Estimating Production And Costs Functions For Some Rural Small Projects

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Abstract: Nowadays the State has encouraged the establishment of small projects which generating and increasing income through providing more working opportunities to achieve the objectives of sustainable development and solving the problem of youth unemployment (Shabrawy Said). To define the role of the rural small projects in solving problems facing the youth in the Egyptian village, the study aims at identifying the implemented projects as well as the identification of problems that stand in the way of success of these projects in an attempt to identify factors that contribute to the success of these projects (Soliman Ibrahim).

The study depended on unpublished data of social fund for development as an important source of the sources of financing the rural small projects in the Egyptian economic structure, and personal questionnaire with owners of these projects by selecting Multi – stages Random sample about 181 project, these projects are working more than one year and funded by social fund for development. The study showed the following: Upon estimation cost and production function for animal production projects in the sample and used the correlation coefficient matrix (R) to know if there relation between the production and the production factors which studied and used in producing it, the results proved that the strong relation between them , Multi regression analyses proved significance the model ,and the total elasticity is greater than 1 these mean that the return increases and the production increases.

Key words : Production function, Cost function, Fixed costs, Variable costs

INTRODUCTION

The efforts to increase productivity, either quantity or quality of the various crops and products to meet the national consumption requirements (Abu Nour) manufacturing and export increased through the improvement, development and modernization production methods and production inputs on one hand, and work for the continuity of new added production resources, on the other hand, and raise economic and production efficiency levels of production factors, to achieve the optimal use of it, and raise participation efficiency resources in the production process which is known as expansion or vertical development or by adding resources and new energies which is known as expansion or horizontal development so that they can contribute to provide today needs and the future requirements for next generations (Erekat Samir) and effort to achieve high degree of self-sufficiency and decrease the gap between production and domestic consumption for various crops and products, encourage projects owners to expand production of goods to be exported and capable of competing, and seek behind the achievement at high degree of employment and create new jobs for the expected joining at the labor market and rising incomes (Alkla Hassan), raise the standard of living to access high degrees of stability, economic growth and social security for these projects owners in order to achieve their economic goals, the potential and accepted at the same time to achieve interest and public benefit of the community.

The Study Problem:

Although the state interest in encouraging the small projects establishment and multiple sources of funding these projects, but these projects are still suffer from the problems, impeding their development and do effective role in solving the problems which facing the Egyptian society, such as unemployment and high commodity prices, especially meat, therefore the small projects study was necessitated in the field of Animal Production and its role in the livestock development, to provide meat prices commensurate with the individuals income.

The Study Objective:

Studying small projects role in the livestock development through: estimate production and costs functions for some rural small projects in the Animal Production field and funded by the Social Fund for Development, and also estimate the optimal productive scale and profit maximization scale.

Research Method:

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Economic analysis either descriptive and statistical methods, have used mathematical models in the linear and logarithmic double form in the calculation of production costs parameters functions also used multiple regression analysis in the logarithmic form and estimate the correlation matrix between the production and the production factors.

The Study Sample And Data Sources:

The study primarily depended on questionnaire data collected from some Animal Production projects owners. These projects were funded by the Social Fund for Development as one of the most important financial institutions for small projects, and has been in existence more than one year, selection of 3 centers (Zagazig city – Al husseiniya city – Awlad Saqr City) as the three important centers which are characterized with concentrating the rural small projects in sharkyia governate and selected 10 villages of these centers as random sample (Zagazig, Alasslojy, Zankalon, Shobak, Awlad Saqr, Al Sufia, Alfaraiha, Husseiniya, Smackinalghrb, Sunalhagar).

The sample study consists of 56 projects were divided into 13 cattle fattening projects, 22 sheep fattening projects, 18 milk production projects. And also depended on statistics data of the Social Fund for Development, unpublished data.

First, Estimating Production Functions for Cattle and Sheep Fattening Projects and Milk Production in the Study Sample in Sharkia Governorate:

Estimate the correlation matrix between the production factors (nutrition, employment, veterinary care value, the animal weight at purchase) as independent variables, and the produced quantity for the livestock production projects, which represents the productivity of the head in the study sample, found that there is a strong relationship between these factors.

Using multiple regression analysis through mathematical models (multiple linear model - the logarithmic model – stepwise multiple analysis regression model) when estimating production functions in its physical form for the animal production projects in the study sample (cattle fattening - sheep fattening - milk production). The dependent variable (y) represents the amount of meat resulting from the head fattening in mathematical models for the cattle fattening projects, and the independent variables are the following factors:

- x1: the amount of nutrition (in units of starch and protein) for the head,
- x2: the number of workers for the head,
- x3: the veterinary care value for the head,
- x4: average weight of the head when purchased (kg).

The data in table no.(1) showed that the double logarithmic model (stepwise) is the optimal model because all the variables in which significant and adjusted determination coefficient value is high, and estimate the degree of response to the amount of production of meat in the cattle fattening projects for the change in the factors involved in the production, productivity flexibility value is positive and less than one for all independent variables this means that independent variables are increased by 1% leads to production of meat increased by 0.76%, x1 0.34% x3, and calculates the total flexibility of independent variables in the double logarithmic model which is the total flexibility of independent variables in the model was about 1.1 and shown to be larger than the one this means increased return on the capacity and the expansion possible of these factors to increase production. Adjusted determination coefficient value was shown (R²) that about 75% of the changes that occur in the amount of production is attributed to independent factors under study, and the model was proven significant at the level 1% and to select the best significant explanatory variables, which explains the changes in the amount of production.
Table 1: Estimating production functions for the cattle fattening projects in the study sample in Sharkia governorate

<table>
<thead>
<tr>
<th>Equation #</th>
<th>The equation</th>
<th>The model</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ye = 20.42 + 0.143 x1e + 0.214 x2e + 0.326 x3e + 0.283 x4e</td>
<td>Multi-linear form</td>
</tr>
<tr>
<td></td>
<td>(1.25) (3.15)* (0.784) (1.12) (2.94)*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>R^2 = 0.83 , R^2/2 = 0.81 , F = 6.84**</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Log Ye = 2.37 + 0.113 Log x1e + 0.108 Log x2e + 0.347 Log x3e + 0.521 Log x4e</td>
<td>The Logarithmic form</td>
</tr>
<tr>
<td></td>
<td>(3.04)* (3.9)** (0.222) (0.753) (1.02)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Ye = 27.14 + 0.1006 x1e + 0.1067 x4e</td>
<td>The gradual linear model</td>
</tr>
<tr>
<td></td>
<td>(3.91) (3.34)* (2.21)*</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Log Ye = 0.531 + 0.757 Log x1e + 0.338 Log x3e</td>
<td>The gradual logarithmic form</td>
</tr>
<tr>
<td></td>
<td>(2.63)* (3.22)** (2.30)*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>R^2 = 0.76 , R^2/2 = 0.75 , F = 8.3**</td>
<td></td>
</tr>
</tbody>
</table>

Source: collected and calculated from the study sample data.

** Represents a significance at 1% , * represents a significance at the 5% , R^2 represents the determination coefficient , R^2/2 represents adjusted determination coefficient.

Estimating Production Functions for the Cattle Fattening Projects in the Study Sample in Sharkia Governorate:

The marginal product of each factor (nutrition, employment, the veterinary care value, the head weight when it purchased) was reached about 0.139 food unit/0.61 employer, 0.252 pounds, 0.248 kg, respectively, this means an increase of feeding by one unit would lead to increased production of meat at about 0.139 kg, increasing employment by one unit would lead to lack of production of meat by about 0.61 kg, and increased expenditures on veterinary care by one pound would lead to increased production of meat by about 0.252 kg. Adjusted determination coefficient value showed (R^2) that about 84% of the changes that occur in the amount of production is attributed to independent factors under study, and the model was proven a significant at the level 5%.

The data in table no.(2) showed that the double logarithmic model (stepwise) is the optimal model because all the variables in which significant and adjusted determination coefficient value is high, and estimate the degree of response to the amount of production of meat in the sheep fattening projects for the change in all independent variables, this means that independent variables increase by 1% leads to increase production of meat by 0.71% x1, 0.44% x4, and calculates the total flexibility of independent variables in the double logarithmic model which is the total flexibility of independent variables in the model was about 1.15 and shown to be larger than one, this means increased return on the capacity and the expansion possible of these factors to increase production. Adjusted determination coefficient value was shown (R^2) that about 79% of the changes that occur in the amount of production is attributed to independent factors, the model has proven significant at 1%.

Estimating Production Functions For The Milk Production Projects:

The marginal product of each factor (nutrition, employment, the veterinary care value, the animal age when it purchased) was about 0.535 food unit 0.431 employer, 0.567 pounds, 0.325 kg, respectively, this means increase of feeding by one unit would lead to increased production of milk at about 0.535 kg, increasing employment by one unit would lead to lack of production of milk by about 0.61 kg, and increased expenditures on veterinary care by one pound would lead to increased production of milk by about 0.567 kg. Adjusted determination coefficient value showed (R^2) that about 81% of the changes that occur in the amount of production is attributed to independent factors under study, and the model was proven a significant at the level 1%.

The data in table no.(3) showed that the double logarithmic model (stepwise) is the optimal model because all the variables in which significant and adjusted determination coefficient value is high, and estimation of the degree of response to the amount of milk production in the milk production projects for the change in all independent variables, this means that independent variables increase by 1% leads to increase milk production by 0.81% x1, 0.27% x4, and calculates the total flexibility of independent variables in the double logarithmic model which is the total flexibility of independent variables in the model was about 1.08 and shown...
to be larger than the one this means increased return on the capacity and the expansion possible of these factors to increase production. Adjusted determination coefficient value was showed \( R^2 \) that about 78% of the changes that occur in the amount of production is attributed to independent factors, the model has proven significant at 1%.

### Table 2: Estimating production functions for the sheep fattening projects in the study sample in Sharkia governorate

<table>
<thead>
<tr>
<th>The equation</th>
<th>The model</th>
</tr>
</thead>
<tbody>
<tr>
<td>( Y_e = 16.65 + 0.139x_{1e} - 0.61x_{2e} + 0.252x_{3e} + 0.248x_{4e} )</td>
<td>Multi-linear form</td>
</tr>
<tr>
<td>( R^2=0.87, R^2=0.8 )</td>
<td></td>
</tr>
<tr>
<td>( F=11.64** )</td>
<td></td>
</tr>
</tbody>
</table>

### Table 3: Estimating production functions for the milk production projects in the study sample in Sharkia governorate

<table>
<thead>
<tr>
<th>The equation</th>
<th>The model</th>
</tr>
</thead>
<tbody>
<tr>
<td>( Y_e = 153 + 1.106x_{1e} - 0.231x_{2e} - 0.61x_{3e} + 0.252x_{4e} )</td>
<td>Multi-linear form</td>
</tr>
<tr>
<td>( R^2=0.76, R^2=0.75 )</td>
<td></td>
</tr>
<tr>
<td>( F=9.13** )</td>
<td></td>
</tr>
</tbody>
</table>

Second: Estimating The Cost Functions For Animal Production Projects In The Study Sample In Sharkia Governorate:

Production costs means the total incurred payments by the production unit in order to obtain the resources that are used in the production process. The cost study is important (Khalifah Abdel-Aal) as it classifies the total costs value to:

1. Fixed costs: are those which do not change with the amount of production, it is independent of production amount, and has to be paid if the property owners wanted to keep it either produced or not produced (Mukhtar Souheir).
2. Variable costs: are those costs that depend on the amount of production, and change with the production, the differentiation between the two is based on how costs change due to change in other factors as technological and unit prices of production factors, and this type shows in the short term analysis (Ibrahim Abdul Wakil).

### Economic analysis to the production costs terms is useful for the animal production:

Projects in the study sample in Sharkia governorate (2008) to know the relative importance of each item and its impact on total costs, also it is useful to know in which economic phase these project operates, as used by deriving the marginal costs function and determine the production scale which maximized profit when the
marginal costs equaling with the unit price of output, and can estimate the production costs flexibility to study economic scale for the projects under study.

Statistical Estimate Of Costs Function For The Cattle Fattening Projects In The Study Sample:

Estimating The Costs Functions Parameters For The Cattle Fattening Projects In The Study Sample In Sharkia Governorate:

\[ C_e = 11537.997 + 1.6688 P_e + 0.0208 P_e^2 \]

\[ (5.42) \ast (4.113) \ast (1.099) \ast \]

\[ R^2 = 0.94, R^2 = 0.92, F = 9.039, \ast \ast \text{represents significance at 1\%, } \ast \text{represents a significance at 5\%} \]

Where: \( C_e \) = estimated value of the annual costs for cattle fattening projects (thousands pound) in the \( e \) observation \( e = 1, 2, 3, \ldots, 13 \).

\( P_e \) = actual productivity (kg) for \( e \) observation.

Adjusted determination coefficient value showed \((R^2)\) that about 92\% of the changes that occur in the annual production costs is attributed to the amount of the cattle meat production, the model has proven significant at 1\%.

The Derivation of Average Cost Function (AC) and Marginal Cost Function (MC) of the Annual Production Cost Function For The Cattle Fattening Projects In The Research Sample: where

\[ AC = 1.668 + 11537.99 P_e^{-1} + 0.0208 P_e \]

\[ MC = 1.668 + 0.0416 P_e \]

average cost for (kg) = 13.62, average sale price for (kg) = 16.68

optimal productive scale which minimize the cost is achieved when \( AC = MC \)

\[ 1.668 + 11537.99 P_e^{-1} + 0.0208 P_e = 1.668 + 0.0416 P_e, P_e = 326.853 \text{ kg} \]

profit maximize scale is achieved when: unit price of output = \( MC \)

\[ 16.68 = 1.668 + 0.0416 P_e, P_e = 408.44 \text{ kg} \]

Estimated costs flexibility was reached about 1.32 this means increasing the return on capacity, meaning that production is in the economic phase of production stages, and this means that it can increase the production and reduce costs.

Table 4: The optimal production, profit maximize scale and actual production (kg) for the cattle fattening projects in the study sample.

<table>
<thead>
<tr>
<th>The optimal production</th>
<th>The profit maximize scale</th>
<th>The actual production</th>
</tr>
</thead>
<tbody>
<tr>
<td>326.853 kg</td>
<td>408.44 kg</td>
<td>399.6 kg</td>
</tr>
</tbody>
</table>

Source: collected and calculated from the study sample data.

Estimating The Costs Functions Parameters For The Sheep Fattening Projects In The Study Sample In Sharkia Governorate:

\[ C_e = 276.89 + 1.076 P_e + 0.0203 P_e^2 \]

\[ (1.76) \ast (5.585) \ast (3.878) \ast \]

\[ R^2 = 0.94, R^2 = 0.90, F = 7.741, \ast \ast \text{represents significance at 1\%, } \ast \text{represents a significance at 5\%} \]

Where: \( C_e \) = estimated value of the annual costs for sheep fattening projects (thousands pound) in the \( e \) observation \( e = 1, 2, 3, \ldots, 22 \).

\( P_e \) = actual productivity (kg) for \( e \) observation.

Adjusted determination coefficient value showed \((R^2)\) that about 90\% of the changes that occur in the annual production costs is attributed to the amount of the sheep meat production, the model has proven significant at 1\%. And all estimated regression parameters were significant at 5\%.

Derivation of average cost function (AC) and marginal cost function (MC) of the annual production cost function for the sheep fattening projects in the research sample: where

\[ AC = \text{total costs (e) / production} \]

\[ AC = 1.076 + 276.89 P_e^{-1} + 0.203 P_e \]

\[ MC = \frac{dC}{dP} \] (Total cost function derivation)

\[ MC = 1.076 + 0.406 P_e \]

The optimal production scale which minimize the cost is achieved when \( AC = MC \)

\[ 1.076 + 276.89 P_e^{-1} + 0.203 P_e = 1.076 + 0.406 P_e, P_e = 37.13 \text{ kg} \]

average cost for (kg) = 15.53, average sale price for (kg) = 18.72

The profit maximize scale is achieved when unit price of output = \( MC \)
18.72 = 1.076 + 0.406 Pe, P = 46.52 kg

flexibility = M C / AC

Estimated costs flexibility was reached about 1.9 this means increasing the return on capacity, and that production is in the economic phase of production stages, and means that it can increase the production and reduce costs.

Table 5: The optimal production, profit maximize scale and actual production (kg) for the sheep fattening projects in the study sample.

<table>
<thead>
<tr>
<th>The optimal production</th>
<th>The profit maximize scale</th>
<th>The actual production</th>
</tr>
</thead>
<tbody>
<tr>
<td>37.13 kg</td>
<td>46.52 kg</td>
<td>42.31 kg</td>
</tr>
</tbody>
</table>

Source: collected and calculated from the study sample data.

Estimating the Costs Functions Parameters For The Milk Production Projects In The Study Sample In Sharkia Governorate:

\[ C_e = 26776.8 + 58.764 P_e + 0.0167 P_e^2 \]

\[ R^2 = 0.94, R^2 = 0.93, F = 2.311 \]

** represents significance at 1%, * represents a significance at 5%.

Where: \( C_e \) = estimated value of the annual costs for milk production projects (thousands pounds) in the \( e \) observation \( e = 1, 2, 3, \ldots, 18 \).

Actual Productivity (kg) for \( e \) Observation:

Adjusted determination coefficient value showed \( R^2 \) that about 93% of the changes that occur in the annual production costs is attributed to the amount of the milk production, the model has proven significant at 1%.

The derivation of average cost function (AC) and marginal cost function (M C) of the annual production cost function for the milk production projects in the research sample: where

\[ AC = 58.764 + 26776.8 P_e^{-1} + 0.0167 P_e \]

\[ M C = d C(e) / d P \] (Total cost function derivation)

\[ M C = 58.764 + 0.0334 P_e \]

The optimal production scale which minimize the cost is achieved when \( AC = M C \)

\[ 58.764 + 26776.8 P_e^{-1} + 0.0167 P_e = 58.764 + 0.0334 P_e, P = 1266.26 \text{ kg} \]

average cost for (kg) = 1.99, average sale price for (kg) = 2.29 (pound)

The profit maximize scale is achieved when unit price of output = \( M C \)

\[ 2.29 = 58.764 + 0.0334 P_e, P = 1690.32 \text{ kg} \]

flexibility = \( M C / AC \)

Estimated costs flexibility was reached about 1.89 this means increasing the return on capacity, meaning that production is in the economic phase of production stages, and this means that it can increase the production and reduce costs.

Table 6: The optimal production, profit maximize scale and actual production (kg) for the milk production projects in the study sample.

<table>
<thead>
<tr>
<th>The optimal production</th>
<th>The profit maximize scale</th>
<th>The actual production</th>
</tr>
</thead>
<tbody>
<tr>
<td>1266.26 kg</td>
<td>1690.32 kg</td>
<td>1006.7 kg</td>
</tr>
</tbody>
</table>

Source: collected and calculated from the study sample data.

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