP models, it can be said that the index of return shows reaction to bad and good news and investors can choose combination of return and risk in Isfahan stock exchange. In fact, it can be suggested with attention to the existence of a positive link between risk and return and confirming CAMP model, investors in order to investment, pay attention to important index of return and risk. In other words people with different personalities in terms of risk scape, choose different investment baskets. Also we must attention to the issue that investment in long term or short term can have different combination of return and risk which can help to investors in this tem.

2-also with regard to the results of this research, it can be said that the estimation of Filter Kalman has less error to compare with CAMP model and it has more suitable efficiency in estimating Beta to compare with conditional CAMP model, therefore, we recommend using Filter Kalman method for estimating risk in Isfahan stock exchange. In fact, it can be said to decrease the risk of investment basket using the Filter Kalman is more reliable. In other words, with considering the rate of error of both analysis and having less error in Filter Kalman method, it can be said that for connecting risk and return and better prediction, it suggests to use Filter Kalman model. Because it is with less error.

References

Abasinejad, H. Mohammadi, SH. Behrozi, V. (2011), “The calculation of the risk-free return on the financial markets of the Kalman filter approach”, Journal of Economic Research, No. 96, pp. 209-184.

Ang Andrew, Joseph Chen & Xing Yuhang (2002)."Downside Risk & The Momentum Effect" Forth Coming Journal of Financial Economics.

Bashiri. M. & Tavakoli. M (2010), “The function of the conditional capital asset pricing model, a negative case study: Tehran stock exchange market”, Journal of Scientific-Research Scholar and behavior, management and development, Shahed University, Issue 44.

Branson, William H. (2007), “Macroeconomic Theory and Policy”, Abbas Shakeri, Nay Publications, Tehran.

Campbell, J., 2001, Why Long Horizons? A Study of Power Against Persistent Alternatives, Journal of Empirical Finance, 8, 491- 459.

Crombez, J. and Vander Vennet, R. (2000). Risk/return relationship conditional on market movements on the Brussels stock exchange, Tijdschrift voor Economie en Management, 45, 163- 188.

Davani, GH. (2002), “Exchange, Stock and how to stock pricing”, Tehran, Nokhostin publication.

Feldhütter, Peter and Heyerdahl-Larsen, Christian and Illeditsch, Philipp K., (2013) “Risk Premia, Volatilities, and Sharpe Ratios in a Non-Linear Term Structure Model, ssrn.224.

Gurnain Kaur Pasricha (2006) “Kalman Filter and its Economic Applications”, Munich Personal RePEc Archive, 15. October 2006, Online at http://mpra.ub.uni muenchen.de/22734/ MPRA Paper No. 22734, posted 17. May UTC.

Jegadeesh, Narasimhan, and Sheridan Titman,(2003). Returns to buying winners and selling losers: Implications for stock market efficiency. Journal of Finance, 48, 91- 65.

Jhankhani. A, Abdo Tabrizi. H. (1993), “The Efficient Market Theory of Capital”, Journal of Financial Research, Tehran University, No. 1, pp. 14.

Karachey, Argun Ali (2000): Beta and Returns: Istanbul stock exchange evidence, Ankara University, Faculty of political scien.

Lewellen, Jonathan, January(2006), The Conditional CAPM Does Not Explain Asset Pricing Anomalies, Forthcoming in Journal of Financial Economics.

Peng Huang and C. James Hueng (2008) “Conditional Risk-Return Relationship in a Time-Varying Beta Model”, Quantitative Finance, 2008, vol. 8, issue 4, pages 381-390.

Sadeghi, SH. Jalal, S. (2003), “Capital Asset Pricing Model in Tehran Stock Exchange”.

Saleh Abadi, A. Radmehdi, Y. (2011), “test the informational efficiency of the weakened Tehran Stock Exchange”, Journal of Humanities, Issue 16, pp. 7- 30.

Thomas Mazzoni (2010) “Are Short Term Stock Asset Returns Predictable? An Extended Empirical Analysis”, FernUniv., Fakultät Wirtschaftswiss., 201 – 58 pages.

Xiao Qin and Tan Gee Kwang, Randolph (2004) “Kalman Filter Estimation of Property Price Bubbles in Seoul", Participation in conference, Business School, Real Estate, Eco Mod.