Measurement and Comparison of Industrial Infrastructures of SMEs among Iranian Provinces

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Abstract

The creation of SMEs is considered, by many governments, private sectors and donor agencies, as the key to economic development in countries regardless of level of development. This research aims to shed lights on the role that SMEs play in the process of industrial and economic.

Research Hypotheses

- SMEs have a positive effect on the industrial infrastructure development of a region.
- The effects of SMEs on regional development are at present time limited with respect to particular components within the manufacturing sector (i.e., capacity and resource).
- SMEs have a high potential to foster industrial infrastructure development within regions.

Outline

- Review of the Literature
- The data
- Research methodology
- Analysis of the Results

Review of the Literature

- SME definition
- Firm characteristics
  - ✓ Size and Age
  - ✓ Ownership
  - ✓ Productivity
  - ✓ Financial characteristics
  - ✓ Innovation
  - ✓ Location
- SMEs capacity building

The Data

- The data used in this study were assembled from ISIPO statistics.
- The statistics includes all 31 provinces for the period of from 2011 to 2013.
- From 2010, due to a statistical plan, every year a statistical yearbook is published that include the main mentioned variables (labelled here as infrastructure variables) in the dissertation at the province and national levels.
- There is a law in the SMEs sector that indicate SMEs must be created in industrial parks. So, our analysis will be carried out based on this criterion.

Research Methodology

- Principal Components Analysis (PCA) is a statistical technique that linearly transforms an original set of variables into a substantially smaller set of uncorrelated variables that represents most of the information in the original set of variables.

- Its goal is to reduce the dimensionality of the original data set. A small set of uncorrelated variables (factors or components) is much easier to understand and use in further analysis than a large set of correlated variables.

Principal Components Analysis

PCA searches for a few uncorrelated linear combinations of the original variables that capture most of the information in the original variables. In most of cases, each variable receives an equal weight in the linear composite. Indices force a *p* dimensional system into one dimension. In PCA, the weights are mathematically determined to maximize the explained variation of the linear composite or, equivalently, to maximize the sum of the squared correlations of principal component with the original variables.

Principal Components Analysis

The linear composites (principal components) are ordered with respect to their variation explanation so that the first few account for most of the variation present in the original variables, or equivalently, the first few principal components together have, over all, the highest possible squared multiple correlations with each of original variables.

Principal Components Analysis

Algebraically, the first principal component, is a linear combination of $x_1, x_2, \ldots, x_p$, written as:

$$y_1 = a_{11}x_1 + a_{12}x_2 + \cdots + a_{1p}x_p = \sum_{i=1}^{p} a_{1i}x_i$$

such that the variance of y_1 is maximized given the constraint that the sum of the squared weights is equal to one (i.e., $\sum_{i=1}^{p} a_{1i}^2 = 1$).

Principal Components Analysis

The second principal component, y_2, involves finding a second weight vector $(a_{21}, a_{22}, \ldots, a_{2p})$ such that the variance of

$$y_2 = a_{21}x_1 + a_{22}x_2 + \cdots + a_{2p}x_p = \sum_{i=1}^{p} a_{2i}x_i$$

is maximized subject to the constraints that it is uncorrelated with the first principal component and $\sum_{i=1}^{p} a_{2i}^2 = 1$.

Principal Components Analysis

- These results in y_2 having the next largest sum of squared correlations with the original variables, or equivalently, the variances of the principal components get smaller as successive principal components are extracted. The first two principal components together have the highest possible sum of squared multiple correlations (i.e., $\sum_{i=1}^{p} R^2_{x_i \cdot y_1, y_2}$) with the p variables.

Principal Components Analysis

This process can be continued until as many components as variables have been calculated. However, the first few principal components usually account for most of the variation in the variables and consequently our interest is focused on these

Principal Components Analysis

In summary:

PCA are the variable weight factor $a = (a_1, a_2, \ldots, a_p)$ associated with each principal component and its associated variance.

Principal Components Analysis

The relative sizes of the elements in a variable weight vector associated with a particular principal component indicate the relative contribution of the variable to the variance of the principal contribution, or, equivalently, the relative amounts of variation explained in the variables by the principal components.

Principal Components Analysis

- The correlations of the variables with a particular principal component are proportional to the elements of the associated weight vector.
- They can be obtained by multiplying all the elements in the weight vector by the square root of the variance of the associated principal component.

Research Methodology

For the non-parametric index, the index is based on normalization of individual indicators and subsequent aggregation using an ad hoc weighting system as follows:

$$Index_i = \sum_{j=1}^{J} \omega_j \sum_{m=1}^{M} \omega_m \frac{X_{jmi} \; X_{jm}^{\min}}{X_{jm}^{\max} \; X_{jm}^{\min}}$$

Research Methodology

For our study, use of sub-indices and a composite of Development Infrastructure Index (DII) could help provinces to evaluate their status of industrial infrastructure. Also, it will benefit from information on the isolated effects of industrial infrastructure on industrial and economic development.

Research Methodology

In this study Industrial infrastructures were categorized into six main dimensions: capacity component, resource component, education component, credit component, employment component and assets component.

Research Methodology

The six development infrastructure sub-indexes are separately calculated using the non-parametric PCA approach and aggregated to form the composite DII index.

Research Methodology

The PCA compute the same aggregate index parametrically, However, PCA does not allow decomposition of the overall index into its underlying components, unless they are estimated individually, but an aggregation is not possible without assuming some weights:

$$\text{Development Infrastructure Index (DII)} = \sum_{i=1}^{6} Indiex_{ic}$$

Research Methodology

To maintain the rationality and objectivity of PCA technique, some tests and criteria are usually conducted to determine the percentage of each variable as denoted by each factor. Eigenvalue is the most common measurement technique used in this dimension reduction approach. Only principal components with an eigenvalue larger than 1.0 are considered. Eigenvectors signs indicates their effects and a coefficient of greater than ±0.30 are considered as contributor indicators to the principal components.

Analysis of the Results

The index numbers were computed based on only the 2013 years data. The previous year of 2012 data contained too many missing units. Another reason for excluding 2012 is that most of the indicators are given in their cumulative forms.

Analysis of the Results

Esfahan, Razavi Khorasan, Khouzestan, East Azarbayejan, Fars and Tehran are leading in all sub-indexes. The mentioned provinces ranked from 1 to 6 respectively based on DII.

Analysis of the Results

In the aggregate level, Kurdistan province with 0.994 for DII is far below than average with 1.361 and ranked as 19^{th}.

Policy Recommendation

By taking into account correlations of the above mentioned components with DII, It seems logical to invest in capacity, employment, resource, education, credit and assets, respectively for gaining at least the average level of the country.

Conclusion

The policy can be customized for provinces that want to prioritize their development plans based on above criterions.

Future Works

One of the important and interested research works after investigating industrial infrastructure, is clustering among SMEs. In addition, due to paying much more attention by government and private sector to this topic, it is expected to have related data in detailed forms in the near future. It is suggested to investigate and find potentials and failures of clustering among SMEs in the national and provincial level.

Thanks for your attention