Entry-based financial statement analysis for small firms

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Abstract: The objective is present an entry-based approach to small business financial statement analysis. This approach is based on a procedure in which financial statements are prepared after each bookkeeping (double) entry. This kind of procedure provides the management in a small firm with an opportunity to control in real time how the annual financial statements (income statement and balance sheet) are formed up from successive bookkeeping entries with the passage of time. The approach can also be used to warn about financial crisis or to direct attention to most important transactions. It is also a useful tool for small business auditors. The procedure is demonstrated by a case study based on an entry-based bookkeeping material from a Finnish micro firm. Probability of bankruptcy is used in this case to warn about financial crisis whereas a balance sheet decomposition (information) measure is employed to reflect the most important bookkeeping entries.

Keywords: auditing; bankruptcy probability; bookkeeping; decomposition measure; financial statement analysis; small firm.


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1 Introduction

Financial statements are an important source of information for several stakeholders. In a small firm, they provide the management with valuable financial information revealing how well business operations perform in comparison with the previous period and with the competitors. The small business manager has often information from three different statements. First, the income (profit and loss) statement shows the profitability of the firm...
Entry-based financial statement analysis over a period. Second, the balance sheet shows the financial position in the form of the development of assets, liabilities, and equity over time. Third, the cash flow statement reflects the adequacy of liquid assets during a period. The information of these three statements is usually summarised as financial (profitability, solidity, and liquidity) ratios facilitating the assessment of financial performance. Financial statement reports can bring clear benefits to a small firm. They may play a critical role in both access to credit and cost of capital (Allee and Yohn, 2009; Van der Bauwhede et al., 2015). However, there is actually a general lack of empirical research to support the claim that accounting reports are a useful control mechanism in small firms (Argiles and Slof, 2003; Collis and Jarvis, 2002; Halabi et al., 2010).

The existence of financial statements does not guarantee that they are useful for small business management. They are worthless in decision-making if small business managers do not know how to evaluate the information (Van Auken, 2005). This is a critical question because these managers often lack the financial skills needed to interpret and use the information contained in financial statements effectively (Brigham and Ehrhardt, 2013; Van Auken and Yang, 2014). The lack of these financial skills can lead a small firm to a failure because being vulnerable to the impact of poor financial decisions due to limited access to financial markets and restricted alternative sources of capital (Collis and Jarvis, 2002; Carter and Van Auken, 2005; Wiklund and Shepherd, 2005). Therefore, new efficient tools to facilitate financial statement analysis in small firms are welcome. These tools should be understandable also for managers with limited skills in financial analysis. Otherwise, they are not used (Carraher and Van Auken, 2013). These new tools should provide the small business management with relevant information for the basic functions of accounting (decision-making, scorekeeping and attention direction). The purpose of this study is to introduce a new approach (entry-based financial statement analysis, EBFSA) that fulfils these requirements.

Van Auken and Yang (2014) show that the use of financial statement information in Chinese small firms for decision-making depends on the ability to interpret the information contained in the financial statements and the frequency of financial statement preparation. The first finding suggests that entrepreneurs who have greater abilities to interpret and use financial statements are more likely to rely on their financial statements to make decisions. The ability to interpret financial statements should be associated with a better understanding of the value of the information contained within them, especially with respect to risk, liquidity and profitability. Van Auken and Yang (2014) conclude that these issues are central to decision-making analyses and processes. The second finding shows that there is a positive association between the use of financial statements to make decisions and the frequency of financial statement preparation. The more (less) frequently financial statements are prepared, the more (less) likely they are to be used for decision-making. Thus, it is important to develop understandable and high-frequency tools for small business financial statement analysis.

Financial statement information is important not only for management but also for other stakeholders of the small business. Carsberg et al. (1985) conclude that for most small firms, the number of external stakeholders is small. Therefore, the inside stakeholders (owners and managers) are the most important users. However, they also found that taxation authorities are another important user of small business financial statements (Barker and Noonan, 1996). Furthermore, Hussey and Hussey (1997) showed that banks are very important users of these reports which play an important role in bank lending decisions and in monitoring financial health. Usually, the production of financial
statements in small firms is, however, mainly carried out for decision-making purposes and to a minor degree for tax and bank purposes (Carsberg et al., 1985; Barker and Noonan, 1996). However, the weaknesses of small business reporting systems complicate the use of financial statements. The reporting practices are identified as time consuming, complex, costly, and lacking relevance. The most important way to reduce the burden of producing financial statements is identified as being computerisation (Maingot and Zeghal, 2006). Therefore, new computerised tools to prepare and produce financial statements are welcome.

In summary, studies in small business literature have found evidence of significant adoption of accounting systems but limited use of the information found in these reports (Halabi et al., 2010). Small business managers do not understand and use complicated accounting systems if these systems produce irrelevant reports with a low frequency and are costly and time consuming. Computer systems may solve a part of these problems. However, as accounting knowledge varies across firms, research has found that accounting software systems are often not used to their full potential (Marriott and Marriott, 2000; Ismail and King, 2007; Halabi et al., 2010). Therefore, the purpose of this study is to introduce EBFSA that is seamlessly connected with the bookkeeping system of the firm and produces computer-based relevant reports with a very high frequency. These reports use recorded accounting transactions (entries) to direct attention and make it possible for a manager to control business operations in real time. However, they also serve as efficient tools for small business auditors as they summarise accounting journal entries. They are also useful for tax and bank purposes as they give a clear snapshot of business.

This paper is organised as follows. The introductory section presented the motivation and purpose of the study. The second section presents a framework for EBFSA. It shortly describes the basic premises of double-entry bookkeeping showing how financial statement analysis can be connected within this system. The framework also shows how a control system for financial risk and for attention direction can be linked to the analysis using statistical risk models and information measures. The system is planned to prepare financial statements after each bookkeeping double entry showing the effect of each entry on the income statement and the balance sheet which allows a real-time control of business activities. The third section presents a case study where the EBFSA is implemented to a small Finnish micro firm. Figures (exemplary reports) from both a good financial year and a poor financial year are considered to show the potential of the system. Experience from the case was promising. The manager of the case firm regarded EBFSA as an efficient management tool providing significant support for control and decision-making. Finally, the last section concludes the paper and gives hints for future research on the topic.

2 Framework for the entry-based financial statement analysis

The primary task of accounting is record keeping based on the bookkeeping system of the firm. Small businesses use sometimes single-entry bookkeeping (SEB) that only tracks revenue and expenditure (income statement) as these transactions occur without any reference to the balance sheet. It is normally used only by sole proprietors handling themselves all of the cash that flows through the firm. However, more complex firms usually make use of double-entry bookkeeping (DEB) showing the effect of each
transaction also on the balance sheet. The present analysis is based on DEB that makes it possible to implement the traditional tools of financial statement analysis within the firm. DEB implicitly uses a specific mathematical construction, the group of differences using pairs of unsigned numbers which are called T-accounts (Ellerman, 2014). The objects in the group of differences are ordered pairs of unsigned numbers that are identified with the T-accounts of DEB:

\[ \text{T-account: } [d // c] = [\text{debit number} // \text{credit number}] \]

The left-hand side number \( d \) is the debit entry, and the right-hand side number \( c \) is the credit entry. Each entry is an accounting transaction that is associated with an economic transaction. Each economic transaction can be described by one or more accounting transactions or entries in bookkeeping. In this framework, an account conveys a list of numbers to be used by a firm that aggregates these numbers so that at any point of time, a unique number (that is, the balance) can be determined (Balzer and Mattessich, 1991). Each T-account is labeled as debit balance or credit balance.

The important characteristic of DEB is that it updates an equation using T-accounts with debit and credit entries (Ellerman, 1986). Each transaction must be recorded with equal debits and credits on appropriate T-accounts. This means that a double entry on an equation transforms the equation into another equation. In accounting, the list of accounting transactions is called the journal, and each transaction is expressed as the journal entry for the transaction. The initial T-accounts in the general ledger add up to the zero account forming a balanced accounting equation. The operation of adding entries to the accounting equation is called posting the journal to the general ledger. Each accounting transaction is encoded as two T-accounts that add to the zero account (double-entry principle). Thus, adding the transaction zero terms to the initial equation zero account (posting journal to the ledger) will yield another equation zero account representing the ending balance ledger (Ellerman, 2014). This can be described as follows:

\[
\text{Initial ledger + Journal = Ending ledger}
\]

The ledger in DEB is the listing of the T-accounts of the zero account leaving out the plus signs. The numbers in DEB are unsigned.

The general ledger is used at the end of the accounting period to prepare financial statements (the income statement and the balance sheet). Let us denote \( p(n) \) the accounting period, \( t(0) \) the beginning of \( p(n) \) and \( t(n) \) the end point of \( p(n) \). The accounting period can be divided into accumulative sub-periods \( p(1), p(2), \ldots, p(n) \). When these accumulative sub-periods are compared with each other, it is crucial that the beginning point is always the same \((t(0))\). In practice, the sub-periods can usually be weeks, months, or quarters whereas the total accounting period \( p(n) \) is often a year. Because of the equational characteristic of the accounting transactions in DEB, the accounting equation holds for each (double) entry and after posting the entry for the ending ledger. In the DEB accounting systems, the balancing of accounts is thus maintained in real time which allows financial statements to be prepared at any time. This means that financial statements can be calculated in computerised accounting systems with a very high frequency to provide managers with fresh and updated information for control and decision-making.
The length of accounting sub-periods has a wide variety between firms. It has an obvious effect on the relevance and use of financial statements (Van Auken and Yang, 2014). In many small firms, managers are willing to prepare and use even daily financial reports (Halabi et al., 2010). Therefore, it is suggested here that accumulative financial statements are calculated after each accounting (double) entry reflecting the highest possible reporting frequency. The analysis of these statements is called here the entry-based financial statement analysis (EBFSA) as is said above. The principle of EBFSA can be described as follows:

Initial ledger $t(0) \rightarrow$ Financial statements $t(0)$

Journal double entry $t(1)$

Ending ledger $t(1) \rightarrow$ Financial statements $t(1)$

.....

Journal double entry $t(n)$

Ending ledger $t(n) \rightarrow$ Financial statements $t(n)$

The journal thus includes $t(n)$ accounting entries and the length of each sub-period $p(i)$ ($i = 1, 2, \ldots, n$) is determined by the time interval between the time points of the previous entry $t(i-1)$ and the current entry $t(i)$. Therefore, EBFSA is not based on calendar time but on timing of journal entries.

In the EBFSA framework, the length of accounting sub-periods is not equal in time but depends on the frequency of bookkeeping entries in the accounting entity. This means that for some small firms, financial statements can be calculated even several times in a day, whereas for some other firms, they are prepared for example once a week depending on the frequency of accounting entries reflecting business activities (economic events). Because EBFSA is based on the highest possible frequency in reporting, it provides the management with the most accurate and fresh financial reports. Because these reports depict the influence of each accounting entry on financial statements, they are very useful also for small business auditors. Moreover, in a summarised form, they give a clear snapshot of the business for external stakeholders for tax and bank purposes. For small businesses, the yearly financial statements are usually too aggregated and produced too late. EBFSA can produce detailed financial reports that follow the economic transactions of the small business during the accounting year in real time.

EBFSA prepares financial statements automatically after each entry. In a normal annual DEB, temporary (income statement) accounts get closed at the end of an accounting year. Therefore, in DEB, these accounts will begin the new accounting year with zero balances whereas EBFSA carries the balances to the next sub-period in the same way as is done with (balance sheet) permanent accounts in DEB. This procedure leads to accumulative income statements which iteratively approach the annual income statement when $t(i)$ approaches $t(n)$. Because EBFSA prepares financial statements with a very high frequency, it is not possible to make all normal annual adjustments to the reports. For example, it is not possible to verify the inventory balance. If the books are kept on the accrual bases, the most adjustments may not be very remarkable in a small firm. The most significant annual adjustment is to match fixed expenditure with revenue as depreciation. When depreciations are matched with revenue, they are not recognised until the associated income is also recognised. This matching principle sets a challenge for EBFSA due to the high frequency of reporting.

Because the financial statements in EBFSA iteratively approach the ones in annual closing of accounts, depreciations should be allocated to sub-periods if the management
is willing to control the development of profit within the year. For consistency, the sum of depreciations over the sub-periods should be equal to the annual depreciation. Therefore, in the beginning of the accounting period at \( t(0) \), the first task is to estimate the amount of annual depreciations for \( p(n) \). This estimation can be done on the basis of the ending balance of fixed assets adjusted by potential investment plan for the period. The second task is to determine the temporal distribution of the estimated depreciations over the sub-periods from \( p(0) \) to \( p(n) \). It is possible to use the same depreciation method as in the annual bookkeeping. For example, annual depreciations can be distributed over the sub-periods using the straight-line depreciation. This method means that depreciations follow a level distribution over calendar time but not over the sub-periods due to the unequal time intervals between the entries. It is also possible to use a transaction-based depreciation or an entry-based depreciation where depreciations are accumulated with the passage of entries (sub-periods). This kind of method is justified if the use of capacity in revenue generation is not reflected solely by time but merely by business transactions. This method allocates a depreciation of \( \frac{1}{n} \) times the annual depreciation for each sub-period \( p(i) \) \((i = 1, 2, \ldots, n)\).

Thus, EBFSA prepares approximate income statement and balance sheet for each sub-period. Therefore, it is possible to use the same kinds of tools (values and ratios of financial variables) as in traditional annual financial statement analysis. Because the sub-periods are very short and numerous, it is useful to implement graphical methods to analyse the intra-year development of the firm. At least, the following sub-periodic time series are relevant to most small business managers and other stakeholders:

1. Net sales (value)
2. Net profit (value)
3. 100·Net profit/Total assets (ratio)
4. 100·Traditional cash flow/Net sales (ratio)
5. Financial assets/Short-term debt (quick ratio)
6. 100·Cash and cash equivalent/Total assets (ratio)
7. 100·Short-term debt/Total assets (ratio)
8. 100·Long-term debt/Total assets (ratio).

The number of potentially useful indicators is high although the horizon is very short. However, in practice, it is reasonable to limit the set of indicators only to include the most relevant time series to avoid information overload. For small business managers, a narrow set of relevant variables (development of sales and profit accompanied with some profitability, liquidity and solidity ratios) is usually enough to give an insight of the intra-year development. This same principle holds even more strictly also for other stakeholders of small business with minor information needs.

EBFSA can be connected with alternative warning systems to facilitate control of business activities for the managers. These warning systems or models can direct the attention of the management for example to increasing risk of payment default (credit risk), liquidity crisis or even bankruptcy. Altman and Sabato (2007) conclude that managing credit risk for small firms requires models specifically focused on small businesses (compare with Collis and Jarvis, 2002). They developed a (logistic regression)
warning model of credit risk based on five financial variables or their logarithmic
transformations: Ebitda/Total Assets, Short Term Debt/Equity Book Value, Retained
Earnings/Total Assets, Cash/Total Assets and Ebitda/Interest Expenses. The performance
(prediction accuracy) of this specific small business model was almost 30% higher than
the performance of the generic corporate model. These results indicate that also for
EBFSA, it is important to develop specific small business models focusing on similar
firms as the user of the model itself. These kinds of specific models can act as efficient
tools for controlling the financial risk faced by the entity.

EBFSA reports can be efficient tools also for auditors because they summarise the
effect of each accounting entry on financial statement. The small business audit
procedure is a formal check of financial accounts of the small firm. It can be conducted
by either members of the organisation (internal audit) or an external auditor (external
audit). The auditor typically requests documents such as a copy of the previous audit
report, original bank statements, receipts and ledgers. EBFSA financial report for
example on sales or profit by journal entries over the accounting period can be very
useful as a road map for the audit. However, EBFSA can be linked to a special system
directing the attention of auditors to find out entries with information of the highest
materiality. This kind of system can be developed using different information measures
connected with the effect of entries. Ball et al. (1976) used a decomposition measure to
reflect the degree to which the composition of the later balance sheet differs from that of
its predecessor. This kind of decomposition measure is a version of the Shannon-Weaver
expected information measure (Shannon and Weaver, 1964). Ball et al. (1976) showed
that large industrial firms with large variations in earnings have large balance sheet
decomposition measures in the same year. Because the material effects of accounting
entries are concentrated on the profit, and consequently on the balance sheet, these kinds
of information measures can serve efficient attention-directing systems for auditors (and
other stakeholders) also in small firms.

3 Entry-based financial statement analysis in practice

3.1 Characteristics of the case firm and EBFSA

The framework of EBFSA is in this paper demonstrated by a case of a small Finnish
micro firm (called here ‘FINN’) that has implemented the system to support decision-
making, control and auditing. This micro firm acts on service industry and has only 2–3
part-time employees. This small firm has not hired any accounting staff. However, in
spite of that FINN keeps its books itself without any external accountant. Practical
business activities and the routines of the accounting system take a lot of time, and the
manager has limited resources to control how the financial situation of the firm develops
during the accounting year. Traditionally, the owner (entrepreneur, here manager) of
FINN has only used the annual financial statements to assess the profitability, liquidity
and solidity of the firm. The annual financial statements have typically been prepared
until the end of March although the accounting year ends at the end of the calendar year.
Therefore, until March, the manager of FINN has been practically unable to identify how
good or bad the preceding accounting year was. However, during the accounting year, the
manager checked very regularly the bank balance on the internet and was well informed
about the liquidity position. The manager anyway told that he had no precise idea of the past year profitability of business activities before March.

FINN has DEB implemented on an Excel worksheet following a simple double-entry procedure. This procedure means that FINN records each accounting transaction by one double entry journalising it daily in the book of original entry (the journal). Each accounting entry includes a description of the transaction, date, monetary amount of transaction, the debit account and the credit account. There in the journal can be several entries for an economic transaction if it is complicated. Because each entry in the bookkeeping is presented on a separate worksheet row of its own, the incorporation of EBFSA within the accounting systems was relatively easy. The programming of EBFSA was made by rows so that each transactional entry (for accounting transactions) was posted to the (ending) ledger, and financial statements (the income statement and the balance sheet) were automatically prepared. Because FINN is a service firm, its inventories are insignificant without any need for checking. It is also a labour-intensive firm with very small investments on fixed assets. Therefore, in practice, it is easy to estimate depreciations for the next accounting year. In this experiment, two previous past years were considered so that it was possible to use the realised value of depreciations in EBFSA. This annual value was allocated to the sub-periods (entries) using entry-based (transaction-based) depreciation method. This method was justified because in this service firm, the use of capacity was strongly associated with periods characterised by a high number of entries (transactions).

### 3.2 Attention-directing systems

EBFSA was in FINN accompanied with two different attention-directing systems. First, a system supporting control of financial position was developed. The manager said that there is not an urgent need for controlling liquidity because he checks the bank balance on the internet at least each week. Therefore, a system warning about bankruptcy risk was implemented to support his control activities. Bankruptcy risk is strongly associated with profitability and solidity (indebtedness) in addition to liquidity. Following the recommendation of Altman and Sabato (2007) a small business-specific logistic warning model was estimated using a large data from Finnish small firms. These data were extracted from the database ORBIS of Bureau Van Dijk (BvD). The estimation data included 640 bankrupt firms and 41 600 non-bankrupt firms. The observations were weighted to give equal weights for bankrupt and non-bankrupt firms leading to a critical probability of 0.50. The logistic model was estimated using the data from the first year before bankruptcy (bankrupt firms) or from the latest year available (non-bankrupt firms). The model was tested in the data of 750 bankrupt firms and 31 500 non-bankrupt firms.

Table 1 presents the estimation results for the logistic model. The statistically most significant variable is $100 \cdot \text{Equity/Total assets}$ (solidity ratio) that strongly influences the probability of bankruptcy. The table shows that the estimated warning system is based on the following logit:
Table 1  Coefficients of the logistic bankruptcy risk warning model for small firms

<table>
<thead>
<tr>
<th>Financial ratio</th>
<th>Coefficient</th>
<th>Mean error</th>
<th>Wald statistic</th>
<th>p -Value</th>
<th>Exp(B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100·Traditional cash flow/net sales (ratio)</td>
<td>-0.0270</td>
<td>0.0060</td>
<td>205.740</td>
<td>0.0000</td>
<td>0.9730</td>
</tr>
<tr>
<td>100·Net profit/total assets (ratio)</td>
<td>-0.0170</td>
<td>0.0070</td>
<td>67.150</td>
<td>0.0100</td>
<td>0.9830</td>
</tr>
<tr>
<td>100·Equity/total assets (ratio)</td>
<td>-0.0290</td>
<td>0.0020</td>
<td>1,566.930</td>
<td>0.0000</td>
<td>0.9710</td>
</tr>
<tr>
<td>Quick ratio</td>
<td>-0.0300</td>
<td>0.0320</td>
<td>0.8880</td>
<td>0.3460</td>
<td>0.9700</td>
</tr>
<tr>
<td>Constant</td>
<td>0.2120</td>
<td>0.0890</td>
<td>56.240</td>
<td>0.0180</td>
<td>12.360</td>
</tr>
</tbody>
</table>

\[ L = -0.0270 \cdot 100 \cdot \text{Traditional cash flow/Net sales (ratio)} \]
\[ -0.0170 \cdot 100 \cdot \text{Net profit/Total assets (ratio)} \]
\[ -0.0290 \cdot 100 \cdot \text{Equity/Total assets (ratio)} \]
\[ -0.0300 \cdot \text{Quick ratio} \]
\[ +0.2120 \]

When the logit \( L \) is replaced in the logistic function, an estimate of the bankruptcy risk is obtained using the mathematical formula \( P(B) = \frac{1}{1 + \exp(-L)} \). In the logistic model, \( P(B) \) measures the (conditional) probability that a firm with the given financial ratios belongs to the group of bankrupt firms. The critical cutoff probability in this weighted case is 0.50. If \( P(B) \) exceeds 0.50, the bankruptcy risk for the firm is immediate.

Table 2 shows that the classification accuracy of the warning model is high in the first year before bankruptcy but that it diminishes quickly when the horizon becomes longer. Therefore, the logistic model is clearly a short-term warning system that is useful in such an intra-year analysis as EBFSAs. The accuracy of the model (in the first year) measured as the area under the ROC (receiver operating characteristic) curve (AUC) is nearly 0.90 (excellent). Thus, the accuracy ratio (AR) calculated as \( 2 \cdot \text{AUC} - 1 = 0.788 \) refers to an efficient classification model. When AR is 0.5, the model in question shows an average accuracy whereas AR = 1.0 refers to a perfect model. The estimated model therefore provides the manager of FINN with a reliable tool to control the bankruptcy risk when incorporated with EBFSAs.

Table 2  The percent of correctly classified firms in the estimation and test samples

<table>
<thead>
<tr>
<th>1 Year before event</th>
<th>2 Years before event</th>
<th>3 Years before event</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimation sample</td>
<td>Test sample</td>
</tr>
<tr>
<td>Non-bankrupt small firms</td>
<td>86,90</td>
<td>81,30</td>
</tr>
<tr>
<td>Bankrupt small firms</td>
<td>81,40</td>
<td>74,70</td>
</tr>
<tr>
<td>Area under the ROC curve (AUC)</td>
<td>0,894</td>
<td></td>
</tr>
<tr>
<td>AR (Accuracy Ratio)</td>
<td>0,788</td>
<td></td>
</tr>
<tr>
<td>Critical probability</td>
<td>0,500</td>
<td></td>
</tr>
</tbody>
</table>
Second, the manager of FINN was interested to test also an attention-directing system based on an information measure. He said that when only looking at the bookkeeping, it is quite difficult to identify the influence of different accounting transactions on the balance sheet. Therefore, a similar balance sheet decomposition measure as used by Ball et al. (1976) was implemented within EBFS. Table 3 shows how the balance sheet of FINN was decomposed for each sub-period (accounting transaction) \( t (t = 1, 2, \ldots, n) \). Then, the balance sheet decomposition measure of sub-period \( t \) was defined as follows:

Table 3 | Decomposition of the balance sheet
---|---
| Assets | Liabilities |
| Short-term | \( p(1,1,t) \) | \( p(1,2,t) \) |
| Long term | \( P(2,1,t) \) | \( p(2,2,t) \) |
| Total | 0.5 | 0.5 |

\( t = \) sub-period \( t \) (accounting entry or transaction)

\( p(i,1,t) = \) percent of asset \( i \) of total assets in sub-period \( t \)

\( p(i,2,t) = \) percent of liability \( i \) of total liabilities in sub-period \( t \)

\[
W(t) = \sum_{i=1}^{3} \sum_{j=1}^{3} p(i,j,t) \log \left( \frac{p(i,j,t)}{p(i,j,t-1)} \right)
\]

This information measure indicates the degree to which the composition of the later balance sheet differs from that of its predecessor. If the four items of the balance sheet change proportionally, their fractions remain unchanged and \( W(t) \) equals zero (no information in the message). The larger the changes in the four fractions are, the larger the measure is. Thus, the value of the decomposition measure indicates the extent to which the structure of a given balance sheet differs from that of the previous balance sheet. When calculating the measure, the logarithm to base 2 is used here. This means that the measure shows the amount of information in the change as bits.

### 3.3 Financial reports of EBFS

Reports play the central role in any management support system. EBFS can be accompanied with different kinds of financial reports. However, because the number of sub-periods (accounting entries) is usually high, graphical time-series reports are preferred. These reports can be printed in real time so that the manager can get at any time an immediate impulse if something important is happening within business activities. This kind of real-time impulse makes it possible to react immediately to any potential warning signals. In graphical reports, the early stages of any unexpected change process can be visually recognised very quickly. In this paper, only a couple of such reports are presented. To show the potential differences in the reports between different accounting years, these exemplary reports are presented for both a financially bad year (2013) and a good year (2015).

Figure 1 presents the graphical development of cumulative net sales and net profit for FINN by accounting entries. The number of (double) entries (in bookkeeping) for the bad year is about 500 whereas it is about 400 for the good year. The time series of (net) sales is not monotonically increasing due to the payment of value-added tax (VAT) on sales. In Finland, VAT is a consumption tax that the seller of goods or services will add to the
price. The seller thus collects this tax from customers to remit it to the state. Panel 1 presents the graphs of cumulated sales and profit for the bad year. There is after entry 150 a longer period without any sales (invoicing) but expenses are running, and consequently, net profit decreases rapidly leading to a significant (annual) loss at the end of the accounting period. The manager of FINN told that he did not exactly recognise the final results of the negative development before March in the next year (2014) when financial statements were finished. The amount of loss was a real surprise. He told that this kind of development (timing of work, timing of invoicing) is normally due to the project nature of business.

**Figure 1** The development of cumulative net sales and net profit by accounting entry (see online version for colours)

The manager also told that he started to re-organise the business when the bad news was received in the spring 2014. His re-organisation activities were successful, and consequently the financial result of FINN in 2014 was small but positive. The effects of re-organisation are clearly recognisable from the panel 2 that presents the figures for 2015 (the good year). Net sales were remarkably increased for this year, but at the same time, expenses were kept in control. Therefore, the accounting year was financially very successful leading to a big profit. The manager told that if he had the graphical real-time report for 2013 (panel 1) available, he would have started re-organisation activities
several months earlier. Visually, he estimated that the turning point in 2013 is located about on entry 280 (September). If he had a warning (attention-directing) system (like EBFSA) at that time, he would have started re-organisation activities at latest on October (entry 300).

Figure 2 shows the development of a profitability (return on investment) ratio and a solidity (debt to assets) ratio for FINN by entry. Panel 1 shows the time series for the bad year conforming that a turning point in the financial development was emerged about on entries 280–300 when the profitability rapidly declines and the indebtedness sharply increases. Although the indebtedness increases, it is at the end of the accounting year still very low, because the debt is less than 5% of total assets. Panel 2 for the good year indicates that the amount of debt has increased about to level 7.5% of total assets, but it is maintained stable over the accounting year. In the same time, the profitability of FINN has increased to a good level so that the net profit makes about 20% of total assets at the end of the year. The manager of FINN said that the report (Panel 2) in a clear way depicts the recent financial strengths of FINN. It shows that the financial development within a calendar year is nowadays stable, and the profitability and the solidity are both at a good level. He also said that this kind of report would be very useful to be given to any stakeholder of FINN, especially for bank and business partnership purposes.

**Figure 2**  The development of profitability and solvency ratios by accounting entry (see online version for colours)
Figure 3 presents (entry-based) time series for the quick ratio and the bankruptcy probability $P(B)$. Bankruptcy risk is affected by four financial ratios, but its level is mainly determined by the solidity. Panel 1 shows the development of the indicators for the bad year by entry. It shows that until entry 300, the quick ratio was very high reaching level of 50 but after that it declined rapidly to level of 13–14 (that is, however, still an excellent value). At the same time, the very low bankruptcy risk started to increase and ended with value of 0.12–0.13 that still refers to a low risk (the critical value is 0.50). Panel 2 presents the time series for the good year. Soon after beginning of the accounting year, the quick ratio is stabilised at level of about 7 whereas the bankruptcy risk is continuously below 0.02. The manager of FINN said that in the bad year, (panel 1) the development of the quick ratio very clearly identifies the point when the negative period suddenly started. He finds the figure for the good year (panel 2) again an excellent report to be given to the stakeholders of FINN. It shows that the liquidity of the firm is very strong and that, at the same time, the risk of bankruptcy is minimal.

Figure 3  The development of quick ratio and bankruptcy probability $P(B)$ by accounting entry (see online version for colours)
Finally, Figure 4 shows the development of the balance sheet decomposition measure for the bad and good years by entry. Panel 1 shows the time series for the bad year and indicates that the curve is dominated by a peak located around entry 315 (when the financial position of FINN dramatically declined). The (information) value of the peak is 167 bits that locates clearly outside the scale. This entry is associated with a relatively large investment outlay done by FINN. The next highest peak only reaches a value of about 2 bits (entry 73). For the good year (panel 2), the highest peak (7 bits) for information value is located at entry 46 (outside the scale). The manager of FINN liked the information value reports and called them the electrocardiogram of the firm. He said that the reports are able easily to recognise the entries when something important in the business has happened. The reports not only immediately tell what is happening but they also direct attention to given entries with the highest influence on the balance sheet. When these entries with the highest materiality have been identified, it is easy to look at the journal and check the description of the entries. Therefore, he recommended this kind of report particularly as a tool (road map) for small business auditors. The decomposition measure is useful especially because it measures different objects (degree of information) than financial variables and thus includes incremental information. In FINN, the information measure was correlated over entries only with the change in financial assets.

**Figure 4** The development of the balance sheet decomposition measure $W(t)$ by accounting entry (see online version for colours)
4 Concluding remarks

Financial statements provide in small business important information not only for the management but also for other stakeholders. There is a lack of empirical research on the use of accounting reports as control mechanism in small firms (Argiles and Slof, 2003; Halabi et al., 2010). These reports can also play an important role in access to credit and cost of capital (Allee and Yohn, 2009; Van der Bauwhede et al., 2015). However, the problem is that managers in small business often do not know how to evaluate the information and lack the financial skills needed to interpret and use the information contained in financial statements effectively (Van Auken, 2005; Brigham and Ehrhardt, 2013; Van Auken and Yang, 2014). This lack can in distressed circumstances lead a small firm to a failure (Carter and Van Auken, 2005; Wiklund and Shepherd, 2005). Evidence has found significant adoption of accounting systems in small firms but limited use of the information found in these reports (Halabi et al., 2010). Moreover, research has found that existing accounting software systems are often not used to their full potential (Marriott and Marriott, 2000; Ismail and King, 2007; Halabi et al., 2010).

The main problem with existing accounting systems is that small business managers do not understand and use them when they are complicated, produce irrelevant reports with a low frequency and are costly and time consuming. The purpose of this study was to respond to the challenges and introduce a system called entry-based financial statement analysis or EBFSA. This system is simple and can be seamlessly linked with bookkeeping. It is easy to understand, and it can produce financial reports with the highest possible frequency considering a journal entry as a sub-period of the accounting year. Thus, it automatically prepares financial statements after each bookkeeping entry. The reports produced by EBFSA are typically graphical and can be accompanied with different attention-directing systems. In this paper, a preliminary EBFSA was applied in a small Finnish microfirm, and two different accounting years were analysed. The results were very encouraging. The manager of the case firm was fond of the graphical reports and regarded them as very useful in controlling and analysing the business. When they are used in real time, the manager is able to respond immediately to any impulse that saves a lot of time and money. Furthermore, the manager considered these financial reports useful for many additional purposes (for example, tax, bank and business partner purposes). Small business auditors may also be interested to use decomposition measures connected with EBFSA as attention-direction devices.

Although the results of the case study are encouraging, the study suffers from many limitations which should be relaxed in further studies. First, EBFSA was only implemented on the bookkeeping system of a very small firm. More cases of bigger firms from several industries should be studied to show the full potential of EBFSA. The usefulness of the reports should be assessed also by other stakeholders than the manager alone. Second, the construction of the computer system was built in a worksheet environment. More advanced programming software is called for. Third, the reports prepared in the case study were selected on the basis of the interests identified by the manager. New systems should be interactive and let the manager freely to make ad hoc analyses with the system. Fourth, the reports were here based on simple Excel graphics. More advanced graphical tools should be implemented. Fifth, the analysis of the detailed reports can be accompanied by advanced time-series methods for example to detect important turning points in the business. Finally, EBFSA prepares financial statements for every journal entry that yields a very large database. Statistical analysis
(such as the factor analysis) could be applied to these large data to provide the management with opportunities of data mining and business analytics.

References


