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Investigating and Comparing Some Consumption-based Asset Pricing Models: The Case of Iran

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ABSTRACT

Studies of last two decades refer to limits on the classical models of asset pricing such capital asset pricing model (CAPM) and consumption-based CAPM (CCAPM). In this article we make adjustments in CCAPM model and have been estimated modified models for the economy of Iran from 1988 to 2011. These models are housing CCAPM (HCCAPM) and SCCAPM that in them investigated the implications of novel classes of preferences for the behavior of asset prices. In SCCAPM model utility function is a function of consumption and savings. In HCCAPM model utility function is a function of nonhousing and housing consumption. In this article estimated Euler equations for these preferences with generalized method of moments. We employ comparison criteria Hansen and Jagannathan (1991) HJ-distance for compare these models. Our empirical results indicated that economic factors are patient and very risk averse. Elasticity of substitution between housing service consumption and nonhousing service consumption is positive. However the HCAPM and SCCAPM have the explanatory power stock returns but compared to CCAPM have less performance or introducing housing and saving into the consumption-based models does not always improve the models' performance. Results of SCCAPM suggested that the preference for saving in Iran is economically significant.

Keywords: Asset Pricing, Preferences, Saving, Saving-based Asset-pricing, Housing Service Consumption
JEL Classifications: G10, G11, G12

1. INTRODUCTION

Asset pricing special stocks for the process of investing in these bonds is the most important issue facing investors and participants in the capital markets. Therefore, researchers are interested in the accurate pricing of stocks to predict their expected returns too. Basically investments for volatility in their returns are risky.

One of the models of capital asset pricing is consumption-based capital asset pricing model (CCAPM)[1] that was presented by Breeden (1979). An investor should decide on the consumption, value of his/her savings, and portfolio of assets that will hold. In this model, the expected return on an equity changes with the beta of consumption. In other words, there is a direct relationship between the uncertainty about stock returns and uncertainty about the consumption. Thus, this model describes how changes in stock market returns are related to the growth in consumption. In the standard model of CCAPM, there is a linear relationship between the consumption's beta and excess return on assets, but unfortunately, the linear CCAPM made the equity premium puzzle. In this case, to explain the large equity, the premium needs to spend a very high risk aversion. This is known as the "equity premium puzzle." The puzzle was presented for the first time by Mehra and Prescott (1985). After presenting puzzles such as the equity premium puzzle, adjustments were made in the CCAPM. These adjustments can be made in the function of preference such as in the research of Bach and Møller (2011), Epstein and Xin (1989).

Based on what was said, especially the criticisms of the CCAPM, which may be the greatest criticism for CCAPM, in this article we have made adjustments in the standard model CCAPM, adjustments have been made in the preferences. These adjustments involve entering savings to the utility function in the SCCAPM and entering housing service consumption to the utility function in the HCCAPM model. After the derivation of Euler equations

1 Consumption capital asset pricing.

we will use generalized method of moments (GMM) method for estimating the models.

This article is organized as follows the second section of the article contains literature review. This section includes a review of studies in the field of CAPMS and adjustments applied in them. The third section contains the theoretical model, the fourth section describes the data and variables of the model, the fifth section will display the results of the estimation, and finally, the last section, presents a summary and the conclusion.

2. LITERATURE REVIEW

In this section we will have a review studies about CAPMs that including CCAPM model and adjustments in it in subsequent studies. The consumption-based CAPM (CCAPM) was established in 1978, by Lucas and Breeden. They described their model to the consumer as being the model where the relative risk aversion coefficient was constant. Then Mankiw and Shapiro (1986) arrived with this claim that a consumption beta could take on the role of risk criteria and tested this model on the New York Stock Exchange. In addition to the findings of Hansen and Singleton (1982), Mehra and Prescott (1985), Mankiw and Zeldes (1991), and Campbell (1993; 1996), literature in the context of the CCAPM showed that the Lucas standard CCAPM has been able to explain Return on Assets in the United States. Additionally Cumby (1990) also showed that this model (CCAPM) could explain the international stock market. In addition to the above findings, Hamorin (1992) also showed that CCAPM could have an important role in the capital market of Japan.

Of the others studies on CCAPM, one could point out the Asprem (1989) studies. He suggested using import instead of consumption in the CCAPM model. Chen (2003) did a comparison between the CAPM and the CCAPM in the Taiwan stock market. He concluded that in all cases of the power of explanatory the traditional CAPM model was superior to the CCAPM model.

Gregoriou and Ioannidis (2006) tested the CCAPM model in the British stock market by entering the variable cost of transactions in this model. It was concluded that by using the seasonal return during the period 1980-2000, although this model could not explain the stock return, the variable transaction cost was significant in all cases and should be considered for this model.

In some studies, such as Karagyozova (2007), Bach and Møller (2011) tested the CCAPM model based on the two groups of consumers. Karagyozova (2007) tested CCAPM model in the Great Britain stock market by dividing the shareholders in the market into two groups of A and B. The results showed that the performance of these two groups was different and had different effects on the CCAPM. Bach and Møller (2011) estimated the asset pricing model based on consumption, with limited participation of consumption, formation, and habits. It was shown that the consumption of those who held shares was higher in performance than those who did not hold shares. In addition, it was shown that a high volatility of consumption of those who held shares enabled the model to explain the equity premium puzzle and the risk-free rate puzzle together for a reasonable value of relative risk aversion.

Conditional CAPMs tested in some studies such as Kang et al. (2011), Ito and Noda (2011), and Kim (2012). Kang et al. (2011) in their article, developed a kind of conditional CAPM, where they used the conditional variable and this variable had a high power of forecasting the expected excess return on the market. This conditioning variable was obtained from the co-integrating relation among the macroeconomic variables (dividend yield, term spread, default spread, and short-term interest rate). The results showed that the value stocks were riskier than growth stocks in bad times, supporting the risk-based story. Kim (2012) has dealt with the CAPM multivariate. This article investigate questions is better performance model CCAPM with intercept restrictions will be maintained? The empirical results show that multifactor CCAPMs work better than classic unconditional models about explaining the cross-section of the expected stock returns. Ito and Noda (2011), in a study, estimated the parameters of the CCAPM for the Japanese economy. These parameters varied over time in this estimation. The experimental results and the CCAPM parameters showed a degree of risk aversion. In addition to the above findings the results showed that the discount rate was variable over time.

Some models with changes in the utility function (neoclassical utility function) have developed the model CCAPM. Studies such as this include like Xiao et al. (2013), Dreyer et al. (2013), Auer (2013), and Kim (2014) studies. Xiao et al. (2013) re-evaluated the cross-sectional asset pricing implications of the recursive utility function of Epstein and Stanley (1989; 1991), their empirical specification helped to explain the size, value, and momentum effects. Dreyer et al. (2013) have made adjustments in the CCAPM model and presented their article as "savings based pricing." This study offers utility function that savings element is inserted. Preferences in this article are related to consumption and saving. Their estimations suggest that the preference for saving is economically significant. Auer (2013), in an article, deals with the "formation of habits" model of Campbell and Cochrane (1999). Results of his search show that in comparison to the CAPM and the standard power utility CCAPM, the habit model has superior explanatory power. Further, the findings indicate that the model presented in this article explains over 90% of the cross-sectional variation in risk premium. Kim (2014) has suggested risk aversion coefficient varies over time. He used CCAPM model. Utility function considered in his article was based on the Epstein–Zin–Weil (Epstein and Zin, 1989; Weil, 1989) recursive utility. The Euler equation was derived in this article, which risk aversion is a non-parametric function of time. The empirical results strongly support the counter cyclicality of the risk aversion parameter.

Some studies about asset pricing have been considered various risk such Márquez et al. (2014), and Fung et al. (2014). Márquez et al. (2014) expanded the CCAPM model by entering the liquidity shocks. Their article derived closed-form expressions for consumption-based stochastic discount factors (SDF) adjusted by market-wide illiquidity shocks. This adjustment was considered both a contemporaneous and ultimate consumption risk. They found a large and highly significant illiquidity risk premium for the first quarter of the year, suggesting a time-varying behavior of the market-wide illiquidity premium. Fung et al. (2014) have started their research with introduction by Bansal and Yaron (2004) study. Authors have shown that conditional excess return of stock is a linear function of the conditional consumption and the volatility of market returns. Their findings indicated that the exponential generalized autoregressive conditional heteroscedasticity (EGARCH) volatility can explain up to 55% of the variation of return and the EGARCH model augmented with cay (a co-integrating factor of consumption, labor income, and asset wealth growth) greatly enhances the model's performance.

Addition to above cases, some researchers with separating domestic and imported goods investigated CCAPM model. Huang et al. (2014) has developed a CCAPM model with a separate goods market and overseas market. In this model, the exchange rate influences the asset prices through the marginal utility of consumption and increases the risks investors face. They find that the model can successfully price the 25 Fama–French portfolios and industry portfolios in the Chinese market, and the exchange rate is an important pricing factor in the unconditional linear model.

One of the important variables that imported to asset pricing models in the last decade is consumer expenditure in the housing sector. Perhaps we can say that enter the housing variable to CAPMs started with Lustig and Van Nieuwerburgh (2005) study. The authors of this study investigated asset pricing model in which the collateral housing have been added to asset pricing models. They point out that in a model with collateral housing decrease in house prices reduce the value of collateral and increases risk households in other words the idiosyncratic risk increase. The mechanism of collateral can be used to explain changes in cross-sectional variations in risk premia on stock.

Although Lustig and Van Nieuwerburgh (2005) introduced housing debate on asset pricing model but in financial literature enter consumer expenditure on housing to the CAPM is known with Piazzesi et al. (2007) study. So that the model used by the authors known as HCCAPM model in financial literature. Piazzesi et al. (2007) to improve the standard asset pricing models introduced the housing sector to these models to increasing the explanatory power of the model for stock returns also helped to explain the equity premium puzzle. In H-CCAPM model the utility of households extracted of two parts: Housing services, or shelter and nonhousing consumption which is the consumption of all nondurables and services except housing services. Eventually Piazzesi et al. (2007) result that entering housing consumption expenditure helps the model improve on the standard CCAPM.

Flavin and Nakagawa (2007) to evaluate the significance of housing consumer expenditure on the returns considered CES utility function that durable good (or house) added to Grossman and Laroque (1990) because the Grossman and Laroque model abstracts completely from nondurable consumption. Using a specification of the utility function which nests both housing model and habit persistence, the Euler equation for nondurable consumption is estimated. Authors result that the habit persistence model (without housing effects) can be decisively rejected, while the housing model (without habit effects) is not rejected.

Davis and Martin (2009) test standard representative agent model with a home-production sector to investigate the equity premium or value premium puzzles. The model is rejected by the data; it cannot explain either the historical equity premium or the value premium.

Flavin and Liang (2013) explicitly modeled housing consumption in a consumption based CAPM framework with heterogeneous agents. They concluded that SDF model HCCAPM is more volatile than the base CCAPM. Empirically, they show that housing CCAPM performs better than a standard CCAPM in terms of both explaining level of equity premium with moderate level of curvature of the utility function and explaining more of the variation of cross-sectional asset returns.

One of the most comprehensive studies on a variety of CCAPM study is study of Kwan et al. (2015). Kwan et al. (2015) in a comprehensive study developed, estimated and compare eight consumption-based asset pricing models for Hong Kong's economy. After estimate the Euler equations they result that introducing housing into the consumption-based models does not always improve the models' performance; how it is introduced matters. Recursive utility model and its housing-augmented variant, which emphasize the importance of early resolution of uncertainty and long term risk, outperform alternative models in forecasting stock returns.

3. THEORY

According to the Cochrane expression each asset pricing model can be written as $p = E\,(mx)$. In this equation, p represents the asset price, m, the random discount factor, and x, the return on assets. The distinction between the different asset pricing models is related to the SDF. For example, in the model of CCAPM, the SDF will be: $\beta\,\frac{U'(C_{t+1})}{U'(C_t)}$. Where C is Per capita consumption, β is the subjective time discount factor (which will be introduced in the following sections thoroughly), and U' is derived utility function to consumption. If the utility function is concave, $\frac{\beta U'\left(C_{t+1}\right)}{U'\left(C_t\right)}$ represents an inter-temporal marginal rate of substitution (IMRS) for the consumer. The substitution rate will be high if $C_{(t+1)}$ is $<C_t$ and *vice versa*. Therefore, IMRS has an inverse relationship with the business cycle, in the other words, in recession it will be high and during the boom it will be less. This relation states that if the covariance between the IMRS and the rate of return on assets is negative, excess return over the risk-free rate will be positive and *vice versa*. Here, similar to the CAPM model, a relationship can be seen between excess returns and the asset beta factor. Common variance between the assets return and consumption is called consumption beta (β).

3.1. CCAPM Model

According to the CCAPM model although returns can vary across assets, expected discounted returns should always be the same for every traded asset:

$$1=E_t(M_{t+1}R_{i,t+1}) \tag{1}$$

Where $R_{i,t+1}$ is the rate of return of asset i, M_{t+1} is a SDF that can be identified with the representative agent's IMRS between consumptions at date t and t+1. Each asset pricing model has unique pricing kernel or SDF and the performance of these models can be compared with the Euler equations according to the SDF. To extract SDF based on CCAPM model first utility function can be defined as follows:

$$U(C,\eta)=\frac{C^{1-\eta}}{1-\eta}, 0<\eta<\infty \quad 0<\eta<\infty \tag{2}$$

Where, parameter η measure the curvature of the utility function. If η is equal to one, the utility function will be logarithmic. Moreover η is relative risk aversion coefficient and the inverse elasticity of substitution between periods. Consumer maximizes lifetime utility that is separable over time and across states of nature:

$$E_0\left\{\sum_{t=0}^{\infty}\beta^t U(C_t)\right\} \quad 0<\beta<1 \tag{3}$$

According to the utility function in Equation 2 can be concluded the consumer will have faced the solving following problem:

$$Max_{C_t} E_t\left\{\sum_{j=0}^{\infty}\beta^j\left(\frac{C_{t+j}^{1-\eta}}{1-\eta}\right)\right\} \quad 0<\beta<1 \tag{4}$$

Where C is Per capita consumption, β is the subjective time discount factor (which describes how impatient households are to consume) and E is expectations operator conditional. About subjective time discount factor we can say that if β is small, people are highly impatient, with a strong preference for consumption now versus consumption in the future. We further consider the utility function to be of the constant relative risk aversion class.

Obviously economic factor (consumer) choices between the consumption of goods or buy an asset with returns R_{t+1} in each period. The budget constraint is given by:

$$W_{t+1}=(1+\Re_{S,t+1})(S_t-C_t) \tag{5}$$

Where (S_t-C_t) is cash-on-hand (S is total wealth) and R is the return on cash-on hand, which is a weighted average of the returns on the financial assets wealth. $\Re_{W,t+1}$ is net return then gross return is defined as follows:

$$R_t=1+\Re_t$$

In this case SDF is:

$$M_{t+1}=\beta\left(\frac{C_{t+1}}{C_t}\right)^{-\eta} \tag{6}$$

Usually the following linear approximation to be considered to SDF:

$$M_{t+1}\approx\beta[1-\eta\Delta LnC_{t+1}] \tag{7}$$

3.2. HCCAPM Model

As previously mentioned HCCAPM model were presented first by Piazzesi et al. (2007). This model is one of the variants of consumption-based and two-good generalization of CCAPM. In this model, consumption expenditures are divided two components. The first component is aggregate of non-housing consumption and the second component excluding expenditures on housing. In this model the utility function will be of two arguments as follows:

$$U(C_t,H_t)=\frac{(\tilde{C}_t)^{1-\eta}}{1-\frac{1}{\eta}}, \tilde{C}_t=\left[C_t^{\frac{\varepsilon-1}{\varepsilon}}+\omega H_t^{\frac{\varepsilon-1}{\varepsilon}}\right]^{\frac{\varepsilon}{\varepsilon-1}} \tag{8}$$

Where C_t is aggregate of non-housing consumption, H_t is housing service consumption, η is the coefficient of relative risk aversion and ω is the relative weight on non-housing consumption in utility function and ϵ is the constant elasticity of substitution between C_t and H_t. For high values of ϵ agents are willing to substitute the two goods within each period. The two goods become perfect substitutes as ϵ→∞ and perfect complements as ϵ→0. Moreover if the value of ε is equal to one yields the Cobb–Douglas specification. The implicit assumption in this model is that the service housing is part of the housing (H). In this case SDF is will be as follows:

$$M_{t+1}=\frac{\beta\frac{\partial U}{\partial C_{t+1}}}{\frac{\partial U}{\partial C_t}}=\beta\left[\left(\frac{C_{t+1}}{C_t}\right)^{-\eta}\left[\frac{1+\omega\left(\frac{H_{t+1}}{C_{t+1}}\right)^{\frac{\varepsilon-1}{\varepsilon}}}{1+\omega\left(\frac{H_t}{C_t}\right)^{\frac{\varepsilon-1}{\varepsilon}}}\right]^{\frac{1-\varepsilon\eta}{(\varepsilon-1)}}\right] \tag{9}$$

It can be proved that the SDF for the HCCAPM model is:

$$M_{t+1}=\beta\left(\frac{C_{t+1}}{C_t}\right)^{-\eta}\left(\frac{\alpha_{t+1}}{\alpha_t}\right)^{\frac{\eta-\phi}{1-\phi}} \tag{10}$$

In the above equation is established the following definitions.

$$\alpha_t=\left(\frac{C_t}{C_t+p_hH}\right), \phi=\frac{1}{\varepsilon}$$

α_t is the ratio of non-housing consumption to total consumption. Compared with the canonical CCAPM case where consumption growth is the only risk factor, agents in this case also care about composition risk - The variability of the relative weight between housing and non-housing consumption. Piazzesi et al. (2007) show that the log pricing kernel can be written as a linear two-factor model:

$$LnM_{t+1}=a+b\Delta LnC_{t+1}+d\Delta LnE_{t+1} \tag{11}$$

Where $E_{t+1}=\frac{p_t^C C_t}{p_t^C C_t+p_t^H H_t}$ is the consumption expenditure share on non-housing consumption and p_t^C, p_t^H are the prices of non-housing and housing consumption, respectively. According to Piazzesi et al. (2007) model, the dividend yield and the nonhousing expenditure share forecast future excess stock returns.

3.3. SCCAPM Model

As explained above, according to the preferences, adjustments can be made to the function in asset pricing models. These models imply that, although returns can vary across assets, expected discounted returns should always be the same for every traded asset (Equation 1). So by changing the utility function, SDF has changed and the Euler equations are also affected.

In SCCAPM model adjustments have been made in the preferences, by entering the savings to the utility function. Entering the savings to the utility function is possible in one of below three ways:

1. With saving-based preferences utility depends upon the growth into the future relative to today so we can write: $u(c_t, S_{t+1}/S_t)$. This related to models of internal habit formation, In other words, in this case a saving-based utility is a kind of anticipatory habit formation.
2. Models of the spirit-of-capitalism are built upon the premise of Weber (1930), where the accumulation of wealth is an end in itself in a capitalist economy. In an empirical study it is usually just wealth that enters into the utility function, so $u(C_t, S_t)$.
3. This case related to the prospect theory. For example Barberis and Huang (2001) propose a utility function that includes future wealth, as an argument, $u(C_t, S_{t+1})$. It also postulates loss aversion, where the degree of loss aversion varies with the previous gains or losses.

We entered savings in the utility function like the first. So the utility function can be written as follows:

$u(C_t, S_{t+1}/S_t)$

Then, according to this utility function we extract the Euler equations. it is worth mentioning the proxy savings used instead of wealth. In the above-mentioned utility function, C denotes consumption and S represents wealth. This function expresses that in addition to consumption, saving or wealth affects preferences. To acquire future utility people ignore the current consumption. However, with the enter time and the dynamic discussion, future utility is discounted according to the current utility. Even the discount factor can be considered as endogenous, because people derive utility from saving.

The period utility function is $u(C_t, S_{t+1}/S_t)$. We will denote the partial derivatives of the utility function with respect to consumption and wealth accumulation by u_1 and u_2, respectively.

The consumer exhibits positive and diminishing marginal utility with respect to both consumption and accumulation of wealth, so $u_1, u_2>0$, $u_{11}, u_{22}<0$. In addition, $u(c_t, S_{t+1}/S_t)$ is strictly concave.

Utility function in this model can be considered as follows. This specified model is suitable for experimental work:

$$u\left(C_t, \frac{S_{t+1}}{S_t}\right) = \frac{\left[C_t\left(\frac{S_{t+1}}{S_t}\right)^{\theta}\right]^{1-\eta}}{1-\eta} \quad \eta>0,\ \eta\neq 1 \tag{12}$$

$$= LnC_t + \theta Ln\left(\frac{S_{t+1}}{S_t}\right),\ \eta=1$$

Where, $\theta>0$ measures the strength of the taste for saving. Parameter η measures the curvature of the utility function. The function inside the brackets is the least concave utility function; it governs the "ordinal" preferences between the two goods. Notice that the utility function Equation (12) can be rewritten as follows:

$$\frac{\left[C_t\left(\frac{S_{t+1}}{S_t}\right)^{\theta}\right]^{1-\eta}}{1-\eta} = \frac{\left[C_t^{\frac{1}{1+\theta}}\left(\frac{S_{t+1}}{S_t}\right)^{\frac{\theta}{1+\theta}}\right]^{(1-\eta)(1+\theta)}}{1-\eta} \tag{13}$$

We know from Pratt (1964) for a utility function $u(x)$ relative risk aversion is $-\frac{U'}{U''}(x)$ then by applying this definition to the transforming function Equation (12 and 13) the "correct" measure of relative risk aversion is Equation 14 (Kihlstrom and Mirman, 1974):

$$\Gamma=1-(1-\eta)(1+\theta) \tag{14}$$

In a dynamic model the curvature parameters of the utility function govern not only risk aversion and preferences between the two goods, but also govern the willingness to substitute consumption over time, as measured by the elasticity of inter temporal substitution.

We now state the consumer's optimization problem: Assuming a constant discount factor of β and an infinite planning horizon, the consumer chooses consumption and portfolio policies to maximize the expected lifetime utility subject to the budget constraint in Equation 5 and given the initial wealth (S_0):

$$\max_{\{C_t,\lambda_t\}_{t=0}^{\infty}} E\sum_{t=0}^{\infty} u\left(C_t, \frac{\mathbf{S}_{t+1}}{\mathbf{S}_t}\right) \tag{15}$$

Investigation of the consumption decision brings us to the following equation[2].

$$\frac{E\left(\frac{S_{t+1}}{S_t}\right)^{\theta(1-\eta)}\left[\frac{\theta\frac{C_t}{S_t}\frac{S_t}{S_{t+1}}+\beta\left(\frac{C_{t+1}}{C_t}\right)^{-\eta}\left(\left(\frac{\frac{S_{t+2}}{S_{t+1}}}{\frac{S_{t+1}}{S_t}}\right)^{\theta(1-\eta)}\right.}{\left[1-\theta\frac{C_{t+1}}{S_{t+1}}\right]}\right]R_{t+1}}{E\left(\frac{S_{t+1}}{S_t}\right)^{\theta(1-\eta)}}=1 \tag{16}$$

3.4. Hansen–Jagannathan (HJ) Distance and Loglinear Reduced form Equation

In this article we use two method comparison criteria. The comparison of "prediction errors" based on theory-motivated loglinear reduced form equation and the Hansen and Jagannathan (1991). The two criteria focus on different characteristics of a theoretical model, and we can view them as complementary to each other. For example, comparing reduced form equations is more robust to specification errors and restrictive functional form in the theoretical models, but it is essentially a model comparison method for linear models, and hence may not capture the structural characteristics of the nonlinear Euler equations. Thus, we also

2 For more details and proofs can see Kocherlakota (1996) and Drayer et al. (2013).

apply the HJ-distance method as well which is specifically designed for measuring Euler equation errors with all structural characteristics preserved.

Compared with reduced form equations used to converting nonlinear Euler equations to linear equations to determine the criteria of Akaike information criterion (AIC), Bayesian information criterion (BIC), mean squared error (MSE) and mean absolute error (MAE) in the models.

Kwan et al. (2015) Show that under the assumptions of lognormality and conditional Homoscedastici the Euler equation can be rewritten as:

$$E_t m_{t+1} + E_t r^i_{t+1} + \frac{1}{2}(\sigma^2_m + \sigma^2_i + 2\sigma_{im}) = 0 \tag{17}$$

Where m_{t+1}, r^i_{t+1} are the logarithm M_{t+1}, R^i_{t+1} respectively; σ^2_m, σ^2_i are the unconditional variance of m_{t+1}, r^i_{t+1}, and σ_{im} is their unconditional covariance. $E_t r^i_{t+1}$ is the one-step ahead forecast of the log-return of asset *i*. Thus, the above loglinear Euler equation can generate forecasts for log-return, provided that a forecast of the log SDF. The model's loglinear Euler equation of HCCAPM model is:

$$E_t r^i_{t+1} = \varphi_0 + \varphi_1 E_t \ln(C_{t+1}/C_t) + \varphi_2 E_t \ln(\alpha_{t+1}/\alpha_t) \tag{18}$$

Where $\phi_{0,}$ $\phi_{1,}$ ϕ_2 are functions the structural parameters.

In addition to the above method we use the Hansen and Jagannathan (1991) (HJ) distance. This method provides measure of the misspecification errors of a SDF model. It is defined as the minimized value δ of the following constrained least squares problem:

Choose *m* to minimize,

$$\delta^2 = E(y-m)^2 \tag{19}$$

$$S.t\ E(mx)=q$$

Where *y* is the SDF of the candidate model, *x* is a vector of asset payoffs, and *q* is a vector of the corresponding asset prices.

Hansen and Jagannathan (1991) show that above equation has a closed-form solution and there are two alternative expressions for the (squared) HJ-distance. The first expression is:

$$\begin{aligned} \delta^2 &= E\left[y^2 - (y-\lambda' x)^2 - 2\lambda' q\right] \\ \lambda &= (Exx')^{-1} E(xy-q) \end{aligned} \tag{20}$$

The second expression is,

$$\delta^2 = (Exy - Eq)'(Exx')^{-1}(Exy - Eq) \tag{21}$$

Which can be interpreted as a weighted average of the pricing errors $E(xy-q)$.

4. RESEARCH QUESTIONS

The most important research questions were examined in the following hypotheses:

1. There is relationship between consumer expenditure and stock returns
2. Consumer expenditure on housing affects stock returns
3. Entering savings to the consumer utility is significant and affect stock returns
4. Adjustments in the basic CCAPM model as changes in the utility function increases the efficiency of this model.

5. DATA ANALYSIS

To estimate the Euler equations, the data have been extracted from the website of the Central Bank of Iran and the Tehran Stock Exchange. The desired data is quarterly, between the years 1988 and 2011. With respect to the importance of the relevant variables in each study, the following will deal with a brief description of the variables used in this study. Variables in this article are as per capita gross national savings, Per capita consumption of the private sector, return on equity, housing consumption expenditure, nonhousing consumption and return on risk-free assets.

In the years before the revolution of Iran (1959-1978), the average economic growth rate was 12.3% and average savings rate was 38.8%. In the years following the revolution (1979-2000), the average growth was 1.7% and the savings rate was 26.9%. By comparing these values it was realized that because of a decrease in the growth average after the revolution, the saving rate declined compared to that which existed prior to the revolution. It was also observed that during the years when oil revenues increased, it not only increased economic growth, but also increased national savings. This was because an increase in oil revenues allowed the private sector and the government to add to the savings rate.

Variable of consumption is the quarterly data on the real consumption of households. Figure 1 depicts the current real consumption per capita in the years 1988-2011. In Figure 2, a graph of the real growth consumption and return on equity can be seen.

The average quarterly consumption growth rate between 1988 and 2011 is 5.78%. In addition, the average growth rate consumption (real) between the years 1988 and 2011 is 4.36 and the annual average growth rate during the same period is 24.88.

To obtain a return on risk-free assets, the investment deposits in banks can be used. In this article, for a risk-free rate, the return (R_f) interest on long- term deposits is used. We use a proxy for returns that is used in some economic studies (such as Mehra and Prescott, 1985) Data on this proxy (stock returns) are calculated using the following equation (*P*: Stock price).

$$\frac{P_t - P_{t-1}}{P_t}$$

Figure 1: Changes in real consumption per capita (C2) current consumption per capita (C1) between years 1988 and 2011

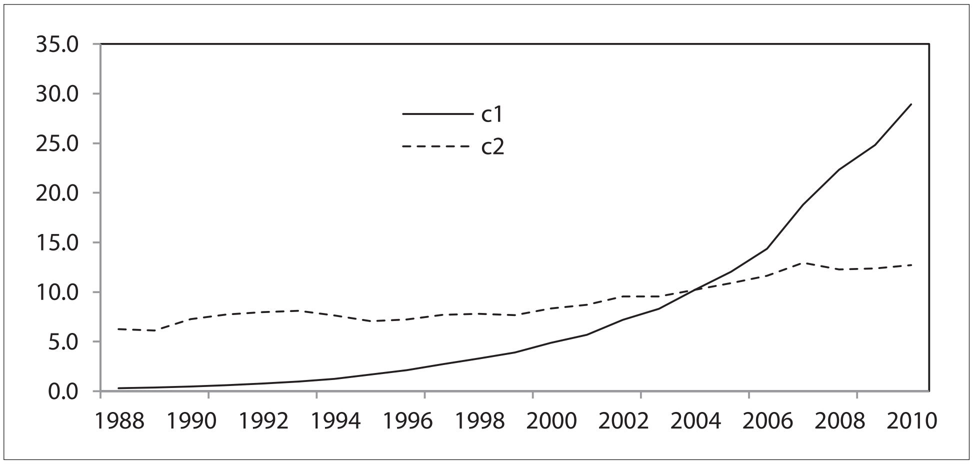

Figure 2: Real consumption growth rate and return on equity between the years 1988 and 2011 as a seasonal

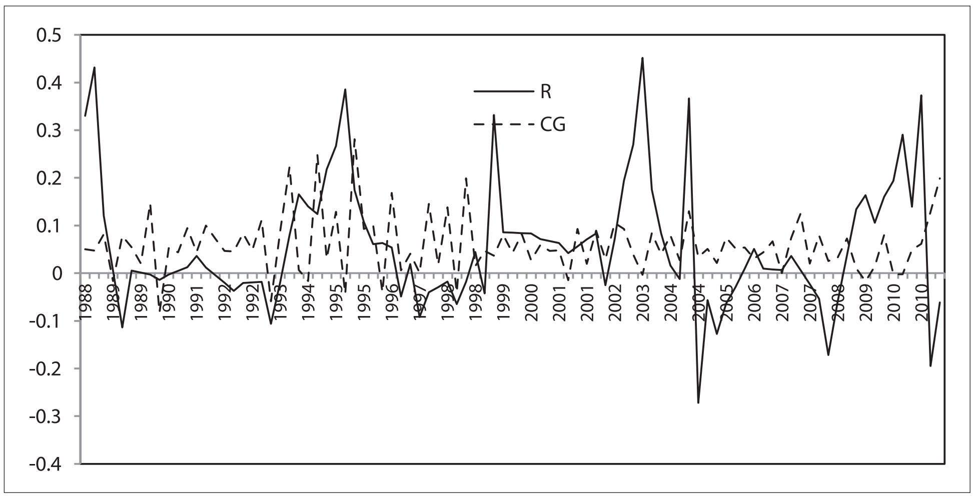

Table 1: Descriptive statistics of variables

Factors	C_t	S_t	C_h	C_P	α_t	R_t	$\frac{C_{t+1}}{C_t}$	$\frac{C_{t+1}}{S_{t+1}}$	$\frac{S_{t+1}}{S}$	$\frac{S_{t+2}}{S_{t+1}}$	$\frac{C_t}{S_t}$
Mean	27.40	22.59	15029.8	32117.2	0.68	23.11	23.8	1.05	0.05	7.42	8.39
Standard deviation	0.79	0.11	4407.8	10576.8	0.03	0.10	0.69	0.03	0.09	7.09	7.36
Max	7.54	2.38	28443.2	52263.8	0.89	2.38	6.65	0.54	0.45	31.09	40.78
Min	0.69	0.01	3040.92	17419.5	0.61	0.52	0.52	0.52	−0.27	0.06	0.34
Median	1.34	1.06	14311.47	27214.1	0.68	1.07	1.05	1.05	0.02	3.09	4.52
Skewness	2.92	1.13	0.29	0.40	1.64	3.30	−2.48	−2.48	0.85	1.17	1.38
Kurt	2.40	16.75	−0.30	−1.56	4.62	20.94	3.97	23.01	1.48	0.18	1.29

Source: Authors findings

Table 1 provides the descriptive statistics of these variables: Per capita gross national savings (S_t), Per capita consumption of private sector ($C1_t$), return on equity (R_t), $C2_t$: Total private consumption in constant prices of 1988, C_h: Housing consumption, C_P: Non-housing consumption, α_t the proportion of consumption expenditure on housing to the total consumption expenditure.

6. METHODOLOGY

For estimation Euler equations is used the GMM. About this method we can say that the GMM estimators are used when θ parameters are marked by excessive torque. In this case equation $E(f(x_t, \theta))=0$ gives q equations for p unknowns that are solved by θ_0. If the items are fully specified, the process to obtain an estimator will continue:

$$F_T\left(\hat{\theta}_T\right) = 0$$

When there are q equations for unknown p, as the equations are more than unknown, we cannot identify a vector $\hat{\theta}_T$ that establishes the $F_T(\theta)=0$ condition. However, we can find a vector $\hat{\theta}_T$ that is close to $F_T(\theta)$ and to zero. These vectors can be defined by:

$\hat{\theta}_T = \arg min_{\theta} Q_T(\theta)$

Where: $Q_T(\theta) = F_T(\theta)' A_T f_T(\theta)$

And A_T is a weighting matrix $p \times p$, positive definite random. It should be noted that $Q_T(\theta) \geq 0$ and $Q_T(\theta)=0$ only if $F_T(\theta)=0$. Therefore, $Q_T(\theta)$ can be zero if it is fully specified, but it is positive if it is too specific[3].

Before estimation of model we investigate the stationary of variables. Although the GMM method does not require many assumptions about the research data, it is important to investigate the stationary of variables. Therefore, before model estimation we need to check the stationary of variables. In this section, unit root tests have been conducted on the variables of the article. We used Advanced Dickey Fuller (ADF) test and Phillips-Perron method to search for stationary variables. As Table 2 shows, all variables are stationary at 1% because the null hypothesis rejected. For more explanation can be stated the computed ADF test-statistic (The third column of the table) is greater than the critical values – "tau" (−3.51 at 1% significant level), therefore we can reject Ho. It means the variables series doesn't have one unit root problem and the variable series are stationary series at 1% significant level.

For the selection instrumental variables we have to consider two important things; first more instrumental variables do not mean they are more advantageous and second, Instrumental variables should be selected according to their ability to estimate and recognize (Dreyer et al. 2013). If adding a new instrumental variable has a positive effect on the quality of the estimation, this variable will be used as an instrumental variable. However, if adding new instrumental variables creates a collinearity between the instrument variables, creates an error model, worsens the situation of the model estimation or the estimated corner results for the parameters, the instrumental variable will not be used. Vectors of instruments for HCCAPM Model and SCCAPM are reported in Tables 3 and 4.

We consider range for parameters because the Euler equations are highly nonlinear. These ranges restrict the parameter estimates to "economically reasonable intervals". Therefore, the following boundaries were imposed on the parameters:

$$\beta \in [0,1],\ \theta \in [0,110], \eta \in [0,110] \quad (22)$$

7. DISCUSSION

Table 5 presents our estimation results. Under the null hypothesis ($E[h(\theta_{GMM}, x_{t+\tau})] = 0$) the test statistic is a Chi-square distribution with degrees of freedom (r−l) that r (orthogonality restrictions or terms of torque) is the number of instrumental variables with a constant factor and l is Number of model parameters.

Using Table 5, we can express that:

3 To learn more about GMM, refer to the article of Hansen.

Table 2: ADF and PP test over model variables

Variable	Include in test equation	Test*ADF	Test PP
C_{t+1}/C_t	Trend and intercept	−11.43	−12.64
S_{t+1}/S_t	Trend and intercept	−12.58	−13.19
S_{t+2}/S_{t+1}	Trend and intercept	−10.82	−10.91
C_{t+1}/S_{t+1}	Trend and intercept	−6.53	−8.35
R_{t+1}	Trend and intercept	−3.60	−5.98
C_t/S_t	Trend and intercept	−6.86	−9.15
S_t/S_{t+1}	Trend and intercept	−13.42	−14.07
α_t	Trend and intercept	−10.025	−10.02
C	Trend and intercept	−6.017	−20.50
RH	Trend and intercept	−4.68	−5.46
TEPEX	Trend and intercept	−9.50	−9.50
PriceH(−1)	Trend and intercept	−4.25	−4.29
S	Trend and intercept	3.22	3.39
GI(−2)	Trend and intercept	−8.25	−9.24
exch(−2)	Trend and intercept	2.30	4.30
S1(−1)	Trend and intercept	−11.19	−11.31
SS0(−2)	Trend and intercept	−10.38	−13.96
Consum76	Trend and intercept	3.35	4.52
IH	Trend and intercept	2.39	3.35
home(−2)	Trend and intercept	2.47	3.48
GC(−1)	Trend and intercept	−4.21	1.80

*Macinnon test at 1% is equal to −3.50. ADF: Advanced Dickey Fuller, PP: Phillips Perron

SCCAPM model is used to estimate the parameters of, the subjective discount factor (β), the curvature of the utility function (η), and the tendency to save (θ), which are equal to 0.71, 0.86, and 28.14, respectively. In this case, estimations for the parameters are within the acceptable boundary restrictions. Estimation for (θ) is significant. In other words, there is evidence that the savings tendency, teta (θ), is significant.

The method of Khilstrom and Mirman (1974 and 1981) can be used to obtain relative risk aversion, so $\Gamma=1-(1-\eta)(1+\theta)=-3.079$ that negative value for relative risk aversion means that economic agents are not averse to risk, but they are lovers of risk.

According to the results of the models in Table 5, can be seen all the variables are significant at the 95% confidence level. In other words explanatory variables (including the consumer expenditures and relative share of housing service in their consumption) have a significant effect on stock returns. In this estimation to investigation validity of instruments matrix is used J-test. In this test, the null hypothesis is no correlation between errors and instruments. As can be seen the null hypothesis of non-correlation tools with errors can't be reject. So it can be concluded that the instruments used to estimate are valid.

The results of CCAPM model indicate that parameter β (subjective time discount factor) is equal to 0.902. t-statistic for this parameter indicates the estimate is significant. As explained in the theoretical foundations of article: If β is big, people aren't highly impatient, and they have not a strong preference for consumption now versus consumption in the future. Estimation parameter η (curvature of the utility function, the coefficient of relative risk aversion and intertemporal elasticity of substitution photos) in this model is 14.742. This number has a positive sign that indicates economic factors are very risk averse.

Table 3: GMM vectors of instruments for HCCAPM model

Variable	Definition	Variable	Definition
R(−2)*	Stock returns	S1(−1)	Ratio S_{t-1}/S_{t-2}
R_H(−1)	Housing return	SS0(−2)	Ratio S_{t-2}/S_{t-3}
TEPEX	Stock price index	Consum76	Private consumption at constant prices 76
PriceH(−1)	Rental housing index	IH	Private sector investment in new buildings
S	Per capita gross national savings	Home(−2)	Number of buildings completed
GI(−2)	Government expenditure	GC(−1)	Government consumption expenditure
Exch(−2)	The unofficial exchange rate	CS(−1)	The ratio of per capita consumption to per capita savings

*The number in parentheses indicates the number of delay periods

Table 4: GMM vectors of instruments for SCCAPM model

Alternatives	Instrument variable
1	$Z=[K_{,} S_{t+1}/St(-2)$, tepex, R(t−2)]

GMM: Generalized method of moments

Table 5: Estimation results (iterative GMM): Starting point (0.9, 0.5, and 0.5)

Model	Estimation parameters GMM				The test statistic J	P-value of J-test
	β	η	ϕ	θ		
CCAPM	0.902 (6.64)	14.742 (2.26)	-	-	18.72	0.34
HCCAPM	0.970 (2.02)	20.69 (3.05)	0.844 (15.29)	-	19.73	0.23
SCCAPM	0.71 (23.57)	0.86 (35.94)	-	28.14 (7.62)	0.18	0.66

Source: Authors findings. CCAPM: Consumption-based capital asset pricing model, GMM: Generalized method of moments, HCCAPM: Housing consumption-based capital asset pricing model

The results of HCCAPM model indicate that parameter β (subjective time discount factor) is equal to 0.907 therefor consumers are patient. Estimation parameter η in this model is 20.69. Similar to CCAPM model estimation this number has a positive sign that indicates economic factors are very risk averse. Parameter φ that there is in HCCAPM model is inverse of intertemporal elasticity of substitution of housing and nonhousing consumption service. The estimated value of this parameter in this model is 0.844. Therefore, it can be concluded that the elasticity of substitution between nonhousing consumption service and housing consumption service is 1.184. Also some economic studies (Kwan et al., 2015, Piazzesi et al. 2007) have found positive value for elasticity of elasticity of substitution between nonhousing consumption service and housing consumption service.

The estimation results suggest parameters in the GMM method are significant. But models differ from each other. Thus, the question arises is to ask which model provides a better description of the data. And since GMM method can't determine which model is better we should introduce other criteria to compare models.

Table 6 indicates the five prediction performance measures for the models. These criteria are AIC, Schwarz BIC, the root MSE (RMSE), MAE and Hansen and Jagannathan (1991) distance. Since there is no linear transformation SCCAPM model we use HJ distance, AIC, and BIC for this model. As the results of Table 6 shows the five criteria indicate that CCAPM have more ability in explaining the stock returns than HCCAPM model and SCCAPM. In other words, the CCAPM operates more efficient in explains stock returns in the period 1988 to 2011.

Table 6: Model comparison by five criteria

Model	AIC	BIC	RMSE	MAE	HJ
CCAPM	4.42	4.50	0.136	0.126	0.06381
HCCAPM	5.89	5.97	0.174	0.164	0.09677
SCCAPM	9.04	9.12	-	-	0.2852

Source: Authors findings. AIC: Akaike information criterion, CCAPM: Consumption-based capital asset pricing model, RMSE: Root mean squared error, MAE: Mean absolute error, HJ: Hansen and Jagannathan

8. CONCLUSION

One of the most important branches of finance is modeling and evaluation pricing assets. Base models of asset pricing such as CCAPM has been criticized so recent studies presented new models in this field. These models included macroeconomic variables sometimes. To investigate performance of consumption-based asset pricing models to explain aggregate stock returns in Iran, we develop, estimate and compare CCAPM and two variants of consumption-based asset pricing models with the asset market data from Iran. They include the Housing-augmented variants including HCCAPM and saving based asset pricing or SCCAPM. The main purpose of this article is investigation signification consumption expenditure and its components (housing service consumption and nonhousing service consumption) in explaining stock returns. Furthermore other purpose in this article is investigation significantly of savings in the utility function. For this purpose we use quarterly data 1988 to 2011 for estimation CCAPM, HCCAPM and SCCAPM models. We are estimated these models with GMM method.

Our empirical results indicated that model parameters are significant. Furthermore results indicated that economic factors are patient and very risk averse. Elasticity of substitution between housing service consumption and nonhousing service consumption is positive. According to the investigation, and the results of this article however, the HCAPM and SCCAPM models have the explanatory power stock returns but compared to CCAPM have less performance. Therefore, it can be concluded that consumer expenditures on housing affect stock returns but when we consider the total consumption expenditures as variable explanatory, explanatory power of the model increases. In the other words the CCAPM model has more ability in explaining the stock returns than HCCAPM model and SCCAPM. In SCCAPM model, which includes the preference function with the saving the results show that preferences for savings are significant statistically and economically. According the method of Khilstrom and Mirman (1974 and 1981) relative risk aversion is −3.079 which actually implies risk-loving behavior. A negative relative risk aversion is not able to explain why people save and would invalidate the model's motivation.

We have shown that the 3 models are indeed different in terms of their ability in explaining the stock returns. This conclusion leads finance researchers to test other pricing models that in these models will be important to pay special attention to macroeconomic variables. According to the importance of the relationship between risk and return it is necessary studying CAPM and test different models with various scenarios is essential for a model in this field. Authors can investigate adjustments to CAPM and test entering other variable special macroeconomic variables.

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