Examination of Equity Premium Puzzle by Consumption Capital Asset Pricing Model with Fuzzy Nested Regimes: Evidence from Iran

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ABSTRACT

The aim of this study is to examine the equity premium puzzle in Iran for the quarterly period of 1993-2016. In this regard, the hybrid bivariate Garch model and also fuzzy dummy variables with consumption capital asset pricing model (C-CAPM) have been used. The results of study show that using C-CAPM within fuzzy dummy variables (CCAPM-F), the relative risk aversion coefficient of investor is various between nested regimes of financial and macroeconomics, so that its value for nested regimes like C-CAPM is not unconventional. In economic recession regime and bear markets, the value of this coefficient is in maximum amount. It means that the investor is willing to take risk just for high compensation and tends to invest in assured asset like bank deposits. Totally, regardless of market conditions, the recession regimes are related to higher levels of risk aversion.

Keywords:

C-CAPM, C-CAPM-F, Bi-variate Garch model, Fuzzy.

1. Introduction

The equity premium is in fact, the difference between the rate of risk-free asset return and stock returns. Is there any reasonable explanation for this premium? The failure of financial theory to explain equity premium became popular as the "equity premium puzzle". This puzzle was proposed by Mehra and Prescott (1985). The standard asset pricing models are able to comply the actual data with theory just when the relative risk aversion coefficient of investor (risk price) is unjustifiably high. Since Mehra and Prescott introduced the equity premium puzzle, this issue has been studied by a wide range of researches. This study also intends to investigate the equity premium puzzle in Iran.

The results of this study showed that within the C-CAPM[1], the value of relative risk aversion coefficient is negative and unusual and it is economically unjustifiable in Iran. According to Donadelli and Prosperi (2012), inaccessibility to suitable substitute for risk-free asset, inappropriate assumptions of C-CAPM and the lack of data have been led to the abnormal estimate of relative risk aversion coefficient both in developed and emerging counties. In C-CAPM, it is assumed that risk aversion coefficient of investor is fixed. In most researches also, the risk aversion has been considered as the fundamental and basic parameter which its value is fixed over the time. Although this hypothesis is so useful to simplify the problem, in the real word is unlikely and too difficult to happen.

In this paper, the possibility of changing relative risk aversion coefficient in combined financial and economic regimes is investigated within the C-CAPM. In fact, it is assumed that the investors who tolerate risk could be affected by financial market and macroeconomic conditions. This hypothesis is examined by inserting fuzzy dummy variables of macroeconomic recession and boom in combination with bear and bull stock market (financial market) in C-CAPM. Furthermore, there is a test in order to explore these effects on the equity premium puzzle. The results of proposed model support the hypothesis of study.

This study has innovation in two aspects. Firstly, the literature of equity premium puzzle is developed by investigating the alterations of financial and economic nested regimes and their influence on the equity premium puzzle. However, attempts have not been made to solve the puzzle, it presents a proper approach for modeling of second-order momentums in C-CAPM. Secondly the applied econometric tools are developed. In fact, the fuzzy logic has been used to make combined financial and economic regimes.

In order to reach aforementioned objectives, the review of literature including theoretical and empirical literatures of equity premium puzzle is considered after the introduction (Section 2). Section 3 contains research methodology. The analysis of experimental data and findings is presented in section 4. Finally, the study will be finished with conclusion.

2. Literature Review

Through a classification in this part, at first, the theoretical literature of equity premium puzzle and then the empirical literature have been examined.

2.1. Theoretical Literature of Equity Premium Puzzle

The equity premium puzzle is indicated in different ways. In this study, we adopt the approach of Campbell (1996,2003) but allow both stock market returns and consumption growth to follow conditionally heteroskedastic processes. We start with a representative agent who maximizes a time-separable utility function:

$$MaxE_t \sum_{j=0}^{\infty} \delta^j \, U(C_{t+j}), \qquad (1)$$

Where δ is a discount factor, C_{t+j} is the investor's future consumption stream and $U(C_{t+j})$ is the period utility derived from such consumption. Equation (2) shows the budget constraint:

$$st. \quad W_{t+1} = (W_t - C_t)(1 + R_{p,t}) \qquad (2)$$

Where W_{t+1} is the wealth and $R_{p,t}$ is the financial asset returns. This problem yields the following Euler equation to describe the optimal consumption and investment path of the representative agent;

$$E_t[M_{t+1}(1 + R_{i,t+1})] = 1 \qquad (3)$$

$$M_{t+1} = \frac{U'(C_{t+1})}{U'(C_t)}$$

With $1+R_{i,t+1}$ representing the gross rate of return available on asset *i*. The investor equates the loss in current consumption with the expected gain in discounted consumption next period. We apply the time-separable power utility function which is presented in 4:

$$U=\frac{C_t^{1-\gamma}}{1-\gamma} \qquad (4)$$

$$U'(C_{t+1})=(1-\gamma)C_{t+1}^{-\gamma}\ , \qquad U'(C_t)=(1-\gamma)C_t^{-\gamma}$$

$$M_{t+1}=\left(\frac{C_{t+1}}{C_t}\right)^{-\gamma} \qquad (5)$$

Where γ is the coefficient of relative risk aversion. Replacement of equation (5) with (3), results following:

$$E_t\left[(1+R_{i,t+1})\delta\left(\frac{C_{t+1}}{C_t}\right)^{-\gamma}\right]=1 \qquad (6)$$

Following Campbell (1996), we assume that the joint conditional distribution of asset returns and consumption is log-normal [2], with time -varying volatility. Taking logarithms of equation (6), we get:

$$0=E_t r_{i,t+1}+log\delta-\gamma E_t[\Delta c_{t+1}] + 0.5\left(h_{rt}+\gamma^2 h_{ct}-2\gamma h_{r,c}\right) \qquad (7)$$

Where $r_{i,t+1}=\log(1+R_{i,t})$ ، $c_t=\log(C_t)$, h_{rt} and h_{rt} denote the conditional variance of log returns and log consumption growth respectively, and $h_{r,c}$ represents their conditional covariance. The log equity premium is:

$$\mathrm{E_t}\left[r_{i,t+1}-r_{f,t+1}\right]+\frac{h_{rt}}{2}=\gamma h_{r,c} \qquad (8)$$

Therefore, the equity premium is equal to the difference in risk- free asset returns from stock return and the log equity premium equivalent with relative risk aversion coefficient multiplied by covariance of stock returns with consumption growth rate.

According to mentioned theory, the relative risk aversion coefficient should stay in the range of 2 to 10. Because the high risk aversion renders the individual's fleeing from instability and volatility in consumption path. However, the consumption is growing over the time. Therefore, in order to modify the current consumption, people should borrow from the future. This propensity for borrowing would lead to increase the rate of real interest of risk- free asset. However, real interest rates of risk- free asset are rarely positive over the time. Consequently, we encounter with risk-free asset rate puzzle proposed by Philip Weil (1989). Since, in empirical studies of equity premium, the relative risk aversion coefficient is unjustifiably obtained in a large value, it is stated that there is a puzzle.

A wide range of researches which are mainly from United States and developed countries are trying to study and solve this puzzle. However, so far, they have failed to provide a satisfactory solution. Some of these studies are focused on preferences and others present some substitutions for risk-free asset. In the following section these studies are reviewed.

2.2. Empirical literature of Equity Premium Puzzle

The neoclassical growth model and its random types comprise a central structure in modern financial affairs, public finance, and business cycles theory. This model has been widely used by researchers like Lucas (1978). In fact, the most insights of economy have been taken from the class of this model. The main concept in the framework of mentioned model renders that the present consumption and some coming periods are accomplished by different products. The relative prices of these different products are equal to people's desire to substitute these goods and business abilities for converting goods to each other. When this model is faced with the empirical data of macroeconomic and especially business cycle theory will achieve a considerable success. Unfortunately, this model is rejected in dealing with financial data of stock market. Perhaps, Mehra and Prescott's paper (1985) and equity premium puzzle can be the best example for this test.

Mehra and Prescott depicted this issue by some alteration in Locus model (1978). By setting the risk aversion coefficient to 10 and discount factor of δ equal to 99 percent, they obtained the risk- free asset rate of 12.7 percent and stock returns of 14/1 percent.

This result implies that equity premium is 1.4 percent which is much lower than observed value of 6 percent. Considering the limitation of relative risk aversion coefficient of γ and discount factor of δ in this class of models, the maximum value of equity premium would be 1.4 percent. Since, the observed equity premium was 6 percent, Mehra and Prescott claimed that there is a puzzle which the risk considerations cannot solve it alone. These researchers alleged that more than 50 problems will be resolved by risk aversion coefficient.

After Mehra and Prescott, many scholars made attempts to analyze and resolve this puzzle. For instance, Campbell and Cochrane (1999) shared the recession to the model by inserting a state variable. In this model, when the chance of recession is increased, risk aversion of investors will increase dramatically and, then it generates high equity premium. This model is compatible with both consumption data and asset market. However, in Mehra's opinion (2003), yet, there is a question in financial literature, that whether investors present a big show of counter-cyclically changes in risk aversion at different times?

According to Constantinides et al. (2002), stock characteristics will change due to its holder as the asset. They tried to resolve the equity premium by inserting the life cycle in asset pricing model. Brandt and Wang (2003) developed consumption based asset pricing model within habits by considering risk aversion alteration towards the news of consumption and inflation. The result of this study within GMM estimator showed that the risk aversion will change responding inflation news and equity premium will increase with insertion of inflation to this model.

Guvenen (2009) studied the application of asset pricing in a macroeconomic with two factors, under the two scenarios. The first scenario is limited participation of stock market and then heterogeneity in intertemporal propensity to substitution. In this paper, the parameter values are adopted from the literature of business cycle. Besides, he assumed that shareholders are individuals who tend to high returns in order to holding stock. These types of behavior from non-shareholders who are unwilling to bear the high risk are determined with distinct portfolio. Non-shareholders are more people with low incomes and dependent on work. They are risk- averse in investment and then cannot bear the business cycles. Contrary with that, there are shareholders - people who enjoy high income and sustain market business cycle with the high stock spending. Their model is able to explain some facts of asset pricing which are compatible with Campbell and Cochrane's model (1999). These fact include equity premium puzzle and risk-free asset rate. Their results suggest the counter cycle risk. Additionally, their model can produce risk-free asset rate with low volatility (5.7 percent per year) and high durability.

Recently, Xie et al. (2016) represented disappointment aversion (avoiding conclusions which may be worse than average expectations). They used it in the portfolio selection model which an investor chooses among risky and non- risky asset, and concluded that disappointment aversion plays an important role in explaining the equity premium puzzle in 19 countries under review. Nonetheless, Mohamadzadeh et al. (2016) studied and compared the models of C-CAPM, housing C-CAPM (H-CCAPM), and S-CCAPM in Iran. In S-CCAPM model utility function is a function of consumption and savings. In H-CCAPM model utility function is a function of nonhousing and housing consumption. The result of their study showed that H-CCAPM and S-CCAPM models can explain stock returns but they have lower operation as compared with C-CAPM model. Another result of this research is the significance of saving preference in Iran.

In the present paper, the equity premium puzzle is examined under two models. At first, the relative risk-averse coefficient resulted from C-CAPM is analyzed. Then this puzzle is checked assuming that relative risk-averse coefficient is not fixed and will change within the financial- macroeconomic combined regimes. CCAPM-F[3] is suggested for testing this model. This model is a combination of C-CAPM with fuzzy logic.

3. Methodology

3.1. Empirical Model of Equity Premium Puzzle

In order to test the equity premium puzzle, the C-CAPM is used with some alteration as follows:

$$\mathrm{E_t}\left[r_{i,t+1} - r_{f,t+1}\right] = \gamma_0 + \gamma_1 h_{r,c} + \varepsilon_t \qquad (9)$$

The second part in the left side of equation (8) is the Jensen inequality correction factor which is omitted as a result of having little effect and simplifying. Moreover, the intercept is added to model. The equation (9) is estimated after substituting $h_{r,c}$through extraction of conditional covariance from fuzzy bivariate Garch system within stock return (r), and growth of household marginal consumption (c) by least square error method.The following assumes that the investor risk aversion coefficient is variable in different regimes of financial and macroeconomic.

In order to examine this hypothesis, the fuzzy dummy variables suggested in model (8) are used. By these explanations, the equation CCAPM-F is offered:

$$E\left[r_{i,t+1} - r_{f,t+1}\right]_t = \gamma_0 + \gamma_1(LL_{Cr,t} * h_{cr,t}) + \gamma_2(LH_{Cr,t} * h_{cr,t}) + \gamma_3(HL_{Cr,t} * h_{cr,t}) + \gamma_4(HH_{Cr,t} * h_{cr,t}) + \varepsilon_t \qquad (10)$$

where $\gamma_1$to γ_4 reflect the variable risk aversion of investor respectively in regimes of recession in economy and bear market ($LL_{Cr,t}$), recession in economy and bull market ($LH_{Cr,t}$), the boom in the economy and bear market ($HL_{Cr,t}$), and the boom in the economy and bull market $(HH_{Cr,t})$. The equation (9) is estimated after substituting $h_{r,c}$ resulted from fuzzy bivariate Garch system by least square error method.

3.2. Fuzzification of Dummy Variables (Fuzzy Regimes)

In model (10), it was assumed that conditional covariance of ($h_{r,c}$) in 4 nested regimes of financial market and economy affects on equity premium and accordingly, the relative risk- averse coefficient varies between these regimes. Indeed, the nested regimes are combination of boom-recession variables in economy and bull- bear market. These non- linear relations can be modeled with TAR models proposed by Tong (1978), Tong and Lim (1980). However, due to the existing uncertainty in these shocks and regimes, measuring them by divalent variables is not accurate. This problem was resolved by presenting transition functions instead of dummy variables in literature of time series. In this model (STAR[4]), different transition functions like logistic were used for dummy variables. The idea of smooth transition between regimes dates back to Bacon and Watts (1971). It was introduced into the nonlinear time series literature by Chan and Tong (1986) and popularized by Granger and Trasvirta (1993) and Trasvirta (1994).

In the present study, the idea of dummy variables fuzzification has taken from nonlinear part of STAR model including transition functions. The concept of transition functions are very close to membership functions of fuzzy sets Zadeh (1968). If STAR model be considered with two parts including the section which acts as linear autoregressive (AR) and nonlinear section containing transition function, therefore, the nonlinear section can be criticized. Transition function is like fuzzy membership function but no rule has been used for inputs. In the other words, this model does not offer any explanation for nonlinear section and its operation that why and on what basis does it use logistic transition function or other available functions.

One of the few studies that show this criticism is the research of Aznarte et al. (2007, 2011). Giovanis (2009) used fuzzy triangular membership functions instead of dummy zero-one variables in a univariate Garch model in order to examine the effects of week days on stock return. Although, the results of that study showed the better operation of model with fuzzy dummy variables, this researcher did not propose any reason for using fuzzy triangular membership functions. Furthermore, Giovanis (2010) compared transition function with fuzzy membership functions in STAR model and concluded that fuzzy membership functions cause to the better operation of model. Abunoouri and Shahriyar (2014) using durable and stationary rules changed the fuzzy transfer function to dependent variable and examined that in the money demand function of Iran. The results indicated that the model was more accurate within the proposed method as compared with STAR model.

Following these explanations, considering Consumption Capital Asset Pricing Model, respectively, the growth rate variable of household marginal consumption and stock returns have been considered as economy and financial market. Two dummy variables of boom and recession and also bull and bear market have been regarded for macroeconomics and financial market separately. Since the data is in the form of negative and positive, the dummy variables of boom and recession and also bull and bear market for macroeconomics and financial market are respectively presented as follows:

$$I_{CL} = \begin{cases} 1 & IFc_t < 0 \\ 0 & o.w \end{cases} I_{CH} = \begin{cases} 1 & IFc_t > 0 \\ 0 & o.w \end{cases}$$

$$I_{rL} = \begin{cases} 1 & IFr_t < 0 \\ 0 & o.w \end{cases} I_{rH} = \begin{cases} 1 & IFr_t > 0 \\ 0 & o.w \end{cases} \qquad (11)$$

The proposed sets of (11) are definitive and classic with divalent range including zero and one values. It can be argued that boom and recession in economy and or bull and bear market are fuzzy concepts and cannot be measured precisely. For a specified times, the amount of consumption growth rate (stock market return) can be partially dependent on recession set (bear market) and approximately depends on boom set (bull market). This concept causes to expand the range sets of (11) from bivariate set of zero and one to the continuous range between zero and one. Additionally, it reminds the notion of fuzzy clustering. In certain clustering a data belongs or does not belong to a cluster. However, in fuzzy clustering, it belongs to all clusters with different membership values. In clustering, we are seeking a group of data which are similar to each other, by exploring this similarity, the behaviors can be better identified and based on which acted in such a way that better results obtained.

Erfani and Safari (2014), used fuzzy clustering strategy in order to examine the inflation regimes effects on the Seigniorage Laffer curve in Iran. The results of this research within the Takagi- Sugeno system (1985) showed that the proposed model acts better as compared with other nonlinear models.

Different algorithms have been presented for fuzzy clustering. In this study, the method of "c-means fuzzy clustering"(FCM) is used for separating data in fuzzy cluster of c. other methods can be compared too. If x_k is considered as k th data and v_i as the center of i th of fuzzy cluster, the distance between them is calculated by $d_{ik} = \|x_k - v_i\|$. Then by showing "degree of membership" in ith cluster with u_{ik}we obtain:

$$u_{it} = \frac{1}{\sum_{j=1}^{k} (\frac{d_{it}}{d_{jt}})^{\frac{2}{m-1}}} \quad \sum_{i=1}^{c} (u_{ik}) = 1 \quad i = 1,2,3,\dots,c$$

The aim is separating data in cluster c, so that the place of clusters and membership degree are determined simultaneously. Therefore, the following objective function will be minimized:

$$j(u,v) = \sum_{i=1}^{c} \sum_{k=1}^{n} {u_{ik}}^m {d_{ik}}^2$$

There is no standard for opting m parameter. However, what is common in practice is choosing m=2. With this explanation, each variable of consumption growth rate and stock return are divided into two clusters and their membership functions are extracted. If $u_{CL}, u_{CH}, u_{rL}, u_{rH}$ imply respectively the values of boom and recession membership of time series consumption growth rate and bull and bear stock market, we have:

- If the macro economy is in recession, then $L_{Ct} = u_{CL}$
- If the macro economy is in boom, then $H_{Ct} = u_{CH}$
- If the stock market (financial market) is bear, then $L_{rt} = u_{CL}$
- If the stock market (financial market) is bull, then $H_{rt} = u_{rH}$

Since there are two dummy variables for each time series, therefore, using fuzzy rules and multiplication, 4 dummy variables have been extracted as follow:

- If the macro economy is in recession and the stock market is bear, then $LL_{Cr,t} = L_{Ct} * L_{rt}$
- If the macro economy is in recession and the stock market is bull, then $LH_{Cr,t} = L_{Ct} * H_{rt}$
- If the macro economy is in boom and the stock market is bear, then $HL_{Cr,t} = H_{Ct} * L_{rt}$
- If the macro economy is in boom and the stock market is bull, then $HH_{Cr,t} = H_{Ct} * H_{rt}$

3.3. Introduction of Fuzzy Bi-variate Garch Model

In order to obtain the conditional covariance between stock return and household marginal consumption rate ($h_{r,c}$) and using that in models (9) and (10), the fuzzy bivariate Garch equations system of VECH- type is proposed as follows:

$$\begin{Bmatrix} c_t = \tau_1 L_{ct} + \tau_2 H_{ct} + \tau_3 c_{t-1} + \varepsilon_{ct} \\ h_{ct} = \omega_1 L_{ct} + \omega_2 H_{ct} + \omega_3 h_{c,t-1} + \omega_4 \varepsilon_{c,t-1}^2 \\ r_t = \partial_1 L_{rt} + \partial_2 H_{rt} + \partial_3 r_{t-1} + \varepsilon_{rt} \\ h_{rt} = \varphi_1 L_{rt} + \varphi_2 H_{rt} + \varphi_3 h_{r,t-1} + \varphi_4 \varepsilon_{r,t-1}^2 \\ h_{cr,t} = \rho_0 + \rho_5 h_{cr,t-1} + \rho_6 \varepsilon_{r,t-1} \varepsilon_{c,t-1} \end{Bmatrix} \qquad (12)$$

In equations system of (12), the effect of fuzzy regimes of recession and economic boom on consumption growth rate and its volatility, and also the effect of bear and bull market on stock return and its volatilities are investigated.

4. Results

4.1. Introducing and Analyzing Data

In this study, the Tehran Price Index (TEPIX) based on quarterly frequency and over the period of 1993-2016 is used. Quarterly returns of the stock market based on seasonal price index is computed as $r_{i,t+1} = \frac{p_{t+1} - p_t + d_{t+1}}{p_t}$. P_t is the seasonal price index of stock and d_{t+1} is the value of dividends in market of Tehran. Since, there was no reliable data relating to the dividends for mentioned period, the value was disregarded (with dividends, the value of equity premium will be higher). The time series of household marginal consumption (C_t) has been adopted quarterly from Central bank of Iran in the period of 1993-2016 and smoothed by inflation index in 2013. The third required variable is providing appropriate means for risk- free asset rate. It is largely accepted in literature that the use of the rate that prevails on the money market is a feasible alternative and a suitable compromise for economies where a long-term treasury is not liquid or may not even exist.

In this paper, along with many studies on the average rate of one-year and five-year bank deposits announced by Central bank of Iran in the period of 1993- 2016 quarterly, it is used as a substitute for risk-free assets (for instance refer to Donadelli and Prosperi (2012)). The equity premium is obtained from difference between risk- free asset return rate and stock returns rate as follows: $r_{i,t+1} - r_{f,t+1}$. where, $r_{f,t+1}$ is the seasonal average rate of real bank deposits.

In the following, some distribution characteristics of time series are indicated in table (1). The results of table (1) show that except equity premium, the time series of real growth rate of household marginal consumption and real stock returns have kurtosis and skewness more than normal distribution. Therefore, their normality hypothesis is rejected by Jarque–Bera test.

4.2. Results of Estimating Fuzzy Bi-variate Garch Model

Before, estimating model (12), the state of autocorrelations with different levels has been investigated in time series and time series square of real growth rate of household marginal consumption and real stock return. The outcomes of this study are reported in table (2).

The results of table (2) indicate that autocorrelation for square of these time series is significant in different lags. Hence, using B-ivariate Garch model is appropriate for modeling two time series with t- distribution. The results of equations system of (11) are reported in table (3). The optimal lags of model are selected based on SBC (Schwarz's Bayesian Criteria), because it loses lesser freedom degrees as compared to other standards.

The results of assessing model (11) present that the average of stock returns in bull market is significantly determined by quarterly value of 13.9 percent and lower volatility towards bear market with the average of seasonal -6 percent. These observations are compatible with leverage effects in market. It means that with a fall in stock price, debt ratio of firms increase and then it leads to increase the asset risk (Bae et al., 2007). Therefore, bear market creates negative returns and high uncertainty for investor.

Table 1: Descriptive statistics of time series

Name of variable	Average	Standard deviation	Skewness	Kurtosis	P- value of Jarque-Bera tes
Real stock return	0.016	0.017	0.699	3.58	0.01*
Equity premium	0.031	0.122	0.52	3.09	0.12
Real growth rate of household marginal consumption	0.01	0.066	0.71	3.9	0.03*
Average real return of one- year and five-year bank deposit	-0.014	0.028	-1.7	8.07	0.00*

Source: Authors findings. * indicate significance of test

Table 2: Autocorrelation of time series

Autocorrelation of real stock return and its square						
Autocorrelation	**γ(1) (p-value)**	**γ(2) (p-value)**	**γ(3) (p-value)**	**γ(4) (p-value)**	**γ(5) (p-value)**	**γ(6) (p-value)**
r_t	0.366	0.212	0.042*	0.176	0.150	0.207
r_t^2	0.0101*	0.0107*	0.0181*	0.0436*	0.0329*	0.0778
Autocorrelation of real growth rate of household marginal consumption and its square						
Autocorrelation	**γ(1) (p-value)**	**γ(2) (p-value)**	**γ(3) (p-value)**	**γ(4) (p-value)**	**γ(5) (p-value)**	**γ(6) (p-value)**
c_t	0.082	0.033*	0.034*	0.0529	0.064	0.072
c_t^2	0.144	0.088	0.174	0.000*	0.000*	0.000*

Source: Authors findings. * indicate significance of test.

The household real marginal consumption rate has similar pattern in macro economy. The average of consumption growth rate in boom period is specified by seasonal value of 8% with lower volatility and negative value of 2.9% in recession period with higher volatility. This outcome shows that as a result of uncertainty in the consumption future growth path, the recession periods have presented higher volatility rather than boom periods. Portmanteau test[5] which is stated in table (3) represents lack of autocorrelation in residuals and appropriateness of model.

4.3. Results of Examining Equity Premium Puzzle

Before evaluation of Models (9) and (10), using Phillips-Perron test, the stationary status of equity premium time series data and conditional covariance resulted from system (12) are checked. The results of this test in variable levels have been shown in table (4).

According to this table, the variables are in stationary level and fixed. The results of evaluating models CCAPM and CCAPM- F have been reported in table (5). In table (5), the results of evaluating CCAPM show that relative risk aversion coefficient (γ_1) with the value of -3.9 is significant in the level of 5% statistically. In model on which the economy representative is very careful about his consumption, explaining the negative risk aversion coefficient is difficult and unreasonable.

Following table (5), the results of CCAPM-F model show that each four relative risk aversion coefficients are statistically meaningful in financial and economic combined regimes and also are closer to the allowed range of 2 to 10 which is reasonable economically. Assessment of these coefficients shows that in Iran, the investor is reasonably risk averse so that logic and theory of economy support it.

Accordingly, the investor's risk aversion in recession regime and bear market and also boom and bull market are respectively the highest and the lowest values. To sum up, the results reveal that risk aversion level in recession regime is higher regardless of market conditions. This suggests that people with low income are disagree with investment in market and prefer to invest in bank deposits.

Table 3: Estimated results of fuzzy Bi-variate Garch of equations system (11) [6]

Name of coefficient	Value of coefficient	Standard error
τ_1	-0.029*	0.005
τ_2	0.08*	0.005
ω_1	0.000268*	0.00007
ω_2	0.0001*	0.00002
∂_1	-0.06*	0.0022
∂_2	0.0139*	0.0099
φ_1	0.0098*	0.001
φ_2	0.0019*	0.0009
Portmanteau test		
The P- value of adjusted statistic Q for lag =1, 8, 12 are respectively 0.39, 0.48, 0.74		

Source: Authors findings. * indicate significance of test.

Table 4: Results of unit root test for model variables

Phillips and Perron (PP) test			
Variable		Value of statistic	P-Value
Equity premium		-12.159	0.0001
($h_{r,c}$) Conditional covariance		-5.9	0.0000
Critical values			
Variable	1%	5%	10%
Equity premium	-3.5	-2.9	-2.58
($h_{r,c}$) Conditional covariance	-3.5	-2.9	-2.58

Source: Authors findings.

Table 5: Results of models CCAPM and CCAPM-F

Parameter					
Model	γ_0	γ_1	γ_2	γ_3	γ_4
CCAPM	0.029 (0.1)	-3.9 (1.8)*			
CCAPM-F	0.0023 (0.1)*	7.9(2.3)*	5.8(1.6)*	2.9(0.2)*	1.8(0.5)*
Diagnostic Tests					
Model	Statistic value of F	Durbin-Watson	Adjusted R	Autocorrelation	
CCAPM	9.14 {0.04}	1.71	0.34	Lag of 1={0.044},Lag of 10={0.089}	
CCAPM-F	42.9{0.00}	1.97	0.66	Lag of 1={0.2010},Lag of 10={0.447}	

Source: Authors findings. Standard error of coefficients has been presented in (). {} shows the P-Value and * indicate significance of test

5. Discussion and Conclusions

In the present study, the equity premium puzzle in Iran has been examined for the period of 1993-2016 quarterly. To achieve this goal, two models were applied. First, by using C-CAPM standard model, the risk aversion coefficient in Tehran market was studied. Then, it was assumed that risk aversion coefficient is variable between combined regimes of market and economy. To examine the assumption, a new approach, which is one the innovations applied in this study, has been used. In other word, the nested regimes of economy and market were combined through fuzzy logic and have been used in C-CAPM which is named CCAPM-F in this study. According to findings, the value of relative risk-averse coefficient in Iran is meaningful statistically with the value of -3.9 within C-CAPM.

On one hand, based on C-CAPM, it has been claimed that the investors are risk- averse and desired to smooth and normalize consumption in lifetime. On the other hand, this result shows that the investors are willing to take risk in Iran. Therefore, this finding does not seem reasonable and is not justified in theoretical framework. Consequently, it results that the equity premium puzzle in Iran is confirmed and C-CAPM is unable to describe it in Iran. Some researchers have also reported the negative risk-averse coefficient. For example Donadelli and Prosperi (2012) have presented that the relative risk-averse coefficient in countries like Japan, USA, and Germany within standard C-CAPM is negative. According to these writers, lack of a suitable substitution for risk free asset, inappropriate assumption of C-CAPM, and lack of data all together lead to abnormal estimation of relative risk-averse coefficient in both developed and emerging countries.

Regarding economy theory, the proposed model in this study, CCAPM-F, has suggested acceptable results. According to findings of this model, the investor in Iran is reasonably risk-averse. The risk aversion coefficient value in both bear and bull markets for recession regime is higher than boom regime. Apart from the regime which stock market is taking place in, the consumption decrease in economic recession regimes lead to the increase of investor's risk aversion? Also consumption increase in economic boom regimes results decrease in risk aversion coefficient. This result is in accordance with risk distribution and normalization of consumption in economy literature. This result also is more confirmed and verified through the result of some papers like Campbell and Cochrane (1999). They have shown that risk aversion increases in recession by making state variable for recession within C-CAPM and inserting habits. On the other hand, the risk aversion coefficient value for economic recession regime in the period of bear market is higher as compared to bull market. In fact, investors in recession regime-bear market are more risk averse and prefer to invest in non-risky affairs like bank deposits. The risk aversion coefficient value in boom regime when bull market is lower in comparison with bear market. It means that when people encounter boom regime-bull market, between stock market and bank deposits, they intend to stock market because of lower value of risk aversion in this condition. The truth and verity of this matter is more substantiated and supported with the result of studies like Gordon and Amour (2000). These researchers in the study have proven that risk aversion coefficient is variable in different regimes of market. While the risk aversion in bull market compared to bear market has lower value.

Briefly, on one hand the results of present study are a guide for proper modeling of time-varying second-order moments in C-CAPM. In other word, the condition of both market and economy has to be concerned together for modeling. On the other hand, it could be used as a guide by market investors in Iran in order to appropriate allocation of their asset portfolio between stock market and bank deposits in different conditions of economy and market.

References

1) Abounoori, E., Shahriyar, B. (2014), A New Nonlinear Specification of Structural Breaks for Money Demand in Iran. Iranian Journal of Economic Studies, 3(1), 1-19.
2) Aznarte, J.L.M., Alcala-Fdez, J,. Arauzo, A,. Benitez, M.J. (2011), Fuzzy Autoregressive Rules Towards Linguistic Time Series Modeling. Econometric Reviews, 30(6), 609-631.
3) Aznarte, J.L.M., Benitez, J.M., Castro, J.L. (2007), Smooth transition autoregressive models and fuzzy rule-based systems: Functional equivalence and consequences. Fuzzy Sets and Systems, 158, 2734-2745.
4) Bacon, D.W, Watts, D.G. (1971), Estimating the transition between two intersecting staraight lines, Biometrika, 58, 34-525.
5) Brandt, M. W., Wang, K. Q. (2003),Time-varying Risk Aversion and Unexpected Inflation. Journal of Monetary Economics, 50 (7): 1457–1498.
6) Chan, K.S. Tong, H. (1986), On estimating thresholds in autoregressive models, Journal of Time Series Analysis, 7, 179–90.
7) Campbell, J.Y. (1996), Consumption and the Stock Market: Interpreting International Experience. Swedish Economic Policy Review, 3, 251-299
8) Campbell, J.Y. (2003), Consumption-Based Asset Pricing, Handbook of the Economics of Finance, George Constantinides, Milton Harris, and Rene Stulz eds., North-Holland, Amsterdam, 1B, 803-887.
9) Campbell, J.Y., Cochrane, J.H. (1999) , By Force of Habit: A Consumption-Based Explanation of Aggregate Stock Market Behavior. Journal of Political Economy, 107(2), 205–251.
10) Constantinides, G.M., J.B. Donaldson., J.B., Mehra, R. (2002), Junior Can't Borrow: A New Perspective on the Equity Premium Puzzle. Quarterly Journal of Economics, 117(1), 269–296.
11) Donadelli, M., Prosperi, L. (2012), The Equity Premium Puzzle: Pitfalls in Estimating the Coefficient of Relative Risk Aversion. Journal of Applied Finance & Banking, 2(2), 177-213.
12) Erfani, A., Safari, S. (2014), Estimation of Seigniorage Laffer Curve in IRAN: A Fuzzy C-Menans Clustering Framework. Jornal of Money and Economy, 9(1), 93-115.
13) Giovanis, E. (2009), Bootstrapping Fuzzy-GARCH Regressions on the Day of the Week Effect in Stock Returns: Applications in MATLAB. MPRA, Working Paper.
14) Giovanis, E. (2010), Proposal of Additional Fuzzy Membership Functions in Smoothing Transition Autoregressive Models. World Academy of Science, Engineering and Technology ,4, 614-618.
15) Gordon, S., & St-Amour, P. (2000), A preference regime model of bull and bear markets. American Economic Review, 90(4) . 1019–1033.
16) Granger, C.W.J., Terasvirta, T. (1993), Modelling Nonlinear Economic Relationships, Oxford: Oxford University Press.
17) Guvenen, F. (2009), A Parsimonious Macroeconomic Model for Asset Pricing. Econometrica, 77, 1711–1750.
18) Lucas, R. E. (1978), Asset prices in an exchange economy. Econometrica, 46, 1429–1445.

19) Mehra, R. (2003), The equity premium: why is it a puzzle?. Financial Analysts Journal, 59(1): 54-69.
20) Mehra, R., Prescott, E.C. (1985), The equity premium: a puzzle. Journal of Monetary Economics, 15(2), 145-161.
21) Mohammadzadeh, A., Shahiki Tash, M.N., Roshan, R. (2016), Investigation and Comparing Some Consumption-based Asset Pricing Models: The Case of Iran. International Journal of Economics and Financial Issues, 6(4), 1884-1894.
22) Takagi, T. Sugeno M. (1985), Fuzzy identification of systems and its application to modelling and control IEEE Transactions on Systems, Man and Cybernetics, 15, 116-132.
23) Tong, H. (1978), On a threshold model, in C.H. Chen (ed.). Pattern Recognition and Signal Processing, Amsterdam: Sijthoff & Noordhoff, 101–41.
24) Tong, H., Lim, K.S. (1980), Threshold autoregressions, limit cycles, and data,. Journal of the Royal Statistical Society B, 42, 245–92 (with discussion).
25) Terasvirta, T. (1994), Specification, estimation, and evaluation of smooth transition autoregressive models. Journal of the American Statistical Association, 89, 208–18.
26) Weil, P. (1989), The Equity Premium Puzzle and the Risk-Free Rate Puzzle. Journal of Monetary Economics, 24(2), 401-421.
27) Xie, Y., Athanasios, A., Florackis, C. (2016). Disappointment aversion and the equity premium puzzle: new international evidence. The European Journal of Finance,1-15.
28) Zadeh, L. A. (1968), Fuzzy algorithms. Information and Control, 12, 94-102.

Notes

[1] Consumption Capital Asset Pricing Model.

[2] if lnx is $N(\mu, \sigma 2)$ then $ln\, E(x) = \mu + \frac{\sigma^2}{2}$

[3] C-CAPM within fuzzy logic.

[4] Smooth Transition AR model

[5] The statistic of Ljung- Box Hasking which is the multivariate form of Portmanteau test is used for checking the autocorrelation effects in residuals of multivariate model.

[6] In table (3) only coefficients have been reported which are important in terms of interpretation.