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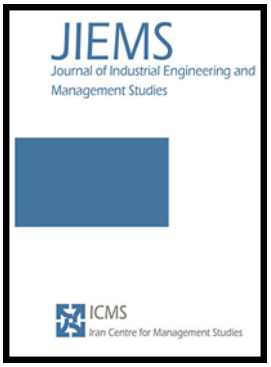

Survey factors affecting performance of industrial clusters by using panel-VAR model

Vida Varharami[1,*]

Abstract
In every country, the efficiency and probability of small and medium firms will cause to economic growth. In this regard, present study aimed to investigate the effective factors on the performance of active industrial clusters in large and industrial provinces by Panel-VAR model during 2006-2015. Results indicated that the access to loan, production rate, cluster size, marketing sector in cluster, closeness of cluster to the market, and the increase of manager's experience have a positive effect while bank facility interest can negatively influence on the performance of industrial clusters.

Keywords: Industrial clusters; Small and medium firms; Panel-VAR model performance; Financing.

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1. Introduction

Industrial clusters are groups of similar and related firms in a defined geographic area that share common markets, technologies, worker skill needs, and which are often linked by buyer-seller relationships. Examples include electronics clusters in Mexico (e.g. Guadalajara) and Argentina (e.g. Córdoba).[2] Industrial clusters in the economy of developing countries have a large contribution in the economic growth, employment, export, and reduction of economy dependence on oil revenues. Thus, studying the effective factors in the performance of industrial clusters is of great significance.

Today, financing is one of the most significant challenges in front of industrial clusters or small and medium firms[3]. If the firms can easily access to their required financial resources with low facilities interest, their performance and industrial clusters will improve because the accessibility to updated and efficient human resources, better technology, and more number

* Corresponding author; vida.varahrami@gmail.com
[1] Shahid Beheshti University, Shahriari square, Tehran, Iran.
[2] https://oregonbusinessplan.org/about-the-plan/industry-clusters/industry-clusters-faq/
[3] SME is a small or medium-sized enterprise, or a business or company that has fewer than 250 employees (European Commission Definition).

of machineries will be achieved. The present study aimed at investigating the effective factors in the performance of industrial clusters in large and industrial provinces of Iran and focused on the active industrial clusters of provinces during 2006-2015. For this purpose, the Panel-VAR model was used for modeling and fitting.

This study has a great significant because most recent studies indicated the critical role of industrial clusters on economic growth and expansion of countries. But, identifying the effective factors in the performance of such clusters and making efforts to remove their inefficiency are so important. Section 2 explains the theoretical foundations and section 3 deals with research background. The 4 section presents the method and the 5 section provides the model and data analysis. Section 6 deals with the conclusion and presents the strategic recommendations.

3. Theoretical foundations

Small and medium firms, as the components of industrial clusters, have a vital role in the economic flourishing of every country and the study of their performance is highly significant. The variable "performance" is mentioned with various interpretations such as annual profit, annual revenue, or human resource employment growth. In this study, performance refers to the annual profit of firms.

In general, the factors affecting the performance of firms can be divided into three groups of "characteristics of entrepreneur", "characteristics of SME", and "contextual variables" (Indarti and Langenberg, 2004). This study attempted to select at least one effective factor from each group due to the available data and conditions of industrial clusters. In this regard, the variables of access to loan, marketing sector, cluster location, and bank facilities interest were selected as contextual variables while the production rate and cluster size were selected as the characteristics of entrepreneur. Finally, the variable "location" should be briefly explained. Location refers to the definitions such as the distance from firm to financial institutions, from firm to market, and from scientific centers and technology. In this study, the closeness or far distance of firms to the current market was considered by the authors.

In this study, the effectiveness of the above-mentioned variables on the access of active small and medium firms in the country was considered.

3. Review of literature

Based on the study of Indarti and Langenberg (2004) on 100 small and medium firms in Indonesia, the factors affecting the performance of firms were identified. The study results indicated that marketing, technology, and capital rate have positive effect but rules play a negative effect on business success. Audretsch and Dohs (2007) evaluated the variable of location in efficiency. The obtained results showed that locating the firms and industrial clusters had a significant effect on the efficiency and promotion of firms than the science and knowledge resources.

Halkos and Tzeremes (2010) studied different levels for the performance and efficiency of small and medium firms. This study was conducted on 353 firms with foreign ownership in Greece and the results indicated that the foreign ownership rate had a positive effect on the performance of small and medium firms. Smolarski and Kut (2011) considered the capital rate and access to financial resources as the effective factors in the performance of firms.

Chittithaworn, et al. (2011) conducted a study on the effective factors in the success of small and medium firms in Thailand. The regression analysis results indicated that firm, customer, market, business method, financial resources, and external environment have the maximum role in the efficiency of small and medium firms.

Mansouri, et al. (2011) concluded that an attention to the development of SMEs in the laws and regulations of developed countries was observed in form of implementing the models such as cluster development model due to the rapid and often unpredictable changes in the world trade markets and the emergence of new rules and regulations in these markets. The industrial cluster model considering the macro criteria such as GDP growth, employment, exports and poverty eradication attracted the attention of policy makers and governments. Hence, the analysis and evaluation of industrial clusters in order to find the weaknesses and advantages of clusters and provide a criterion for achieving the best performance of similar development projects becomes critical. Therefore, this study emphasized the concept of industrial cluster and the performance of industrial clusters at different times was evaluated using the data envelopment analysis method in the industry field.

Jasra, et al. (2012) examined the key factors in the success and efficiency of small and medium firms in Pakistan. The target population of this study included the small and medium firms in different fields from services to production. The sample size included 250 different firms. The results indicated that the access to financial resources was the most significant factor affecting the success of firms' business.

Riahi (2013) identified the critical factors of success in small and medium industries' development project in form of industrial clusters in Iran. In addition, he weighted and ranked the significance of each factor based on experts' opinions by using the hierarchical decision-making process. Jones et al (2013) studied the relationship of different educational methods on the human resources of firms.

Pollack and Adler (2014) tested the hypothesis examining the relationship between the use of project management as well as the efficiency and productivity of small and medium firms. The data collected from the Australian Bureau of Statistics were related to some firms from Australia having less than 500 employees. The study results showed the positive effect of project management in the efficiency of firms. Dragnić (2014) reported the small and medium firms of Croatia, which are rapidly growing. The research findings showed that internal variables such as size, products, and type of market affect the efficiency and performance of firms.

Muhammadi, et al. (2015) identified the factors affecting the competitive power of clusters in the textile industry. The statistical population included 135 managers of active industrial units in the industrial towns of Mazandaran province. Stratified random sampling was used for sampling and the theoretical foundation was based on Porter's competitive model (1990). Poter's model, as a basic and fundamental model in analyzing the competitiveness of an industry, showed the factors included in competition at a certain industrial level. In this study, the researchers added the entrepreneurial organizational culture to the research theoretical foundation in order to identify the factors affecting the competitive power of clusters in the textile industry. The study results indicated that the six factors of Porter's model including the production factor conditions, demand conditions, strategy and competition, relevant supportive industries, role of government, and entrepreneurial culture have a significant effect on increasing competitiveness in manufacturing units of the textile industry.

In another study, Peric and Vitezic (2016) focused on the effect of firm size on firm development. This study was conducted on a large number of active firms in the field of hospitality industry during 2008-2013. The study results confirmed the positive effect of firm size on the growth efficiency and revenue.

Ipinnaiye, et al. (2016) studied the effect of external economy factors and characteristics of SME on their growth and performance. This study investigated the factors affecting the development of firms in Ireland by using the Panel model during 1991-2007.

This study was different from the above-mentioned studies due to the analysis and modeling of the effect of economic and non-economic factors affecting the efficiency of industrial clusters in large and industrial provinces of Iran and the Panel-VAR model.

4. Methodology

The sample in this study included the active industrial clusters in large and industrial provinces of Iran. The present study evaluated the factors affecting the performance of the above-mentioned factors while the statistics of annual profit of clusters during the studied period was used as the performance. Factors affecting the performance of clusters during 2006-2015 were presented in Table 1.

Table 1. Variables

contextual variables	characteristics of SME	characteristics of entrepreneur
access to loan	production rate	work experience
marketing sector	cluster size	
cluster location		
bank facilities interest rate		

"Source of data": www.ispo.ir and amar.org

4.1. Model estimation and result analysis

As mentioned in the previous section, equation 1 is fitted for active industrial clusters in large and industrial provinces during 2006-2015 as follows:

$$P = \alpha_0 + \alpha_1 R + \alpha_2 LA + \alpha_3 Q + \alpha_4 LO + \alpha_5 A + \alpha_6 F + \alpha_7 M \quad (1)$$

In equation 1:
P: Cluster performance (annual profit of industrial cluster)
LA: Industrial cluster size (the total number of employees working in active small and medium firms in the industrial cluster was used for this variable)
R: The facility interest rate granted to the industrial clusters from banks
Q: Cluster production rate (the annual production of industrial clusters for this variable was included)
LO: The closeness of industrial cluster to market (if the cluster is close to the capital of the province, this variable should be considered as 1 but if the cluster is close to the large cities of the province, this variable should be zero).
F: Access to loan (it enters the model as 0 and 1. If the firm succeeds to receive loan during the studied period, it should be considered as 1, otherwise zero).
M: Since having the marketing sector affects the profitability of an industrial cluster, this variable was considered as 1 for the clusters in which small and medium firms have a marketing unit while this variable was considered as zero for other clusters.
A: The work experience of cluster manager (since , the managers of small and medium firms were constant during their activity period in the studied cluster, the years of establishing the industrial cluster was considered in this variable as the work experience of cluster manager.
In this study, the Panel-VAR method was used to estimate the variable coefficients and extract their relationships. The Panel-VAR is as follows:

$$X_{it} = \Gamma(L)X_{it} + U_i + \epsilon_{it} \quad (2)$$

In equation 2, X_{it}represents the dependent variable of vector and $\Gamma(L)$indicates the polynomial matrix from dependent variable lag as $\Gamma(L) = \Gamma_1 L^1 + \Gamma_2 L^2 + \cdots + \Gamma_P L^P$. U_i is considered as the fixed effects vector and ϵ_{it}indicates the error vector . In the Panel-VAR model, the fixed effects estimator is not consistent since the vector of fixed effects with is correlated with dependent variable lags. The orthogonal deviation (Helmert's method) was

used to solve this problem (Zichino & Lau (2006)). In this model, by removing the fixed effects, the model variables is adjusted as $\bar{x}_{it}^{m} = \sum_{s=t+1}^{Ti} \frac{x_{is}^{m}}{T_i - t}$and the dependent variable vector is as $X_{it} = \left(x_{it}^{1}, x_{it}^{2}, \dots, x_{it}^{M}\right)'$where$T_i$ is thelast year of the studied sample . $\bar{\epsilon}_{it}^{m}$ Represents the adjusted variable of ϵ_{it}^{m} and specfiic error vector is as $\epsilon_{it} = \left(\epsilon_{it}^{1}, \epsilon_{it}^{2}, \dots, \epsilon_{it}^{M}\right)'$. Thus, the adjusted variables are as follows:

$$\tilde{x}_{it}^{m} = \delta_{it}(x_{it}^{m} - \bar{x}_{it}^{m}) \text{و} \tilde{\epsilon}_{it}^{m} = \delta_{it}(\epsilon_{it}^{m} - \bar{\epsilon}_{it}^{m}) \quad (3)$$

In equation 3, $\delta_{it} = \sqrt{(T_i - t)/(T_i - t + 1)}$. Finally, after the adjustments, the equation 3 changes in to the following equation.

$$\tilde{X}_{it} = \Gamma(L)\tilde{X}_{it} + \tilde{\epsilon}_{it} \quad (4)$$

In equation 4, $\tilde{\epsilon}_{it} = \left(\tilde{\epsilon}_{it}^{1}, \tilde{\epsilon}_{it}^{2}, \dots, \tilde{\epsilon}_{it}^{M}\right)'$and $\tilde{X}_{it} = \left(\tilde{x}_{it}^{1}, \tilde{x}_{it}^{2}, \dots, \tilde{x}_{it}^{M}\right)'$. Performing such adjustments and using the orthogonal deviation method express each variable as deviation from the average future observations and solves the problem of inconsistency. Thus, applying the adjustments and using the orthogonal deviation method leads to the establishment of consistency variance and removal of consecutive correlation (Arlano and Bor, 1995). On the other hand, the lags of dependent variables can be used as a tool in the Panel-VAR model leading to the increase of model efficiency. One of the reasons for selecting this model was the economic variables are often affected by exogenous variables and their lagged values.

Before fitting the equation 1, the variables reliability was first studied by LLC[1] test. In this test, the null hypothesis is $\rho = 0$expressing that all variables are unstationary. As shown in Table 2, all variables are stationary.

Table 2. The testing results of unit root test

Variable	Statistics	Probability value	Status
LA	8.65	0.0000	stationary at level I(0)
R	2.55	0.001	stationary at level I(0)
Q	2.91	0.005	stationary at level I(0)
P	2.04	0.0000	stationary at level I(0)
A	2.16	0.0000	stationary at level I(0)

Then, the Fischer coitegration test was used for studying the coitegration of variables in the long term. As indicated in Table 3, the model variables are significant at 5% level and the null hypothesis as the lack of coitegration among the variables is rejected. In addition, the coitegration among the variables in the long term is confirmed.

Table 3. The results of Fischer coitegration test

Test statistics	t-statistic	Probability
ADF	-4.124	0.0000

In this section, the effect of exploratory variables in the model on the performance of industrial clusters in large and industrial provinces of Iran is studied. Table 4 indicates the results obtained from estimation.

[1] Levene, Lynn, and Chu (2002)

Table 4. The estimation results of Panel VAR model

Dependent variable	Coefficient	Probability	t-statistics
C	0.388	0.017	2.24
P(-1)	0.645	0.01	-3.65
LA(-1)	0.021	0.002	1.85
LO(-1)	0.059	0.0019	-3.101
R(-1)	-0.015	0.0026	-1.97
Q(-1)	0.32	0.00421	-2.23
F(-1)	0.765	0.0018	-2.45
M(-1)	0.016	0.0019	2.31
A(-1)	0.108	0.002	2.61
R^2=0.82			

As indicated in Table 4, all variables are effective in the performance of industrial clusters during the studied period. The coefficient of facilities interest rate was -0.015 indicating that the more facility interest rate leads to more increase in returning the loan, leading to a reduction in the performance of firms. Therefore, this variable plays a negative effect on the dependent variable. In case of LA variable or industrial cluster size (0.021), the bigger cluster leads to more tendencies toward the banks for granting loans. Thus, financing these clusters is performed more easily with less expensive expenses leading to better performance.

In addition, Q or the production rate of industrial clusters in the selected provinces (0.32) plays a positive effect on their performance. Further, LO or the closeness of industrial cluster to the market (0.059) has a positive effect on the performance of industrial clusters in the selected provinces. As these clusters are closer to the capital of provinces and big cities, they should pay less transportation cost to transport their products to the market. Thus, they can prepare their products and input with less cost and transfer them to the market leading to an increase in the performance of clusters. The access to loan (0.765) could positively influence on the performance of industrial clusters among the selected provinces. As the clusters have easier access to financial resources, they can provide their required equipment and technology more easily and timely affecting their performance. Finally, the variable M or marketing had the coefficient of 0.016 having a positive effect on the performance of industrial clusters among the selected provinces. In fact, the clusters having an appropriate marketing unit in small and medium firms can sell more products with better prices and have more performance. The work experience of cluster managers or A had the coefficient of 0.108 indicating the more work experience of a firm manager has a positive effect on its performance. Among the studied variables in this study, the access to loan had the maximum effect on the performance of industrial clusters. The fitting R^2 is 0.82 indicating the goodness of fit. In the Panel-VAR model, the variance was analyzed after the fitting to determine the share of each shock in the variance of the endogenous variable in the system.

5. Analysis of variance

Analysis of variance measures the share of each shock in the variance of the endogenous variable in the system. The variance was analyzed to measure the share of the variables affecting the performance of industrial clusters among the selected provinces of this study.

Table 5. The analysis of variance for performance

Period	S.E.	P	R	Q	LA	F	M	A	LO
1	0.1194	100	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	0.2945	21.7636	0.0953	13.8827	0.1171	63.8349	0.1162	0.1285	0.0002
3	0.3578	19.6548	0.3297	9.4942	0.1286	70.1565	0.1352	0.2559	0.0137
4	0.3932	18.3485	0.2732	11.8239	0.3047	68.8531	0.3217	0.3651	0.0133
5	0.4313	17.3954	0.3990	9.9452	0.4032	71.4732	0.4514	0.4526	0.02021
6	0.0044	16.9449	0.3720	10.8845	0.6770	70.6734	0.6765	0.6874	0.0209
7	0.0470	16.6940	0.4416	9.9045	0.8814	71.6527	0.8815	0.8927	0.0258
8	0.4821	16.2712	0.4285	10.6306	1.2165	70.9565	1.2612	1.3174	0.02675
9	0.4955	16.3723	0.4940	10.03031	1.5928	71.0250	1.5929	1.5925	0.0291
10	0.5044	15.8594	0.4976	10.9348	2.0919	70.065	2.0919	2.1954	0.03002

Since the prediction error of each year is calculated based on the error of the last year, the prediction always increases during the studied period. The columns of the above table showed the percentage of prediction variance due to different shocks that the total of each row should be equal to 100%. Based on the obtained results, 100% of explanations in performance were conducted in the first period. Explanatory power was reduced during that time reaching to 15.8% in the tenth period. The access to loan in the second period explained 63% of explanations in performance reaching to 70% in the 10^{th} period and having the maximum explanatory rate. Thus, the share of other explanatory variables, especially the access to loan in explaining the performance of industrial clusters in big and industrial provinces of Iran during the studied period significantly increased by changing one period. The variables of production and industrial cluster size were the next rank of explaining the performance in the selected industrial clusters' during the studied period.

6. Conclusion

Industrial clusters have a highly effective role in the economic growth of the country. Thus, identifying the effective factors in the performance of industrial clusters should be highlighted. The present study aims to evaluate the effective factors in the performance of industrial clusters in big and industrial provinces of Iran during 2006-2015. Based on foreign and domestic studies, the variables of access to loan, cluster size, facilities interest rate, production rate, marketing, and closeness to market cluster were among the factors affecting the performance of industrial clusters. Finally, the model fitting in the studied period was examined by the Panel-VAR model. Before fitting the model, the LLC unit root test and Fischer coitegration test were used.

The results of model fitting and analysis of variance indicated that the access to loan had the maximum effect on the performance of clusters in the above-mentioned provinces during the studied period. The positive coefficient of this variable showed that the easier access to loan increases the performance of clusters. In addition, production rate, cluster size, marketing sector in cluster, and closeness of cluster to market had a positive effect on the performance of industrial clusters. As the industrial clusters are closer to sale markets and capitals of provinces, the products can be sold more easily leading to better performance. Based on the fitting results, the facilities interest rate had a negative effect on the performance of firms. Therefore the high bank facilities rate imposed a high cost to banks leaving a negative effect on their performance. Further, the work experience of managers as the characteristics of entrepreneur had a positive effect on the performance of industrial clusters during the studied period.

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