Asset Pricing Model with Liquidity Variables in Stock Market

PITHAK SRISUKSAI
School of Economics
Sukhothai Thammathirat Open University
9/9 Moo 9, Bangpood Subdistrict, Pakkret District, Nonthaburi 11120
THAILAND
pithak.sri@stou.ac.th http://www.stou.ac.th

Abstract: This study derives asset pricing model with liquidity variables to examine the relationship between expected returns and other explanatory variables in the case of Thailand and Singapore. It also compares the results from the stock exchange of Thailand with those from the stock exchange of Singapore. By introducing liquidity variables in business cycle model, the dynamic stochastic general equilibrium is derived to come up with a new asset pricing model in order to account for expected returns and equity premium. The modeled economy shows the substitution between consumption today and consumption in the future. In fact, consumption at different times has different prices. The discrete time optimization model is employed to write Bellman's equation, Lagrange equation, and solve for Euler equation and Envelope condition before end up with general equilibrium. Therefore, the new asset pricing model is computed by using Log-linear approximation. In addition, simulation method and Generalized Method of Moments are employed to test such model. The next findings show that this model has an ability to capture the data of Thailand and Singapore. Indeed, the growth rate of aggregate consumption is positively related to the expected returns in case of banking group index of Thai stock market and Straits Times Index. Still, the growth rate of market index is positively related to the expected returns in the case of Singapore. Furthermore, such theoretical and empirical results demonstrate that transaction cost has a positive effect on the expected stock returns in both cases. In contrast, the coefficient of relative risk aversion has a negative effect on the expected stock returns.

Key-Words: Dynamic stochastic general equilibrium model, Asset pricing model, Expected return, Liquidity variables, Consumption growth rate

1. Introduction

This paper characterizes the asset pricing model by introducing the transaction cost into the standard real business cycle model. Such model is analogous to the consumption-based asset pricing model and production-based asset pricing model as well as productivity-based asset pricing model, but it considers the distorted economy instead of complete markets. In particular, this model is used to show the link between the asset price and the equity premium with the economic fluctuations and the market liquidity.

The history of asset pricing model initials with the well-known Capital Asset Pricing Model (CAPM) of Lintner (1965) and Sharpe (1964). Such model measures the risk of an asset by its covariance with the stock market return, which is the so-called market beta. Still, the CAPM does not consider consumption decisions. The standard Consumption-based Capital Asset Pricing Model (CCAPM) of Lucas (1978) and Breeden (1979) take this disadvantage away by measuring the risk of a security as the covariance of its return with consumption. The main advances of this model in financial economics is its ability to provide a simple linkage between intertemporal consumption choices and asset returns. Another, Mehra and Prescott (1985) solve for equilibrium asset prices by assuming that the representative agent has a constant relative risk aversion utility function. They find that the equity premium over the period 1889–1978 in the US is 6 percent which is much too high than model measure. That is why it is called the equity premium puzzle.

Such puzzle challenges the economist to solve for a long time. They introduce various frictions such as capital adjustment costs, habit formation, labor market frictions, limited stock market participation and idiosyncratic risk. It is still puzzle, however. In addition, there are few studies which develop the model merging the RBC model with the transaction cost. The theoretically relevant study is that Fisher (1994) considers the effect of introducing the bid-ask spread and asset turnover into the Lucas (1978) asset pricing model. The finds show that they lead to an higher expected gross return on the risky equity, but the agents invest in financial market through the mutual fund.

Furthermore, Balvers and Huang (2007) examine the cross-section of asset return from the production side of the economy by solving the social planner problem within the real business cycle model. Moreover, the result argues that asset returns are determined by a one-factor model-the aggregate productivity shock- with one conditioning variable (the state of the economy). Consistent with Jermann (1998), the paper explores the asset pricing facts in the standard real business cycle model which show that the habit formation preferences result in the low risk premium while the capital adjustment cost plays an important role in describing the equity premium.

More typically, the paper of Jermann (2008) develops the real business cycle model with explicit roles for debt and equity financing to take into account the volatility of financial flow of firms. The results state that the financial frictions play a central role for an increase in shocks. In addition, the financial innovations reduce the importance of financial frictions which lead to lower macroeconomic volatility but greater volatility in the financial structure of firms.

The interesting study of liquidity is the paper of Acharya and Pedersen (2005) which develops the overlapping generation model to account for the liquidity premium. The findings demonstrate that the model generates time-varying expected returns predictable on the basic of liquidity variables since the liquidity is persistent as well as that the expected return rise with the expected cost of the individual security and the four types of betas.

In particular, Lonstaff (2004) shows the extension of Lucas model with heterogeneous agents which introduce the illiquidity (blackout period) into the model to account for the asset price. The results state that the agents with the highest subjective discount rate concentrate their portfolio in the riskiest asset, and the more-patient, longer-horizon agents may hold very little of the risky asset. Additionally, asset price can differ significantly from agents' liquid-market value when they must wait before they can trade again. Eisfeldt (2004) explores the dynamic economy which finds that higher productivity leads to higher investment in risky assets and hence more rebalancing trades, mitigating the adverse selection problem and improving liquidity.

Empirically, the paper of Fujimoto and Watanabe (2005) finds that illiquidity is positively related to the conditional variance of daily individual stock return using GARCH models, similar to the monthly data, and the proportional spread is a significant and positive determinant of conditional heteroscedasticity after orthogonalization against share turnover and return on the NYSE and NASDAQ. More importantly, Skjetorp, Naes and Odegaard show the evidence of the contemporaneous relation between stock market liquidity measured by bid-ask spreads. That paper states that the stock market liquidity is worsen when the economy is slowing down, and vice versa.

In addition, the evidence of Fujimoto (2003) is not quite difference from the previous ones which shows that the intertemporal relation between market liquidity and various macroeconomic factors has changed dramatically over time. The macroeconomic influence on liquidity is stronger before the mid 1980's of NYSE and American Stock Exchange (AMEX) when business cycle dynamics is more volatile, macroeconomic shocks also affect market return, volatility, and share turnover.

While the empirical examinations of the asset pricing model are mainly confined to major developed financial markets, this study aims to expand the application of such model to compare Thai stock market with Singapore stock market. Indeed, the real business cycle model is straightforward extension of equilibrium model. The asset price and expected return are derived from the household's problem, the firm's problem and market-clearing condition, also. The findings characterize that, in frictionless market, the cost of acquiring capital equals to the discounted expectation of marginal rate of intertemporal substitution of the next period consumption for this period consumption, and equals to the bond price. In the market equilibrium with transaction cost, the spread is a positively important determinant of the equilibrium stock price. On the contrary, the growth rate of aggregate consumption has an empirically negative effect on expected stock return and a theoretically positive effect on one.

The remainder of the paper is organized as follows. Section 2 presents a real business cycle model with transaction cost, and solving for the equilibrium price. Section 3 derives the equity premium and expected return. The steady-state equilibrium is illustrated in Section IV. Section V concludes and recommends the further work.

2. The model

The modeled economy is an extension of the Brock and Mirman (1972) optimal stochastic growth model. This study considers the standard real business cycle with a large number of infinitely-lived identical households and firms that will exit forever. Each of these household has an endowment of time for each period, which it must divide between leisure, l_t, and work, h_t. The households' time endowment is normalized to one; that is, $h_t + l_t = 1$. The household own initial stock of capital, k_0, which they rent to firms and may augment through investment. Each agent might invest in either risk-free bonds, b_t, or equities, s_t. These bonds are short-lived lasting one period and may be purchased directly from the issuer at zero cost.

Alternatively, each agent can invest in stock market in the form of a bid-ask spread. In particular, each agent can adjust the stock portfolio which is captured by the turnover rate. In fact, it is the ratio of the total number of shares traded to the total number of shares outstanding, Φ, unlike Fisher (1994).

2.1 Households

The household's utility for each period is defined over stochastic sequences of consumption and leisure:

$$U[c(.),h(.)] = E\left\{\sum_{t=0}^{\infty} \beta^t u(c_t, 1-h_t)\right\}, 0 < \beta < 1 \quad (1)$$

where c_t, h_t represent the per capita contingent consumptions and labor supplies. β^t is subjective discount factor at time t and E is the expectation operator. This expected lifetime utility function is assumed that u is twice continuously differentiable, increasing in both arguments and strictly concave, $u_c(.) > 0, u_h(.) > 0, u_{cc}(.) < 0, u_{hh}(.) < 0$. , and satisfies the Inada condition: $\lim_{c\to 0} u_c(.) = \infty, \lim_{h\to 0} u_h(.) = \infty$.

Following Fisher (1994), a representative agent faces the following budget constraint and law of motion for shareholdings:

$$c_t + p_t^a i_t + q_t b_{t+1} \le w_t h_t + s_t d_t + b_t + \Phi_t s_t p_t^b \quad (2)$$

$$s_{t+1} = (1-\Phi_t)s_t + i_t \quad (3)$$

where d_t represents a stochastic dividend payout, b_t stands for the risk-free bond holding which is carried into the next period, b_{t+1}, and pays one unit of consumption. Φ_t is the proportion of an agent's stock portfolio which is liquidated at time t due to an agent adjusts the amount of stock. i_t represents the investment in stock market. q_t, p_t^b, and p_t^a denote the relative bond price, the relative bid price and the relative ask price, respectively, which take as given. In addition, the price of labor supplied is w_t.

The agents are assumed that they are the owners of firms; hence, a representative agent in the modeled economy finances for his expenditure from wage income, $w_t h_t$, the dividend payout, $s_t d_t$, bond holding at time t, and cash flow from the liquidation of an agent's portfolio at the bid price, $\Phi_t s_t p_t^b$, it is due to the competitive market which takes all prices as given. All revenues are allocated to purchase the consumption good, c_t, invest in asset market: stock and bond, $p_t^a i_t, q_t b_t$. The agent can rebalance the stock portfolio by following the law of motion, $s_{t+1} = (1-\Phi_t)s_t + i_t$, it states that $\Phi_t s_t$ are the amounts of stock liquidated of agent's portfolio; consequently, $(1-\Phi_t)s_t$ are the amounts of remaining stock in agent's portfolio which are not traded, the price of stock is also assumed that $p_t^a \ge p_t^b$.

In each period, the representative agent choose the consumption, hours of work, the next period bond holdings, and the next period stock holding to maximized the expected discounted value of utility subject to sequences of agent's budget constraint and the law of motion for shareholdings.

$$\underset{c_t, h_t, b_{t+1}, s_{t+1}}{Max} E\left[\sum_{t=0}^{\infty} \beta^t u(c_t, 1-h_t)\right]$$

subject to

$$c_t + p_t^a i_t + q_t b_{t+1} \le w_t h_t + s_t d_t + b_t + \Phi_t s_t p_t^b$$

$$s_{t+1} = (1-\Phi_t)s_t + i_t$$

To find the efficiency allocation, using the method of Lagrange multiplier, the Lagragian equation is:

$$L = E\left[\sum_{t=0}^{\infty} \beta^t u(c_t, 1-h_t)\right] + \sum_{t=0}^{\infty} \lambda_t \left[w_t h_t + s_t d_t + \Phi_t s_t p_t^b + b_t - c_t - p_t^a \left(s_{t+1} - (1-\Phi_t) s_t\right) - q_t b_{t+1}\right] \quad (4)$$

The first-order conditions with respect to consumption, work hours, the next period bond holding, and the next period shareholding are

$$FOC_{c_t} : E\left[\beta^t u_h\left(c_t, 1-h_t\right)\right] = \lambda_t \quad (5)$$

$$FOC_{h_t} : E\left[\beta^t u_h\left(c_t, 1-h_t\right)\right] = \lambda_t w_t \quad (6)$$

$$FOC_{b_{t+1}} : \lambda_{t+1} = \lambda_t q_t \quad (7)$$

$$FOC_{s_{t+1}} : \lambda_{t+1} d_{t+1} + \lambda_{t+1} \Phi_{t+1} p_{t+1}^b - \lambda_t p_t^a + p_{t+1}^a (1-\Phi_{t+1}) \lambda_{t+1} = 0 \quad (8)$$

Combining the equation 5 with 6 and equation 5, 7 with 8, respectively, the optimal choices (the Euler equations) are:

$$w_t = \frac{u_h\left(c_t, 1-h_t\right)}{u_c\left(c_t, 1-h_t\right)} \quad (9)$$

$$q_t = \beta E_t \left[\frac{u_c\left(c_{t+1}, 1-h_{t+1}\right)}{u_c\left(c_t, 1-h_t\right)}\right] \quad 10)$$

$$E_t\left[d_{t+1} + \Phi_{t+1} p_{t+1}^b + p_{t+1}^a \left(1-\Phi_{t+1}\right)\right] = p_t^a E_t \left[\frac{u_c\left(c_t, 1-h_t\right)}{\beta u_c\left(c_{t+1}, 1-h_{t+1}\right)}\right] \quad (11)$$

The equation 9, 10 and 11 are the key to determine the real wage rate, the relative bond price, and the relative stock price. In fact, the equation 9 states that the real wage rate is equal to the ratio of the marginal utility of work hour to the marginal utility of consumption at time t, or it is equivalent to the marginal rate of substitution between work hour, h_t, and consumption, c_t. The bond price in equation 9 shows that it equals to the marginal rate of intertemporal substitution between the next period consumption and the consumption at time t, or the risk-free asset return. More importantly, the relative ask price, p_t^a, is the risk-free asset return multiplied by the term of dividend payout, the value of portfolio proportion liquidated, and the value of portfolio proportion remained, $\left[d_{t+1} + \Phi_{t+1} p_{t+1}^b + p_{t+1}^a \left(1-\Phi_{t+1}\right)\right]$.

2.2 Firms

The representative agent can access to a technology that produces a single consumption-investment good from capital, k_t, and labor, h_t.

$$y_t = z_t F\left(k_t, h_t\right) \quad (12)$$

The production function is concave, twice continuously differentiable, increasing in both arguments, and is assumed constant returns to scale; i.e.

$$z_t F_k\left(k_t, h_t\right) > 0, z_t F_h\left(k_t, h_t\right) > 0, \forall k, h > 0$$

$$z_t F_{kk}\left(k_t, h_t\right) < 0, z_t F_{hh}\left(k_t, h_t\right) < 0, \forall k, h > 0$$

$$\lim_{k \to 0} F_k(.) = \infty, \lim_{h \to 0} F_h(.) = \infty$$

z_t is a technology shock which is the source of the uncertainty in the economy

Observed at the beginning of the period and evolves according to the law of motion:

$$z_{t+1} = \rho z_t + \varepsilon_{t+1} \quad (13)$$

where: ε is distributed normally, with mean zero and standard deviation ($\varepsilon \sim N\left(0, \sigma_\varepsilon\right)$)

The single consumption-investment good can be allocated to either consumption or investment:

$$z_t F\left(k_t, h_t\right) = c_t + x_t \quad (14)$$

In each period, a representative firm has to decide how much labor to hire and how much capital to rent. Furthermore, the firm faces the cost of adjusting its capital stocks; for example, the cost of installing the new capital and training program are such the internal adjustment costs. Denote $c(x_t)$ as the internal adjustment cost, and assume that it is convex; that is, $c_{xx}(x_t) > 0$. It implies that the marginal adjustment cost is increasing in the size of the adjustment. Therefore, a representative firm maximizes the present value of its dividend, d_t:

$$d_t = y_t - w_t h_t - x_t \tag{15}$$

Let denote δ be the rate of capital depreciation. Consequently, the investment in this period becomes productive capital in the next period so that the capital stock evolves according to the law of motion:

$$k_{t+1} = (1-\delta)k_t + x_t, 0 < \delta < 1 \tag{16}$$

Thus, following Hall (2001) and Jermann (2008) , the firm chooses the investment, work hour, and the next period capital stock such that the optimization problem of firm in a recursive form is:

$$V(z_t, k_t) = \underset{x,h,k}{Max}\, z_t F(k_t, h_t) - w_t h_t - x_t + \beta E\left[V\left(z', k',\right)\right] \tag{17}$$

subject to:

$$k_{t+1} = (1-\delta)k_t + x_t$$

The first-order conditions for the investment, labor, and the next period capital stock are as follows:

$$FOC_{x_t} : \mu_t = -1 \tag{18}$$

$$FOC_{h_t} : z_t F_h(k_t, h_t) = w_t \tag{19}$$

$$FOC_{k'} : \beta E\left[V_{k'}(z', k'\right] = -\mu_t \tag{20}$$

The envelope conditions are:

$$V_z(z_t, k_t) = z_t F(k_t, h_t) \tag{21}$$

$$V_k(z_t, k_t) = z_t F_k(k_t, h_t) + \mu_t(1-\delta) \tag{22}$$

Combining equation 18 with 20 and 22, we come up with the Euler equation as follows:

$$\beta E_t\left[V_{k'}(z', k')\right] = 1 \tag{23}$$

$$\beta E_t[z_{t+1} F_k(k_{t+1}, h_{t+1}) + (1-\delta)] = 1 \tag{24}$$

Equation 23 shows that the shadow price of installed capital, or the Lagrange multiplier associated with the constraint 19, μ_t is equal to the purchase price of capital goods which equals to one. In addition, the equation 24 states that the discounted expectation of marginal product of capital in the next period plus the retained depreciation rate equals to one.

2.3 Market equilibrium

The economy is considered by the household's problem, the firm's problem, and market-clearing condition which characterize the general equilibrium of the economy. To specify the market-clearing constraint for consumption good, labor and capital at time t, all consumption-investment goods are either consumed or invested:

$$z_t F_t(k_t, h_t) = c_t + k_{t+1} - (1-\delta)k_t \tag{25}$$

The asset market-clearing condition for bond holdings is: $b_t = b_{t+1} = 0$, and the constraint for clearing the stock market is: $s_{t+1} = s_t = 1$

The equilibrium in the modeled economy is the set of prices: the relative stock price, the real wage rate, and the relative bond price, p_t, w_t, q_t, respectively and the allocation: $\{x_t, h_t, k_{t+1}, c_t, h_t, b_{t+1}, s_{t+1}\}_{t=0}^{\infty}$ that satisfies the efficiency condition of the representative agent, equation 9, 10 and 11, and representative firm, equation 23 and 24; as well as the consumption good market-clearing condition 25 and the asset market-clearing condition, including that,

$$p_t^b = p_t(1-\alpha) \tag{26}$$

and

$$p_t^a = p_t(1+\alpha) \tag{27}$$

Let α denote the ratio of transaction cost which reflects the relative bid-ask spread (the ask price minus the bid price divided by an average of bid and ask price) In fact, this spread can be thought of as implicit cost which is a part of total transaction cost.

Therefore,

$$q_t = E_t\left[\frac{\beta u_c\left(c_{t+1}, 1-h_{t+1}\right)}{u_c\left(c_t, 1-h_t\right)}\right] \tag{28}$$

The equation 28 states that the price of bond holding equals to the discounted expectation of marginal rate of intertemporal substitution of the next period consumption for this period consumption, or the stochastic discount factor.

2.4 Reduced Form

To examine whether the relative spread determine the expected return within the real business cycle model, this study uses the simple abstraction to build quantitative economic intuition about what the returns on equity and equity premium should be. Utility is non-separable over consumption, the increasing, continuously differentiable concave function. Furthermore, such utility function is restricted to be of the constant relative risk aversion (CRRA) class as the followings.

$$U(c_t) = \frac{c_t^{1-\sigma} - 1}{1-\sigma}, 0 < \sigma < \infty \qquad (29)$$

Where σ measures the curvature of utility function or the relative risk aversion parameter. We further assume $\phi_{t+1} = 1$ which means that the investors sell out their stocks at time $t+1$.
Therefore, equation 11 can be transformed into the expected stock return as

$$p_t^a c_t^{-\sigma} = \beta E_t \left[c_{t+1}^{-\sigma} (d_{t+1} + p_{t+1}^b) \right] \qquad (30)$$

Define gross return on stock as : $R_{t+1} = \dfrac{d_{t+1} + p_{t+1}^a}{p_t^a}$

,then equation (30) becomes

$$1 = \beta E_t \left[\left(\frac{c_{t+1}}{c_t} \right)^{-\sigma} \left(R_{t+1} - \frac{p_{t+1}^a - p_{t+1}^b}{p_t^a} \right) \right] \qquad (31)$$

Define $\dfrac{p_{t+1}^a - p_{t+1}^b}{p_t^a} = \omega$, then equation 31 can be written as

$$1 = \beta E_t \left[\left(1 + g_c\right)^{-\sigma} \left(R_{t+1} - \omega\right) \right] \qquad (32)$$

As a result, equation 32 is not a linear equation, but which in turn is the main contribution of this paper. Such finding displays the relationship between expected stock return at time $t+1$, the relative bid-ask spread time $t+1$,and the growth rate of aggregate consumption. This relative bid-ask spread has a negative effect on expected stock return. In contrast, the growth rate of aggregate consumption is negatively related to such return.

In addition, equation 31 can be simplified in term of the transaction cost. In fact, $p_{t+1}^a = 0$ which means that a representative investor does not hold any share of stock after he sell out at time $t+1$. Assuming further that $p_t^b = p_t(1-\alpha)$ and $p_t^a = p_t(1+\alpha)$. α is the proportion of transaction cost. Rearranging equation 32, so it becomes

$$1 + \rho = E_t \left[\left(\frac{c_{t+1}}{c_t} \right)^{-\sigma} \left(R_{t+1} + \frac{p_{t+1}(1-\alpha)}{p_t(1+\alpha)} \right) \right] \qquad (33)$$

where ρ is the rate of time preference.

Define $g_x = \dfrac{x_{t+1}}{x_t}$. Let $\hat{x}_t$ be a deviation from steady state at time t, such that $\hat{x} = \dfrac{x_t - x}{x}$. Equation 33 can be approximated by applying the method of log-linearization. That is,

$$E_t \hat{R}_{t+1} = 1 + \rho + 2\sigma \hat{g}_c - \hat{g}_p - \frac{1-\alpha}{1+\alpha} \qquad (34)$$

Thus, the equity premium of stock return will be

$$2E_t \hat{R}_{t+1} - \left(1+\rho\right) = 2\sigma \hat{g}_c - \frac{1-\alpha}{1+\alpha} \qquad (35)$$

Equation 35 states that the rate of time preference (ρ) has a positive impact on expected stock return. Similarly, the deviation of consumption from steady state $(\hat{g}_c)$ and transaction cost (α) are positively correlated with expected stock return. On the contrary, the deviation of market index from steady state $(\hat{g}_p)$ has a negative effect on expected stock return. Equation 36 shows that the deviation of consumption from steady state and transaction cost have positive effects on the equity premium, also.

3. Empirical results

This paper explores the mutual effects of the transaction cost, the rate of time preference, the deviation of consumption from steady state ,
and the deviation of market index from steady state on expected stock return. The generalized method of moments (GMM) will be applied to test equation 35. Data for this studying come from quarterly data on

the SET index (Stock Exchange of Thailand: SET), the Thai Bond Market Association (ThaiBMA), and The Office of the National Economic and Social Development Board (ONESD) between 1993 and 2012. They also come from yearly data on the Straits Times Index (STI) and World Bank national accounts data between 1988 and 2012.

3.1 Estimation Results

Table 1 Generalized Method of Moments model for the deviation of expected stock return in case of Thailand.

Model	Intercept	$\hat{g}_c$	$\hat{g}_p$	J-statistic	Prob(J-Statistic)
1	-	$-1.68\times10^{17*}$	-	3.5799	0.0584
2	$-1.68\times10^{17***}$	-10.6722	-	19.8251	0.0001
3	$-1.68\times10^{17***}$	-10.6722	-0.3048	19.8289	0.0000
4	-	-1.68×10^{17}	-10.6721	2.1383	0.3433

Note : $\hat{g}_c$ stands for the deviation of consumption from steady state. $\hat{g}_p$ represents the deviation of market index from steady state.
* Denotes a 0.10 significance level.
*** Denotes a 0.01 significance level.

Table 1 shows that the estimated coefficients on the deviation of nondurable consumption from steady state are negative and statistically significant at a 0.10 significance level only in Model 1. The average slope on this one is -1.68×10^{17}, and J-statistic is 3.5799 and probability of J-statistic equals to 0.0584. It is larger than 0.10. Such finding is dissimilar to the estimation of Table 2. The estimated coefficients on the deviation of expected stock return of Banking group is positive and statistically significant at a 0.10 significance level only in Model 2. The mean of slope on $\hat{g}_{cs}$ is 71,892,118. It is implies that the growth rate of nondurable consumption has a large effect on expected stock return of Banking group. In addition, the probability of J-statistic is higher than 0.10.

Table 2 Generalized Method of Moments model for the deviation of expected stock return of Banking group index in case of Thai Stock Market.

Model	Intercept	$\hat{g}_{cs}$	$\hat{g}_{ps}$	J-statistic	Prob(J-Statistic)
1	-	-17.7081	-	0.2137	0.8986
2	-84261.43	71892118^{*}	-	3.1028	0.2119
3	-27165.35	71892710	-976200.6	2.1899	0.3345
4	-	-27153.01	71892710^{**}	10.1845	0.0171

Note : $\hat{g}_{cs}$ stands for the deviation of nondurable consumption from steady state. $\hat{g}_{ps}$ represents the deviation of Banking group index from steady state.
* Denotes a 0.10 significance level.
*** Denotes a 0.01 significance level.

Table 3 Generalized Method of Moments model for the deviation of expected stock return of the Straits Times Index in case of Singapore Exchange.

Model	Intercept	$\hat{g}_{cs}$	$\hat{g}_{ps}$	J-statistic	Prob(J-Statistic)
1	-	-6.0379^{***}	-	1.1771	0.5551
2	-0.0241	-5.7835^{***}	-	1.0152	0.3136
3	9239.615	12468937	2626719	1.6852	0.1942
4	-	21740826	5231327	1.0456	0.3065

*** Denotes a 0.01 significance level.

Consistent with the results Banking group index of Thai stock market, the deviation of nondurable consumption from steady state is positively related to the deviation of expected stock return of the Straits Times Index. This positive relationship is statistically significant at a 0.01 significance level. The probability of J-statistic is also higher than 0.10.

3.2 Simulation Results

The model presented in Equation 35 can be simulated to numerically evaluate its performance in explaining the observed gross return on stocks in SET and STI. Calibrating the model requires specification of the preference parameters, ρ, the transactions parameters, α ,the relative risk aversion parameter, σ. In fact, $\rho = 0.0005$ per quarter, $0 \le \alpha \le 0.0075$, and $\sigma \le 2$ like Hansen and Singleton (1982) and Fisher (1994).

Calibration results are reported in Table 4 and 5. The proportion of transaction cost strongly affects the expected stock return. Indeed, taking the deviation of growth rate of nondurable consumption at steady state and the deviation of growth rate of SET index as given, the deviation of expected stock return at steady state dramatically increase when transaction cost goes up. For instance, given the relative risk aversion parameter $\sigma = 10$, the deviation of expected stock return at steady state goes up from 0.001 to 1.001 while transaction cost goes up from 0 to 1. It implies that transaction cost is positively related with expected stock return, consistent with the model.

Equally important, the relative risk aversion is negatively related to the expected stock return, given other variables constant. In fact, the deviation of expected stock return at steady state graduatedly declines when the relative risk aversion increase.

Table 4 The quarterly deviation of expected stock return at steady in case of SET when the relative risk aversion, σ , and the proportion of transaction cost, α , dramatically change.

α	σ													
	0	1	2	3	5	8	9	10	13	15	18	19	20	50
0	0.00110	0.00109	0.00108	0.00106	0.00103	0.00099	0.00097	**0.0010**	0.0009	0.0009	0.000	0.0008	0.0008	0.0004
0.001	0.00310	0.00309	0.00307	0.00306	0.00303	0.00299	0.00297	**0.0030**	0.0029	0.0029	0.0028	0.0028	0.0028	0.0024
0.002	0.00510	0.00508	0.00507	0.00505	0.00502	0.00498	0.00497	**0.0050**	0.0049	0.0049	0.0048	0.0048	0.0048	0.0044
0.003	0.00709	0.00707	0.00706	0.00704	0.00701	0.00697	0.00696	**0.0069**	0.0069	0.0069	0.0068	0.0068	0.0068	0.0064
0.004	0.00907	0.00906	0.00904	0.00903	0.009	0.00896	0.00894	**0.0089**	0.0089	0.0089	0.0088	0.0088	0.0088	0.0084
0.005	0.01105	0.01104	0.01103	0.01101	0.01098	0.01094	0.01092	**0.0109**	0.0109	0.0108	0.0108	0.0108	0.0108	0.0103
1	**1.00110**	**1.00109**	**1.00108**	**1.00106**	**1.00103**	**1.00099**	**1.00097**	**1.0010**	**1.0009**	**1.0009**	**1.0008**	**1.0008**	**1.0008**	**1.0004**

In case of STI, the yearly rate of Time Preference, ρ , is equal to 0.0204. The proportion of transaction cost, $0 \le \alpha \le 0.03$, and $\sigma \le 2$. Table 5 shows that the proportion of transaction cost strongly has a positive effect on the expected stock return. In fact, taking the deviation of growth rate of nondurable consumption at steady state and the deviation of growth rate of STI index as given, the deviation of expected stock return at steady state dramatically goes up when transaction cost increase. For example, given the relative risk aversion parameter $\sigma = 10$, the deviation of expected stock return at steady state goes up from 0.0204 to 0.1599 while transaction cost goes up from 0 to 0.075. It implies that transaction cost is positively related with expected stock return, like in case of SET. Similarly, the relative risk aversion has a negative impact on the expected stock return, given other variables constant.

2

Table 5 The yearly deviation of expected stock return at steady in case of Straits Times Index when the relative risk aversion, σ , and the proportion of transaction cost, α , dramatically change.

α	σ													
	0	1	2	3	5	8	9	**10**	13	15	18	19	20	50
0	0.02040	0.02040	0.02040	0.02040	0.02040	0.02040	0.02040	**0.02040**	0.02040	0.02040	0.02040	0.02040	0.02040	0.02040
0.01	0.04020	0.04020	0.04020198	0.04020198	0.04020198	0.04020198	0.04020198	**0.0402019**	0.04020198	0.0402019	0.0402019	0.0402019	0.0402019	0.0402019
0.02	0.059615686	0.059615686	0.05961569	0.05961569	0.05961569	0.05961569	0.05961569	**0.0596156**	0.05961569	0.0596156	0.0596156	0.0596156	0.0596156	0.0596156
0.03	0.078652427	0.078652427	0.07865243	0.07865243	0.07865243	0.07865243	0.07865243	**0.0786524**	0.07865243	0.0786524	0.0786524	0.0786524	0.0786524	0.0786524
0.04	0.097323077	0.097323077	0.09732308	0.09732308	0.05886154	0.09732308	0.09732308	**0.0973230**	0.09732308	0.0973230	0.0973230	0.0973230	0.0973230	0.0973230
0.05	0.115638095	0.115638095	0.1156381	0.1156381	0.1156381	0.1156381	0.1156381	**0.1156381**	0.1156381	0.1156381	0.1156381	0.1156381	0.1156381	0.1156381
0.075	**0.159934884**	**0.159934884**	**0.15993488**	**0.15993488**	**0.15993488**	**0.15993488**	**0.15993488**	**0.1599348**	**0.15993488**	**0.1599348**	**0.1599348**	**0.1599348**	**0.1599348**	**0.1599348**

4. Conclusion

This study tries to explore the asset pricing model within the real business cycle model. By introducing the transaction cost, the model shows that transaction cost, the growth rate of nondurable consumption, and the growth of market price of stock are strongly correlated with expected stock return.

In particular, there are three main findings in such model: the relationship between transaction cost and expected stock return, the relationship between the coefficient of relative risk aversion and expected stock return, and the relationship between growth rate of nondurable consumption and expected stock return

Another, the findings show that this model has an ability to capture the data of Thailand and Singapore. Indeed, the growth rate of aggregate consumption is positively related to the expected returns in case of banking group index of Thai stock market and Straits Times Index. Still, the growth rate of market index is positively related to the expected returns in the case of Singapore. Furthermore, such theoretical and empirical results demonstrate that transaction cost has a positive effect on the expected stock returns in both cases. In contrast, the coefficient of relative risk aversion has a negative effect on the expected stock returns.

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