SHARE PRICING OF SOUTH AFRICAN BANKING GROUPS - IMPORTANCE OF EFFICIENCY AND EARNINGS PER SHARE

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Abstract

Previous research findings indicate that the relevant performance of firms is one way or another, reflected in the market prices of shares. Such research is focussed on different performance components of firm individual risk (FIR), but none of the research segregates systematic and unsystematic risk of the shares to levels where the relative FIR components that were researched could be quantified in proportion to FIR level share price determinants. This brings about the objective of this research to segregate the pricing of shares in terms of market and firm specific factors with the intention to quantify the association of relative bank efficiency and earnings performance with the pricing of South African bank shares. The study draws a parallel between the actual significance of measured efficiency and earnings per share (EPS) with share pricing and quantified FIR. Within this context the comparative significance of measured efficiency and EPS are explored to investigate the Efficient Market Hypothesis (EMH) prevalence. An analysis of efficiency and share price relationships at different financial year time points shows a semi-strong form of the EMH in both the pre-Global Financial Crises (GFC) and GFC periods. This indicates that the application of an active investment strategy by investors based on efficiency measures may be beneficial. The impact of EPS as contributing determinant of share prices increased during the GFC period compared to the pre-GFC period, but reflects a strong form of the EMH.

Keywords: Systematic risk; sector risk; firm individual risk; global financial crises; data envelopment analysis

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Introduction

The relationship between share returns and publicly available information has attracted considerable attention in the finance and accounting literature. The findings of Kothari (2001) and Chen and Zang (2007) were that the earnings of firms reflect some of the information in share prices, although it can be regarded as minor considering the total share price movements.

An efficient market incorporates all relevant publicly known information into share prices, therefore share performance can be regarded as the best measure of the value that firms create for shareholders (Majid, Zulkhibri, and Fadzlan, 2008). For firms to create value for the shareholders requires operating efficiency that denotes whether firms are minimising costs and maximising profits based on published accounting numbers (Beccalli, Casu and Girardone, 2006). According to the authors operating efficiency of firms represents public information that the efficient share market should take into consideration in the price-formation process. Therefore the assimilation of these statements results in an expectation that efficient firms perform financially better than inefficient firms and the relative performance is reflected in the market price of shares (Majid, Zulkhibri and Fadzlan, 2008).

Research based on different aspects of business performance and share returns were conducted by researchers like Sloan (1996), Biddle, Bowen and Wallace (1997), Alam and Sickles (1998), DeFond, and Park (2001), Chan, Chan, Jegadeesh and Lakonishok (2006), Jegadeesh and Livnat (2006) and Chen and Zang (2007).

The studies conducted by the abovementioned researchers all focussed on the extent that share prices reflect information about specific firm risk components like accrual and cash flow components (Sloan, 1996 and Chan et al. 2006); Economic value added (EVA) compared to accrual earnings (Biddle, Bowen and Wallace, 1997); technical efficiency (Alam and Sickles, 1998); reversing implications of abnormal working capital accruals (DeFond and Park, 2001); incremental information conveyed by revenues reported during preliminary earning announcements

(Jegadeesh and Livnat, 2006); and accounting information (Chen and Zang, 2007).

The empirical findings and conclusions of Sloan (1996) are that share price results are inconsistent with the traditional efficient market's view that share prices fully reflect all publically available information. However, he concludes that his findings provide simple evidence of a normal return to an active investment strategy based on financial statement analysis (thus acknowledging the Efficient Market Hypothesis (EMH)). His conclusions are also supported by the findings of other researchers like DeFond and Park (2001) that share prices do not fully impound the implications of reported earnings.

The findings of other researchers like Alam and Sickles (1998) are that compelling evidence of a relationship between technical efficiency scores and share market movements exist. They conclude that an industry trader can exploit the timing mechanism and derive excess portfolio returns without exposing himself to systematic risk. This conclusion challenges the strong form of the EMH which states that all publically available information is instantaneously reflected in the share price and, hence, no opportunity exists to extract excess returns. Jegadeesh and Livnat (2006) also state that practitioners can use their results to improve portfolio performance by exploiting not only the under-reaction to earnings surprises, but also to revenue surprises. The findings of Chan et al. (2006) are that accruals have predictive power for returns, but that it differs between industries and between different forms of accruals. However, researchers like Biddle, Bowen and Wallace (1997) and Cheng and Zang (2007) do not express an explicit opinion about the association of their findings with the EMH.

The aforementioned findings and statements of the researchers all indicate that the relevant performance of firms is one way or another reflected in the market prices of shares. They all focussed on different performance components of firm individual risk (FIR), but none of the research segregated systematic and unsystematic risk of the shares to levels where the relative FIR components that they researched could be quantified in proportion to FIR-level share price determinants. This brings about the objective of this research to segregate the pricing of shares in terms of market and firm specific factors with the intention to quantify the association of relative bank efficiency and earning performance with the pricing of South African bank shares. The study draws a parallel between the actual significance of measured efficiency and earnings per share (EPS) with share pricing and quantified FIR. Within this context the comparative significance of measured efficiency and EPS are explored to investigate the EMH prevalence.

Previous Research about Bank Performance And Share Returns

Researchers that focussed on bank performance and share return relationships were inter alia Adenso-Diaz and Gascon (1997), Chu and Lim (1998), Beccalli, Casu and Girardone (2006), Kirkwood and Nahm (2006), Sufian and Majid (2006), Sufian and Majid (2007), Ioannidis, Molyneux and Pasiouras (2008), Liadaki and Gaganis (2008), Muliaman, Maximilian, Hall, Kenjegalieva, Santoso, Satria and Simper (2008), Pasiouras, Liadaki, and Zopounidis (2008) and Thamron (2009).

All the aforementioned researchers find significant relationships between some specific bank performance measures used by them and the share returns of banks. This is substantiated by statements like that of Kirkwood and Nahm (2006) and Muliamman et al. (2008) that their findings indicate that the share markets appear to be efficient with the market valuing of banks in accordance to their performance.

The specific findings common to the findings of Chu and Lim (1998), Kirkwood and Nahm (2006), Ioannidis, Molyneux and Pasiouras (2008), Liadaki and Gaganis (2008) are that changes in profit efficiency are statistically significant and positively related to share returns. However, they do not find evidence of a significant relationship between cost efficiency and share returns. On the other hand, Beccalli, Casu and Girardone (2006), Sufian and Majid (2006) and Majid, Zulkhibri and Fadzlan (2008) conclude that changes in prices of bank shares reflect percentage changes in cost efficiency. These challenging findings and conclusions of the researchers are due to differences in their research methodologies. The group of researchers that indicate that they do not find any significant relationship between cost efficiency and share returns, have used specific variables that they believe are applicable to cost and profit efficiency separately in their research methodology models. Other researchers, who state that there exists a significant relationship between share prices and cost efficiency, have used single efficiency models that combined cost and profit variables.

Previous Data Envelopment Analysis (DEA) Bank Performance Research

Researchers that focussed on determining bank efficiency by applying DEA include Chu and Lim (1998), Mukharjee, Nath and Pal (2002), Stavarek (2002), Cronje (2003), Oberholzer and Van der Westhuizen (2004), Ho (2001), Ho and Zhu (2004), Kao and Liu (2004), Beccalli, Casu and Girardone (2006), Howland and Rowse (2006), Sakar (2006), Kirkwood and Nahm (2006), Wu, Yang and Liang (2006), Cronje (2007), and Mostafa (2007), Fadzlan

(2008), Ioannidis, Molyneux and Pasiouras (2008), Muliamal et.al (2008) and Thamron (2009).

The methods applied by researchers to conduct bank efficiency studies differ in terms of variables used for the efficiency analysis because some researchers supplement accounting based financial information with other company information. However, some researchers like Kao and Liu (2004), Cronje (2007), Mostafa (2007), Muliamal et.al (2008), Ioannidis, Molyneux and Pasiouras (2008) and Thamron (2009) used different components of historical financial information that make up ROA to compare the relevant efficiency of banks within the context that it is acknowledged by researchers like Dehning and Stratopolous (2002), that DuPont analysis enables efficiency analysis. They applied Data Envelopment Analysis (DEA) based on financial ratio figures constituting different elements of ROA by decomposing such financial performance indicators to their efficiency and effectiveness equivalents.

Kirkwood and Nahm(2006) as well as Ioannidis, Molyneux and Pasiouras (2008) indicate that they have examined both cost and income efficiency in the application of DEA to compare the performance of banks. This can be described as an alignment with the principles of the DuPont analysis. Ioannidis, Molyneux and Pasiouras (2008) also referred to Maudos, Pastor, Perez and Quesada (2002) who argue it provides a more important source of information than the partial view offered by analyzing cost efficiency.

Methodology of This Study

The data used in this study consists of the 1999 to 2009 financial and share price information of the nine listed banking groups in South Africa. These banking groups are listed on the Johannesburg Stock Exchange and constitute all formal banking operations in South Africa. Financial information was obtained from the Osiris database of Bureau van Dijk Electronic Publishing (2010) and the share price information from McGregor Bureau for Financial Information.

The focus of this study is on South African banking groups because no similar previous research involving these banking groups was conducted and the research also serves as a good case study for banking industries in similar developing countries.

The study consists of a four stage process. Firstly, systematic risk and FSR are segregated and quantified. Then DEA is conducted to determine the cost and income efficiency of banks. The third stage entails the calculation of the efficiency and share return relationship. Finally, the study provides evidence of the actual significance of measured efficiency and actual bank earnings as components of FIR and explores the appropriateness of applying micro-fundamental investment strategy activities for investors in South African banking groups with specific reference to the EMH basics.

Stage 1: Segregation of systematic and firm specific risk

The index model is applied in both single and multifactor format to decompose the returns of bank shares into systematic and bank specific risk components.

The single format $\Delta R_{it} = \alpha + \beta \Delta MR_t + \varepsilon 1_t$ regression findings are rephrased to provide the estimate of $FSR = \varepsilon 1_t = 1 - R^2 of\ \Delta R_{it}$. ΔR_{it} constitutes the change in share returns of banks during a specific time period whilst MR_t is the change in the market return of the Johannesburg Stock Exchange (JSE) for the same period of time. $E1_t$ is the random error term of the equation.

The index model's decomposition of returns into systematic and FSR components provides a first broad classification of risks. However, we know that FSR risks can be classified into two major categories, namely sector risk (SR) and firm individual risk (FIR). Therefore, by applying the index model in multifactor format (including the financial index return (FM_t), the equation $\Delta R_{it} = \alpha + \beta \Delta MR_t + \beta \Delta FM_t + \varepsilon 2_t$ provides a further segregation of firm-specific risk into SR and FIR components in the sense that SR can be expressed as $SR = \varepsilon 1_t - \varepsilon 2_t$. FIR components can, on the other hand be stated as $FIR = \varepsilon 2_t$.

The aforementioned segregation makes it possible to determine the relative contribution of the three levels of risk on share performance returns over the period 2000 to 2007 and to compare the impact of the Global Financial Crises (GFC) on the relative importance of the risk categories with effect from 2008 to 2009.

Similar principles than those applied by Jegadeesh and Livnat (2006) are used with the segregation procedure in this study in this sense that $\varepsilon 2_t$ is calculated at times that represent interim performance announcements; actual financial year-ends; official post financial year announcements; and a lag period after financial year-end that represents no announcement. For this purposes all analysis is done for the annual ΔR_{it} at the following stages for each banking group:

- Three months before financial year-end, since it represents the stage where official interim six-month financial performance results for the current financial year have been announced.
- At financial year-end as financial performance information is then internally available in banking groups.
- Three months after financial year-end as

official full financial year results have been announced at this stage.

- Six months after financial year-end as it represents a more dormant public information period of time, except when media coverage of abnormal circumstances occurs. Financial performance of banking groups is, however, internally available at this stage. This stage provides information about future performance anticipation or lags in the incorporation of previous available information.

Stage 2: DEA analysis to determine the cost and profit efficiency of banks

DEA is used to compute a comparative ratio of outputs to inputs for each banking group to obtain their relative efficiency scores. The DEAP 2.1 software of Coelli (1996) is used for the DEA analysis. The efficiency score is usually expressed as either a number between zero and one or 0% and 100%. A decision making unit (DMU) with a score less than one is deemed inefficient relative to other DMUs (Avkiran, 1999).

The following formulation, also known as the input-oriented Charnes, Cooper and Rhodes (CCR) Model, is applied in this study to determine the relative cost efficiency of the banking groups:

$$\text{Minimize } H_A - \varepsilon\left(\sum_{r=1}^{R} s_r^+ + \sum_{i=1}^{I} s_i^-\right)$$

$$\text{subject to: } H_A x_{iA} - \sum_{j=1}^{n} \lambda_{Aj} y_{ij} - s_i^- = 0, \text{ for all } i = 1,2,...,I,$$

$$\sum_{j=1}^{n} \lambda_{Aj} y_{rj} - s_r^+ = y_{rA}, \text{ for all } r = 1,2,....,R,$$

$$\lambda_{Aj}, s_r^+, s_i^- \geq 0, \text{ for all } j, r, i.$$

Where: H_A = the minimum proportion such that for each input, the weighted combination of input of all banking groups does not exceed the proportion H_A of the input of bank group A. At the same time the weighted combination of output of all banking groups is at least as great as that of bank group A.

s^+_r = slack variables corresponding to the outputs.

s^-_i = slack variables corresponding to the inputs.

R = the number of outputs.

I = the number of inputs.

λ_{Aj} = the optimal weights calculated by the linear programme for the outputs of bank group A.

The formulation for the output-oriented CCR model that is applied in this study to determine the relative income efficiency of the banking groups is:

$$\text{Maximise } -H_A + \varepsilon\left(\sum_{r=1}^{R} s_r^+ + \sum_{i=1}^{I} s_i^-\right)$$

In the application of DEA the inputs and outputs that apply to the type of efficiency that is being assessed should be determined (Sherman and Rupert, 2006). Manandhar and Tang (2002) states that the efficiency that can be determined by applying DEA is not confined to a traditional sense of operating efficiency; the inputs and outputs used will determine the relative evaluation of performance in a specific performance dimension. Since the objective of the research is to determine the efficiency of the ROA of banking groups and the principles of DuPont analysis is applied in this regard, the following financial statement figures are regarded as relevant elements of ROA: Interest income, non-interest income, other income, interest expenses, non-interest expenses, loan losses and other expenses (Cronje, 2007). These figures represent the assemblage of the net profit before tax figure (numerator) in the ROA ratio. The other financial statement figure that is relevant and also forms part of the ROA ratio is total assets (denominator).

Another aspect that is relevant to the inputs and outputs that have to be selected for efficiency analysis is that the measured DEA efficiency in small samples is sensitive to the difference between the number of DMUs and the sum of inputs and outputs used (Button and Weyman-Jones, 1992). In a typical analysis each ratio may be associated with a different DMU and the number of such ratios will be the product of the number of inputs and the number of outputs. In general if there are t outputs and m inputs we would expect the order of tm efficient DMUs, suggesting that the number of units in the set should be substantially greater than tm, in order for there to be suitable discrimination between the DMUs. Raab and Lichty (2002) suggest a general rule of thumb – the minimum number of DMUs should be greater than three times the number of inputs plus outputs.

Based on the aforementioned criteria regarding performance dimension and the limitations relating to the number of inputs and outputs that are used, two DEA input and output datasets were set up for this research. This created a profit efficiency dataset consisting of one input, namely average total assets and three outputs – interest income, non-interest income and other income. For the cost efficiency dataset four inputs were considered – interest expense, non-interest expense, loan losses and other expenses with average total assets as output. The general rule of thumb criteria of Raab and Lichty (2002) in terms of the number of inputs cannot be attained completely but the non-interest expenses and loan losses are combined in the cost efficiency dataset (because loan losses are generally reported as part of non-interest expenses in financial statements).

DEA is conducted with both constant returns to scale (CRS) and variable returns to scale (VRS). This procedure makes it possible to decompose technical efficiency (TE) into pure technical efficiency (PTE) and scale efficiency (SE). The CRS efficiency score represents technical efficiency that measures the inefficiencies due to the input/output configuration as well as the size of operations while the VRS efficiency score only represents pure technical efficiency without scale efficiency. Coelli (1996) indicates that the scale inefficiency of a DMU can be calculated from the difference between the VRS TE score and the CRS TE score by applying the following calculation:

$$Scale - efficiency = \frac{\theta^*_{CRS}}{\theta^*_{VRS}}$$

Stage 3: Calculation of efficiency and share return relationship

The efficiency combinations that are evaluated in terms of their link with the return on shares represent the separate CRS, VRS and Scale efficiency scores of the individual banking groups. All efficiency scores are evaluated by replacing the market return (MR) in the multifactor index model with the different CRS, VRS and Scale efficiency scores of banks:

$$\Delta R_{it} = \alpha + \beta \Delta BE_{it} + \beta BE_{it} + \varepsilon 3_t$$

Where: ΔR_{it} = period over period change in the return of individual bank shares in period t.
ΔBE_{it} = period over period change in a vector of independent efficiency variables (CRS, VRS and Scale efficiency).
BE_{it} = a vector of independent efficiency variables (CRS, VRS and Scale efficiency).

All CRS, VRS and Scale efficiency variables used in the analysis are calculated as follows:

$$\text{DEA score} = \frac{\text{Cost efficiency score } + \text{ income efficiency score}}{2}$$

Stage 4: Exploring the extent to which comparative bank efficiency information provides beneficial insight to investors compared to financial bottom line results

Since the efficiency and earnings per share (EPS) differences between banks may include a level of covariance with systematic and sector factors, the calculation of efficiency and EPS isolated from such covariance is determined by incorporating the efficiency and EPS of banks into a multifactor model with systematic and sector factors $\Delta R_{it} = \alpha + \beta \Delta MR_t + \beta \Delta FM_t + \beta \Delta BE_t + \beta BE_t + \beta \Delta EPS + \beta EPS + \varepsilon 4_t$ and comparing the R^2 of this equation with the R^2 of only systematic and sector factors included in the equation $\Delta R_{it} = \alpha + \beta \Delta MR_t + \beta \Delta FM_t + \varepsilon 2_t$. Therefore, the actual combined impact of efficiency and EPS on share returns can be expressed with the equation $R_{it} = (100 - \varepsilon 4_t) - (100 - \varepsilon 2_t)$. However, to determine the individual relative impact of efficiency and EPS on share prices requires that the following multifactor models be applied:

$$\Delta R_{it} = \alpha + \beta \Delta MR_t + \beta \Delta FM_t + \beta \Delta BE_t + \beta BE_t + \varepsilon 5_t$$
$$\Delta R_{it} = \alpha + \beta \Delta MR_t + \beta \Delta FM_t + \beta \Delta EPS + \beta EPS + \varepsilon 6_t$$

With these equations the individual relative impact of efficiency and EPS on share prices can be stated as follows:

$$\text{Efficiency impact on } R_{it} = (100 - \varepsilon 4_t) - (100 - \varepsilon 6_t))$$
$$\text{EPS impact on } R_{it} = (100 - \varepsilon 4_t) - (100 - \varepsilon 5_t)$$

The extent to which share returns are affected by individual bank efficiency and EPS (from which covariance with systematic risk and sector risk has been removed) can be quantified as components of FIR by:

$$EFF \text{ as \% of } FIR_{it} = \frac{(100 - \varepsilon 4_t) - (100 - \varepsilon 6_t)}{\varepsilon 2_t} x \frac{100}{1}$$

$$EPS \text{ as \% of } FIR_{it} = \frac{(100 - \varepsilon 4_t) - (100 - \varepsilon 5_t)}{\varepsilon 2_t} x \frac{100}{1}$$

Efficiency and EPS as percentage of FIR are calculated at times that represent interim performance announcements; actual financial year-ends; official post financial year announcements; and a lag period after financial year-end that represents no announcements to serve as indicators of the extent to which micro fundamental analysis based on efficiency and EPS comparisons between banks are reflected in share pricing and to what extent it confirms EMH basics.

Findings

The systematic risk and FSR components (SR and FIR risks) of the banking groups are indicated in table

1 in both the pre-Global Financial Crises (GFC) period (2000 to 2007) and the 2008 to 2009 GFC period.

Table 1. Segregation of systematic risk, SR and FIR

Equation		R^2 at announcement of interim 6 months financial results	R^2 at financial year end	R^2 at announcement of full year financial results	R^2 at mid-half of financial year - no announcements
$\Delta R_{it} = \alpha + \beta \Delta MR_t + \varepsilon 1_t$	Pre-GFC	18.0484	19.7672	11.8346	23.3497
	E_1 value	81.9516	80.2328	88.1654	76.6503
$\Delta R_{it} = \alpha + \beta \Delta MR_t + \varepsilon 1_t$	GFC	39.9567	45.7284	30.1954	49.6847
	E_1 value	60.0433	54.2716	69.8046	50.3153

The findings indicate that the effect of systematic risk on the market price of the shares of banking groups shows a definite change at different financial year time points in both pre- and GFC time periods. The systematic risk effect on share prices is lower at those times when interim financial results and final financial results are announced compared to non-announcement times. The most significant difference is between the announcement of full financial year results and the mid-half financial year time points when no announcements are made. In essence, SR and FIR information are incorporated into share prices when announcements are made; in the pre-GFC time period systematic risk had a much smaller effect on share price movement than in the GFC time period; and the volatility of systematic risk increased in the GFC period.

The combined relationship of systematic risk and SR with the share prices of bank groups are contained in table 2.

Table 2. Relationship of systematic risk, SR and FIR with share prices

Equation		R^2 at announcement of interim 6 months financial results	R^2 at financial year end	R^2 at announcement of full year financial results	R^2 at mid-half of financial year - no announcements
$\Delta R_{it} = \alpha + \beta \Delta MR_t + \beta \Delta FM_t + \varepsilon 2_t$	Pre-GFC	40.5988	42.9243	37.1707	49.2072
	E_2 value	59.4012	57.0757	62.8293	50.7928
$E_1 - E_2$	SR	22.5504	23.1571	25.3361	25.8575
$\Delta R_{it} = \alpha + \beta \Delta MR_t + \beta \Delta FM_t + \varepsilon 2_t$	GFC	55.0034	53.1951	30.6437	50.6894
	E_2 value	44.9966	46.8049	69.3563	49.3106
$E_1 - E_2$	SR	15.0467	7.4667	0.4483	1.0047

During the pre-GFC period, the SR relationship with bank share prices was at all times larger than the systematic risk, but SR showed very little movement between different financial year time points. It is therefore evident that SR information has more stable alignment with share prices. The FIR risk components constituted the majority share price determinants with peaks of 59.40% at announcement of interim 6 month financial results and 62.83% at announcement of full year financial results.

The GFC SR differs from the pre-GFC SR due to the tremendous increase in systematic risk. The SR relationship with individual bank group share prices was much less during this time period and even became very small at the announcement of full financial year financial results and at the mid-half year intervals when no financial announcements were made. In such circumstances systematic risk and FIR risk seems to be the major risk factors impacting on share prices with very little sector risk relationship. The GFC systematic risk implications also reduced the FIR effect on share prices in general except at the announcement of full year financial results where FIR increased to a level of 69.36% that also exceeded pre-GFC FIR levels.

The combined effect of efficiency and EPS on share prices showed in the pre-GFC period surged at the announcement of interim 6 months financial results and at the announcement of full year financial results of bank groups (table 3). However, in the GFC time period the combined relationship of efficiency and EPS with share prices was on average higher than in the pre-GFC time period, but points in time when surges occurred did not match up with that of pre-GFC surges, as it occurred at the time point of interim 6 month financial result announcements as well as at financial year-end, but dropped at the announcement of full-year financial results and the no-announcement period thereafter. The findings for the pre-GFC period are indicative of a strong form of the EMH. However, the GFC period reflected a semi-strong form of the EMH due to the surge in the R^2 of efficiency and EPS with share prices at the announcement of interim financial results, and due to the lag in the further increase of the R^2 to the financial year-end of the banking groups.

Table 3. Relationship between bank efficiency, EPS and share prices

Equation		R^2 at announcement of interim 6 months financial results	R^2 at financial year end	R^2 at announcement of full year results	R^2 at mid-half of financial year - no announcements
$\Delta R_{it} = \alpha + \beta \Delta MR_t + \beta \Delta FM_t + \beta \Delta BE_t + \beta BE_t + \beta \Delta EPS + \beta EPS + \varepsilon 4_t$ (Applied to find highest R2 with alternative inclusion of CRS, VRS and Scale efficiency in equation)	Pre-GFC	59.5906 (CRS)	61.0681 (CRS)	61.6998 (Scale efficiency)	63.7058 (CRS)
	GFC	78.4613 (VRS)	83.1811 (VRS)	54.7578 (VRS)	69.1734 (CRS)
Combined EFF and EPS impact on R_{it} = $(100-\varepsilon 4_t)-(100-\varepsilon 2_t)$	Pre-GFC	18.9918	18.1438	25.6921	14.4986
	GFC	23.4579	29.986	24.1141	18.484
$\Delta R_{it} = \alpha + \beta \Delta MR_t + \beta \Delta FM_t + \beta \Delta BE_t + \beta BE_t + \varepsilon 5_t$ (Used same CRS, VRS and Scale efficiency alternatives as has been done with E4 equation)	Pre-GFC	58.112 (CRS)	60.1948 (CRS)	52.6671 (Scale efficiency)	61.0958 (CRS)
	GFC	50.4524 (VRS)	56.0172 (VRS)	43.8151 (VRS)	61.0958 (CRS)
$\Delta R_{it} = \alpha + \beta \Delta MR_t + \beta \Delta FM_t + \beta \Delta EPS + \beta EPS + \varepsilon 6_t$	Pre-GFC	47.703	48.8594	55.1188	57.0719
	GFC	65.1641	61.5733	41.1196	51.6145
Efficiency impact on R_{it} = $(100-\varepsilon 4_t)-(100-\varepsilon 6_t))$	Pre-GFC	11.8876	12.2087	6.581	6.6339
	GFC	13.2972	21.6078	13.6382	17.5589
EPS impact on R_{it} = $(100-\varepsilon 4_t)-(100-\varepsilon 5_t)$	Pre-GFC	1.4786	0.8733	9.0327	2.61
	GFC	28.0089	27.1639	10.9427	8.0776

The segregation of the effects of efficiency and EPS on share prices shows that that a semi-strong form of the EMH existed for efficiency in both the pre-GFC and GFC periods. In the pre-GFC period a very minor lag existed in the increase of the R^2 between the announcement of interim 6 months financial results and the financial year-end. In fact, the increase in R^2 was so small that it could almost represent a strong form of efficient market hypothesis. The GFC period is characterised by a definite semi-strong form of efficient market hypothesis due to considerable changes in three month lag periods of time in R^2 after interim 6 month financial announcements and full year financial announcements.

A strong form of efficient market hypothesis exists in both pre-GFC and GFC periods with regard to EPS with decreases in R^2 after financial result announcements.

The importance of efficiency and EPS as determinants of share prices as part of FIR in the pre-GFC and GFC periods is reflected in table 4. It is evident that the importance of both efficiency and EPS as components of FIR increased tremendously since the GFC. The pre-GFC importance of EPS was very low, representing only 14.38% of FIR of share prices at full financial year result announcements. EPS was much lower at all other time points during financial years. Since the GFC it became a much more prominent component of FIR with extensive increases at certain financial year time points.

Efficiency was a much more prominent component of FIR than EPS in the pre-GFC period, and also increased with the GFC. Both efficiency and EPS reflected the same average importance in the GFC period, although showing non-related fluctuation at different financial year time points.

Table 4. Quantification of efficiency and EPS as components of FIR

Equation		Percentage of FIR at announcement of interim 6 months financial results	Percentage of FIR at financial year end	Percentage of FIR at announcement of full year financial results	Percentage of FIR at mid-half of financial year - no announcements
Efficiency as % of FIR_{it} = $\frac{(100-\varepsilon 4_t)-(100-\varepsilon 6_t))}{\varepsilon 2_t} x \frac{100}{1}$	Pre-GFC	20.0124	21.3904	10.4757	13.0607
	GFC	29.5516	46.1657	19.6640	35.6088
EPS as % of FIR_{it} = $\frac{(100-\varepsilon 4_t)-(100-\varepsilon 5_t)}{\varepsilon 2_t} x \frac{100}{1}$	Pre-GFC	2.4892	1.5301	14.3766	5.1385
	GFC	62.2467	58.0364	15.7775	16.3811

Summary and Conclusion

The methodology applied in this study provides a segregation of the risk components related to share pricing into three categories, namely, systematic risk, SR and FIR. The quantification emanating from the separation of the risk components into different categories provides evidence of the significance of each in the pre-GFC and GFC periods. It furthermore indicates the importance of efficiency and EPS as components of FIR in the determination of share prices and the extent to which the EMH applies.

Application of the single index model to determine the relationship between systematic risk and share price movements indicates that the systematic risk effect on share prices was, during both the pre-GFC and GFC periods, lower at time points in financial years when financial performance announcements were made. It confirms the logical expectation that the market incorporates FIR information when it becomes publicly available.

Segregation of risk components into the major categories indicates that the relationship between SR and share prices was higher than the relationship between systematic risk and share prices in the pre-GFC period, whilst the FIR was the highest, constituting a R^2 of between 50.19 and 62.83. The SR relationship with share prices reduced significantly in the GFC period. The lowest R^2 of only 0.44 occurred at the announcement of full year financial performance results. It is evident that FIR information was incorporated when it became public and played a more prominent role in share pricing during the GFC period.

A strong form of the EMH existed in the pre-GFC period considering the relationship of FIR with share prices, thus confirming an efficient market. During the GFC period a semi-strong form of the EMH existed due to the increase of the R^2 between FIR and share prices over the three month period of time after the announcement of interim 6 month financial results. However, at announcement of full year financial performance results it turned to a strong form of the EMH.

Efficiency and EPS have a combined R^2 relationship with share pricing of between 14.50 and 25.69 at different points in time of financial years in the pre-GFC period. The R^2 relationship increased to between 18.48 and 29.99 in the GFC period. This substantiates the findings that SR importance in share pricing has reduced with the increase in FIR during the GFC.

Efficiency together with EPS constituted 24% of FIR in share pricing in the pre-GFC period. This increased to more than 94% at certain points in time of financial years in the GFC period with EPS showing the highest increase.

An analysis of efficiency and share price relationships at different financial year time points shows a semi-strong form of the EMH in both the pre-GFC and GFC periods. This indicates that the application of an active investment strategy by investors based on income and cost efficiency measures may be beneficial. The impact of EPS as contributing determinant of share prices increased during the GFC period compared to the pre-GFC period, but reflects a strong form of the EMH.

This study can in future be expanded to include long post-GFC periods that may reflect time series differences in the importance of different share price determinants. Applying it in different market environments may also provide good comparative findings.

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