An aggregate measure of financial ratios using a multiplicative DEA model

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Abstract: This paper examines the problems in the definition of the General Non-Parametric Corporate Performance (GNCP) and introduces a multiplicative linear programming as an alternative model for corporate performance. We verified and tested a statistically significant difference between the two models based on the application of 27 UK industries using six performance ratios. Our new model is found to be a more robust performance model than the previous standard Data Envelopment Analysis (DEA) model.

Keywords: DEA; data envelopment analysis; financial ratio; GNCP; general non-parametric corporate performance; MNCP; multiplicative non-parametric corporate performance.


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1 Introduction

In managerial decision-making, the traditional indicators for performance evaluation are financial ratios such as profitability, leverage, liquidity and efficiency ratios, among others. Financial ratios have achieved a widespread use in practice because of their relative simplicity in computation, easy to understand and serve as valuable tools of interpreting the financial statements. More importantly, financial ratios also enable analysts to conduct a certain degree of comparison across firms of different sizes and of firms with the total industry.

We can cite many specific applications of financial ratios, but most financial management textbooks have grouped them into four categories: performance evaluation, description of the industry or firm-specific conditions, predictions, and preparation of binding contracts. As early as 1966, a model developed by William Beaver (1966) used financial statement information to predict corporate bankruptcy, using a discriminant analysis. Subsequently, it gained widespread popularity, but attempts to estimate probabilities of failure instead of classifications-yielded questionable results. Technically speaking, the statistical assumption of multivariate normality in undertaking a discriminant analysis is often violated. Many financial ratios are not normally distributed because they have lower or upper bounds (Ezzamel et al., 1987; Watson, 1990). In regression-based techniques, the assumption of proportionality is violated and the distribution is skewed. In the univariate ratio approach, the major weakness is on its specification requirement of a small set of indicators to examine but does not help much the analyst in the reconciliation of conflicting signals among competing ratios. This approach also ignored information contained in the interdependencies between ratios. Thus, the principal obstacle to the use of traditional statistical techniques is the technical difficulty of developing an acceptable model (Fernandez-Castro and Smith, 1994).

The use of financial parameters to describe states and dynamics of financial market and to evaluate corporate performance is widespread in the literature (Barnes, 1987; Walter and Robert, 1988; Whittington, 1980; Salami and Martikikainen, 1994). Most of these parameters depend on proportions of the appropriate variables rather than on their actual values. A common feature of all areas of financial ratio analysis seems to be that while significant regularities can be observed, they are not stable across different ratios, industries and time period (Salami and Martikikainen, 1994). However, one major caution on the use of ratio analysis is that a single ratio does not generally provide sufficient information from which to judge the overall performance of a firm. Only when a group of ratios is used can reasonable judgements be made (see Gitman, 2000). Generally, there is no criterion for selecting a ratio that is agreeable by all users. Therefore, a lack of an objective standard for selecting the ratios would cause instability and could not satisfy the needs of all users.
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The use of financial performance indicators represent a partial measurement of a corporate performance and focused only on short-term results. Financial measures are based on single input factors to a corporation’s output, and do not have partial effect of other input(s). Corporate performance is recognised as a multi-dimensional construct since it covers diverse and various variables (aside from financial ratios) (Zhu, 2000). There are other non-financial performance indicators that importantly considered in today’s complex global market environment such as manufacturing capability, innovation capability and supply-chain relationship, using Data Envelopment Analysis (DEA) and fuzzy multi-criteria approach (Tseng et al., 2009). The combined financial and non-financial indicators for corporate performance evaluation are also evident in most current literature, using the DEA method (Feroz et al., 2003; Halkos and Salamouries, 2004; Yang, 2007; Guzman and Arcas, 2008; Sueyoshi and Goto, 2009). Financial ratio analysis can also be used for measuring production efficiency and operating efficiency (Moynihan et al., 2006) and also Wang and Lee (2008) presented a clustering method to identify representative of financial ratios.

It is clear in the preceding discussion that there is a need to continuously search for a more robust method of analysing financial ratios. In the existing efficiency literature there has been an increasing interest in non-parametric techniques to measure a firm’s performance. The most widely used non-parametric method is DEA that have been applied in the performance evaluation of banks, financial institutions, universities, hospitals and health organisations, manufacturing and service industries, etc. (see Emrouznejad et al., 2008). DEA has a unique property that does not require specification of the functional forms for the frontier of performance possibilities compared to traditional statistical regression techniques. As such, DEA can be an alternative method of analysing financial ratios which do not depend on unsustainable assumptions. DEA is a distribution-free method and also does not assign pre-specified weights. Another striking characteristic of DEA, which is useful in our present analysis, is its ability of providing an aggregate measure of efficiency, using multiple outputs and inputs as indicators of performance.

The multi-dimensional nature of corporate performance is better addressed by the multi-factor criteria of DEA that can provide a general measure of a corporate performance compared to the inadequate conventional growth accounting model, which yields only a partial performance measure. Fernandez-Castro and Smith (1994) introduced a seminal model of the General Non-Parametric Corporate Performance (GNCP) that combines all financial ratios to a single measure, using the standard DEA model. This seminal work was a good starting point for aggregating the financial ratios into a single measure of corporate performance using the DEA model when no input variables are involved. However, we found that there are critical issues (technical in nature) in using the standard DEA model to construct an aggregate measure. This is the apparent motivation of this paper, and we will discuss this in succeeding sections.

This paper offers significant contributions to the performance measurement on the use of geometric means with non-dimensional properties (unit invariance) rather than weighted average of ratios. The use of a new multiplicative DEA model can provide advantages for extending the range of potential uses for DEA, especially in corporate performance field due to its non-dimensional nature and therefore can be used for the case that all variables are in the form of ratios. Our new model here provides new insights that a firm’s efficiency scores are derived from a multi-dimensional data without a priori of functional forms of the efficient frontier. This is in contrast to the arbitrary weights inherent in conventional multivariate statistical techniques.
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The remaining part of this paper is organised as follows. Section 2 describes the GNCP model and problems of using this model. Section 3 introduces a multiplicative linear programming as an alternative model for corporate performance. This is followed by results and discussion in Section 4. Section 5 presents our conclusion and future research.

2 Corporate performance model development

To develop our corporate performance model, we first describe the GNCP model of Fernandez-Castro and Smith (1994) and show why this model becomes problematic. We then develop the alternative multiplicative non-parametric corporate performance model for our empirical analysis.

2.1 GNCP model

Mostly DEA is undertaken with absolute numerical data, which among other things reflect the size of the units of observation. There are many cases reported in the DEA literature (Emrouznejad et al., 2008) that the authors used ratio variables rather than absolute numbers as inputs (input ratios) and/or outputs (output ratios). For example, a health database presents almost all its indicators in the form of ratios, such as expenditure as a percentage of GDP, discharge rates from hospital per 1,00,000 population, and annual number of days lost through sickness per employee. Hollingsworth and Smith (2003) explained that the CCR formulation of Charnes et al. (1978) should not be used; instead, the BCC formulation of Banker et al. (1984) must be used when input or output variables include a ratio.

As one of the major developments towards aggregation of financial ratios, Fernandez-Castro and Smith (1994) reformulated DEA to introduce a model to combine a set of financial ratios to a single measure and called it GNCP. This approach has been used by many authors for comparison of DMUs (firms) and in the presence of ratio outputs (for example, see Salinas-Jimenez and Smith, 1996; Mar-Molinero and Serrano-Cinca, 2001; Halkos and Salamouris, 2004; Blancard et al., 2006). More examples can be found in the DEA comprehensive literature (Emrouznejad et al., 2008).

Let us start with the definition given by Fernandez-Castro and Smith (1994, p.241). Suppose that there are $N$ firms which are appraised on $m$ financial ratios, and that the observed ratios for firm $j$ are $\{r_{ij}; i = 1, \ldots, m\}$. The problem of assessing the performance of a firm (say firm $j_0$) can be represented as a linear programme. It is assumed that the ratios are ordered such that a higher level of ratio is preferred to a lower level. Then, the GNCP approach of Fernandez-Castro and Smith (1994) is presented in Model 1, which we refer to it as GNCP efficiency score of firm $j_0$:

$$
\begin{align*}
\text{max} & \quad h \\
\text{s.t.} & \quad \sum_{j=1}^{n} r_{ij} \lambda_j \geq h r_{i0}; i = 1, \ldots, m \\
& \quad \sum_{j=1}^{n} \lambda_j = 1 \\
& \quad \lambda_j \geq 0 \quad j = 1, \ldots, n
\end{align*}
$$
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Notice that, in contrast to the original Charnes et al. (1978) DEA model, no inputs are specified. The decision variables in this linear programme are \( h \), the proportion by which all the firm’s ratios can be increased, and \( \{ \lambda_j; j = 1, \ldots, n \} \), which indicate the weight placed on each of the firms in forming the efficiency frontier for firm \( j_0 \). The efficiency of firm \( j_0 \) is then given by \( 1/h \).

Fernandez-Castro and Smith (1994) used this model to evaluate the performance of 27 industries using six financial ratios including cash position, liquidity, working capital position, leverage, profitability and turnover. Emrouznejad and Amin (2009) have recently shown that the standard DEA model may produce incorrect results in the presence of a ratio variable. The main two problems of using ratio as an input and/or an output in DEA are convexity and proportionality properties of Production Possibility Set (PPS).

2.2 The convexity issue

DEA is defined based on observed units and by finding the distance of each unit to the border of the PPS. The convexity is one of the underlying properties of the PPS. It is obvious that the weighted sum of ratios does not equal the ratio of weighted sum of nominators and the weighted sum of denominators, hence the convexity of ratio variable may cause problem in defining PPS for DEA (for details, see Emrouznejad and Amin, 2009).

2.3 The proportionality issue

The proportionality axiom in DEA models is another underlying property of PPS, and it defines as ‘if output increases by that same proportional change then there are constant returns to scale (CRTS), sometimes referred to simply as returns to scale’. It is obvious that this property also does not satisfy when data are in the form of ratios, since if the nominators and denominators increased (decreased) by the same proportional change the ratio will not be changed (for details, see Emrouznejad and Amin, 2009).

3 MNCP model

An investigation of Model 1 shows that the mentioned problems arise because the convexity and the proportionality properties of PPS both are correct when arithmetic operations are considered. In the case of GNCP the output variables are in the form of ratios, and therefore any arithmetic combination of ratios is meaningless. Alternatively, a multiplicative model should be considered. The aggregate measure results in that the multiplicative GNCP is of piecewise log-linear form rather than piecewise linear form. An important property of this model is that it uses the concept of the geometric mean with non-dimensional (units invariance) properties, and hence, it is more suitable for all financial ratios data (see Emrouznejad and Amin, 2009). In this model, the validity proportionality assumption for ratios is strengthened.
For this purpose, we propose a Multiplicative Non-parametric Corporate Performance (MNCP) model as follows.

\[
\text{max } h \\
\text{s.t.} \\
\prod_{j=1}^{n} r_{ij}^{x_{ij}} \geq h r_{0i}, \ i = 1, \ldots, m \\
\sum_{j=1}^{n} \lambda_j = 1 \\
\lambda_j \geq 0, \ j = 1, \ldots, n
\] (2)

This model is a specific case of multiplicative DEA model initially proposed by Banker and Maindiratta (1994) (see also Seiford and Thrall, 1990). However, the difference is that unlike the standard multiplicative DEA, similar to GNCP there is no input ratio in this model. We use the following transformation to convert the above multiplicative model to a linear programming (Banker et al., 2004).

\[
h r_{0i} = e^{-S_i} \prod_{j=1}^{n} g_{ij} \lambda_j, \ i = 1, \ldots, m
\]

Now, replace the objective in Model 2 by \( h e^x \sum_{i=1}^{n} S_i \) where \( S_i \geq 0 \) represents slacks and \( \varepsilon \) is the non-Archimedean infinitesimal.

Assume \( g = \log(h) \) and \( \rho_g = \log(r_i) \), employing the above transformation and taking logarithm from equation (2) we could conclude the following model.

\[
\text{max } g + \varepsilon \sum_{i=1}^{n} S_i \\
\text{s.t.} \\
\sum_{j=1}^{n} \lambda_j \rho_g - S_i = g + \rho_g, \ i = 1, \ldots, m \\
\sum_{j=1}^{n} \lambda_j = 1 \\
\lambda_j, S_i \geq 0, \ i = 1, \ldots, m \text{ & } j = 1, \ldots, n
\] (3)

Note that Model 3 is an output maximisation and efficiency is inverse to the optimum value of objective function in equation (2). After solving equation (3) the efficiency of firm \( j_0 \) can be obtained from:

\[
h_j = \frac{1}{e^{S_j}}.
\]
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In most cases the financial ratios are values between 0 and 1. In these cases the MNCP Model 3 cannot be used directly since the log-transform of value less than 1 is negative, however MNCP requires positive values. Hence, we suggest using the MNCP model after scaling the data as follows:

**Step 1.** Assume all variables are positive, find the minimum of each variable across all financial sector and assume \( R = \min \{r_{ij}; i = 1,\ldots,m & j = 1,\ldots,n\} - \varepsilon \), where \( \varepsilon \) is a positive value less than \( \min \{r_{ij}; i = 1,\ldots,m & j = 1,\ldots,n\} \). The use of this \( \varepsilon \) guarantees a positive value for the log-transform.

**Step 2.** Amend the MNCP Model 2 to the following model

\[
\begin{align*}
\max \ h \\
\text{s.t.} \\
\prod_{j=1}^{n} \left( \frac{r_{ij}}{R} \right)^{\lambda_j} \geq h \left( \frac{r_{ij}}{R} \right); i = 1,\ldots,m \\
\sum_{j=1}^{n} \lambda_j = 1 \\
\lambda_j \geq 0 \quad j = 1,\ldots,n
\end{align*}
\]

Obviously, we have

\[
\prod_{j=1}^{n} \left( \frac{r_{ij}}{R} \right)^{\lambda_j} = \frac{\prod_{j=1}^{n} r_{ij}^{\lambda_j}}{\prod_{j=1}^{n} R^{\lambda_j}} = \frac{\left( \prod_{j=1}^{n} r_{ij}^{\lambda_j} \right)}{\left( \prod_{j=1}^{n} R^{\lambda_j} \right)} = \frac{\left( \prod_{j=1}^{n} r_{ij}^{\lambda_j} \right)}{R^{\sum_{j=1}^{n} \lambda_j}}
\]

since

\[
\left( \prod_{j=1}^{n} R^{\lambda_j} \right) = (R)^{\sum_{j=1}^{n} \lambda_j} = R \), since, \( \sum_{j=1}^{n} \lambda_j = 1 \).
\]

Hence

\[
\prod_{j=1}^{n} r_{ij}^{\lambda_j} \geq h \left( \frac{r_{ij}}{R} \right) \)

implies that

\[
\frac{\prod_{j=1}^{n} r_{ij}^{\lambda_j}}{R} \geq h \left( \frac{r_{ij}}{R} \right), \text{ i.e. } \left( \prod_{j=1}^{n} r_{ij}^{\lambda_j} \right) \geq hr_{ij}.
\]
As results, the objective values of Model 4 and Model 2 are equal. However, Model 4 can easily be transferred to a log-linear form without any problem as all values are now positive (note that $\frac{r_i}{R} \geq 1; \forall i$ since $R \leq r_{ij}; \forall i$). Thus, this model can be applied to all other ratios simultaneously.

4 Results and discussion

To demonstrate that how we could combine the financial ratios to a single measure, we consider the same data used by Fernandez-Castro and Smith (1994). In order to illustrate the differences between the two GNCP model and MNCP model, we evaluate the performance of 27 industries using six financial ratios including: cash position (cash/total assets), liquidity (current assets/current liabilities), working capital position (working capital/total assets), leverage (long-term liabilities/total assets), profitability (net income/total assets), and turnover (sales/total assets).

The average ratio for each industry is reported in Appendix A and the results for both GNCP and MNCP models are reported in Table 1. A score of 100% implies an efficient industry, and below 100% is inefficient.

Table 1 Combined measure, comparison of GNCP and MNCP models

<table>
<thead>
<tr>
<th>Industry</th>
<th>Combined measure; GNCP (%)</th>
<th>Rank-order GNCP</th>
<th>Combined measure; MNCP (%)</th>
<th>Rank-order MNCP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical</td>
<td>98.88</td>
<td>13</td>
<td>100</td>
<td>1</td>
</tr>
<tr>
<td>Chemicals</td>
<td>100</td>
<td>1</td>
<td>100</td>
<td>1</td>
</tr>
<tr>
<td>Industrial plant</td>
<td>100</td>
<td>1</td>
<td>100</td>
<td>1</td>
</tr>
<tr>
<td>Overseas trade</td>
<td>100</td>
<td>1</td>
<td>100</td>
<td>1</td>
</tr>
<tr>
<td>Furnishing stores</td>
<td>100</td>
<td>1</td>
<td>100</td>
<td>1</td>
</tr>
<tr>
<td>Construction</td>
<td>99.33</td>
<td>12</td>
<td>99.95</td>
<td>15</td>
</tr>
<tr>
<td>Office equipment</td>
<td>100</td>
<td>1</td>
<td>100</td>
<td>1</td>
</tr>
<tr>
<td>Furnishing stores I</td>
<td>78.56</td>
<td>18</td>
<td>99.35</td>
<td>16</td>
</tr>
<tr>
<td>Multiple stores</td>
<td>68.62</td>
<td>22</td>
<td>97.2</td>
<td>21</td>
</tr>
<tr>
<td>Engineering</td>
<td>51.39</td>
<td>26</td>
<td>92.35</td>
<td>26</td>
</tr>
<tr>
<td>Durable goods</td>
<td>100</td>
<td>1</td>
<td>100</td>
<td>1</td>
</tr>
<tr>
<td>Construction</td>
<td>67.96</td>
<td>23</td>
<td>95.04</td>
<td>24</td>
</tr>
<tr>
<td>Construction</td>
<td>100</td>
<td>1</td>
<td>100</td>
<td>1</td>
</tr>
<tr>
<td>Motor distributors</td>
<td>65.78</td>
<td>24</td>
<td>97.71</td>
<td>18</td>
</tr>
<tr>
<td>Food retailing</td>
<td>100</td>
<td>1</td>
<td>100</td>
<td>1</td>
</tr>
<tr>
<td>Engineering</td>
<td>36.99</td>
<td>27</td>
<td>88.68</td>
<td>27</td>
</tr>
<tr>
<td>Metal forming</td>
<td>77.94</td>
<td>20</td>
<td>96.83</td>
<td>22</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>96.06</td>
<td>15</td>
<td>100</td>
<td>1</td>
</tr>
<tr>
<td>Instrument makers</td>
<td>77.09</td>
<td>21</td>
<td>96.1</td>
<td>23</td>
</tr>
</tbody>
</table>
An aggregate measure of financial ratios

Table 1  Combined measure, comparison of GNCP and MNCP models (continued)

<table>
<thead>
<tr>
<th>Industry</th>
<th>Combined measure; GNCP (%)</th>
<th>Rank-order; GNCP</th>
<th>Combined measure; MNCP (%)</th>
<th>Rank-order; MNCP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transport</td>
<td>60.88</td>
<td>25</td>
<td>93.35</td>
<td>25</td>
</tr>
<tr>
<td>Metallurgy</td>
<td>97.36</td>
<td>14</td>
<td>100</td>
<td>1</td>
</tr>
<tr>
<td>Industrial holdings</td>
<td>78.14</td>
<td>19</td>
<td>97.75</td>
<td>17</td>
</tr>
<tr>
<td>Property</td>
<td>100</td>
<td>1</td>
<td>100</td>
<td>1</td>
</tr>
<tr>
<td>Financial holdings</td>
<td>100</td>
<td>1</td>
<td>100</td>
<td>1</td>
</tr>
<tr>
<td>Mech. engineering</td>
<td>79.61</td>
<td>17</td>
<td>97.71</td>
<td>19</td>
</tr>
<tr>
<td>Pharmaceuticals</td>
<td>83.26</td>
<td>16</td>
<td>97.47</td>
<td>20</td>
</tr>
<tr>
<td>Oil</td>
<td>100</td>
<td>1</td>
<td>100</td>
<td>1</td>
</tr>
<tr>
<td>Mean</td>
<td>85.85</td>
<td></td>
<td>98.13</td>
<td></td>
</tr>
</tbody>
</table>

It is noted that there are some negative ratios in the data; however, the MNCP Model 3, like standard DEA Model 2, requires positive data. For this purpose any negative ratio, as well as zero ratios, substitutes with a very small positive value (see Ali and Seiford, 1990; Lovell and Pastor, 1995). As described earlier, first we scaled the six variables as follows. As shown before the rescaling, it will not affect the optimum value of Model 3 but allow us to use Model 4, all variables of which are positive. We assume R = 0.001875; the models GNCP and MNCP were applied and results are reported in Table 1. The second and third columns show the combined measure and ranking based on the GNCP model of Fernandez-Castro and Smith (1994), the last two columns show the combined measure and ranking based on the MNCP model as developed in this paper. Based on the two models, there are 11 industries, representing 41% of the sample, that have produced similar ratings and rankings. These are chemicals, industrial plant, overseas trade, furnishing stores, office equipment, durable goods, construction, food retailing, property, financial holdings and oil (refer to Table 1). Sixteen industries, 59% of the sample, have obtained different rankings and ratings. For example, in the multiple stores, GNCP’s efficiency score (68.62%) is much lower than MNCP’s (97.2%) among others. Overall, the mean efficiency score (98.13%) in MNCP is higher than that (85.85%) obtained in GNCP.

To verify the robustness of our new model, we tested if there is a significant difference between the two models. We used the non-parametric Wilcoxon rank test since this is a distribution-free test like the DEA. We found that there is a significant difference (z statistic = –3.516) at 5% probability level in the rating of industries between GNCP and MNCP models. Using the correct measure of MNCP, more industries are found to be efficient at the production possibility frontier in the aggregate six financial ratios (see Figure 1). Under the standard GNCP, more industries are found to be below the efficiency frontier.
Under the new MNCP model, the validity proportionality assumption for ratios is sustained, and we confirmed the theoretical assumptions forwarded by Emrouznejad and Amin (2009). Therefore, our new model is found to be a more robust performance model than the previous standard DEA model. In this paper, the benefits and managerial implications of MNCP are the following:

- It does not require weights to be determined in combining ratios for ranking of industries in contrast to a multivariate analysis.
- Firm’s efficiency scores are derived without a priori of functional forms of the efficient frontier and free from statistical distributions.
- Inefficient firms can benchmark the best-practice firms on the frontier and provides information on feasible targets for improvements in the ratios. These new insights may help managers in their decision-making in which ratio dimensions of performance need improvements.

We have shown here the correct and technically appropriate way of using a DEA model for financial ratio analysis without discounting the general benefits of the standard DEA model. This new multiplicative DEA model can open new areas for extending the potential advantages and applications of DEA for performance evaluation.

5 Conclusions and future research

This research has examined the critical issues in the definition of GNCP and has introduced a multiplicative linear programming as an alternative model for corporate performance. The MNCP model is verified, and proven to be a valid model based on the earlier work of Emrouznejad and Amin (2009) and the previous benefits as discussed earlier. We verified and tested a statistically significant difference between the two models based on the application of 27 UK industries using six performance ratios.
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This research is just a starting point and opens many areas for further investigation on the DEA performance field. Future theoretical research is needed to draw properties of MNCP such as duality, weights and returns to scale assumptions. In addition, future empirical research will focus on the managerial implications of MNCP on the performance of any firms, sub-units or regions using all financial ratios and to be combined with other non-financial indicators. Aside from the DEA model, other statistical techniques should be used to complement and verify the MNCP results. These issues are also the limitations of this paper. Finally, this research forms as part of a continuing research on potential uses and applications of the non-parametric DEA model as a corporate performance measurement.

References


### Appendix A  Industry average of financial ratio*

<table>
<thead>
<tr>
<th>Industry</th>
<th>Cash position</th>
<th>Liquidity</th>
<th>Working capital position</th>
<th>Leverage</th>
<th>Profitability</th>
<th>Turnover</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( r_1 )</td>
<td>( r_2 )</td>
<td>( r_3 )</td>
<td>( r_4 )</td>
<td>( r_5 )</td>
<td>( r_6 )</td>
</tr>
<tr>
<td>Electrical</td>
<td>0.058</td>
<td>3.01</td>
<td>0.279</td>
<td>1.324</td>
<td>0.057</td>
<td>1.431</td>
</tr>
<tr>
<td>Chemicals</td>
<td>0.139</td>
<td>1.366</td>
<td>-0.139</td>
<td>1.138</td>
<td>0.005</td>
<td>1.431</td>
</tr>
<tr>
<td>Industrial plant</td>
<td>0.112</td>
<td>2.075</td>
<td>0.296</td>
<td>1.338</td>
<td>0.005</td>
<td>1.431</td>
</tr>
<tr>
<td>Overseas trade</td>
<td>0.122</td>
<td>1.405</td>
<td>0.179</td>
<td>1.568</td>
<td>-0.001</td>
<td>7.46</td>
</tr>
<tr>
<td>Furnishing stores</td>
<td>0.107</td>
<td>2.053</td>
<td>0.304</td>
<td>1.318</td>
<td>0.057</td>
<td>1.422</td>
</tr>
<tr>
<td>Construction</td>
<td>0.055</td>
<td>1.577</td>
<td>0.227</td>
<td>0.687</td>
<td>0.075</td>
<td>1.368</td>
</tr>
<tr>
<td>Office equipment</td>
<td>0.094</td>
<td>1.566</td>
<td>0.223</td>
<td>1.432</td>
<td>0.077</td>
<td>1.364</td>
</tr>
<tr>
<td>Furnishing stores I</td>
<td>0.062</td>
<td>2.165</td>
<td>0.16</td>
<td>2.58</td>
<td>0.023</td>
<td>1.418</td>
</tr>
<tr>
<td>Multiple stores</td>
<td>0.052</td>
<td>1.101</td>
<td>0.13</td>
<td>0.973</td>
<td>0.041</td>
<td>1.872</td>
</tr>
<tr>
<td>Engineering</td>
<td>0.038</td>
<td>1.345</td>
<td>0.095</td>
<td>1.009</td>
<td>-0.009</td>
<td>3.16</td>
</tr>
<tr>
<td>Durable goods</td>
<td>0.113</td>
<td>1.241</td>
<td>0.088</td>
<td>3.62</td>
<td>0.068</td>
<td>1.645</td>
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<tr>
<td>Construction</td>
<td>0.054</td>
<td>1.454</td>
<td>0.182</td>
<td>1.136</td>
<td>0.022</td>
<td>1.671</td>
</tr>
<tr>
<td>Construction</td>
<td>0.058</td>
<td>1.527</td>
<td>0.204</td>
<td>2.029</td>
<td>0.071</td>
<td>1.536</td>
</tr>
<tr>
<td>Motor distributors</td>
<td>0.024</td>
<td>1.256</td>
<td>0.087</td>
<td>1.357</td>
<td>0.021</td>
<td>3.133</td>
</tr>
<tr>
<td>Food retailing</td>
<td>0.086</td>
<td>2.38</td>
<td>0.018</td>
<td>1.562</td>
<td>0.051</td>
<td>3.519</td>
</tr>
<tr>
<td>Engineering</td>
<td>0.031</td>
<td>1.191</td>
<td>0.069</td>
<td>1.125</td>
<td>0</td>
<td>1.232</td>
</tr>
<tr>
<td>Metal forming</td>
<td>0.044</td>
<td>1.626</td>
<td>0.221</td>
<td>1.235</td>
<td>0.027</td>
<td>1.433</td>
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<td>Miscellaneous</td>
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<td>2.425</td>
<td>0.163</td>
<td>1.431</td>
<td>0.058</td>
<td>1.803</td>
</tr>
<tr>
<td>Instrument makers</td>
<td>0.098</td>
<td>1.804</td>
<td>0.017</td>
<td>0.939</td>
<td>-0.254</td>
<td>1.467</td>
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<td>Transport</td>
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<td>1.204</td>
<td>0.032</td>
<td>1.735</td>
<td>0.038</td>
<td>1.363</td>
</tr>
<tr>
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<td>1.754</td>
<td>0.235</td>
<td>1.28</td>
<td>0.015</td>
<td>4.294</td>
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<td>Industrial holdings</td>
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<td>0.16</td>
<td>1.747</td>
<td>0.042</td>
<td>1.383</td>
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<td>Property</td>
<td>0.116</td>
<td>2.238</td>
<td>0.189</td>
<td>1.381</td>
<td>0.033</td>
<td>0.587</td>
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<tr>
<td>Financial holdings</td>
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<td>0.159</td>
<td>4.76</td>
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<td>0.458</td>
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<tr>
<td>Mech. engineering</td>
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<td>1.45</td>
<td>0.034</td>
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<td>Pharmaceuticals</td>
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<td>1.357</td>
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<td>1.365</td>
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<td>Oil</td>
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<td>0.046</td>
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<td>0.039</td>
<td>2.057</td>
</tr>
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</table>

*Source: Adapted from Fernandez-Castro and Smith (1994, p.245)*