Investigating the Effect of Energy Carrier Prices on the Investment of Iranian Industrial Enterprises

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Abstract

In the present paper, a dynamic investment model with combined data related to Iranian industries with double-digit ISIC codes during the years 2009 to 2018 is estimated. The main purpose of this article is to investigate the effect of energy carrier prices and firm size on the level of investment in the industrial sector. For this purpose, a dynamic programming system and Euler equations are used. The results of show that the price of energy carriers has a negative impact on the level of investment of the firm, but its impact is very small. In other words, increasing the value of fuel consumption of firms reduces investment at the firm level. Previous period investment, industry size and industry sales also have a positive effect on firm investment. Also, the coefficient of variable combination of energy carrier prices and firm size is significant and its effect is positive and very small; In other words, it can be said that the positive effect of firm size on the negative effect of energy carrier prices has prevailed and their combined effect on investment in the current period has been positive. This indicates that investment in large industrial enterprises is not more affected by changes in energy carrier prices than small industrial enterprises. Also, investment in the stock market by industrial enterprises has shown its effect by lagged and this effect has been positive.

Keyword: Energy Carrier Prices, Investment, Firm Size Effect, Iranian Industry.

JEL Classification: C33, E22, L60, Q43.

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1. Introduction

Looking at developing countries that have experienced extensive industrial progress and high growth rates in recent decades, it can be seen that investment has been one of the most important economic factors that has played a significant role in their development. Therefore, it can be said that investment is one of the most important factors in economic growth and development of any country. In today's world, energy has a special place and importance for all countries of the world .In the last two decades, energy has been mentioned as one of the important factors of production, which along with other factors of production such as labor, capital and raw materials, plays a decisive role in the economic life of countries. So, in the present paper, a dynamic investment model with combined data related to Iranian industries with double-digit ISIC codes during the years 2009 to 2018 is estimated. The main purpose of this article is to investigate the effect of energy carrier prices and firm size on the level of investment in the industrial sector. For this purpose, a dynamic programming system and Euler equations are used. Therfore, the present article, by examining the data of Iranian industrial enterprises, seeks to answer the questions: "How do changes in energy carrier prices (fuel value) affect investment behavior and decisions in Iranian industry?"

And in terms of the size of the industry, "Is investing in large industries more affected by changes in energy carrier prices or investing in small industries?"

2. Theoretical and experimental foundations

Mukhtarov, S., Mikayilov et al (2018), Zeng, S., Jiang, C., Ma, C., & Su, B. (2018), Wang et al (2017), Henriques, I., & Sadorsky, P. (2011), Sadeghi Zein Al-Abedin in themselves studies investigated the effect of energy carrier prices on the investment of industrial enterprises. They found that two mentioned variables related to them. The basic model used in the present study is the dynamic investment model presented below and is based on the Euler equation method introduced by Abel (1980) and modified by Rati et al. (2011).It is assumed that capital and energy are the only inputs to production and debt in finance.

We consider managers or shareholders, who choose investments and loans that maximize the present value of dividends subject to capital accumulation and external financing constraints.

Therefore, the objective function is expressed as (1) and its constraints are expressed as (2), (3) and (4):

$$V_t(K_t, B_t, P_t, \xi_t) = \max_{\{I_{t+s}, B_{t+s+1}\}_{s=0}^{\infty}} D_t + E_t\left[\sum_{s=1} \beta^s D_{t+s}\right] \quad (1)$$

Subject to:

$$D_t = \Pi(K_t, P_t, \xi_t) - C(I_t, K_t, P_t) - I_t + B_{t+1} - (1 + r_t)\big(1 + \eta(B_t, K_t, \xi_t)\big)B_t \quad (2)$$

$$K_{t+1} = (1 - \delta)K_t + I_t \quad (3)$$

$$D_t \geq 0 \quad (4)$$

Therefore, the first-order condition of the Euler equation for investment, assuming an incomplete capital market, is as follows:

$$1 + \frac{\partial C(I_t, K_t, P_t)}{\partial I_t} = E_t\left[\beta\left(\frac{1 + \lambda_{t+1}}{1 + \lambda_t}\right)\left\{\begin{matrix}\frac{\partial \Pi(K_{t+1}, P_t, \xi_{t+1})}{\partial K_{t+1}} + \\ (1 - \delta)\left(1 + \frac{\partial C(I_{t+1}, K_{t+1}, P_t)}{\partial I_{t+1}}\right)\end{matrix}\right\}\right] \quad (5)$$

After solving the above maximization problem with the help of dynamic planning and some adjustments, we will reach Euler equation (6) and (7):

$$\frac{I_{it}}{K_{it}} = (\beta_{10} + \beta_{11}P_{ct})\frac{I_{it-1}}{K_{it-1}} + (\beta_{20} + \beta_{21}P_{ct})\frac{S_{it}}{K_{it}} + \beta_3 CFK_{it} + f_i + d_{ct} + u_{it} \quad (6)$$

$$\frac{I_{it}}{K_{it}} = \beta_1\frac{I_{it-1}}{K_{it-1}} + \beta_2\frac{S_{it}}{K_{it}} + \beta_3 CFK_{it} + \beta_4 P_{ct}\frac{I_{it-1}}{K_{it-1}} + \beta_5 Z_{it}\frac{I_{it-1}}{K_{it-1}} + \beta_6 P_{ct} Z_{it}\frac{I_{it-1}}{K_{it-1}} + f_i + d_{ct} + u_{it} \quad (7)$$

In experimental sector, we estimated (6) and (7) models that theire results are presented in tables (1) and (2).

Tabl1 1. Results of estimating the first model of the research using the GMM method

Possibility	Statistics t	Value	Variable name
0.0000	12.79	0.18	I1K1
0.0000	17.57	0.0043	SK
0.0000	-8.96	-0.00000007	PSK
0.3064	-1.02	-۰/۰۳۲	CFK
0.0000	8.74	0.096	CFK(-1)

Resource: Research findings

Tabl1 2. Results of estimating the second model of research by cumulative method (POOLING

Possibility	Statistics t	Value	Variable name
0.0000	4.94	0.25	I1K1
0.07	1.76	0.001	SK
0.0246	-2.26	-0.00002	PI1K1
0.0013	3.25	0.041	ZI1K1
0.0375	2.09	0.0000025	PZI1K1
0.1574	-1.31	-.025	CFK
0.085	1.73	0.038	CFK(-1)
0.0000	5.25	0.078	C

Resource: Research findings

3. Conclusion

The results of estimating of equations (6) and (7) by data of Iran's industrial show that the price of energy carriers has a negative impact on the level of investment of the firm, but its impact is very small. In other words, increasing the value of fuel consumption of firms reduces investment at the firm level. Previous period investment, industry size and industry sales also have a positive effect on firm investment. Also, the coefficient of variable combination of energy carrier prices and firm size is significant and its effect is positive and very small; In other words, it can be said that the positive effect of firm size on the negative effect of energy carrier prices has prevailed and their combined effect on investment in the current period has been positive. This indicates that investment in large industrial enterprises is not more affected by changes in energy carrier prices than small industrial enterprises. Also, investment in the stock market by industrial enterprises has shown its effect by lagged and this effect has been positive.

Refrences

Abada, I.; Briat, V. & Massol, O., (2013). “Construction of a fuel demand function portraying interfuel substitution, a system dynamics approach”. *Energy*, No. 49, Pp: 240-251.

Abel, A. B., (1980). “Empirical investment equations: An integrative framework”. *Carnegie-Rochester Conference Series on Public Policy*, No. 12, Pp: 39-91.

Allah Verdi, atefeh And Pourhatami, Zohreh, (2015), "Study of the effect of urbanization and industrialization on energy intensity in Iran." *International Conference on New Research in Management, Economics and Accounting*, No. 2 (In Persian).

Ansari, Saeedeh; Roshan, Reza; and Hadi, Keshavarz, (2017). "The effect of intangible capital components on energy intensity in Iran's industrial sector". *Master Thesis*, Department of Energy Economics, Persian Gulf University, Bushehr (In Persian).

Arman, Aziz; and Taghizadeh, Samira, (2013). "Study of effective factors of energy intensity in Iranian factory industries". *Iranian Energy Economics Quarterly*, No. 2(8), Pp: 20-1 (In Persian).

Atrkar Roshan, Sediqe; and Rasooli, Fatemeh, (2015). "Measuring and analyzing the productivity of production factors (Case study: Industrial sector of Kurdistan province)*". Productivity Management*, No. 9(33), Pp: 25-7(In Persian).

Fattouh, B. & El-Katiri, L., (2013). “Energy subsidies in the Middle East and North Africa”. *Energy Strategy Reviews*, No. 2.1, Pp: 108-115.

Gilchrist, S. & Himmelberg, C., (1998). “Investment: fundamentals and finance”. *NBER macroeconomics annual*, No. 13, Pp: 223-262.

Goskaria, Reyhaneh; and Eghbali, Alireza, (2005). "The effect of oil shock on private sector investment in Iran". *Quarterly Journal of Economic Research and Policy*, No. 13(36), Pp: 62-75 (In Persian).

Henriques, I. & Sadorsky, P., (2011). “The effect of oil price volatility on strategic investment”. *Energy Economics*, No. 33.1, Pp: 79-87.

Jones, C. M. & Kaul, G., (1996). “Oil and the stock markets”. *The journal of Finance*, No. 51(2), Pp: 463-491.

Laeven, L., (2003). “Does financial liberalization reduce financing constraints?”. *Financial Management*, No. 32, Pp: 5–34.

Love, I., (2003). “Financial development and financing constraints: international evidence from the structural investment model”. *Review of Financial Studies*, No. 16, Pp: 765–791.

Mangali, Hoda, and Golestani, Shahram, (2015). "The effect of oil price instability on private investment in the agricultural sector." *Research in Economics and Agricultural Development of Iran* (Iranian Agricultural Sciences), No. 2 (4), Pp: 687-695 (In Persian).

Mukhtarov, S.; Mikayilov, J. I.; Mammadov, J. & Mammadov, E., (2018). “The impact of financial development on energy consumption: evidence from an oil-rich economy”. *Energies*, No. 11(6), Pp: 15-36.

Phan, D. H. B.; Tran, V. T. & Nguyen, D. T., (2019). “Crude oil price uncertainty and corporate investment: New global evidence”. *Energy Economics*, No. 77, Pp: 54-65.

Poor Masoumi, Saeed; Bushehri Shetab, Seyed Nader; Arbab Shirani, Behrooz and Mashayekhi, Ali Naghi (2010) "A Dynamic System Model for Analyzing Iran's Economic-Energy System"; *Industrial Engineering and Management*, No. 26 (2), Pp: 71-87 (In Persian).

Ratti, R. A. & Vespignani, J. L., (2016). “Oil prices and global factor macroeconomic variables”. *Energy Economics*, No. 59, Pp: 198-212.

Ratti, R. A.; Seol, Y. & Yoon, K. H., (2011). “Relative energy price and investment by European firms”. *Energy Economics*, No. 33(5), Pp: 721-731.

Sadorsky, P., (1999). “Oil price shocks and stock market activity”. *Energy economics*, No. 21(5), Pp: 449-469.

Sayadi Mohammad, Shakeri, Abbas; Mohammadi, Timur; and Bahrami, Javid, (2006). "Accidental shocks and management of oil revenues in Iran; Dynamic Stochastic General Equilibrium Approach (DSGE*). Research Journal of Economics*, No. 16(61), Pp: 33-80 (In Persian).

Wang, Y.; Xiang, E.; Ruan, W.; & Hu, W., (2017). “International oil price uncertainty and corporate investment: Evidence from China's emerging and transition economy”. *Energy Economics*, No. 61, Pp: 330-339.

Wu, X. & Wang, Y., (2021). “How does corporate investment react to oil prices changes? Evidence from China”. *Energy Economics*, No. 97, Pp: 105-215.

Zeng, S.; Jiang, C.; Ma, C. & Su, B., (2018). “Investment efficiency of the new energy industry in China”. *Energy Economics*, No. 70, Pp: 536-544.

Zera Nejad Mansoor and Ansari, Elahe, (2007). "Measuring Capital Productivity in Large Industries of Khuzestan Province". *Quarterly Journal of Economic Studies*, No. 4(4), Pp: 26-1(In Persian).