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Developing a Measurement Model for the Sensitivity Analysis of Asset Returns with Regard to Beta Index of Exchange Rate in the Context of the Modified Capital Asset Pricing Model

Reza Alizadeh, Farhad Dehdar**, Mohammadreza Abdoli

Department of Accounting, Shahrood Branch, Islamic Azad university, Shahrood, Iran

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ABSTRACT

With increasing trade among different countries the exchange rate fluctuations, consumption, inflation, and market portfolios are considered as major risk factors in financial markets. Hence this study aimed to examine the relationship between the exchange rate fluctuations and asset returns within a theoretical and empirical model, i.e. Consumption-based Capital Asset Pricing Model (CCAPM). To this end, a basic CCAPM is extended and imported consumables are included in Epstein and Zin’s recursive utility function. The research sample encompasses eight portfolios and monthly data from 2003 to 2014. The pricing model parameters are estimated using Euler's equations and Hansen and Singleton’s generalized method of moments (GMM). An estimation of the parameters of Euler's equations indicates the risk aversion and tolerance of economic factors, low elasticity of substitution for domestic consumables and imported consumables, and high elasticity of intertemporal substitution. In the next step, using Euler’s linearized equations as asset pricing model and Fama and Macbeth's two-step regression method, the effects of exchange rate risk premium, inflation, market efficiency, and consumption growth on return premium on assets are investigated. The results indicates the positive impact of the exchange rate risk premium, inflation, and market returns on the return premium on assets.

1 Introduction

Undoubtedly, one of the most fundamental factors in the economic development of each country is the performance of its capital market. The stock exchange, as a symbol of the capital market, plays a significant role in absorbing financial resources and attracting investors in productive economic activities and consequently the increased economic growth. The pricing method of traded securities is the result of interactions among various variables, each of which differently influence the price of the securities. One of the factors affecting the price of securities is their risk and returns, so that the highest returns with respect to minimum risk has always been an acceptable measure of investment. Accordingly, high risk assets should have higher returns in order to motivate the investors in holding such assets [31, 32]. With the expansion of globalization, exchange rate risk is considered an important factor in investment

* Corresponding author. Tel.: *+9809125468102*
E-mail address*: f.dehdar1970@yahoo.com*

decisions. In theory, exchange rate fluctuations, in addition to foreign trade, affect the domestic economy, especially the stock market. In an open economy, services and capital in countries are provided with regard to their exchange rate. Developing countries such as Iran have been experiencing a high degree of instability in macroeconomic variables. In these countries, in comparison to the developed and industrial economies, exchange rate, stock prices, and other important macroeconomic variables have been more fluctuated and these, in turn, have created an uncertain environment for investors, make investors unable to decide more safely on future investment, and enhance the likelihood of huge loss to them. In this regard, different pricing models are developed, one of which CCAPM model (Consumption-based Capital Asset Pricing Model). According to Lettau and Ludvigson [20] and Cochran [10], in the rational equilibrium of financial markets, the systematic risk in the CCAPM model is measured through covariance between final utility and return on assets, and this theoretical assumption is one of the distinguishing features of this model compared to other models.

When the real exchange rate is reduced, or the real value of the domestic currency is strengthened (i.e., boom period), the value of the foreign commodities would decrease. The exchange rate fluctuations would have two substitution and income effects. The income effect increases the consumption of foreign commodities, which itself would lead to an increase the individual utility (the decline of the final utility). In contrast, when the real exchange rate increases or the real value of the domestic currency decreases (i.e. recession period), the income effect would reduce the consumption of foreign commodities, which consequently reduce the individual utility (the increase of the final utility). This means that the exchange rate has a negative correlation with the utility level; thus, consumption would have a feature synchronous with the trading period and the exchange rate would have a counter-periodic effect. Furthermore, the effect of the exchange rate on the consumption of domestic commodities would depend on the substitution degree of these two commodities. In sum, the exchange rate fluctuations strengthen the relationship between returns on assets and ultimate utility and leads to risk fluctuations for investors. The effects of exchange rate on stock prices and returns is such that the CCAPM model can be used to examine the relationship between exchange rate (through imports) and return on assets. Hence a systematic perspective, instead of examining the effects of exchange rates on stock returns, addresses the effects of macroeconomic variables, including imports, which are correlated with exchange rate. This study is novel in a way that it examines the effect of exchange rate on asset returns within the framework of an exchange economy with the outside world in Tehran Stock Exchange through developing an CCAPM model within an open economy framework, solving the equilibrium model by including the imports of consumables in the preferences posed by Epstein and Zin [13], introducing the utility function with Constant Elasticity of Substitution (CES) to determine the relationship between two imported commodities and domestic consumables instead of the expected utility function with Constant Relative Risk Aversion (CRRA) in the traditional CCAPM model, and using Euler's equations. The outline of this paper is as follows: the second section encompasses a review of the research literature. The third section addresses the features and theoretical framework of the traditional CCAPM model and the adjusted CCAPM model and the extraction procedure of the research equations. The fourth section also contains data and research variables. In Section V, the findings and suggestions for future studies are presented.

2 Literature Review

Antell and Vaihekoski [1] in their study examined the effect of exchange rate fluctuations on return on assets from the viewpoint of an American investor in Finland's stock market in the form of a conditional international pricing model for assets (i.e., C-ICAPM). Assuming that investors fail to protect themselves against the exchange rate risk, they considered the local market portfolio as a source of risk, as suggested by Errunza and Losq [14]. They also included the exchange rate as a factor effective in determining local and foreign portfolios into the model. The results of the study indicate that exchange rate fluctuations from 1970 to 2004 impose no cost on the investors in the stock markets of these countries. Aggarwal and Harper [2] examined the effects of exchange rate fluctuations on the returns of companies, even those companies that had little connection to the outside world. The proposed model, developed by Adler and Dumas [3], Jorion [20], and Fama–French [16], suggests that exchange rate fluctuations significantly affect the monthly returns of assets in companies surveyed from 1995 to 2003. Olufem [27] also investigated the effect of the exchange rate on stock returns of 117 firms in Nigeria during 1998-2007 through using three alternative exchange rates (namely dollar, pound, and euro) and expanding Jorion's model (1991).

The companies are divided into two subgroups of financial and non-financial companies. The results indicate that the exchange rate beta is meaningful (both positively and negatively) in most companies and the sensitivity of return to dollar-rate fluctuations is generally higher than to the other currencies. Chaieb and Mazzotta [8] studied the effects of exchange rate fluctuations on firms' value for the two groups of export and non-export companies (and eleven subgroups) during 1989 to 1994 and 1995 to 2005 using the conditional unconditional panel data model. In the non- unconditional model, the exchange rate beta has a significant and negative effect on the return on assets and, in the conditional model, considering the trade-off index for the cases when the economy is in a contraction mode, exchange rate fluctuations in most industries have a significant effect on the returns. Mouna and Jarboui [26] examined the effect of the stock market index, the exchange rate risk, and risk on the stock returns of Tunisia's banks during 2007-2010 through using the ordinary least squares method (OLS) and generalized autoregressive conditional heteroscedasticity (GARCH). The results show that exchange rate and market index play an important role in determining the dynamics of conditional stock returns in banks. However, interest rates play no significant role in determining these returns. Miao et al. [24] investigated the sensitivity and asymmetric effects of exchange rate fluctuations on stock returns of 16 industries in China and 2277 active companies during 2002 to 2012 within the framework of a conditional asset-pricing model. They found out that an increase in the value of China's currency reduces exports and decreases the competitive advantage of export firms as well as the profits of these firms. In contrast, an increase in the value of domestic currency in the import firms reduces costs and increases their profits. The results of the study indicate that the returns of seven industries out of these 16 industries is exposed to negative exchange rate fluctuations.

Saleem [34] used a Conditional International CAPM from the viewpoint of an American investor to examine the significance of the inflation and exchange rate risk in the stock market of the concerned countries according to generalized autoregressive conditional heteroscedasticity based on the conditional heterogeneity variance during 1988 to 2000. The results show that the exchange rate risk has a negative effect and the inflation risk has a positive effect on return on assets. In the form of a Markov Switching Vector Autoregressive Model (MSVAR), Chkili and Nguyen [9] investigated the relationship between exchange rate and stock returns in the stock market of BRICS member countries during 1997 to 2013. The results show that, regardless of the type of exchange rate regime, exchange rate fluctuations have had no effect on stock returns. Using the CCAPM and Co-integrated VAR (CVAR) models as well as an error correction model (ECM), Stillwagon [37] studied the covariance relationship between expected returns on assets, exchange rate, and consumption through employing three Pound, Yen and Mark rates versus Dollar during 1982-2000. The results indicate that the exchange rate is one

of the variables that can influence the improvement of the CCAPM model. Among the studies conducted in Iran, Shaki and Tofighi [35] evaluated the effect of exchange rate fluctuations on stock returns in Iran using the conditional GARCH model. Then they used Johansson's Co-integrated VAR, Vector Auto Regression (VAR), Impulse Response Function (IRF) and Variance Decomposition (VD) to determine the relationships between these variables. The results indicate a positive relationship between stock returns with market exchange rate and price index, and a negative relationship between oil price and stock returns.
Vakilifard and Ali Farry [38] studied the effect of exchange rate fluctuations on risk and return on stocks in the three cement, petrochemical, and automobile industries during 1998-2012. In order to identify the balanced relationship among the macroeconomic variables and its effect on stock returns using the convergence approach, the research objective is tested. The results of this study confirm no relationship between risk and total returns of stock with macroeconomic variables in the companies accepted Tehran Stock Exchange. In order to identify the relationship between exchange rate and return on assets and determine its effect, a majority of studies have generally considered exchange rate risk as a risk factor along with other traditional risk factors in the form of some pricing and econometric models and have not been established based on a specific theory. They have been largely unsuccessful and thus achieve no consistent result. In this regard, the present paper is presented in the framework of a balanced and general approach to study the impact of exchange rate on return on assets.

3 Asset Pricing Model

3.1 Traditional Consumption-Based Asset Pricing Model

This model was founded by Hansen and Singleton [18] in 1982. In this model, the economic factor seeks to maximize its utility:

$$\max_{C_t} E_t\left[\sum_{i=0}^{\infty} \beta^i u(C_{t+i})\right] = 0 \tag{1}$$

$$u(C_t) = \frac{{C_t}^{1-\gamma}}{1-\gamma} \;; \qquad \gamma > 0 \tag{2}$$

$$u(C_t) = \ln(C_t) \;; \quad \gamma = 1 \tag{3}$$

Where, C_t is per capita consumption at time *t*, β is subjective time discount factor, γ is the risk aversion parameter, and $E_t$is the conditional expectation operator at time *t*. If β is small, people get intolerant, and in other words, prefer the current consumption to future consumption. In this model, the utility function has a CRRA and Stochastic Discount Factor (SDF) equal to the Intertemporal Marginal Rate of Substitution (IMRS). According to Dreyer et al. [12], each asset-pricing model has a unique pricing kernel or a unique discount factor, and the performance of each model can be compared by developing Euler's equations for the stochastic discount factor. Hence, in order to obtain a stochastic discount factor, the first-order condition of (1) is used to achieve optimal consumption:

$$C_t^{-\gamma} = \beta E_t\{(1 + R_{i,t+1})C_{t+1}^{-\gamma}\} \tag{4}$$

The momentum conditions of (4) form the basis of the GMM estimation. Given that the variables of the model must be static, this condition is met by the GMM theory and the following equation:

$$0 = E_t\left\{1 - \beta\left[(1 + R_{i,t+1})\frac{C_{t+1}^{-\gamma}}{C_t^{-\gamma}}\right]\right\} \tag{5}$$

In the standard CCAPM model, only two parameters β and γ are estimated. Equation (5) explains the cross-sectional difference in expected yield through yield covariance with SDF, where:

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

Now, x_t is assumed to be an M × 1 vector from the investor's available information. According to (5), r = N × M, and there is a moments condition by which the asset pricing model is tested [14]. The following linear approximation is usually considered for the SDF:

$$SDF_{t+1} = M_{t+1} \approx \beta(1 - \gamma\Delta LnC_{t+1}) \tag{7}$$

After obtaining the pricing Kernel and placing it in Euler equation (5), we can estimate the model parameters.

3.2 Adjusted Consumption-based Capital Asset Pricing Model

In recent years, many studies have been carried out on the CCAPM model as a main model explaining the behavior of the stock market. In most of these studies, the traditional CCAPM model has not sufficiently explains the market behavior and this model has failed in practice as this linear model has created an Equity Premium Puzzle. In this case, high risk aversion is required to explain the magnitude of the equity premium (the extra return on assets to the risk-free return on assets), while, the risk aversion parameter is not a large number in traditional CCAPM. This puzzle was first proposed by Mehra and Prescott [23, 25]. Following the presentation of puzzles such as equity premium puzzle, there are some modifications in the CCAPM model (e.g., Bach and Møller, [4]; Epstein and Zin, [13]; and Xiao et al., [40]). According to Xiao et al. [40], one of the main reasons for the failure of the standard CCAPM is that it, in general, ignores the other variables such as macroeconomic variables that affect the ultimate utility of consumption, because the risk premium is reflected in the macroeconomic variables as well. In this regard, the research model is defined by expanding Epstein and Zin's [15] CCAPM model as follows:

It is assumed that N is an asset with the gross return $R_t = (R_{1t}, R_{2t}, \dots, R_{Nt})'$ in economy, $\omega_{j,t}$ represents a proportion of investment by the economic factor on the asset *j* at period *t*, se we have:

$$\sum_{j=1}^{N} \omega_{j,t} = 1 \qquad t = 1,2, \dots . T \tag{8}$$

The wealth and budget constraints for an individual at time *t* is equal to S_t:

$$S_{t+1} = (S_t - P_t^* e_t^n C_t^f - P_t C_t^d)\omega_t' R_{t+1} \tag{9}$$

Where, C_t^d is the consumption of domestic commodities and C_t^f is the consumption of foreign commodities, through which the economic factor obtains utility in each period. P_t is the price of domestic commodities, P_t^* is the price of foreign commodities in foreign currency, e_t^n is the nominal exchange rate (the domestic currency value equivalent to the value of foreign currency), and $P_t^* e_t^n$ is the price of foreign commodities in domestic currency. In the finance markets, the developing countries are facing many constraints, one of the most important of which is access to foreign currency. Hence this study assumed that domestic consumers can consume both domestic and foreign commodities and can only invest in domestic markets. By dividing both sides of (9) by P_t, $W_t = \frac{S_t}{P_t}$ represents wealth at its domestic price. Then the budget constraint is changed as follows:

$$\pi_{t+1} W_{t+1} = (W_t - e_t C_t^f - C_t^d)\omega_t' R_{t+1} \tag{10}$$

The real exchange rate is $e_t = \frac{P_t^* e_t^n}{P_t}$ and $\pi_{t+1} = \frac{P_{t+1}}{P_t}$ is the change at its domestic price (inflation index). In addition, it is assumed that each person has preferences for constant elasticity of substitution (CES) at each time period as follows:

$$U(C^f, C^d) = [(1-\alpha)(C^d)^\rho + \alpha(C^f)^\rho]^{\frac{1}{\rho}} \tag{11}$$

$\alpha \in (0,1)$ expresses the subjective preferences for two commodities and $\rho \in (-\infty, 1)$is used to determine the elasticity of substitution for the two commodities, so that $\mathrm{ES} = \frac{1}{1-\rho} \in [0, +\infty)$. If $\rho < 0$, then $0 < \mathrm{ES} < 1$, that is, the effect of substitution between the domestic and foreign commodity is small. When $0 < \rho < 1$, then $\mathrm{ES} > 1$ so that the effect of substitution between the domestic and foreign commodity is significant and large (according to the findings of Dunn and Singleton [11] and Ogaki and Reinhart, [28]). To model the factor's behavior, Epstein and Zin's [15] preferences were used. It is assumed that the utility function of a person's life cycle has the following recursive form:

$$U(C_t^d, C_t^f) = \{(1-\beta)([(1-\alpha)(C_t^d)^\rho + \alpha(C_t^f)^\rho]^{\frac{\sigma}{\rho}} + \beta[E_t(J_{t+1}(W_{t+1})^\gamma)]^{\frac{\sigma}{\gamma}}\}^{\frac{1}{\sigma}} \tag{12}$$

Where, $\beta \in (0,1)$ is subjective discount factor and $\gamma \in (-\infty, 1)$ is risk aversion. When γ decreases, the risk aversion degree decreases, and the relative risk aversion is equal to $(1-\gamma)$. $\sigma \in (-\infty, 1)$ determines the elasticity of intertemporal substitution $\mathrm{EIS} = \frac{1}{1-\sigma}$, J_{t+1} is the value function of Bellman Equation and E_t is the conditional expectation operator of the information available at any time. The advantages of using the utility function (12) are as follows: Firstly, it distinguishes risk aversion from elasticity of intertemporal substitution, and secondly, it can obtain the substitution effect between two domestic and foreign commodities, so that an individual not only selects his consumption over different times but also selects his own consumption from domestic and foreign commodities. This finding is in accordance with the findings of Epstein [13], Weil [39], Kreps and Porteus [21], and Pepin [29].

Using the recursive utility function, CES function, and budget constraint (equations 8 and 10), optimization is as follows:

$$J_t(W_t) = \mathrm{Max}\{(1-\beta)[(1-\alpha)(C_t^d)^\rho + \alpha(C_t^f)^\rho]^{\frac{\sigma}{\rho}} + \beta[E_t(J_{t+1}(W_{t+1})^\gamma)]^{\frac{\sigma}{\gamma}}\}^{\frac{1}{\sigma}} \tag{13}$$

Assuming that $J_t(W_t) = \Phi_t W_t$, through maximizing the utility and the first-order condition of (12), we have:

$$\frac{\partial U}{\partial C_t^d} = 0;\ (1-\beta)\frac{\sigma}{\rho}\left[(1-\alpha)\rho\left(C_t^d\right)^{\rho-1}\right]\left[(1-\alpha)\left(C_t^d\right)^{\rho} + \alpha\left(C_t^f\right)^{\rho}\right]^{\frac{\sigma}{\rho}-1} = \sigma\beta\left(W_t - e_t C_t^f - C_t^d\right)^{\sigma-1} E_t\left[\Phi_{t+1}^{\gamma} R_{w,t+1}^{\gamma}\right]^{\frac{\sigma}{\gamma}} \tag{14}$$

$$\frac{\partial U}{\partial C_t^f} = 0;\ (1-\beta)\frac{\sigma}{\rho}\left[\alpha\rho\left(C_t^f\right)^{\rho-1}\right]\left[(1-\alpha)\left(C_t^d\right)^{\rho} + \alpha\left(C_t^f\right)^{\rho}\right]^{\frac{\sigma}{\rho}-1} = \sigma\beta\left(W_t - e_t C_t^f - C_t^d\right)^{\sigma-1} E_t\left[\Phi_{t+1}^{\gamma} R_{w,t+1}^{\gamma}\right]^{\frac{\sigma}{\gamma}} e_t \tag{15}$$

Where, $\omega_t' R_{t+1} = R_{w,t+1}$ is the yield of the optimal portfolio and represents the total return on capital assets. According to (14) and (15), the ratio of the two commodities is as follows:

$$\frac{C_t^f}{C_t^d} = \left[\frac{e_t(1-\alpha)}{\alpha}\right]^{\frac{1}{\rho-1}}, \quad \rho \in (-\infty, 1) \tag{16}$$

According to this equation, when the real exchange rate decreases, the consumption rate of the foreign commodity increases in comparison to that of the domestic commodity. In other words, e_t estimates the relative price of domestic and foreign commodities as a decrease in e_t makes the foreign commodity less expensive than the domestic one and further enhances the demand for foreign commodities. At each time period *t*, the total value of the domestic and imported consumables for each individual is $e_t C_t^f + C_t^d$. According to (16), the total value of consumption is:

$$e_t C_t^f + C_t^d = e_t\left[\frac{e_t(1-\alpha)}{\alpha}\right]^{\frac{1}{\rho-1}} C_t^d + C_t^d = c_t^d\left[1 + e_t^{\frac{\rho}{\rho-1}}\left(\frac{1-\alpha}{\alpha}\right)^{\frac{1}{\rho-1}}\right] \tag{17}$$

Assuming that $A_t = \left[1 + e_t^{\frac{\rho}{\rho-1}}\left(\frac{1-\alpha}{\alpha}\right)^{\frac{1}{\rho-1}}\right]$, then:

$$e_t C_t^f + C_t^d = A_t C_t^d \tag{18}$$

Thus $1/A_t$ measures the ratio of expenditure on domestic commodities to total expenditures. Eq. (18) describes how the real exchange rate and the subjective parameters α and ρ affect the consumption rate of both domestic and foreign commodities. $1/A_t$ is a descent function of α, and a small α represents a larger ratio of expenditure on domestic commodities to total expenditures, when $\rho < 0, \mathrm{ES} < 1$. $1/A_t$ is also a descent function ofe_t. When e_t is decreased, the cost of the domestic commodity is higher than the total expenditures; however, according to Eq. (16), it can be shown that when e_t is reduced, the substitution of the two totals of consumable would lead to an increase in the consumption of foreign commodities compared to the total consumption (the substitution effect). In other words, the low elasticity of substitution ($\mathrm{ES} < 1$) between the two commodities implies that the person is less willingness to substitute these two commodities and that a decrease in e_t increases the relative value of domestic commodities. Hence, the effect of the increased value of the domestic commodity (income) dominates the effect of decrease (substitution) and leads to an increase in total expenditures. On the contrary, when ($\mathrm{ES} > 1$) $0 < \rho < 1$, the results are completely reversed. By placing Eq. (16) and Eq. (18) in the utility function, the utility function of the domestic and foreign commodities as a function of A_t can be obtained:

$$U\left(C_t^d, C_t^f\right) = \left[(1-\alpha)\left(C_t^d\right)^{\rho} + \alpha\left(C_t^f\right)^{\rho}\right]^{\frac{1}{\rho}} = C_t^d\left[(1-\alpha)A_t\right]^{\frac{1}{\rho}} \tag{19}$$

With respect to the utility maximization in (13) and the assumption set for Φ_t, we have:

$$J_{t+1}^{\gamma}(.) = (\Phi_{t+1}W_{t+1})^{\gamma} = \Phi_{t+1}^{\gamma}\pi_{t+1}^{-\gamma}\left(W_t - A_tC_t^d\right)^{\gamma}(\omega_t'R_{t+1})^{\gamma} \tag{20}$$

By placing (19) and (20) in (13) and the first-order condition of the equation for C_t^d, we have:

$$\sigma(1-\beta)[(1-\alpha)A_t]^{\frac{\sigma}{\rho}}(C_t^d)^{\sigma-1} = \sigma\beta\left[W_t - A_tC_t^d\right]^{\sigma-1}A_t(\mu^*)^{\sigma} \tag{21}$$

Where, $\mu^* = \left(E_t[\Phi_{t+1}^{\gamma}\pi_{t+1}^{-\gamma}\,R_{w,t+1}^{\gamma}]\right)^{\frac{1}{\gamma}}$ and $C_t^d = \varphi_tW_t$ are the optimal consumption of the domestic product, which is proportional to the total wealth. According to (21), we have:

$$(\mu^*)^{\sigma} = \frac{\sigma(1-\beta)[(1-\alpha)A_t]^{\frac{\sigma}{\rho}}\varphi_t{}^{\sigma-1}}{\beta[1-\varphi_tA_t]^{\sigma-1}A_t} \tag{22}$$

Now, by inserting (22) in (13) and sorting the equation, we have:

$$(\Phi_tW_t)^{\sigma} = (1-\beta)\left(C_t^d\right)^{\sigma}[(1-\alpha)A_t]^{\frac{\sigma}{\rho}} \tag{23}$$

$$+\beta W_t^{\sigma}(1-\varphi_tA_t)^{\sigma}\,\frac{(1-\beta)[(1-\alpha)A_t]^{\frac{\sigma}{\rho}}\varphi_t^{\sigma-1}}{\beta(1-\varphi_tA_t)^{\sigma-1}A_t}$$

$$\Phi_t = [(1-\beta)(1-\alpha)^{\frac{\sigma}{\rho}}A_t^{\frac{\sigma}{\rho}-1}]^{\frac{1}{\sigma}}\varphi_t^{1-\frac{1}{\sigma}} \tag{24}$$

$$B_t = [(1-\beta)(1-\alpha)^{\frac{\sigma}{\rho}}A_t^{\frac{\sigma}{\rho}-1}]^{\frac{1}{\sigma}} \tag{25}$$

$$\Phi_t = B_t\varphi_t^{1-\frac{1}{\sigma}} = B_t\left(\frac{C_t^d}{W_t}\right)^{1-\frac{1}{\sigma}} \tag{26}$$

By replacing Φ_t in the equation μ^* and putting it in (21), the following equation is obtained:

$$E_t\left[\beta\pi_{t+1}^{-1}\left(\frac{B_{t+1}}{B_t}\right)^{\sigma}\left(\frac{C_{t+1}^d}{C_t^d}\right)^{\sigma-1}R_{w,t+1}\right]^{\frac{\gamma}{\sigma}} = 1 \tag{27}$$

This equation will determine the optimal value of C_t^d. In order to select the optimal portfolio ω_t, Bellman equation (13) is:

$$V = \max[E_tJ_{t+1}(W_{t+1})^{\gamma}]^{\frac{1}{\gamma}};\quad \text{s.t.}\sum_{j=1}^{N}\omega_{j,t} = 1 \tag{28}$$

Where, $J_{t+1}(W_{t+1}) = \Phi_{t+1}W_{t+1} = \Phi_{t+1}\pi_{t+1}^{-1}\left(W_t - A_tC_t^d\right)(\omega_t'R_{t+1})$ is assumed to be $\omega_{1t} = 1 - \sum_{j=2}^{N}\omega_{j,t}$ for the first asset $j = 1$. By putting the budget constraint and taking the first-order condition for $\omega_{j,t}$ from (28), then we have:

$$\frac{\partial V}{\partial\omega_{j,t}} = \frac{1}{\gamma}V^{\frac{1}{\gamma}-1}\gamma E_t[(\Phi_{t+1}\pi_{t+1}^{-1}\omega_t'R_{t+1})^{\gamma-1}\Phi_{t+1}\pi_{t+1}^{-1}\left(R_{j,t+1} - R_{1,t+1}\right)] = 0,\ j \neq 1 \tag{29}$$

Now if (24) is placed in (29), then:

$$E_t\left[\left(\frac{B_{t+1}}{B_t}\right)^{\gamma}\left(\frac{C_{t+1}^d}{C_t^d}\right)^{\gamma\left(1-\frac{1}{\sigma}\right)}\pi_{t+1}^{-\frac{\gamma}{\sigma}}R_{w,t+1}^{\frac{\gamma}{\sigma}-1}(R_{j,t+1} - R_{1,t+1})\right] = 0,\quad j \neq 1 \tag{30}$$

According to (30) and (27), $R_{j,t+1} = R_{w,t+1}$ in an equilibrium condition. For each asset $j \neq 1$, (31) is thus established:

$$E_t\left[\beta^{\frac{\gamma}{\sigma}}\pi_{t+1}^{-\frac{\gamma}{\sigma}}\left(\frac{B_{t+1}}{B_t}\right)^{\gamma}\left(\frac{C_{t+1}^d}{C_t^d}\right)^{\gamma\left(1-\frac{1}{\sigma}\right)}R_{w,t+1}^{\frac{\gamma}{\sigma}-1}R_{1,t+1}\right]=1,\qquad j\neq 1 \tag{31}$$

Then (31) is formed for $j = 2, \dots, N$; therefore, the optimal investment for all assets meets the following condition:

$$E_t\left[\beta^{\frac{\gamma}{\sigma}}\pi_{t+1}^{-\frac{\gamma}{\sigma}}\left(\frac{B_{t+1}}{B_t}\right)^{\gamma}\left(\frac{C_{t+1}^d}{C_t^d}\right)^{\gamma\left(1-\frac{1}{\sigma}\right)}R_{w,t+1}^{\frac{\gamma}{\sigma}-1}R_{j,t+1}\right]=1\quad j=1,2,\dots,N \tag{32}$$

Where, $R_{w,t+1}$ is the return on the revenue from the optimal portfolio. Using Euler equation (32) and the GMM method, the preference parameters of the (32) can be estimated. Furthermore, the SDF is defined as follows according to the relevant literature and Epstein and Zin [13] experimental work:

$$SDF_{t+1}=\left[\beta\pi_{t+1}^{-1}\left(\frac{B_{t+1}}{B_t}\right)^{\sigma}\left(\frac{C_{t+1}^d}{C_t^d}\right)^{\sigma-1}\right]^{\frac{\gamma}{\sigma}}R_{w,t+1}^{\frac{\gamma}{\sigma}-1} \tag{33}$$

The SDF function has two parts: The first part is related to domestic consumption, and the second part is related to the total return of the wealth. In the traditional consumption-based asset pricing model in an open economy compared to a closed economy, the SDF function is affected by two macroeconomic factors (namely inflation rate and real exchange rate). The real exchange rate fluctuations are represented by B_t^{γ} (exchange rate multiplier). According to the traditional CCAPM model, a risk averse person faces an important economic fluctuation, i.e., consumption fluctuation. When future consumption is high due to high income or high return on assets, the final utility is low and the return on assets is not high in this case. Furthermore, when future consumption is low, final utility is high and high returns on assets are expected in this situation. This indicates that asset risk is determined by a negative relationship between returns and final utility; hence, riskier assets should yield more to motivate the investors to keep this kind of assets. This relationship is established according to the findings of a study by Campbell et al. [6], through which the asset pricing equation can be expressed. According to (33), it is assumed that the following equation is established for each risky and risk-free asset:

$$E_t\left[SDF_{t+1}R_{j,t+1}\right]=1 \tag{34}$$

$$E_t\left[R_{j,t+1}\right]E_t[SDF_{t+1}]+\mathrm{cov}\left[SDF_{t+1}R_{j,t+1}\right]=1 \tag{35}$$

Given that we have $\mathrm{cov}\left[SDF_{t+1}R_{f,t+1}\right]=0$ for each risk-free asset, (35) will be as follows:

$$E_t[SDF_{t+1}]=\frac{1}{E_t[R_{f,t+1}]} \tag{36}$$

By placing (36) in (35), the asset pricing equation is:

$$E\left(R_{j,t+1}-R_{f,t+1}\right)=-R_{f,t+1}.\mathrm{cov}\left(SDF_{t+1},R_{j,t+1}\right)=-R_{f,t+1}.\mathrm{cov}\left(f(.).MU(C_{t+1}),R_{j,t+1}\right) \tag{37}$$

Where, $MU(C_{t+1})$ is the final utility of consumption and $f(.)$ is a function of the variables in the utility function. In the proposed model, the exchange rate fluctuations affect the return on assets through the

SDF function, or B_t^{γ}. When the economy is in a favorable condition, the decline in the real exchange rate (strengthening the real value of the domestic currency) leads to a decline in B_t^{γ} and final utility, and when the economy is in an unsuitable condition and recession, an increase in the real exchange rate (undermining the real value of the domestic currency) leads to an increase in B_t^{γ} and final utility. In fact, in both conditions, the exchange rate strengthens the negative relationship between return on assets and ultimate utility, thereby increases the risk for investors. To better understand (B_t^{γ}), $\gamma < 0$ and $\sigma < \rho < 0$ are assumed to be met, accordingly the relative risk aversion coefficient should be $1-\gamma > 1$. This is consistent with the empirical findings of the literature on equity premium (Mehra and Prescott, 2003) so $\sigma < \rho < 0$ implies $EIS < ES < 1$. When these two conditions are met, it can be shown that B_t^{γ} is an incremental function of e_t that can be proved by (18) and (19):

$$\frac{d(B_t)^{\gamma}}{dA_t} = \frac{\gamma}{\sigma}\left[(1-\beta)(1-\alpha)^{\frac{\sigma}{\rho}} A_t^{\frac{\sigma}{\rho}-1}\right]^{\frac{\gamma-\sigma}{\sigma}}\left(\frac{\sigma}{p}-1\right)A_t^{\frac{\sigma}{\rho}-2} > 0 \tag{38}$$

$$\frac{dA_t}{de_t} = \left(\frac{1-\alpha}{\alpha}\right)^{\frac{1}{\rho-1}}\left(\frac{\rho}{\rho-1}\right)e_t^{\frac{1}{\rho-1}} > 0 \tag{39}$$

According to (38) and (39), B_{t+1}^{γ} is an incremental function of e_{t+1}. Given the SDF (32), if we have $(B_t)^{\sigma} = (1-\beta)(1-\alpha)^{\frac{\sigma}{\rho}-\frac{1}{\rho}} V(e_t)^{\sigma-\rho}$ and $V(e_t) = [1-\alpha+\alpha(\frac{e_t(1-\alpha)}{\alpha})^{\frac{\rho}{\rho-1}}]^{\frac{1}{\rho}}$, then:

$$SDF_t = \beta^{\frac{\gamma}{\sigma}}\left[\left(\frac{V_{(e_t)}}{V_{(e_{t-1})}}\right)\right]^{\frac{\gamma}{\sigma}(\sigma-\rho)}\left(\frac{C_t^d}{C_{t-1}^d}\right)^{\frac{\gamma}{\sigma}(\sigma-1)} \pi_t^{-\frac{\gamma}{\sigma}} R_{w,t}^{\frac{\gamma}{\sigma}-1} \tag{40}$$

By taking the logarithm from the two sides of (40) in accordance with Yogo's [41-42] investigations:

$$\lim_{\rho\to 0}\log(SDF_t) = \frac{\gamma}{\sigma}\log\beta - \alpha\gamma\Delta\log(e_t) + \frac{\gamma}{\sigma}(\sigma-1)\Delta\log(C_t^d) + \left(\frac{\gamma}{\sigma}-1\right)\log(R_{w,t}) - \frac{\gamma}{\sigma}\Delta\log(P_t) \tag{41}$$

Where, $\Delta\log(e_t) = \log(\frac{e_t}{e_{t-1}})$ ، $\Delta\log(C_t^d) = \log(\frac{C_t^d}{C_{t-1}^d})$ and $\Delta\log(P_t) = \log\left(\frac{P_t}{P_{t-1}}\right) = \log(\pi_t)$.

According to Yogo's [41] method, the SDF equation can be rewritten as follows:

$$\frac{SDF_t}{E_{t-1}[SDF_t]} \approx 1 + \log(SDF_t) - E_{t-1}[\log(SDF_t)] \tag{42}$$

By inserting (41) in (42), the SDF of the adjusted pricing model is a linear model:

$$-\frac{SDF_t}{E_{t-1}[SDF_t]} \approx k + b_1\Delta\log(e_t) + b_2\Delta\log(C_t^d) + b_3\Delta\log(P_t) + +b_4\log(R_{w,t}) \tag{43}$$

$$k = -1 - \alpha\gamma E_t[\Delta\log(e_t)] + \frac{\gamma}{\sigma}(\sigma-1)E_t[\Delta\log(C_t^d)] - \frac{\gamma}{\sigma}E_t[\Delta\log(P_t)] + \left(\frac{\gamma}{\sigma} - 1\right)E_t[(\log(R_{w,t})] \tag{44}$$

$$b_1 = \alpha\gamma, \quad b_2 = \frac{\gamma}{\sigma}(1-\sigma), \quad b_3 = \frac{\gamma}{\sigma}, \quad b_4 = 1 - \frac{\gamma}{\sigma}$$

Equation (43) can also be summarized as follows:

$$-\frac{SDF_t}{E_{t-1}[SDF_t]} \approx k + b' f_t \tag{45}$$

Where, the vector of coefficients $b = (b_1, b_2, b_3, b_4)'$ and the vector of factors are $f_t =$

$(\Delta\log(e_t), \Delta\log(C_t^d), \Delta\log(P_t).\log(R_{w,t}))'$. Considering that $E[SDF_t(R_{j,t} - R_{f,t})] = 0$ is held for each asset, then:

$$E\,[SDF_t]E[R_{j,t} - R_{f,t}] = -Cov(SDF_t\,, R_{j,t} - R_{f,t}) \tag{46}$$

$$\begin{aligned} E\,[R_{j,t} - R_{f,t}] &= Cov(-\frac{SDF_t}{E_{t-1}[SDF_t]}, R_{j,t} - R_{f,t}) = Cov(k + b'f_t, R_{j,t} - R_{f,t}) \\ &= b'Cov(f_t, R_{j,t} - R_{f,t}) \end{aligned} \tag{47}$$

Finally, the Euler equation implied by the utility function in (32) is approximately expressed based on the linear factor model for pricing the adjusted assets:

$$\begin{aligned} E\,[R_{j,t} - R_{f,t}] &= b_1 Cov(\Delta\log\,(e_t), R_{j,t} - R_{f,t}) + b_2 Cov(\Delta\log(C_t^d)\,, R_{j,t} - R_{f,t}) \\ &+ b_3 Cov(\Delta\log(P_t)\,, R_{j,t} - R_{f,t}) + b_4 Cov(\log\,(R_{w,t}), R_{j,t} - R_{f,t}) \end{aligned} \tag{48}$$

Eq. (48) represents a linear asset-pricing model that uses Fama and Macbeth's [16] two-step regression method to estimate the sensitivity coefficients and the risk premium of these variables compared to the equity premium (portfolios).

4 Data and Research Variables

The data and variables needed to estimate Euler equation and Fama and Macbeth's regression equation are obtained for April 2003 until the late March 2015 from the website and annual reports of the Central Bank, Rahavard Novin's Database, and the Organization for Economic Co-operation and Development. The statistical population of the study encompasses 47 companies which are accepted in Tehran Stock Exchange[1]. The other variables required for model estimation are as follows:

The return on each share (company), which is calculated according to the following equation:

$$R_{j,t} = \frac{(1+a_{j,t})\times P_{j,t} - P_{j,t-1} + D_{j,t} - M}{P_{j,t-1}} \tag{49}$$

$R_{j,t}$ is the stock returns of company *j*, $P_{j,t}$ is the share price of the company *j*, $a_{j,t}$ is the ratio of capital increase for the company *j*, $D_{j,t}$is the dividend of the company *j* during the period *t*, and *M* is the stock-holders' yield per share. Return on assets (portfolios): Considering the formation of Fama and French's [16] and Carhart's [7] portfolios, the companies are first divided into small (S) and big (B) companies based on the firm size (natural logarithm of market value for each share). Then they again are independently divided into two relatively low (L) and relatively high (H) groups based on the annual book value to the market value (B / M) of the share (high ratio shows the value and low ratio shows the growth of the share). In the last step, based on the momentum factor of the available share according to the yield of each share over the last six months (at the beginning of each year), they are classified into two winner (W) and loser (L) groups. After three consecutive classification of the companies, eight portfolios are formed as shown in the following table, so that each of the companies is in one of the categories in each period that are summarized in Table 1. Moreover, Table 2 presents the other variables and their calculation method.

[1] The scope of the research consists of all companies accepted in the stock market; however, only 47 companies are selected based on the following criteria to be included in this study: 1) Being accepted in stock market before 2003 and not being removed by the end of fiscal year 2014; 2) Their fiscal year ends in March; 3) They are not part of the investment and financial intermediation firms; 4) The company's book value is not negative; 5) No trading stop for more than 3 months.

Table 1: Portfolio information used in the model

Portfolio No.	Portfolio symbol	Portfolio Content
1	BHW	Big company, with a high B / M ratio and a winner
2	BLW	Big company, with a low B / M ratio and a winner
3	BLL	Big company, with a low B / M ratio and a loser
4	BHL	Big company, with a high B / M ratio and a loser
5	SHW	Small company, with a high B / M ratio and a winner
6	SLW	Small company, with a high B / M ratio and a winner
7	SHL	Small company, with high B / M ratio and a loser
8	SLL	Small company, with low B / M ratio, and a loser

Table 2: Variables used in portfolio formation and model estimation

Variables	Calculation method
$R_{j,t}$	Returns for each of the portfolios in Table 1
$R_{w,t}$	Returns on the market based on the weight index of the portfolios in Table 1
SMB_t	Size factor, average returns on small portfolios (S) minus the return on big portfolios (B) at any time SMB=1/4×(SHW-BHW)×(SHL-BHL)×(SLW-BLW)×(SLL-BLL)
HML_t	Value Factor, average returns on B / M portfolios with high B/M minus portfolios with low B / M at any time HML=1/4×(SHW-SLW)×(SHL-SLL)×(BHW-BLW)×(BHL-BLL)
WML_t	Momentum factor, the difference between the average returns of winner and loser portfolios WML=1/4×(SHW-SHL)×(SLW-SLL)×(BHW-BHL)×(BLW-BLL)
$R_{f,t}$	Risk-free returns, interest rate of bonds, which is available seasonally. The monthly risk-free returns rate can be calculated as follows: $R_{f,t} = \left[\left(1+\left(\frac{i}{4}\right)\right)^4 - 1\right] \div 12$
C_t^d	Consumption cost of short-lived consumables and domestic services per capita (million Rials) in 1997. This information is available seasonally; therefore, in order to estimate the model of this monthly series based on the Denton method with regard to seasonal aggregation, the total consumption was used as an indicator.
C_t^f	Import of consumables (million Rials) in 1997. This information is available seasonally; therefore, in order to estimate the model of this monthly series based on the Denton method with regard to seasonal aggregation, the total import was used as an indicator.
$Growth_t$	The growth of domestic consumption, i.e. the growth of domestic private consumption plus the imports of consumables.
$Cpio_t$	Europe's consumer price index of Organization for Economic Co-operation and Development (EIC) in 1997
$Cpii_t$	Iran's consumer price index in 1997
e_t^n	Nominal market exchange rate
e_t	Real exchange rate$e_t = \frac{Cpio_t}{Cpii_t} \times e_t^n$
π_t	$\frac{Cpii_t}{Cpii_{t-1}}$ is used as inflation index.

Source: Research calculations from statistical resources

5 Estimation of Models

5.1 Estimation of Euler Equations by GMM Method

In this section, the generalized momentum method is used to estimate the parameters of (32). The GMM method, an extended form of the momentum technique, is extended beyond linear regression. Regarding this method, the unknown parameters must be estimated by matching the momentums of the population (which are functions of the unknown parameters) and the appropriate sample momentums. The advantage of this method in comparison to the previous methods is that it can estimate the model parameters without any assumptions about the distribution of the variables. In addition, since this method uses the instrumental variables, it inhibits the correlation between the variables and the model error term. This method also allows the serial correlation in the error terms. In this study, according to the studies by Cohen et al. [5] and Yogo [41], the variables SMB_t ،HML_t ،WML_t ،$Growth_{t-1}$ and e^n_{t-1} are considered as instrumental variables. Although the GMM method does not require a lot of assumptions regarding the research data, the stability of the variables is of particular importance. Hence the unit root test is first run for the concerned variables, as shown in Table 3. According to Augmented Dickey-Fuller (ADF) and Phillips–Perron (PP) tests, the H0 assumption indicating the existence of a unit root is rejected, and it can be concluded that all variables are static.

Table 3: Stability analysis of model variables

Variable	**Symbol**	**Status**	**ADF**	**Phillips–Perron Test**
The ratio of domestic consumption per period to the consumption ratio of the previous period	$\frac{C^d_t}{C^d_t - 1}$	*y-intercept* and Trend	-11.8	-11.8
Inflation index	π	*y-intercept*	-7.3	-7.5
Return on asset #1	R_1	and Trend	-9.7	-9.5
Return on Asset # 2	R_2	*y-intercept*	-8.4	-8.5
Return on Asset # 3	R_3	and Trend	-8.8	-8.9
Return on Asset # 4	R_4	*y-intercept*	-9.6	-9.6
Return on Asset # 5	R_5	and Trend	-9.1	-9.3
Return on Asset #6	R_6	*y-intercept*	-8.6	-8.5
Return on Asset #7	R_7	and Trend	9.7	-9.5
Return on Asset # 8	R_8	*y-intercept*	11.4	11.4
Return on risk-free assets	R_f	and Trend	-9.7	-6.3
Market yield	R_w	*y-intercept*	-7.9	-7.9
Size factor	SMB	and Trend	-9.1	-8.8
Value factor	HML	*y-intercept*	-10.2	-10.3
Momentum factor	WML	and Trend	-10.7	-10.7
domestic consumption growth	Growth	*y-intercept*	-8.6	-8.7

Source: Research calculations. The critical values of McKinon's Table at 1%, 5%, and 10% are -3.65, -2.59, and -2.61, respectively.

Euler's equations for the adjusted CCAPM model (Eq. 32) are estimated using the GMM method and MATLAB2013a software, as presented in Table 4. In addition to the estimated numerical values for the parameters, the final row of the Table shows Hansen's [18] statistics or *J*, which is proposed for extra constraints to measure the adjacency to zero for the sample momentum conditions as follows:

$$nJ_n(\Theta_{GMM}) \rightarrow {\chi^2}_{r-1} \tag{50}$$

Where, Θ_{GMM} minimizes the target function. Under the zero hypothesis E [h (xt; ΘGMM, Zt)] = 0, the test statistic has Chi-square distribution with *r-1* degrees of freedom [25]. According to the estimation results of (32) in Table 4, all the parameters are meaningful. In other words, the explanatory variables of the model, including consumption expenditure, real exchange rate, market efficiency, and inflation index, have a significant effect on the return on assets. To check the validity of the instrument matrix, as can be seen, the zero hypothesis of the test *J* indicating the lack of correlation among the instruments at 95% cannot be rejected; therefore, it can be concluded that the instruments are valid. The parameter

β is equal to 0.539 within $0 < \beta < 1$, the larger value of this parameter indicates the individuals' patience and preferences for future consumption (they do not show much preference for current consumption compared to future consumption in their consumption behavior).

Table 4: Estimation Results of GMM

Variable	Symbol	Value	SD	Student's t-test
Subjective time discount	β	0.539	0.122	4.39
Subjective preferences between two commodities	α	0.076	0.019	3.84
Elasticity of substitution	ρ	-0.05	0.028	-1.76
Risk aversion	γ	-0.127	0.067	-1.89
Elasticity of intertemporal substitution	σ	-0.206	0.101	-2.03
$\mathrm{J-statitics} = 9.89$				

Source: Research findings; All variables are significant at 95% confidence level.

This parameter α is 0.076 within $0 < \alpha < 1$, the smaller value of this parameter indicates that investors' greater preference for domestic commodities compared to the foreign ones. The parameter ρ used to determine the ES is -0.05 within $-\infty < \rho < 1$, according to the theory $\mathrm{ES} = \frac{1}{1-\rho} \in [0, +\infty)$, the elasticity of substitution is equal to 0.95; hence, the substitution effect between the domestic consumable and the import of the consumable is low. A decrease in the real exchange rate (strengthening the real value of the domestic currency) reduces B_t^{γ} and final utility. When and when the economy is in an unsuitable condition and recession, the results are quite reversed. In fact, in both conditions, the exchange rate strengthens the negative relationship between return on assets and ultimate utility, thereby increasing the risk for investors. Considering (16), when the real exchange rate is reduced, the value of the domestic consumable to the total consumption enhances, which results from the substitution effect between the imported and domestic consumables.

Hence the effect of the increased value of the domestic commodity (income) dominates the effect of decrease (substitution) and leads to an increase in total expenditures. The parameter γ is risk averse, and the higher the degree of risk aversion is, the greater the decrease in γ is. The results estimate the value of γ to be -0.127; thus, the risk aversion coefficient is $1- \gamma = 1.127$, indicating a person's relatively high risk aversion. The parameter σ is -0.206, determining the elasticity of intertemporal substitution (EIS); hence, the $\mathrm{EIS} = \frac{1}{1-\sigma}$ is 0.83, indicating that individuals, in addition to setting their own consumption plans, participate in the asset market, and if the conditions are favorable in the markets, they tend to transfer a part of their consumption to the next periods and invest in assets. In sum, the results of the research reveal that $\gamma < 0$ and $\sigma < \rho < 0$ imply $\mathrm{EIS} < ES < 1$, which is consistent with empirical findings in the literature on equity premium [17].

5.2 Estimation of Pricing Equations using Fama and Macbeth's Regression Method

In order to estimate the linear model of asset pricing (48), Fama and Macbeth's [16] two-step regression method is used.

$$r_{j,t} = \alpha_j + \sum_k \beta_{jk} f_{kt} + \varepsilon_{j,t} \tag{51}$$

$$E[r_{j,t}] = \lambda_0 + \sum_k \beta_{j,k} \lambda_k + \varepsilon_{j,t} \tag{52}$$

In this method, the parameters are estimated in two steps: In the first step (51), the returns of each portfolio are fitted on the risk factors to determine its value for the concerned risk factor. In the second step, to calculate the risk premium of each factor in each period, the equity premium is fitted on the coefficients estimated in the previous step. By averaging the y-intercepts and the coefficients of each factor, the overall result is an average of the model estimation results for each portfolio. Regarding (52), (48) can be expressed as the equation of return on assets with the asset sensitivity coefficient (beta):

$$\mathrm{E}\left[R_{j,t} - R_{f,t}\right] = \beta'_j \lambda \tag{53}$$

$\beta_{j,k} = \frac{\mathrm{cov}(f_{k,t}, R_{j,t} - R_{f,t})}{\mathrm{var}(f_{k,t})}$ stands for the beta risk of the asset *j* to the factor *K*, and $\lambda_k = b_k \,\mathrm{var}\left(f_{k,t}\right)$ also indicates the risk or cost premium of the factor *K*. In equilibrium, the difference in the expected returns of assets is explained by the difference in the asset risk, which is expressed by the exchange rate beta and other factors. The estimation results of (53) are produced by Eviews software version 9 and presented in Table 5.

Table 5: Estimation results of Fama and Macbeth's two-step regression

Variable	Symbol	Coefficient	SD	Student's t-test	Probability
Risk premium of exchange rate	λ_1	0.81	0.166	4.901	*0.016
Risk premium of domestic consumption growth	λ_2	0.53	0.365	1.458	0.240
Risk premium of inflation rate	λ_3	0.25	0.078	3.238	*0.047
Risk premium of market return	λ_4	0.65	0.142	4.608	*0.019
The coefficient of determination (R^2)=0.907					
** (probability = 0.0724) Total significance of regression (F)= 7.34					

Source: Research findings, * significance level of 5% and ** significance level of 10%

The model estimation results show that the risk premium coefficient of exchange rate is 0.81, that is, there is a positive and significant relationship between the risk premium coefficient of exchange rate and stock returns. In (46) and (48) for assets with a high exchange rate beta, $\frac{\mathrm{Cov}(-\Delta\log(e_t), R_{j,t} - R_{f,t})}{\mathrm{var}(-\Delta\log(e_t))}$, when $b_1 > 0$, there must be higher returns since $b_1 = -\alpha\gamma$. When $\gamma < 0$, the risk premium of exchange rate $\lambda_1 = -\alpha\gamma\mathrm{var}\left(-\Delta\log(e_t)\right)$ is positive. During the boom period or when the real exchange rate falls $(-\Delta\log(e_t) > 0)$, the return on assets and the exchange rate beta are high, and when the economy is in a bad condition and a recession, the return on assets is low.

The risk premium of inflation is 0.25. Despite the unexpected inflation, stock returns are under the influence of the inflation fluctuation risk, and shareholders and creditors request more return premium to accept their lower purchasing power [36]. The risk premium of market efficiency is 0.65, which indicates a positive relationship between market premium and return premium on assets. That is, with increasing market risk, investors need greater returns on each share to invest in. The risk premium of consumption growth is positive but not statistically significant. Moreover, the coefficient of determination (R^2) is high and the f-value shows the high explanatory power of independent variables for the return premium on assets.

6 Conclusions and Suggestions

In recent years, economists have introduced new models in the field of financial economics and asset pricing, one of which is CCAPM. This model, though, failed and raised critiques in many studies. The

main reasons for the failure of this model are disregarding the other variables, besides consumption, affecting the return on assets, including exchange rate, inflation, and market portfolios. By expanding a CCAPM model within the framework of an open economy and entrance of imported consumer goods and solving the equilibrium model, we aim to evaluate the effect of change in the evaluation of some of the fundamental variables in the macroeconomics, including exchange rate, inflammation rate, and rate of consumption on return on assets for monthly data of the stock exchange of Iran during 2003-2014 using the GMM model and Fama and Macbeth's two-stage regression method. Estimation results for the dynamic GMM model show that the parameters of subjective time discount (β), subjective preferences between two commodities (α), elasticity of substitution between two domestic consumer goods and consumer imports (ρ), risk aversion (γ), and elasticity of intertemporal substitution (σ) are significant, and asset returns in the Iranian stock market have shown sensitivity to these parameters. In addition, the values of these parameters demonstrate that since economic factors are relatively risk-averse and tolerant, they have little preference for current consumption than their future consumption. The elasticity of substation between domestic consumption expenditure and consumption expenditure of imported goods is relatively low, and the factors has a greater desire to consume domestic goods.
According to the estimation results of Fama and Macbeth's regression method, exchange rate risk premium, inflation risk premium, market efficiency premium, and consumption growth on return of domestic goods premium are significant considering the critical values of all variables in the model, with the exception of the growth on return of domestic goods premium, and positively affect the asset returns premium in the stock exchange of Iran. In other words, each economic factor demands a higher return, compared to the previous one, in order to tolerate the higher risk of determinants (exchange rate risk, inflation risk, and market risk) of asset return. Accordingly, it is suggested that, given the importance of explaining the relationship between risk and return, asset pricing models are more considered in the economy of the country and attempts should be made to achieve a suitable model in this regard.
Moreover, the investors, investment companies, capital market analysts, and other financial market users are also recommended to pay particular attention to macroeconomic variables such as consumption expenditures, imports, exchange rates, and inflation in order to investigate the factors affecting stock returns. Regarding the variables considered in this study, it is suggested to consider consumption expenditures of durable commodities instead of consumption expenditures of short-lived consumables and services and to import capital and intermediary commodities instead of consumables in order to compare the results with the coefficients of determination for the variables included in this research. Politicians are also recommended to maintain macroeconomic variables stable in order to improve the performance of the stock market, so that investors (especially foreign investors) are attracted to invest in a market with a stable exchange rate system.

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