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The effect of systematic exchange rate risk on asset returns by using consumption-based asset pricing (Case study: Companies admitted to the Tehran Stock Exchange)

Javad Dadashi[a], Seyed Ali Nabavi Chashmi[b,*], Erfan Memarian[c]

[a] *Department of Financial Engineering, Babol Branch, Islamic Azad University, Babol, Iran*
[b] *Department of Financial Management, Babol Branch, Islamic Azad University, Babol, Iran*
[c] *Department of Economic, Babol Branch, Islamic Azad University, Babol, Iran*

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Abstract

Along with the increase in trade between countries, exchange rate changes are considered as one of the most important risk factors in the financial markets, so these changes affect macroeconomic variables such as the price of imported goods and services, the price of domestically produced goods, and the yield of companies' shares. The purpose of this research is to investigate the relationship between exchange rate changes and asset returns in the framework of a theoretical and empirical model of the consumption-based capital asset pricing model (CCAPM), for this purpose, through the development of a basic CCAPM model with the help of Epstein and Zin's return utility function and entering Imported consumer goods in it, this relationship is examined. The research sample included 69 companies in Tehran Stock Exchange and monthly data from 1390 to 1398. Linear asset pricing model using Fama and Macbeth's two-stage regression method, the effects of exchange rate risk on asset returns were investigated. The estimation results of the two-stage regression model or the linear asset pricing model indicate that the beta coefficient of the exchange rate (exchange rate risk adjustment, λ_1) is equal to 0.81, that is, there is a positive and significant relationship between the exchange rate risk adjustment and the asset return adjustment.

Keywords: systematic risk, exchange rate, return on assets, asset pricing model based on consumption
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1 Introduction

One of the characteristics of the common movement towards sustainable economic growth is obtaining the necessary financial resources for a set of economic activities by equipping the savings resources available in the national economy so that; During the last three to four decades, the expansion of money and capital markets in developing countries has brought favorable economic growth [16]. The stock exchange is one of the most important financial markets, which is an indicator of the economy of any country. The recession and prosperity of the stock exchange affects not only the

*Corresponding author
Email addresses: j.dadashiacbabol@yahoo.com (Javad Dadashi), anabavichashmi2003@gmail.com (Seyed Ali Nabavi Chashmi), er-memarian@yahoo.com (Erfan Memarian)

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national economy but also the regional and global economy, on the one hand, this market is the place to collect savings and liquidity of the private sector in order to finance investment projects [7] and on the other hand, it is an official authority. And it is certain that the holders of stagnant savings can look for a relatively suitable and safe investment place and use their funds to invest in companies. Obviously, the boom and bust of the stock market can be caused by many factors in the economy. If this market does not have a logical relationship with other sectors, there will be problems and shortcomings in their performance [4], so that developed countries owe a large part of their development course to financial markets and especially the stock exchange [1].

Today, the openness of a country's economy is known as a cause of fluctuations in the country's stock market. In addition, with the advent of globalization, developing economies are becoming more integrated with developed economies through the results of the increasing flow of exports and imports, so that the securities market and the currency market are considered as sensitive parts of the financial market [2]. These two markets are quickly affected by fluctuations and business cycles in the economy and reflect economic changes quickly. At the same time, turmoil in one or both markets leads to concern among market policymakers, therefore, the dynamic interactions between these two markets have encouraged researchers, policymakers, and analysts to conduct accurate and detailed analyzes [8].

In recent years, the liberalization of financial markets has exposed companies to various risks, including exchange rate risk. The increase in global trade has caused the exchange rate to be considered as one of the most important factors determining the profitability of companies and their stock prices [3] so that the international economic environment has witnessed significant fluctuations in the currency exchange rate between countries and this issue has also affected companies. This has led financial managers and academic researchers to research the effects of exchange rates on the value and characteristics of the company, price and stock returns [9]. Most of these researches have been conducted mainly in the financial markets of developed countries and rarely in the Asian markets, especially Iran, and on the other hand, with the beginning of the American financial crisis in August 2007, the parity rate of the US dollar with the Iranian Rial has increased, as in many countries, and also with the change in political conditions. And Iran's economy has created new conditions in Iran's financial markets in recent years. A series of factors of the repetition of financial crises in emerging and developing markets led to the identification of the exchange rate regime as a key element in the macroeconomic and financial framework of the country, in addition, due to a number of economic fluctuations, the decision-making regime and the devaluation of the domestic currency in the direction of Restoring the balance played a key role. In general, the interaction between the exchange rate market and the securities market has led us to answer this question between the exporting and importing companies accepted in the largest financial market of Iran "Tehran Stock Exchange": Is there a relationship between the exchange rate change and the returns of the companies' shares? Is there a candidate accepted in the Tehran Stock Exchange?

2 Research method and specification of the model

Due to the fact that this research uses past information to test hypotheses, it is a type of post-event research. In terms of theory, the research is of the affirmative research type and in terms of reasoning, it is of the inductive type. On the other hand, this research is a quasi-experimental research in the field of financial and accounting research. In recent years, many studies have been conducted on the CCAPM model as a main model to explain the behavior of the stock market. In most of the relevant studies, the traditional CCAPM model does not have enough power to explain the market behavior, and this model has failed in practice, so that this linear model causes Creating a puzzle is spent on stocks. In this way, to explain the greatness of the stock market (the excess return of an asset compared to the return of a risk-free asset) requires a very high risk aversion. While in the traditional CCAPM, the risk aversion parameter does not get a large number. This puzzle was first presented by [15, 16]. After presenting riddles such as the stock exchange, adjustments were made in the CCAPM model, among which studies such as [5, 11, 17] can be mentioned. According to Xiao et al. [17], one of the main reasons for the failure of the standard CCAPM is that it generally ignores other variables, including macroeconomic variables that can affect the final utility of consumption, because the risk aversion is also reflected in the macroeconomic variables. In this regard, the research model will be specified through the development of a CCAPM model by Epstein and Zin [11] and the use of Yugo's model.

To understand the concept of asset pricing based on consumption, the issue of optimizing individual consumption should be considered; In each period, a person chooses a level of consumption and also in each period he will have a different portfolio allocation of different assets. In the basic CCAPM model, the autocovariance of returns with cumulative consumption growth is introduced as a measure of systematic risk.

In this research, through the development of a traditional CCAPM model in the framework of an open economy in the financial market of the developing (emerging) country of Iran, we will examine the effect of the exchange rate on asset returns. An open economy is considered with an agent who receives utility from the consumption of domestic goods and foreign goods, in each time period the agent buys C_t^d units of the domestic good and C_t^f units of the foreign good. P_t indicates the price of domestic goods based on the domestic currency of the country and P_t^* the price of foreign goods based on the currency of the foreign country. e^n represents the nominal exchange rate that equals the value of the domestic currency to the value of the foreign currency; Therefore, the price of foreign goods in domestic currency will be equal to $P_t^* e_t^n$. On the other hand, in the financial markets of developing (emerging) countries, we face many restrictions, one of these important restrictions is access to foreign currency, so in this research, it is assumed that domestic consumers are able to consume domestic and foreign goods, but they can only invest in domestic markets.

It is assumed that there are N assets with gross return $R_t = (R_{1t}, R_{2t}, ..., R_{Nt})'$ in the economy, $\omega_{j,t}$ represents the ratio of investment of the economic agent in asset j and period t, and ω_t represents the weight vector of the portfolios , then:

$$\sum_{j=1}^{N} \omega_{j,t} = 1 \qquad t = 1, 2, ..., T \tag{2.1}$$

The wealth that the individual has at time t is equal to S_t and the budget constraint that the individual faces is equal to:

$$S_{t+1} = (S_t - P_t^* e_t^n C_t^f - P_t C_t^d)\omega_t' R_{t+1} \tag{2.2}$$

By dividing both sides of equation (2.2) by P_t, $W_t = S_t/P_t$ will represent wealth in the domestic price, then the budget limit will change as follows:

$$\pi_{t+1} W_{t+1} = (W_t - e_t C_t^f - C_t^d)\omega_t' R_{t+1} \tag{2.3}$$

where the real exchange rate is equal to $e_t = P_t^* e_t^n / P_t$ and the change in domestic prices is equal to $\pi_{t+1} = P_{t+1}/P_t$ which can be defined as the inflation rate. In addition, it is assumed that in each time period t, through the consumption of domestic and foreign goods, the individual has an interperiod utility with constant elasticity of substitution (CES) as follows:

$$U(C^f, C^d) = [(1-\alpha)(C^d)^\rho + \alpha(C^f)^\rho]^{\frac{1}{\rho}} \tag{2.4}$$

where $\alpha \in (0, 1)$ represents subjective preferences between two goods, $\rho \in (-\infty, 1)$ is used to determine elasticity of substitution (ES) between two goods, so that $ES = \frac{1}{1-\rho} \in [0, +\infty)$. When $\rho < 0$, then $0 < ES < 1$, that is, the substitution effect between domestic and foreign goods will be small, and when $0 < \rho < 1$, $ES > 1$, it means that the substitution effect between domestic and foreign goods will be significant and large. Was. We will use the preferences proposed by [10] to model the behavior of the economic agent, assuming that the utility function of the agent's life cycle has the following recursive form:

$$U(C_t^d, C_t^f) = \{(1-\beta)[(1-\alpha)(C_t^d)^\rho + \alpha(C_t^f)^\rho]\frac{\sigma}{\rho} + \beta[E_t(J_{t+1}(W_{t+1})^\gamma)]^{\frac{\sigma}{\gamma}}\}\frac{1}{\sigma} \tag{2.5}$$

where $\beta \in (0, 1)$; subjective discount factor, $\gamma \in (-\infty, 1)$; It represents the risk aversion parameter when γ decreases, the degree of risk aversion will increase, also the relative risk aversion parameter is equal to $(\gamma - 1)$. $\sigma \in (-\infty, 1)$ determines the elasticity of interperiod substitution (EIS), which is: $EIS = \frac{1}{1-\sigma}$. J_{t+1} is equal to the value function of the Bellman equation. E_t is the expectation operator conditional on the available information at time t.

The advantages of using the above utility function (2.5) is that first, the return utility function of Epstein and Zin can be followed, and the utility function with constant elasticity of substitution (CES) allows us to separate the risk aversion parameter and the inter-period substitution elasticity parameter from each other. Second, we can obtain the effect of substitution between two domestic and foreign goods. Third, a person not only chooses his consumption during different times, but he can also choose the amount of consumption of domestic and foreign goods.

Now the problem of optimizing the life cycle of the agent using the return utility function and the budget constraint will be as follows:

$$\begin{aligned} J_t(W_t) = \max\{(1-\beta)[(1-\alpha)(C_t^d)^\rho + \alpha(C_t^f)^\rho]^{\frac{\sigma}{\rho}} + \beta[E_t(J_{t+1}(W_{t+1})^\gamma)]^{\frac{\sigma}{\gamma}}\}\frac{1}{\sigma} \\ s.t\ \pi_{t+1} W_{t+1} = (W_t - e_t C_t^f - C_t^d)\omega_t' R_{t+1} \\ s.t\ \sum_{j=1}^{N} \omega_{j,t} = 1 \qquad t = 1, 2, ..., T \end{aligned} \tag{2.6}$$

Assuming that $J_t(W_t) = \Phi_t W_t$, by maximizing the utility and the first order condition from equation (2.5) with respect to C_t^d and C_t^f, the following relationships will be obtained:

$$\frac{\partial U}{\partial C_t^d} = 0;\ (1-\beta)\frac{\sigma}{\rho}\left[(1-\alpha)\rho(C_t^d)^{\rho-1}\right]\left[(1-\alpha)(C_t^d)^{\rho}+\alpha(C_t^f)^{\rho}\right]^{\frac{\sigma}{\rho}-1} = \sigma\beta(W_t - e_tC_t^f - C_t^d)^{\sigma-1}E_t\left[\Phi_{t+1}^{\gamma}R_{W,t+1}^{\gamma}\right]^{\frac{\sigma}{\gamma}} \tag{2.7}$$

$$\frac{\partial U}{\partial C_t^f} = 0;\ (1-\beta)\frac{\sigma}{\rho}\left[\alpha\rho(C_t^f)^{\rho-1}\right]\left[(1-\alpha)(C_t^d)^{\rho}+\alpha(C_t^f)^{\rho}\right]^{\frac{\sigma}{\rho}-1} = \sigma\beta(W_t - e_tC_t^f - C_t^d)^{\sigma-1}E_t\left[\Phi_{t+1}^{\gamma}R_{W,t+1}^{\gamma}\right]^{\frac{\sigma}{\gamma}}e_t \tag{2.8}$$

where $\omega_t' R_{t+1}$ is the optimal portfolio yield and represents the total wealth yield. In other words, $R_{W,t+1} = R_{W,t+1}$, according to equation (2.7) and (2.8), the ratio of two goods can be obtained as follows:

$$\frac{C_t^f}{C_t^d} = \left[\frac{e_t(1-\alpha)}{\alpha}\right]^{\frac{1}{\rho-1}},\ \rho \in (-\infty, 1) \tag{2.9}$$

This equation shows that when the real exchange rate decreases, the consumption rate of foreign goods will increase compared to the consumption rate of domestic goods, in other words, e_t measures the relative price of domestic and foreign goods, as e_t decreases, foreign goods become cheaper than domestic goods. And the demand for foreign goods will increase compared to domestic goods.

In each time period t, the total value of the individual's domestic and imported consumer goods will be equal to $e_tC_t^f + C_t^d$, the relationship between C_t^d and C_t^f f is shown in equation (2.9), so the total consumption value is equal to:

$$e_tC_t^f + C_t^d = e_t\left[\frac{e_t(1-\alpha)}{\alpha}\right]^{\frac{1}{\rho-1}}C_t^d + C_t^d = C_t^d\left[1+e_t^{\frac{\rho}{\rho-1}}\left(\frac{1-\alpha}{\alpha}\right)^{\frac{1}{\rho-1}}\right] \tag{2.10}$$

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

$$e_tC_t^f + C_t^d = A_tC_t^d \tag{2.11}$$

Therefore, $1/A_t$ measures the ratio of domestic goods expenses to total expenses, equation (2.10) is how the real exchange rate and the subjective parameter α and ρ affect the consumption rate of two domestic and foreign goods. $1/A_t$ is a decreasing function of α, a small α will indicate a larger ratio of domestic goods consumption expenses to total expenses, in other words, α indicates the subjective preferences of imported consumer goods compared to domestic consumer goods. When $\rho < 0$ ($ES < 1$), $1/A_t$ is a decreasing function of e_t, when e_t decreases, the expenditure of domestic goods will be higher than the total expenditure. According to equation (2.9), it can be shown that when e_t decreases as a result of substitution between two consumer goods, the consumption of foreign goods will increase compared to the total consumption (substitution effect), on the other hand, the elasticity of substitution is low ($ES < 1$) between two The goods means that the person has less desire to substitute these two goods, so the relative value of domestic goods expenditure increases as e_t decreases. Therefore, the effect of increasing the value of domestic goods (income) will prevail over its decreasing substitution (substitution) and will lead to an increase in total expenses. On the other hand, when ($ES > 1$) $0 < \rho < 1$, the elasticity of substitution between two goods will be high, $1/A_t$ will be an increasing function of e_t, in other words, when e_t decreases, the domestic good will become more valuable than before, but the effect The effect of substitution prevails and the individual replaces two goods and the expenditure of domestic goods will have a lower relative value than the total expenditure.

Now, if we put equation (2.11) and (2.9) in the utility function of CES, then the utility function resulting from domestic goods and foreign goods can be obtained as a function of A_t:

$$U(C_t^d, C_t^f) = \left[(1-\alpha)(C_t^d)^{\rho}+\alpha(C_t^f)^{\rho}\right]^{\frac{1}{\rho}} = C_t^d\left[(1-\alpha)A_t\right]^{\frac{1}{\rho}} \tag{2.12}$$

According to the utility maximization problem in equation (2.20) and according to the assumption we have about Φ_t:

$$J_{t+1}^{\gamma}(.) = (\Phi_{t+1}W_{t+1})^{\gamma} = \Phi_{t+1}^{\gamma}\pi_{t+1}^{-\gamma}(W_t - A_tC_t^d)^{\gamma}(\omega_t' R_{t+1})^{\gamma} \tag{2.13}$$

By placing equation (2.12) and (2.13) in the utility maximization problem (2.6) and taking the first order condition of the equation with respect to C_t^d, we have:

$$\sigma(1-\beta)\left[(1-\alpha)A_t\right]^{\frac{\sigma}{\rho}}(C_t^d)^{\sigma-1} = \sigma\beta[W_t - A_tC_t^d]^{\sigma-1}A_t(\mu^*)^{\sigma} \tag{2.14}$$

where $\mu^* = \left(E_t\left[\Phi_{t+1}^{\gamma}\pi_{t+1}^{-\gamma}R_{W,t+1}^{\gamma}\right]\right)^{\frac{1}{\gamma}}$. It is assumed that $C_t^d = \varphi_t W_t$ which is the optimal consumption amount of domestic goods and is a proportion of the total wealth. It follows from equation (2.28) that:

$$(\mu^*)^{\sigma} = \frac{\sigma(1-\beta)\left[(1-\alpha)A_t\right]^{\frac{\sigma}{\rho}}\varphi_t^{\sigma-1}}{\beta[1-\varphi_t A_t]^{\sigma-1}A_t} \tag{2.15}$$

Now, by placing equation (2.14) in equation (2.6) and arranging it, the following relationship will be established:

$$\Phi_t = \left[(1-\beta)(1-\alpha)^{\frac{\sigma}{\rho}}A_t^{\frac{\sigma}{\rho}-1}\right]^{\frac{1}{\sigma}}\varphi_t^{1-\frac{1}{\sigma}} \tag{2.16}$$

It is now assumed that:

$$B_t = \left[(1-\beta)(1-\alpha)^{\frac{\sigma}{\rho}}A_t^{\frac{\sigma}{\rho}-1}\right]^{\frac{1}{\sigma}} \tag{2.17}$$

Therefore, equation (2.17) will be reduced to the following equation:

$$\Phi_t = B_t\varphi_t^{1-\frac{1}{\sigma}} = B_t\left(\frac{C_t^d}{W_t}\right)^{1-\frac{1}{\sigma}} \tag{2.18}$$

Now replace Φ_t in the μ^* equation and put it in the equation (2.14) and sort it:

$$E_t\left[\beta\pi_{t+1}^{-1}\left(\frac{B_{t+1}}{B_t}\right)^{\sigma}\left(\frac{C_{t+1}^d}{C_t^d}\right)^{\sigma-1}R_{W,t+1}\right]^{\frac{\gamma}{\sigma}} = 1 \tag{2.19}$$

This equation will determine the optimal value of C_t^d. Above we proved that by using the first order derivative of equation (2.5) with respect to C_t^d, equation (2.19) was established and the optimal amount of consumption was determined, now we can show that for choosing the optimal portfolio ω_t the Bellman equation (equation (2.6)) is It will be as follows:

$$V = \max\left[E_t J_{t+1}(W_{t+1})^{\gamma}\right]^{\frac{1}{\gamma}}; \; s.t. \; \sum_{j=1}^{N}\omega_{j,t} = 1 \tag{2.20}$$

where $J_{t+1}(W_{t+1}) = \Phi_{t+1}W_{t+1} = \Phi_{t+1}\pi_{t+1}^{-1}(W_t - A_tC_t^d)(\omega_t' R_{t+1})$. It is assumed that $\omega_{1,t} = 1 - \sum_{j=2}^{N}\omega_{j,t}$ holds for the first asset $j = 1$, by placing in the budget constraint and taking the first order condition with respect to $\omega_{j,t}$ from equation (2.20):

$$\frac{\partial V}{\partial \omega_{j,t}} = \frac{1}{\gamma}V^{\frac{1}{\gamma}-1}\gamma E_t\left[\left(\Phi_{t+1}\pi_{t+1}^{-1}\omega_t' R_{t+1}\right)^{\gamma-1}\Phi_{t+1}\pi_{t+1}^{-1}(R_{j,t+1}-R_{1,t+1}\right] = 0, \; j \neq 1 \tag{2.21}$$

Now if equation (2.17) is put in equation (2.21):

$$E_t\left[\left(\frac{B_{t+1}}{B_t}\right)^{\gamma}\left(\frac{C_{t+1}^d}{C_t^d}\right)^{\gamma\left(1-\frac{1}{\sigma}\right)}\pi_{t+1}^{-\frac{\gamma}{\sigma}}R_{W,t+1}^{\frac{\gamma}{\sigma}-1}(R_{j,t+1}-R_{1,t+1})\right] = 0, \; j \neq 1 \tag{2.22}$$

According to equation (2.13) and equation (2.19), in an equilibrium situation, $R_{j,t+1} = R_{W,t+1}$ will be, therefore, for each asset $j \neq 1$, the following condition will be fulfilled:

$$E_t\left[\beta^{\frac{\gamma}{\sigma}}\pi_{t+1}^{-\frac{\gamma}{\sigma}}\left(\frac{B_{t+1}}{B_t}\right)^{\gamma}\left(\frac{C_{t+1}^d}{C_t^d}\right)^{\gamma\left(1-\frac{1}{\sigma}\right)}R_{W,t+1}^{\frac{\gamma}{\sigma}-1}R_{1,t+1}\right] = 1, \; j \neq 1 \tag{2.23}$$

Therefore, when $j = 2, ..., N$, we will have the above results, so the optimal investment for all assets will establish the following condition:

$$E_t\left[\beta^{\frac{\gamma}{\sigma}}\pi_{t+1}^{-\frac{\gamma}{\sigma}}\left(\frac{B_{t+1}}{B_t}\right)^{\gamma}\left(\frac{C_{t+1}^d}{C_t^d}\right)^{\gamma\left(1-\frac{1}{\sigma}\right)}R_{W,t+1}^{\frac{\gamma}{\sigma}-1}R_{j,t+1}\right] = 1, \; j = 1, 2, ..., N \tag{2.24}$$

where $R_{W,t+1}$ is the return of the total wealth resulting from the optimal portfolio. Equation (2.39) expresses the moment conditions (Euler's equations) which can be estimated using the generalized moments method (GMM).

Now, the final inter-period substitution rate or pricing kernel or random discount factor is defined as follows according to the literature in this field and the empirical work of [10]:

$$SDF_{t+1} = \left[\beta \pi_{t+1}^{-1} \left(\frac{B_{t+1}}{B_t} \right)^{\sigma} \left(\frac{C_{t+1}^d}{C_t^d} \right)^{\sigma-1} \right]^{\frac{\gamma}{\sigma}} R_{W,t+1}^{\frac{\gamma}{\sigma}-1} \tag{2.25}$$

Using the SDF function, we can determine the price of securities, this function in an open economy model has two parts, the first part is related to domestic consumption and the second part is related to the yield of total wealth. In comparing a traditional consumption-based asset pricing model in an open economy model compared to a closed economy, the SDF function will also be affected by two macroeconomic factors, inflation rate and real exchange rate. Changes in the real exchange rate are represented by B_t^{γ}, so it can be called the increasing coefficient of the exchange rate. As stated, in pricing models based on consumption, the risk-averse person is faced with an important economic fluctuation, i.e. consumption fluctuation. In an economic situation, when the future consumption is at a high level due to the high income of the labor force or the yield of the assets, the marginal utility is at a low level, and the return of the assets in this case will not have a high value, and when the future consumption is low, the marginal utility is at a high level. And the high yield of assets will be expected in this situation, which indicates that the risk of assets will be determined by the negative relationship between yield and ultimate utility, therefore, for riskier assets, they should have higher yield in order to motivate investors to keep such assets.

Also, for any risk-free asset, $cov[SDF_{t+1}R_{f,t+1}] = 0$, so equation (2.25) will be transformed into the following form:

$$E_t[SDF_{t+1}] = \frac{1}{E_t[R_{f,t+1}]} \tag{2.26}$$

By putting this equation in equation (2.25), the following asset pricing equation will be obtained:

$$E(R_{j,t+1} - R_{f,t+1}) = -R_{f,t+1}.cov(SDF_{t+1}, R_{j,t+1}) = -R_{f,t+1}.cov(f(.).MU(C_{t+1}), R_{j,t+1}) \tag{2.27}$$

where $R_{f,t+1}$ is the risk-free asset return, $MU(C_{t+1})$ is the final utility of consumption and $f(.)$ is a function of the variables in the utility function.

In the introduced open economy model, exchange rate changes will have an effect on asset returns through the SDF function, or in other words, through B_t^{γ}. When the economy is in a good and prosperous state, a decrease in the real exchange rate (strengthening the real value of the domestic currency) will lead to a decrease in B_t^{γ} and a decrease in marginal utility, and when the economy is in an unfavorable state and stagnation, an increase in the real exchange rate (weakening the value real domestic currency) will lead to an increase in B_t^{γ} and an increase in marginal utility, in fact, in both situations, the exchange rate will strengthen the negative relationship between asset returns and marginal utility, therefore, it will lead to an increase in the risk of investors. In order to better understand the relationship between the increasing coefficient of the exchange rate B_t^{γ}, simultaneously with the economic situation and the amount of consumption, it is first assumed that the risk aversion parameter γ, the temporary elasticity of substitution parameter σ and the elasticity of substitution parameter between two domestic and foreign goods ρ condition, $\gamma < 0$ provide, according to this assumption, it is necessary that the relative risk aversion coefficient $1 - \gamma$ is greater than one, which is in accordance with the empirical findings in the literature related to the use of shares, so the condition $\sigma < \rho < 0$ means $EIS < ES < 1$. When these two conditions are met, we can show that the increasing coefficient of the exchange rate B_t^{γ} will be an increasing function of e_t so based on equations (2.11) and (2.16), we will have:

$$\frac{d(B_t)^{\gamma}}{dA_t} = \frac{\gamma}{\sigma} \left[(1-\beta)(1-\alpha)^{\frac{\sigma}{\rho}} A_t^{\frac{\sigma}{\rho}-1} \right]^{\frac{\gamma-\sigma}{\sigma}} \left(\frac{\sigma}{\rho} - 1 \right) A_t^{\frac{\sigma}{\rho}-2} > 0 \tag{2.28}$$

$$\frac{dA_t}{de_t} = \left(\frac{1-\alpha}{\alpha} \right)^{\frac{1}{\rho-1}} \left(\frac{\rho}{\rho-1} \right) e_t^{\frac{1}{\rho}-1} > 0 \tag{2.29}$$

Therefore, according to equations (2.28) and (2.29), $\frac{d(B_t)^{\gamma}}{de_t} > 0$ will B_{t+1}^{γ}, in other words, B_{t+1}^{γ} is an increasing function of e_{t+1} will be. Considering the stochastic discount function in equation (2.24), if $(B_t)^{\sigma} = (1-\beta)(1-$

$\alpha)^{\frac{\sigma}{\rho}-\frac{1}{\rho}}V(e_t)^{\sigma-\rho}$ and $V(e_t)=\left[1-\alpha+\alpha\left(\frac{e_t(1-\alpha)}{\alpha}\right)^{\frac{\rho}{\rho-1}}\right]^{\frac{1}{\rho}}$ in this case, SDF_t will be rewritten as follows:

$$SDF_t=\beta^{\frac{\gamma}{\sigma}}\left[\left(\frac{V_{(e_t)}}{V_{(e_{t-1})}}\right)\right]^{\frac{\gamma}{\sigma}(\sigma-\rho)}\left(\frac{C_t^d}{C_t^d-1}\right)^{\frac{\gamma}{\sigma}(\sigma-1)}R_{W,t}^{\frac{\gamma}{\sigma}-1}\pi_t^{-\frac{\gamma}{\sigma}} \tag{2.30}$$

By taking logarithms from both sides of equation (2.30), we will have:

$$\lim_{\rho\longrightarrow 0}\log(SDF_t)=\frac{\gamma}{\sigma}\log\beta-\alpha\gamma\Delta\log(e_t)+\frac{\gamma}{\sigma}(\sigma-1)\Delta\log(C_t^d)+\left(\frac{\gamma}{\sigma}-1\right)\log(R_{W,t})-\frac{\gamma}{\sigma}\Delta\log(P_t) \tag{2.31}$$

Again, according to Yugo's [18] method, the SDF equation can be rewritten as follows:

$$\frac{SDF_t}{E_{t-1}[SDF_t]}\approx 1+\log(SDF_t)-E_{t-1}[\log(SDF_t)] \tag{2.32}$$

By inserting equation (2.31) into equation (2.32), the SDF of the capital asset pricing model in an open economy (adjusted model) will become a linear model:

$$-\frac{SDF_t}{E_{t-1}[SDF_t]}\approx k+b_1\Delta\log(e_t)+b_2\Delta\log(C_t^d)+b_3\Delta\log(P_t)+b_4\log(R_{W,t}) \tag{2.33}$$

where in:

$$k=-1-\alpha\gamma E_t\left[\Delta\log(e_t)\right]+\frac{\gamma}{\sigma}(\sigma-1)E_t\left[\Delta\log(C_t^d)\right]-\frac{\gamma}{\sigma}E_t\left[\Delta\log(P_t)\right]+\left(\frac{\gamma}{\sigma}-1\right)E_t\left[(\log(R_{W,t}))\right] \tag{2.34}$$

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

Therefore, equation (2.32) will be as follows:

$$-\frac{SDF_t}{E_{t-1}[SDF_t]}\approx k+b'f_t \tag{2.35}$$

where the vector of coefficients $b=(b_1,b_2,b_3,b_4)'$ and the vector of equal factors $f_t=\big(\Delta\log(e_t),\Delta\log(C_t^d),\Delta\log(P_t),$ $\log(R_{W,t})\big)'$ will be. Considering that $E[SDF_t(R_{j,t}-R_{f,t})]=0$ for each property, then:

$$E[SDF_t]E[R_{j,t}-R_{f,t}]=-Cov(SDF_t,R_{j,t}-R_{f,t}) \tag{2.36}$$

$$E[R_{j,t}-R_{f,t}]=Cov\left(-\frac{SDF_t}{E_{t-1}[SDF_t]},R_{j,t}-R_{f,t}\right)=Cov(k+b'f_t,R_{j,t}-R_{f,t})=b'Cov(f_t,R_{j,t}-R_{f,t}) \tag{2.37}$$

Finally, the implied Euler equation of the utility function in equation (2.39) can be approximated from the linear factor model of asset pricing in the adjusted model as follows:

$$\begin{aligned}E[R_{j,t}-R_{f,t}]=b_1Cov(\Delta\log(e_t),R_{j,t}-R_{f,t})&+b_2Cov(\Delta\log(C_t^d),R_{j,t}-R_{f,t})\\&+b_3Cov(\Delta\log(P_t),R_{j,t}-R_{f,t})\\&+b_4Cov(\log(R_{W,t}),R_{j,t}-R_{f,t})\end{aligned} \tag{2.38}$$

This equation can also be expressed as the equation of asset yield with the sensitivity coefficient of assets (beta):

$$E[R_{j,t}-R_{f,t}]=\beta_j'\lambda \tag{2.39}$$

where $\beta_j'=(\beta_{j,1},...,\beta_{j,k})$ represents the asset's beta risk with respect to each of the factors affecting the assets' return. Beta factors equal to $\beta_{j,k}=\frac{cov(f_{k,t},R_{j,t}-R_{f,t})}{var(f_{k,t})}$ and $\lambda_k=b_kvar(f_{k,t})$ also expresses the risk expenditure or risk cost related to the kth factor. Equation (2.38) and (2.39) show that an asset with a high exchange rate beta $\frac{Cov(\Delta \log(e_t), R_{j,t}-R_{f,t})}{var(\Delta \log(e_t))}$, when $b_1 > 0$ should have a higher yield, since $b_1 = \alpha\gamma$, so as long as $\gamma < 0$ and the economy is in a prosperous state, the real exchange rate will decrease (strengthening the real value of the domestic currency or $\Delta \log(e_t) < 0$, exchange rate risk $\lambda_1 = \alpha\gamma var(\Delta \log(e_t))$ will be positive and the return on assets is at a high level. But when the economy is in a bad state and stagnant, the return on assets will be low. Equations (2.38) and (2.39) represent the linear model of asset pricing, which will be estimated using the two-stage regression method of Fama and Macbeth [14], the coefficients of sensitivity and risk of exchange rate variables and market returns compared to the returns of assets (portfolios).

The statistical population includes 69 active companies in the Bahadur Stock Exchange of Iran, which were admitted to the stock exchange before 2013 and somehow the exchange rate has a significant effect on their stock value, for this purpose, from the companies that are exporters and raw materials producers They have been imported and used, as well as the Fama and French model [12, 13] and the Carhart model [6] have been used to form portfolios among selected companies. The statistical data required by the central bank and the sources published by the central bank, the Iranian Statistical Center, the Tehran Stock Exchange and the International Monetary Fund have been extracted.

3 Research findings

To estimate the Linear Model of the Asset Pricing (equation (2.38)), the Fama and Macbeth two -step regression method has been used. In this method, the parameters are estimated in two stages: In the first step, the efficiency of each portfolio is fitted to the risk factors in question to determine the coefficient for the risk factor (desired). In the second stage, in each period, to calculate the risk of each factor, the spending of stock returns on the estimated coefficients in the previous step is fitted. With the average width of the origins and coefficients of each factor, the average overall results are the results of the model estimation for each portfolio, which is estimated using EViews software and presented in Table 1:

Table 1: Results of Linear Pricing Model of Assets Using Fama and Macbeth Domain Regression ($*$ Significant level of 5% and $**$ 10% significant level).

Variable	Symbol	Coefficient	SE	t	Sig
Exchange rate risk	λ_1	0.56	0.219	2.546	0.011*
Risk of growth in domestic consumption	λ_2	0.38	1.437	1.437	0.151*
Risk of inflation rate	λ_3	0.11	0.167	0.656	0.512
Market return risk	λ_4	0.31	0.127	2.442	0.015*
$R^2 = 0.682$					
$F = 32.86$ Sig(F) =0.000**					

The results of the model estimation indicate that the exchange rate risk coefficient (λ_1) is 0.56, meaning there is a positive and significant relationship between the exchange rate mere and the return on assets. In the equation (2.36) and (2.38), assets with high exchange rate beta, $\frac{Cov(\Delta \log(e_t), R_{j,t}-R_{f,t})}{var(-\Delta \log(e_t))}$, when $b_1 > 0$ must have a higher return, since $b_1 = \alpha\gamma$ is, so the real exchange rate decreases as long as the economy is in the state of prosperity ($\Delta \log(e_t) < 0$), the amount of $\lambda_1 = \alpha\gamma var(\Delta \log(e_t))$ will be positive and the return on assets is at high level. But when the economy is in poor condition and stagnation, asset returns will be low. Therefore, the positive relationship between the risk (average beta coefficients) and the return means that the condition of the assets with the exchange rate changes is a strong predictor for a time long series of assets.

4 Conclusion

The purpose of this study was to investigate the impact of systematic exchange rate risk on the return on assets in the Tehran Stock Exchange. The results of the two -step regression model or linear asset pricing model indicate that the beta coefficient of the exchange rate (spent on exchange rate risk, λ_1) was 0.81, meaning that there is a positive and significant relationship between the exchange rate risk and asset returns. Theoretically, in addition to the foreign trade sector, in addition to the foreign trade sector, the internal sector, especially the stock market, affects the domestic sector. In an open economy, services, goods and capital between countries are provided according to the exchange rate. Therefore, the exchange rate can affect the major variables of the export, import, and capital departure sector. Therefore, if the exchange rate changes are adjusted in the right direction, it can provide a better and more favorable environment for production, trade and investment. The exchange rate fluctuations change the price of goods and services, production and production factors, thereby affecting the current and future cash flows and consequently the return on the stocks of the firm, so that the decline in the value of money increases demand for domestic production goods. Due to the increase in the relative price of foreign goods, the result is the result of increasing the general level of prices, on the other hand, it reduces the import of intermediary and capital data due to increased prices, which increases production costs and reduced investment, demand for reduced stocks or reduced stocks. And as a result, the return on stock market returns is reduced, so the result of this hypothesis shows that investors will claim higher returns for each asset in order to withstand higher exchange rate risk in the stock market. The exchange rate is considered an important and key variable in economic patterns, and since this variable has a significant impact on the real and financial sector of the economy, policy proposals for this variable require particular sensitivity and precision. As we know, at present, the stock market in most countries, including Iran, forms the central core of the capital market. On the other hand, the exchange rate change can have a significant impact on companies' profitability due to their degree and degree of dependence on foreign currency and therefore on the return on stocks of companies listed in the Tehran Stock Exchange. Therefore, investors need to be aware of the influence of corporate stock returns through exchange rate change, and on the other hand, stock exchange officials must pay more attention to their dependence on the exchange rate in order to make the stock price of its inherent value in its intrinsic value. To. Since the exchange rate immobilization leads to currency speculation and cash transfer, and on the other hand, the cost of active firms on the stock market is increasing and their stocks are less attractive, so there is expectation of stagnation and reduction in stock prices and reduced stock returns, so a specific policy proposal is suggested. It is to avoid policies that cause further fluctuation and the creation of uncertainty in the currency market to provide the market growth and price index.

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