Economic Research-Ekonomska Istraživanja

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/rero20

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To cite this article: Gong Yan & Weijun Bian (2023) The impact of relative energy prices on industrial energy consumption in China: a consideration of inflation costs, Economic Research-Ekonomska Istraživanja, 36:3, 2154238, DOI: 10.1080/1331677X.2022.2154238

To link to this article: https://doi.org/10.1080/1331677X.2022.2154238

Published online: 13 Jan 2023.

ECONOMIC RESEARCH-EKONOMSKA ISTRAŽIVANJA
2023, VOL. 36, NO. 3, 2154238
https://doi.org/10.1080/1331677X.2022.2154238

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The impact of relative energy prices on industrial energy consumption in China: a consideration of inflation costs

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ABSTRACT

Rapidly changing relative energy prices (R.E.P.) have put pressure on global markets all over the world. Even economic factors must have a high degree of self-sufficiency related to the R.E.P. and increasing consumption and its production costs in consumer sectors of China. This research is based on R.E.P. impact on the industrial energy consumption (E.C.) of the Chinese economy. The key dependent and independent variables employed for this purpose were R.E.P.s, consumption price index (C.P.I.), inflation expenses, and so on. The R-square test between R.E.P.s and industrial consumption sectors (C.S.), f-statistical analysis, graphical analysis, and a summary of the Model and its analysis were utilised for this aim. Results run from the P.L.S. software and data collected from the World Bank, and world indicators also collect data from different websites. Data form is secondary and is based-on frequency panel data for 1990 to 2019. Results concluded that the impact of R.E.P.s is fast growing on the E.C. of China and is positively related with the consumer prices index. The contribution of this research is the comprehensive review of the existing and potential markets and services. The assistance can be mainly found in the study on the distribution network reliability service. The change in energy policies considering the different countries must be highly changing on imported energy which occurs high self-sufficiently. This examination of R.E.P.s and index relates to China. The results indicate a significant impact between industry E.C. and R.E.P.s. Therefore, this research is more reliable due to the literature and enhances the knowledge related to the study of relative consumption energy prices in energy industries.

ARTICLE HISTORY
Received 26 March 2022
Accepted 29 September 2022

KEYWORDS
relative energy prices (R.E.P.); economy of China; energy consumption (E.C.); consumption prices index (C.P.I.); industrial consumption sector (C.S.)

JEL CODES
P18; Q43; Q51; R53

1. Introduction

Energy efficiency is an important factor in calculating the development of economy and humanity. In economy power is both an input factor and general commodity. A main problem by which the economy of any country is affected is the conflict between lower energy efficiency and higher energy usage. In China, energy prices have influenced the

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Chinese economy on a great scale. After the beginning of open-door policy since 1979 the energy section of China has developed (Carmona et al., 2017). China established the great China's Energy Policy to attain complete, balanced and long-term development of country's economy and environment and for the government of China establishment of modern energy industry is a vital task which is very effective for economy of country and depend on renewable energy resources (Ren et al., 2016; Xiong et al., 2019). In 1978 by bringing changes in economy China became successful in decreasing the surplus utilisation of energy that's why the intensity of energy is now comparatively equal to Russia (Altounjy et al., 2020; Asha & Makalela, 2020) and India and this success could not be possible without the changes that have transferred the energy sector in to profit oriented sector. China's energy zone also faces many difficulties before meeting the successful achievements in energy section (Mukherjee, 2008).

The fundamental issue in the energy sector is that untrained ersonel and those who are not qualified or competent in the responsible government energy sectors do not have an inclination to execute environmental rules and laws (Dlalisa & Govender, 2020; Makhalima, 2020). In the late 1990s and early 2000s, researchers and scholars predicted that China's energy demand would rise from 1.3 billion to 3.3 billion tons of coal by 2020, assuming an energy elasticity of 0.5, which was higher than the observed figure during the 1980s and 1990s (Gong et al., 2021). Finally, between 2000 and 2005, the G.D.P. increased to 1.0, while energy consumption (E.C.) increased to 2.2 billion in 2005 (Leikin et al., 2020). The Chinese government has given its markets a substantial amount of power over energy pricing (Mohsin et al., 2020; Román-Collado & Morales-Carrión, 2018). With the magnificent achievements in the energy section China slowly appeared as the country whose imported things values are higher than the exported things over a given period of time. During the past four decades, different economic policies are responsible for increasing and decreasing energy prices in China (Ghauri et al., 2020). It is essential to study the factors of economy such as cost of energy to recognise the growth of any country's economy and energy usage because there occurs a strong association among expenses of energy and demands of energy. Some mechanisms are also present to study the effect of energy charges on Chinese economy in which pricing mechanism is also present. Some researchers described the rate of energy value against Gross domestic product and determined the inverse relationship between them. There occurs a decrease in G.D.P. with an increase in energy prices and vice versa (Streimikiene & Akberdina, 2021). For industries of any country (Vveinhardt et al., 2020; Žmuidzinaitė et al., 2021), the relative energy prices (R.E.P.) of the market also play a significant role. Before 1978 concerning the energy pricing mechanism of China, the energy prices were entirely under the control of the Chinese government. The government relaxed the economic agencies and markets by undergoing policies and forming new opening policies (Gorączkowska, 2020). In China, the energy prices are not enterprise and they continue evidently less than the rate of energy of other countries that have more variable and elastic energy prices. Between 2002 and 2012, a rapid increase in China's economy occurs, which increases the demand of both energy sources (coal) and energy prices (Burniaux & Truong, 2002).

In fact the relative prices of energy are defined as the proportion between energy price to general level of energy price and these both are internal powers of country.

Consumption of energy and general price level are affected by energy prices (Barkhuizen et al., 2020; Hassan & Meyer, 2020). Scholars identified that the increment in prices of energy results in the saving of energy. It is affirmed by many researchers that there occurs an association between economy and energy prices of a country either affects each other positively or negatively and rely on various economic conditions. China's prices of energy would be depending on demand and supply. Energy prices are significant for E.C. consumers (Castillo-Vergara et al., 2021; Rudnicki, 2021).

Given the disruption of energy prices in the economy and environment caused by market activity, a country's energy pricing should integrate those from other nations (Auriacombe & Sithomola, 2020). Energy price fluctuations, whether positive or negative, are significant in the energy business and the environment (Chen et al., 2017). The pricing mechanism currently present in China is applied to all energy resources (coal, oil, electricity and gas) and is a modified regulation mechanism (Vaitkevicius et al., 2021). In China the important measure for the energy price regulation of crude oil, natural gas, thermal coal and electricity is described by the Government of China and then ascribed to China's 'government guidance price' or 'governmental pricing' (Román-Collado et al., 2018).

This study aims to measure whether R.E.P.s in industrial E.C. in China are the main consideration of inflation costs (De Jongh, 2020; Molek-Kozakowska & Kampka, 2021). More consideration, however, is being given to the supply and demand factors of international and domestic markets and the possibility of using an alternative market-orientated pricing mechanism to overcome the shortfalls of the current price mechanism. At domestic and international level more attention is being given to supply and demand factors (Emeljanovas et al., 2020). For the betterment of energy efficiency in China effective prices play an important role in the business case (Si et al., 2018). In China the energy prices are determined by the index of purchasing price of fuel and unprocessed materials. Researchers concluded that the increase in prices of energy leads to a rise in the prices of product and ultimately increment of inflation takes place in any country (Song et al., 2019).

Predicted or unpredicted inflation both produces costs for society. G.D.P. and E.C. are also affected by energy prices which obviously affect intensity of energy. The factors which influence the E.C. are output, structure of industries, efficiency of technology and productive factors. Inversely the rise in energy prices of any country attributed to the development of country's technology. The rise in inflation cost of China in some previous years is due to some multiple factors: increase in consumer price, higher cost of production (Ghauri et al., 2020). The E.C. has become the global issue and needs the attention of recent study especially in economically developed countries like China. Thus, the aim of the current study is to examine the impact of energy price and inflation on the E.C. in China. Based on these objectives, the researchers conducted the study to find out the answer to the research questions such as: What is the impact of R.E.P.s on industrial E.C. in China? What is the role of inflation cost on industrial consumption in China?

This article is divided into five parts; Section 1 explains the research study's background and its introduction related to the R.E.P.s, E.C. and inflation costs. Section 2 presents a literature review of different articles. Section 3 explains about methodology and Section 4 defines the results and their interpretations. The last section summarises the conclusion related to the research study and defines some specific recommendations.

2. Literature review

Korsakiene explains that economy growth is responsible for the durable development of any country. In any country, economic growth itself depends upon the prices of energy and E.C. In their research article, Renata aimed to investigate the R.E.P.s and their impacts on industrial E.C. (Babu, 2021). It was studied whether the increase in energy prices like electricity and gas slowed down the industrial development in China. Apart from this, in their article, Renata also raised a question that whether with the change in relative prices of energy, the industries at international level affected or not? And to learn about this fact this article used the method of correlation analysis (Kennedy et al., 2020). For this purpose, the sample data was collected from 2000 to 2011 and the results showed that there was not much impact of change in energy prices on industrial development but the expansion in energy prices affected the consumption of energy at the industrial level and thus affected economic growth (Malla & Brewin, 2020). This showed a direct impact on consumption and economy growth but no impact on development of industries or on worldwide competitiveness (Anugrah & Dianawati, 2020).

Yemelyanov investigates the changes in the economy growth and consumption of energy due to change in energy prices. In this research, the Olexandr purpose was to examine the potential of Ukrainian industries and the Ukrainian economy to make sure, during the state of increasing economy, a firm decrease in E.C. and to lessen their dependence on their imports (Corrás-Arias, 2020). For this purpose, the author uses different models to identify the association between them. After investigation, six types of association were recognised between the variation in E.C., i.e., natural gas and variation in regional added value. Different conditions were presented under which the reduction led to the growth of regional value in the consumption of different energy resources (Gohin, 2005). Apart from this, in this research article, the index of regional effectiveness for the utilisation of different energy resources was also presented. The model was also constructed for the reduction in the rate of growth of this index. In this article, quantitative indexes were also presented to investigate the economic obstruction in establishing new energy saving techniques. Regional consumption of natural gas in Ukrainian were also explained. It was also noted that the decrease in the consumption of natural gas in industries occurs due to rise in energy efficiency and this occurs in those industries in which the price of purchasing the energy resources has an average of the total cost of operating expenses (Blundell et al., 1993).

Canh explain that innovation has great importance to influence stakeholders. It is a complicated process. According to the theory of stakeholders, creditors and stakeholders were always anxious about cooperative economic performance. While in the new stage of time, a firm's responsibility has to hold out different stakeholders along with their employees, communities, and suppliers (Kim & Loungani, 1992). In this research article, Nguyen aims to expand the writing by studying the independent impact of process innovations and products and their interconnection with exterior collaboration on C.S.R. enterprise in terms of regional endowment and industry's performance during the sample period of 2011 to 2013. The results of this research show that the products and process innovation are favourable to the performance of industry in term of trade share but there was no gain on total worth. It means that in an innovative enterprise, a lot of time has been required to make positive changes in the profit of funding, but it seems helpful to win stakeholders loyalty (Kilian, 2008). It was also noted that when industries involved external parties, innovation made industries more abstruse. So, it encourages industries to pass out different signals related to their feasibility and collaboration by C.S.R. activities. Regarding to the activities of C.S.R. this research article was the first which presented a collapse of classification for the social contributions of corporative towards regional welfare and it also presented detailed corroboration on the impact of innovation at each class, rather than complex index.

Gohin investigated the impact of long-term energy costs on energy usage at the industrial level. The price of items and things has been fluctuating for decades due to changes in energy costs, according to this study article. Because changes in energy costs have a direct influence on industrial E.C. and output, the prices of goods and services have also altered in response to the changes in energy prices. It was noted that some energy products and foods have experienced significant fluctuations in recent decades. This study report attempts to explain this phenomenon. Gohin used the W.C.G.E. model and a complete description of the energy and food markets to investigate the long-term relationship between energy and food prices. The macroeconomic connection, which has been the subject of much recent discussion and research, has received special attention (Gohin & Chantret, 2010). In this article, it was also found that excluding these correlations has a considerable effect on this association. Apart from this, in most of the analysis, it was also noted that there is a positive association between them. There seems to be a negative association between energy prices and food prices but a strongly positive association between the prices of energy and its consumption has been observed (Ang & Liu, 2007).

H1: Energy prices have a significant and positive association with industrial E.C. in China.

Qian Wang studied the price of different energy sources and its impact on industrial E.C. He studies that with the decrease in energy resources there is a significant need to make different developing techniques for the better utilisation of these energy resources and to consume less energy in industries without a lot of renouncing of economic output. For this purpose, there was the need to set different key drivers according to E.C. growth rate. It was analysed that in 2016 the top three countries of the world – India, the U.S.A. and China – consume 45% of universal fuel. Because of the consumption of these countries they should make effective strategies for industrial E.C. Apart from this, in this research article, the G.D. model and different sampling techniques have been utilised to find the critical drivers for the consumption of energy (Ang & Liu, 2007).

After analysing different techniques and models, the results showed that coal was the most significant driver that significantly affected the rate of E.C. in India and China. While for the case of U.S., the most important energy drivers were oil intensity and wages of individuals. It was also noted that all these variables have co-integration among them and enlarging the performance of each other along with also effecting consumption of energy growth rate in industries of India, China and the U.S. (Matyushok et al., 2021; Staff et al., 1979). Whereas in India, these variables have the strongest co-integration among them and positive influence on consumption rate and economy growth. While the U.S. does not have much of a significant impact when compared to India and China. Apart from this, the author also suggests different techniques for the better utilisation of energy (Tokgoz et al., 2008).

Behname presented the research in 2013 on the association among inflation, industrial development, E.C. and energy prices. To explain this association, Mehdi utilised sample data of the period from 1980 to 2010 and use (panel data) P.D.M. This model's findings showed that all variables in the first order equation were stationary (Wang et al., 2010). For this purpose, in this research paper, Ruipeng used cross-price and own-price elasticities to examine the changes in demand due to these factors. First, the results showed an association between energy price, capital and labour because by changing the prices of one factor, there was also a significant change in the other two factors. Secondly, there was negative elasticity for own price factors. In contrast, this elasticity was positive in the case of cross-price factors, which shows their substitutability. In contrast, a direct relationship between energy prices and industrial E.C. has been observed (Hamilton, 2008). Hausman and Pedroni also suggest different test; according to them the variables were also not showing co-integration. So, Mehdi apply momentary granger test, which showed a two-sided association among E.C., market size, and unemployment, which is the major sources of inflation and economy growth. It was said that energy prices are also a major source of economy growth and production in any country, if the prices of energy increase gradually then energy importing countries are not able to import such high price sources due to which their industries will produce less production and as a result of which economy will decrease (Gohin & Chantret, 2010). This means that there is a strongly positive association between industrial E.C. and R.E.P.s. Along with these findings, the author also suggests that energy importing countries should have made different arrangements to lessen the impacts of relative prices of energy on economy growth and E.C. in the industrial sector (Cesarec et al., 2020; Svoboda, 2020).

H2: Energy prices have a significant and positive association with inflation costs in China.

3. Theoretical framework and theoretical construction model

3.1. Definition of energy prices and E.C

The essentiality of R.E.P.s is a based-on relationship among all prices of energy. By taking about the definition of R.E.P. as referenced by Wei and Lin the R.E.P.s as a basic comparison between general prices and energy prices levels from all perspectives of inflation rates. Thus, all relative prices are not be based on other input factors such as labour and capital of price comparisons relating to different types of energy.

Moreover, E.C. is a part of consumption prices; there are two parts to measure E.C.: the total E.C. and the second is E.C. intensity related to price fluctuations. Based on these two levels the industries are linked with energy prices and that general prices level.

However, some economic theories often cannot specify these relations completely (Cansino et al., 2016; Lan et al., 2020). And these endogenous variables must appear on both the right and left sides of equations make them estimated. Thus, some non-structure approaches included vector error correction models and autoregression models. They are applied in a research study to measure high energy prices in consumer sectors based on the Chinese economy. The vector autoregression (V.A.R.) analysis is mainly used to forecast the time series systems and estimate the dynamic effect of kinds of all random disturbance on all methods of variables (Cansino et al., 2015).

3.2. Theoretical relationship between E.C. and energy prices

According to the general theory the relationship between E.C. and energy prices essence belongs to the demand of prices research framework. This relationship can must be interpreted based on two components, market equilibrium and prices factors involvement. The R.E.P. is a most important factor in production and they must be increase energy prices when increasing the energy prices then result is increase in the costs of the products.

Furthermore, the prices operate continuously and maintain that profit margin, also the sustainability of competitive advantage for all alternative energy-related sources. Therefore, the R.E.P. must regulate E.C. and influence the economy in all aggregate market structures.

3.3. The basic equational model

There are many factors impact on E.C. of energy industries. Previous studies focus on specific factors, including the production factors, such as input or output, the overall industrial structure, technology efficiency, population, per capita income, etc. These factors are based on the equation of all decompositions.

$$C{*}E{*}Y{*}P{*} \ = EC \tag{1}$$

where, C, E, Y, P, are content of the energy intensity, the G.D.P., per capita and population these are all factors of E.C., respectively. This research article focuses on the production factors of relative energy and E.C. in addition all factors are based on the energy intensity (Ang, 2004).

This research is based on relative variables (see Table 1) related to the energy prices and E.C. of energy industries. In this research, the main focus is that inflation costs relative to energy prices are independent variables: E.C., consumption on price index, and inflation cost. These are all dependent variables of research study.

3.4. Data source and data collection:

This research study based on the secondary data of research related to the R.E.P.s and E.C. of industries, shown in Figure 1. The data was collected from websites, including world development indicators (W.D.I.), and world banks through the websites. The total sample of this study is 2010 to 2020 selected R.E.P.s.

Table 1. Relative variables.

Sr. No	Variables	Notations
1	Relative energy prices	REP
2	Total investment in energy	TIE
3	energy consumption	EC
4	Consumption on price index	CPI
5	Inflation cost	IC

Source: data-collected by authors.

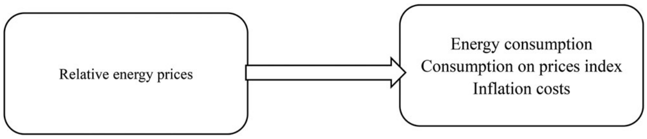

Figure 1. Theoretical model of R.E.P.s and E.C.
Source: made by authors.

4. Results

4.1. P.L.S. algorithm model

The P.L.S. algorithm model shown in Figure 2 explains the least square relation between R.E.P.s and E.C. also consider as inflation costs. The consumption prices index creates negative impact on inflation costs related to the energy prices. On the other hand, the E.C. shows positive effect on the inflation costs at rate is 0.313 and 0.34, respectively. The model shows correlation coefficient effect among consumption indexes, consumption of energy and inflation costs at the rate 1.000, 100% significantly.

4.2. Model selection criteria

The Table 2 present that model selection criteria test between consumption prices index and also that E.C. This result used different Akaike's information creation, the corrected Akaike information criterion, Bayesian information criteria, and that corrected Hannan-Quinn criterion shows that selection criteria regarding R.E.P.s and consumption index. The rates of consumption price index (C.P.I.) are −1.618, 0.448, 33.240, 1.314, −0.646 and 0.064, respectively (Keeney & Hertel, 2005). Another one

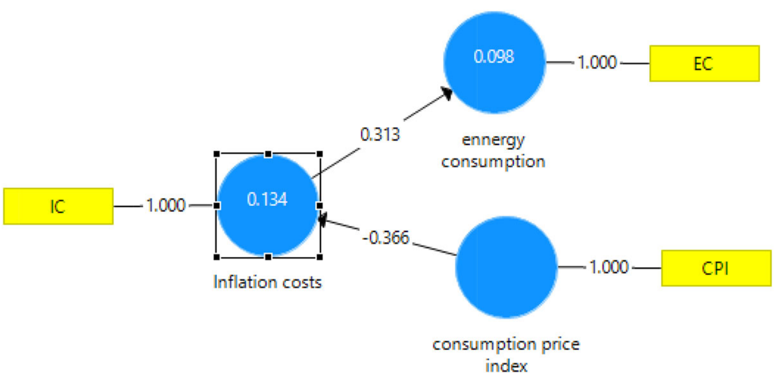

Figure 2. P.L.S. algorithm model.
Source: made by authors.

Table 2. Model selection criteria of indexing.

	AIC (Akaike's Information Criterion)	AICu (Unbiased Akaikes Information Criterion	AICc (Corrected Akaikes Information Criterion)	BIC (Bayesian Information Criteria)	HQ (Hannan Quinn Criterion)	HQc (Corrected Hannan-Quinn Criterion)
Consumption Price Index	−1.618	0.448	33.240	1.314	−0.646	0.064
Energy Consumption	−0.311	1.754	34.546	2.620	0.660	1.371

Source: data-collected by authors.

variable is E.C. according to the result its rate is −0.311, 1.754, 34.546, 2.620, 0.660 and 1.371, respectively. These are all rates that show specific criteria regarding model selection or the effect of relative prices and consumption prices in energy industries.

4.3. Model fitness analysis

The results shown in Table 3 describe that fitness of model analysis related to the impact of relative prices and E.C. The result describes that saturated model and that estimated model of SRMR, D ULS and Chi, Square values. The total estimated mode values are 0.315, 0.594, 0.436, the chi square values show that 44.312 means 44% significantly, the value of NFI is 0.147 explains that 14% rate of performance in energy industries.

4.4. Discriminant validity

The results shown in Table 4 describe that the discriminant validity analysis between consumption prices, energy relative prices and that inflation costs effect of both consumptions values. The first values explain that positive validity between consumption and prices indexes at rate is 0.313, and 0.885, respectively. The second result table presents that the loading performance of relative prices its values shows that 0.366

Table 3. Model of fitness and its analysis values.

Fit summary	Saturated model	Estimated model
SRMR	0.000	0.315
d_ULS	0.000	0.594
d_G	0.000	0.436
Chi-square	0.000	44.312
NFI	1.000	0.147

Source: data-collected by authors.

Table 4. Discriminant values of variables.

Fornell-Larcker criterion	Latent variable 1	Consumption price index	Energy consumption
Latent variable 1	1.000		
consumption price index	−0.366	1.000	
energy consumption	0.313	−0.885	1.000
Cross loadings	Latent variable 1	Consumption price index	Energy consumption
CPI	−0.366	1.000	−0.885
EC	0.313	−0.885	1.000
IC	1.000	−0.366	0.313
Heterotrait-Monotrait Ratio (HTMT)	Latent Variable 1	consumption price index	energy consumption
Latent variable 1			
Consumption Price Index	0.366		
Energy Consumption	0.313	0.885	

Source: data-collected by authors.

rates and 0.885 rates are such a way to show the impact of R.E.P.s and their impact on E.C. in energy industries (Gohin & Chantret, 2010). This research considers inflation rate as a main indicator for measuring the both relations. Similarly, Figure 3 shows the Heterotrait-Monotrait Ratio (H.T.M.T.) for measuring the results; its latent variable value is 0.366 and 0.313 the value of C.P.I. is considered as dependent variable its rate is 0.885.

The second P.L.S. algorithm model shown in Figure 4 explains discriminant validity performance with the help of a specific figure of the inflation costs, E.C. and that C.P.I. These are shows that 0.000 relation, which means 100% significantly relation among them. The inflation costs positively effect with E.C. at 1.979, respectively. So, the result accepts the alternative hypothesis and rejects that null hypothesis related to the research analysis. The consumer price index shows a positive impact on inflation costs and its fluctuation is at the rate of 2.998.

4.5. Inner model residual score test

The result analysis shown in Table 5 represents that inner Model of residual score values with the case ID 1 to 30. The results show that rates are negative in some

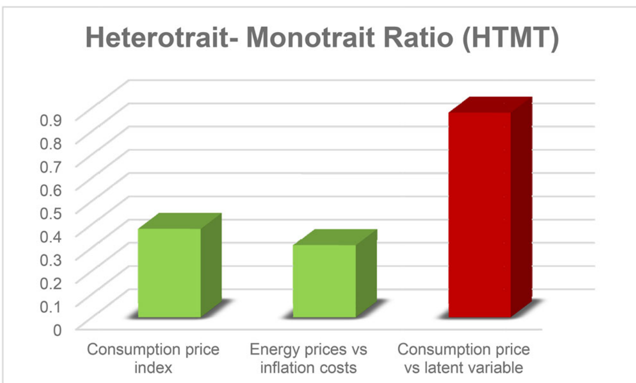

Figure 3. Graph present that Heterotrait-Monotrait ratio.
Source: made by authors.

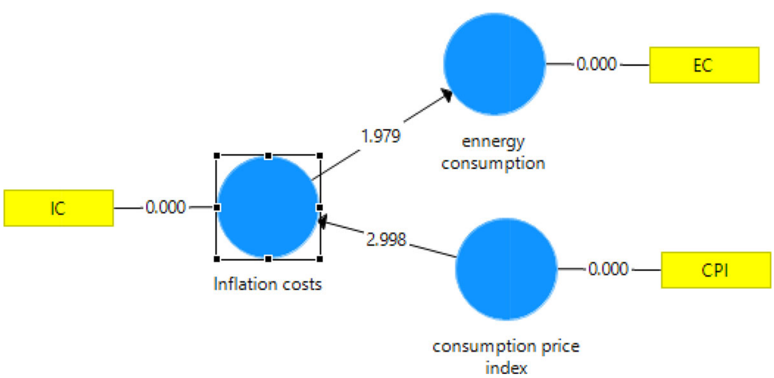

Figure 4. Second P.L.S. algorithm model.
Source: made by authors.

Table 5. Score test of inner model residuals.

Case ID	Consumption price index	Energy consumption
1	−2.204	1.550
2	−2.105	1.425
3	−1.792	1.221
4	−0.929	0.585
5	0.293	−0.037
6	0.250	0.200
7	−0.064	0.826
8	−0.348	1.113
9	−0.624	1.273
10	−0.718	1.399
11	−0.585	1.205
12	−0.533	1.035
13	−0.660	0.964
14	−0.490	0.488
15	−0.163	−0.101
16	−0.238	−0.217
17	−0.183	−0.339
18	0.225	−0.729
19	0.546	−0.882
20	0.052	−0.567
21	0.460	−0.918
22	0.873	−1.197
23	0.793	−0.991
24	0.920	−1.006
25	0.966	−0.920
26	1.005	−0.869
27	1.147	−1.583
28	1.202	−1.444
29	1.346	−0.773
30	1.560	−0.710

Source: data-collected by authors.

cases, and in some other cases, the result shows that positive impact. The test analysis uses two specific variables included consumption prices index and E.C. values. The rates of these indicators are 1.560, 1.346, 1.202, 1.147 and −0.225, respectively, these are all E.C. values. Another variable is the consumption prices index. According to the results, the analysis values negatively affect inflation costs such as −0.710, −0.773, −1.444, −1.583, respectively.

4.6. Variance ratio analysis

The results shown in Table 6 indicate that the performance of R.E.P.s related to the consumption performance by using the test analysis of variance ratio analysis. The total observation of this research study is 29 after the all adjustment the minimum value is 2 and maximum value is 16. In the joint test analysis related to the relative price index and also that consumption energy prices and its expenditure the results based on the two joint test one is Max z and second one is Wald chi square analysis with the help of values, the value of df and also that probability values. The results of first joint test is that its value is 2.2349 and its value of df is 29 also that the probability value of this test analysis is 0.0410 shows 14% significantly level (Ang et al., 2015). The second test of joint represent the Wald chi square analysis in between energy relative prices and also that E.C. prices its basic value is 46.0675 its value of df is 15

Table 6. Variance ratio analysis.

Null Hypothesis: Relative energy prices is a random walk

Sample: 1990 2020
Included observations: 29 (after adjustments)
Standard error estimates assume no heteroskedasticity
Lags specified as grid: min = 2, max = 16, step = 1
Test probabilities computed using permutation bootstrap: reps = 1000, rng = kn, seed = 1260245151

Joint Tests		Value	Df	Probability
Max |z| (at period 2)		2.234976	29	0.0410
Wald (Chi-Square)		46.06754	15	0.0110
Individual tests				
Period	Var. Ratio	Std. Error	z-Statistic	Probability
2	0.584975	0.185695	−2.234976	0.0300
3	0.520361	0.276818	−1.732685	0.0950
4	0.284236	0.347404	−2.060319	0.0160
5	0.319507	0.406838	−1.672637	0.0690
6	0.204680	0.459051	−1.732531	0.0330
7	0.236805	0.506120	−1.507932	0.0850
8	0.150985	0.549294	−1.545647	0.0350
9	0.137165	0.589391	−1.463943	0.0440
10	0.082266	0.626980	−1.463738	0.0080
11	0.110703	0.662474	−1.342388	0.0610
12	0.073071	0.696186	−1.331440	0.0270
13	0.067791	0.728357	−1.279879	0.0490
14	0.044898	0.759180	−1.258070	0.0170
15	0.052874	0.788811	−1.200702	0.0480
16	0.040394	0.817376	−1.174008	0.0340
Test details (Mean = 0)				
Period	Variance	Var. Ratio	Obs.	
1	1.00000	–	29	
2	0.58498	0.58498	28	
3	0.52036	0.52036	27	
4	0.28424	0.28424	26	
5	0.31951	0.31951	25	
6	0.20468	0.20468	24	
7	0.23681	0.23681	23	
8	0.15099	0.15099	22	
9	0.13716	0.13716	21	
10	0.08227	0.08227	20	
11	0.11070	0.11070	19	
12	0.07307	0.07307	18	
13	0.06779	0.06779	17	
14	0.04490	0.04490	16	
15	0.05287	0.05287	15	
16	0.04039	0.04039	14	

Source: data-collected by authors.

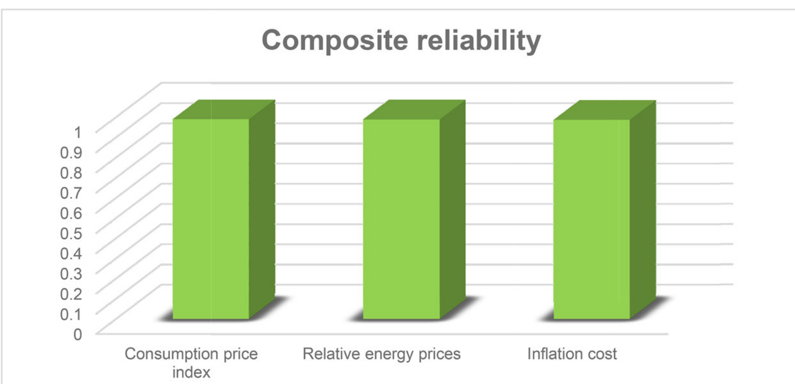

Figure 5. Graph of composite reliability analysis.
Source: made by authors.

and also that the probability value is 0.010 shows 10% significantly level with relative energy and consumption prices index also that its significant effect on inflation costs, shown in Figure 5. Variance test analysis shows that individual test with the help of variance ratio, the values of standard error, the value of Z-statistic, and the values of probability. This test analysis divided into different periods such as 2, 3, 4, etc. its variance ratio analysis shows positive relation between them its values 0.58, 0.53, 0.28, 0.31, 0.23, 0.13 and that 0.04, respectively (Hamilton, 2013). The standard error also presents that positive effect between R.E.P.s and E.C. In some cases, the value of z-statistic shows negatively performance its value of probability is 0.03, 0.09, 0.016, 0.033, 0.85, respectively. These are all present that significant relation between R.E.P.s and also that E.C. Another variance ratio test analysis shows that test details in the form of variance, the variance ratios, and observation values. Its rate of variance of all periods are 1.00, 0.584, 0.52, 0.28, 0.23, respectively the results also shows that variance ratios regarding performance of energy relative prices such as its value 0.58, 0.52, 0.28, respectively these are present that accepted alternative hypothesis. Similarly, its observation values are 29, 28, 27, 26, 25, 21, etc.

4.7. Value of R-square

Result analysis shown in Table 7 and Figure 6 present that values of R-square and that R-square adjusted values of C.P.I. and E.C. values. The rate of R-square is 0.134, and 0.098 shows that the research model is fit for analysis. Its adjusted R-square values is 0.105 and 0.068 shows that 10% and 6% level of validity affects between them.

Table 7. Values of R square with variables.

	R square	R square adjusted
Consumption price index	0.134	0.105
Energy consumption	0.098	0.068

Source: data-collected by authors.

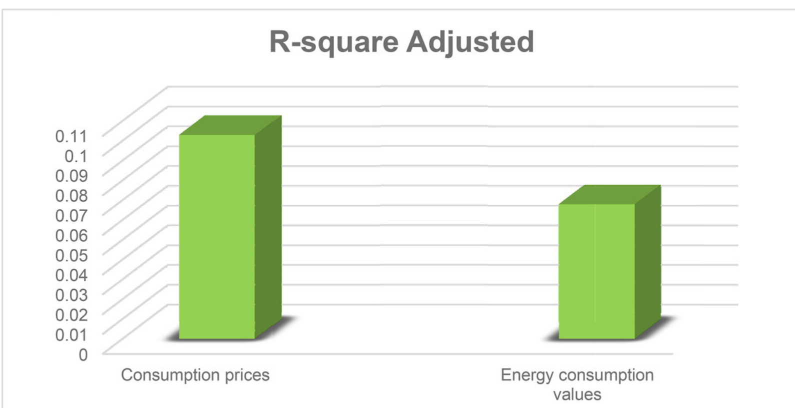

Figure 6. Square adjusted performance.
Source: made by authors.

Table 8. Test for equality of variances between series sample: 1990 2020.

Test for equality of variances between series

Sample: 1990 2020				
Included observations: 31				
Method		df	Value	Probability
Bartlett		5	NA	NA
Levene		(5, 176)	77.56204	0.0000
Brown-Forsythe		(5, 176)	59.57944	0.0000
Category statistics				
Variable	Count	Std. Dev.	Mean Abs. Mean Diff.	Mean Abs. Median Diff.
C	31	0.000000	0.000000	0.000000
REP	30	1.5409	1.2909	1.2709
EC	30	9.049251	8.357966	8.291259
EPI	30	23.55306	18.35327	18.21245
IC	30	5.538345	3.602867	3.163511
CE	31	4.683584	4.092509	4.062224
All	182	9.6608	2.1308	2.1008

Bartlett weighted standard deviation: NA.
Source: data-collected by authors.

4.8. Test of equality

The Table 8 explain that result of equality test analysis of all variance between all series the total sample is 1990 to 2020 shows 20 years effect of R.E.P.s on E.C. For this purpose, used different test method one is Bartlett test its value of df is 5. Second method is Levene that shows the values of result is 77.56 and its probability value is 0.000 shows 100% significantly. Third method of result is Brown-Forsythe its value is 59.57 and its probability value is 0.000. The equality test present that 31 observation for results. Category statistical analysis of all variables included dependent variable and independent variable with the help of standard deviation values, the mean observation means difference values. R.E.P.s show the value of standard deviation is 1.5409 and the value of mean difference is 1.2909. The E.C. shows that value of standard deviation is 9.04 the value of mean is 8.357 similarly, the values of energy prices index shows deviated rate is 23%, respectively. The inflation costs present that 5.53 deviated rate its value of mean observation is 3.60, respectively. The overall count value is 182 and the standard deviation value is 9.6608 also that the mean observation value is 2.1 shows positive relation with E.C. in energy industries.

4.9. Overall unit root ratio analysis

The result analysis represents that automatic lag length related to the summary of root test analysis. This result used different methods, including Levin, Lin and Chu t values of statistic, the value of probability, the values of cross sections, and that shows values of observation analysis. The statistic value is −2.44748 its probability value is 0.00072 also that results shows the overall cross section rate is 5. The total observation of result analysis is 138, 133, 141, respectively. In the unit root test used different method second method is Im, Pesaran and Shin W-Stat its value of statistic is −3.7454 its value of probability is 0.005 shows 100% significantly. The Fisher chi square shows statistic value is 281.303 and the value of probability is 0.000 shows 100% another method of unit root test is Fisher chi square its statistic value is 31.52 and probability value is 0.005, respectively (Table 9).

Table 9. Overall unit root ratio analysis.

Group unit root test: Summary

Series: CONST, Repaid energy prices, Energy consumption, Energy price index, Inflation costs, Consumption expenditure
Sample: 1990 2020
Exogenous variables: Individual effects, individual linear trends
Automatic selection of maximum lags
Automatic lag length selection based on SIC: 0 to 2
Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	−2.44748	0.0072	5	138
Breitung t-stat	−3.83602	0.0001	5	133
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	−3.74547	0.0001	5	138
ADF—Fisher Chi-square	31.5255	0.0005	5	138
PP—Fisher Chi-square	281.303	0.0000	5	141

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.
Source: data-collected by authors.

Table 10. Normality test values.

VAR residual normality tests

Orthogonalisation: Cholesky (Lutkepohl)
Null Hypothesis: Residuals are multivariate normal
Sample: 1990 2020
Included observations: 28

Component	Skewness	Chi-sq	Df	Prob.*
1	0.232884	0.253097	1	0.6149
2	−0.653943	1.995659	1	0.1578
3	−0.459842	0.986788	1	0.3205
4	0.122572	0.070112	1	0.7912
5	−0.139111	0.090309	1	0.7638
Joint		3.395965	5	0.6392
Component	Kurtosis	Chi-sq	Df	Prob.
1	2.257754	0.642751	1	0.4227
2	4.689094	3.328544	1	0.0681
3	3.455529	0.242091	1	0.6227
4	2.805591	0.044094	1	0.8337
5	2.734213	0.082417	1	0.7740
Joint		4.339897	5	0.5016
Component	Jarque-Bera	Df	Prob.	
1	0.895849	2	0.6390	
2	5.324203	2	0.0698	
3	1.228879	2	0.5409	
4	0.114206	2	0.9445	
5	0.172726	2	0.9173	
Joint	7.735862	10	0.6546	

*Approximate p-values do not account for coefficient.
Source: data-collected by authors.

4.10. Normality test

The above test analysis shown in Table 10 presents that variance normality test analysis of all components included skewness, chi-square values, the value of df, and the probability values of component five. The value of skewness are 0.23, −0. 65, −0.45 and 0.12, respectively. The chi-square value is 0.25, 1.99, 0.98, 0.07 and 0.09 shows positive square values the probability value is 0.61, 0.15, 0.32 shows insignificantly effect of all indicators related to the R.E.P.s and E.C. The value of kurtosis of five components is 2.25, 4.68, 3.4, 2.8 and 2.7, respectively, which shows a significant effect between them. The chi-square value is 0.64, 3.32, 0.24, 0.04 and 0.08, showing positive results related to relative energy enterprises. The probability of all components is 0.42, 0.06, 0.62, 0.83 and 0.77, respectively shows that some is significant, and some is insignificant effect between them. In the normality test shows that Jarque-Bera test analysis of all components its Jarque-Bera rates according to the results are 0.895, 5.32, 1.22, 0.11 and 0.17, respectively. The value of df is 2 and total value of df is 10 its probability values is 0.63, 0.06, 0.54, etc. some shows significantly, and some shows insignificant effects between them. Normality test analysis represent all approximated results related to the R.E.P.s and consumption performance in industries of China.

4.11. Cointegration test

The results shown in Table 11 present that cointegration analysis related to the integrated values of R.E.P.s and that E.C. values are based on eigenvalue, the value of statistic, value of critical, and probability values. The probability values show that 0.000, 0.009, 0.50, 0.61, respectively. The result indicates that at most 1, 2, 3 and 4

Table 11. List of cointegration test.

Sample (adjusted): 1993 2019

Included observations: 27 after adjustments
Trend assumption: Linear deterministic trend
Series: REP EC EPI IC CE
Lags interval (in first differences): 1 to 2
Unrestricted Cointegration Rank Test (Trace)

Hypothesised No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical value	Prob.**
None*	0.880161	142.2113	69.81889	0.0000
At most 1*	0.788221	84.92804	47.85613	0.0000
At most 2*	0.730004	43.01835	29.79707	0.0009
At most 3	0.240047	7.665912	15.49471	0.5018
At most 4	0.009380	0.254463	3.841466	0.6139

Trace test indicates 3 cointegrating eqn(s) at the 0.05 level.
* Denotes rejection of the hypothesis at the 0.05 level.
Source: data-collected by authors.

Table 12. Unrestricted cointegration rank test.

Hypothesised No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None*	0.880161	57.28327	33.87687	0.0000
At most 1*	0.788221	41.90969	27.58434	0.0004
At most 2*	0.730004	35.35244	21.13162	0.0003
At most 3	0.240047	7.411449	14.26460	0.4417
At most 4	0.009380	0.254463	3.841466	0.6139
Unrestricted Cointegrating Coefficients (normalised by b′*S11*b = I)				
REP	EC	EPI	IC	CE
1.40E-09	−0.051340	−0.039635	−0.513709	0.062700
−7.66E-10	0.596549	0.270798	1.136740	−0.460981
1.06E-09	−0.528592	−0.169697	1.001309	0.139719
1.11E-10	−0.146259	0.040935	−0.139957	0.596814
−2.90E-10	−0.202133	0.039480	−0.031448	0.336240

Max-eigenvalue test indicates 3 cointegrating eqn(s) at the 0.05 level.
* Denotes rejection of the hypothesis at the 0.05 level.
***p*-values.
Source: data-collected by authors.

the level of 0.05 its results values shows that 0.88, 0.788, 0.73, 0.24 and 0.0093 shows positive relation between them. The results show performance of probability shows that 0.000, 0.000 shows 100% significantly.

The results shown in Table 12 explain that the fourth cointegration equation test related to the normalised cointegration explains R.E.P.s and E.C. its values are 1.000, 0.000, −16,898,123, respectively. The adjustment coefficient values of standard error in all parameters related to the inflation costs of the E.C. values. Its rate of analysis is −2.08, 1.48, −2.74, 7.9 and 4.00, respectively. The result indicates that normalised cointegration coefficient test analysis relation to the second equation its normality rate is 1.000. The value of energy price index is −2.827 also that shows consumption expenditure shows that normalised comigration value is 44,721, respectively. The adjusted coefficient values of standard error is −1.35, −1.94 and 5.8010, respectively.

The results indicate that unrestricted adjusted coefficient values of alpha, at D(REP0), D(EC), etc. are negative and some show a positive relation between them. The values of results show −32762, −9.69, 0.300, 0.41, positively related to the coefficient performance between E.C. and R.E.P.s.

5. Discussion

The research study is based on R.E.P.s and its impact on industries E.C. the main consideration is inflation costs. This research was conducted in China and results run from the P.L.S. software regarding performance measurements of E.C. The main results concluded that there is a significant relationship between R.E.P.s fluctuations and the consumption of Chinese industries. These outcomes are similar to the results of Ike et al. (2020), who also investigated that if the prices of the energy change, the consumption level of the energy in the industry also changes. Moreover, a study conducted by Ferdaus et al. (2020) also examined that the consumption level of energy in the industry could be affected by the prices of energy in the country. In addition, the results also exposed that the inflation rate changes due to changes in R.E.P.s so, there is a direct relationship between R.E.P.s and inflation costs of the Chinese economy. These results are also similar to the outcomes of Usman et al. (2020), who also investigated that the inflation cost also moves with the movement of the energy prices in the country. In addition, a study by Pernetti et al. (2021) also indicated that increases in energy prices cause increases in the cost of inflation in the country and this outcome is matched with the current research outcomes. Research study enhance the values in economy and markets of E.C. In this research the dependent variable is consumption prices, inflation costs, the value of consumption prices index, etc. the independent variable is R.E.P.s related to the E.C.

6. Conclusion

As it noted that with the variation in energy prices, the values of different products and goods also changed. It is also examined that changes in energy prices have been leaving lasting impact on stock market of China from recent many years. In this research article, we studied the association between relative prices of energy and consumption of energy at industrial level in China. To examine these associations, we use different models, showing the direct influence of energy prices on industrial consumption of energy and at household consumption. There seems direct relationship between them, which means that with the change in energy prices, prices of goods and products also changed, and it has also a lot impact on consumption of energy. The effects of low and high prices of energy are also discussed in this research article. After examining the high and low energy prices effects, it is concluded that high prices of energy have a significant impact on China's industry compared to the low prices of energy. During this research, it was also noted that with the increase in the price of energy, the countries that import energy resources have been affecting more significantly, especially those countries that have no energy resources in their country. Due to the increase in energy price consumers consume less energy in their homes. At the industrial scale less E.C. products have been made. Because of this, the price of products and goods increased in these countries, affecting the economy significantly.

Apart from this, these relative changes in the prices of energy also affect the supply and demand of different things. To explain the impact of R.E.P.s on China's industrial E.C. a vast literature from different research is presented in this article. Furthermore, the association between economy growth and E.C. has also been discussed in detail. For this purpose, we investigate sample data from different resources from the period of 1998 to 2019. After examining this sample data and their results, it is concluded that there is a direct strong positive association among relative prices of energy, economic development of any country and consumption of energy at industrial scale. Apart from this, we also examined the association between change in energy price and international competitiveness to export and import of goods and products. The results showed the negative relationship between them, which means that the increase in the prices of energy has no impact on the international market. In addition, we further research the impact of R.E.P.s on industrial consumption of energy in China.

Firstly, according to the I.D. economic development model, the distressing impact of increase in the price of energy on overall consumption is not obvious because the energy demand was firm, and prices of energy are not trade oriented. Whereas for a certain period, when the overall energy prices are stable, it enabled industries for regular consumption of energy. During this period, the impact of energy prices seems negative. Which shows that increase in the prices of energy enhance energy efficiency and reduce the intensity of energy in China for a certain period. Especially when the level of energy prices is relatively firm.

Secondly, it is also concluded that the impact of increasing and decreasing R.E.P.s on the consumption of energy in China is remarkably unsymmetrical. Because the distressing impact of increasing prices of energy on overall consumption of energy and the intensity of energy seems so far lower than the uphill impact of falling prices of energy. Our findings also indicate that less energy prices from today's compulsory energy prices techniques are the vital element obstructing in the path of saving energy and in the reduction of emission. Therefore, trade-oriented refinement for the prices of energy is an important policy supervision to conserve energy. Apart from this, our findings also explain that accommodations to the internal structure of industries are the key factor in conserving energy. But the leading force is mandatory to attaining these consequences. Trade-oriented energy prices could effectively provide the leading force for the accommodation of industrial internal structure and optimisation.

Therefore, there is a need to pay more attention to the association between marketisation of energy prices and accommodation of the industrial internal structure. Results run from the P.L.S. software with the help of different normality test, test of R-square, values of F-statistic, the cointegration test, the summary of unit root test analysis shows that there is a direct relationship between R.E.P.s and E.C. in energy industries when the prices of relative energy increase there is also increase the inflation costs. So, these concluded a significant impact between R.E.P.s on industrial E.C. in China. Thirdly, in this research article, we also discussing that the trade-oriented refinement is an important factor for the saving of energy and reducing emission in China. So, the government of China should made different policies to control the prices of energy and economic growth of China.

6.1. Future research direction and limitations

The current research has several limitations that provide the guidelines to the future studies, such as the current study examined only the energy prices to predict inflation and consumption and ignores the other factors and suggested that future studies should add these factors in the analysis. In addition, the present study also investigated the economy of China and ignored the other economies and suggested that future studies should add other economies to expand the study scope. Moreover, the time span of the study is limited, such as from 1990 to 2019 and recommended that future studies should include more time span in their studies. Finally, most of the statistical techniques were ignored by the study, such as error correction model (E.C.M.) and autoregressive distributive lag models (A.R.D.L.) and suggested that future studies should add these techniques in their articles. The fact is that for achieving our goals, there is the need to reduce government control on the prices of energy, which lead us towards more effective techniques of discovering the prices of energy due to which prices of energy more significantly reflect by the demand and supply. Furthermore, accommodation in the price of energy subsides slowly to get rid of confusions in information related to the consumption of energy and leading company to promote technological revolution and for the betterment of the effectiveness of energy which in result will boost up saving of energy in industries and reduce emission. Apart from this, energy prices refinement decreases the use of energy. There is also a need to further review the leading forces for saving energy and growth of economy; specifically, there is a need to pay attention to new technologies to conserve energy for future use.

Disclosure statement

No potential conflict of interest was reported by the authors.

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