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ScienceDirect

Procedia Computer Science 20 (2013) 466 – 471

Procedia Computer Science

Complex Adaptive Systems, Publication 3
Cihan H. Dagli, Editor in Chief
Conference Organized by Missouri University of Science and Technology
2013- Baltimore, MD

Time-series Analysis for Detecting Structure Changes and Suspicious Accounting Activities in Public Software Companies

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Abstract

This paper offers a novel methodology using several new ratios and comparison approaches to investigate public software companies' financial activities and condition. The methodology focuses on time-series data mining, monitoring and analyzing. The dataset is based on 100 U.S. software companies with least ten-year SEC verified income statement, balance sheets and cash flow statement. The contribution of this paper is creating and applying several new financial ratios combined with traditional approach to detect companies' financial structure changes and accounts manipulation. For cash flow statement operating section, our proposed major account to operating net cash inflow and outflow ratios provide a better visualization of the cash sources and usage, which help analysts to observe major cash flow structure changes and make predication. For investing section, our proposed investing cash flow growth contribution ratio is used to identify irregular investment behavior. Combining with the traditional financial ratio tests, we believe that our approach significantly facilitates early detection on suspicious financial activities and the evaluation of its financial status.

Selection and peer-review under responsibility of Missouri University of Science and Technology

Keywords: Data mining; Structure changes; Accounts manipulation; Classification; Financial ratios; Cash flow; Text information; Time series analysis

1. Traditional Financial Ratio Tests

Based on *PwC's Global 100 Software Leaders* [1] and SEC verified financial statements, we selected and investigated 40 companies which were pre-categorized into high, middle and lower group by its combined licence, maintenance and support revenue. With traditional financial ratios tests, we found that Paychex Inc. and Convergys displayed unusually favorable signs even both companies were originally sorted into the low rank group according to PwC's survey. Table 1 shows that Paychex Inc. has a fantastic marginal operational ratio (MOP) which is close to or even higher than many high rank large companies. Combing with its decent revenue figure, it indicates that Paychex Inc. does not only have a strong earning power but also operates in a highly efficient way. Similarly, Convergys displays a higher net income to revenue ratio than the MOP ratio, indicating it owns some other significant income sources other than its main business. However, both companies were put at the bottom of the PwC ranking list. To clarify the intricacy and have a better understanding of a company's status, we carried our in-depth investigation by treating each company's management team as a decision maker and focusing on its income sources, operating efficiency, financial structure and resource allocation.

Selection and peer-review under responsibility of Missouri University of Science and Technology
doi:10.1016/j.procs.2013.09.304

Table 1. Selected financial ratio test results

Traditional Financial Ratios	Oracle ORCL May 31,2011	EMC Dec 31,2011	INTUIT Jul 31, 2011	Adobe Dec 02 2011	Netsuite Dec 31, 2011	PayChex May 31,2011	Convergys Dec 31.2011
MOP=OPER/Revenue	33.78%	17.21%	27.49%	26.04%	-12.71%	**37.72%**	**5.70%**
Net Income/Revenue	23.99%	13.04%	17.29%	19.73%	-13.56%	**24.71%**	**14.61%**
OPER Expense/Revenue	66.22%	82.79%	72.51%	73.96%	112.71%	62.28%	94.30%
RoR = Earnings on Capital	28.69%	16.26%	-69.12%	11.25%	-23.26%	52.92%	31.26%
Times Interest Charges	14.122525	18.24706	16.3	15.43284	-145.341	-	27.4
Times Interest Charges & dividend	14.122525	18.24706	16.3	15.43284	-145.341	-	27.4
EPS Basic	$1.69	$1.20	$2.07	$1.67	($0.48)	$1.42	$2.79
EPS Diluted	$1.67	$1.10	$2.00	$1.65	-	$1.42	$2.72
Depreciation/Sales	8.02%	14.16%	14.87%	12.52%	9.32%	14.83%	17.79%
Inventory Turnover	11756.44%	1980.99%	-	-	-	-	2214.43%
Cost of sales/Inventory	2771.62%	776.14%	-	-	-	-	1516.72%
Credit Policy	68	54	17	55	60	33	58
Bond Capitalization	28.59%	15.30%	-240.14%	14.07%	0.00%	0.00%	8.26%
Book Value/Share	8	9	8	11	-	4	11
CA/CL	2.8	1.1	1.2	3.0	1.5	1.1	2.6
(CA-Inventories)/CL	2.7	1.0	1.2	3.0	1.5	1.1	2.3

1.1. A brief introduction of the company Paychex Inc.

Paychex Inc. was founded in Delaware, 1979. Revenue of this company is consisted of two parts: service revenues and investment revenues. Service revenues are based on two segments: Payroll and Human Resource Services-Professional Employer Organization after 1990s multiple acquisitions and expansion.

The company claims its consecutive revenues growth resulted from a growing client base, the sales of ancillary services and the decreasing operating expenses. Meanwhile, intensive competition faced by Paychex Inc. includes manual payroll systems, in-house computer capability, and one large payroll processing company targeting mainly on big companies.

Specifically, Payroll segment is responsible for preparing paychecks, accounting records, all tax returns, collection and remittance of payroll obligations. It utilizes Taxpay through Electronic Network Services (ENS) to collect and pay taxes to the authorities. The company also makes a great amount of investment by taking advantage of the short period between collecting clients' funds and remitting them to tax authorities and clients' employees.

Investment revenues face both credit risks and interest rate risk, therefore the company tried to limit risks by investing mainly in good rating securities, short- to intermediate- term instruments which are less sensitive to interest rate, and avoiding investment concentration on one or few securities.

The other important source of revenue is Human Resource Services (HRS-PBS). HRS includes 401 (k) recordkeeping services, premium only plan and employee handbook. Besides, PBS is a subsidiary which provides outsourcing solution for small to medium sized business to deal with complicated employer service [2].

1.2. Eleven years basic financial data analysis

Table 2 shows its eleven year continuous service growth rate (490%) outpaced the selling general and administration expenses (SGAE) and operating costs growth rate (371%), generating a decent operating income growth rate (1229%). HRS-PEO stably advanced and gradually become a significant source of total service revenues (1%-9%). SGAE increased much more rapidly (401%) than operating costs (327%) and since it started with a higher

base, so it is the major offset factor to the fast growing revenue (59%-63%). The average net income growth rate is 39% and investment income took stable portion as 6%-7% of the total net income.

HRS-PEO surfaced as a new source of income. While analyzing income sources, we tend to focus on the main, the recurring and stable one. If great future profits were expected to be raised from new projects or different business based on a company's estimation without solid records, we should cast our doubt on it [3]. Especially, by launching a new product or service line, a significant client growth rate will appear at first then drop significantly. However, due to HRS-PEO initial rapid increase, even this segment displayed a decreasing growth rate over the following years, it still gradually become a significant revenue resources of the total service revenues.

Table 2. Eleven year growth rate and growth contribution

Item	1999	1998	1997	1996	1995	1994	1993	1992	1991	1990	1989	11-year
Growth Rate:												
Payroll	20%	23%	19%	22%	18%	17%	17%	17%	13%	18%		443%
HRS-PEO	**35%**	**25%**	**30%**	**32%**	**60%**	**47%**	**47%**	**60%**	**61%**	**207%**		**7715%**
Total Service Revenues	21%	24%	20%	22%	20%	18%	18%	18%	14%	19%		490%
Operating Costs	15%	15%	14%	24%	17%	13%	15%	7%	11%	27%		327%
SGAE	13%	21%	16%	17%	16%	16%	15%	21%	17%	22%		401%
Operating Income	25%	27%	23%	24%	23%	21%	21%	20%	14%	15%		581%
IBIT	25%	27%	23%	25%	23%	21%	21%	20%	13%	15%		587%
Net Income	36%	36%	37%	36%	41%	42%	47%	44%	12%	-9%		1373%
* HRS-PEO % of Total Service Revenues	9%	8%	8%	7%	7%	5%	4%	3%	2%	2%	1%	
Growth Contribution:												
Payroll'/ Total Service Revenues'	87%	92%	89%	91%	85%	90%	92%	92%	93%	93%		
HRS-PEO'/Total Service Revenues'	13%	8%	11%	9%	15%	10%	8%	8%	7%	7%		
OPER'/Revenues'	20%	18%	21%	32%	26%	23%	27%	15%	30%	50%		
SGAE'/Revenues'	29%	42%	39%	39%	41%	47%	45%	63%	64%	61%		371%
Investment Income'/IBIT'	2%	2%	2%	2%	2%	2%	1%	0%	-2%	1%		

2. In-depth Segment Analysis

We then focused on the entity's 1993-1999 segment information since the company expanded aggressively, making multiple acquisitions and several three for two stock splits in that period.

2.1. Structure change observation and detection:

Before 1997, Electronic Network Services (ENS) funds generated from Taxpay and Direct Deposit were actually used by the company in short-term investment and not reported in balance sheet. Since 1997, the company was requested to restate and reveal this practice by law enforcement. We use several traditional financial ratios to display and evaluate this transition. Table 3 clearly shows that there was a major financial structure variation followed by the change of reporting method: First of all, the ratio of current assets (CA) to current liabilities (CL) significantly dropped from 5 to 1, so did the ratio of total assets (TA) to total liabilities (TL) changed from 6 to 1. Both indexes are important in evaluating a company's financial status, which indicates how much safety it provides for its bonds and preferred stock holders, how capable it is to get fast cash and deal with immediate liabilities. The minimum

requirement is two times and the higher the safer the entity may be. Second, after combining a great amount of ENS funds into current assets and current liabilities, the ratio of current assets to assets significantly increased from 74% to 93% even when current assets before ENS growth rate kept steadily.

Table 3. Structure changes

% of Total Property and Equipment	1999	1998	1997*	1996*	1995	1994
Total Current Assets/Total Assets	96%	95%	95%	93%	74%	67%
CA before ENS growth rate	33%	33%	38%	33%	43%	
Total CA growth rate	21%	30%	47%	33%	43%	
Total CL growth rate	18%	28%	48%	6%	41%	
Total L growth rate	18%	28%	48%	3%	34%	
CL before ENS/Total Liabilities	5%	5%	5%	6%	94%	89%
(CL + ENS)/Total Liabilities	100%	100%	100%	100%		
Others/Total Assets	0%	0%	0%	0%	6%	11%
CA-CL	$360,784	$263,118	$194,614	$138,639	$97,558	$68,031
CA/CL	1	1	1	1	**5**	**5**
Total A-Total L	$435,800	$329,607	$251,542	$191,072	$139,932	$108,508
Total A/Total L	1	1	1	1	**6**	**6**

2.2. Growth contribution to net cash flow

Cash flow is an important way to measure an entity's capability of getting cash and equivalents. It is mainly influenced by net income, depreciation and amortization charges. The net cash flow is used to support normal business operations, the expansion of property and equipment, and the payment of dividend. A cash flow analysis greatly facilitates the understanding of an entity's operational and financial activities [4]. A 2006 cross-country research shows that a company's cash flow is constrained by the accessibility and expense of outside funds. The dataset covers more than 30 countries and 13,000 firms with 9 year records, and the results made researchers firmly believe that financial development matters the most to the financial capability [5]. Specifically, Frino and Heaney (2005) found out that Australian retail superannuation companies' past performance is positively related with current cash flows [6]. Moeinaddin and Akhoondzadeh (2012) investigated and predicted Iranian companies' earnings based on cash flow information [7]. Garrett and Priestley (2012) claims that cash flow news significantly affect dividend growth and used cash flow betas to explain value and size effects [8]. On the other side, Guo, Wang and Zhang (2013) concentrated on manipulation issues, claimed that non state-owned enterprises in China are more prone to manipulate their cash flow statements in order to attract outside supportive funds [9].

Therefore, how to accurately analyze and forecast a company's cash flow draws most of research attention. Although forecasting accuracy is primarily determined by an analyst's experience, the scope, the time frame and the source of information, Pae and Yoon (2013) reinforced that a specific company oriented cash flow predication display much more accuracy than the generalized industrial-wide one [10]. Multiple approaches have been explored to forecast future cash flow, such as artificial intelligence hybrid system based EFSIM method [11], fuzzy set theory, risk sensitivity analysis [12], neural networks and regression approach [13].

Farshadfar & Monem (2013)'s sensitivity analysis results provide evidence that detailed and categorized cash flow components analysis significantly increase future cash flow forecasting accuracy [14]. Similarly, Ahmadi,A and Ahmadi, V. (2012) 's research further demonstrate that the current operating cash flow is a more accurate index for future cash flow prediction than others [15]. Moreover, according to their short-and long- term balance sheet

observation, Dasgupta, Noe & Wang (2011) found out that besides investment, purchase of property and equipment, other accounts undertake the responsibility to absorb short-term cash flow shocks [16]. In sum, with primary focus on monitoring the constitution and changes of cash inflow and outflow, we believe that our segmented cash flow analysis is helpful for cash flow analysis and future cash flow predication.

Payroll Inc.'s main cash flow sources were made up of net income, depreciation and amortization (D&A), amortization of premiums and discounts on securities. We categorize all operating cash flow accounts into two categories: Operating Cash Inflow (OCI) and Outflow (OCO). By monitoring new ratios of Net Income/OCI, D&A/OCI, we found out that trades payable accounts actually played as an important "back-up" role in cash flow adjustment. It may testify that the entity has a great ability to control its cash flow by adjusting the payment to vendors or liabilities to others.

For instance, table 4 shows that fiscal year 1994 and 1998's major operating cash inflows decreased to 79%. Meanwhile trade payable account became a significant cash inflow source, which took a 15% of total cash inflow.

Table 4. Sources of operating cash inflow

Year	OPER Cash inflow	Net Income/ OPER Inflow	D&A/ OPER Inflow	MAJOR	Trade payable/OPER Inflow
1993	$34,738	57%	31%	88%	7%
1994	$41,831	67%	27%	94%	0%
1995	$65,017	62%	17%	79%	14%
1996	$78,610	70%	18%	88%	6%
1997	$112,475	67%	14%	80%	12%
1998	$154,112	66%	12%	79%	15%
1999	$195,743	71%	11%	82%	11%

As table 5 shows that traditional growth rate of each account only reflects its own increasing or decreasing trend and pace, without clearly showing how much influence the account actually generated to the net result.

Table 5. Traditional growth rate

Traditional Growth Rate	1999	1998	1997*	1996 *	1995	1994
Net Income	36%	36%	37%	36%	44%	41%
Depreciation and amortization	18%	22%	10%	26%	-1%	5%
Amortization of premiums and discounts on securities	27%	39%	90%	33%		
Trade accounts payable and other current liabilities	-5%	64%	186%	**-46%**	**9011%**	-96%
Net cash provided by operating activities	27%	34%	50%	27%	57%	16%
*If without trade accounts payable and other current liabilities:	34%	30%	40%	43%	30%	26%

Therefore, we established a new ratio to measure in percentage, how much *growth contribution* an account actually made to the annual net cash flow. Table 6 clearly shows that trade accounts payable and other account liabilities fluctuated irregularly (In percentage, the contribution to the cash inflow increases: -31% ,39%,-33%), playing as a supportive role when net income and other major cash inflow accounts underperformed. We did similar tests in investing section which is beneficial in identifying irregular investment behavior.

$$Growth\ Contribution = \frac{Current\ Year\ Account\ Value - Previous\ Year\ Account\ Value}{Current\ Year\ Cash\ Inflow - Previous\ Year\ Cash\ inflow} \quad (1)$$

$$GC_f = \frac{V_A^c - V_A^p}{\sum_i C_i^c - \sum_i C_i^p} \quad (2)$$

Table 6. Growth contribution to the total cash flow and the net cash inflow

In Percentage, the Contribution to Total Cash Flow Increases:	1999	1998	1997	1996	1995	1994
Trade accounts payable and other current liabilities	-3%	26%	27%	-29%	47%	-50%
Depreciation and amortization	9%	10%	4%	20%	-1%	11%
Amortization of premiums and discounts on securities	6%	7%	8%	5%	13%	0%
Net Income	99%	77%	59%	100%	64%	174%
In Percentage, the Contribution to the Cash Inflow Increases:						
Trade accounts payable and other current liabilities	-3%	22%	27%	-31%	39%	-33%
Depreciation and amortization	8%	8%	4%	21%	-1%	7%
Amortization of premiums and discounts on securities	6%	6%	9%	6%	10%	0%
Net Income	89%	65%	59%	108%	53%	114%

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