

Composite Indicators for Financial Problems

Sugli Indicatori Composti per Problematiche Finanziarie

Marco Marozzi

Dipartimento di Economia e Statistica, Università della Calabria

Luigi Santamaria

Istituto di Statistica, Università Cattolica del Sacro Cuore

Riassunto: quando si tratta di affrontare problemi in campo finanziario, sono spesso coinvolte variabili complesse che non si prestano ad essere misurate in maniera diretta. Si pensi alla valutazione di una società quotata su un mercato regolamentato. Tale valutazione viene in genere effettuata indirettamente, attraverso la considerazione di diversi indicatori finanziari di bilancio e la costruzione (almeno implicita) di un indicatore composto. Nella nota, si affronta il problema della costruzione di indicatori composti in ambito finanziario. Vengono considerati metodi lineari e non lineari. Viene inoltre discussa un'applicazione alle banche italiane appartenenti all'indice DJ Euro Stoxx bancario, e si mostra come la valutazione delle banche desumibile da indicatori composti sia molto poco correlata con la variazione dei corsi azionari.

Keywords: Composite Indicators, Financial Indicators, Classification, Corporate Finance, Equity Market.

1. Introduction

When one is interested in a financial problem, generally faces a complex variable which cannot be directly measured. Think about a financial analyst who is deciding to take or not to take a stake in a listed company. To rate the company, the analyst takes into account many indicators from company accounting book. The indicators are thought to be related to the company rating which cannot be directly measured. The rationale is to indirectly rate the company through the considered financial indicators.

Complex variables which are not directly measurable may be measured by composite indicators. The idea is to emphasize components of the complex variable which can be measured by means of simple indicators which transform the original data into comparable data through a function $T(\cdot)$. The simple (partial indicators) are then combined using a proper link (combining) function $f(\cdot)$. If $X_1, \dots, X_K$ are the measurable components of the complex variable Z , then the composite indicator can be written as

$$M=f(T_1(X_1), \dots, T_K(X_K)).$$

Fayers and Hand (2002) report extensive literature on composite indicators. It is worth noting that the simple weighted or unweighted sum are generally used as link function. See Aiello and Attanasio (2004) for a review of the most commonly used transformations to develop simple indicators.

In this paper, the construction of composite indicators for financial problems is addressed. Different methods based on linear and non linear transformations of the

original data are discussed. The considered methods are applied to a data set which contains financial indicators of the fourteen DJ Euro Stoxx Italian banks⁽¹⁾. The following financial indicators (Mln Eur) have been considered: money management margin; brokerage margin; net (loss) income; employments of clients; portfolio share and securities; total common equity; collected manager. The data concern both 2003 and 2004 year results. Indicators have been taken from company annual reports.

2. On the Construction of Composite Indicators

Let X_{ik} denote the value of partial component X_k $k=1, \dots, K$ for unit $i=1, \dots, N$. Without loss of generality, partial components are supposed to be positively correlated to the complex variable. A linear transformation LT changes the origin and scale of the data, but it does not change the shape. Linear transformations maintain the same ratio between observations. We consider the four linear transformations most used in practice (Aiello and Attanasio 2004). The first two linear transformations are defined as

$$LT_1(X_{ik}) = \frac{X_{ik}}{\max_i(X_{ik})} \text{ and } LT_2(X_{ik}) = \frac{X_{ik} - \min_i(X_{ik})}{\max_i(X_{ik}) - \min_i(X_{ik})}.$$

LT_1 and LT_2 cancel the measurement units and force the results into a short and well-defined range: $\min_i(X_{ik})/\max_i(X_{ik}) \leq LT_1(X_{ik}) \leq 1$ and $0 \leq LT_2(X_{ik}) \leq 1$ respectively. The third and fourth considered linear transformations are defined as

$$LT_3(X_{ik}) = [X_{ik} - E(X_k)]/SD(X_k) \text{ and } LT_4(X_{ik}) = [X_{ik} - MED(X_k)]/MAD(X_k).$$

$LT_3(X_{ik})$ indicates how far X_{ik} lies from $E(X_k)$ in terms of standard deviation $SD(X_k)$. LT_4 is similar to LT_3 and uses median $MED(X_k)$ instead of the mean as a location measure and median absolute deviation $MAD(X_k)$ instead of the standard deviation as a scale measure. Once the original data have been transformed through LT_h $h=1,2,3,4$, the composite indicator is defined as

$$M_{h,i} = \sum_{k=1}^K LT_h(X_{ik}), \quad h=1,2,3,4,$$

and $M_{h,i} > M_{h,j}$ means unit i is better than unit j (as far as Z is concerned). The sum is used as a combining function in accordance with general practice (see Aiello and Attanasio 2004). $M_{h,i}$ s are used to rank the units.

A well-known and much used non linear transformation is the rank transformation RT which is defined as

$$RT(X_{ik}) = \sum_{j=1}^N I(X_{ik} \geq X_{jk}),$$

⁽¹⁾ We do not consider foreign banks since their results are not homogeneous with respect to Italian ones which (for 2003 and 2004) are not yet delivered following the International Accounting Standards (IAS).

where $I(\cdot)$ denotes the indicator function. $RT(X_{ik})$ indicates the position of X_{ik} with respect to the increasing ranking of $X_{1k}, \dots, X_{Nk}$ and its range is $1 \leq RT(X_{ik}) \leq N$. The composite indicator based on RT is defined as $M_{5,i} = \sum_{k=1}^K RT_h(X_{ik})$. $M_{5,i}$ s may easily be used to rank the units.

A rather different way to develop a composite indicator is based on Lago and Pesarin's (2000) Nonparametric Combination of Dependent Rankings (NPCR). NPCR consists of three steps. In the first, the i th relative partial score is computed as

$$S_{ik} = \left[\sum_{j=1}^N I(X_{ik} \geq X_{jk}) + 0.5 \right] / (N+1),$$

where $I(\cdot)$ is the indicator function. The vector $(S_{ik}, i=1, \dots, N)$ may be used to rank the units with regard to partial component X_k because S_{ik} is an increasing transformation of X_{ik} . The basic idea is to compute a partial score which takes values in the open interval $]0, 1[$. In the second step, in order to simultaneously take all the K partial components of the complex variable into account, the partial scores for unit i $S_{i1}, \dots, S_{iK}$ are combined through a suitable combining function. We consider the Fisher omnibus combining function $S_i = -\sum_{k=1}^K \ln(1 - S_{ik})$ since its behavior is intermediate with respect to that of the other functions (Marozzi and Santamaria, 2005). Finally, the composite indicator based on NPCR is computed as $M_{6,i} = \sum_{j=1}^N I(S_i \geq S_j)$, so that the larger the $M_{6,i}$, the better.

3. Results and Discussion

Application of the methods discussed in section 2 to data about DJ Euro Stoxx Italian banks gives rise to the results reported in Tables 1 and 2. Different methods give rise to very similar results, in particular for what concern linear methods M_1 , M_2 , M_3 and M_4 . This is not surprising, since that these methods are very similar among themselves.

Table 1: Ranking of DJ Euro Stoxx Italian banks, 2003 annual results

	M_1	M_2	M_3	M_4	M_5	M_6	median
Banca Antonveneta	13	12	13	13	11	10	12.5
Banca Fideuram	14	14	14	14	14	14	14
Banca Intesa	1	1	1	2	1	1	1
Banca Lombarda e Piemontese	12	13	12	12	13	13	12.5
Banca Nazionale del Lavoro	6	6	6	6	7	6	6
Banca Popolare di Lodi	10	9	10	10	10	11	10
Banca Popolare di Milano	11	11	11	11	12	12	11
Banca Popolare Verona e Novara	8	8	8	8	8	8	8
Banche Popolari Unite	7	7	7	7	6	7	7
Capitalia	5	5	5	5	5	5	5
Mediobanca	9	10	9	9	9	9	9
Monte dei Paschi di Siena	4	4	4	4	4	4	4
Sanpaolo IMI	3	3	3	3	3	3	3
Unicredit	2	2	2	1	2	2	2

Table 2: *Ranking of DJ Euro Stoxx Italian banks, 2004 annual results*

	M_1	M_2	M_3	M_4	M_5	M_6	median
Banca Antonveneta	9	9	9	9	9	9	9
Banca Fideuram	14	14	14	14	14	14	14
Banca Intesa	1	1	1	1	1	1	1
Banca Lombarda e Piemontese	13	13	13	13	12	12	13
Banca Nazionale del Lavoro	7	7	7	8	7	7	7
Banca Popolare di Lodi	10	10	10	10	10	10	10
Banca Popolare di Milano	12	12	12	12	12	13	12
Banca Popolare Verona e Novara	8	8	8	7	8	8	8
Banche Popolari Unite	6	6	6	6	6	6	6
Capitalia	5	5	5	5	5	5	5
Mediobanca	11	11	11	11	11	11	11
Monte dei Paschi di Siena	4	4	4	4	4	4	4
Sanpaolo IMI	3	3	3	3	3	3	3
Unicredit	2	2	2	2	2	2	2

It is quite interesting to note that 2003 ranking is very similar to 2004 ranking. It should be also emphasized that the stock price variation in the period between the publication of the annual reports is very poorly correlated with the median ranking (the correlation coefficient is 0.234 for 2003 and 0.214 for 2004).

4. Conclusion

The problem of how to construct a composite indicator for financial problems has been considered. Different methods based on linear and non linear transformations of the original data have been discussed and applied to data about DJ Euro Stoxx Italian banks. The methods gave rise to very similar results. Moreover, correlation between stock price variation and median ranking is very poor. This is not a so surprising result, in fact it is known that stock prices are often driven by reasons unrelated to the so called company “fundamentals”.

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