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Effects of Declining Energy Subsidies on Value Added in Agricultural Sector

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ABSTRACT

Production subsidies, as a part of the strategy of economic growth of the agricultural sector, are of great importance around the world. Subsidizing production inputs, particularly energy input, is another way of directing subsidy to the agricultural sector. In this research, production function of the agricultural sector was estimated using econometric methods and time series data. After calculating the elasticity of agricultural sector inputs and, simultaneously, estimating their cost and demand functions of production inputs using ISUR (Iterated Simingly Unrelated Regression), farmers' elasticity of price fluctuation of these inputs was determined. The findings of the production function demonstrated that all inputs, including capital, labor, and energy were used in the optimal production region. The findings of the cost function demonstrated that there was negative and low own elasticity price for inputs, in accord with economic theory. In addition, cross price elasticity of all inputs was positive, i.e. they were substitutes for each other. The findings of the subsidization policy showed that since price elasticity of demand for energy inputs was inelastic, reducing the energy subsidy would reduce energy consumption slightly and, eventually, would decrease value added in the agricultural sector. Finally, it is suggested that the government implements the energy subsidy reduction policy based on cost-benefit analysis.

Keywords: Value added, Energy, Production function, Subsidy.

INTRODUCTION

After more than two decades of general neglect of agriculture as a source of balanced socio-economic growth, there is increasing recognition of the importance of this sector in development. For example, the International Bank for Reconstruction and Development (the World Bank) published its 2008 World Development Report on agriculture entitled "Agriculture for Development". This publication and its message in support of agriculture as a key sector to economic growth have been welcomed by a wide range of audiences, from politicians to academics (Salami *et al*., 2012).

Energy markets are important to agriculture. Energy prices affect agricultural production costs directly through fuel and energy use and indirectly through the employment of farm inputs such as fertilizers and chemicals that rely on energy in their manufacturing (Lambert and Gong, 2010). Traditionally, energy is considered as an input for agricultural production. In the new era of renewable energy production, the relationship between energy and agricultural sector has become more interdependent (Aravindhakshan and Koo, 2011).

From the standpoint of the executives of Iran's economic freedom policy, the low price of agricultural inputs and production subsidies leads to low productivity in the agricultural sector and lower increases in production. The leaders of this policy believe that the low price of production inputs causes suboptimal use of

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these factors. Therefore, they argue that after implementing economic freedom and the consequent increase in the price of inputs, producers would optimize use of production factors (Zibayi and Najafi, 2004).

Debra (2002), in "Agricultural Subsidy in Africa", states the main reasons for supportive policies in the world's agricultural sector. Those reasons are economic development and growth, especially in rural areas, as well as supporting investment and employment; maintaining domestic product with less dependency on overseas agriculture; and removing or reducing poverty to reach suitable life conditions.

Energy carrying materials have been important ever since they could be used as a substitute for other factors, and have had a significant role in providing goods and services. Energy carrying materials were much used in the manufacturing sector, but technology improvements and machinery for providing services in different sectors, including agriculture, could become important factors in providing goods and services (Fallahi and Khalilian, 2009).

Since agricultural products are essential for provision of a society's needs, governments normally pay subsidies for their production in order to both strengthen the agricultural sector and keep prices low for consumers. Since energy is a strategic input in different sectors of production, its effects on the agricultural sector are studied here.

Subsidy policy is the main supportive tool of government. At the same time, paying agricultural subsidies is one of the main supportive governmental policies benefitting the agricultural sector. By paying subsidies on agriculture inputs, government tries to keep the input price low and to reduce production costs, increase farmers' incomes, increase domestic producers' competitiveness and support them, reduce exchange run out, and increase production. On the other hand, farmers may overuse these inputs because of their low price (Shemshadi, 2007).

Commonly, the two inputs of capital stock and labor are used in estimating the total production function. Results of new researches in Iran's agricultural sector have shown that energy input is very important, next to capital stock and labor inputs, and directly affects the production level (Hozhabr Kiani and Varedi, 2000; Fallahi and Khalilian, 2009). Ma *et al.* in an article entitled " China's energy economy: Technical change, factor demand and interfactor/interfuel substitution," calculated the Allen partial elasticities of factor and energy substitution, and price elasticities of energy demand for China using a two-stage Translog cost function approach during the study period (1995–2004). The results of their article showed that energy is substitutable for both capital and labor. Coal is significantly substitutable with electricity and complementary with diesel, while gasoline and electricity are substitutable with diesel (Ma *et al.*, 2008).

In a research in Gilan Province, different production functions were estimated and the best one (Translog) was selected, production inputs were calculated, and the Translog cost function was estimated using ISUR and relative and cross elasticity. Allen's cross elasticity and demand functions of inputs were calculated to investigate the effects of removing the subsidy on fertilizer and insecticides in this province. The findings showed that fertilizer was consumed in Production region II since its demand function was elastic. Removing its subsidy would increase its price and decrease the use of fertilizer in production; moreover, insecticide was consumed in Production region III and was demand elastic. Hence, increasing its price leads to this input being used in Production region II (Azizi, 2005).

Becker (2010) stated that, from 1992 to 2007, the US agricultural market underwent many changes with respect to the inputs they utilized, as well as the prices they paid for them. Among these changes, fuel prices displayed the most severe volatility. By using the Translog Production Function, the price elasticity of substitution was estimated for all agricultural inputs during the period studied, in order to determine how farms change production allocations due to increasing energy prices. It was found that price elasticities were very low between energy and other inputs, suggesting that farms did not change their input allocations due to increases in energy prices (Becker, 2010).

The present paper addresses the sensitivity of the coefficient of energy input consumption and the value added of the agricultural sector to a one percent change in the energy input price in the agricultural sector. In other words, the present paper explains how sensitive agriculture is to changes in the energy price, based on the policy of energy price increases in Iran.

MATERIALS AND METHODS

Determining farmers' sensitivity to price changes is an essential part of policymaking about production subsidies. In this research, a production function was used to determine the agricultural sector's sensitivity to changes in inputs consumption and the sector's sensitivity to inputs' changing prices was determined through cost function and cost share equations.

We investigated the rationality of the agricultural sector by using inputs through the production function, input-output relationship, and the relative importance of every input in increasing the sector's production and determining production elasticity. The consumption amount, which is affected by price changes, and production quantity, which is affected by consumption changes, also are determined through the demand for production inputs.

In this research, in order to estimate the production function and to investigate the long-term and short-term relationships between dependent variables and other dependent variables of pattern, we used an auto regressive distributed lag model (ARDL). Because of the limitations in the methods of the Engel-Granger, Johansen, and Juselius test and error correction model, some research, such as that of Pesaran and Pesaran (1977), tried to find a better method for analyzing long-term and short-term relationships between variables, to cover the shortcomings of these methods. The Pesaran and Pesaran method simultaneously estimates the relationships between the dependent variable and the variables of other dependent models, and solves the problem of variable omission and autocorrection. Since this model does not have problems such as serial autocorrelation, its estimates are unbiased and effective (Siddiki, 2000).

Cost Function and Demand Functions

For the first time, Christensen *et al.* (1973) studied theoretical principles using the Translog cost function, which is a function of production level and input prices, and is used to estimate the cost function of the agricultural sector and to define inputs' demand functions. The Translog function can be changed using Taylor's Expansion (Carr, 1992):

$$\ln \mathrm{C} = Ln\alpha_0 + \sum_{i+1}^{n} \alpha_i LnP_i + \frac{1}{2}\sum_{i=1}^{n}\sum_{j=1}^{n} \gamma ij LnP_i LnP_j + \sum_{i=1}^{n} \gamma_{yi} LnyLnP_i + \gamma_y Lny + \frac{1}{2}\gamma_{yy}\left[Lny\right]^2 \quad (1)$$

Using the partial derivative of the Translog logarithmic cost function for the n^{th} input and considering Shepherd's theorem, the demand function of the n^{th} input becomes:

$$S_i = \frac{X_i P_i}{C} = \alpha_i + \sum_{i=1}^{n} \gamma_{ij} \ln p_i + \gamma_{iy} \ln Y \quad (2)$$

Where, $C = \sum_{i=1}^{n} X_i P_i$ and S_i is the cost portion of the n^{th} input.

ISUR was used to estimate the Translog simultaneous equations system and the demand functions of inputs. SUR effectively estimates a group of linear regression equations that are interconnected. Zellner (1962) describes this method. In his work, joint generalized least squares are used to estimate the coefficients of a group of linear regression equations. In estimating equations using ISUR, one of the cost share equations is removed from the system of equation and the other parameters are estimated; then, the parameters of the equation are taken away and the equations are solved based on other parameters. Next, one of the variables is removed from the cost portion equation, and the price of other inputs is replaced with relative price (relative to the removed input prices) and the total cost is replaced with relative total cost (relative to removed input prices) in the model (Greene, 2003). Since the total cost share equals 1, any item can be removed (Lindert, 1989). However, in the SUR method, the equation that has had the least determination coefficient (R^2) in OLS estimation method is removed. In order to avoid these limitations, ISUR is used instead of SUR, because ISUR estimations are not sensitive to the removed equation of the maximum likelihood (ML) method, which is unique and independent from the removed equations (Barten, 1969). In fact, ISUR repeats the SUR method until reaching convergence.

Accordingly, applying the conditions and assumptions of symmetry and homogeneity in cost function equations, the form of the function changes to:

Considering the results of cost function and inputs demand, Allen's substitution elasticity is calculated in the following way:

$$Ln(\frac{c}{P_0}) = Ln\alpha_0 + \sum_{i=1}^{n}\alpha_i Ln(\frac{P_i}{P_0}) + \frac{1}{2}\sum_{i=1}^{n}\gamma_{ij}Ln(\frac{P_i}{P_0})^2 + \sum_{i=1}^{n}\sum_{j=1}^{n}\gamma_{ij}Ln(\frac{P_i}{P_0})Ln(\frac{P_j}{P_0}) + \sum_{i=1}^{n}\gamma_{iy}LnyLn(\frac{P_i}{P_0}) + \gamma_y Lny + \frac{1}{2}\gamma_{yy}(Lny)^2 \quad (3)$$

$$S_i = \alpha_i + \sum_{i=1}^{n}\gamma_{iy}Lny + \sum_{i=1}^{n}\gamma_{ij}Ln(\frac{P_i}{P_0}) \quad (4)$$

$$A_{ii} = \frac{(\gamma_{ii} + S_i^2 - S_i)}{S_i} \quad i = \text{K, L, S} \quad (5)$$

$$A_{ij} = \frac{\gamma_{ij} + (S_i S_j)}{S_i S_j} \quad (6)$$

Based on the relationship between price elasticity of demand and Allen's substitution elasticity:

$$E_{ij} = S_j A_{ij} \quad E_{ji} = S_i A_{ji} \quad (7)$$

The macro data were gathered from the published database of the Central Bank, Energy Balance Sheet, and the Iran Statistics Center (1974–2008).

Consequently, the agricultural production function was estimated and production elasticity of the inputs was calculated. Then the demand function of the agricultural sector's inputs was estimated to investigate the effect, as well as the effectiveness, of this policy on the value added of the agricultural sector. Next, the way this governmental policy can influence value added was estimated by calculating the price elasticity of demand.

RESULTS AND DISCUSSION

In a number of countries including Iran, production functions like the Cobb-Douglas, Transcendental, and Translog are chosen for estimation of the agricultural production function (Torkamani, 1998). In this research, results from investigation of the mentioned functions showed that the Cobb-Douglas function was best suitable for the agricultural sector production function, in agreement with most of the literature on the production function of Iran's agricultural sector (Amir Teymori and Khalilian, 2008; Soltani, 2005). Cobb-Douglas function's form is shown below:

$$LnVA = C + \beta_1 LnL + \beta_2 LnK + \beta_2 LnE + \text{Dj} + \text{D7476} \quad (8)$$

The variables of the research are:

LVA: Natural logarithm of value added in the agricultural sector

LL: Natural logarithm of labor in the agricultural sector

LK: Natural logarithm of capital in the agricultural sector

LE: Natural logarithm of energy in the agricultural sector

Dj: Imaginary variable related to wartime

D7476: Imaginary variable related to trend changes in labor of the agricultural sector in 1976.

The Cobb-Douglas production function was calculated for Iran's agricultural sector using Microfit 4.1 and the time series statistics of 1974–2008. To have a better estimation of the Cobb-Douglas function of the agricultural sector in this research, two dummy variables were used to alleviate the structural failure of the agricultural sector capital stock in wartime (Dj) and changes in labor trends before revolution (D7476). The results of the Cobb-Douglas proportion function in the agricultural sector are shown in Table1.

Since the absolute value of sample t is greater than the critical quantity, *H0* (null hypothesis, no collective relationship) is rejected, and the long-term equating relationship between the variables in the model is verified. The long-term model coefficient in the Cobb-Douglas function indicates the production elasticity in the function after a 1% change in the dependent variables, i.e., what percentage change will occur in the dependent variable. Production elasticity of labor, capital, and energy is 0.90, 0.29, and 0.60, respectively. (Table 2)

The results of the Cobb-Douglas production function show that the inputs' production elasticity is between 0 and 1, demonstrating that the inputs are in the optimal area. Overall, we have an increasing return to scale in agricultural sector; therefore, the degree of homogeneity in agricultural sector is greater than one. Therefore, production in this sector can be estimated because, as production increases, the cost of producing each additional unit falls.

As can be seen from Table 2, most of the variables are significant beyond the 5% level. The coefficient of ECM (-1) in the short-term model is -60%. This is statistically significant and negative. A -60% coefficient of ECM means that approximately 60% of value-added variable deviations in the agricultural sector will disappear after one year. In other words, complete justification of the results of implementing a policy requires less than two years' time.

Estimating Cost Function and Demand Functions of Inputs

Based on the aforementioned methodology and using ISUR, the cost function and demand functions of inputs were simultaneously estimated. With the imposition of linear homogeneity in factor

Table 1. Testing the existence of a long-run relationship between the variables of the Cobb-Douglas production function pattern.

Banerjee critical quantity: Dolado and Mestre at 1% level	Banerjee critical quantity: Dolado and Mestre at 5% level	Sample *t*
-3.82	-4.59	-6.1

Table 2. Coefficients of the Cobb-Douglas model.

Sig level	Sample *t*	SD	Coefficient	Variable
[0.080]	1. 85	0.49	0.90	*LL* [a]
[0.000]	5.32	0.05	0.29	*LK* [b]
[0.000]	13.34	0.04	0.60	*LE* [c]
[0.000]	14.5	0.2	-4.32	*C*
[0.000]	-4.36	0.017	0.39	*D7476* [d]
[0.001]	3.83	0.1	-0.07	*Dj* [e]
[0.000]	-5.63	0.1	-0.60	*ECM(-1)* [f]

[a] Natural logarithm of labor in the agricultural sector, [b] Natural logarithm of capital in the agricultural sector, [c] Natural logarithm of energy in the agricultural sector, [d] Imaginary variable related to trend changes in labor of the agricultural sector in 1976, [e] Imaginary variable related to wartime, [f] The error correction variable in the short-term model

prices, symmetry was estimated for the period of 1974–2008. The results are shown in Table 3.

As can be seen in Table 3, most of the own and cross effects are significant beyond the 5% level. Based on the estimations of cost function, the determination coefficient of the estimated cost function is 0.99, which demonstrates that the independent variables of the cost function strongly describe the dependent variable. This allows us to capture the two elements that tell us a great deal about farming production. These elements are the own-price elasticity and the cross-price elasticities for all inputs. These elasticities will help us to answer how firms in the agricultural sector react to changes in prices. In this research, after estimating the Translog cost function, by using ISUR, own and cross price elasticities of demand were calculated.

Calculating Relative and Cross Price Elasticity of Inputs' Demand

The cost function of the agricultural sector was used to calculate the relative and cross price elasticity of inputs' demand. The results are shown in Table 4.

The findings show that each of the own price elasticities of inputs is negative, in accord with economic theories. This implies that increasing the price of each input decreases the demand for it. The absolute value of price elasticity of demand for all inputs (capital, labor, and energy) is less than 1, meaning that these inputs are inelastic to changing price. In other words, 1% change in input price leads to less than a 1% change in input demand. Cross price elasticity of demand between energy to capital and energy to labor is 0.088 and 0.033, respectively. This means that increasing the energy price increases the

Table 3. The results of the demand function of the agricultural sector and cost function using ISUR.

Parameter	Estimated value	Sample *t*	Parameter [b]	Estimated value	Sample *t*
α_0 [a]	1178. 139*	6.76	γ_{ee}	-0.05	_
α_k	2. 93*	11.78	γ_{lk}	-0.009 *	-2.29
α_l	-0.54**	-2.3	γ_{le}	0.0005	_
α_e	-1.39	_	γ_{ke}	-0.032	_
γ_y	-75.56 *	-12.5	γ_{ly}	0.011	1.57
γ_{yy}	1.23*	12.73	γ_{ky}	-0.072 *	-2.96
γ_{kk}	0.041 *	11.30	γ_{ey}	0.061	_
γ_{ll}	0.009 *	5.85			
R^2	0.99	D.W	1.95	SE of regression	0.001

* Significant at 5%, ** Significant at 1%.

[a] α_x= constant term. [b] Numbers above represent parameter estimates γ_{ii} and γ_{ij} from model.

Table 4. Own and cross price elasticity of demand.

Variable	Capital	Labor	Energy
Capital	-0.02	0.012	0.015
Labor	0.25	-0.012	0.087
Energy	0.088	0.034	-0.096

demand for capital more than for labor. In other words, implementing the policy of reducing energy subsidy increases the demand for capital in order to use more modern machines with less fuel consumption, more than the demand for labor. In other words, if the energy subsidy has reduced, capital is a better substitute for energy.

Price elasticity of demand between labor and energy is positive ($E_{LE} = 0.087$, $E_{EL} = 0.034$), which means that labor and energy substitute for each other. In other words, a 1% increase in energy prices leads to a 0.034% increase in labor demand, indicating their weak substitution in the event of a reducing energy subsidy. If the labor price is increased by 0.087%, energy use will increase and more work hours of machines will cover the omitted labor.

Moreover, price elasticity of demand between labor and capital is positive and inelastic ($E_{kL} = 0.012$, $E_{Lk} = 0.25$), showing the substitution power between labor and capital is weak. In most cases, labor employed at the agricultural level before a reduction of energy subsidy was relatively unskilled. It is clear, most of the labor inputs employed during this period began to become more technically advanced.

Analyzing the Government's Subsidy Policies in the Agricultural Sector

Subsidy reduces the price of inputs of the agricultural sector. When an input is elastic in demand, farmers use it more and, according to the demand rule, there are some potential reactions of farmers to it. If the price elasticity of demand for input is inelastic, a subsidy policy has no effect on the amount of consumption.

Figure 1 is designed to define the conclusions and policymaking of the authorities. This framework is designed for the time when energy demand is elastic, and it is adaptable for other situations.

The effects of subsidy policy on value added in the agricultural sector are shown in Table 5. This table shows the percentage of changes in value added of the agricultural sector when an input's price changes by 1%, which is equal to multiplying the demand elasticity of inputs by the production elasticity of input.

Government's policy about reducing the energy subsidy increases energy price and, based on the demand rule and also since price elasticity of demand for energy is inelastic (-0.096), increasing energy price by 1% reduces the demand for this input less than 1%. On the other hand, since production elasticity of this input is between zero and 1 (0.60), a 1% reduction in energy decreases value added less than 1%. Accordingly, combining price elasticity of demand and energy production elasticity, when government increases the price of energy by 1%, the value added of the agricultural sector decreases by 0.057%.

Based on the findings about capital input, since price elasticity of capital demand is inelastic, a 1% reduction in the price of capital decreases the capital in the agricultural sector by 0.02%. According to the production elasticity of capital, a 1% reduction in capital leads to 0.29% reduction of value added of the agricultural sector, therefore, a 1% reduction in the price of capital reduces the value added of the agricultural sector by 0.0058%.

Table 5. The effects of subsidy policy on value added in the agricultural sector.

Input	Capital	Labor	Energy
Price elasticity of Demand	-0.02	-0.012	-0.096
Production elasticity	0.29	0.9	0.6
The percentage change in value added of the agricultural sector because of a 1% change in input price	-0.0058	-0.01	-0.057

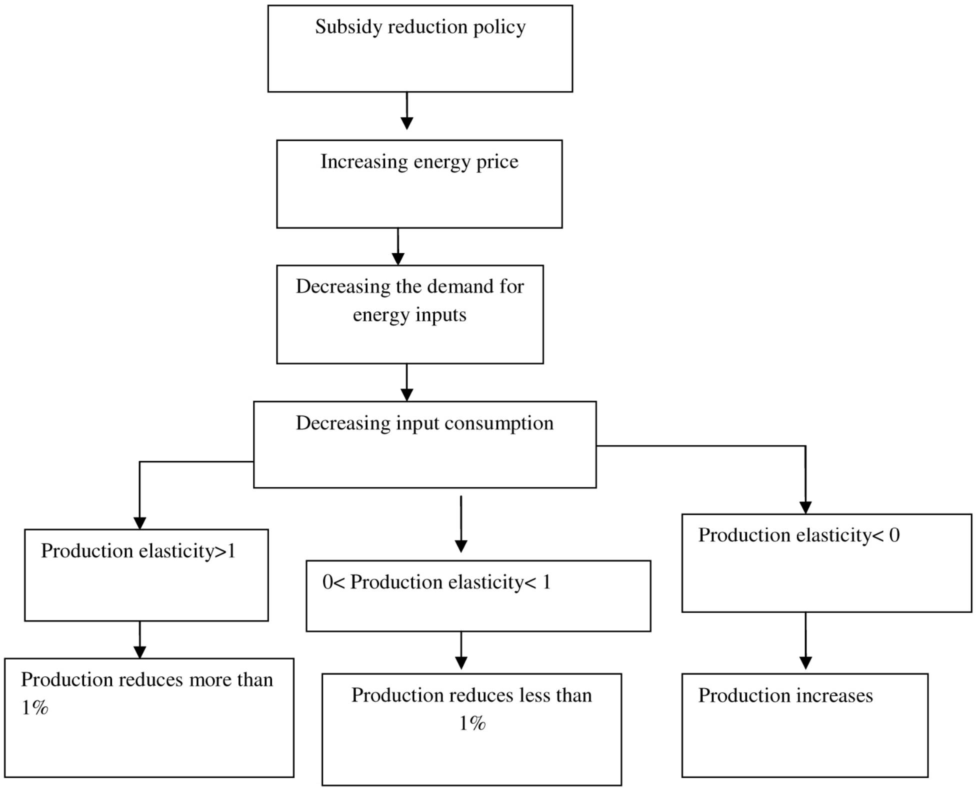

Figure 1. The effects of decreasing energy subsidy when energy demand is elastic.

Moreover, since labor production elasticity is 0.90, it can be inferred that decreasing the labor in agricultural sector by 1% leads to a 0.90% reduction in value added. Finally, by combining price elasticity of demand and production elasticity of labor in the agricultural sector, a 1% increase in the labor process increases value added in the agricultural sector by 0.01%. Consequences of subsidy policy on value added in the agricultural sector are shown in Table 5.

Analyzing Profits and Losses of a Subsidy Reduction Policy

In reducing the energy subsidy of the agricultural sector, government should consider the consequent profits and losses. Government should implement this policy only if its benefits cover its losses. The profits and losses of implementing energy subsidy reduction are shown in Table 6.

The indirect profits of reducing the energy subsidy are pollution reduction, reducing government's financial burden, and the responsibility for maintaining and distributing energy.

CONCLUSIONS

Based on our research and the preceding calculations, we conclude that:

The production elasticity of every

Table 6. Comparison of the benefits and losses of a 1% increase in energy price.

Profit	Loss
1. Reducing energy consumption by about 0.05% is worth *X* 2. Saving the energy subsidy	1. Reducing the value added of the agricultural sector because of using less inputs

production input is between zero and 1, which means these inputs are economically in the second production region. Since all of the inputs, energy in particular (which is the main subject of this research), are used in the optimal production region, it is suggested that government implement this policy stage by stage, because a sudden increase in prices may bring a price shock to the agricultural sector and cause more damage and deterioration to the agricultural sector.

The price elasticity of demand for all inputs is low, which means that increasing the energy price by 1% decreases the use of that input less than 1%. Consequently, energy demand is inelastic. If government increases the energy price by 1%, the agricultural sector value added decreases by 0.057%.

Low elasticity of demand for production inputs shows that price changes have negligible effect on the use of these inputs. It shows that farms will not change their input allocations due to increases in energy prices.

Based on positive cross elasticity of demand between every two inputs, substitution among inputs is confirmed. Therefore, if the price of each one increases, the other one should replace it.

Positive cross elasticity of demand between energy and labor indicates the possibility of their substitution. If energy price is increased, experienced labor can take the place of machines that are high consumers of energy; and vice versa.

Positive cross elasticity of demand between energy and capital indicates the possibility of their substitution, which means that when the energy price increases, using advanced machines to reduce energy consumption is preferred. Therefore, when the energy price increases, government can give some debt capital to farmers to help them buy modern machines and indirectly prepare for increasing productivity and reducing energy consumption.

REFERENCES

1. Aravindhakshan, S. C. and Koo, W. W. 2011. Energy, Agriculture, and GHG Emissions: The Role of Agriculture in Alternative Energy Production and GHG Emission Reduction in North Dakota. Report, 677, North Dakota State University.
2. Amir Teymori, S. and Khalilian, S. 2008. Survey of Factors Affecting Capital Stock Productivity of Iran's Agricultural Sector. *Agri. Econ. Dev.,* **61:** 57–77. (in Persian)
3. Azizi, K. 2005. Impact of Removal of Subsidy from Fertilizer and Pesticides on Production of Rice in Gilan. *Agri. Econ. Dev.,* **50:** 95–123. (in Persian).
4. Banerjee, A., Dolado, J. J. and Mestre, R. 1992. On Some Simple Tests for Co-integration. The Cost of Simplicity, Mimeo, Institute of Economics, Aarhus, Banco de Spana, Denmark, pp. 267–283.
5. Barten, A. P. 1969. Maximum Likelihood Estimation of a Complete System of Demand Equations. *Europ. Econ. Rev.,* **1:** 7–73.
6. Becker, J. 2010. Energy Substitution in Agriculture: A Translog Cost Analysis of the US Agricultural Sector, 1992–2007. Thesis, MS. Degree in Arts in the General Economics Program, Youngstown State University.
7. Carr, B. 1992. The Economics of Agricultural Policy. CRS (Congressional Research Service) Report for Congress, Library of Congress, February 20, Washington, D.C, 92–198.
8. Christensen, L. R., Jorgenson, D. W. and Law, L. J. 1973. Transcendental Logarithmic Production Frontiers. *Rev. Econ. Statist.,* **55**: 28-45.
9. Debra, K. 2002. Agricultural Subsidies in Sub-Saharan Africa: A Reflection. *IFDC Africa Division APIA Workshop,* December 5-6 Lome.
10. Economic Time Series Database, The Central Bank of the Islamic Republic of Iran 1974-2008, http://tsd.cbi.ir, Retrieved 2011.
11. Fallahi, E. and Khalilian, S. 2009. Study and Comparison of the Importance of Oil Products and Electricity with Other Production Factors in Iran, Agricultural Sector. *Agr. Econ. Res.,* **1(2):** 1–19.
12. Greene, W. H. 2003. *Econometric Analysis* (Solution Manual). Prentice Hall, New Jersey, 152 PP.
13. Hozhabr Kiani, K. and Varedi, S. 2000. Coefficient of the Importance of Energy in Iran

Agricultural Sector Production. *Agri. Econ. Dev.,* **30:** 7-41. (in Persian)
14. Iran Energy Balance Sheet, published by Iran's Energy Ministry, Secretariat of Energy and Electricity, (2008, in Persian).
15. Lambert, D. K. and Gong, J. 2010. Dynamic Adjustment of US Agriculture to Energy Price Changes. *J. Agr. Appl. Econ.,* **42(2):** 289–301.
16. Ma, H., Oxley, L., Gibson, J. and Kim, B. 2008. China's Energy Economy: Technical Change, Factor Demand and Interfactor/interfuel Substitution. *Energy Econ.,* **30(5):** 2167–2183.
17. Lindert, P. H. 1989. Economic Influences on the History of Agricultural Policy. University of California. Agricultural History Center (Working Paper Series No. 68), Davis, CA.
18. Pesaran, M. H. and Pesaran, B. 1977. *Working With Microfit 4.0: An Interactive Introduction to Econometrics*. Oxford University Press, pp.205.
19. Salami, H., Sadat Barikani, H. and Noori Naeini, M. S. 2012. Can Agriculture Be Considered a Key Sector for Economic Development in an Oil Producing Country? The Case of Iran. *J. Agr. Sci. Tech.,* **14:** 1–10.
20. Shemshadi, K. 2007. The Effect of the Government's Subsidizing Policy on Wheat Production. MSc. Dissertation in Agricultural Economics, Tarbiat Modares University. (in Persian)
21. Shepherd, R. W. 1970. *Theory of Cost and Production Functions*. Princeton University Press, Princeton, NJ, pp.308.
22. Siddiki, J. U. 2000. Demand for Money in Bangladesh: A Co-integration Analysis. *Appl. Econ.,* **32:** 1997–1984.
23. Thompson, C. D. 1988. Choice of Flexible Functional Forms: Review and Appraisal. *Western J. Agr. Econ.,* **13:** 169–183.
24. Soltani, G. 2005. Determination of Investment Return Rate in the Agricultural Sector. *Agri. Econ. Dev.,* **45:** 19–40. (in Persian).
25. Statistical Center of the Islamic Republic Iran.(SCI), http://www.amar.org.ir/.
26. Torkamani, J. 1998. Determination of Risk Aversion, Technical Efficiency and Effective Factors on it, a Case Study in Fars Province. *Agri. Econ. Dev.,* **24:** 49-68. (in Persian)
27. Zellner, A. 1962. An Efficient Method of Estimating Seemingly Unrelated Regression Equations and Tests of Aggregation Bias. *JASA,* **57:** 500–509.
28. Zibayi, M. and Najafi, B. 1994. Economic Freedom and the Outcome of Changes in Relative Price Production in the Agricultural Sector. *J. Agric. Econ. Devel*. Special Seminar on Liberalization and Agricultural Development, 72pp. (in Persian).

بررسی اثر کاهش یارانه انرژی بر ارزش افزوده بخش کشاورزی

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چکیده

بعنوان بخشی از راهبرد توسعه اقتصادی بخش کشاورزی، یارانه‌های تولیدی در کشورهای جهان از جایگاه خاصی برخوردار است و یکی از راه‌های پرداخت یارانه‌های تولیدی در بخش کشاورزی اعطای یارانه به نهاده‌های تولیدی، از جمله نهاده انرژی می‌باشد. در این تحقیق با استفاده از روش‌های اقتصاد سنجی، و با استفاده از اطلاعات سری زمانی، ابتدا تابع تولید بخش کشاورزی تخمین زده شد و پس از محاسبه کشش‌های تولید نهاده‌های بخش کشاورزی، با تخمین همزمان توابع هزینه و تقاضای نهاده‌های تولیدی به روش ISUR ، حساسیت کشاورزان نسبت به تغییرات قیمت این نهاده‌ها مشخص شده است. نتایج بدست آمده از تابع تولید بخش کشاورزی نشان داد که هر سه نهاده سرمایه، نیروی کار وانرژی در

ناحیه بهینه تولید مصرف می‌شوند. نتایج بدست آمده از تابع هزینه نشان داد که کشش قیمتی خودی نهاده‌ها، منفی و کم کشش است که سازگار با تئوری اقتصاد می‌باشد. همچنین کشش قیمتی متقاطع تمامی نهاده‌ها مثبت می‌باشد که بیانگر جانشینی هر سه نهاده به جای یکدیگر می‌باشد. نتایج حاصل از سیاست یارانه‌ای نشان داد که کاهش یارانه نهاده انرژی به دلیل کشش ناپذیر بودن تقاضای این نهاده نسبت به قیمت باعث کاهش اندک در مصرف آن نهاده گردیده و در نهایت ارزش افزوده بخش کشاورزی را کاهش می‌دهد. در پایان پیشنهاد می‌شود دولت با توجه به تحلیل هزینه- فایده اقدام به اجرای سیاست کاهش یارانه انرژی نماید.