CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter discusses the data set, theoretical framework and data analysis techniques used in the study.

3.2 Data

The data set used in this study consists of annual observations on profitability in selected firms from different sectors, which are listed in the KLSE Main Board.[2] The selection criterion is to include only firms with a complete run of data of 15 observations (from 1985 to 1999) in the analysis. Profitability for firm i at time t, π_{it}, i = 1, 2, ...N, t = 1, 2, ...T, is measured by the return on assets, defined as profit after tax divided by total assets. The data set is collected from the KLSE Annual Companies Handbook 1989 and 1990 for the period from 1985 until 1989. Data from 1990 and onwards are downloaded from the KLSE-RIS website at http://www.klse-ris.com.my. Table 3.1 shows the sectors involved and the number of firms included in each sector. The firms are listed in Appendix I.

[2] The allocation of firms within their respective sector is as on November 2000.

Table 3.1 Number of firms included in each sector

Sector	Number of firms
Construction	8
Consumer Products	26
Finance	12
Hotels	3
Industrial Products	39
Mining	4
Plantation	27
Properties	37
Trading / Services	33

3.3 Theoretical Framework

The theoretical framework discussed in this section follows the study of Glen et al. (2000) in the model used for testing the speed of convergence of profit rates (discussed below), it is assumed that the profit rate of a firm (or industry) i at time t (π_{it}) consist of

a. the profit rate that would be earned in perfectly competitive industry (c), known as the 'normal' profit rate,

b. the firm-specific permanent rent (r_i), and

c. a short run or transitory component (s_{it}) reflecting the influence of short-run factors.

Thus, the profit rate is given as follows:

$$\pi_{it} = c + r_i + s_{it} \qquad (3.1)$$

The first two components are considered to be long-run in nature and represent the permanent profit rate of the firm ($\pi_{ip} = c + r_i$). In terms of persistence, the profit rate is composed of a permanent and a transitory component that can be written as

$$\pi_{it} = \pi_{ip} + s_{it} \qquad (3.2)$$

Traditionally, the competitive return is approximated by the yield on long-term government securities. Whereas, r_i is usually assumed to reflect the effective cost of entry into (or exit from) the industry and hence the level of abnormal profits that are sustainable.

The terms 'permanent' and 'transitory' implicitly assume that the erosion of r_i takes place on long time scale, whereas s_{it} in the fast time scale. Let τ and $\bar{t}$ denote the fast and slow time variables respectively. If the time interval T during which we seek to examine the behaviour of the profit rate is such that $\tau << T \sim O(\bar{t})$, then it is appropriate during that period to focus on the variation of s_{it} alone. The period t is measured in years. If $\tau << t$, we could assume that the transitory components in successive years are uncorrelated, whereby, cor $(s_{it}, s_{it+1}) = 0$. This implies that the forces of competition function rapidly such that any short-run rents earned this year are independent of any rents that were earned last year. If t and τ are of same order, a more reasonable assumption would be that cor $(s_{it}, s_{it+1}) \neq 0$, whereby the short-run rents are intertemporally related.

For computational convenience, s_{it} is assumed to follow the first-order autoregressive process

$$s_{it} = \lambda_i s_{it-1} + u_{it} \qquad (3.3)$$

where for stationarity, $|\lambda_i|<1$ and u_{it} represents independently and identically distributed random errors with zero mean and finite variance. The following begins by taking equation (3.2) with one period lag, multiplying both sides with λ_i,

$$\lambda_i \pi_{it-1} = \lambda_i \pi_{ip} + \lambda_i s_{it-1}$$

subtract the resulting equation from (3.2),

$$\pi_{it} - \lambda_i \pi_{it-1} = (1-\lambda_i)\, \pi_{ip} + s_{it} - \lambda_i s_{it-1}$$

Using equation (3.3),

$$\pi_{it} = (1-\lambda_i)\, \pi_{ip} + \lambda_i\, \pi_{it-1} + u_{it}$$

Therefore,

$$\pi_{it} = \alpha_i + \lambda_i\, \pi_{it-1} + u_{it} \qquad (3.4)$$

where $\alpha_i = (1-\lambda_i)\pi_{ip} = (1-\lambda_i)(c + r_i)$. The values of α_i and λ_i can be estimated from equation (3.4) and then the permanent component of the rate of profit becomes

$$\pi_{ip} = \frac{\alpha_i}{1-\lambda_i}. \qquad (3.5)$$

For analysis purposes, it offers more intuition to use $Y_{it} = \pi_{it} - \pi_t$, where π_t is the average of the π_{it} across firms. The measure of Y_{it} represents the deviation of the profitability of firm i at time t from the average profitability of all other firms at that time. This implies that firm i earns profits above (below) the average in year t, if Y_{it} is positive (negative) respectively. This standardisation has the advantage of eliminating the effects of cyclical factors on profits that operate at the aggregate level. This approach is used by Glen et al. (2000), Y_{it} represents the abnormal profit earned by firm i in period t. Without any change in the earlier discussion, equation (3.4) can be applied in the same manner for Y_{it}, that is

$$Y_{it} = \alpha_i + \lambda_i\, Y_{it-1} + u_{it} \qquad (3.4')$$

Consequently, $YLR = \pi_{ip} = \frac{\alpha_i}{1-\lambda_i}$ (3.5')

Additional restriction is imposed, whereby $0<\lambda_i<1$. It is assumed that $\lambda_i > 0$ to ensure that Y_{it} does not oscillate between positive and negative values in successive years. The parameter '$1-\lambda_i$' measures the speed of adjustment and indicates how quickly the profit rate (Y_{it}) approaches its long-run equilibrium level (YLR). Consequently, λ_i is the degree of persistence. There are 3 possible outcomes:

a. When $\lambda_i = 0$, Y_{it} has the properties of a white noise process, centred on a non-zero mean if $\pi_{ip} \neq 0$. This means that abnormal profit is not persistent. The condition implies that the competitive pressure on firm i (exerted by actual and threatened entry) is sufficiently strong that any abnormal profit earned at time t-1 is dissipated completely by time t. This case corresponds to a firm operating under highly competitive conditions, with zero or low entry barriers and rapid transmission of information.

b. When $0<\lambda_i<1$, Y_{it} is a stationary AR(1) process with mean YLR. The persistence of abnormal profit (measured by the magnitude of λ_i) is short-run in nature. The competitive process exerts some discipline on firm i's profits, whose time path always tend to revert towards YLR. Any abnormal profit earned by firm i in year t will tend to decay, following a time path proportional to λ_i, λ_i^2, λ_i^3 ... in years t+1, t+2, t+3, ... until complete dissipation. The greater is the value of λ_i, the slower the decay, and the more successful is firm i in insulating itself from competitive pressure.

c. When $\lambda_i = 1$, barriers to entry are sufficiently high that abnormal profit earned by firm i does not produce any threat of entry. Y_{it} is a non-stationary AR(1) process (or random walk) and profitability is completely persistent. The competitive process exerts no influence on firm i's profit, whose value at time t is the summ

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specifically on expected positive or negative excess returns (relative to the long-term norm). However, the classic latent variable problem distorted the estimation of a full structural model, whereby changes in profits are a function of the threat of entry, rather than entry itself. Even if no entry takes place, the threat of entry may induce firms to lower prices and profits as a strategic option. Geroski (1991) emphasises the distinction between imitative and innovative entry. The former is an equilibrating force that dissipates abnormal profit, driving markets towards equilibrium. The latter is disequilibrating, creating a new configuration of those firms that are able to adapt to the change, and that ultimately will progress towards a new equilibrium. Equation (3.4) has the virtue of not requiring any unobservable variables to map competitive dynamics. However, equation (3.4) does not allow us to distinguish between different sources of persistence, which could be monopoly power or efficacy of management's policy and its implementation. Entry and exit forces that erode excess profit apply to both sources of such profits.

3.4 Data Analysis Techniques

The methodology adopted follows closely the work of Glen et al. (2000). The difference is that the analysis in this study is performed by sector. The regression analysis is based on the transformed profitability measure $Y_{it} = \pi_{it} - \pi_t$ for each sector. This means that π_t is the average of the π_{it} across firms for a particular sector. The measure of Y_{it} in this case represents the deviation of the profitability of firm i at time t from the average profitability of all other firs within the same sector for the same time period. The analytical framework discussed earlier can be extended to higher autoregressive processes.

In this study, the analysis is based on second-order autoregressive (AR) model of the form

$$Y_{it} = \alpha_i + \lambda_{1i} Y_{it-1} + \lambda_{2i} Y_{it-2} + \varepsilon_{it} \qquad (3.6)$$

for i = 1, 2, ..., N and t = 1, 2, ...T, where α_i, λ_{1i}, and λ_{2i} are coefficients and the ε_{it} are random errors. This analysis is performed sector by sector.

Since our period of study is relatively short, it is reasonable to impose a second-order autoregressive model. Essentially, both equation (3.4') and (3.6) provides a simple characterisation of the dynamics of profitability for each firm. If $\lambda_{2i} = 0$ for all i, then the estimates of λ_{1i} provide a direct measure of the speed of adjustment of profitability following a shock. Adjustment to equilibrium is monotonic when $\lambda_{1i} < 1$ is assumed. Thus, profitability is less sticky in firms with smaller values of λ_{1i}. When λ_{2i} is not zero, adjustment to a shock can take place non-monotonically. There is no unique way of characterising the speed of adjustment based on the estimated parameters. Hence, there is no unique ranking of firms' speeds of adjustment. Therefore, we shall treat $1-\lambda_i = 1 - (\lambda_{1i} + \lambda_{2i})$ as an indication of the speed of adjustment.

3.4.1 Testing for the presence of unit roots

In the analysis of the persistence of profitability, it is examined whether a unit root exists in the profitability data. The presence of a unit root implies that shocks to profitability are permanent in nature and competitive pressures do not reduce differentials in profitability.

Before analysing the speed of adjustment of profitability in model (3.6), it is necessary to examine if any unit root is present in the profitability series. The tests of the unit root hypothesis are known to have low power and the problem is more serious due to relatively short time period of observations for each firm.

Glen et al. (2000) proposed to use a relatively powerful test of the unit root hypothesis provided by Im et al. (1997) to handle the panel structure of the data. The test is known as the standardised t-bar test, which is based on the average value of the Augmented Dickey Fuller (ADF) statistics calculated for each of the individual firms' data. Im et al. showed that the standardised t-bar statistic has a standard normal distribution when N and T are large and $\sqrt{\frac{N}{T}}$ is small. For smaller samples, they provide the appropriate critical values obtained through Monte Carlo simulations. Equation (3.6) can be rewritten as follows in the form of the Dickey Fuller regression:

$$\Delta Y_{it} = \alpha_i + \beta_i Y_{it-1} + \gamma_i \Delta Y_{it-1} + \varepsilon_{it} \qquad (3.7)$$

where $\beta_i = \lambda_{1i} + \lambda_{2i} - 1 = \lambda_i - 1$ and $\gamma_i = -\lambda_{2i}$. The ADF statistic is given by the t-statistic of the coefficient β_i.

In calculating the ADF statistics, it is important that ε_{it} do not exhibit serial correlation. Despite the relatively small samples size, the inclusion of the lagged ΔY_{it-1} term is potentially important. However, the inclusion of an unnecessary additional regressor must be avoided if it does not contribute to the regression. In this study, the software Eviews is used for all the estimations. The standardised t-bar statistic is computed as the average value of the ADF statistics for firms within the same sector. Further steps would be to determine whether the computed average value of the ADF statistics is less than simulated critical value from Im et al. (1997). If it is, the null hypothesis of a unit root in Y_{it} is rejected. Thus, the series is stationary, which implies that abnormal profits are not persistent.

If Y_{it} is stationary, the estimates for equation (3.7) can be applied to make inferences on the speed of adjustment ($1-\lambda_i$) and the long-run equilibrium profitability (YLR). In contrast to the speed of adjustment, λ_i represents the degree of persistence. When the value of λ_i is higher, so does the degree of persistence. As for the long run equilibrium profitability ($YLR = \frac{\alpha_i}{1-\lambda_i}$), the mean value of the YLR_i estimates lies relatively close to zero implies that for the average firm, there is no long-run excess profits.

Finally, comparisons of average rate of return, the speed of adjustment and long-run equilibrium profitability for different sectors are made in this study. These procedures are conducted in 3 sets of regression models. In the first set, the regression model excludes ΔY_{it-1} (known as Model 1) that would take the form of $\Delta Y_{it} = \alpha_i + \beta_i Y_{it-1} + \varepsilon_{it}$. This assumes that $\lambda_{2i} = 0$. In the second set, the regression model includes ΔY_{it-1} (known as Model 2) that would take the form of equation (4.7). The third set of the regression model (Model 3) is chosen between Model 1 and Model 2 through a specification search, whereby the value of Schwarz criterion for both models are compared to determine the form of regression model that is better for each firm. The decision is to choose the model with smaller Schwarz criterion.

As we presume that $\lambda_i = \lambda_{1i} + \lambda_{2i}$, $\lambda_i = \beta_i + 1$ applies to both models (Model 1 and Model 2). The $YLR = \frac{\alpha_i}{1-\lambda_i} = \frac{\alpha_i}{-\beta_i}$ will also be the same for both models. The critical value for the unit root hypothesis test will be the same for both models. Thus, all models are comparable owing to the same comparison thresholds. In addition to the estimation of the regression model, we also test the significance of long-run equilibrium profitability (YLR) at 5%. This means testing for $YLR = \frac{\alpha}{1-\lambda} = 0$, or essentially testing H_0: $\alpha = 0$. The t-test can be applied for this purpose.