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Determinants of firms' performance: some Chinese evidence

Abstract

This paper explores the factors that affect the performance of Chinese firms. It employs a relatively large sample with data from 31 industries. It attempts to explain the impact of the firms' relative efficiency and market power on their profitability. It is found that such factors as operational liquidity, growth and growth potential, asset structure, and size have significant effects on the firms' profitability. It is also found that the type of industry has little effect on firm performance.

Keywords: performance, market structure, China, efficiency and DEA.
JEL Classification: D2, D4, D7.

Introduction

China is emerging as a major force in the global market, having recorded a 10% average annual economic growth rate since the beginning of its economic reforms in 1978 (Li, Yue, & Zhao, 2009). Major economic reforms that it has introduced during the past two decades have especially affected this trend, particularly those allowing a limited right to own private property. A large number of privately-owned or semi-state-owned enterprises have therefore emerged in addition to the previously existing state-owned enterprises. Two stock exchanges have become established, and Chinese companies started to list on both of them and on international stock markets and have begun to dominate in all segments of the world market.

Despite the economic reforms, however, state-owned or partially privatized state-owned enterprises dominate a significant portion of the Chinese market, and many privatized businesses are still under direct or indirect government control. These firms have, moreover, enjoyed a significant amount of market power in their industries.

Lin, Ma and Su (2009) explained that such massive structural changes as reductions in government intervention, the deregulation of price controls, the development of product markets, and improvements in the legal environment have accompanied the economic reforms. These reforms have substantially affected market structures and business's efficiency and profitability. Such studies as Lim and Lovell (2009) have examined the impact of changes in market structures, firm characteristics, and the regulatory and industrial environment on Chinese firms' performance. No such study has been conducted in China, however, to find the factors that affect firms' profitability. This paper, therefore, aims to examine how changes in market structure, efficiency, and industrial structure have affected Chinese firms' profitability.

This paper's next section presents a brief review of the literature addressing market structure and bank efficiency, with special attention to the banking industry. The second section presents research methodology. The third section presents its findings and the analysis's implications. The last section concludes.

1. Literature review

Researchers use both structural and non-structural approaches to investigate the relationship between market structure and firm performance. Traditional industrial organization theories, which are based on the structure-conduct-performance (SCP) paradigm and the efficient structure paradigm, provide the theoretical frameworks for these approaches.

Studies using structural approaches investigate how market concentration weakens market competition by fostering collusive behavior among firms, while non-structural approaches assume that such factors other than market structure and concentration as entry and exit barriers and a market's general contestability can affect competitive behavior (Panzar & Rosse, 1987; Rosse & Panzar, 1977). The non-structural approaches have been developed in the context of the new empirical industrial organization literature. This paper employs a structural approach.

Mason first used the SCP paradigm in 1939 as a method of analyzing markets and firms (Worthington, Briton & Rees, 2001). It explains that market concentration fosters collusion among large firms in the industry, which subsequently leads to higher profits. Changes in market concentration may therefore have a positive influence on the financial performance of the firms involved (Goldberg & Rai, 1996).

SCP also explains that a positive relationship exists between market concentration and performance as a result of anti-competitive behavior by firms with a large market share (Berger & Hannan, 1989; Edwards, Allen & Shaik, 2009). Edward et al. (2009) found that firms in more concentrated industries tend to earn higher profits than those operating in less concentrated industries irrespective of their efficiency.

The relative-market-performance hypothesis (RMPH) is a special case of SCP. It posits that only firms with large market shares and well-differentiated product lines are able to exercise market power to improve their profits by employing non-competitive price-setting behavior (Berger, 1995).

The efficient structure hypothesis (ESH) provides an alternative view of the relationship between market structure and performance. According to the ESH, the aggressive behavior of efficient firms in a market leads to increases in those firms' sizes and market share, thereby consolidating their political strength in the market and maximising their profits and their ability to control prices and production quantities in their respective markets (Lloyd-Williams, Molyneux & Thornton, 1994).

Berger and Hannan (1989) found that firms in markets with a large dispersion of efficiency create unequal market shares and a high level of concentration. The ESH posits accordingly that the positive relationship between profit and concentration results in lower costs achieved through superior management and efficient production processes (Goldberg & Rai, 1996).

Proponents of the ESH explain that efficiency differences among decision-making units (DMUs) within markets create high levels of concentration that result in greater than average efficiency and a positive profit concentration relationship (Berger & Hannan, 1989). Berger and Hannan (1989) explained that SPC and the ESH make similar observations in regard to the relationship between concentration and performance and its consequent profitability, but differ mainly in regard to how to interpret this relationship.

Some studies, however, have challenged the acceptability of assuming this positive relationship between market concentration and profitability. Smirlock (1985) found that no relationship exists between concentration and profitability, but rather that one does between profitability and market share, which is a proxy for efficiency. This means that market concentration is not a signal of collusive behavior but of the leading firms' superior efficiency.

Berger and Hannan (1994) highlighted four sources of anti-competitive behaviors that can arise in highly concentrated markets. Firms with a significantly high share of market are able to set their prices in excess of competitive levels due to less pressure on their managers to maintain operating costs at or near their competitive level. Next, managers' self-interested behavior may result in their making more risky financing decisions above the shareholders' expectations in order to reduce instability in their firms' earnings and thereby protect their positions. They may also increase the political costs associated with obtaining and maintaining their existing market positions.

Finally, such firms may retain inefficient managers or continue inefficient practices, thereby allowing them to lead a *quiet life* that enables them to pursue other objectives or to maintain their market positions. This quiet-life hypothesis is an alternative to SCP and the ESH. It assumes that the managers of firms with relatively large market shares pay little attention to the efficient use of resources, as they can make profits using their price-setting power. It predicts further that large firms are likely to use their market power to be quiet in the market and earn profits without having to improve productivity and efficiency, thereby creating economic rent for themselves (Punt & Rooij, 1999).

Instead of direct efficiency measures, early ESH studies used firms' market shares as a proxy for their efficiency (Molyneux & Forbes, 1995). Berger and Hannan (1995) were the first to measure efficiency directly in their empirical models. The main disadvantage of using market share is that it fails to represent firms' overall productivity and efficiency levels, while measuring efficiency directly reveals the impact of all the factors affecting firm performance.

SCP has provided the main theoretical basis for most studies investigating market behavior. It explains the operational behavior of different markets and the different forces that restrict or expand the scope of firms' operations in those markets. It helps, furthermore, to interpret different sources of productivity and efficiency gains or losses in studies of these phenomena. It also provides a rational basis for analyzing market behavior.

This theoretical basis of market structure and performance emerged more than 50 years ago. Empirical studies using it have, however, only focused on a few developed countries in North America and Europe. Gilbert (1984), for example, summarized 44 such studies focusing on the United States banking industry. Such studies' findings have less empirical validity in regard to emerging and developing countries, but they are important for understanding the theory of market structure, so this paper will summarize them briefly.

Most studies of the relationship between firm performance and market structure have concentrated on the banking industry, using either price or profitability information as proxies for firm performance (Berger & Hannan, 1989; Molyneux & Forbes, 1995). In multi-industry environments, however, it is impossible to identify a standard measure of price to indicate the overall performance of every firm in the market, but measuring profitability can be a comprehensive performance indicator, since doing so integrates both cost and revenue into one measure. Most existing studies have therefore used profitability measures as proxies for firm performance.

Short (1979) found a positive relationship between bank concentration and return on equity (ROE) among banks from Canada, Western Europe, and Japan. Moore (1998) found that advanced communication technology enables bank managers to serve distant customers using alternative banking methods such as telebanking and internet banking. By examining changes in the relationship between concentration ratio and profitability using both univariate and multivariate regression tests, Moore found that even though the technology had changed bank concentration had positively affected performance.

Molyneux and Forbes (1995) found evidence to support traditional SCP in European banking. Lloyd-Williams, Molyneux, and Thornton (1994) investigated the applicability of the SCP and efficient market paradigms for analyzing the Spanish banking structure using three firms' concentration ratio and the market share of an individual firm to represent efficiency and found a positive relationship between concentration and return on assets (ROA) as a proxy for performance, thereby supporting the SCP paradigm's applicability to the Spanish banking industry.

Some studies have found increased market concentration to be associated with higher prices and greater than normal profits. Smirlock (1985) concluded that the higher profits in concentrated markets could be the result of greater productive efficiency. Berger (1995) found some evidence supporting the ESH for United States banking.

Differences among the variables that studies use and the hypotheses that they test limit the comparability of their findings. Berger and Hannan's (1993) research framework provides a comprehensive methodology for testing potential relationships between market structure and performance using both the SCP paradigm and the ESH. They proposed to test the traditional SCP paradigm's hypothesis, the RMPH, the X-efficiency (XEFF) hypothesis, and the ESH in order to investigate whether market concentration affects performance or if efficiency affects market concentration.

Using the Berger and Hannan approach, Goldberg and Rai (1996) examined the structure-performance relationship of banks in European countries and found no significant positive relationship between concentration and profitability. They did, however, find evidence supporting the RMPH for all banks located in highly concentrated industries. Using a similar approach, Fu and Heffernan (2005) found support for the RMPH in a study of the structure of the Chinese banking market. Although they found a significant positive coefficient for efficiency variables they found no positive relationship between market share and efficiency, which was one of the conditions necessary for accepting the hypothesis.

The SCP framework has been widely used in the literature to examine market structures, but it does not account for other factors that influence firms' profitability and concentrations. SCP studies also ignore long-run market equilibrium. The evidence from market concentration studies may therefore be insufficient to support firm conclusions about the relationship between market behavior and competition.

2. Methodology

2.1. Hypotheses. Following Berger and Hannan (1993), this study used four hypotheses based upon the traditional market structure and the efficient structure paradigms for testing the relationship among market structure, efficiency, and firm performance. The SCP paradigm's hypothesis predicts that collusive behavior among the dominant firms in an industry is likely to influence the market's price-setting process, thereby enabling those firms to obtain profits superior to those of other firms. This hypothesis therefore predicts a positive relationship between market concentration and firm performance.

The RMPH predicts that firms with relatively bigger market shares and differentiated product lines use their superior market power to set market prices, thereby earning above-average profits. This hypothesis therefore predicts that a positive relationship exists between market share and firm performance. The XEFF hypothesis predicts that technically efficient firms with superior management, production processes, or both are able to operate with lower costs and consequently obtain higher profits and market shares than others. This hypothesis therefore predicts that a positive relationship exists between profitability and such variables as technical efficiency, market share, and concentration. The scale-efficient firm (SEFF) hypothesis predicts that differences in performance among firms exist as a result of differences in their levels of economics of scale rather than differences in the superiority of management and production approaches. This hypothesis therefore predicts that firms operating at an optimum scale of the production of goods and services have relatively lower costs and are able to obtain higher profits than others and thereby attain a higher market share.

This study used the first two hypotheses to test the influence of market structure variables on firms' performance. The coefficient for the market-structure variables should be positive and significantly different from zero to support either of these hypotheses. It, therefore, tested these hypotheses to investigate the relationship between market structure and conduct. Ashton (1999) used such variables as the buyer and seller cost relationship, the degree of product differentiation, market concentration, market share, and market entry conditions to represent market structure. These hypotheses therefore predict that market power is the dominant variable in determining firm profitability.

This study used the XEFF and SEFF hypotheses to test the validity of the ESH's paradigm, which argues that greater operational efficiency of individual DMUs in the market results in both superior performance and high market share. These hypotheses, therefore, predict that the influence of market structure on firm performance is insignificant and economically meaningless. The ESH explains that the cost advantages that efficient firms enjoy result in their having higher profits than inefficient firms. Efficient firms pass cost advantages on to their customers by adjusting their prices, which improves their market share. These hypotheses, therefore, predict that, respectively, technical and scale efficiency will have a statistically significant positive relationship with firms' performance and that the coefficients for the relative market share and market concentration variables will be statistically equal to zero or insignificant.

2.2. Empirical model. This study calculated the coefficients using the following reduced-form profit equation to test its hypotheses using a simple linear regression approach:

$$p_i = \alpha + \beta_c C + \beta\ M + \beta_E T + \beta_S S + + \sum_{1=k}^{m} v_k d_k + \sum_{i=1}^{n} \lambda_i Z_i + \varepsilon_i^7, \quad (1)$$

where p_i is the ROA, which is the performance indicator, for firm i. 'C' represents industry concentration, 'M' is relative market share, 'T' is technical efficiency, and 'S' is scale efficiency. Z represents a vector of the control variables and d represents a vector of industry and time, which are variant dummy variables. β, v_k, and λ are calculated coefficients, and ε is the random error.

Since efficient firms tend to have relatively high cost advantages resulting in higher profits, the hypothesis predicts a statistically significant positive relationship between firm performance and efficiency. In order to support the ESH, therefore, efficiency must have a statistically significant positive relationship with market share and concentration. This study, therefore, used the following two equations to find what factors affect market share and concentration:

$$M_i = \alpha + \beta_E T + \beta_S S + \sum_{i=1}^{n} \lambda_i Z_i + \varepsilon_i^2, \quad (2)$$

$$CON_i = \alpha + \beta_E T + \beta_S S + \sum_{i=1}^{n} \lambda_i Z_i + \varepsilon_i^3, \quad (3)$$

The above models producing a statistically positive coefficient for the efficiency variables would support the relationship between market structure and efficiency unconditionally.

2.3. Model variables and data. The above regression models include as variables ROA, market share for sales, and the Herfindahl-Hirschman Index (HHI) for sales as dependent variables. ROA, data envelopment analysis (DEA) calculated super technical efficiency (X-efficiency) score, scale efficiency score, market share for sales, and HHI for sales are the main explanatory variables. The model uses several dummy variables to represent the industry and time variants' unobservable effects on the dependent variables. It uses as proxies for other control variables such financial ratios as quick assets for liquidity, total debt to total assets ratios for leverage, book value per share, sales growth for growth potential, natural log value of total assets for size, and fixed assets to total assets ratios for asset structure.

Either profitability or price indicators can be proxies for firm performance (Gilbert, 1984; Goldberg and Rai, 1996; Smirlock, 1985; Yu & Neus, 2005). The use of price indicators is difficult, however, in multi-product and multi-industry settings, so this study relied on profitability measures. Such studies as (Goldberg & Rai, 1996; Yu & Neus, 2005) have used ROA and studies such as Smirlock (1985) and Yu and Neus (2005) have used ROE to represent profitability. ROA reflects in principle the ability of a firm's management to generate profits, so this study used it to proxy firm performance.

This study used non-parametric, input-oriented DEA to calculate Chinese firms' efficiency, as it has the capacity to incorporate multiple inputs and outputs in the efficiency assessment process and enables the progressive assembly of production frontiers without a pre-specified functional form. This study further used the constant return to scale DEA model, which is called the Charnes, Cooper, and Rhodes (CCR) model (Charnes, Cooper & Rhodes, 1978), and the variable return to scale DEA model, which is called the Banker, Charnes, and Cooper (BCC) model (Banker, Charnes & Cooper, 1984), to calculate technical and pure-technical efficiency.

This study utilized a super-efficiency DEA model together with these CCR and BCC DEA formulations to calculate technical efficiency. It also applied the CCR DEA formulation to calculate technical efficiency and BCC DEA formulation to calculate pure-technical efficiency. Technical efficiency is the product of pure technical efficiency and scale efficiency. It is, therefore, possible to calculate scale efficiency by dividing the calculated CCR efficiency scores by the BCC efficiency scores (Coelli, Rao & Battes, 1998). Coelli, Rao and Battese (1998) also used a Malmquist Productivity Index to decompose scale effects from the technical efficiency scores.

One of this study's major challenges was specifying a uniform set of input and output variables to represent the production processes of all the industries represented in its sample. It, therefore, used income statement data to identify the appropriate combination of input and output. Since the data in income statements has a common format it was possible to identify the main variables that contribute to firms' overall performance. The efficiency estimation model includes cost of sales, other operating costs, and non-operating expenses as inputs and net sales income and other income as outputs. This study further established the production frontiers for estimating relative efficiency of each DMU separately for each industry.

This study used an unbalanced panel dataset consisting of data for firms listed on the Shanghai and Shenzhen stock exchanges from the *Taiwan Economic Journal* (TEJ) database, which includes financial statement data from 31 industries (see Appendix B) and contained 7,820 observations. This study used the TEJ's industry classifications for estimating each firm's efficiency and relative market share and each industry's market concentration. It excluded seven industries from its sample due to their insufficient number of firms to calculate their relative efficiency using DEA. It created separate production frontiers for each period to calculate the relative efficiency of the remaining 24 industries.

This study used both net sales and total assets to represent the market size for each industry. Such studies as Goldberg and Rai (1996), Molyneux (1999), and Yu and Neus (2005) have used the HHI and Goldberg and Rai (1996) used the k firms' concentration ratio (CR_k) to proxy the collusive power of an industry's dominant firms.

CR_k and the HHI measure the collusive power in a market based on the size of the dominant firms' work forces, total assets, and sales. CR_k considers the total market shares of the k^{th} largest or most dominant firms in the market and ignores its relatively smaller ones (Bikker & Haaf, 2002; Worthington et al., 2001). The HHI considers the sum of the squares of the market shares of all the firms within a given industry. Since the HHI considers all the firms in the industry it avoids an arbitrary cut-off (Bikker & Haaf, 2002). This study, therefore, used the HHI to evaluate market collusive power by separately estimating the respective market concentration indexes and relative market share of each firm in all 24 industries after regrouping them into five industry clusters for further analysis in order to reduce its complexity.

$$HHI = \sum_{i=1}^{N} \left(\frac{v_i}{V} \right)^2, \quad (4)$$

where N is the number of firms, v_i is the market share of the i^{th} firm, and V is the total market share.

Other control variables this study used were firm size, liquidity via acid-test ratios, business growth via sales growth, growth potential via tangible-assets to total assets ratios, leverage via total debt to total assets ratios, and asset structure through fixed assets to total assets ratios. Similarly to Goldberg & Rai (1996), Smirlock (1985), this study used firms' sizes to proxy their diversification ability. If large firms have significant cost advantages over small firms, size should be positively correlated with profitability.

This study employed two sets of dummy variables with each model to represent the variant unobservable effects, with four for those of industry and eight for those of time. It employed these variables to find how differences in industry cluster and time influence firm performance.

3. Results and discussion

3.1. Descriptive statistics of test data. Table 1 presents the test data's averages and standard deviations. The observed dataset contained several outliers, which this study excluded from its sample. It directly abstracted the date for all variables from the TEJ database except those representing efficiency and market structure. Overall, the test data's standard deviations show relatively low statistical dispersion. The low standard deviations recorded indicate further that the data points are not highly variable.

This study used two sets of variables to represent market structure and firm efficiency, estimating the HHI of market concentration and the relative market shares for companies in each industry based on their annual sales. It based the figures for the market-share variable on the TEJ database's original industry classifications.

Table 2 presents the average annual values for the different industry clusters, showing that little annual differences occurred in them. The HHIs show that the collusive power in the market increased slightly during the study period, but the average relative market shares reduced slightly. These findings indicate that the degree of competition in the Chinese market improved during the study period.

Table 1. Descriptive statistics of test data

	Consumer	Heavy	High-tech	Industrial	Services	Grand
Liquidity (Acid test ratio (ATR))	0.322	0.372	0.315	0.317	0.425	0.353
	(0.505)	(0.495)	(0.543)	(0.467)	(0.712)	(0.549)
Growth potential (Book value per share (BPS))	10.767	8.931	11.815	13.234	13.539	11.875
	(14.606)	(9.312)	(17.132)	(15.079)	(19.446)	(15.420)
Technical efficiency – Super (TE-SUP)	0.981	0.946	1.024	0.877	0.819	0.907
	(0.411)	(0.341)	(0.507)	(0.388)	(0.385)	(0.397)
Scale efficiency (SEF)	0.935	0.957	0.942	0.905	0.894	0.921
	(0.082)	(0.063)	(0.085)	(0.120)	(0.130)	(0.107)
Assets structure (Fixed assets to total assets)	0.318	0.367	0.201	0.408	0.369	0.361
	(0.157)	(0.182)	(0.146)	(0.188)	(0.246)	(0.200)
Size (LN(Total assets) (LNTA))	13.980	14.311	13.832	14.150	14.315	14.165
	(0.950)	(1.120)	(0.962)	(1.007)	(1.034)	(1.033)
Concentration (HHI (Sales) (HHIS))	0.100	0.054	0.078	0.076	0.102	0.083
	(0.083)	(0.020)	(0.019)	(0.039)	(0.062)	(0.056)
Market share ((Sales) (MS-Sales))	0.032	0.021	0.036	0.021	0.023	0.024
	(0.059)	(0.028)	(0.043)	(0.039)	(0.045)	(0.044)
Profitability (Return on assets (ROA))	5.466	5.323	5.886	5.428	4.807	5.302
	(5.001)	(4.435)	(8.158)	(4.668)	(4.339)	(4.901)
Growth (Sales growth (SGR))	0.971	0.611	1.031	1.062	1.330	1.014
	(3.457)	(1.869)	(3.527)	(3.799)	(4.621)	(3.644)
Liquidity (Total debt to total assets (TDTA))	0.230	0.223	0.198	0.245	0.258	0.238
	(0.157)	(0.136)	(0.164)	(0.151)	(0.166)	(0.155)
Number of observations	1619	1517	450	2482	1752	7820

Note: Standard deviations are in the parentheses.

Table 2. HHI and relative market share

Industry	Year								
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Market Share-Sales									
Consumer	3.92% (0.06)	3.45% (0.06)	3.27% (0.06)	3.18% (0.06)	2.91% (0.05)	2.97% (0.05)	4.17% (0.07)	2.98% (0.06)	3.00% (0.07)
Heavy	2.77% (0.04)	2.42% (0.03)	2.23% (0.03)	2.13% (0.03)	2.01% (0.03)	2.08% (0.03)	3.36% (0.04)	2.11% (0.03)	2.07% (0.03)
High-tech	4.70% (0.05)	3.96% (0.04)	3.56% (0.04)	3.57% (0.04)	3.25% (0.04)	3.12% (0.04)	4.76% (0.06)	3.39% (0.04)	3.50% (0.05)
Industrial	2.69% (0.04)	2.29% (0.04)	2.11% (0.03)	2.10% (0.04)	1.98% (0.04)	2.03% (0.04)	2.65% (0.06)	2.06% (0.05)	2.04% (0.05)
Services	2.56% (0.05)	2.55% (0.05)	2.49% (0.05)	2.53 (0.05)	2.34% (0.05)	2.59% (0.05)	2.72% (0.06)	2.53% (0.05)	2.49% (0.05)
HHI-Sales									
Consumer	8.22% (0.08)	7.52% (0.08)	8.55% (0.08)	8.43% (0.07)	8.68% (0.07)	8.74% (0.07)	11.34% (0.08)	11.14% (0.06)	19.11% (0.11)
Heavy	6.89% (0.03)	6.11% (0.02)	5.30% (0.02)	4.93% (0.02)	4.82% (0.02)	5.05% (0.02)	7.88% (0.04)	6.08% (0.02)	6.17% (0.02)
High-tech	8.54% (0.02)	8.04% (0.02)	7.78% (0.01)	7.75% (0.01)	8.40% (0.01)	8.34% (0.01)	10.77% (0.02)	8.68% (0.01)	9.26% (0.01)
Industrial	8.32% (0.02)	8.60% (0.03)	6.91% (0.03)	7.29% (0.03)	7.46% (0.03)	8.75% (0.05)	11.36% (0.07)	9.05% (0.06)	8.80% (0.06)
Services	9.74% (0.09)	9.32% (0.07)	8.87% (0.07)	8.68% (0.06)	9.41% (0.05)	7.87% (0.07)	11.56% (0.09)	11.27% (0.06)	11.87% (0.06)

Note: Standard deviations are in parentheses.

3.2. Summary of efficiency scores. This study used three DEA models to calculate the relative efficiency of Chinese firms (Appendix A). Table 3 shows the average annual efficiency scores for each industry cluster, using basic BCC DEA formulation to calculate technical efficiency and the CCR DEA for pure technical efficiency. All of the firms that these two models found to be efficient normally received equal weighting, however, as the models disregarded their efficiency differences. This study, therefore, used a super-efficiency DEA model to calculate technical efficiency in order to discriminate somewhat efficient firms from more efficient ones. It calculated the scale efficiency scores using the efficiency scores from the BCC and CCR DEA formulations.

Table 3. Descriptive statistics of estimated efficiency scores (1989-2004)

Variable	Industry	1999	2000	2001	2002	2003	2004	2005	2006	2007
Technical efficiency-CRS_SUP	Consumer	0.977	1.052	1.020	1.026	0.988	0.897	0.891	0.988	0.983
		(0.363)	(0.394)	(0.279)	(0.616)	(0.534)	(0.400)	(0.432)	(0.411)	(0.413)
	Heavy	0.947	0.993	1.006	0.968	0.978	0.895	0.873	0.932	0.887
		(0.456)	(0.458)	(0.347)	(0.283)	(0.450)	(0.466)	(0.311)	(0.447)	(0.408)
	Hi-tech	0.924	1.015	1.070	1.088	1.051	0.969	0.950	1.078	1.019
		(0.442)	(0.388)	(0.351)	(0.320)	(0.535)	(0.308)	(0.285)	(0.342)	(0.365)
	Industrial	0.824	0.929	0.886	0.933	0.903	0.807	0.796	0.936	0.865
		(0.542)	(0.320)	(0.374)	(0.354)	(0.437)	(0.526)	(0.373)	(0.410)	(0.300)
	Services	0.757	0.831	0.860	0.900	0.798	0.728	0.729	0.890	0.871
		(0.411)	(0.236)	(0.368)	(0.118)	(0.578)	(0.532)	(0.375)	(0.460)	(0.300)
Scale efficiency	Consumer	0.918	0.927	0.931	0.945	0.948	0.933	0.907	0.952	0.941
		(0.071)	(0.063)	(0.079)	(0.108)	(0.101)	(0.144)	(0.084)	(0.120)	(0.089)
	Heavy	0.951	0.967	0.973	0.957	0.965	0.948	0.955	0.947	0.948
		(0.066)	(0.080)	(0.050)	(0.104)	(0.079)	(0.121)	(0.129)	(0.147)	(0.104)
	Hi-tech	0.922	0.902	0.947	0.963	0.925	0.943	0.935	0.957	0.942
		(0.079)	(0.074)	(0.073)	(0.061)	(0.085)	(0.149)	(0.116)	(0.115)	(0.146)
	Industrial	0.871	0.906	0.881	0.935	0.910	0.901	0.898	0.939	0.902
		(0.091)	(0.107)	(0.042)	(0.068)	(0.058)	(0.088)	(0.106)	(0.154)	(0.128)
	Services	0.851	0.897	0.884	0.905	0.890	0.894	0.885	0.924	0.922
		(0.105)	(0.078)	(0.057)	(0.060)	(0.081)	(0.069)	(0.101)	(0.111)	(0.129)

Note: Standard deviations are in parentheses.

Table 4. Correlation coefficients

	ATR	BPS	TDTA	TE-SUP	SEF	FATA	SGR	LNTA	HHI-Sales	MS-Sales
BPS	-0.059									
TDTA	-0.016	-0.000								
TE_SUP	0.032	0.065	-0.197							
SEF	-0.002	-0.079	-0.101	0.405						
FATA	0.034	0.068	0.177	-0.059	-0.075					
SGR	-0.045	0.364	0.068	0.008	-0.066	0.002				
LNTA	0.174	-0.063	0.086	-0.008	-0.076	0.184	-0.056			
HHI-Sales	-0.022	0.070	-0.023	0.060	-0.035	0.101	0.034	0.083		
MS-Sales	0.171	-0.124	-0.075	0.065	-0.135	-0.003	-0.065	0.498	0.204	
ROA	0.096	0.409	-0.034	0.060	0.011	0.042	0.138	-0.067	-0.010	0.014

Table 4 shows that little correlation was present among the regression models' variables. Gujarati (2003) explained that a serious multicollinearity problem exists if the pair-wise correlation coefficient between two regresses exceeds 0.80. This study's pair-wise correlation coefficients for its explanatory variables show no such relationships. This indicates that no serious threat of having a multicollinearity problem was present.

Table 6 presents the parameters for equations (1)-(3). Their R^2 values indicate that the three regression models do explain the identified dependent variables, as most of the coefficients for the parameters have a statistically significant relationship with the explanatory variable.

This study used the HHI to proxy each industry cluster's collusive power. Instead of the predicted positive relationship between collusive power in the second DEA model and the firms' performance under the SCP hypothesis, this study found a statistically significant negative relationship. This finding rejects the SCP hypothesis, which predicts that the collusive power of an industry's dominant firms can result in superior profit for them. This study also found that collusive power may adversely affect firms' performance, as the quiet life hypothesis predicts.

Table 6. Regression coefficients

	Profitability (ROA)	Market share (Sales)	Concentration-Sales
Constant	8.944 (9.550)***	-0.267 (-35.260)***	0.017 (1.529)
Profitability (ROA)		0.001 (7.303)***	-0.000 (-1.754)*
Technical efficiency (TE-SUP)	0.158 (2.019)**	0.005 (6.874)***	0.006 (6.197)***
Scale efficiency	1.798 (3.605)***	-0.058 (-13.441)***	0.004 (0.573)
Market Share-Sales	10.491 (7.898)***		
Concentration-Sales	-3.107 (-3.476)***		
Operational liquidity	1.106 (11.254)***	0.006 (6.450)***	0.001 (0.977)
Growth potential	0.134(38.673)***	-0.000 (-13.850)***	0.000 (5.821)***
Leverage	-0.478 (-1.456)	-0.027 (-9.643)***	-0.014 (-3.428)***
Asset structure	1.025 (3.921)***	-0.010 (-4.436)***	0.035 (10.462)***
Growth	0.018 (1.252)	0.000 (1.400)***	-0.000 (-0.659)
Size (LN – Total Assets))	-0.495 (-8.075)***	0.026 (56.935)***	0.003 (4.537)***
Dummy-Consumer	0.287 (2.025)**	0.014 (11.360)***	0.022 (12.043)***
Dummy-Heavy	0.426 (2.928)***	-0.004 (-3.058)***	-0.025 (-13.433)***
Dummy-High tech	0.493 (2.199)**	0.021 (10.695)***	0.008 (2.868)***
Dummy-Services	-0.611 (-4.487)***	-0.002 (-1.405)	0.015 (8.343)***
Year 2	-0.733 (-3.364)***	-0.005 (-2.781)***	-0.003 (-1.196)
Year 3	-1.217 (-5.693)***	-0.008 (-4.420)***	-0.010 (-3.504)***
Year 4	-0.736 (-3.423)***	-0.012 (-6.220)***	-0.010 (-3.712)***
Year 5	-1.154 (-5.418)***	-0.016 (-8.773)***	-0.008 (-2.749)***
Year 6	-0.472 (-2.189)**	-0.020 (-10.619)***	-0.006 (-2.163)**
Year 7	1.319 (5.658)***	-0.013 (-6.392)***	0.022 (7.368)***
Year 8	-0.552 (-2.484)**	-0.025 (-13.029)***	0.008 (2.693)***
Year 9	-2.391(-10.661)***	-0.022 (-11.187)**	0.026 (9.115)***
R^2 (Adjusted)	0.250	0.364	0.144
Durban-Watson	1.751	1.908	1.881

Notes: t-statistics are in parentheses, *** denotes significance under 1% confidence level, ** denotes significance under 5% confidence level, * denotes significance under 10% confidence level.

This study's findings do, however, support the RMPH, which predicts a positive relationship between relative market power and firm performance. Using individual firms' market share for sales to represent relative market power (RMP), the coefficient for the variable revealed a statistically significant positive relationship between RMP and firm profitability. This finding supports the RMPH and indicates that having high market power significantly improves individual Chinese firms' performance.

This study used the XEFF and SEFF hypotheses to test its ESH hypotheses. The XEFF hypothesis predicted a positive relationship between firm performance measured as ROA and technical efficiency. This study found a statistically significant positive relationship, thereby supporting the hypothesis. In order to accept the XEFF hypothesis, however, the coefficient for HHI, representing market concentration, and RMP, representing market structure, needed to be either zero or negative and the variable representing technical efficiency needed to have statistically significant positive coefficients for market share and market concentration. Table 5 shows statistically significant coefficients for technical efficiency in both regressions.

Even though the coefficient for the technical efficiency variable is positive and statistically significant, thereby satisfying the requirement for the relationship between efficiency and market structure, the predicted relationship is unacceptable because the coefficient for RMP is positive and statistically significant for the regression based on firm performance.

The scale efficiency variable also shows a statistically significant positive relationship with firm performance, indicating that firms at an optimal scale of operation can earn greater profits than others. The coefficients for the regressions based on market share and market concentration, however, failed to satisfy the requirement for accepting this hypothesis. Nevertheless, this study did find that firms with high levels of scale and technical efficiency perform better than inefficient ones. The main factor that determines firms' performance, however, is their relative market shares rather than collusive power or efficiency.

This study found statistically significant coefficients for the dummy variables it used to represent the different industry clusters. This is evidence that the nature of a firm's industry affects its performance. This study also found that the time factor plays a vital role in firm performance, as all the dummy variables it used to represent time produced statistically significant coefficients, possibly indicating that technological changes combined with other local and international socioeconomic changes have a significant role in determining firm performance. A need, therefore, exists to investigate further what these are.

The control variables for liquidity, growth, and asset structure had a significant positive relationship with firm performance, indicating that liquidity, growth potential, and investment in long-term assets are important factors in regard to profit size. This study found, however, a significant negative coefficient for its firm-size variable, indicating that larger firms tended to have a quiet-life approach to the market and that smaller firms tended to be more successful at managing costs than larger ones and therefore tended to earn higher profits.

The acid test ratio had a positive relationship with all the dependent variables and the leverage ratio had a negative relationship with them, which indicates that both lowering liquidity levels and increasing the percentage of debt in regard to overall capital increases firms' risk levels. This study's finding of a negative coefficient for the debt to total assets ratio, which shows firms' financial risk, and a positive coefficient for the acid-test ratio, which shows their liquidity risk, indicate a negative relationship between firm performance and risk.

This study's overall findings do not support either the traditional SCP hypothesis or the ESH, but do support the RMPH, as the scale-efficiency variable produced a positive coefficient with ROA with it, but it failed to fulfil the other two conditions that needed to be satisfied to accept it. One of this study's drawbacks is that no empirical findings already existed to support its findings or to compare with them.

Conclusion

This study examined the interrelationships among performance, market structure, efficiency, and industry variables in regard to Chinese firms by testing the four main hypotheses proposed by Berger and Hannan (1997). Its findings are inconsistent with both the basic SCP hypothesis and the ESH.

This study found that market concentration has a negative effect on firm performance, thereby supporting the quiet-life hypothesis. Its findings also support Molyneux's (1999) argument against the profit-concentration relationship by rejecting the basic SCP hypotheses and support Goldberg and Rai's (1996) finding of a significant relationship between profit and market power. Its findings do not support the ESH, but it did find a positive relationship between scale efficiency and firm performance. It also found that acquiring greater technical efficiency tends to improve firms' market share and consequently their profitability. Finally, this study found that policy makers should focus on encouraging firms in all industries to achieve an optimum scale of operation and thereby maximize their performance, and that it is also important to focus on large firms that use only their excessive market power to stay in the market and pay little attention to the efficient use of productive resources.

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Appendix A. Measures of efficiency

Data envelopment analysis is presented here.

DEA Model 1 Basic CCR formulation (Charnes et al., 1978):

$$\text{Min } \theta$$

Subject to

$$\sum_j x_{ij}\lambda_j - \theta x_{ij_{i\bar{i}}} \le 0 \quad for\ i = 1,2,...m,$$

$$\sum_j y_{rj}\lambda_j \ge y_{rj_0} \ for\ r = 1,2,...k,$$

$$\lambda_j \ge 0.$$

DEA Model 2 Basic BCC Formulation (Banker et al., 1984):

$$\text{Min } z_0 = \theta_{PTE}$$

Subject to

$$\sum_j x_{ij}\lambda_j - \theta x_{ij_{i\bar{i}}} \le 0 \quad for\ i = 1,2,...m,$$

$$\sum_j y_{rj}\lambda_j \ge y_{rj_0} \ for\ r = 1,2,...k,$$

$$\sum \lambda_j = 1,$$

$$\lambda_j \ge 0.$$

DEA Model 3 Supper efficiency DEA model (Zhu, 2008):

Min θ^{Supper}

Subject to

$$\sum_{\substack{j=1 \\ j \neq 1}} x_{ij} \lambda_j \leq \theta^{Supper} x_{io} \quad for\ i = 1,2,...m,$$

$$\sum_{\substack{j=1 \\ j \neq 1}} y_{rj} \lambda_j \geq y_{rj_0} \quad for\ r = 1,2,...k,$$

$$\lambda_j \geq 0,$$

where, y_{rj} is the amount of r^{th} output produced by DMU 'j' using x_{ij} amount of i, whis is the input. θ denote the CCR efficiency of DMU j. Both y_{rj} and x_{ij} are exogenous variables and λ_j represents the intensity variables assigned to each DMU under observation.

Appendix B

Table 1A. Industry re-classification

Industry cluster	TEJ industry classification
Consumer	Beverages
	Electronic, electrical equipment
	Food producers
	Household goods
	Leisure goods
	Personal goods
Heavy industry	Construction & materials
	Industrial engineering
	Mining
High-tech	Software & computer services
	Technology hardware & equipment
Industrial	Automobiles & parts
	Chemicals
	Forestry & paper
	General industrials
	Industrial metals
	Industrial transportation
	Pharmaceuticals, biotechnology
Services	Electricity
	Food & drug retailers
	General retailers
	Real estate
	Support services
	Travel & leisure
Industries which are excluded from the study	Aerospace & defence
	Gas, water & multi-utilities
	Healthcare equipment, services
	Media
	Mobile telecommunications
	Oil & gas producers
	Oil equipment & services