Chapter 3

Theoretical Framework

3.1 Introduction

A stock market is a place for the transaction of stocks between buyers and sellers. Investments are made by investors with expectations of profit. They will only be undertaken if their value exceeds the cost of acquiring and installing the necessary investment. Investing in the stock markets is an exciting process. Portfolio managers in France, Germany, and England for decades have routinely invested a large fraction of their portfolio in securities that were issued in other countries (Elton and Gruber, 1995). Section 3.2 defines Tobin's q theory which is used to explain the decision making and demand of investment by investors. Section 3.3 defines the literature of the internationalization of stock markets. Section 3.4 contains a brief discussion of the theory of the internationalization of stock markets. Section 3.5 concludes this chapter.

3.2 Tobin's q Theory

From an economics view point, there is Tobin's q theory (Tobin,1969) which can be used to explain the decision making and demand of investment by investors. This is captured in the following equations:

$$1 + C'[I(t)] = q(t) \qquad (3.2.1)^{18}$$

and

$$q(t) = \int_{\tau = t}^{\infty} e^{-r(\tau - t)} \pi(K(\tau))\, d\tau \qquad (3.2.2)^{19}$$

where C is the adjustment costs[20], given by the cost of acquiring a unit of capital equals to the purchase price (which is fixed at 1) plus the marginal adjustment cost. The equation *(3.2.1)* states that the firm invests capital to the point where the cost of acquiring capital equals the value of the capital. Equation *(3.2.2)* states that the value of a unit of capital at a given time equals the discounted value of its future marginal revenue products.

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[18] Kindly refer to *Appendix I* for detail.
[19] Kindly refer to *Appendix 1* for detail.
[20] Adjustment costs come in two forms, internal and external. *Internal adjustment costs* arise when firms face direct costs of changing their capital stocks. Examples of such costs are the costs of installing the new capital and training workers to operate the new machine. *External adjustment costs* arise when firms face situation where the price of capital goods relative to other goods adjusts so that firms do not wish to invest or disinvest at infinite rate (Romer 1996).

The q summarizes all information about the future that is relevant to a firm's investment decision. q shows how an additional dollar of capital affects the present value of profits. Thus the firm wants to increase its capital stock if q is high and reduce it if q is low (Romer, 1996).

Although the above expression of q is from the view point of firm, q has a natural economic interpretation for the investor. A one unit increase in the firm's capital stock increases the present value of the firm's profits by q, and thus raises the value of the firm by q. Thus q is the market value of a unit of capital. If there is a market for shares in firms, for example, the total value of a firm with one more unit of capital than another firm exceeds the value of the other by q (Romer, 1996). For a rational investor, he or she will want to increase his or her holding shares of a firm if it's q is high and reduce it if q is low.

3.3 The Internationalization of Stock Markets

There are two views that can be identified in the literature regarding the internationalization of the stock markets. One group of studies such as Grubel (1968), Levy and Sarnat (1970) and Ripley (1973) has investigated the potential gains to an investor from diversifying his or her portfolio across countries and indicates that there are gains from international diversification, particularly into markets with a low correlation with the domestic stock market. These benefits tend to accrue in the short term, since in the long run, country-specific factors tend to wash over into other countries (Taylor and Tonks, 1989).

The second view in the literature has been to study whether stock markets are segmented or integrated. In a segmented market, assets are priced according to factors particular to that domestic market. This approach treats the different national stock markets as separate entities with different currency areas, separate political organizations and trade barriers, the stock markets are hardly related to each other (Agmon 1972). In an integrated stock market, domestic assets are priced according to international factors (Taylor and Tonks, 1989). According to Stehle (1977), if there were no barriers to international capital flows theoretically, all the assets in all the countries should be priced according to an integrated world market. For the purpose of this study, we make use of the international asset pricing model (IAPM) theoretical frame which is developed by Solnik (1974).

3.4 The International Asset Pricing Model (IAPM)

According to Solnik (1974) the traditional form of Sharpe-Lintner capital asset pricing model has its limitations because it only considers national investment. It is not true that it could easily be extended by simply including foreign investment opportunities in the market portfolio. Among the various complexities of such a task are the non-existence of a universal risk free asset and the presence of exchange risk which alters the characteristics of the same investment for different nationals. Therefore, the most realistic description of the international relations of stock prices seems to be a multi-index specification taking into account both national and international factors.

Following Solnik (1974), the international asset pricing model (IAPM) can be represented by two equations which link the price of a security to national and world factors respectively and assuming all capital markets to be perfect with free flow of capital between nations. There is a common world currency to abstract from exchange risk problems, which implies a common world risk-free rate of interest denoted by r. Each individual will invest in his or her domestic risk free asset, domestic common stocks, foreign stock and foreign risk free assets which are pure exchange risk free assets to maximize his or her expected utility. Under certain assumptions of market perfection and the consumption behaviour of investors, the IAPM has been developed by Solnik (1974).

The equations can be written as below:-

$$\check{r}_{ki} = \alpha_{ki} + \beta_{ki} (\check{I}_k - \alpha_k) + \eta_{ki} \quad \text{for all } i \text{ and } k \qquad (3.4.1)$$

and

$$\check{I}_k = \alpha_k + \gamma_k (\check{r}_m - \alpha_m) + \varepsilon_k \quad \text{for all } k \qquad (3.4.2)$$[21]

where, $\check{r}_{ki}$ is the (realized) return on security k_i of country k

α_k is the expected return on that index

β_{ki} is the national systematic risk of security k_i

$\check{I}_k$ is the (realized) return on the national index of country k

γ_k is the international systematic risk of country k.

ε_k is a term which represents the degree of segmentation in the national market

If ε_k is identically zero, integrated markets are implied by substituting *(3.4.2)* into *(3.4.1)* and denoting $\gamma_{ki} = \beta_{ki} \gamma_k$ where γ_{ki} is the international systematic risk of asset k_i.

A straightforward test for whether the country-specific factors, ε_k, have diminished in importance over time is to compute the correlation coefficients between the returns of the market portfolio for two countries over two separate time periods; a significant

[21] Kindly refer to *Appendix II* for detail.

increase in the correlation coefficient will imply that the two stock markets have become more integrated (Taylor and Tonks, 1989).

If stock market returns from country *j* and *k* are perfectly correlated in the long run, then we would have the long-run relationship $\alpha_j = b\alpha_k$ for some scalar *b*. If the stock market returns are approximated as the percentage change in the portfolio index per unit period, then stock market integration in the long run implies a linear relationship between the respective *logarithms* of the portfolio price indices, S_j, S_k (Taylor and Tonks, 1989).

In the short run, however, the relationship may be significantly distorted by the joint effect of country-specific factors, which can be represented by the random variable *e* :

$$S_j = a + b S_k + e \qquad (3.4.3)$$

where *a* is some arbitrary scalar.

Typically, many economic and financial time series will require first differencing in order to induce stationarity (they are "integrated of order one," *I (1)* - Engle and Granger, 1987). In order to test for this proposition, firstly we use Augmented Dickey Fuller (ADF) Test (1979, 1981) to test for unit roots, followed by Johansen and Juselius (1990) cointegration test to test whether S_j and S_k are *I (1)*. If S_j and S_k are *I (1)* then *e* in *(3.4.3)* must be stationary and integrated of order zero, *I (0);* only if we can reject the hypothesis of $I(1)$ residuals in the cointegration regression then we can claim to find cointegration between S_j and S_k, and hence a form of long-run stock market integration (Taylor and Tonks, 1989).

According to the " Granger Representation Theorem" (Engle and Granger, 1987), if two variables are cointegrated, then they have an error correction representation – i.e., there exists a bivariate vector autoregressive representation of the first differences of the variables, with each equation augmented by one lag of the cointegrating residual. Given the dynamic form of the error correction representation, this means that one stock market index must help in forecasting the other – i.e., there must be Granger-causality in at least one direction. It is also of interest, however, to examine the direction of Granger-causality between Malaysia and overseas markets, i.e., whether market trends tend to originate in Malaysian stock market and spill overseas, or vice versa, or whether there is bi-directional feedback.

3.5 Conclusion

In this chapter we have discussed the international asset pricing model (IAPM) which is developed by Solnik (1974). The IAPM indicates that stock prices are strongly affected by domestic and international factors. The coming chapter will be more focused on the methodology of testing the stock market integration.

Appendix I (Romer, 1996)

Assumptions:-

1. Consider an industry with N firms. A representative firm's real profits at time t, neglecting any costs of acquiring and installing capital, are proportional to its capital stock, $\kappa(t)$, and decreasing in the industry-wide capital stock, $K(t)$; thus they take the form of $\pi(K(t))\,\kappa(t)$, where $\pi'(\bullet) < 0$. The assumption expresses that the firm's profits are proportional to its capital.

2. There is constant return to scale of production function.

3. Output markets are competitive.

4. Supply of all factors other than capital is perfectly elastic.

5. The firm faces adjustment costs of their capital stocks. The adjustment costs are a convex function of the rate of change of the firm's capital, $\dot{\kappa}$. Specifically, the adjustment costs, $C(\dot{\kappa})$, satisfy $C'(0) = 0$, and $C''(\bullet) > 0$. The assumption implied that it is costly for a firm to increase or decrease its capital stock, and the marginal adjustment cost is increasing in the size of the adjustment.

6. Purchase price of capital goods is constant and equal to 1; thus there are only internal adjustment costs.

7. Finally, the depreciation rate is assumed to be zero; thus $\dot{\kappa}(t) = I(t)$, where I is the firm's investment.

The firm's problem is to maximize its profits with the continuous-time objective function. The first step is to set up *the current-value Hamiltonian*:

$$H(\kappa(t), I(t)) = \pi(K(t))\,\kappa(t) - I(t) - C(I(t)) + q(t)\,[I(t) - \dot{\kappa}(t)] \quad (1)$$

The first condition characterizing the optimum is the derivative of the Hamiltonian with respect to the control variable at each point in time is zero. This condition is,

$$1 + C'(I(t)) = q(t) \quad (2)$$

The second condition is that the derivative of the Hamiltonian with respect to the state variable equals the discount rate times the costate variable minus the derivative of the costate variable with respect to time. In this case, the condition is,

$$\pi(K(t)) = r\,q(t) - \dot{q}(t) \quad (3)$$

The final condition is the continuous-time version of the transversality condition:

$$\lim_{t \to \infty} e^{-rt}\, q(t)\, \kappa(t) = 0 \tag{4}$$

Equations *(2)*, *(3)* and *(4)* characterize the firm's behaviour.

Finally, it is useful to note that we can express q, the value of capital, in terms of capital's future marginal revenue products.

$$q(t) = \int_{\tau=t}^{T} e^{-r(\tau-t)}\, \pi(K(\tau))\, d\tau + e^{-r(T-t)}\, q(T) \tag{5}$$

for any $T > t$. One can show that the transversality condition implies that the second term approaches zero as T approaches infinity. Thus we have

$$q(t) = \int_{\tau=t}^{\infty} e^{-r(\tau-t)}\, \pi(K(\tau))\, d\tau \tag{6}$$

Expression *(6)* states that the value of a unit of capital at a given time equals the discounted value of its future marginal revenue products.

Appendix II (Solnik, 1974)

According to Solnik (1974), a stochastic security price process which considers the national characteristics of the international capital market structure would be more appropriate. In other words, all securities are affected by the international factor through their national index.

For a security k_i of country k, this can be written as:

$$\tilde{r}_{ki} = \alpha_{ki} + \beta_{ki} (\tilde{I}_k - \alpha_k) + \eta_{ki} \quad \text{for all } i \text{ and } k \qquad (1)$$

where $\tilde{r}_{ki}$ is the (realized) return on security k_i of country k, $\tilde{I}_k$ is the (realized) return on the national index of country k, α_k is the expected return on that index, β_k is the *national* systematic risk of security k_i.

For national indices:-

$$\tilde{I}_k = \alpha_k + \gamma_k (\tilde{r}_m - \alpha_m) + \varepsilon_k \quad \text{for all } k \qquad (2)$$

where γ_k is the *international* systematic risk of country k.

The variables η_{ki} and ε_k assumed to be normal random varaibles with standard linear independence conditions between themselves, $\tilde{r}_m$ and $\tilde{I}_k$. Some important results can be derived from this price structure.

It can be shown by computing γ_k : $\gamma_k = \dfrac{cov(\check{r}_{ki}, \check{r}_m)}{var(\check{r}_m)}$

replacing from *(1)* and *(2)*,

$$\gamma_k = \frac{cov(\check{r}_m - \alpha_m, \beta_{ki}\gamma_k(\check{r}_m - \alpha_m) + \beta_{ki}\varepsilon_k + \eta_{ki})}{var(\check{r}_m)}$$

Since $cov(\check{r}_m - \alpha_m, \varepsilon_k) = cov(\check{r}_m - \alpha_m, \eta_{ki}) = 0$, it can be derived that,

$$\gamma_k = \beta_{ki}\gamma_k \frac{cov(\check{r}_m - \alpha_m, \check{r}_m - \alpha_m)}{var(\check{r}_m)} = \beta_{ki}\gamma_k$$

$$\gamma_k = \beta_{ki}\gamma_k \qquad (3)$$

Equation *(3)* shows that the international systematic risk of γ_{kk} of a security k_i is equal to the product of the national systematic risk of that security, β_{ki}, by the international risk of its country, γ_k.