Journal of Economic and Social Research Vol. 19, Issue.1, 2020, 44-54

A SURVEY OF THE EFFECTIVE FACTORS ON THE DEVELOPMENT OF THE INDUSTRIAL SECTOR IN THE ECONOMY OF THE ISLAMIC REPUBLIC OF IRAN

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Abstract. In the present study, the effects of commercial liberalization, financial development and research costs on value added of industry sector, along with other influential variables, were tested in Iran between 1973 and 2014. To test the research hypotheses, the human capital model ofLucas's endogenous growth (1988) and Autoregressive-Distributed Lag (ARDL model) are used. Also, the MICROFIT 5.5 software has been used. according to long-term results, physical capital and skilled human resources have the most positive effect on industry value added, and average tariff rates on imports and non-oil exports are substitutes for trade liberalization policy, and have a significant negative and positive effect on industry value added respectively. The volume of liquidity and domestic credit to the private sector, which has been a substitute to the development of financial markets, has had a significant positive and negative effect on the value added of the industry, respectively. Also, the research cost has been positively associated with the growth of value added in the industry. There is a positive relationship between oil and gas export revenue and industry value added in the short run but there is no significant relationship in the long run.

Keywords: Value Added of industry, Industrial Growth, Autoregressive-Distributed Lag, Commercial Liberalization, Financial Markets, Research Costs, Human Capital Model of Lucas Endogenous Growth

INTRODUCTION

During the 1970 decade, some of developing countries have made extensive efforts to liberalize their economies via reforms aimed at increasing the role of the market and reducing the barriers to international trade and capital transfers. In the 1980s, the successful experience of several Southeast Asian countries, such as Korea, Taiwan, and Singapore, besides arousing the interest of scholars and international economists and development economists in reform, has also led policymakers and economic practitioners in other countries to follow them. Trade liberalization was regarded as one of the key elements of economic liberalization, and with the WTO's activation and accession of more countries, various countries, especially developing countries, performed a general shift towards trade liberalization. In recent years, one of the main discussions of development economists has been to explain the relationship between trade liberalization and economic growth in developing countries. On the other hand, financial markets are considered because of their crucial role in gathering resources via the large and small savings in the national economy, optimizing the flow of financial resources and directing them to the investment needs of the productive economic sectors. The positive effects of the securities market on economic development, including increased investment incentives through risk reduction, risk pricing, and facilitating liquidity risk, gathering deposits etc. are so sensitive that some economists believe that the difference of developed and underdeveloped economies is not in the developed countries' advanced technology but it is in theactive integrated financial markets. As we can see, the underdeveloped countries lack such markets. These studies show that the level of development of financial markets, especially the stock market, and the impact they have on corporate financing and the choice of corporate financing methods, ultimately have a significant influence on economic growth. The advanced financial markets such as the financial markets of advanced industrialized countries control a significant amount of the financial capital of the respective economy. These markets have the incentive to save and convert savings into investment with the aim of capital formation and hence play an important role in facilitating economic growth (Khatai et al., 1999).

The innovations of this study can be introduced in the following areas: Although various studies have been conducted on the role of trade liberalization development and the development of financial markets on economic growth at macro level, such studies are more limited at a micro level. In the present study, it is attempted to investigate the effects of trade

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ISSN: 1302-1060
www.jesr.org

liberalization policies, financial development and research costs on the value added of the industrial sector in Iran simultaneously and determine the position of these policies on the Iranian economy. Also, the present study evaluates the validity of the Lucas model in the Iranian economy. In this study, instead of applying cost function method with standard regression methodology in production function studies we use Autoregressive-Distributed Lag (ARDL) and Error Correction Method (ECM) analysis.

REVIEW OF THE LITERATURE

Various theories have been proposed by economists on the relationship between financial development, trade liberalization and industrial growth. Reza Mohseni and SaeedGholamiNajat Amir (2005), in a study "Trade Liberalization and Industrial Growth in Iran" conclude that with the adoption of trade liberalization policy, industrial growth is increased. Elias Naderan (2004), in his study on the effect of credit policies on the value added of Iran's industrial sector, concluded a positive, strong and sustained relationship between bank credit and industrial value added.

KiomarsShahbazi and ElhamKarimzadeh (2014) in the study “the effect of monetary and fiscal policies on the added value of industry in Iran” showed that monetary policies have a negative effect on the added value of industry and a positive effect on financial policy. Gold Smith (1969) was the first to point out a positive relationship between financial development and economic growth in an empirical study, based on empirical evidence. In traditional models of growth, Solow (1956) states that financial development is also enhanced by increasing physical capital accumulation level as well as by increasing the efficiency of capital on the level of real production but do not affect economic growth in the long run. Goldsmith (1969) , Shaw (1973)and McKinnon (1973) emphasize the existence of a positive correlation between financial development and economic growth, and Townsend (1979), Diamond (1984), and Boydupskat (1968) emphasize the impact of financial development on economic growth. Pagano (1993) by using endogenous growth models, states that financial development through increasing savings rates increases investment rates and ultimately increases economic growth. In Demetrias's (1996) study the causality test between financial development and real GDP has been conductedusing the cointegration technique, the findings of which provide little support for this view. Levin (1992) examined the effects of different structures on economic growth and found that the expansion of banks, stock markets and investment banks enhances economic growth through increased investment allocation efficiency. Saint Paul (1992) developed a model in which the development of financial markets promotes the economic growth via affecting the technological choices. On tradeliberalization, Fleiztekin (2000) investigated the effects of economic liberalization on Turkish factory industries. Turkey's economy has shifted from import substitution industrialization to an extrovert strategy that accounts for at least half of its value-added growth. Meanwhile, industries have experienced high growth rates in business shares and productivity growth. Imports leadto productivity growth while productivity growth isGranger’s causal factor of export. Farjadi and Lali (1997) have studied the effect of export and import variables including intermediate, capital and consumer imports on economic growth based on the production function paradigm for the period 1961 to 1994. The results show that there is a strong positive relationship between export and import growth rate and economic growth rate. . Shoraka and Safari (1998) studied the relationship between economic growth and export during 159 to 1993in agriculture, industry and services using the Granger causality test and the Feder model. The results of this study show that non-oil exports in Iran have positive effect on economic growth and this effect in industry is more than other sectors. Motevaseli(1998) tested the effect of export (total) on GDP using Granger causality test during 1959-1995. Seyyed Reza Azimi (2000) investigated the effect of non-oil export on economic growth using the production function model.The results of this study do not verify the effects of non-oil exports on GDP growth without oil in Iran according to the statistic data of 1967-1997.

AUTOREGRESSIVE-DISTRIBUTED LAG (ARDL)

The use of traditional econometric methods for empirical studies is based on the assumption of variable reliability. But studies in this area show that in many time series, this assumption is wrong and most of these variables are non-stationary. This may lead to spurious regression and loss of reliability in the estimated coefficients. Therefore, according to the cointegration theory in modern econometrics, it is necessary to use methods in estimation when using time series to pay attention to the issue of reliability and cointegration. The *Johansen* and *Juselius'*smethod has some problems. One is that there are no specific assumptions about economic theories and in fact it is simply the role of the data leads to obtaining the vectors. Although the *Johansen* and *Juselius'*smethod has an intrinsic mechanism for finding even up to n-1 convergence vectors, if this method reaches someconvergence vectors, there is no consensus about how one should choose from the resulting vectors to explain a long-term behavioral relationship.

Some researchers choose the economically significant vector (the sign of coefficient is expected) with reasonable coefficients as convergent vector and perform their analysis accordingly. On the other hand, the Engel-Granger method in small samples provides a biased due to not considering the short-term dynamic reactions between variables. Banerjee (1993) and Inder (1993) using the Monte Carlo simulation method have shown that in small samples the bias estimation may be significant. Therefore, it seems reasonable to employ a model that incorporates short-term dynamics and useAutoregressive-Distributed Lag (ARDL) models in this regard.

An Autoregressive-Distributed Lag (ARDL) model has a relationship such as the following:

$$ARDL(p, q_1, q_2, ...q_k)$$

$$Q(L, p)Y_t = \sum_{i=1}^{k} \beta_i (L, q_i) X_{it} + \delta w_t + u_t \quad (1)$$

Where

$$Q(L, p) = 1 - Q_1 L - Q_2 L^2 - ..... - Q_p L^p \quad (2)$$

$$\beta_i (L, q_i) = 1 - \beta_{i1} L - \beta_{i2} L^2 - ....\beta_{iq} L^{qi} \quad (3)$$

L is thelag operator, w_1 is a vector of crisp (non-random) variables such as intercept, trend variable, dummy variables, or exogenous variables, with constantlags, P is the number of lags used for the dependent variable and q_1 is the number of lags used Indicates for independent variables.

Another advantage of the Autoregressive-Distributed Lag(ARDL) method is that, regardless of whether the explanatory variables are I (0) or I (I), this method can be used, in other words, we don't need to classify the variables into I (0) or I (I) in such a way existing instandard convergence analysis (especially Johannes-Joselius convergence).

The Autoregressive-Distributed Lag (ARDL)method consists of two steps. In the first step, the existence of the long-term relationship between the variables is tested, so that the sum of the estimated coefficients is dedicated to the dependent variable lags less than one and this requires that the dynamic model tends to the long-run equilibrium. Therefore, for the convergence test, it is necessary to perform the following hypothesis.

(4)

$$H_0 : \sum_{i=1}^{p} a_i - 1 \geq 0$$

$$H_1 : \sum_{i=1}^{p} a_i - 1 < 0$$

The quantity of t statistic to perform the above test is calculated by Equation (4):

$$\frac{\sum_{i=1}^{p} \hat{a}_i - 1}{\sum_{i=1}^{p} s\hat{a}_i} \quad (5)$$

If the absolute value of the critical quantity presented by Banerjee 1, J.J. Dolado&R.Master (1992) is less than the absolute value of the above quantitative t-statistic, the H0 is rejected, and we conclude that there is a long-run equilibrium relationship between the model variables.

In the second stage, estimating and analyzing long-term coefficients and deducing their value is done. Long-term coefficients of the explanatory variables are calculated based on the following Equation:

(6)

$$\hat{\theta}_i = \frac{\hat{\beta}_{i0} + \hat{\beta}_{i1} + \hat{\beta}_{i2} + ... + \hat{\beta}_{iq}}{1 - \hat{a}_1 - \hat{a}_2 - ..... - \hat{a}_p}$$

Where p,qfor i = 1,2,3, …… .. kselected values of p,q are based on one of the lag criteria.

One of the important items about ARDL model is to determine the optimal lags. The optimal lags for each of the explanatory variables can be determined by one of the*Akaike* Information Criterion (AIC), Schwarz-Bayesian AIC (SBC), *Hannan*-Quin (GQC) or $\overline{R}^2$.

PROVIDING A MODEL FOR THE GROWTH OF THE INDUSTRY

In endogenous growth models, instead of considering human capital as a production factor, it is considered as an effective variable on the technology parameter. For this purpose, Lucas model for industrial production function for Iran is considered as follows. Therefore, model (7) extends Lucas's (1988) model by adding the TL variable. In this section, we examine the relationship between the desired variables and the rate of growth of industrial production using Autoregressive-Distributed Lag (ARDL) method. In this study, the method of extraction and generalization of TL variable is not considered. Based on empirical evidence and its test in Iranian economy, this variable is generalized to Lucas model.

Y=f (A, K, L, H, TL) (7)

Where, Y is industrial value added and K, L, H, TL are capital input, Labor force, human capital and other variables added to the model, respectively. Index A is the total productivity factor. Exports of non-oil goods and the average tariff rate are the criteria for trade liberalization. According to these studies, trade liberalization policies by removing import barriers will increase imports and increase competition among domestic enterprises and the efforts of domestic enterprises to maintain their market share cause that the enterprises with less efficiency are removed and thetotal productivity of the remaining enterprises is increased. The relative price of capital goods in developed countries is cheaper than in developing countries, so developing countries can provide industrial growth by importing cheaper capital and intermediate goods from developed countries, and also by Import liberalization,it is expected that technology transfer into the country will be achieved through the capital investments import with advanced technology. In the Encyclopedia of Monetary and Banking Concepts (Khalatbari, 1992), financial development is equal to deepening financial assets.

The variables of the volume of liquidity and internal credits to the private sector are financial development measures. Financial development has is effective on industry growth through easier financing for firms in order to increase investment and increase productivity, as well as providing the necessary credits to buy machineries and replace labor. Lucas's (1988) andVautwani and Balanova's (1990) effective labor criterion is used to evaluate the quality of human resources HUMCUP, which emphasizes higher education and the effectiveness of government spending on human resources. That is, in growth models, government policies that can influence the motivation for investing in human capital can affect the economic growth rate. Government spending on education and public health are two policy variables that affect growth, assuming that a well-trained and educated workforce is both more efficient, with high learning power, and is faster adapting to technological changes. Consequently, the explicated model for industrial production in the Iranian economy is:

AVI=f(K ,HUMCUP,OILEXPO,TARIFF,M1,M2,EXPORT,DR,DUM) (8)

The industrial production function is expressed in the form of linear logarithm (with the error term u_t) because we use linear regression coefficients directly as their elasticities. The function at logarithmicstate [2]is as follows.

$$LAVIt=\alpha_0+ \alpha_1LK+ \alpha_2HUMCUP+ \alpha_3LOILEXPO+ \alpha_4LTARIFF+ \alpha_5LM1+ \alpha_6LM2+ \alpha_7LEXPORT+ \alpha_8LDR+ \alpha_9DUM+u_t \quad (9)$$

Theoretical expectations show that the elasticity parameters are >0) $\alpha_1,\alpha_2,\alpha_3,\alpha_5,\alpha_7+,\alpha_8$ (and $(\alpha_4,\alpha_6,\alpha_9)<0$. For the analysis of short-term dynamics, the error correction model (ECM) form of the industrial production function is used as follows.

$$\text{LAVI}_t = \beta_0 + \sum_{i=0}^{n} \beta_{1i}\, LK_{t-1} + \sum_{i=0}^{n} \beta_{2i}\, HUMCUP_{t-1} + \sum_{i=0}^{n} \beta_{3i}\, \text{LOILEXPO}_{t-1} + \sum_{i=0}^{n} \beta_{4i}\, \text{LTARIFF}_{t-1} + \sum_{i=0}^{n} \beta_{5i}\, LM1_{t-1} + \sum_{i=0}^{n} \beta_{6i}\, LM2_{t-1} + \sum_{i=0}^{n} \beta_{7i}\, \text{LEXPORT}_{t-1} + \sum_{i=0}^{n} \beta_{8i}\, \text{LDR}_{t-1} + \sum_{i=0}^{n} \beta_{9i}\, \text{DUM}_{t-1} + \sum_{i=0}^{n} \beta_{10i}\, \text{EC}_{t-1} + \varepsilon_t \quad (10)$$

Where $\text{EC}_{t-1}$is an error correctionterm and $\varepsilon_t$is residualterm which is white noise

Because of the large number of explanatory variables (eight independent variables) and the low number of observations relative to the number of variables, using Johansen's method and ARDL model don't give good results, so the ARDL method andMicrofit software are used.

The stages are as, in the first step by unit root test, the degree of cointegration of existence or non-existence, F of each of the model variablesis determined. Then, the long run relationship between the variables is tested and the long run coefficients are calculated. In the next step, by examining the short-term relationship between variables, the ARDL error correction model is estimated and the speed of adjustment is obtained in each period in order to establish a long-run relationship. Finally, to ensure consistency of the model coefficients over time, CUSUMSQ and CUSUM stability tests are performed.

[2] One of the advantages of using the model at logarithmic state is the reduction of heteroskedasticity variance.

INTRODUCE MODEL VARIABLES

The statistical information applied in the model estimation for the time period (1973-2014) is as follows:

1-VAI: Industry value added at fixed prices in 1997 in Billion Rials, Source: Iran Statistics Center

2-K: Inventory of physical capital in the Mining and Industry at fixed prices in 1997 in Billion Rials, Source: economic accounts of Central Bank Office.

3-HUMCUP: Human capital (Thousands of active and working population with higher education as thousands people, Source: Iran Statistics Center).

4-OILEXPO: Oil and gas exports (Million $) .Source: Economic accounts of Central Bank office.

5-Tariff: Average import tariff rate (calculated by dividing import tax on total imports (Rials)), Source: calculation.

6-M1: Cash volume (Thousand billionRials), Source: Central Bank of Iran

7-M2: Private sector credits (% of GDP), Source: World Bank

8-Export: The export of non - oilgoods at fixedprices in 1997 in Billion Rials, Source: Central Bank of Iran.

9-DR: Research Cost (The research budget ratio to GNP) in Billion Rials, Source: Program and Budget Organization

10-DUM: The dummy variable that equals one for the revolution years and the imposed war and zerofor the rest of years.

UNIT ROOTTEST (RELIABILITY EVALUATION)

Before estimating the model, the stationarity test for the variables must be performed to ensure that none of them are second order, I (2), and thus ,spurious results are avoided, because when the I (2) variables in the model, calculated F statistics, are not reliable. The F test is based on the assumption that all the variables in the model are I (0) I or (1). Therefore, it is necessary to perform unit root test in the ARDL model to determine none of the variables are rank one or more (Azarbayjan et al., 2009).

There are various methods for performing a unit root test, by which the stationarity of variables isinvestigated. Among the numerous tests to evaluate the reliability of the variables, the Adjusted Dickey-Fuller test (ADF) is given below:

$$\gamma_t = \alpha + \beta_t + \rho\gamma_{t-1} + \sum_{i=1}^{\rho} \theta_i \Delta\gamma_{t-1} + \varepsilon_t \qquad (11)$$

The number of appropriate dependent variable lags in this test for the good behavior of the disturbanceterms of regression, can be obtained using the *Akaike* Information Criterion (AIC), Schwarz-Bayesian AIC (SBC), *Hannan*-Quin (GQC). In the Micro fit4.0 software, the maximum of each of the above criteria determines the optimal lags. SBC usually saves the number of lags and in this study the optimal number of lags is selected based on SBC.

The results of the variables reliability test by the Adjusted Dickey-Fowler method are presented in (Table 1) with respect to the states of the intercept and the absence of the trend as well as the intercept and trend. By comparing the test statistic and presentation value at the significancelevel, it is observed that in all variables except LDR, absolute value of the Adjusted Dickey-Fuller test statistic is lower than absolute value of critical value. Therefore, the null hypothesis regarding the presence of unit root is not rejected and we concluded that the time series of each of the variables except LDR is non-stationary.

Table 1. The reliability of the model variables at the surface state based on the ADF test

Test result	With intercept and trend			With intercept and without trend			Variable
	Critical value	ADF statistics	Number of optimal lags	Critical value	ADF statistics	Number of optimal lags	
Non-stationary	53.-3	-2/44	3	-2.94	-0.74	3	LVAI
Non-stationary	53.-3	84.-1	0	-2.94	-1.55	0	LK
Non-stationary	53.-3	60.-2	2	-2.94	-0.74	3	LHUMCAP
Non-stationary	53.-3	-2.45	0	-2.94	-2.07	0	LOILEXPO
Non-stationary	53.-3	-2.33	0	-2.94	-1.73	0	LTARIFF
Non-stationary	53.-3	-1.59	1	-2.94	0.17	3	LM1
Non-stationary	53.-3	-1.81	3	-2.94	-1.59	3	LM2
Non-stationary	53.-3	-2.36	1	-2.94	-0.35	1	LEXPORT
Stationary	53.-3	-3.83	0	-2.94	-3.57	0	LDR

Source: Research results

Given that Iran's economy has been affected by developments such as revolution and war, and there are structural changes in time series, we should use the tests regarding the structural break down in time series such as the Peron test.

Peron argues that the unit root test and the non-stationarity found in most macroeconomic time series may be due to the lack of attention to major structural breakdowns in the trend of these variables. To identify the main nature of the model variables, the effects of structural changes on the series are evaluated by adding the dummy variables to the ADF model and test the final state of the model variables.
(Table 2) shows the results of the Peron test for model variables. By comparing the Peron statistic and the critical value of the test statistic at the significance level of 5%, all variables except LDR have unit root and are non-stationary. The results of adjusted Dickey-Fowler test are also confirmed by Peron.

Table 2. Reliability of model variables atsurface state based on Philips-Peron test

Test result	With intercept and trend		With intercept and without trend		Variable
	Critical value at the level 5%	ADF statistics	Critical value at the level 5%	ADF statistics	
Non-stationary	-3.55	-2.44	-2.95	-1.36	LVAI
Non-stationary	-3.55	-2.30	-2.95	-1.91	LK
Non-stationary	-3.55	-2.74	-2.95	-1.50	LHUMCAP
Non-stationary	-3.55	-2.20	-2.95	-1.77	LOILEXPO
Non-stationary	-3.55	-2.17	-2.95	-1.93	LTARIFF
Non-stationary	-3.55	-1.75	-2.95	-0.25	LM1
Non-stationary	-3.55	-1.78	-2.95	-1.48	LM2
Non-stationary	-3.55	-1.95	-2.95	-0.12	LEXPORT
Stationary	-3.55	-4.09	-2.95	-3.77	LDR

Source: Research results

INVESTIGATION OF TIME SERIES COINTEGRATION OF VARIABLES
After determining the reliability and non-stationarity of the variables, we examine the rank of time series, to do this, we should determine the number of first differentiation frequencies making the series stationary.

Table 3. The reliability of the first difference of model variables by test

Test result	With intercept and trend			With intercept and without trend			Variable
	Critical value	ADF statistics	Number of optimal lags	Critical value	ADF statistics	Number of optimal lags	
Stationary	-3.55	-5.23	0	-2.94	-5.29	0	dLVAI
Stationary	-3.55	-3.81	0	-2.94	-3.87	0	dLK
Stationary	-3.55	-6.48	0	-2.94	-6.53	0	dLHUMCAP
Stationary	-3.55	-5.99	0	-2.94	-6.06	0	dLOILEXPO
Stationary	-3.55	-6.46	0	-2.94	-6.37	0	dLTARIFF
Stationary	-3.55	-6.69	0	-2.94	-6.74	0	dLM1
Stationary	-3.55	-5.60	0	-2.94	-5.59	0	dLM2
Stationary	-3.55	-4.39	0	-2.94	-4.39	0	dLEXPORT
Stationary	-3.55	-9.98	0	-2.94	-9.06	0	dLDR

Source: Research Results
According to the results of (Table 3), it is concluded that the research cost variables of LDR are I (0) and the rest is I (1). Since none of the variables are of the second order, I (2), so the ARDL method is used to examine the relationships between the variables.

ESTIMATION OF ARDL MODEL AND ECM ERROR CORRECTION MODEL
The model estimation results are presented in three sections: dynamic or short-run relationships, long-run relationship and error correction model (ECM).
Examine the dynamic or short-term relationships of the model: At this stage, using the microfit software, the maximum lag was 2. Then, using the Bayesian-Schwarz criterion, the optimal lag was determined by whichindustrial value added, human capital, oil and gas exports, liquidity, non-oil exports, zero research costs, human capital, import tariffs, and domestic credit to a private sector are obtained and the model was estimated as ARDL (2,0,0,1,2,0,2,0,0,2) and the results of its short-run coefficients are presented in (Table 4).

Table 4. Results of estimating the short-term coefficients of model ARDL (2,0,0,1,2,0.2,0,0,2)

Variable	Coefficients	T statistics	Confidence interval (90%)
LVAI (-1)	0.28	0.08	3.3513 [0.003]
LVAI (-2)	-0.11	0.07	-1.6308 [0.118]
LK	0.30	0.05	5.8483 [0.000]
LHUMCAP	0.20	0.09	2.2372 [0.036]
LOILEXPO	0.06	0.02	3.2159 [0.004]
LOILEXPO (-1)	-0.04	0.02	-1.9276 [0.068]
LTARIFF	0.03	0.03	1.3161 [0.202]
LTARIFF (-1)	-0.04	0.03	-1.4295 [0.168]
LTARIFF (-2)	-0.06	0.02	-2.4705 [0.022]
LM1	0.05	0.03	2.0631 [0.052]
LM2	-0.01	0.05	-0.23990].813 [
LM2 (-1)	0.16	0.07	2.4039 [0.026]
LM2 (-2)	-0.26	0.06	-4.6220[0.000]
LEXPORT	0.09	0.03	3.5971 [0.002]
LDR	0.02	0.01	2.6114 [0.016]
DUM	0.12	0.03	4.0758 [0.001]
DUM (-1)	-0.13	0.03	-4.3398 [0.000]
DUM (-2)	0.14	0.03	4.5256 [0.000]
C	2.78	0.56	4.9566 [0.000]

Source: Research Results

By specifying the model variables, the model estimation result by ARDL is as follows:

$$\mathrm{LVAI_t} = 2.78 + .28\mathrm{LVAI_{t-1}} + 0.30LK_t + 0.20\mathrm{LHUMCAP}_t + 0.06\mathrm{LOILEXPO}_t - 0.06\mathrm{LTARIFF}_{t-2} + 0.05LM1_t + 0.16LM2_{t-1} + 0.09\mathrm{LEXPORT}_t + 0.02LDR_t - 0.13\mathrm{DUM}_{t-1} \quad (12)$$

According to the results of the table, the estimated coefficients are consistent with theoretical foundations and all of them are statistically significant at the level 95%. Since the model is logarithmically stated, the obtained coefficients show the short-run elasticity of value added of the industrial sector relative to each of the effective factors on it. The added value of the industry in the short run is affected by a value added with one lag.

Physical capital and human capital growth have a strong positive and significant effect on the growth of value added of the industrial sector, which plays a role in the endogenous model. This strong effect is as one percent increase in physical capital, human capital, increases the added value of the industrial sector by 0.30and 0.20 percent, respectively.

One percent increase in oil and gas export earnings results in a 0.06 percent increase in the value added of the industrial sector.

One percent decrease in import tariff rate with two lagsincreases the industrial value added as 0.09%. In other words, decrease in tariff rate after two lags affects the value added of the industry sector and increases it.

1% increase in liquidity at the level 1%, increases value added of industry by 0.05%. One percent increase in domestic credit to the private sector with one lag increases the value added of the industry by 0.16 percent.

One percent increase in non-oil exports and research costs increases the value added of the industry by 0.09 percent and 0.02 percent, respectively. The revolution and the imposed war had a negative impact on industry value added.

Results of diagnostic tests: Tests for classical standard assumptions to ensure the estimation efficiency of the equations are also presented in (Table 5). These results show that the model has no classical assumption problem, meaning that the null hypothesis cannot be rejected and there is no serial auto-correlation between the disturbance terms and variance heteroskedasticity, the functional form of the model is explicated welland the normal component distribution denotes theaccuracy of the results of estimated model. The coefficient of determination of the model is 90%, which indicates the high explanatory power of the model.

Table 5. The diagnostic tests of dynamic model (ARDL) (2,0,0,1,2,0,2,0,0,2)

Model information		
R^2=0.90	f=1701.1 [0.000]	dw=2.14
A:Serial Correlation	F= 1.156 [0.696]	
B:Functional Form	F=0.617 [0.441]	
C:Normality	Not applicable	
D:Heteroscedasticity	F= 1.4010 [0.244]	

Source: Research Results

Examine the long-term relation of the model: Before estimating the ARDL dynamic model, we test the long-run relationship between the variables. If the sum of the coefficients of the variables with lag for the dependent variable is less than one, the dynamic pattern will tend to be long-run equilibrium. The hypothesis test is as follows.

(13)

$$H_0 : \sum_{i=1}^{p} \alpha_i - 1 \geq 0$$

$$H_1 : \sum_{i=1}^{p} \alpha_i - 1 < 0$$

(14)

$$t = \frac{\sum_{i=1}^{p} \hat{\alpha}_i - 1}{\sum_{i=1}^{p} s\hat{\alpha}_i} = \frac{0/38 - 1}{0/152} = -4.07$$

According to Equation (13), the statistic required for the test is calculated as follows:
Although the absolute value t obtained is bigger than the absolute value of the critical values provided by Banerjee. Dolado and Masters (-3.47), the null hypothesis that "there is no long-term relationship" is rejected. The result is that there is a long-term relationship between the explanatory variables and the dependent variables. Hence, the long-run model is estimated using the ARDL method, which is shown in (Table 6).

Table 6. Estimation of long-term model of ARDL

Variable	Coefficients	SD	[Prob]T statistics
LK	0.36	0.07	5.1873 [0.000]
LHUMCAP	0.24	0.10	2.4067 [0.025]
LOILEXPO	0.02	0.03	.69992 [0.492]0
LTARIFF	-0.07	0.02	-3.1198 [0.005]
LM1	0.06	0.03	2.1061 [0.047]
LM2	-0.13	0.06	-2.3230 [0.030]
LEXPORT	0.11	0.03	3.3097 [0.003]
LDR	0.03	0.01	2.6769 [0.014]
DUM	0.16-	0.04	3.7718 [0.001]-
C	3.32	0.50	6.6350 [0.000]

Source: Research results

Based on the above results, the long-run relationship between industry value added and selected variables is as follows:

$$\mathrm{LVAI_t} = 3.5 + 0.36LK_t + 0.24\mathrm{LHUMCAP}_t - 0.02\mathrm{LOILEXPO}_t - 0.07\mathrm{LTARIFF}_t - 0.06LM1_t + 0.13LM2_t + 0.11\mathrm{LEXPORT}_t + 0.03LDR_t + 0.16\mathrm{DUM}_t \quad (15)$$

The results of the long-term estimation presented in (Table 4) and (Table 5) show that the coefficient of physical investment in the industrial sector was 0.36% and was statistically significant, which means that a 1% increase in physical capital added value increases the industry value added by 0.36 percent.,The coefficient of human capital (active and highly educated population) was 0.24% and significant. This means that a 1% increase in human capital will increase the value added of the industry by 0.24%. The coefficient of revenues from oil and gas exports is 0.02% but is not significant. The average rate of tariffs and exports of non-oil goods as alternative variables of liberalization policies in the long run have significant, negative and positive effect on the value added of the industrial sector, respectively. Increasing the tariff rate by 1% reduces the value added of the industry by 0.07% and by increasing 1% non-oil exports; the industry value added is increased by 0.11%. The liquidity and domestic credit on the private sector as alternative variablesof monetary and financial markets in the long run has a significant positive and negative effect on the value added of the industry, respectively. With a 1% increase in the volume of liquidity, industry value added increased by 0.06% and with a 1% increase in domestic credit to the private sector, industry added value decreased by 0.13%. The research cost coefficient is 0.03% and it is significant. With the 1% increase in the cost of research, the industry value added increases by 0.03%. The dummy variable of revolution and war had a negative and significant effect on the growth of value added in the industrial sector. The Islamic Revolution with the war and shock inflicted on the country's economy have led to some changes such as the withdrawal of capital from the country and increased investment risk, reduced production and destruction of

economic infrastructures ,etc. These factors had a negative and significant impact on the value added growth of the industry sector.

Error Correction Model (ECM): The Cointegration between a set of economic variables provides the statistical basis for using error correction models. The main reason for the popularity of the error correction model is that connects the short-run volatilitiesof the variables with their long-run equilibrium values (Tashkini 2005). As in the above regressions, the long-term relationship was proved, we investigate the error correction model of regressions. In this research, the Autoregressive-Distributed Lag (ARDL) model is used to obtain long-run relationships, the error correction model is estimated by the ARDL model. In micro fit 4.0 software, if the long-run equilibrium modelof ARDL was extracted, the corresponding error correction model was also presented. The results of the error-correction model estimation are presented in (Table 7).

In the error correction model, the coefficients of all variables in the short run are statistically significant at the level 0.95%. The important point in the error correction model is the error correction coefficientecm (-1), which indicates the adjustment speed of non-equilibrium process. As can be seen, this coefficient is significant and has a negative sign and confirms the cointegration between the variables. This coefficient is equal to -0.84%, which means that about 84% of the deviations (non-equilibrium) of the value added of the industrial sector are removed from its long-run equilibrium values after a period. It can be said that the adjustment speed in the selected model is relatively high and desirable.

Table 7. Short-term error correction model for ARDL method

Variable	Coefficient	SD	T-Statistics [Prob]
dLVAI1	0.11	0.07	1.6308 [0.115]
dLK	0.30	0.05	5.8483 [0.000]
dLHUMCAP	0.20	0.09	2.2372 [0.034]
dLOILEXPO	0.06	0.02	3.2159 [0.004]
dLTARIFF	0.03	0.03	1.3161 [0.200]
dLTARIFF1	0.06	0.02	2.4705 [0.021]
dLM1	0.05-	0.03	2.0631 [0.050]-
dLM2	-0.01	0.05	-.23990 [0.812]
dLM21	0.26	0.06	4.6220 [0.000]
dLEXPORT	0.09	0.03	3.5971 [0.001]
dLDR	0.02	0.01	2.6114 [0.015]
dDUM	0.12	0.03	4.0758 [0.000]
dDUM	-0.14	0.03	-4.5256 [0.000]
Ecm (-1)	-0.84	0.08	-10.0746 [0.000]

Source: Research results

THE STABILITY TEST

After making sure that the explicated model has no problem in terms of the underlying assumptions of regression, we evaluate the stability test. CUSUM and cusumsq tests were used to investigate the presence or absence of structural break down in the estimated model residuals. (Chart 1) and (Chart 2) show the stability test for ARDL residual estimation. As can be seen, as the obtained statistical charts are between the upper and lower bound and the statistical value is not out of the critical range, it can be claimed that the residuals of the estimated model are stable and the coefficient stability hypothesis significant at the level 5% cannot be rejected. Therefore, the model is stable for long-term analysis and the results of the research are valid.

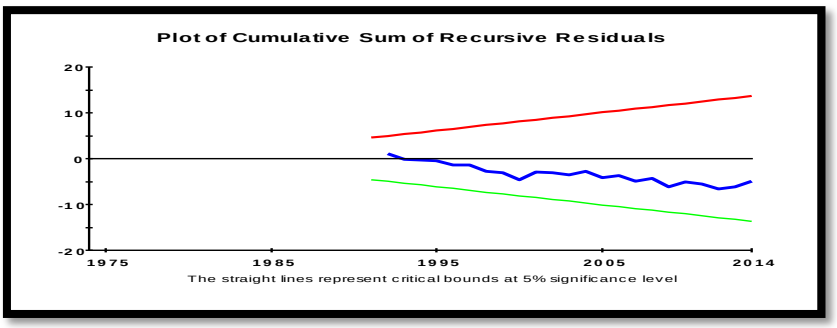

Chart 1. Cumulative Sum of Recursive Residuals (CUSUM)
Source: microfit software output

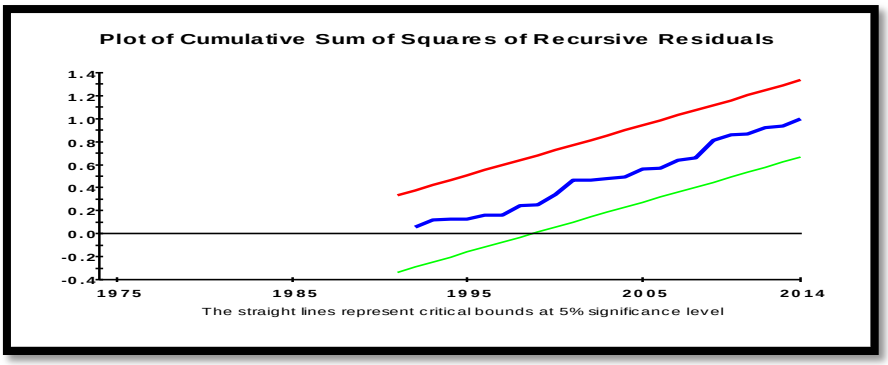

Chart 2. Cumulative Sum of Squares of Recursive Residuals (CUSUMSQ)
Source: microfit software output

CONCLUSION OF THE RESEARCH MODEL

The most important results of this research model are as follows:
The industry value added coefficient (LVA (-1)) with a lag in the short term pattern is equal to 0.28 which is smaller than one and indicates that the short term model will converge to the long term model and it can be claimed that estimating the coefficients in the ARDL model is unbiased. The variables of physical capital and human capital in the short and long run have a significant positive effect on the added value of the industry whose effects in the long run are stronger than the short run. The coefficient of variable of oil and gas export value in the short run had a positive and significant effect on the added value of industry but in the long run, no significant relationship was found between the two variables. The average rates of tariffs and exports of non-oil goods are considered as alternative variables to trade liberalization policies that in the long run have a significant, negative and positive effect on the value added of the industry, respectively. Trade liberalization, when exposing the domestic enterprisesto competition, enhances their discipline and increases the efficiency of all firms, thereby increasing their productivity and increasing their exports, thus increasing industrial growth. By increasing the liberalization of imports, it is expected that by import of capital goods with advanced technology, the technology transfer to Iran is performed. Volume of liquidity and domestic credit to the private sector are considered as alternative variables to financial development. The short-term and long-term liquidity volumes have a significant effect on the value added of the industry. In the short run, domestic credit to the private sector has a positive effect and in the long run has a significant negative effect on the value added of the industry. The negative effect is due to the state-owned banks in Iran and the government's involvement in the credits presentation to the economically inefficient companies and institutions. The banking loans pursue a set of different goals, and the economic considerations are not on priority. As a result of the increasing trend of loans, one cannot expect to make optimal use of the country's financial and economic resources and thus promote the growth of the country's industrial sector. Research costs in the short and long run have a significant positive effect on the value added of the industry. But the low research cost can be attributed to the very low cost of research to the GNP, which may be due to various reasons. For example, investments in research and development (R&D) activities in the industrial sector are small and insignificant, and can not lead to technological change and dynamics in the industrial sector of the country. Also, due to the lack of research workforce in Iran's industrial sector relative to the world level and the lack of links between scientific and research centers in Iran and abroad, the industry sector as an infrastructural sector has failed to establish coherent and continuous research centers to organize the research sector. Significance of ecm (-1) with -0.83 indicates that the long-run model explication principle is correct and all equilibrium relationships explained are from the explanatory variables tovariable dependent.

POLICY RECOMMENDATIONS

The policy recommendation that can be deduced from this paper is as follows.
1-The physical capital plays an important role in the growth and development of the industry, thus expanding the size of the country's capital market through the most participation of people areas by physically and electronically expanding the country's stock market, defining and designing various investment instruments in the stock market, andfacilitating privatization and transition from the state economy are necessary.
2-Based on the importance of skilled labor (as human capital) in industrial growth, it is necessary to consider the education and training of human resources to acquire different skills in universities and other training centers, as increasing the skill level and expertise of the

workforce, improvesthe quality of production and enhances the use of capital and their optimal application.

3-In Iran, long-term oil and gas revenues are not associated with industrial growth. Thus, the government can invest oil revenues in the development of health, medical, industrial and educational infrastructure that will not only lead to higher inflation rates but also provide the basis for comprehensive economic development.

4-Consider business development policies besides their long-term and short-term planning. It should be considered, however, that in the short term these policies may have consequences for the country, such as increasing unemployment, inflation and other crises, but by creating the necessary institutional infrastructures and predicting problems, it can take benefit of the long-term effects of such policies, including economic growth and total productivity of production factors.

5-Considering the role of financial market variables such as credit in transferring monetary resources to industrial production, it is recommended to have competitive conditions in financial markets and credit policies for industrial enhancing. Given that in Iran banks are often required to give credits to the people and they need the allowance of the government, it is necessary to reduce the government's supervision on the banks and by creating a competitive environment in the country's banking system and efficiency of the interest rate, giving the credits to the inefficient economic sectors without high value added should be stopped. Given the country's growing liquidity, policymakers can reduce inflationary effects in society by properly directing existing cash flow towards production, industry, and investment in well-performing sectors and enhance production in the economic sector, including industry

6-Regarding researches, the role of the government is important as it can support R&D spending in the various economic sectors and to create some norms to use it. Also, increasing the research human resources in the Iranian industry sector and the link between scientific and research centers in Iran and abroad is essential.

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