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INVESTIGATING THE VARIABILITY OF THE INVESTMENT EFFECT IN ALTERNATIVE ENERGIES ON CRUDE OIL PRICE: STATE-SPACE APPROACH

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ABSTRACT

During the recent years, most countries are paying a great deal of attention to alternative energy for reducing dependency on an energy carrier and also for environmental considerations. The limitations in the fossil energy sources and the large volume of their pollution, have caused more serious inclinations towards alternative energies. It seems that the mutual effect of crude oil's price and investment in alternative energies is significant. Moreover, since the relationships between different economy variables in the course of time undergo variations, the model's parameters are quite likely to be changed within a given period of time. the present study takes advantage of state-space models and applied Kalman Filter to investigate the variability of the mutual effect of crude oil price and investment in alternative energies for a period of time between 1995 and 2017 for the entire energy market. The results of the present study indicate that the crude oil price has a significant effect on the investment in the majority of alternative energies but the effect of investment in alternative energies on the crude oil price is weak. The effect of investment in solar and wind energies on the crude oil price is acceptable to some extent and it is predicted with the growth in these energies and increase in the energy market's demand quotient that their effects on the crude oil price are increased more than before. Furthermore, no variability was observed in regard to the relationship between crude oil price and investment in alternative energies.

Keywords: *Oil price, Investment, Alternative Energy, State Space*

INTRODUCTION

ALTERNATIVE ENERGIES:

Alternative energies point to the set of energies that can be used as fossil fuels (crude oil derivatives) including all of the resources and technologies that reduce the bioenvironmental effects related to the hydrocarbon resources and the economic issues related to the fossil fuels. Based on this approach, natural gas can also be considered as an alternative source for crude oil and fuel cell, and natural gas and diesel fuels can be alternatives for coal and nuclear energy (Farret and Simoes, 2006). Nuclear energy and fossil fuels are the primary methods of energy generation but they are harmful to nature. In another definition of alternative energy, it is a sort of energy that is produced in a way that the natural resources are not depleted and the environment is not damaged and it is a substitute for fossil fuels. The term "alternative" has been selected for the reason that these energies are good substitutes for fossil fuels (that account for the highest share of the world population's means of energy needs satisfaction) (Al-Mudafer, 2016).

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In a general perspective, alternative energies can be divided into two sets of renewable[1] and non-renewable energies with the former being generated by the sun or other natural processes like solar (light and heat), wind, water (pouring and flowing), stable biomass, waves, ebb and flow and geothermal energy (Farret and Simoes, 2006).

Table 1: classification of alternative sources for crude oil

Uncommon resources	Common fossil sources	Renewable sources	Other
• Uncommon oils • Uncommon gases	• Natural gas • Coal	• Hydraulic energy • Solar energy • Wind and waves' energy • Geothermal energy • Hydrogen technology • Biomass	• nuclear energy

(Source: the researcher)

In the present study, the mutual effect of alternative (renewable) energies with crude oil has been investigated. Therefore, alternative energies mean renewable energies that can be substituted for fossil fuels in the entire study. These resources can cover a part of the consumers' final demands directly (such as supplying household heat with solar energy) and/or indirectly (such as the substitution of oil byproducts in the thermal power plants). The reservoirs of the renewable resources are unlimited in some cases (like solar energy) but the cost of converting them to the required energy as a constraint prevents them from being considered as reservoirs financially and economically justifiable. Renewable resources have a greater diversity than other energy sources.

Factors Influencing the Development and Investment of Alternative Resources:

Since one of the most important instruments of the consumers versus suppliers is their possession of monopoly and existence of alternative goods, the substantial crude oil consumers have provisioned programs for creating and developing alternative energies since the past years. However, the development of alternative energies is not a simple task; the following section presents the most effective factors in the development of alternative energies.

Bioenvironmental Regulations:

Every goods or service supplied by economic agents can be followed by positive or negative ancillary outcomes. The advantage or disadvantage caused by many of these outcomes to the other factors (including human beings and other living beings) are precisely assessable but these outcomes are per se not recognizable in their origins in many instants. This is while one of the reasons for the direction of attention towards alternative energies can be sought in the reduction or absence of such outcomes. Meanwhile revealing the outcomes of the production and consumption of fossil fuels and the exact and correct codification of the bioenvironmental regulations during the recent years clarifies the shadow value of production and consumption of alternative energies. For example, the international unions should increase their investments during the forthcoming 15 years by about 130 billion dollars corresponding to Paris Agreement

[1] A group of sources that are the preliminary source of energy supply according to processes based on natural forces that repeatedly replicated (renewed). Part of this source of energies is known as novel energies.

for the achievement of reduction in CO_2 emissions and prevention of global warming to over 2°C (till 2020) and/or based on G8 Resolution that aims at a 50% reduction in greenhouse gases by 2050. This means that investment in renewable energies needs to be rapidly increased because the use of renewable energies as an alternative to fossil fuels is one of the most common policies for this goal.
Since the international unions and EU have chosen CO_2 emission reduction as one of their important goals, the governments worldwide are seeking the expansion of producing energy from renewable resources. Therefore, the government's interference in the alternative energy market can possibly be taken into account as a determinant of the amounts of investment during some years but the governments' interferences diminish as competition in alternative energy production technology and the rate of substitution of these energies with oil increase (Shah et al., 2018).

Knowledge Development:

Various individuals do not identically react to the part of the outcomes that can be proposed within counteraction and controlling the framework of the free-ride phenomenon and/or its outcomes are not tangible in short run. Knowledge development means the elevation of information and understanding about the long-term and general outcomes of energy carriers' production and consumption and it can be of great importance (Heydari, 2015).

Fossil Fuels Prices (Crude Oil):

The crude oil price has a major impact on the global economy and the performance of nearly all companies is influenced by the oil price fluctuations and oil shocks (Rockström et al., 2009). Since alternative (renewable) energies are substitutes for oil-based energy, investment in them should be also subject to the changes in oil prices. Based on Marshal's theory of supply and demand, the increase in the crude oil price should increase the alternative energies' demand and this augments the motivations of the investors for making more investment in the alternative energies as a result of which investment in these energies is also increased (Rukavishnikova & Baars, 2014).
However, in sum, there is no consensus on the effect of oil price on investment in alternative energies because the impact of substantial changes in crude oil prices on alternative energy investments depends on the extent of oil price changes as well as the direction and level of initiation of change (Shah et al., 2018). For instance, a 10% increase in crude oil price can lead to an initial price of 40-dollar or 100-dollar and these two prices do not have identical effects on investing in alternative energies and the 10-percent reduction in crude oil price from an initial price of 87 dollars can have the same effect on investing in alternative energies that the increase in the crude oil price from an initial 54-dollar can have.

Use of Renewable Energies and Energy Policies:

Alternative energies include a vast spectrum of various types of energy carriers but they can be classified into smaller classes by extracting common features. As an example, if the renewability of the energy supply source is considered as a special property, the energy from wind, water, and the sun falls in one set. Besides the renewability of the energy supply source, this group is qualified for other common properties including non-consumption of fossil fuels for the energy generation or conversion hence being followed by no pollution. It is worth mentioning that the gaps between the energy carriers of this set are revealed considering the various forms of polluting. Applying the renewable energies (including the water-based energy and other kinds of novel energies) for producing secondary energies prevents the consumption of fossil fuels. Therefore, the absence or trivialness of the fossil fuel costs for some technologies of the secondary energy generation can be considered as the latent interests stemming from the application of alternative (renewable) energy resources.

Of course, in this state, attention should be paid to the outcomes of exchanging the current (fuel) costs with the capital (reduction in the current cost in contrast to the increase in the fixed cost). It is expected that the increase in the balance price of the fossil energy market can provide the investment in and application of renewable energies with more and higher economic advantages. Therefore, there is a need for more investment for getting this industry reached maturity and become cost-effective and efficient so that it can compete with energies that are based on fossil fuels (Ghenai and Janajreh, 2016).

On the other hand, the uncommon resources and even natural gas and coal can be also introduced as alternative resources for crude oil. Therefore, an increase in the price of crude oil may make a vast spectrum of energy resources to be used as substitute energies depending on the conditions. In other words, an increase in the crude oil price makes the countries possessing coal reservoirs supply part of their required energy through their own domestic coal resources rather than purchasing oil from the global markets for such a reason as its being more cost-effective. This is while another country might not have enough coal resources but other sources of energy like natural gas, renewable energy, etc. Therefore, the global reaction to the increase or decrease in crude oil price and substitution of the other energy resources in lieu of this carrier can be recognized by investigating the alternative energy supply behavior. It is predicted that the main reason for the growth in investment in alternative energies is the changes in the national and international policies that encourage investment (Rukavishnikova and Baars, 2014).

The Effect of Investment in Alternative Energies on Crude Oil Price:

To more precisely investigate the issue, it is better to explore the factors influencing the crude oil price seminally based on the micro-level economy. Put another way, based on the basics of micro-level economy, every goods is in the simplest form influenced by the supply and demand of the same goods and its substitutes. Thus, we will have:

Supply Side Factors:

The oldness of the fields, their entry into the secondary and tertiary periods, the small fields' quotients and high costs of uncommon fields' production cause a gradual decrease in the amount of crude oil produced and this directly influences the crude oil price. On the other hand, the reduction in the crude oil supply along with the increase in the environmental costs has caused it possible for us to delineate the crude oil supply in a descending trend that would mean an increase in the costs of crude oil supply.

The increase in the costs of crude oil supply corroborates the supply of alternative energies and facilitates the exchange of fuel with capital. Considering the fact that part of the alternative energies is in a stage of daily increasing output, unlike scale output, expanding the capacity to supply these resources would be synonymous to a reduction in the production cost and this is per se a factor easing these resources' more substitution for crude oil.

In case that the final costs of oil production considered to be about 80 dollars for extra-heavy crude oil and marine oil under the current condition and also considering a contingent increase therein up to 140 dollars for the exploitation of uncommon resources as well as the solar electricity costs (as the endless source of an alternative energy), the occurrence of the energy cost umbrella peak curve point becomes likely during the years from 2035 to 2040.

This curve is not dissimilar to the curve known as the oil peak. However, oil peak points to the physical production and supply of oil (disregarding its cost). The curve takes the cost of oil supply into consideration without paying attention to the production and cost of oil supply and, on the other hand, points to a combination of the costs of oil supply and alternative energy. The other important point is that the emergence of the curve peak point of the natural ceiling of the energy costs can influence the oil peak point.

Thus, the use of renewable energies (including water-based energy and other types of novel energies) for producing secondary energies prevents the consumption of fossil fuels. Therefore, the fuel cost of rival technologies can be considered as the hidden interests of the application of this source. Of course, in this state, the outcomes of exchanging the current (fuel) costs with the capital (reduction in the current cost in contrast to the increase in the fixed cost) should be taken into account. It is expected that an increase in the balance price of the fossil energy market can provide the investment in and application of renewable energies with more and higher economic advantages.

Demand Side Factors:

It has to be noted that crude oil is not directly consumed as a preliminary source of energy. This material is consumed for commercial exploitation, refinement, and processing in various sectors. Therefore, in order to precisely recognize the crude oil consumption cycle, it is necessary to analyze the composition of the byproducts produced by crude oil refinement as the most important scale. Oil byproducts' are most widely demanded to supply the transportation sector as the most important fuel consumption sector. In case that an event can fundamentally influence the demand by this sector, it can be expected that the crude oil market would be seriously influenced by this event. Such incidents can be divided into two general groups:

- Events with the objective of optimizing fuel consumption (without structural variations) This case either brings about a reduction in fuel consumption or causes substitution of the oil byproducts. In fact, the optimization of fuel consumption and the use of fuels like biofuels fall in this set. Improvement of productivity is not solely limited to the transportation and consumption sectors of the oil byproducts. The optimum use of the existing resources and even the exchange of the current costs with the fixed costs for reducing the outcomes stemming from the use of some throughputs has always been the focal point of attention. However, the attention to and concentration on productivity improvement, especially in the fuel area, is increased in proportion to the pressure of the market forces (with the increase in the cost of using a throughput) and social pressures (for reducing pollutants) and even enactment of the national regulations and/or international agreements. In addition, measures have been taken in the transportation sector for the manufacturing of automobiles with lower fuel consumption or pollution.
- Invention and Innovation (Creation of Structural Changes):
  This case dismisses the need for the direct use of oil byproducts. According to the fact that a vast part of the oil byproducts is consumed in the transportation sector, attention should be directed at the structural changes of the transportation sector for investigating the structural variations influencing the crude oil price. The structural change in the transportation sector should be realized as a path other than the method of supplying

liquid fuel for the vehicles (biofuels instead of benzene or gasoil obtained from the refining of the common and uncommon oil). During recent years, research and development have entered a new course for the production of electric vehicles and this has led to the commercial manufacturing of these vehicles. These automobiles have been offered based on the slogan "the vehicle without a droplet of fuel" and some of the problems and issues put forth in the previous sections like the reciprocal effect cannot reduce the effect of the production and exploitation of these vehicles on the fuel consumption. Under the current conditions, these vehicles do not enjoy a determinative scale in the market and the existing information demonstrates a 1% annual share of the electric vehicles' manufacturing out of the total automobiles manufactured worldwide (Voelcker, 2012).

In fact, the development of alternative energies with their covering of part of the market demand for energy causes a reduction in the crude oil demand.

Based on what was mentioned, the effect of investment in alternative energies on the crude oil price happens in two ways: one is through supply and the other is through demand. Therefore, we will have:

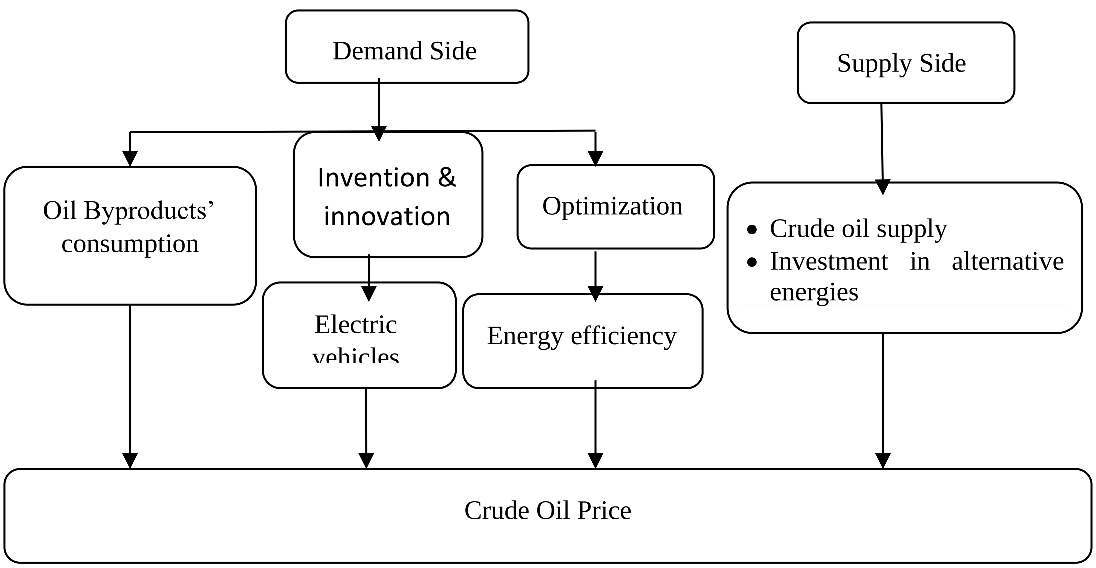


Figure 1: the framework of the effect of investment in alternative energies on the crude oil price

(Source: the author)

The Necessity for Investigating Variability:

One of the properties of the price time series in the financial markets and energy market and, particularly, in the crude oil market is that it exhibits high fluctuations in certain periods and subsequently stagnation and stasis in certain other periods. In other words, it has volatility and variance inconsistency in the course of time. Specifically, the price instability of an asset is expressed in the form of deviation from the standard or variance. In such a situation, the variance stability is incorrect as assumed in the classics and unconditional models. Additionally, considering the fact that the countries are not necessarily homogenous in terms of infrastructures, energy structures, and market, and they are more likely to show different individual effects, some of the factors (political, economic and others), as compared to the others, actually exert their effects on the model's variables with a longer temporal break because there is a need in some of the cases for structural changes, legislation, and so forth. The recognition of these differences in the exogenous component of the technical changes is difficult (Mousavi and Mahmoodzadeh, 2013). Therefore, in order to investigate the mutual effect of the oil price change on the investment in alternative energies, use should be made of a model enabling the determination of the mean effects between the inhomogeneous groups and recognition of the individual effects.

A set of models have considered the variability of the mean and standard deviation of data in the course of time. As a specimen, unlike in the unconditional models, the conditional variance changes in the course of time in autoregressive conditionally heteroscedastic (ARCH) model that was introduced in 1982 by Angles. In this model, the conditional variance error model depends on the past value of the error term's square root. Therefore, it is always positive. The problem in this method is that the volatility clustering is not taken into account. Volatility clustering expresses the state wherein the large price variations follow the large changes and the small price variations follow the small changes. The issue leads to the formation of the GARCH model as a generalization to ARCH method that was posited by Bollerslev in 1986 (Basel et al., 2005). In generalized ARCH model or GARCH, conditional variance depends on both the past value of the error term's square root and its own breaks. But, this model, as well, falls short of taking the good and bad news into consideration. Put differently, the effect of bad news on volatility is more than the effect of positive news of the same volume. To solve this problem, flexible models like exponential GARCH and threshold GARCH have been introduced (Basel et al., 2005). Amongst the other GARCH models, component GARCH (CGARCH) can be pointed out that divides uncertainty into two components of long-term (permanent) and short-term (temporary) and investigates the uncertainty (Ahmad et al., 2012). But, the problem in these models is that the unconditional variance is considered to be fixed. This problem is missing from the structural equation pattern.

In the studies in the area of humanities and social sciences, the analysis of the study data is carried out based on a generally specific and identical format and numerous statistical analysis methods have been so far introduced accordingly among which, the structural equation modeling that was posited during the late 1960s provided the researchers with an instrument for investigating the relationships between several variables in a model. The power of this technique in developing theories has caused its vast application in various sciences including marketing, human resources management, strategic management and information systems, economy, and other numerous social sciences fields. One of the most important reasons for the researchers' frequently use of this method is its ability to test the theories within the format of equations between the variables. The other reason is the consideration of the measurement error into account that allows the researchers to report the analyses of their data via considering the measurement error. The common models in the structural equation modeling are indeed comprised of two parts: the measurement model that investigates the quality of explaining and elaborating the hidden variables by the corresponding observed variable and the structural model that shows how the hidden variables are interrelated (Davari and Rezazadeh, 2013; Habibi and Adanvar, 2017).

Study Pattern:

Time series models are structures composed of decomposing the dependent variable to explanatory variables along with the process and irregular components. Although it is possible for a model to be created based on a given process and the preferential flexibility to be brought about through providing of a chance for the process to change in the course of time or remain random at least in the overall initial model, the statistical framework for the models that have non-observable components is the space-state form that is used to refer to a space the constituent components of which are state variables and the state of a system, as well, is a vector exhibited in the space (Nademi and Zabiri, 2016).

In most of the systems, the transfer function is used for showing the relationship between the input and the outputs. This method is more widely applicable to the systems with one single input and output but the modeling of the space-state does not have such a limitation and various types of systems with multiple transactions, discontinuous nonlinear systems, and time-independent systems can be analyzed by this method. In space-state modeling, the differential equations governing a system are used (Najafi and Naddaf, 2015). The subject of the space-state is one of the relatively novel discussions in mathematics and it is the time series posited for the first time from control systems in 1970 and gradually developed to the other study fields by the efforts of Agatha and later more applications were found with the publication of the book "optimum refinement" by Anderson and Moore in 1979. Afterward, it was with the studies by Ansley and Kohn (1985) that the subject found a particular position in various issues and drew the attention of the scientific circles. To predict and refine the non-stationary systems, Kitagawa (1987) used the space-state modeling and showed that the use of space-state method can enable the purging, smoothing, and predicting the behaviors of a system. Carlin et al. (1992) believe that the space-state method is a powerful tool for modeling and predicting the dynamic systems in such a way that the model is currently being applied in vast areas like economic and engineering sciences.

The expression of the models in space-state has two substantial advantages. Firstly, in this method, it is possible to estimate the unobserved variables along with other variables. Secondly, in this state, it is possible to estimate the aforementioned variables by means of strong recursive algorithms like Kalman Filter, which is a strong method that can be updated (Soleyman et al., 2016). Moreover, considering the fact that macro-economic time series are prone to structural failures and cyclic changes in the course of time, the use of time-varying parameter (TVP) leads to more precise results (Del Negro and Otrok, 2008; Eickmeier, et al., 2011; Korobilis, 2013). Space-state model can be expressed in the following form:

$$y_t = c_t + \beta_t X_t + \gamma_t H_t + \varepsilon_t \qquad \text{Measurement equation (1)}$$

$$\gamma_t = \mu_t + F\gamma_{t-1} + \vartheta_t \qquad \text{State model (2)}$$

β_t, H_t, and F are the matrices containing the parameters and reaching in dimension to $(n \times k)$, $(n \times r)$, and $(r \times r)$, respectively, and changes in the course of time. In case that the equation is certain, the system's matrices are fixed. The first equation is known as the measurement or observation equation wherein X_t is a $(K\times1)$ vector including the exogenous or predetermined variables. Y_t is an $(n\times1)$ vector for t=1, ..., T and acts as the dependent variable. The equation relates the unobservable state vector to the scalar values of the observable dependent variable.

The second equation (2) determines the pattern of the state variable and is known as the state equation. Vector γ_t is (r×1) and contains an unobservable component or the very state variable. The explanatory variable, H_t, provides additional information by the assistance of which the dependent variable can be explained; in fact, H is a matrix that relates the observed y_t vector to γ_t. If the dependent variable's changes can be only explained by the explanatory variables, in this state, the process part is downgraded to a fixed term. Furthermore, it identifies the dynamics transition equation and evaluates the unobservable variables (Nademi and Zabiri, 2016).

$$\varepsilon_t \sim i.i.d.N(0,Q) \quad (3)$$
$$\vartheta_t \sim i.i.d.N(0,R)$$
$$E(\varepsilon_t \acute{\vartheta}_s) = 0$$

Q and R are (r×r) and (n×n) matrices, respectively. In addition, the error components of the measurement and state equations are not associated with respect to their own breaks.

Kalman Filter:

Kalman Filter is applied in the space-state model. This algorithm is a recursive solution for updating or synchronizing a system described in the space-state model. The filter can be used for both stationary and non-stationary data. The solution uses the existent data for optimizing previous data. Kalman filter is also a method wherein the previous data are stored for obtaining the next data and model's specification and it makes direct use of the mathematical models for model specification. The method simultaneously solves the state and measurement equations for obtaining the unobserved state in an optimal way; in other words, this method uses all the observed variables, including $y_1, y_2, y_3, \ldots . y_T$, for obtaining the state β_t with the least error. In case that i=T, it is called filtering and in case that i>T, it is called forecasting and, finally, when i<T, it is called smoothing (Gudarzi, 2008). In fact, filtering is performed at first in such a way that the information related to each period is used for calculating the unobserved variable in the same period; then, forecasting is carried out in which data obtained from filtering stage are used to compute the future values of state variable and, at the end, smoothing is conducted to compute the state variable using the calculated data for the entire filtering and forecasting process; such a filtering is carried out on the state equation.

Another application of the Kalman filter is for the state that the coefficients of the model change in the course of time in which case TVP models would be followed. In this state, the important application of the state-space models with variable and random parameters is for the regression the coefficients of which change in the course of time in such a way that if the measurement equation takes the form $Y_t = c_t + \beta_t X_t + \gamma_t H_t + \varepsilon_t$, wherein X_t is a (K×1) vector of the predetermined and exogenous variables independent from the error term ε_t, the parameters' coefficient vector changes in the following form in the course of time:

$$\beta_{j,t} = \varphi_j \beta_{j,t-1} + \omega_{j,t} \quad (4)$$

If the matrix φ_j is equal to unity in relation for each element, the above equation or the transfer equation would follow a random step as demonstrated below:

$$\beta_{j,t} = \beta_{j,t-1} + \omega_{j,t} \quad (5)$$

If the transfer equation is found having a random-step process, β_t would be non-stationary. In the above equation, $\omega_{j,t}$ indicates the external shocks imposed onto the equation and these shocks might be due to the change in the economic policies or economic regime's transfer at t. Since $\beta_{j,t-1} = \beta_{j,t-2} + \omega_{j,t-1}$, its replacement in the above relation gives the term $\beta_{j,t} = \beta_{j,t-2} + \omega_{j,t-1} + \omega_{j,t}$. Substituting the other breaks of t in relation (5) eventually gives the following relation:

$$\beta_{j,t} = \beta_{j,0} + \sum_{h-0}^{n} \omega_{j,t-k} \quad (6)$$

The above relation shows that the parameters at time t equal the initial values of the parameters and the sum of the external shocks in n past periods. As for the method of specifying the transfer equation, it can be stated that the structure of the transfer equation is determined by means of the scales of the model's fit estimation. It is worth mentioning that use should be of other criteria like the determination of Akaike and Schwarz break as well as the autoregressive models (AR), moving average (MA) or a combination of the autoregressive models and moving average (ARMA) for making a decision about the proper correction of the transfer equation.

Based on what was mentioned, in order to investigate the mutual relationship between crude oil price and investment in alternative energies, two different patterns have been used, which will be explained separately. Due to the existence of scale differences between the changes in the investment and oil price and in case that simple regression is applied for investigating the relationship between these two variables, it should be noted that the relationship between the oil price and investment in alternative energies can be clarified only when severe reduction (increase) occurs (Alazraque et al., 2016). Therefore, to eliminate the scale differences, use is made of a logarithmic state on e-basis because the natural logarithm is directly interpreted as an appropriate approximation (Gelman and Hill, 2006; Ott and Longnecker, 2015). The advantage of this performance is that is not only considered for one year but is used for other years to investigate the relationship between oil price and investment in the alternative energies and this permits the comparison of the aforesaid variables' interrelationships in more than two consecutive years. The pattern used to investigate the effect of investment in alternative energies on the oil price takes the form of the equation shown below:

$$POIL_t = \alpha + AY_t + u_t \qquad \text{Measurement Equation (7)}$$

$$A_{j,t} = A_{j,0} + \sum_{h-0}^{n} \omega_{j,t-k} \qquad \text{State equation (variable parameters at time) (8)}$$

$POIL_{it}$: Matrix demonstrates the price of crude oil at t and Matrix Y includes the model's indigenous variables including the followings:

$SOIL_{it}$: Crude oil supply

AEI_{it}: Investment in alternative energies

EI_t: Energy consumption intensity

A: Parameters' matrix

α: Fixed coefficients matrix or y-intercept

u_t and $\omega_{j,t-k}$: Error components

The matrices used in the proposed patterns have been regulated and applied in logarithmic form. The study data has been collected from the databases belonging to the World Bank, UN, International Energy Agency, British Petroleum, and OECD Data Center.

Tests:

A) Investigating the Signal to Noise Ratio:

Table 2: Results of the investigation of signal to noise ratio

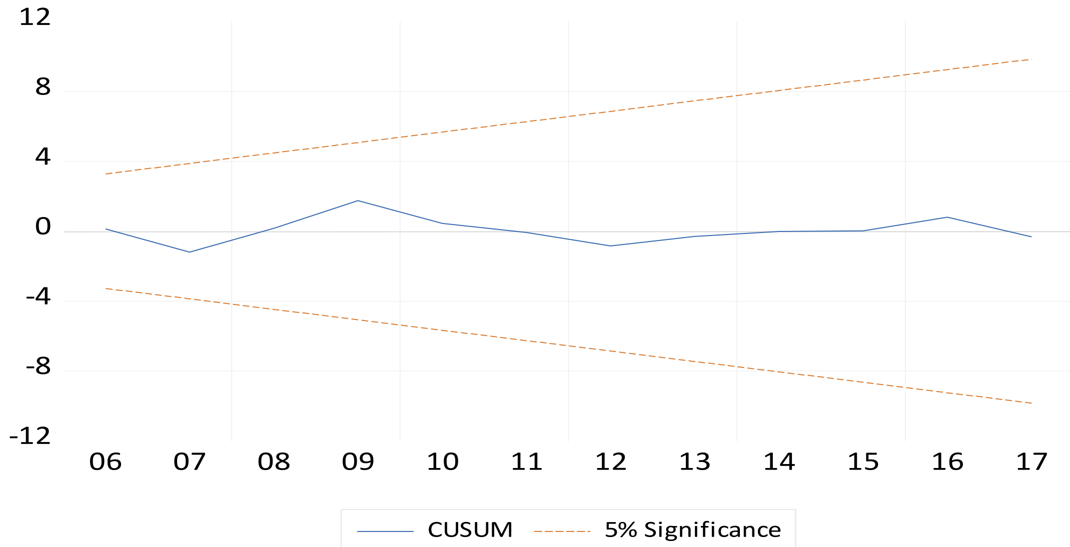
Row	Explanation	Amount
1	The ratio of y-intercept's coefficient variance	0.68223575436
2	Variance ratio of the oil supply variance	0.01702027497
3	The variance ratio of the GDP coefficient	0.00146548358
4	The ratio of the energy consumption intensity's coefficient variance	0.14218588900
5	bio[2] variance ratio	0.00250311330
6	lg[3] variance ratio	0.00400664919
7	Geo[4] variance ratio	0.06783683110
8	Hyd[5] variance ratio	0.00120865150
9	Sol[6] variance ratio	0.04895420548
10	Two[7] variance ratio	0.00198765446
11	Win[8] variance ratio	0.00009479916

(Source: the authors)

As seen in the above Table, the test statistic obtained for most coefficients is close to zero, indicating the invariability of the coefficients of these variables.

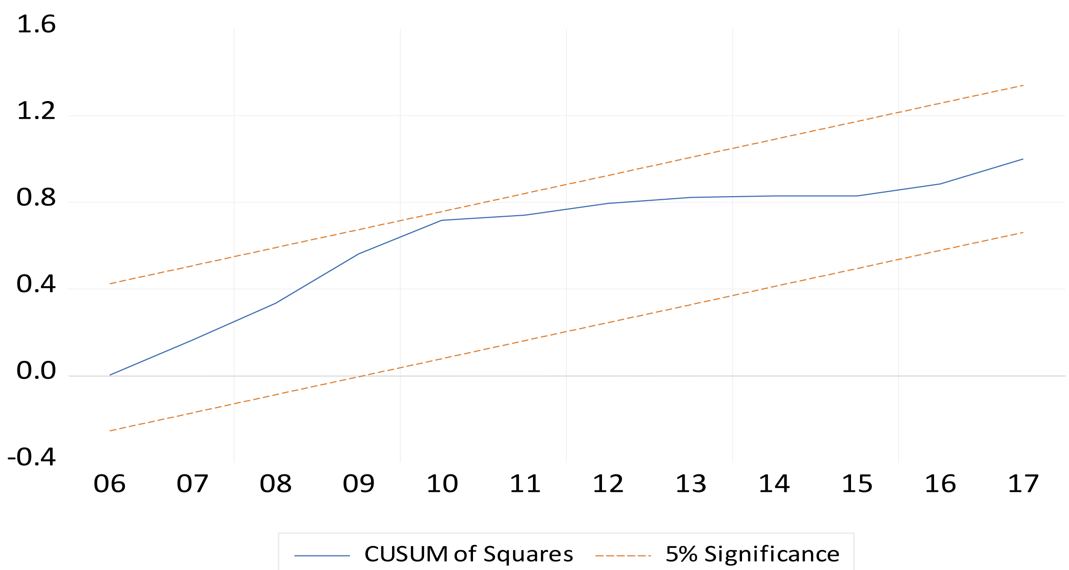
B) CUSUM Test:

[2] Bioenergy
[3] Liquid Biofuels Energy
[4] Geothermal Energy
[5] Hydropower Energy
[6] Solar Energy
[7] Tide, Wave and Ocean Energy
[8] Wind Energy



(Source: the authors' calculations)

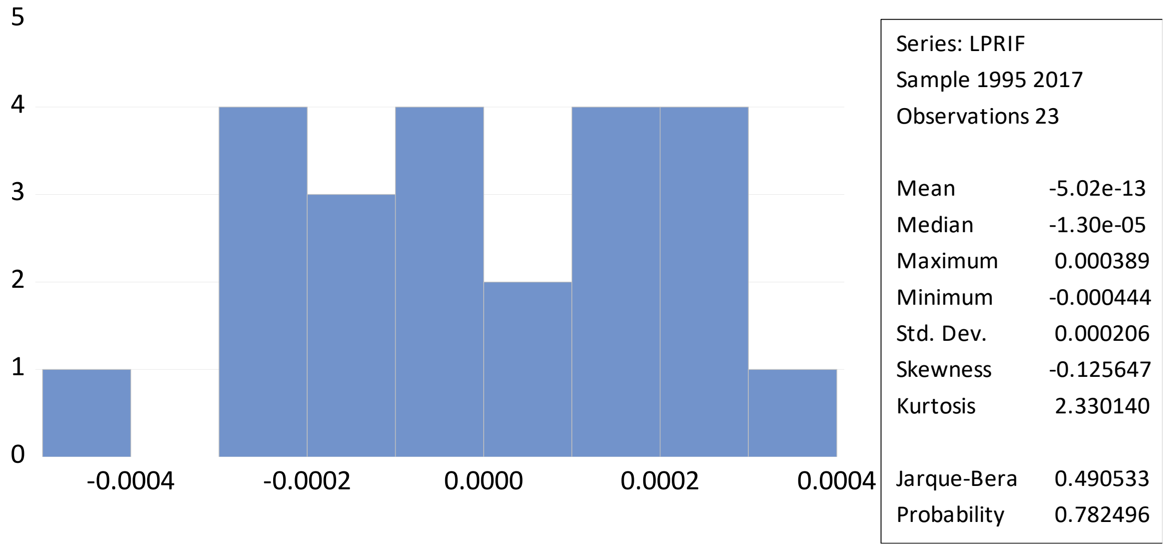
C) CUSUM SQUARED Test:



(Source: the authors' calculations)

As it is observed, in the CUSUM test in the entire period's length, the amount of test statistic is within a 95% confidence interval indicating that no failure has occurred and the coefficients are stable during the period. But, the results of CUSUM SQUARED indicate that a failure or change in the variables is possible.

D) Jarque-Bera Test:



(Source: the authors' calculations)

The amount of the obtained test is equal to 0.49 that, considering the amount of the corresponding probability (0.78), indicates that the null hypothesis, i.e. the normality of the regression's error term, is not rejected. In other words, considering the idea that the probability value (0.78) is larger than 0.05 (the probability value related to the significance level in 5% level or the very 95% confidence interval), it can be concluded that the test's null hypothesis is not rejected, hence, the regression's error terms are normal.

Model Estimation:

The coefficients of the study pattern have been modeled in the form of a randomized step-process. In addition, considering the fact that the error term's variance should be a positive value, the variance of the error component has been exponentially modeled. The following Table gives the results of estimating the effect of investment in alternative energies on the price of crude oil.

Table 3: The results of the estimation model pertaining to the effect of investment in alternative energies on the crude oil price

Kalman filter estimation results				
Method: Maximum likelihood (BFGS/Marquardt steps)				
Sample: 1995 2017				
Included observations: 23				
Failure to improve likelihood (non-zero gradients) after 61 iterations				
	Coefficient	Std. Erro	z-Statistic	Prob.
C(1)	-12.95567	162.3101	-0.079820	0.9364
C(2)	-13.33805	706.7724	-0.018872	0.9849
C(3)	-17.02902	916.9315	-0.018572	0.9852
C(4)	-19.48124	1582.796	-0.012308	0.9902
C(5)	-14.90629	23.58179	-0.632110	0.5273

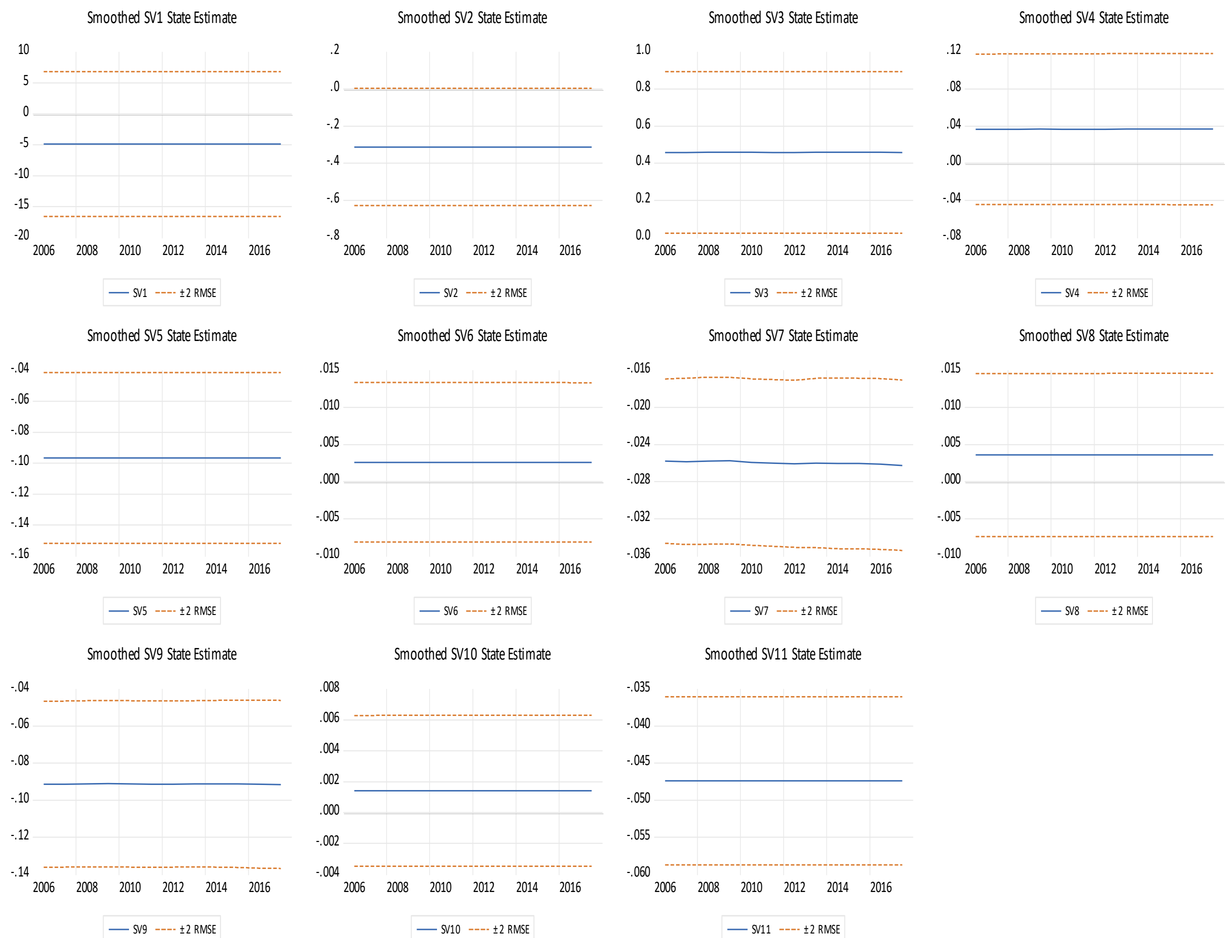
C(6)	-18.94589	2714.689	-0.006979	0.9944
C(7)	-18.47547	396.3871	-0.046610	0.9628
C(8)	-15.64632	77.60560	-0.201613	0.8402
C(9)	-19.67392	1233.721	-0.015947	0.9873
C(10)	-15.97254	58.69983	-0.272105	0.7855
C(11)	-19.17647	172.3956	-0.111235	0.9114
C(12)	-22.21942	26902.71	-0.000826	0.9993
	Final State	**Root MS**	**z-Statistic**	**Prob.**
SV1	-4.890916	5.862294	-0.834301	0.4041
SV2	-0.312355	0.157689	-1.980833	0.0476
SV3	0.458556	0.217617	2.107166	0.0351
SV4	0.036760	0.040822	0.900502	0.3679
SV5	-0.096655	0.027603	-3.501644	0.0005
SV6	0.002592	0.005373	0.482473	0.6295
SV7	-0.026243	0.004611	-5.691923	0.0000
SV8	0.003594	0.005496	0.653842	0.5132
SV9	-0.091563	0.022660	-4.040717	0.0001
SV10	0.001403	0.002447	0.573425	0.5664
SV11	-0.047397	0.005673	-8.355195	0.0000

Log-likelihood	**Akaike info criterion**
-49.01963	5.306055
Parameters	**Schwarz criterion**
12	5.898487
Diffuse priors	**Hannan-Quinn criterion**
11	5.455050

(Source: author's calculations)

As it is observed, the coefficient of the variance of the main equation has been obtained equal to -12.9. In fact, the variance of the equation's error components equals to $e^{-12.9}$. Based thereon, the larger the estimated value, the larger the variance of the equation's error components. c(2) to c(12), as well, are the coefficients of the error components related to the state equations. The smaller estimated coefficient for these components means that the coefficient has not undergone a change in the course of time. In fact, the zero value for the variance of the state equation's error components means that the coefficient has been fixed for that variable in the course of time and that it has had no variance or change.

The SV1 to SV11 values show the coefficient amounts of the model's variables (y-intercept, the coefficient of the crude oil supply logarithm, GDP logarithm, energy consumption intensity's logarithm and the logarithm of investment in such alternative energies as biomass, liquid biofuels, geothermal, hydraulic, solar, flow and edd, and wind) in the last year of sampling, to wit 2017. According to the idea that the amounts of the coefficients have not changed in the course of time, the amounts reported above for 2017 also hold for the rest of the years. As it is observed, some of the coefficients are not significant in the studied model. The coefficients related to the crude oil supply, GDP, and investment in some of the alternative energies are significant. The following diagrams confirm the result mentioned above.



(Source: author's calculations)

SUMMING AND CONCLUSION:

The structural models and time series were used to estimate the time series. The multivariate models explain a variable's variations with respect to several others. The space-state model is a structural model that allows the coefficient change in the course of time. In the present study, the Kalman filter was used to estimate the coefficients varying in time. Amongst the advantages of this model, its ability for estimating the non-stationary series can be pointed out in such a way that no problem would occur in the results. Therefore, it is the most suitable method for estimating the equations with variable coefficients in time.
According to the results of the study pattern's estimation, it is clear that there is no significant relationship between the energy consumption intensity, liquid biofuels, hydraulic energy, flow

and edd, and ocean and oil price whereas the relationship between the intensity of the energy consumption and the crude oil price is undeniable and the result of the present study brings testimony to the unilateral relationship between the crude oil price and the energy consumption intensity. In addition, there was estimated very weak effect for wind, solar, biomass, and geothermal energies on the crude oil price. In fact, share of fossil fuels in the energy market is huge that the investment in the renewable alternative energies can only influence a trivial quotient of the energy market's demand; thus, it has little effect on the change in the crude oil (fossil fuels) price.

It seems that the expansion in the investment in renewable energies and an increase in the market shares of these energies or the considerable reduction in the finished price of the alternative energies can add to their effect on the crude oil price. But, the estimations indicate a fixed effect during the studied years.

References

Ahmed, H. J. A., Bashar, O. H., & Wadud, I. M. (2012). The transitory and permanent volatility of oil prices: What implications are there for the US industrial production? *Applied Energy*, 92, 447-455.

Alazraque-Cherni, J., He, J., & Rosillo-Calle, F. (2016). Renewable energy investment in China: the impact of low oil prices. *Economic and Political Studies, 4*(3), 278-298.

Al-Mudhafar, W. J. M. (2016). Statistical reservoir characterization, simulation, and optimization of field scale-gas assisted gravity drainage (GAGD) process with uncertainty assessments (Doctoral dissertation, Louisiana State University).

Anderson, B., & Moore, J. (1979). *Optimal filtering. Prentice-Hall, Englewood Cliffs*. New Jersey.

Ansley, C. F., & Kohn, R. (1985). Estimation, filtering, and smoothing in state space models with incompletely specified initial conditions. *The Annals of Statistics*, 1286-1316.

Basel M., & Corradi, V. (2005). Predicting the volatility of the S&P-500 stock index via GARCH models: the role of asymmetries. *International Journal of Forecasting, 21*(1), 167-183.

Bollerslev, T. (1986). Generalized autoregressive conditional heteroskedasticity. *Journal of econometrics, 31*(3), 307-327.

British Petroleum, (2018). Available at: www.bp.com.

Carlin, B. P., Polson, N. G., & Stoffer, D. S. (1992). A Monte Carlo approach to nonnormal and nonlinear state-space modeling. *Journal of the American Statistical Association, 87*(418), 493-500.

Davari, A. & Rezazadeh, A., (2013). *Modeling the Structural Equations using PLS*, Jahad Daneshgahi, Tehran, First Edition.

Del Negro, M., & Otrok, C. (2008). *Dynamic factor models with time-varying parameters: measuring changes in international business cycles*. FRB of New York Staff Report, (326).

Eickmeier, S., Lemke, W., & Marcellino, M. G. (2011). The changing international transmission of financial shocks: evidence from a classical time-varying FAVAR.

Farret, F. A., & Simoes, M. G. (2006). Integration of alternative sources of energy. *John Wiley & Sons.*

Gelman, A., & Hill, J. (2006). *Data analysis using regression and multilevel/hierarchical models.* Cambridge university press.

Ghenai, C., & Janajreh, I. (2016). Design of solar-biomass hybrid microgrid system in Sharjah. *Energy Procedia*, 103, 357-362.

Gudarzi, A. (2008). Using Kalman Filter for Predicting Exchange rates. Master of Science Thesis, University of Tehran

Habibi, A. & Adanvar, M., (2017). *Modeling the Structural Equations and Factor Analysis*, Applied Learning of LISREL, Jahad Daneshgahi, Tehran, First edition.

Heydari, K. (2015). The Causality of Crude Oil Price and Alternative Energy Supply (Toda and Yamamoto Test). *Journal Economy Researches, 50*(1), 129-146.

International energy agency, (2017), available at: www.iea.org.

Kitagawa, G. (1987). Non-gaussian state—space modeling of nonstationary time series. *Journal of the American statistical association, 82*(400), 1032-1041.

Korobilis, D. (2013). Assessing the transmission of monetary policy using time-varying parameter dynamic factor models. *Oxford Bulletin of Economics and Statistics, 75*(2), 157-179.

Mousavi, M. H., & Mahmoodzadeh, M., (2013). Value Added Growth Accounting in Iranian Manufacturing Industries with Emphasis on Information Technology, *Journal of Economic Modeling Research, 9*(32), 64-41.

Nademi, Y., & Zabiri, H., (2016). The Effect of Exchange Rate Gap on Unemployment in Iranian Economy, *Journal of Economic Modeling Research*, 26.

Najafi, A., & Nadaf, A., (2015), Optimal Forecasting and Control of Country Industrial Staffs with Laplace Transform and State-Space Modeling Approach, *Journal of Industrial Management Perspective*, 17, 135-119.

OECD Data, (2018). Available at: www.data.oecd.org.

Ott, R. L., & Longnecker, M. T. (2015). An introduction to statistical methods and data analysis. Nelson Education.

Rockström, J., Steffen, W. L., Noone, K., Persson, Å., Chapin III, F. S., Lambin, E., ... & Nykvist, B. (2009). Planetary boundaries: exploring the safe operating space for humanity. *Ecology and society*.

Rukavishnikova, A., & Baars, N. (2014). The Impact of Oil Price Fluctuations on Stock Performance of Clean Energy Companies: A global study on a corporate level.

Shah, I. H., Hiles, C., & Morley, B. (2018). How do oil prices, macroeconomic factors and policies affect the market for renewable energy? *Applied energy*, 215, 87-97.

Soleyman, S., Falahati, A., & Rostami, A. (2016). Permanent and Temporary Components of Stock Returns: an Application of State-Space Models with Markov Switching Heteroskedasticity. *Journal of Economic Modeling Research, 7*(25), 69-90.

United Nations data, (2018), available at: www.data.un.org.

Voelcker, J. (2012). Toyota Rav4 EV: First Drive of Tesla-Powered Crossover. Green Car Reports, August 2012.

World Bank, (2018), available at: www.worldbank.org.