The Impact of Different Industrial Classification Schemes on Firm Performance: An IVs Analysis

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Abstract

Market concentration ratio is argued to be an important driver of the firm performance. The measurement of its influence, however, is difficult since it is considered to be an endogenous variable. This paper applied the instrumental variables (IVs) approach using the SCP paradigm to model company performance. A panel analysis is carried out against a sample of 641 companies listed on the Main Board of Bursa Malaysia, over the period 2001 to 2006. The Durbin-Wu-Hausman (DWH) test results provide some support for the contention that the market concentration ratio variables are endogenous for SIC and Bursa classifications. After the market concentration ratio variables have been instrumented, it has a positive impact on firm performance. In addition, firm performance was found to be positively related to leverage, but negatively affected by firm capital intensity and openness.

Keywords: Instrumental variables; Endogeneity; Market concentration; Firm performance; Industrial classification; Panel

JEL Classification: L20, L22, L25, C13, C14, C23, C26

1. Introduction

There has been a longstanding tradition in industrial economics of modelling firm profitability, which can be traced back to the seminal contribution of Bain (1951) and the 'so-called' Structure, Conduct, Performance (SCP) model. This model suggests that the performance of a firm depends upon its conduct which, in turn, depends upon the industry, or the market, in which it operates. The empirical economic literature on firm performance has focused heavily on the role of industry concentration and firms' market share (e.g. Schmalensee (1989) and Feeny and Rogers (1999)). Companies are owned by shareholders and thus the primary measure of performance is profitability[3]. The main objective of this paper is to apply this model to the companies listed on the Main Board of Bursa Malaysia using the 12 sector classification the Board employs. In this, firms are grouped according to their key economic activities. However, two other industrial classification schemes, namely the North American Industry Classification System (NAICS) and the Standard Industry Classification (SIC) are included in the analysis for purpose of comparison. The roles of market share, market concentration ratio, firm size, leverage, openness, industry growth, firm growth, labour productivity and firm capital intensity are also subjected to empirical scrutiny.

Over the decades, research in this field has advanced in two directions: empirical models have become richer and econometric techniques more sophisticated. Therefore, the paper begins modelling firm performance within the framework of SCP paradigm, using an instrumental analysis technique. The work then investigates how sensitive the results are to the choice of industrial classification and it was revealed that certain of them were, as anticipated, sensitive to the classification scheme utilised. The paper is organised as follows: the next section examines some past related studies in Malaysia. The econometric issues will be discussed in Section 3. In Section 4, the methodology and the data are outlined and, the definitions of the different industrial classification schemes are briefly explained. Section 5 presents the results from empirical tests of the performance hypothesis. Section 6 concludes the paper.

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[3] Although agency theory suggest that managers may pursue their own goals (Jensen and Meckling, 1976).

2. Related Malaysian Studies

Malaysia is a small, open and fast growing economy which has been recognized as one of Asia's dynamic industrializing countries. Past research focusing on the manufacturing showed that barriers to entry (e.g. scale economies, capital requirements, advertising and product differentiation) were correlated with industries' profitability. Gan and Tham (1977) found that barriers of entry had a significant influence on industry price-cost margins (PCM) and that concentration was positively related to profitability. In a similar vein, Gan (1978) showed that concentration was related to profitability but that this relationship was discontinuous.

Bhattacharya (2002) used cross-sectional analysis and partial adjustment model to investigate 102 manufacturing industries at the five-digit level between 1986 and 1996[4]. He found that domestic factors such as capital intensity, advertising intensity and market size were significant in most cases in explaining the level of concentration. The annual adjustment rate of concentration was lower compared to developed countries. Labour productivity and the net entry of firms were significant in explaining the adjustment procedure.

A few studies have also attempted to ascertain the influence of imports, exports and foreign direct investment (FDI) on competition. Rugayah (1992) found some evidence that exports and imports are related to market concentration but this has been refuted by Zainal and Phang (1993) [cited from Lee (2004)]. Using the 46 industries at the four-digit level in Malaysia manufacturing industry to test the relationship between market concentration and its determinants, Lall (1979) found that barriers of entry (e.g. scale economies, capital requirements and product differentiation) affected industry profitability while FDI was positively related to concentration but that this impact was greater in the non-consumer goods industries. A more recent study by Lee (2004) found that the propensity to innovate was positively correlated with market concentration.

In an attempt to test the simultaneity between market concentration and industry PCM in the West Malaysia, Kalirajan (1993) found that the simultaneity did not hold true in the case of Malaysian manufacturing industries and single equation approach may provide reliable results, which corroborates earlier findings for developed countries. Foreign investment appeared to be the most important variable determining both concentration and PCM in West Malaysia. The present study contributes to the limited literature in the area.

3. Econometric Issues

In an economic model, an endogenous change is one that comes from inside the model and is explained by the model itself. Endogeneity is the degree to which a variable's value can be explained by the model. For example, in the simple SCP model, suppose that there is a change in concentration or advertising intensity; this would imply an exogenous change on profitability. However, the resulting change in equilibrium profit can now be derived given only the exogenous variables, and is an endogenous output of the model. Therefore, the profit variable has total endogeneity in this model, once the profit, concentration, advertising values are known.

The problem of endogeneity in econometrics occurs when there is feedback between the dependent and an independent variable[5]. This causes the independent variable to be correlated with the error term in a regression model and implies that the regression coefficient in an OLS regression is biased. Therefore, in this case one should use a simultaneous equations estimator, instead of OLS.

There are several methods to estimate a simultaneous equation model. These methods fall into two broad categories: single-equation methods, also known as limited information methods, and system methods, also known as full information methods (Gujarati, 1995). In the single equation methods, we estimate each equation in the system individually, taking into account any restrictions placed on that equation, such as exclusion of some variables, without worrying about the restrictions on the other equations in the system. On the other hand, in the system methods, we estimate all the equations in the model simultaneously, taking due account of all restrictions on such equations by the omission or absence of some variables.

[4] The author managed to get the supplied of unpublished data from the survey conducted by the Department of Statistics (West Malaysia, Kuala Lumpur) on manufactures for 1986 and 1996.

[5] Feedback creates the familiar simultaneous-equations bias in the OLS estimator of the effect of concentration on price. Froeb and Werden (1991, pp. 10-12) derive the asymptotic bias in the OLS estimator for a simple symmetric model with linear demand, constant marginal cost, Cournot competition, and feedback only through entry and exit (cited from Evans et al., 1993, pp. 432-433).

For reasons of economy, specification errors, etc. the single equation methods are by far the most popular (Klein, 1974, p. 150). The commonly used single equation method is two-stage least squares (2SLS). The basic idea behind 2SLS is to replace the endogeneous explanatory variable by a linear combination of the predetermined variables in the model and use this combination as the explanatory variable in lieu of the original endogenous variable. The 2SLS method thus resembles the instrumental variables (IV) method of estimation in that the linear combination of the predetermined variables serves as an instrument, or proxy, for the endogenous regressor. Other single equation methods are recursive models[6] and indirect least squares[7] (ILS).

In theory, limited information methods are not fully efficient because they ignore the possibility that information concerning the structure of one equation in a system could be used to improve the efficiency of estimator in another. However, system methods, for example three-stage least squares (3SLS), require that the system specification is correct. 3SLS procedure of Zellner and Theil (1962) is a technique to analyse multivariate data which combines 2SLS with seemingly unrelated regression (SUR)[8]. It provides consistent estimates for linear regression with explanatory variables correlated with the error term. It also extends ordinary least squares analysis to estimate system of linear equations with correlated error terms. However, misspecification of a single equation can contaminate all parameter estimates in the model.

In terms of studies which explicitly address the endogeneity issue, Evans et al. (1993) pointed out that concentration may not be exogenous for two reasons. First, performance feeds back into market structure. According to these authors, the structure of an industry reflects a complicated evolutionary process involving feedback from conduct and performance to structure. Among these feedback processes are investment in new capacity, research and development, and, especially, entry and exit. To oversimplify quite a bit, relatively profitable industries are attractive for entry, and relatively unprofitable ones are attractive for exit. Over time, structure evolves as performance feeds back into structure. Furthermore, concentration causes price, but price also causes concentration. In addition, the concentration variable is normally a function of endogenous firm outputs or revenues. In general, prices and outputs are endogenous, so too is the concentration of output or revenue. In concentration-price regressions for the airline industry, and using a combination of instrumental variables and fixed effects procedures, the authors exploited the unique structure of panel data and produced an unbiased estimate of the effect of concentration on price, which exceeded the OLS estimate by about 250 percent (p. 437).

Feedback from performance to structure is the sort of endogeneity problem that was also addressed by Bresnahan (1989) and Schmalensee (1989). A form of feedback from performance to structure also was the basis of the critique offered by Demsetz (1973) and Peltzman (1977) in their concentration-profit studies. They postulated that there was a certain quality possessed by a limited number of firms that allows them to operate at a lower cost, or to produce a better product than others. These superior firms grow, increasing market concentration, but also decreasing average cost, or increasing quality. This causes profits to be positively related to concentration, but that relationship says nothing about the likely effects of mergers. Although the Demsetz-Peltzman critique was a factor leading many economists to turn from concentration-profit studies to concentration-price studies, the more general observation is that performance feeds back into structure and affects the concentration-price relationship as well.

Instrumental variables is one way to consistently estimate the parameters in a linear model when one or more explanatory variables is endogenous. An instrumental variable must have two properties: (1) it must be exogenous, that is, uncorrelated with the error term of the structural equation and (2) it must be partially correlated with the endogenous explanatory variable. In reality, finding a variable with these two properties is usually challenging (Wooldridge, 2006, p. 540). Moreover availability of appropriate instruments also allows one to analyse and test the model for the significance of endogenous effects (Zheka, 2006, p. 34).

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[6] A recursive model is a model in which the current values of a variable affect the current value of another, while the previous values of the second variable have already affected the current values of the first. This model does not exhibit such a unilateral cause and effect relationship, and therefore, is inappropriate.

[7] In this method, OLS is applied to the reduced-form equation, and it is from the reduced-form coefficients that one estimates the original structural coefficients.

[8] SUR (Zellner, 1962) is a generalisation of a linear regression model that consists of several regression equations, each having its own dependent variable and potentially different sets of exogenous explanatory variables, and each equation is a valid linear regression on its own and can be estimated separately.

Statistically, IV methods allow consistent estimation when the explanatory variables (covariates) are correlated with the error terms. Such correlation may occur when the dependent variable causes at least one of the covariates ("reverse" causation) (Pearl, 2000). In this situation, although ordinary linear regression generally produces biased and inconsistent estimates (Wooldridge, 2006, p. 179), if an *instrument* is available, consistent estimates may still be obtained. An instrument is a variable that does not itself belong in the explanatory equation and is correlated with the endogenous explanatory variables, conditional on the other covariates (Wooldridge, 2006, p. 512).

In term of an estimation strategy, this implies that modelling concentration in a structural-type equation – with the ultimate determinants of concentration estimated via instrumental variables or simultaneous equations technique – or one could estimate a reduced form price-cost margin equation with concentration 'instrumented out'. In this study, we employed a structural-type equation via instrumental variables because it allows us to examine directly the effects of concentration and analyse other effects. It is also possible to test for endogeneity, or otherwise, of the concentration variable through the Durbin-Wu-Hausman specification test.

In the current application, lagged firm size, lagged market concentration and market share are used as instrumental variables to control for potential endogeneity[9]. In reality, it is difficult to find 'good' instruments. There is no 'correct answer' for this. How much credence should be granted to instrumental variable analysis? Murray (2006) said it depends in part on the quality of the arguments made for the instruments' validity. He also argued that even valid instruments that are correlated with the troublesome variable might still prove too inefficient to be informative. Evans et al. (1993) used a one-year lagged Herfindahl as the instrument in their model to estimate the effect of concentration on price in the airline industry. Economic theory provides no guidance as to the selection of instruments and so this choice has to be an empirical matter. Initially, a lagged market concentration measure was employed as a sole instrument. However, when two additional instruments' – lagged firm size and market share – were entered in the model, standard diagnostic tests indicated enhanced performance, thus they were retained. Ideally, additional market-level instruments would have been utilised but, in this case, none were available.

An alternative approach adopted by Gupta (1983), Pagoulatos and Sorensen (1981), Chou (1986), Kalirajan (1993), Uri (1988), Delorme Jr. et al. (2002) and Martin (1979) would be to use a full simultaneous system and to explicitly model market power. As mentioned earlier, any misspecification problems in any one equation in a simultaneous system affect all parameter estimates in the model and so this approach is not pursued here.

We can test for endogeneity in a regression estimated via IVs. The null hypothesis for this is that an ordinary least squares (OLS) estimator would yield consistent estimates: that is, any endogeneity among the regressors would not have deleterious effects on the OLS estimates. A rejection of the null indicates that the endogenous regressors' effects on the estimates are meaningful, and instrumental variables techniques are required. The test was first proposed by Durbin[10] (1954) and separately by Wu[11] (1973) (his T4 statistics) and Hausman[12] (1978). This Durbin-Wu-Hausman (DWH) test is numerically equivalent to the standard Hausman test, in which both forms of the model must be estimated. Under the null, the statistic distributed as chi-squared with *m* degrees of freedom, where *m* is the number of regressors specified as endogenous in the original instrumental variables regression.

4. Methodology, Data and Industry Classsification

Industrial organisation (IO) is the study of similarities and differences between industries based on the structure of firm sizes within industries, the manner in which firms conduct their business and their economic performance (Clarke, 1989, p. 19). The performance of an industry is the heart, or the most essential, part of the economy. Agents in the economy such as shareholders, economists, businesses, policy makers and government are very concerned with how industry functions and operates in order to achieve higher economic growth and to enable firms to compete in the globalised world.

[9] Appropriate tests were performed, and the reported diagnostics are given in Section 5.

[10] This is a test for the specification error which involves computing the OLS and IV estimates for the parameter, or parameters, of interest, together with their standard errors, and hence can be carried out using a standard regression package.

[11] Wu proposed four tests (T_1, T_2, T_3 and T_4) for the specification error which may be applied in a range of situations where IVs exist for the relevant regressors.

[12] This is a test whether the regressors are independent of the equation disturbance term which can be carried out using any asymptotically efficient estimator and some consistent but asymptotically inefficient estimator (Nakamura and Nakamura, 1981).

According to Manson (1939) and Bain (1956), the basic tenet of the SCP paradigm is that the economic performance of an industry is a function of the conduct of buyers and sellers which, in turn, is a function of the industry's structure. The SCP paradigm suggests that greater market concentration leads to a greater degree of collusion[13] which, in turn, leads to a higher level of industry profit. Up to the 1970's there was general agreement that concentration and profits were positively related. However, during the 1970's a new interpretation of the evidence started to emerge which argued that it is a firm's market share rather than industry concentration which leads to higher rates of return.

In general, the basic model postulates that profitability for a firm depends on structural and firm-related variables. Specifically, let

Profit rate = f [CR, CR^2, MS, MS^2, S, MES, ICI, FCI, LEV, IGR, FGR, OPEN, LP, FC, II, ADV, R&D]

where:
CR = Market concentration (i.e. Herfindahl index and 4-firm concentration ratio)
CR^2 = Market concentration squared
MS = Market share
MS^2 = Market share squared
S = Firm size
MES = Minimum efficient scale
ICI = Industry capital intensity
FCI = Firm capital intensity
LEV = Leverage
IGR = Industry growth
FGR = Firm growth
OPEN = Openness
LP= Labour productivity
FC = Foreign competition
II = Import intensity
ADV = Advertising expenditures
R&D = research and development expenditures

Therefore, to estimate the determinants of profitability for Malaysian industries, we constructed the following regression model. Two alternative measures of market concentration ratios are used (HI and CR4)[14] to test if these measures have a similar impact on profitability. Summary statistics of variables are presented in Appendix I. Preliminary screening of the data revealed no serious bivariate collinearity problems as shown in Appendix II. The final equations selected were:

$$\text{Profit rate} = a_0 + a_1\, ms + a_2\, hi + a_3\, lev + a_4\, lp + a_5\, fg + a_6\, ig + a_7\, fci + a_8\, open + a_9\, asset + u_1 \quad (1)$$

$$\text{Profit rate} = b_0 + b_1\, ms + b_2\, cr4 + b_3\, lev + b_4\, lp + b_5\, fg + b_6\, ig + b_7\, fci + b_8\, open + a_9\, asset + u_2 \quad (2)$$

The existence of persistent differences in profitability is tested for using a sample of 641 firms listed on the Main Board of Bursa Malaysia drawn from the Perfect Analysis and Datastream databases from 2001 to 2006. Financial information retrieved from this database included total sales, total assets, shareholders' equity, gross profit, earnings before interest, taxes, depreciation and amortization (EBITDA)[15] and number of employees.

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[13] Formal collusion illegal in most countries. Tacit collusion gives individual firms the incentive to cheat which actually lowers industry profit.

[14] HI = Herfindahl index and CR4 = 4-firm concentration ratio

[15] Because the amount of debt used to finance a firm's assets will vary both across and within industries, a firm's capital structure choice and associated interest expenses may confound any measurement of profitability based on a denominator of net income. In addition, accounting flexibility in the treatment of depreciation and goodwill across firms may further complicate the analysis. Therefore, to minimise these confounding influences, this paper uses a standardised measure of EBITDA as the dependent variable in the models proposed an approach that follows the work of, *inter alia*, Wayman (2002) and Rogers et al (2010).

Data on imports, exports, gross domestic product and sales by industry were provided by the Department Statistics of Malaysia.

Although we do not have all measures of structure and conduct[16], the available data are useful in shedding some light on the performance effects of structural variables in developing countries. Table 1 shows the notation and how the variables were computed.

Table 1. Definitions of variables.

Variables	Notations	Computation
Profitability	Profit rate	Earnings before interest, taxes, depreciation and amortization / Total assets
Market share	ms	Company sales / Industry sales
Herfindahl index	hi	Sum of squared market share of all companies in an industry
4-firm concentration	cr4	Sum of the four largest squared market shares in an industry
Firm capital intensity	fci	Firm assets / Firm sales
Firm size	asset	Ln (assets)
Leverage	lev	Shareholders' equity / Total assets
Labour productivity	lp	Total sales / Number of employees
Openness	open	(Export + Import) / Gross domestic product
Industry growth	ig	Industry sales in year t / Industry sales in year t-1
Firm growth	fg	Firm sales in year t / Firm sales in year t-1

In addition, the difficulty of how to define an industry, and a market, implies that 'the International Standard Industrial Classification, or any national version of it, is unable to provide a valid statistical basis for the range of analyses presently conducted on it' (Nightingale, 1978, p. 36). This author also stated that many problems occur when using the Standard Industrial Classification to analyse industry models. First, there is the geographical problem; second, the homogeneity problem and, third, the activity approach itself cuts across technical boundaries. He also reported that technological change had outstripped the classification.

Most of the hypotheses subjected to test by the use of SIC data relate as closely to market behaviour as to industry behaviour. The standard example is the attempt to relate profitability of SIC industries to so-called 'seller concentration', which was very popular and dates from the late 1930s. Therefore, in this paper we conduct an econometric analysis not only of the linkages between industrial structure and firm performance but we also focus on the extent to which different industrial classification schemes (either the Bursa Malaysia classification, NAICS or SIC) influence company performance.

This paper deals with three distinct samples. In the first the dataset was based on the current grouping of the Bursa Malaysia which divides the companies into 12 sectors. Then, the one-digit SIC and two-digit NAICS codes were assigned to all companies listed on the Board to form the second and the third set of samples. The broadly defined SIC and NAICS are used because it is the closest classification to the Bursa 12 sectoral classification one. Although it is difficult to ascertain how the level of misreporting can differ across sectors/industries in Malaysia, this study tests for an independent industry classification effect within the SCP paradigm. Table 2 provides brief information on the historical development and basic doctrine behind each of the competing classification algorithms.

[16] Unfortunately, data for advertising expenditure and R&D intensity are not complete, which complicates the use of these measures in analysis.

Table 2. Background information on SIC, NAICS and Bursa Malaysia classifications.

SIC (Standard Industry Classification)	− Oldest among the industrial classifications. − Established in the 1930s by an Interdepartmental Committee on Industrial Classification operating under the jurisdiction of the Central Statistical Board. − The objective is to develop a plan of classification of various types of statistical data by industries and to promote the general adoption of such classification as the standard classification of the Federal Government
NAICS (North American Industry Classification System)	− Jointly developed by governmental statistical agencies in Canada, Mexico and U.S. in 1999. − Improves the SIC by using a production-based framework throughout to eliminate definitional difference; identifying new industries and reorganizing industry groups to better reflect the dynamics of the economy; and allowing first-ever industry comparability across North America.
Bursa Malaysia Classification	− Bursa Malaysia Berhad, formerly known as the Kuala Lumpur Stock Exchange, the only stock exchange in Malaysia, and it is a public company limited by shares under the Companies Act 1965. − The companies listed in Bursa Malaysia are classified according to their main economic activities into 12 sectors.

Source: Bhojraj et al. (2003, pp.7-9) and Palanyandy and Talha (2002)

5. *Results*

Before the market concentration ratio had been instrumented, it had a negative impact on firm performance when we modelled profitability in a non-linear model[17]. Therefore, in this paper, we account for the possible endogeneity of market concentration ratio variables in modelling the firm performance. We are careful to select our instrument set contingent on a test of instrument validity. Therefore, lagged firm size, lagged market concentration and market share are used as instrumental variables to control for this potential endogeneity in our analysis. Appropriate tests are therefore presented, and the reported diagnostics, are given in Table 3.

There are many possible systems which could be used, differing both in the selection of endogeneous variables and in the detailed specification of these equations. While economic theory provides much guidance to solving this model selection problem, the theories we have are too loose to unambiguously select one particular model as preferable to all rivals, but to ensure unbiased and consistent estimation of those parameters, then statistical criteria is necessary to evaluate the appropriateness of any model prior to accepting estimates of its unknown parameters (Geroski, 1982). The Durbin-Wu-Hausman (DWH) test results in Table 3 indicated that we reject the null hypothesis not for NAICS, which means the OLS estimator of the same equation would yield inconsistent estimates for SIC (significant at 1% level) and Bursa (significant at 5% level) classifications. Therefore, the market concentration ratio variables are endogenous for SIC and Bursa classifications.

In order to test for the validity of the instruments, the Sargan (1964) test is used. This is a test of overidentifying restrictions. The joint null hypothesis is that the instruments are valid instruments, i.e., they are uncorrelated with the error term, and the excluded instruments are correctly omitted from the estimating equation. Our Sargan test results do not reject the null hypothesis and this result supports the instruments as valid. The underidentification test is the Lagrange Multiplier (LM) test of whether the equation is identified, i.e., that the excluded instruments are "relevant"; meaning correlated with the endogenous regressors. The test is essentially the test of the rank of a matrix: under the null hypothesis that the equation is underidentified, the matrix of reduced form coefficients on the L1 excluded instruments has rank = K1-1 where K1=number of endogenous regressors. Under the null, the statistic is distributed as chi-squared with degrees of freedom = (L1-K1+1).

[17] Results not reported in this paper.

When errors are assumed to be independent and identically distributed (*i.i.d.*), an LM version of the Anderson (1951) canonical correlations test is reported[18]. We rejected the null hypothesis and this indicates that the matrix is of full column rank, i.e., the model is identified variables.

Table 3. Sargan statistics and LM test for sub-model.

HI			
	SIC (C1)	**NAICS (C3)**	**Bursa (C5)**
Endogeneity test	DWH test = 10.874 (0.0010)	DWH test = 1.682 (0.1946)	DWH test = 4.259 (0.0390)
Underidentification test	Anderson cc LM statistic = 39.033 (0.0000)	Anderson cc LM statistic = 52.291 (0.0000)	Anderson cc LM statistic = 34.029 (0.0000)
Weak identification test [a]	Cragg-Donald Wald F statistics = 13.400	Cragg-Donald Wald F statistics = 18.188	Cragg-Donald Wald F statistics = 11.618
Overidentification test	Sargan statistic = 0.674 (0.7138)	Sargan statistic = 1.583 (0.4531)	Sargan statistic = 4.521 (0.1043)
CR4			
	SIC (C2)	**NAICS (C4)**	**Bursa (C6)**
Endogeneity test	DWH test = 10.740 (0.0010)	DWH test = 1.613 (0.2041)	DWH test = 4.226 (0.0398)
Underidentification test	Anderson LM statistic = 34.816 (0.0000)	Anderson LM statistic = 58.302 (0.0000)	Anderson LM statistic = 35.519 (0.0000)
Weak identification test [a]	Cragg-Donald Wald F statistics = 11.901	Cragg-Donald Wald F statistics = 20.405	Cragg-Donald Wald F statistics = 12.145
Overidentification test	Sargan statistic = 0.826 (0.6618)	Sargan statistic = 1.589 (0.4517)	Sargan statistic = 4.423 (0.1095)

Notes: a: Stock-Yogo weak ID test critical values: 5% = 13.91; 10% = 9.08; 20% = 6.46; and 30% = 5.39.
p-values in parentheses.

Estimators can perform poorly when instruments are weak, and different estimators are more robust to weak instruments (e.g. limited information maximum likelihood (LIML)) than others (e.g. IV)[19]. The null hypothesis is that the equation is weakly identified, and our results showed that we reject the null hypothesis at 90% according to the Stock-Yogo weak ID test critical values[20] (Stock and Yogo, 2003).

The full IV fixed effects regression results are shown in Table 4. Because we only encountered the endogeneity problem using the SIC and Bursa classifications, the discussion in this section is focused on the results for these.

[18] See Hall et al. (1996) for a discussion of this test.
[19] See Stock and Wright (2000) and Stock and Yogo (2003) for further discussion.
[20] This is a test for weak instruments by using the Wald F-statistic form of the Cragg-Donald (1993) (C-D) statistic. Their test comes in two forms: maximal relative bias (relative to the bias of OLS) and maximal size.

Interestingly, after the market concentration ratio variables have been instrumented, both hi and cr4 have a positive impact on firm performance for the SIC and Bursa classifications (Columns R1, R2, R5 and R6), which is consistent with the theory underpinning the empirical model. Other parameters estimates remain robust. The parameter coefficients for both of the SIC's hi and cr4 are highly significant and larger than the Bursa one. This is not surprise due to the fact that the SIC and Bursa classify firms differently, and we do found some evidence in another paper that the SIC outperforms the NAICS and Bursa classifications.

Leverage is likewise strongly significant in all regressions and tends to be positively associated with profitability. This would imply that more debt in relation to assets a positively impact on profitability, which is consistent with the theory on financial risk (Bouchaud and Potters (2000) and Leroy and Werner (2001)).

Furthermore, labour productivity appears to have a positive significant effect on firm profitability. More productive firms have a competitive advantage over their less productive rivals which is likely to be reflected in profitability (Demsetz, 1973). Ceteris paribus, an increase in relative efficiency (e.g. labour productivity) should lead to higher profitability. Labour productivity and profits are clearly linked. Therefore, more efficient and productive firms are rewarded with greater profits.

Table 4. Instrumental variables analysis.

	SIC		**NAICS**		**Bursa**	
	C1	**C2**	**C3**	**C4**	**C5**	**C6**
hi	7.213***		2.586		2.213*	
	(2.344)		(2.039)		(1.162)	
cr4		7.657***		3.004		2.695*
		(2.541)		(2.362)		(1.388)
lev	0.290***	0.292***	0.288***	0.290***	0.302***	0.299***
	(0.0815)	(0.0824)	(0.0794)	(0.0786)	(0.0770)	(0.0771)
asset	0.0690	0.0696	0.108	0.106	0.101	0.101
	(0.0870)	(0.0881)	(0.0819)	(0.0823)	(0.0817)	(0.0812)
lp	0.154**	0.157**	0.128**	0.124**	0.0822	0.0793
	(0.0658)	(0.0668)	(0.0599)	(0.0589)	(0.0624)	(0.0626)
fg	0.0408	0.0400	0.0292	0.0287	0.0449	0.0445
	(0.0395)	(0.0399)	(0.0355)	(0.0354)	(0.0383)	(0.0381)
ig	0.494	0.471	1.653*	1.481*	-0.124	0.0655
	(0.489)	(0.494)	(0.909)	(0.815)	(0.970)	(0.891)
fci	-0.359***	-0.358***	-0.396***	-0.398***	-0.463***	-0.466***
	(0.0732)	(0.0741)	(0.0664)	(0.0659)	(0.0723)	(0.0725)
open	-0.397***	-0.347***	-0.293***	-0.269***	-0.361***	-0.370***
	(0.0875)	(0.0765)	(0.0955)	(0.0790)	(0.0990)	(0.102)
Observations	1374	1374	1391	1391	1392	1392
F-test	16.93	16.52	21.39	21.49	20.21	20.34
Instrumented variable: market concentration ratio (e.g HI and CR4)						
Instrument variables: lagged firm size, lagged market concentration and market share						

Notes: Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

In addition, a firm level capital to asset ratio is included, since capital earns normal profits even under conditions of perfect competition. Thus the inclusion of this variable controls for differences in capital intensity across different firms. Firm capital intensity is found to have an inverse relationship with the profit margin in most of the regressions. This is not surprising because small and traditional firms are easy to manage and have their own market and demand as well. Our result conflicts with Campbell and Hopenhayn's (2002) findings as these authors found a significant, positive, effect on firm performance. International trade cannot exist without the economic openness[21] of the countries involved.

[21] Since we cannot get the import, export and tariff data by industry for the relevant years, we proxied the degree of openness using the macro level data.

By openness, we mean the degree to which local producers are exposed to external competition and the higher the value, the greater international competition. Our openness result is negatively related to the profit margin indicating that the greater proportion of the domestic market supplied by foreign firms, the lower are domestic firms' profit margins. Thus, Malaysian firms appear to be more profitable when shielded from overseas competition. This result supports D'Souza et al.'s (2005) finding, but is opposite to the findings of Boubakri et al. (2005) for firms in developing countries. Firm size, firm growth and industry growth do not play any significant role in the models presented in Table 4.

Comparing the parameters of all the variables across the three classifications, we noticed that the differences between the parameter estimates do exist when we used different industrial classification schemes. The parameter estimates that were most affected was market concentration ratio. This implies that the results are sensitive to the industrial classification employed.

For example, under the manufacturing sector, Bursa and SIC classifications comprise 262 and 238 companies, respectively, with only 186 companies in common. Clearly, this also means that we would expect to find differences in the market concentration parameter estimates across industrial classifications given the nature of the construction of this index. We found that the parameter estimates for hi were 7.21 and 2.21, respectively for the SIC and Bursa classifications. These differences arise due to the fact that each of the three classifications under consideration have different definitions of industry size which appears as the denominator in the market share measure used. Of course, this brings into question whether one classification can be considered 'correct', which infers that the market share measures of the other two suffer from measurement error or whether no perfect definition of industry exists, thereby suggesting that all of the market share measures are, to some extent, afflicted by this econometric problem[22].

6. Conclusions

This paper has reported estimates of the determinants of profitability of companies listed on the Main Board of Bursa Malaysia over the period 2001-2006. To control for the potential endogeneity problem in the model, lagged firm size, lagged market concentration and market share were used as instrumental variables. The Sargan test confirmed that the instruments used were valid. The market concentration variables were significant and have a positive impact on firm profit under the instrumental variables analysis.

Generally, leverage is highly significant and positive related to profitability. Labour productivity also found to be positively associated to profit margins. On the contrary, the effect of firm capital intensity and openness are inversely related to profitability.

The limitations of this research have to be kept in mind when interpreting the results of this paper. First, is the availability of data, in particular the level of disaggregation which is arguably insufficient in the data set employed but was all that was publically available to conduct the work. In addition, we only look for the years 2001 to 2006, and future researchers may want to extend this study by including a longer time period to see if the model results are robust when additional years of data and a broader sample of firms are used.

Other factors such as advertising expenditure and, research and development intensity at the firm or industry level have proved to be very important determinants of performance in other studies because they form the basic of product differentiation, unfortunately, for the sample of companies under investigation, data are not available which means that their exclusion might be introducing bias into the results.

We also noticed that the parameters of all the variables across different industry classifications will give different impact on firm profitability. Krishnan (2003) pointed that the results depends on specific research design and sample properties. Hopefully, future research efforts will overcome these by analysing how homogeneity and heterogeneity issues within the industry affected firms' profitability.

[22] Of course, this problem is not restricted to the current model under investigation. Most applied work necessitates the use of imperfect proxy variables.

Appendix I. Summary statistics of variables.

		Obs	Mean	Median	Std. Dev.	Min	Max
	Profit	2920	-2.524297	-2.355087	0.8839277	-9.128958	4.451995
	lev	2339	-7.647703	-7.515722	0.9264051	-11.70477	6.91242
	asset	3359	13.0862	12.89071	1.46738	2.484907	19.22281
	lp	2909	5.743454	5.730557	1.036676	-3.723683	10.61943
	fg	2800	0.1078909	0.0880746	0.5444237	-5.678202	8.404416
	fci	3339	0.8678835	0.6495301	1.067391	-6.35786	11.33986
	open	3846	1.786699	1.757792	0.3301933	1.421378	2.202668
SIC	**ms**	3433	0.0118224	0.0026869	0.0345779	2.21E-07	0.4757459
	hi	3846	0.0774804	0.027105	0.0867321	0.0000742	0.4229518
	cr4	3846	0.0559353	0.0174159	0.0811129	0.0000732	0.3995825
	ig	3219	0.0550439	0.0645961	0.0539244	-0.3505474	0.1377415
NAICS	**ms**	3433	0.0127115	0.0027215	0.0363377	2.03E-07	0.5096401
	hi	3846	0.0632381	0.0403445	0.0631915	0.0000633	0.3474375
	cr4	3846	0.047492	0.0265301	0.0560058	0.0000633	0.3418754
	ig	3205	0.0541472	0.0617825	0.0293055	-0.0457418	0.1103481
Bursa	**ms**	3433	0.0144734	0.0035146	0.0375465	7.24E-07	0.4757459
	hi	3846	0.1381697	0.018473	0.2016838	2.43E-09	0.6927528
	cr4	3846	0.1052481	0.0137498	0.1551221	2.43E-09	0.5452863
	ig	3205	0.0601937	0.0645708	0.0244231	-0.0824279	0.1762407

Note: All variables are expressed in log form except ms, hi, cr4 and openness.

Appendix II. Pairwise correlation coefficients between explanatory variables.

			ms	hi	lev	asset	lp	fg	ig	fci	open
SIC	**HI**	**ms**	1								
		hi	0.2911*	1							
		lev	-0.1833*	-0.0888*	1						
	CR4	**ms**	1								
		cr4	0.3115*	1							
		lev	-0.1833*	-0.0576*	1						
		asset	0.5627*	0.2099*	-0.3943*	1					
		lp	0.2138*	0.1539*	-0.1024*	0.2093*	1				
		fg	0.0307	0.0148	-0.0276	0.0481*	0.1207*	1			
		ig	-0.0376*	0.0575*	0.0313	0.0081	-0.0275	0.0256	1		
		fci	-0.0314	0.1282*	-0.1696*	0.3343*	-0.2512*	-0.1298*	0.0125	1	
		open	0.0158	0.0953*	-0.0164	0.0405*	0.0892*	0.014	0.1710*	-0.0647*	1
NAICS	**HI**	**ms**	1								
		hi	0.3347*	1							
		lev	-0.1401*	-0.0457*	1						
	CR4	**ms**	1								
		cr4	0.3578*	1							
		lev	-0.1401*	-0.0433*	1						
		asset	0.5213*	0.1656*	-0.3943*	1					
		lp	0.1770*	0.0527*	-0.1024*	0.2093*	1				
		fg	0.0245	-0.0234	-0.029	0.0490*	0.1209*	1			
		ig	-0.0913*	-0.1601*	0.0296	-0.0820*	-0.0835*	0.0456*	1		
		fci	-0.007	0.0666*	-0.1696*	0.3343*	-0.2512*	-0.1262*	-0.2175*	1	
		open	0.0093	0.2072*	-0.0164	0.0405*	0.0892*	0.0104	0.0457*	-0.0647*	1
Bursa	**HI**	**ms**	1								
		hi	0.1727*	1							
		lev	-0.2152*	-0.0919*	1						
	CR4	**ms**	1								
		cr4	0.1752*	1							
		lev	-0.2152*	-0.0920*	1						
		asset	0.6300*	0.1307*	-0.3943*	1					
		lp	0.2239*	0.1066*	-0.1024*	0.2093*	1				
		fg	0.0399*	-0.0045	-0.0291	0.0522*	0.1259*	1			
		ig	-0.1308*	-0.0155	0.0363	-0.0406*	-0.0773*	0.0154	1		
		fci	0.0333	-0.0401*	-0.1696*	0.3343*	-0.2512*	-0.1280*	-0.0342	1	
		open	0.0205	0.1913*	-0.0164	0.0405*	0.0892*	0.0147	0.1556*	-0.0647*	1

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