The profit impact of IT investment

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Two models were used to study the relationships between profitability and the level of information technology (IT) among long-term life insurance companies. The first compared the computerization index (CI) with profitability ratios. The second used the operating expense ratio (profitability measure) and the IT expense ratio to measure the level of IT capital intensity. The results of the present study showed a positive correlation between the CI and the financial ratios and the most profitable firms are more likely to spend a higher proportion of their non-interest operating expenses on IT.

Introduction

This study examined the relationship between profitability performance and the level of information technology (IT) investment amongst the long-term life insurance firms in South Africa. In order to do this, two studies were replicated. The first of these was by Harris and Katz (1988) which involved 40 life insurance companies in the United States of America (USA) and showed that the most profitable firms are more likely to spend a significantly higher proportion of their non-interest operating expense on IT. It also showed that the least profitable firms are likely to spend a significantly smaller proportion of their non-interest operating expense on IT. The second study was by Kwong and Mohamed (1987) which involved six petroleum companies in Malaysia and showed that the profitability performance is positively correlated with the degree of computerization. The aim of this study was to see if the conclusions in the above-mentioned studies are applicable to the long-term life insurance industry in South Africa.

Review of related literature

Weill and Olson (1989) noted that the product portfolio and profit impact of marketing strategy (PIMS) established the mean IT expenditure in 1983 as 2% of revenues while the Diebold Group survey in 1984 revealed that centralized management information systems expenditures on average accounted for 1.44% of revenues. One of Weill and Olson’s recommendations was that IT expenditure must be measured and tracked over time against a convenient base (that is, revenues, total expenses or management controlled costs).

Shoval and Lugasi (1988) focused on selecting between alternative computer systems while considering not only the cost–benefit ratio, but also the relative importance of the benefit and cost factors. They assumed that benefits (unlike the costs) are difficult to measure in quantitative terms. Ahituv and Igbaria (1990) recorded that the difficult part of cost–benefit analysis is the identification of all the elements that form part of the costs and benefits and the determination of how to measure or estimate these elements.

Kwong and Mohamed (1987), in a case study between a sample of petroleum-producing companies in Malaysia, suggest the use of a computerization index (CI) which measures the extent and sophistication of computerization (see Appendix A). The CI incorporates a number of factors, namely the management activity level, the number of years using computers, the number of computers, the application software used, the central processing unit (CPU) size, the hardware cost, the staff, the number of shifts, the organizational location and the project investment analysis.

In an empirical study of insurance companies in the USA, Harris and Katz (1988) established a relationship between an organization’s profitability and their IT capital intensity. They used the ratio of non-interest operating expense to premium income (operating expense ratio) to measure a firm’s cost advantage–disadvantage from current operations (profitability) and the ratio of IT expense to non-interest operating expense (IT expense ratio) to measure the degree of operating dependency on the level of IT capital intensity. They concluded that the most profitable firms or top performers are more likely to spend a significantly higher proportion of their non-interest operating expense on IT and, secondly, the least profitable firms are more likely to spend a significantly
smaller proportion of their non-interest operating expense on IT. Ward (1987) conjectures that there is a trend towards decreasing IT costs and increasing IT capabilities that will make the use of IT both economically and technically feasible. This, it could be conjectured, could result in a decrease in the amount of resources invested in IT.

Bender (1986) examined the relationship between the ratio of information-processing expense to total operating expense and the ratio of total operating expense to premium income in life insurance companies. The correlation between the two ratios was negative, indicating that higher values of the ratio of information-processing expense to total operating expense were associated with better performance. Whereas Bender (1986) did not provide a clear interpretation of the ratio of information-processing expense to total operating expense, his results did establish the potential of linking firm performance to IT expense measures.

Chargeback systems are one method of quantifying the benefits an organization receives (Huflagel and Birnberg, 1989). Mauz et al. (1983), in a study of IT controls, observed that these systems are difficult to operate. However, Allen (1987), in a literature study on methods to make information systems (IS) pay its way, postulates that a competitive advantage can be gained if IT is run as a profit centre. Surveys done (Drury, 1980; Choudhury et al. 1986) in both chargeback and non-chargeback environments show that management information system (MIS) managers are in favour of using chargeback to control the use of scarce information resources.

The hypotheses and research methodology

The hypotheses

Relationship between profitability (operating expense ratio)—and IT investment (IT expense ratio)

Harris and Katz (1988) studied the relationship between profitability and IT expenditures in 40 American insurance companies. The study of Harris and Katz (1988) did not establish the direction of causality between profitability and IT capital intensity. However, the findings note empirical relationships.

Turner (1985) noted that there is no relationship between an organization's performance and the relative portion of resources allocated to information systems. He postulated that the measure of performance will not capture all factors which contribute to high performance. Using case studies, Weill and Olson (1989) noted the importance of converting IT investment into productive inputs with different levels of effectiveness, depending on the organization. Thus, the first hypothesis, based on the hypothesis of Harris and Katz (1988), can be formulated.

H1: The most profitable firms will invest significantly more in IT capital than the least profitable firms.

Relationship between profitability (financial ratios) and computerization index (CI)

The study of Bender (1986) established the potential of linking firm performance to IT expense measures. Harris and Katz (1988) conjectured that the ratio of IT expense to total operating expense tended to be higher in top performance firms. In a case study of the profit impact of computerization, Kwong and Mohamed (1987) suggest that IT investment reduces the cost of revenue generation. The second hypothesis can thus be conjectured, based on the hypothesis of Kwong and Mohamed (1987).

H2: Profitability performance is positively correlated with the degree of computerization.

Research methodology

In order to gather the data needed to complete a CI for a company, a structured questionnaire was formulated. This questionnaire collected values for the variables associated with the Kwong and Mohamed (1987) model and the IT expense value needed for the ratios used by Harris and Katz (1988). The population consisted of all the long-term life insurance companies in South Africa based on a list supplied by the Financial Services Board (FSB) of South Africa. From this population, a sample was selected, based on their position in the Financial Mail's top 20 long-term life insurance companies for each of the 3 years (this list is based on the net premium income (NPI) of each company). The financial data was obtained from the FSB who maintain financial records for all long-term life insurance companies.

The completed questionnaires were analysed to extract the data needed. The CI was calculated using questions from the questionnaire. Financial ratios were calculated using data from the FSB and the questionnaire. Graphs showing the relationships between the CI and the measures of financial performance were plotted. In addition to the analysis used by Harris and Katz (1988) and Kwong and Mohamed (1987), it was decided to perform statistical analysis. Statgraphics was used for regression analysis and the Spearman rank correlation test.

The ratios of non-interest operating expense to premium income (operating expense ratio) and IT expense to operating expense (IT expense ratio) were calculated. Using this measure, insurance companies with similar lines of business can be compared. The IT expense ratio is a measure of capital intensity in IT as supported by Harris and Katz (1988). Graphs of sample versus industry total premium income and operating expense ratio versus IT expense ratio were produced to show the various
relationships. The pre-tax return on assets, pre-tax return on turnover, asset turnover, gross margin, 3 year profit growth rate and 3 year turnover growth rate were calculated in order to apply the model proposed by Kwong and Mohamed (1987). Composite graphs were produced showing relationships between these ratios and the CI for each company. Finally, a graph and statistical analysis of the CI versus the operating expense ratio was produced to see if any relationship could be ascertained.

**Pilot study**

A pilot study was completed using two companies in Cape Town to test for aspects of the questionnaire which respondents may have had difficulty in understanding. In addition, it was necessary to ensure that it was possible to collect all data required for the ratios.

**Precautions taken**

It was assumed that the companies figures, as reflected by the FSB of South Africa, were accurate and complete. In addition, it was assumed that the respondent completing the questionnaire did so accurately. However, a possible source of error lies in the respondent's interpretation of the terminology used in the questionnaire. Furthermore, some of the data given by the respondent in the questionnaire could not be verified in full. The study also did not check the method of accounting and it is acknowledged that this could influence some of the results obtained. This research did not investigate the effect of inflation on IT investments. The questionnaire defined IT expenditure as all hardware costs, all software costs, communications costs, software and other expenses such as environment, staff and supplies. These expenses were consistent across the respondent organizations.

Kwong and Mohamed (1987) postulated that there was no consensus on the appropriate measurement of financial performance. That is why they used multiple measures of financial performance. Brown and Howard (1969) conjectured that accounting ratios are a guide and must be used in conjunction with other information of a comparable nature. Cash-flow-based ratios could have been employed, but limited time and funds forced the study to use the same ratios as Kwong and Mohamed (1987). It is acknowledged that the operating expense ratio is only a short-term measurement of profitability (Harris and Katz, 1991), but was deemed adequate for the purpose of this study.

**Response rate**

Of the 20 questionnaires sent out (the population was 23), 12 were received in time to be fully analysed. This gives a response rate of 60%. Of the 12 questionnaires, two were discarded due to the fact that they were incomplete. The number of valid responses prescribed that the data be split into thirds (tertiles), with three companies in each tertile. This was necessary in order to compare the research with that of Harris and Katz (1988). This meant that one response had to be discarded at random and this produced a return rate of 45% of the initial sample. The sample companies account for approximately 72% of the total premium income for the industry during the period 1989–1991. It can be noted that the sample of nine companies represents a significant portion of the total long-term insurance industry.

| Table 1 Operating expense ratios and IT expense ratios |
|-------------------------------------------------------|
|            | 1989       | 1990       | 1991       | 1989–1991  |
| C   | 1 | 0.142 | 0.019 | 0.152 | 0.119 | 0.157 | 0.128 | 0.150 | 0.119 |
|     | 2 | 0.117 | 0.044 | 0.128 | 0.037 | 0.148 | 0.053 | 0.131 | 0.045 |
|     | 3 | 0.872 | 0.191 | 0.162 | 0.117 | 0.180 | 0.145 | 0.405 | 0.151 |
|     | 4 | 0.464 | 0.084 | 0.257 | 0.160 | 0.427 | 0.180 | 0.383 | 0.141 |
|     | 5 | 0.024 | 0.469 | 0.172 | 0.483 | 0.252 | 0.820 | 0.149 | 0.591 |
|     | 6 | 0.888 | 0.174 | 0.189 | 0.152 | 1.318 | 0.106 | 0.798 | 0.144 |
|     | 7 | 0.549 | 0.120 | 0.422 | 0.139 | 0.374 | 0.232 | 0.448 | 0.164 |
|     | 8 | 0.785 | 0.090 | 0.783 | 0.118 | 0.718 | 0.099 | 0.762 | 0.102 |
|     | 9 | 0.378 | 0.336 | 0.487 | 0.284 | 0.350 | 0.290 | 0.405 | 0.303 |

C, company number; OPEX, operating expense ratio; ITEX, IT expense ratio.
Impact based on the had a positive effect on (Figures investment accepts the first though ranked industry intensity the lowest 33% of the The expense ratio versus the noted computerization the highest mean companies with the +-----f-4--....- The sophistication operating operating total Tertile groupings: needed -l--------- IT higher for this section were IT expense ratio is figure reveals to the (Table 0 from this figure that companies falling an overall increase. profitability and IT operating 33%). grouped expense ratio versus IT expense ratio was its expense profitability operating 2 and 3). companies, group II was the second lowest 33% and group III the highest 33%). This gave a measure of short-term profitability performance for the companies. The companies with the lowest operating expense ratio (group I) were the most profitable and the companies with the highest operating expense ratio (group III) were the least profitable. The graph of the operating expense ratio versus the IT expense ratio for 1989–1991 is plotted in Figure 1 based on the results in Table 2. It depicts a diagram of the relationship between IT and organizational performance.

It can be noted from this figure that companies falling in group I (most profitable companies) invested the most in IT per rand of non-interest-operating expense. The least profitable companies (group III) invested significantly less a proportion of their non-interest operating expense. Group I companies exhibited the highest mean level of IT capital intensity over the 3 years (0.25) while group III companies invested less (0.137).

Regression analysis portrayed an association of −0.291 between the operating expense ratio and the IT expense ratio. In other words, there was nearly a 30% probability that the operating expense ratio is correlated negatively with the IT expense ratio. The R-squared figure reveals that only 8.49% of variation in the IT expense ratio was caused by the operating expense ratio. There was a small relationship between profitability and IT investment in the South African long-term insurance industry and this study accepts the first hypothesis.

### Results

#### Relationship between profitability and IT investment

The data needed for this section were gathered from financial returns provided by the FSB of South Africa. The operating expense ratio and the IT expense ratio were calculated for the companies during the period 1989–1991 (Table 1). The ratios were averaged over 3 years (1989–1991). The companies were ranked according to the operating expense ratio, as prescribed by the study of Harris and Katz (1988) and grouped into tertiles (Table 2, group I represents the lowest 33% of the companies, group II the second lowest 33% and group III the highest 33%).

This gave a measure of short-term profitability performance for the companies. The companies with the lowest operating expense ratio (group I) were the most profitable and the companies with the highest operating expense ratio (group III) were the least profitable. The overall results are shown in Table 3. The companies were ranked in ascending order according to their CI. However, because the CI measures the relative extent of sophistication of computerization compared to the other companies, it follows that for instance C5 is not exactly twice more computerized than C2, even though C5 has a CI of 10 and C2 has a CI of 5.

It can be discerned from the next figure that the ratio of pre-tax profit to total assets showed a general increase as the sophistication of the computerization increases. This suggested that, with higher sophistication of computerization, the total assets of the companies are better used for generating profit. The ratio of pre-tax profit to turnover showed a decline and then an increase with the level of computerization. With regard to the total revenue to total assets ratio, the upward trend reflects a general increase with the level of computerization.

There seemed to be two clusters of companies, those with a CI of 7 or below and those with a CI above 10. The lower cluster exhibited an overall general decrease whereas the higher cluster exhibited an overall increase. This could be due to the fact that as a company moved towards a higher level of computerization, its profitability seems to decrease until it reached some point where the sophistication of computerization had a positive effect on profitability (Figures 2 and 3).

![Figure 1 Tertile groupings: operating expense ratio versus IT expense ratio (1989–1991). □ IT × ratio; ■ operating × ratio](image)
This trend continued when the CIs were compared with the other ratios. Figure 3 illustrates that the ratio of gross profit to turnover showed an initial decrease and then increased slightly. This suggests that the cost of revenue generation declines in a more sophisticated IT environment as a result of a more efficient operations function. Similarly, the profit growth rate in the higher cluster companies shows a general increasing trend. The trend in the turnover growth rate is not as clear, but appears to decrease well into the higher cluster companies and only then reflected a general increase.

Figure 3 reflects that the CIs of the companies are comparable to the profitability ratio used by Harris and Katz (1988) (operating expense ratio). As the level of computerization increased, the operating expense ratio decreased, showing that the higher the level of computerization, the better the profitability performance of the companies.

The CI correlated positively with the net profit: total revenue ratio (+0.817). This could be because of the interrelationship between benefits received and positive management. This supports the findings above. The CI correlated positively with the net profit: total asset ratio.
(+0.602), again supporting the conclusions drawn from previous figures (2 and 3). This is consistent with the findings of Kwong and Mohamed (1987). A correlation of 0.167 between the CI and the total revenue : total assets ratio was discovered, which is inconsistent with that of Kwong and Mohamed (1987). It was, however, generally found that the CI correlated positively with profitability performance ratios (Figure 4). This leads to the acceptance of this hypothesis.

Conclusion

It can be concluded, from the results, that both the studies by Harris and Katz (1988) and Kwong and Mohamed (1985) are applicable in the long-term life insurance industry in South Africa. The direction of causality between profitability (operating expense ratio) and IT capital intensity (IT expense ratio) was not established, but empirical relationships were discovered. The analysed results for hypothesis 1 show the following.

1. The most profitable companies or top performers are likely to spend a significantly higher proportion of their non-interest operating expense on IT.
2. The least profitable companies are more likely to spend a significantly smaller proportion of their non-interest operating expense on IT.

Levels of IT capital intensity, as noted by Harris and Katz (1988), are related to profitability performance. The findings suggested that low profitability companies (high operating expense ratio) are at greater risks with low levels of IT capital intensity than high-profitability companies with high levels of capital intensity. In addition, when the technology fits the organizational situation, significant savings in operating costs are possible.

Kwong and Mohamed (1987) constructed a composite measure of the various factors influencing the extent and sophistication of computerization. It can be seen from the results for hypothesis 2 that the degree of computerization, when related to multiple measures of profitability performance, generally exhibited a positive correlation. However, the companies appeared to be divided into two clusters, the low cluster having a very low CI and the high cluster having a higher set of CIs. The results for the high cluster show a general increase, suggesting that increased profitability performance increases as the level of sophistication of computerization increases. The results for the low cluster show a general decrease, suggesting that profitability performance initially decreases as the level of computerization rises. Once a certain threshold has been reached, then the increase in computerization displays a positive effect on profitability performance.

When the CI for each company was compared to the short-term profitability measure proposed by Harris and Katz (1988) (the operating expense ratio), a clear positive relation was found without any apparent clustering of companies. This suggests that the level of computerization is positively related to profitability performance, even in the short-term.

It can be conjectured that courses in politics (that is affirmative action) are playing a major part in the re-allocation of resources that eventually will influence the decision to invest in IT or not. Political considerations, important in most organizations, impacts on the buying of IT equipment as suggested by Harris and Katz (1991). These political considerations sometime eclipse technical and economic considerations and were generally perceived as becoming important in the third world.

Harris and Katz (1991) suggested that organizations with available resources may be the best positioned to respond to environmental uncertainty and increases in technical complexity that can satisfy their internal coordination needs. This is in contrast to the organizations exhibiting the strongest growth in income; the slow-growing organizations may not be as well positioned to address their internal coordination needs because of the reduced availability of scarce resources as noted by them.

It may be difficult to evaluate the relationship between investments in IT and the performance of an organization because there are several complex factors that must be considered. Some of these factors are the structure of the industry, the business strategy of the organization and the 'tradition' and behaviour of the organization. This is because these factors change over time. IT decisions could interact directly on the organization, especially where IT budgets are determined by the accomplishments of the organization. IT management can be a critical activity in any IT intensive industry and must be handled with care as conjectured by Harris and Katz (1991).

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Biographical notes

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Sam Lubbe is busy with his M Com at the University of Cape Town which he aims to complete in 1994. He finished a B Com honours degree at Free State University in 1982. He delivered papers at the CISNA conferences in Malawi (1991) and Botswana (1993) and the Eighth National Conference of Masters and PhD Students at UNISA in 1993. He has published articles in the African Computing Journal and The Magazine for Business Leadership in South Africa. He is presently a lecturer in the Department of Information Systems, Rhodes University, Grahamstown.

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Appendix A: Kwong and Mohamed (1987) computerization index

The (CI) that measures the extent and sophistication of computerization is constructed according to the following formula.

\[ CI = V_1(W_1) + V_2(W_2) + \ldots + V_n(W_n) \]

where \( V_1-V_n \) are the variables affecting the degree of computerization and \( W_i \) is the weight applied to variable \( V_i \).

Ten variables \( V_1-V_{10} \) were chosen to represent the computerization process collectively and their importance was indicated by the weight applied to each variable as shown in the following table.

| Variable                         | Weight |
|----------------------------------|--------|
| Management activity level        | 0.40   |
| Years using computers            | 0.10   |
| Number of computers              | 0.10   |
| Application software             | 0.06   |
| Size of CPU                      | 0.06   |
| Hardware cost                    | 0.06   |
| Staff                            | 0.06   |
| Number of shifts                 | 0.06   |
| Organizational location          | 0.05   |
| Project investment analysis      | 0.05   |
| Total                            | 1.00   |

Management activity level

Computer applications in each of the four management activities were weighted by Kwong and Mohamed (1987) as follows: strategic planning (40%), management control (30%), operational control (20%) and transaction processing (10%). The calculation for management activity level can be represented as follows:

\[
\text{Total score for management activity level} = \left( \text{number of strategic planning applications} \times 0.4 \right) + \left( \text{number of management control applications} \times 0.3 \right) + \left( \text{number of operational control applications} \times 0.2 \right) + \left( \text{number of transaction processing applications} \times 0.1 \right)
\]
Other variables
For the variable years using computers, number of installations, number of application software, number of staff and number of shifts, the score is simply the numerical value multiplied by the predetermined weight.

For the other variables, size of CPU, hardware cost, organizational location and method of project investment analysis, a ranking procedure is used. The largest CPU size will be given an interval ranking of 6 while the smallest CPU size is given a ranking of 1. The hardware cost has a value of 5 for the highest and 1 for lowest, reflecting its lesser importance compared to CPU size. For computing facilities located in the autonomous computer/IT department the value is 5 and for any other department, the value is 2. Companies using the discounted cash-flow (DCF) method in evaluating hardware purchase were assigned a value of 5 and for non-DCF users a value of 2.

Measures of financial performance
As discussed in the literature review, return on investment (as used in the BCG and PIMS approaches) has been found to be deficient as the best measure of corporate financial performance. Kwong and Mohamed (1987) suggest that multiple measures of financial performance be used. They are as follows:

1. Pre-tax return on assets \((\text{pre-tax profit/total asset})\).
2. Pre-tax return on turnover \((\text{pre-tax profit/total turnover})\).
3. Asset turnover ratio \((\text{total turnover/total assets})\).
4. Gross margin \((\text{gross profit/total turnover})\).
5. Three-year net premium income growth rate.
6. Three-year turnover growth rate.

Classification of computer applications
This is done according to the Robert Anthony framework. This is acceptable to IT research as supported by Burns (1989) in her study of the impact of IT on organizational structures.

| Transaction processing                  | Operational control | Management control | Strategic management |
|-----------------------------------------|---------------------|--------------------|---------------------|
| Accounts receivable                     | Inventory control   | Budgeting          | Corporate modelling |
| Accounts payable                        | Raw material        | Wage and salary analysis |
| General ledger                          | Work in progress    | Sales analysis     |
| Delivery report                         | Finished goods      | Sales forecasting  |
| Payroll                                 | Sales report        | Financial analysis |
| Processing job request                   | Sales planning      | Responsibility accounting |
| Customer billing and invoicing          | Personnel status report | Investment analysis |
| Share registration                      | Computer use report | Production/job costing |
|                                        | Production scheduling| Product variance analysis |
|                                        | Computer scheduling | Computer budget     |