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Investigation of the Impact of Energy Consumption on Added Value in Agriculture Sector in Iran

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ABSTRACT

The present research tries to investigate relationship between fuel consumption in agriculture sector, agricultural prices and added value in this sector during 1961-2007 period of time. Results of the present research can facilitate investigation of possible impacts of fuel price increase on added value and agricultural products price in light of execution of Targeted Subsidies Policy and increase in fuel prices. In order to collect data, library method, valid statistical resources like national energy balance sheet, economic accounts department of IRI national Bank, time series, economic statistics of organization of National Management and Planning and International Money Fund statistics were used. In order to investigate causal relationship, Granger's causality test was used. In order to identify relationships among variables, Johnson test and error correction model were used. Results of the research show that implicit index of agriculture price and fuel consumption in this sector cause changes in added value of agriculture sector. Fuel consumption has positive impacts on increasing added value and increase in agricultural products prices result in increase in agriculture sector added value both directly and via increase in supply and production.

KEYWORDS: added value-price index-fuel consumption-energy

INTRODUCTION

Today's world is the world of economic and industrial development and the process of development has been accelerated within the past few decades. Energy is the most important commercial product and has the greatest share in global commerce. Energy is of great importance for human activities. After industrial revolution beginning and formation of machine industries, energy became the main factor in production in industries. Gradually, energy became more and more important as industries became modernized and economies began to grow. Fluctuations in petroleum prices in 1970s along with economic recession in western countries increased the importance of energy in economic transformations and in 80s, relationship between energy consumption and economic growth received a lot of attention by economists.

Thus, relationship between consumption and cost of different fuels like petroleum products, natural gas and electricity received a lot of attention by economical analysts as important factors of production and added value in agriculture sector. Determination of relationship between energy consumption (especially in agriculture sector) and added value in agriculture sector can be effective in making policies in energy sector. Since Targeted Subsidies Policyhas been passed and enacted in Iran and government economic policies are concentrated on restriction of energy consumption and especially petroleum products and gasoline and due to problems arising from natural gas pressure reduction and disconnection of gas in some provinces or reduction in electricity production in factories which consume natural gas as fuel in the past few years, it seems necessary to specify and clarify energy consumption policies in agriculture sector. The present research tries to investigate variables like fuel consumption in agriculture sector, agriculture prices index and other concerning variables during1961-2007 time period.

Research theoretical framework

Cheng and Lai (1997) used Granger Heshyao's causality test and found a causal one-way relationship from national gross production towards energy consumption and a one-way causal relationship from energy to employment during 1993-1995 period in Taiwan. Glasher (2002) investigated relationship between energy consumption and real income in Korean economy during 1961-1990. Glasher concluded that absence of relationship between national income and energy consumption in former studies is resulted from absence of variables affecting national income. Pardo and Climents (2006) investigated relationship between GDP and energy consumption using multivariate method and assuming substitution of energy consumption with other inputs and considering technologic changes. They concluded that a long-term causal relationship between energy consumption and GDP can be considered using multivariate co integration analysis. Further, they found

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a one-way causal relationship between energy consumption and economic growth. Koucheki and Sadr AbadiHaghighi (1998) investigated some of agricultural products of Khuzestan Province in order to evaluate energy inputs and their shares in the province agricultural systems and also evaluate energy efficiency of these systems. Results showed that tomato needs the most human work hours and non-irrigated crops need the least human work hours. Further, lentil had the greatest energy efficiency. Results of measurement of share of each energy input revealed that low energy efficiency is resulted from high share of fossil energy, inadequate use of human resource input and weak performance in unit area.

Arman and Zare (2004) investigated causal relationship between energy consumption and economic growth. They used error correction method in order to investigate causal relationship between the mentioned variables during 1967-2002.Results of error correction models estimation revealed that there is a mutual causal Granger relationship between electricity consumption and economic growth in the short term and long term. NajjarZadeh and Abbas Mohsen (2004) investigated relationship between fuels consumption (petroleum, gas and electricity) and development of economic sectors including agriculture, industry, transportation and service in Iran using Hisao causality test during 1971-2002. They concluded that there is a mutual causal relationship between fuels consumption and development of economic growth in Iran.

Research hypotheses

1. Reduction in fuel consumption in agriculture sector causes positive fluctuations in added value.
2. Reduction in fuel consumption in agriculture sector has positive significant influence on price indices of agricultural products.

RESULTS

Since only variables which have the same cointegartion degree can be accumulated. First, it is necessary to determine degree of cointegartion for variables. Dickey Fuller test or generalized Dickey Fuller test was used for determination of degree of cointegartion for variables. The results have been summarized in table 1.

Table 1. Results of investigation of stagnation for inserted variables in the model in the first order level and subtraction

		ADF in level			Firs order subtraction ADF		
variable		AP	AF	AAD	AP	AF	AAD
H0		AP has unit root	AF has unit root	ADD has unit root	AP is statistic	AF is statistic	ADD is statistic
remarks		Intercept and trend	Intercept and trend	Intercept and trend	Intercept and trend	Intercept and trend	Intercept and trend
Test statistic		-1.12	-1.38	-0.93	-4.13	-7.83	-8.31
Critical values	%1	-4.1	-4.1	-4/1	-4.1	-4.1	-4.1
	%5	-3.52	-3.52	-3.52	-3.52	-3.52	-3.52
	%10	-3.19	-3.19	-3.19	-3.19	-3.19	-3.19

Reference: research results

Philips Pron and KPSS tests were used in order to control and make sure of the results of Dickey Fuller's unit root test. These tests have different zero hypotheses and therefore, exactness of investigation of stagnation of variables increases. According to the results of tables 2 and 3 which verify the results of Dickey Fuller test, first order subtraction of all variables of the model is static and we can conclude that their cointegrationdegree is equal to 1.

Table 2: results of investigation of stagnation for variables inserted into the model in level

		Phillips-Perron			KPSS		
variable		AP	AF	AAD	AP	AF	AAD
H0		AP has unit root	AF has unit root	ADD has unit root	AP is statistic	AF is statistic	ADD is statistic
remarks		Intercept and trend	Intercept and trend	Intercept and trend	Intercept and trend	Intercept and trend	Intercept and trend
Test statistic		-0.19	-1.89	-2.42	0.19	0.20	0.17
Critical values	%1	-4.1	-4.1	-4.1	0.21	0.21	0.21
	%5	-3.52	-3.52	-3.52	0.15	0.15	0.15
	%10	-3.19	-3.19	-3.19	0.12	0.12	0.12

Reference: research results

Table 3.Results of investigation of stagnation for variables inserted into the model in the form of first order subtraction

		Phillips-Perron			KPSS		
variable		D(AP)	D(AF)	D(ADD)	D(AP)	D(AF)	D(ADD)
H0		D(AP) has unit root	D(AF)has unit root	D(ADD)has unit root	D(AP)is statistic	D(AF)is statistic	D(ADD)is statistic
remarks		Intercept and trend	Intercept and trend	Intercept and trend	Intercept and trend	Intercept and trend	Intercept and trend
Test statistic		-8.68	-7.48	-8.21	0.08	0.11	0.056
Critical values	%1	-4.1	-4.1	-4.1	0.21	0.21	0.21
	%5	-3.52	-3.52	-3.52	0.15	0.15	0.15
	%10	-3.19	-3.19	-3.19	0.12	0.12	0.12

Reference: research results

After determination of the variables integration order, it is necessary to determine the number of optimum break inserted into the model using one of the Akaike or Schwartz Bayesian criteria. In the present research, the number of optimum break was assumed equal to 2 using Akaike or Schwartz Bayesian criteria. Before investigation of long-term relationship, we can investigate causal relationship between model variables. Results of Granger's causality test have been summarized in table 3.

Table 4.Results of Granger's causality test

H0	*Number of observations*	*F statistic*	*probability*
Fuel consumption is not a cause for added value in agriculture sector	29	20.98	0.005
Added value is not a cause for fuel consumption in agriculture sector	29	0.49	0.85
Price index is not a cause for added value in agriculture sector	37	6.17	0.0018
Added value is not a cause for price index in agriculture sector	37	1.41	0.27
Price index is a cause for fuel consumption in agriculture sector	29	0.70	0.71
Fuel consumption is a cause for price index in agriculture sector	29	8.53	0.02

Reference: research results

Results of causality test in table 4 show that as it was expected, implicit index of agricultural products prices and fuel consumption in this sector are causes for changes in agricultural sector added value. This is while the reverse of this relationship does not hold zero hypotheses -which refers to the absence of causal relationship from added value to price and consumption of agriculture sector-is not rejected. Results also indicate that there is a causal relationship from fuel consumption to implicit index and fuel consumption is the cause of fluctuations in agricultural prices index. The reverse of this relationship is not verified.

Matrix test was used to determine the number of cointegration vectors among variables and its results have been summarized in table 5. In order to investigate the presence of trend and intercept in the model, this test was conducted considering 3 cases: presence of cointegration in long-term relationships, presence of cointegration in short-term relationships and presence of first grade temporal trend in the long-term model. First and fifth cases are eliminated because they are less possible (Noferesti, 1999). Considering the results of table 5, the hypothesis of absence of a cointegration vector among model variables in the three cases is rejected. Therefore, the hypothesis of presence of a cointegration vector is investigated in the next step. Results of the test verify this assumption in tables (3) and (4). Therefore, the number of cointegration vectors among variables is equal to 1 and this vector is estimated considering cointegration in short-term relationships (case 3).

Table 5.Matrixrank test and identification of cointegration and trend in the model

Case 4		Case 3		Case 2		H1	H0
CV (95)%	Statistic	CV (95)%	Statistic	CV (95)%	Statistic		
λ_{Trace}							
42.34	44.64	28.78	29.54	34.87	63.34	R=1	R=0
25.77	23.84	15.75	8.90	20.18	25.47	R=2	R≤1
12.39	8.26	6.5	0.60	9.16	7.53	R=3	R≤2

Reference: research results

Results of estimation of normalized cointegration vector are as follows:

LADD=0.21(LAP)+ 0.086(LAF)

(0.019) (0.098)

(numbers inside the parentheses show standard deviation)

According to this equation, fuel consumption has a positive impact on increasing added value. This is not unexpected because of the impact of increasing input consumption on increasing production and increasing

added value. Price variable coefficient in agriculture sector has a significant positive influence on agriculture added value. This means that increase in agricultural products prices increases agricultural added value both directly and via increasing supply and production. According to long-term relationship, 1% of increase in fuel consumption and agriculture price implicit index increase agricultural added value by 0.086% and 0.21%, respectively. Error correction term was extracted through calculation of disruption element in cointegration vectors using the results of the previous section. Error correction model connects variables short-term fluctuations to long-term balance values. Results of estimation of error correction models have been summarized in table 6 (numbers inside parentheses are t statistics values).

Table 6.Results of estimation of vector error correction estimation for variables under study during 1968-2007

	LAD	LAP	LAF
intercept	**0.629 (0.96)**	**-8.03 (-3.08***)**	**3.19 (2.75***)**
breakLAD	**-0.25 (-1.44)**	**-1.6 (-2.3**)**	**0.37 (1.2)**
breakLAP	**-0.008 (-0.23)**	**-021. (-1.46)**	**-0.22 (-3/34***)**
breakLAF	**0.009 (0.10)**	**0.68 (1.98**)**	**-0/025 (-0/16)**
ECM	**0.061 (0.87)**	**-0.88 (-3/16***)**	**0/33 (2/66***)**
R^2	**0.1**	**0.88**	**0.38**
DW	**1.98**	**2.07**	**1.99**

Reference: research results

Conclusion

The main results of the hypotheses tests can be summarized as follows:

- Results of causality test revealed that implicit index of agriculture price and fuel consumption of this sector is a cause for fluctuations in agricultural added value. Further, presence of a causal relationship from fuel consumption to implicit index of price was verified.
- Results of cointegration test showed that fuel consumption has a positive impact on increasing added value. This is an expected result because of the impact of increasing input consumption on increasing production and added value. Price variable coefficient in agriculture sector has a positive and significant impact on added value in agriculture sector. This means that an increase in agricultural products price results in increase in agriculture sector added value both directly and via increasing supply and production. According to the long-term relationship, 1 percent increase in fuel consumption and implicit price index of agriculture sector increases agriculture added value by 0.09% and 0.21%, respectively.
- Results of cointegration vector, error correction term coefficient is equal to 0.06 in agriculture added value equation. This is indicative of adjustment speed towards long-term balance. In other words, in each period, 6% of the imbalance of added value in agriculture sector is adjusted.
- Error correction coefficient in agriculture price index equation shows that 88% of imbalance is adjusted in each period. Results of fuel consumption error correction coefficient indicate that 38% of imbalance is adjusted towards long-term balance in each period. A high value of error correction coefficient and adjustment speed is indicative of government's short-term policies effectiveness. This indicates that more attention should be paid to policy-making, selection of instrument and target variable. Unit root test which was conducted on the remainder of the model is indicative of stagnation of model remainder in level.
- Results of instantaneous response function on the three variables: added value, implicit price index and fuel consumption in agriculture sector in 10-year temporal horizon show that an impulse and shock has been exerted into added value, fuel consumption and price index equations which are equivalent to standard deviation from added value. Results show that the exerted shock into added value is not adjusted by fluctuations in added value while the shock exerted to fuel consumption and price index becomes zero in periods 2 and 3.
- According to instantaneous response function, added value and fuel consumption of agriculture sector responded seriously to the shock exerted by prices index such that the effect of the shock exerted by price index into added value becomes zero in period 3 and the effect of the shock exerted on fuel consumption becomes zero in period 1. This is while the shock resulted from price index is adjusted slowly.
- For the case of price index, return to long-term balance due to the shock lasts long but adjustment speed is more than the shock exerted on added value on cointegration vector.

- The effect of the shock exerted on fuel consumption on cointegration vector tends to long-term relationship with a slow speed and imbalance increases in the primary periods and then decreases.
- Results of variance analysis of agriculture sector added value variable shows that added value has the greatest share in added value fluctuations and fuel consumption and prices index have a small share of the variance of this variable. In period 25, added value share is 85% of the variance of the added value and other two variables (fuel consumption and prices index) own less than 15% of this variance and do not have much impact on fluctuations.
- Results of price index variance analysis revealed that the share of added value in price index variance is increasing by time and it reaches 67% in period 25 and this is indicative of the effectiveness of this variable on price index fluctuations.
- Results of fuel consumption variable variance analysis revealed that fuel consumption has the greatest share in variance of fuel consumption variable but the share of price index variable increases by time. Results showed that price index share becomes 33% in period 25 and the share of fuel consumption variable becomes 43% of the variance of fuel consumption in period 25.

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