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Measuring associations between working capital and return on investment

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The two conflicting goals of working capital management are profitability and liquidity. This article looks at return on investment as a measure of profitability and some traditional and more recently developed working capital concepts as liquidity measures. Associations were measured between profitability and the liquidity concepts by using chi-square analysis and stepwise forward regression. The statistical test results showed that a traditional working capital leverage ratio, current liabilities divided by funds flow, displayed the greatest associations with return on investment. Well-known liquidity concepts such as the current and quick ratios registered insignificant associations whilst only one of the newer working capital concepts, the comprehensive liquidity index, indicated significant associations with return on investment.

Die twee teenstrydige doelwitte by die bestuur van vlottende kapitaal is winsgewendheid en likwiditeit. Hierdie artikel neem die opbrengskoers op kapitaal as 'n maatstaf van winsgewendheid, en sekere tradisionele asook meer resente konsepte by die bestuur van vlottende kapitaal as maatstawwe van likwiditeit, in oënskou. Verwantskappe tussen winsgewendheids- en likwiditeitskonsepte is gemeet deur gebruik te maak van chi-kwadraatontledings en stapsgewyse voorwaardse regressie. Die statistiese toetsresultate dui aan dat 'n tradisionele vlottende kapitaal-hefboomverhouding, naamlik vlottende laste gedeel deur die vloei van fondse, die beduidendste verwantskap met opbrengskoers op kapitaal aandui. Alombekende likwiditeitskonsepte soos die bedryfs- en likwiditeitsverhouding dui op onbeduidende verwantskappe terwyl een van die jongste vlottende kapitaalbegrippe, naamlik die omvattende likwiditeitsindeks, 'n beduidende verwantskap het met die opbrengskoers op kapitaal.

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Introduction

Promoters of working capital theory share the axiom that profitability and liquidity comprise the salient (albeit frequently conflicting) goals of working capital management. The conflict arises because the maximization of the firm's returns could seriously threaten the liquidity, and, on the other hand, the pursuit of liquidity has a tendency to dilute returns. Over the years analysts have employed traditional ratio analysis as a primary instrument in the measurement of corporate liquidity. Many well-established liquidity ratios, for example the current ratio, are simple to apply and have some theoretical merit: increases in, say, accounts receivable will increase the current ratio (current assets/current liabilities), suggesting improved liquidity. However, the ability to match short-term obligations has only improved from a liquidation perspective (providing current assets may be liquidated at current market value), and not from a going-concern approach (Shulman & Dambolena, 1986: 35). Liquidity for the on-going firm is not reliant on the liquidation value of its assets, but father on the operating cash flow generated by those assets (Soenen, 1993: 53).

In recent literature some alternative working capital concepts have been advocated as likely (and possibly improved) measures of liquidity. Four such measures are the cash conversion cycle, the net trade cycle, the comprehensive liquidity index and the net liquid balance. The purpose of this article is to report on some results of research undertaken to measure associations between traditional and alternative working capital measures and return on investment (ROI), specifically in industrial firms listed on the Johannesburg Stock Exchange (JSE).

The article proceeds with an assertion of the problem to be investigated, followed by a short description of the traditional and alternative working capital measures included in the study. It then advances to the method of research and a brief discussion on the data set, variables used and the statistical tests applied. Thereafter findings are presented and discussed.

Problem definition

The problem under investigation was to establish whether the more recently developed alternative working capital concepts show improved association with return on investment to that of traditional working capital ratios.

Working capital measures examined

Traditional working capital ratios may be classified according to whether they measure working capital position, working capital activity or leverage (Emery, 1984: 26; Lovemore & Brümmer, 1993: 83). Working capital position ratios, typically the current and quick ratios, measure the degree to which the firm's currently maturing obligations are covered by currently maturing assets. The current ratio is regarded as a broad measure of liquidity and is expressed as current assets divided by current liabilities. The quick ratio is considered to be a narrow measure of liquidity and is expressed as current assets minus inventory divided by current liabilities.

Working capital activity ratios attempt to measure the relative efficiency of the firm's resources by relating the level of investment in different current assets to the level of operations (Gallinger & Healey, 1991: 73). Frequently cited activity measures are inventory turnover, accounts receivable turnover, accounts payable turnover and sales to net working

capital. Inventory turnover is defined as the cost of sales over average inventory. Accounts receivable turnover measures the speed of converting accounts receivable into cash, and is calculated as credit sales divided by accounts receivable. Accounts payable turnover reveals the effectiveness of the management of a firm's short-term financing, and is represented by credit purchases divided by accounts payable. Sales to net working capital centres on the proficiency of the utilization of working capital, and the higher the ratio, the greater the proficiency will be.

Leverage measures provide evidence of cash obligations attributable to the firm's long-term financing, demonstrating the existence of debt capacity that could be used to provide additional liquidity (Emery, 1984: 26). Frequently used leverage measures include long-term loan capital divided by net working capital, accounts receivable divided by accounts payable, and total current liabilities divided by gross funds flow. Long-term loan capital divided by net working capital provides evidence of the magnitude of the long-term loan capital financing of working capital. Accounts receivable divided by accounts payable reflects the degree to which credit extended by the firm is financed by the credit supplied by creditors. Total current liabilities divided by gross funds flow, expressed in years, reflects the ability of the firm to repay the various short-term funds received from its gross funds flow, the latter being defined as the income after taxation plus the net nonfunds flow items of the firm (BFA, 1989: 39–40).

Alternative working capital measures developed over the years (in an effort to surmount the imperfections of conventional ratio analysis) include the cash conversion cycle, the comprehensive liquidity index, the net liquid balance and the net trade cycle. The cash conversion cycle, developed by Richards & Laughlin (1980: 33–34), may be computed as follows: the average collection period of accounts receivable is added to the average age of the inventory; the sum of the two statistics represents the firm's operating cycle, from which the average payment period is subtracted. In this way, the working capital cycle is quantified to portray the residual time interval for which nonspontaneous financing needs to be negotiated to compensate for the unsynchronized nature of the firm's working capital investment flows.

The net trade cycle, similar to the cash conversion cycle, measures liquidity on a flow basis. Where the measure differs from the cash conversion cycle, instead of computing number of days of cost of goods sold in inventory and number of days of purchases in accounts payable, the net trade cycle calculates days of sales in both (Kamath, 1989: 26).

The comprehensive liquidity index developed by Melnyk & Berati (Scherr, 1989: 357–372), is a liquidity-weighted version of the current ratio, where each current asset and liability is weighted based on its nearness to cash. The weighting is done by multiplying the monetary value of each current asset or liability by one minus the inverse of the asset or liability's turnover ratio. Where more than two turnovers are required to generate cash from the asset, the inverse of each of these ratios is deducted, and the results added for all the current assets and liabilities. The added totals depict liquidity-adjusted measures of total current assets and liabilities. In this way the current ratio can be computed, based on the adjusted values for current assets and liabilities.

The net liquid balance approach, applied by Shulman & Dambolena (1986: 35–38), differentiates operational assets from liquid assets in an attempt to measure the true liquid balance of financial assets after operational needs have been met. The net liquid balance may be defined as cash plus marketable securities less all liquid financial obligations including notes payable and the current portion of long-term debt (Kamath, 1989: 28). A positive net liquid balance would indicate the true liquid surplus of a firm, while a negative net liquid balance would indicate a dependence on short-term external funding. The net liquid balance divided by total assets could be regarded as a relative measure of liquidity.

Method of research

This section of the article discusses the firms and variables included in the study, the distributional patterns of the data and the statistical techniques applied in the investigation of associations between traditional and alternative working capital measures and ROI.

Data set

The data used in this study were acquired from the databank of the Bureau of Financial Analysis (BFA) at the University of Pretoria. Data from the financial statements of all industrial firms listed on the JSE for the most recent ten years formed the basis of the calculations. Exclusion of pyramid and foreign firms resulted in a data set of 135 firms, representing all industrial firms listed on the JSE for the years 1984 to 1993.

Variables used

Every working capital measure defined in the previous section was computed from the BFA database for each of the 135 firms from 1984 to 1993. Analogously ROI, defined as net income divided by total assets, was ciphered for each firm for the ten years.

Data verification tests per year entail time series analysis which attempts to isolate and quantify the influence of environmental forces on a number of variables (Wegner, 1994: 329). Scientific time series analysis requires many more than ten data points per firm per variable, and using more than ten years of observations would have meant the exclusion of too many firms. Hence a meaningful proxy for ten years of observations for each variable for every participating firm had to be decided upon. The mean was chosen as summary measure because it meant that *all* the information contained in the data set would be utilized (Wegner, 1994: 58). This choice was ratified by ANOVA test results indicating that there were no significant differences amongst the years with respect to the independent variables.

Data exploration

The statistical package SAS was used to discern the distributional patterns in the data. Examination of variable skewness and kurtosis coefficients indicated positively skewed, particularly nonsymmetric distributions for many of the variables. Positively skewed distributions are in undisputed accord with other research findings on financial ratios (see for instance Jordaan, Smit & Hamman, 1994: 65–66), and data transformations, in this case, natural logarithms, are the

accepted method of improving the distributional properties of the raw data (Hair, Anderson, Tatham & Black, 1992: 52; Ezzamel, Mar-Molinero & Beecher, 1987: 473). Only those variables whereby the symmetry was markedly improved by doing so (for example all of the traditional measures other than sales divided by net working capital, and the comprehensive liquidity index) were transformed.

Statistical tests applied

A chi-square test for association was initially performed. Thereafter, stepwise regression analysis was undertaken, in an effort to quantify the underlying relationships between the working capital measures (independent variables) and ROI (dependent variable).

Chi-square test

The Pearson chi-square statistic was applied to test for independence of association for two-dimensional contingency tables. The SAS PROC FREQ command was used to compute the statistics for the two-way tables that test the statistical null hypothesis of no association. The medians of all independent variables and the dependent variable were calculated. All observations per variable were then classified into below and above the variable median (we would expect around 50% of the values above and 50% below the median). At the 5% level of significance, the critical value for the chi-square (χ^2) statistic is 3.84 (Lapin 1990: 961). If $\chi^2 \leq 3.84$, accept H_0. If $\chi^2 > 3.84$ reject H_0. The rejection of H_0 would indicate that there is association between the independent and dependent variables.

Table 1 is a synopsis of the chi-square and exceedence probabilities (p-values) reflected by the two-way tables of the independent variables *versus* the dependent variables. H_0 can be rejected, at the 5% level of significance, in those instances that are shaded, with negative associations depicted in brackets.

The highest χ^2 statistic (35.26) signifying the greatest (negative) association, was recorded for the log of the mean of total current liabilities divided by funds flow. This is not incredulous considering the common income element present in the denominator of total current liabilities divided by funds flow and in the numerator of ROI. The negative association concurs with normative theory that a smaller total current liabilities divided by funds flow is preferable to a larger one, in turn benefitting firm returns. The only other significant negative statistic was displayed by long-term loan capital divided by net working capital, again in accordance with theoretical conjecture.

Significant positive association was recorded between inventory turnover, accounts receivable turnover, and accounts payable turnover (the latter in discord with the theory). The net liquid balance divided by total assets was the only alternative working capital measure indicating a significant (positive) association at the 5% level, with a χ^2 statistic of 12.46. The comprehensive liquidity index displayed significant positive association at the 10% level.

Regression analysis

The SAS PROC REG with SELECTION = STEPWISE procedure was used to perform stepwise forward regression,

Table 1 Chi-square and probability statistics for association between ROI and traditional and alternative working capital measures

Working capital measures	χ^2	Prob
Traditional measures		
Log of the mean of the current ratio	0.89	0.35
Log of the mean of the quick ratio	3.27	0.07
Log of the mean of inventory turnover	**4.43**	**0.04**
Log of the mean of accounts receivable turnover	**8.91**	**0.00**
Log of the mean of accounts payable turnover	**6.03**	**0.01**
Log of the mean of long-term loan capital divided by net working capital	**(6.71)**	**0.01**
Log of the mean of accounts receivable divided by accounts payable	0.90	0.34
Log of the mean of current liabilities divided by funds flow	**(35.26)**	**0.00**
Mean of turnover divided by net working capital	0.12	0.73
Alternative measures		
Mean of the cash conversion cycle	1.97	0.16
Log of the mean of the comprehensive liquidity index	3.10	0.08
Mean of the net trade cycle	1.11	0.29
Mean of the net liquid balance divided by total assets	**12.46**	**0.00**

whereby each independent variable, starting with the one most highly correlated with the dependent variable, is considered for inclusion prior to developing the regression equation. The coefficient of variation (R^2) is used to assess how much of the variation in the dependent variable is explained by the independent variables included in the regression equation. The emphasis in the study was on determining associations, hence the independent variables in the regression models were used for explanatory and not predictive purposes (Marx, 1992: 152).

The *full* regression model for the mean of ROI yielded an R^2 of 0.6138. This means that the maximum variance that can be explained when all the independent variables are forced into the regression model is 61.38%. The results of the stepwise regression are presented in Table 2.

The 8-step regression model for ROI resulted in an R^2 of 0.5896, indicating that a total of 58.96% of the variance can be explained by the independent variables in this model. By far the greatest contribution (43.97%) came from the log of the mean of total current liabilities divided by funds flow. The mean of the cash conversion cycle was entered into the equation in step 3, but removed again in step 7, after the admission of the mean of turnover divided by net working capital. The presence of multicollinearity between the cash conversion cycle and some of the other variables already in the equation probably accounts for its removal in step 7.

The estimated regression equation for the mean of ROI is:

$$ROI_e = 3.22 - 4.28LMR14 - 0.83LMR12 + 3.04LMR16 + 1.94LMR9 + 0.02MR25 - 1.04LMR13$$

and may be interpreted as follows:

- A unit increase in LMR14 (the log of the mean of total current liabilities divided by funds flow [measured in

Table 2 Results of stepwise regression of the working capital measures with the mean of ROI

Step	Variable entered	Final model R^2	Standardized regression coefficient	T value	Sig T
1	Log of the mean of total current liabilities divided by funds flow	0.4397	–0.60	–8.680	.0000
2	Log of the mean of long-term loan capital divided by net working capital	0.4953	–0.24	–4.034	.0001
3	Mean of the cash conversion cycle	0.5365	–	–	–
4	Log of the mean of the comprehensive liquidity index	0.5502	0.18	2.876	.0048
5	Log of the mean of inventory turnover	0.5717	0.25	3.972	.0001
6	Mean of turnover divided by net working capital	0.5819	0.12	1.745	.0834
7	Mean of the cash conversion cycle	0.5766	–	–	–
8	Log of the mean of accounts receivable divided by accounts payable	0.5896	–0.12	–1.968	.0514

years]), would produce an expected 4.28% decrease in ROI.

- A 1% increase in LMR12 (the log of the mean of long-term loan capital divided by net working capital) would produce an expected 0.83% decrease in ROI.
- A 1% increase in LMR16 (the log of the mean of the comprehensive liquidity index) would produce an expected 3.04% increase in ROI.
- A unit increase in LMR9 (the log of the mean of inventory turnover [measured in times]), would produce an expected 1.94% increase in ROI.
- A 1% increase in MR25 (the mean of turnover divided by net working capital) would produce an expected 0.02% increase in ROI.
- A 1% increase in LMR13 (the log of the mean of accounts receivable divided by accounts payable) would produce an expected 1.04% decrease in ROI.

The standardized regression coefficients (βs) given in Table 2 indicate the relative contribution of each variable within the final regression equation for ROI. The log of the mean of total current liabilities divided by funds flow, with a β of –0.60, explains 2.5 times more of the variation than the log of the mean of long-term loan capital divided by net working capital, with a β of –0.24, and so forth.

The applicability of the regression model for ROI was assessed by means of an examination of the residuals. Figure 1 is a plot of the predicted values of ROI against the standardized residuals.

Figure 1 indicates that the spread of residuals of the 8-step regression model for ROI falls within an arbitrary configuration around zero, with a number of variables lying above and below the 5% significance values of 1.96 and 1.96. As outliers in the data set were regarded as representative of the data, and therefore retained, it is not unexpected that there are deviations of this magnitude between some of the observed and expected values. Accordingly, the examination of the plot reinforced the aptness of the model regarding the overall

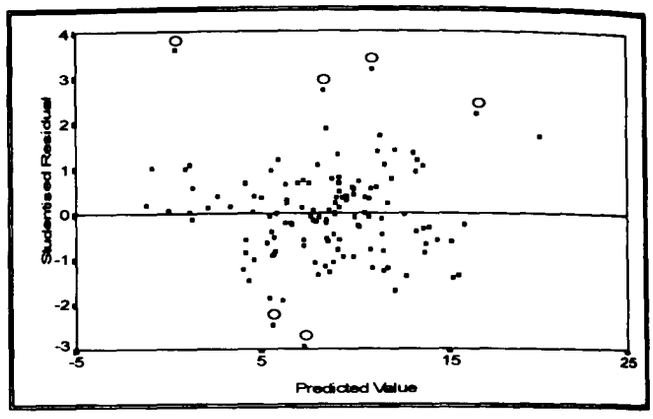

Figure 1 Plot of predicted values *versus* studentized residuals for ROI

regression assumptions of linearity, independence of residuals and constancy of variance.

Further stepwise regression analysis was performed using only the traditional measures. A 5-step regression model produced an R^2 of 0.5616 for the traditional measures with the log of the mean of total current liabilities divided by funds flow displaying the same partial R^2 of 0.4397. Using only alternative measures, a 2-step regression model produced an R^2 of 0.2506, with the mean of the net liquid balance divided by total assets contributing 0.1898 in the first step, and the log of the mean of the comprehensive liquidity index contributing 0.0608 in the second step.

Comments on the findings

The results of the stepwise regression corroborate those of the chi-square tests, namely that total current liabilities divided by funds flow accounted for most of the variability in ROI. This is not unexpected considering the presence of the income element in both the dependent and independent variables, albeit in the numerator in the former, and the denominator in the latter. A method of dealing with the common source component would be to select a dependent variable, for example market return, which is not an accounting return, and therefore autonomous from the balance sheet ratios used in the study. However the inclusion of market return would have meant accounting for share splits and thin trading. This would have necessitated the elimination of so many participating firms that subsequent meaningful test results would have been invalidated. Accordingly, the use of such a measure fell outside the scope of the study.

The working capital measures entering second and third into the regression model were long-term loan capital divided by net working capital and the comprehensive liquidity index. Again, this was in accordance with the chi-square results of significant negative association at the 5% level for the former measure, and significant positive association at the 10% level for the latter.

Summary

Working capital management consumes the majority of the financial manager's time and is considered a most important decision-making area in his or her day-to-day responsibilities (Beaumont, 1991: 74–76). Despite this finding, working

capital management receives less attention in the literature than long-term investment and financing decisions, and further lacks empirical confirmation of the normative theorems (Beranek, 1988: 12).

This article presented some empirical findings on associations between traditional and alternative working capital measures of liquidity and ROI. The results of a chi-square test for association and stepwise forward regression indicated that the traditional working capital leverage measure of total current liabilities divided by gross funds flow displayed the greatest associations with ROI. Of the alternative measures, only the comprehensive liquidity index entered into the regression model, although the net liquid balance indicated significant association in the one-on-one chi-square tests. A reason for the net liquid balance not entering into the regression model could be the presence of multicollinearity between the measure and those already in the model.

The well-recognized current and quick ratios did not enter into the regression model, nor did they display the expected negative association with ROI in the chi-square tests. The positive association indicated by the χ^2 statistics, although contrary to the theory, is in agreement with Kamath (1989: 28), who found that the current and quick ratios did not exhibit the expected inverse relationship with operating profit.

Hence the statistical tests undertaken to measure association between traditional and alternative working capital concepts and ROI indicated that the traditional working capital leverage ratio of current liabilities divided by funds flow displayed the greatest associations with ROI. Based on historical trends, for industrial firms listed on the JSE, a decrease in total current liabilities divided by gross funds flow could indicate an improvement in ROI and *vice versa*.

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