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Cost Efficiency Analysis of Indian Agricultural Marketing Cooperatives – A Case of Markfed

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Abstract

The main objective of this paper is to empirically investigate the potential of acting as an investor owned firms by the agricultural marketing cooperatives, keeping in view the policy reforms taken during the tenth five year plan (2002-2007) towards the development of agro-processing sector. Cooperatives processing operations are also based on various agricultural produce like wheat, rice, pulses, oilseeds etc. Therefore to develop insights whether cooperatives were possessed with a potential of investor owned firms, at the time of policy reforms, this study has been conducted by taking a sample of industrial units of Markfed Punjab for a period of 2004 to 2013. In order to answer the research questions, single output Cobb Douglas cost function has been employed to estimate economies of scale for a panel data of three plants of Markfed covering a time period of 10 years. Markfed plants could achieve cost advantages by increasing the scale of production of their existing products with the same cost of production. Insights revealed from this study, emphasize that well managed operations and suiTable policy reforms related to development of agro-processing sector would also be helpful in promoting the industrial units of cooperatives. This could further act as a source of boon for the main stakeholder of the cooperatives i.e. for farmers in improving their economical condition in particular and of the nation in general.

Key Words

Cost Efficiency, Cost Function, Economies of Scale, Investor Owned Firms, Marketing Cooperatives, Panel Data, Stochastic Frontier Analysis, Cooperatives.

INTRODUCTION

A Cooperative is defined as an autonomous association of persons united voluntarily to meet their common economic, social and cultural needs and aspirations through a jointly owned and democratically controlled enterprise (International Cooperative Alliance). Cooperation is the act of persons, voluntarily united for utilizing reciprocally their own forces, resources, or both, under their mutual management to their common profit or loss (Herrik, M.T. (1933). A marketing cooperative is a business organization owned by farmers to collectively sell their products. Agricultural marketing cooperatives perform several functions like they enables producers to 1) correct market failure where prices are too low or buyers have left the market; 2) provide a service not available otherwise; 3) gain market power (negotiating power) against much larger buyers; 4) spread risks and costs; 5) have enough volume to operate a processing plant efficiently or enough to meet the demands of buyers (USDA, 2021).

Production Cost Efficiencies may be achieved for an individual firm in any industry by two ways. First one is economies of scope, which relates to the joint production of two or more products and another one is economies of scale, which are associated with firm size (Clark, 1988). Firms in any industry realize economies of scale if technology allows production costs to rise proportionately less than output when output increases. It means, economies of scale exist if per unit or average production costs decline as output rises (Clark, 1988).

Estimation of economies of scale for cooperatives is based on the firm view (Robottka, 1947 & Savage, 1954 and Helmberger & Hoos, 1962). According to this view cooperatives could be considered as an Investor Owned Firms (IOF). This view, interprets cooperatives as a firm managed and controlled by entrepreneurs as the absolute decision makers who seeks to achieve the single objective of cooperatives is profit maximization without having the consent of the members and discarding members' objectives in the decision making process (Suboh, Oude, Alfons & Dijk, 2009, p.8).

Viewing the cooperatives as an equivalent to Investor owned firms; the only single objective of the cooperative is profit maximization in context of traditional firm theory (Williamson, 1981). On the other hand vertically integrated cooperatives are all about members' objectives having decision making powers vested with them and without showing personal interests or gains. The Performance of these kinds of firms doesn't measure only in terms of prices they received for their products marketed through the cooperatives but also through patronage funds (Sexton & Iskow, 1993).

Based on different views proposed by various authors had changed the perspectives towards cooperatives, which were earlier considered as an organization for mutual benefits of members of cooperatives. But over a period of time different perspectives towards cooperatives are categorized into three different views (shown in Table 1). Keeping in view the cooperatives as a firm or business entity in nature, this objective has been undertaken to analyze cost efficiency of industrial units set up by Markfed Punjab units with the help of Economies of Scales' estimates.

Table 1
Three Views Regarding Nature of Cooperatives

	Extension of the Farm View (Philips 1953, Trifon 1961)	**Vertical Integration View (Philips 1953, Trifon 1961)**	**Firm View (Robo-ttka 1947, Savage 1954, Helmberger & Hoos 1962)**
The Nature of a Cooperative	An association of firms, not a new firm	Several production stages brought under one entrepreneurial control	A business enterprise, a new decision making body
Focus of Analysis	The member firms	The interaction between members and the cooperative firm	The Cooperative firm

Source : Adapted from Feng, L., 2010, Table 1, p.4 of thesis titled "Motivation, Coordination and Cognition in Cooperatives (No. EPS-2010- 220-ORG)".

Markfed being the oldest marketing cooperative in the northern India has been selected for this study. It is because similar to other marketing cooperative of various states of northern India like Haryana, Himachal Pradesh, Jammu & Kashmir, Uttar pradesh, and Uttarakhand, it has been indulging in various similar in nature business activities like Supply of Agri inputs; Food grains procurement; Food grains warehousing; Agro-processing; Marketing / Exports and Mega Food park etc. (shown in Table 2). On the basis of insights received from the Table 2, Markfed Punjab has been shortlisted to act as a representative for exploring cost efficiency on behalf of all other marketing cooperatives of northern India for the purpose of analyzing future growth potential of these agricultural marketing cooperatives.

Table 2
Description of various Agricultural Marketing Cooperative of Northern India

Sr. No.	State	State Level Federation	Major Business Activities	Agro-processing Units	Year of Establishment & Website/ Working URL
1.	Haryana	HAFED - Haryana State Cooperative Supply and Federation Limited	Supply of Agri inputs; Food grains procurement; Food grains warehousing; Agro-processing; Marketing/Exports and Mega Food park	Rice Mills; Oil Mills; Cattle Feed Plants; Sugar Mill; Pesticide Plant; Turmeric Plant and Flour Mill	Year, 1966 http://hafed.gov.in/
2.	Jammu & Kashmir	JAKFED - J&K Cooperative Supply and Marketing Federation Limited	Key construction material; Fertilizer; LPG distributorship; Transport and Marketing	N.A.	Year, 1960 https://jakfed.jk.gov.in/
3.	Himachal Pradesh	HIMFED – Himachal Pradesh State Cooperative Marketing & Consumer Federation Ltd.	Fertilizers; Petroleum products; Farm inputs; Procurement; Consumer items; Steel and Horticultural tools & equipments	N.A.	Year, 1968 http://www.himfed.com/index.php
4.	Uttar Pradesh	UPPCF – Uttar Pradesh Cooperative Federation Limited	Marketing; Agro-processing; Supply of Agri inputs; Distribution of essential commodities; Construction and Consultancy	N.A.	Year, 1943 http://www.uppcf.org/index-eng.aspx
5.	Punjab	MARKFED – Punjab State Cooperative Supply & Marketing Federation Limited	Agro processing; Marketing; Exports; Fertilizer; Food grain procurement and Engineering	Canneries; Vanaspati & Allied Industries (MVAI); Cattle Feed & Allied Industries; Rice Mills and Agro Chemical Plant	Year, 1954 https://markfedpunjab.com/markfed/

6.	Uttara-khand	UCF – Uttara-khand State Co-operative Federation Ltd.	Fertilizer; Production of Ayurvedic Medicines; Supply of Agri inputs; Consultancy & Marketing	N.A.	Year, 2002 https://Ucf.org.in/

Source : Author's own creation

Markfed is a Punjab State Co-op Supply & Marketing Federation Ltd, which got registered in 1954. Markfed has emerged as a very solid and sTable organization committed to the service of the farmer community of the state of Punjab. It was also awarded with National Productivity Awards in various fields like co-operative marketing activities, food processing, cattle feed production etc., to name a few. For that sole purpose of its establishment was to take care of needs of cooperative societies and their members. In starting its main business was procurement of farmers' produce e.g. wheat, rice. etc. and disbursement of fertilizer at subsidized rates to them. (Corporate profile, Markfed).

Over a period of time Markfed has shifted towards entrepreneurship and established various industrial units which had undergone no. of operations ranging from making of processed foods to agrochemical products etc. in the early seventies. Like in 1971 Vanaspati & Allied Industries was established at Khanna to promote oil seed farming and to provide cooking medium to rural and urban people; in 1972 cannery was established in Jalandhar and start producing various ready to eat canned food products like canned rajmah, alu methi, alu palak, sarson ka saag, daal makhni etc. Agro Chemical unit of Markfed has been established since 2004 to facilitate efficient crop management. All these three plants have been established for a long time and contributing in wealth maximisation of Markfed (manufacturing operations, markfed).

As a main method of analysis, econometric method: stochastic frontier analysis technique known as single output stochastic Cobb Douglas cost function has been employed to estimate economies of scale for industrial units of Markfed.

This paper is structured as follows : In Section (2) we describe the literature covering tools and techniques used in the estimation of scale economies in varied sectors ranging from manufacturing to service industries. Section (3) describes about data and methods used in our empirical analysis. Section (4) represents the result of econometric estimation and, finally, Section (5) describes conclusion, limitations and suggestions for future research.

LITERATURE REVIEW

This literature review provided insights towards usage and implication of suiTable research technique to analyse the data. Following studies are covered for this purpose: Akridge and Hertel (1986) explored cost relationships for retail fertilizer plants producing multiple products. A short-run, translog cost function was estimated using pooled data from twenty-four Indiana and Illinois retail fertilizer plants over the 1975-82 periods. Results revealed that the average plant in the sample was found to exhibit economies of scale and could lower average cost by increasing output and by diversifying into anhydrous ammonia as one of their product. Porter and Scully (1987) concluded in their study on fluid milk processing plants that cooperatives were less efficient than non-cooperatives due to control problems cooperatives were not able to perform up to the mark. Horizon problem and the commitment tendency of cooperatives prevents them from invest in long term investments that leads to choice of input mix which firmly leads to allocative inefficiency for cooperative firms. Control problem also results in scale inefficiency because of the agency cost associated with the large membership is necessary for achieving scale economics.

Cohn, Rhine and Santos (1989) estimated multi output cost function of Higher Education Institute (IHES) in the U.S. employing data for the year 1981-82, conducted by the Higher General Information Survey (HEGIS). Flexible fixed cost quadratic function includes three outputs- undergraduate teaching, graduate teaching and research grants one input price saving faculty salaries. Zardkoohi and Kolari (1990) examined the operating cost of thrift institutions which had dominating positions in Finnish financial markets and small change in their performance can impact the Finland financial sector Bank output was measured as both advances and bills dominated in Finnish markets. Translog cost function was used to examine the cost economies of saving and cooperative banks. Schroeder (1992) estimated scale and scope economies for a sample of multiproduct farm supply and grain marketing local cooperatives. Specifically, financial records from 29 cooperatives over 1979 to 1988 were used to estimate multiproduct economies of scale and scope. A bootstrapping regression technique was used to estimate confidence intervals for the scale and scope elasticities.

Featherstone and Moss (1994) estimated economies of scope and scale in agricultural banking. This was accomplished through estimation of an indirect multi-product cost function. A normalised quadratic cost function was estimated with curvature properties imposed. Cook (1995) concluded on the basis of findings of model incorporated on life cycle of cooperatives that cooperative continue to

operate throughout life cycle will eventually tend towards under capitalization and stressed on adoption of various alternatives to maximise their performance**.** Hughes (1998) estimated cost function for English residential child care in order to examine cost inefficiency factors for these child care homes. National wide this survey was conducted on a sample of 351 homes with complete information through 25 local authorities. Results revealed that estimates obtained from stochastic cost frontier model are more reliable than estimates obtained from average cost methods. Hence it was implied that in researches deal with questions of social policy research using welfare production models. Findings obtained through stochastic cost frontier models are more accounTable.

Barros and Garcia (2001) examined the performance of Portuguese pension management companies for a period of 10 years from 1994 to 2003. Cobb Douglas stochastic cost frontier model was used to generate efficiency scores for these companies. Panel of 12 pension fund management companies was created. Results revealed that mean efficiency score for pension fund Management Company was 87.8%. It meant they could reduce their output cost by 12.2% without decreasing their inputs. Liu (2003) examined scale economies of academic research libraries. Total cost function model was applied by considering academic research libraries as a case of producers of multi-products and multi-services like vol. held; serials and group presentations. Results revealed that function coefficient was 0.93 which indicates slight economies of scale exist.

Segal (2003) estimated overall and product specific economies of scale and scope for the three main outputs of insurance industry. They were amount of life insurance, total annuity considerations and Accidental & Health premiums. Translog cost function was used as a statistical technique for the study to measure EOS & PSE. Sensarma (2005) examined cost and efficiency of Indian banks during the transition period between pre and post liberalization era. Period of study was from year 1986-2003. Stochastic frontier analysis was employed to measure bank specific measures of cost and profit efficiencies on a unbalanced panel of 87 banks and panel composition consisted of 27 public sector banks, 26 domestic private sector banks and 25 foreign banks. Results revealed public banks appear to be more cost efficient than the private banks were appeared as poor performer in terms of cost efficiency.

Miller, Clauretie and Springer (2006) revealed facts regarding operating efficiencies of real estate investment trust (REIT). Translog variable stochastic cost function was estimated for a panel of 1851 REIT for a period of 9 years from 1995 to 2003. Results of the study revealed that the estimates of cost function for publically traded REITs didn't support economies of scale. Farsi, Fetz and

Filippini (2007) investigated the cost structure of the Swiss urban public transport sector so that economies of scale and scope could be accessed. This paper explored the empirical evidence of scale and scope economies in sixteen transport companies operating multi mode transport facilities like trolley-bus, motor-bus and tramway systems in Switzerland. Period of study was from 1985 to 2003. A normalised total cost function with quadratic form had been estimated.

Kolawale and Ojo (2007) examined the overall efficiency of small holder cropper in Nigeria with a view to examine productive efficiency in food crop production in the country. Stochastic frontier production model of Cobb Douglas functional form was employed to estimate the firm level technical and allocative efficiencies of the farmers of small landholders. A structured questionnaire was used to collect data. Results explored that estimated gamma parameters (γ) of model 2 for production function was 0.955 indicating that about 96% of the variation in output of food crop among the farmers was due to differences in their technical efficiencies while the estimated gamma parameter (γ) for model 2 for the cost frontier was 0.73 indicating that about 73% of the variation in the total cost of production among the famers was due to the presence of allocative inefficiency. Martin, Roman, and Dorta (2009) estimated relative efficiency of Spanish airports. Stochastic cost frontier model was applied on a panel of 37 commercial Spanish airports for a period of seven years from 1991 to 1997. The results of the study revealed that economic efficiencies for these airports range in between 15-26%. Ramos- Real (2010) evaluated the productivity of Spain's terminals through the case of Las Palms port. The analysis encompasses the period from 1991-99. A normalized quadratic cost function was employed on the firm panel data set covered around 264 monthly observations. Findings conclude that important productivity gains explained by scale effects. Worthington and Higgs (2011) estimated economies of scale and scope for 36 Australian universities with the help of multi output cost function for a period of 1998 to 2006. Findings revealed that ray economies of scale hold up to about 120% of current mean output while product specific economies of scale existed for only undergraduate teaching. Global economies of scope existed in the sector while product specific economies of scope exited for all outputs except publications.

Mandal and Madheswaran (2012) evaluated the role of scale effect in productivity growth in the context of Indian manufacturing industry by taking the case of cement industry specifically. Sample for the study comprised of unbalanced panel of 70 firms from a period of 1989-90 to 2006-2007. Frontier 4.1 software was used to estimate Total Factor Productivity (TFP) and its components. Results

revealed that annual growth in TFP in the Indian cement industry during the study period accounts for 5.27% while 94.63% of the output growth was achieved through input growth. Chen and Ray (2013) investigated the cost efficiency and scale economies in general dental practice level data collected by the American Dental Association (ADA) for a period of 2005-2006 in the U.S. dental industry. Both the non-parametric method of data envelopment analysis (DEA) and the econometric method of stochastic frontier analysis (SFA) had been applied. Findings of the study from the parametric and non parametric approaches suggested that dental practice could, on average, reduce their cost of production by somewhere between 11.7 and 21% respectively.

Worthington and Higgs (2014) estimated economies of scale and scope for 55 major Australian urban utilities over the period 2005-06 to 2008-09. The input variables used to help determine water utility costs include the density of properties served and the sourcing of water from bulk suppliers, ground water, recycling and surface water. Results of the study suggested strong economies of scale at relatively low level of output (50-75% of mean output). Economies of scope existed when joint production of treated quality water delivered across a network with mineral water losses and main breaks. Oliver (2015) analyzed cost, capacity, mileage and technical data for 254 U.S. natural gas pipeline projects over the period 1997-2012. A log linearized Cobb Douglas cost function was applied to analyze the data. Results of the study highlighted that project costs exhibit economies of scale over the capacity margin and economies of scope over the spatial margin network expansion cost may not exhibit cost economies overall.

Biam, Okorie and Nwibo (2016) examined economic efficiency of small scale soyabean farmers in central agricultural zone of Nigeria. A multistage sampling procedure was used to select 485 soyabean farmers in the zone in year 2010. This study employed the Cobb Douglas stochastic frontier cost function to measure the level of economic efficiency and its determinants. Results of the study revealed that average economic efficiency was 52%. The study found age, farm size and household size to be negatively and significantly related to economic efficiency at 5% and 1%.

Johnes and Johnes (2016) examined costs, efficiency and economies of scale and scope in the English higher education. Sample of the study comprises 103 higher education institutions in England for a year 2013-2014. A latent class stochastic cost function was applied to analyze the data. Results of the study revealed that product specific economies of scale are exhausted except for research and post graduate education. Economies of scope existed in undergraduate teaching in subjects other than science. Alem, Lien, Kumbhakar, and Hardaker

(2017) investigated economies of scale and scope among Norwegian dairy and crop producing farm controlling for regional differences. Data set comprises farm level unbalanced panel data set with 14357 observations from 2219 specialized crop farms, 5929 specialized dairy farm and 6209 mixed farm during the period 1991-2004. Translog cost function was applied. Results of the study suggested both economies of scale and scope exist for Norwegian dairy and crop producing farms.

Li and Marinc (2018) confirmed the existence of substantial economies of scale in trading and post-trading financial market infrastructures (FMI). Panel data for the study comprises of thirty stock exchanges, twenty nine clearing houses and twenty three central securities depositories from 36 countries. Results of the study highlighted positive relationship of economies of scale with size and vertical and horizontal integration of FMI provides and it existed higher in North America than in other regions. Analysis of economies of scope highlighted efficiency of FMI provider's increases with vertical integration with a focus on a narrow range of asset class.

Vamosiu, McClure and Titus (2018) examined economies of scale and scope with regards to undergraduate enrollment, graduate enrollment and research at public master's institutions by employing panel data on 248 institutions spanning fiscal years 2004-2012. A flexible fixed quadratic cost function was employed that also accounts for spatial interdependency. Results revealed that economies of scale exist for undergraduate and graduate enrollments at mean, below and above it but not for research. Economies of scope both at the individual and global level are found at mean, below and above output levels.

Bartolacci, Del Gobbo, Paolini and Soverchia (2019) analyzed the cost efficiency of waste management companies by verifying existence of economies of scale with respect to separate waste collection preceding reuse, recycling and recovery of wastes. Companies engaged in waste management services throughout Italy were analyzed based on partial elasticity approach. Results revealed that the greater the separate waste collection rate, the higher the total costs incurred by the analyzed companies but this finding depicts a non-linear relationship which ultimately proved that separate waste collection rate increases total costs proportionately less and provides evidence for the existence of economies of scale. The findings also revealed that such cost advantage is strengthened by a positive interaction effects with population density.

Parsa (2020) attempted to compare the efficiency, technological gap and stability of Islamic and conventional banks in the GCC region. Generalized method of moments (GMM) was used to highlight the major determinants of bank efficiency

in GCC countries. A panel data set of 72 banks over the period 2005-2011 that covers the crucial period of global financial crisis was used for the analysis. The results showed that there was no statistically significant difference in mean efficiency between Islamic and conventional banks when efficiency is measured relative to the group frontier.

Tran (2021) examined cost efficiency of public universities of Vietnam through the estimation of economies of scale and scope in order to seek for explaining whether the even application of standardized "one size fits all policy" in distributing public budget works or not when the cost budget is stratified into rural and urban universities. The quadratic cost function with random effects for a panel structure of 2011-12 to 2013-2014 was employed. The findings show that public universities are cost inefficient in their performance and there are no economies of scale and scope in public universities. It also highlighted the even distribution of delivering state funding is more likely to be ineffective for public universities due to their different characteristics.

Siwach, Paul and Hoop (2022) presents evidence on the association between programme scale, costs and cost effectiveness by analyzing the case of self-help groups in India. Time period of the study comprises from year 2017 to 2019. Data for the study comprises expenditure data from programme's audit statement of Jeevika – the Bihar Rural Livelihoods Promotion Society. Results revealed that a 1% increase in programme membership was associated with a 0.6% increase in annual programme expenditures, indicating large economies of scale. Predicted costs from Regression analysis suggest that the annual per capita expenditure declined from $29 to $5 when number of members rises from 100,000 to 10 million.

It is observed that agricultural marketing cooperatives being acted as an investor owned firms (Williamson, 1981) tried to maximize their profits in order to serve the interest of their various stake holders in an efficient manner. Literature review has provided very limited insights on measuring cost efficiency analysis of agricultural marketing cooperatives. Since the launching of working report on Agricultural Credit, Cooperation and Crop Insurance for formulation of the Tenth Five year plan (2002-2007) policy reforms related to non-credit cooperatives as well as agro-processing sector during the tenth five year plan, no such study has been found, consisting insights related to the cost efficiency analysis of industrial units of Indian agricultural marketing cooperatives. Cooperatives processing operations are also based on various agricultural produce like wheat, rice, pulses, oilseeds etc. Therefore to develop insights whether cooperatives were possessed with a potential of investor owned firms, at the time of policy reforms, this study

has been conducted by taking a sample of industrial units of Markfed Punjab for a period of 2004 to 2013 in order to find their operational efficiency's conduciveness with the various initiatives and policy reforms taken by the government in order to boost the agro-processing sector. So cost efficiency analysis of industrial units set up by various cooperatives would be helpful in achieving deep insights related to the better management of their operating expenses as well as revenues. Results of this study could develop insights and could act as guide towards analyzing the potential of various existing cooperatives as investor owned firms and also to create and enforce policies that contribute more towards the promotion of their industrial establishments by analyzing cost as well as operational efficiency in current economic scenario.

MATERIALS AND METHODS

This study aimed at investigation of future growth potential for the industrial units of agricultural marketing cooperatives. Three plants of Markfed Punjab situated at different locations in Punjab state of Northern India has been selected to estimate the production cost efficiency. Three plants selected for the study are: Cannery, Jalandhar; Vanaspati & Allied Industries, Khanna; and Agro Chemicals, Mohali. These three plants contributed towards the major portion of revenue generation for Markfed Punjab. Estimation of Economies of scale is based on secondary data. Secondary data consisted of the ten years balance sheets, i.e. from year 2004 to year 2013 for these three plants of Markfed. Balance Sheets have been collected from the head office of Markfed situated at Sec – 35b of Chandigarh (capital of Punjab state). Estimation of economies of scope is limited to ready to eat products of cannery only.

The stochastic frontier analysis (SFA) technique has been employed to measure economies of scale for these three plants of Markfed through the estimation of the cost function. SFA techniques are concerned with the estimation of frontiers which envelope data, rather than with functions which intersect data. Proximity to estimated frontiers, define the degree of efficiency with which producers pursue their objectives. These objectives can be purely technological, or economic in nature, that deals with the estimation of production, cost and profit frontiers (Kumbhakar & lovell, 2000).

In the study, single output scale economies have been measured with the help of single output stochastic Cobb Douglas cost function of the single equation system. The single output Cobb Douglas cost function has been adopted due to its simplicity. For example, it is quite easy to readily verify whether the cost function is increasing in every input price wi (as required by economic

theory) by looking at the sign of the relevant estimated coefficients (β_j). In spite of this benefit, an important limitation of this cost function is that it implies globally increasing, constant or diminishing returns to scale. As can be seen from this equation:

$$\frac{\partial lnC}{\partial lnY} = \frac{\frac{\partial c}{\partial y}}{\frac{c}{y}} = \beta y \qquad (1)$$

It means If $\beta_y < 1$, marginal cost is less than average cost and the average cost is declining. In other words, there are positive economies of scale at every level of output. Similarly, diseconomies of scale hold everywhere if $\beta_y > 1$. For $\beta_y = 1$, the average cost is a constant (Chen & Ray, 2013). Maximum likelihood estimation (MLE) technique is used to estimate the coefficients of the cost function. MLE technique is a method of point estimation with some stronger theoretical properties than the method of Ordinary Least Square (Gujarati, Porter & Gunasekar, 2012).

The panel has been created with the three firms: Markfed Cannery Jalandhar; Markfed Vanaspati & Allied Industries, Khanna and Markfed Agro Chemicals Mohali for a time period of ten years i.e. from year 2004 to year 2013. It is so because panel contains more information than a single cross section and it also results in estimates of technical as well as cost efficiency with more reliable statistical properties. (Kumbhakar & Lovell, 2000). Although three firms of Markfed industry (taken for panel creation) are different in nature of products being produced by them, but they are supposed to constitute one panel because in order to constitute panel, population parameters must be similar because it hardly matters whether the samples or units are similar or not (Beck, 2004). Similar heads are used in the balance sheets of these plants to highlight the various components of cost of production like raw material cost, sales, direct labour expenses, etc. which support the notion proposed by (Beck, 2004) to consider these firms as similar units to form a panel. Total 30 observations are analyzed in this study due to non availability of data beyond year 2004 and after year 2013.

RESULTS AND DISCUSSION

Estimation of Economies of Scale for Industrial Units of Markfed

Variables required for estimating Cobb Douglas single output equation cost function for a panel of three plants of Markfed are categorized in to three types. They are:

Output

Value of total annual sales of finished products of each plant is considered as output because balance sheets of these plants provided information only on

total sales value and it is not differentiated as per different product categories, produced by these plants.

Variable Costs

Total variable cost is defined as sum of annual amount of Raw Material Cost (RMC), Packing Material Cost (PMC), Direct Labour Expenses (DLE) and Other Factory Expenses (OFE) for three plants of Markfed.

Variable Inputs & Prices

Variable inputs are classified into two categories: Labour and all other variable inputs. Data on prices of inputs is not available from the balance sheets of these plants. Averages of Punjab state hourly labour rates from year 2004 to year 2013 for unskilled, semi-skilled and skilled labour are used as the input price for labour. Price of other variable inputs is assumed to follow the GDP implicit price deflator (Akridge & Hertel, 1986) for India from the year 2004 to 2013 which has been obtained from the website of World Bank and it is named as input price for other inputs.

Estimation of economies of scale is based on maximum likelihood estimates. Frontier 4.1 software developed by Tim Coelli is used to analyze data and for the estimation of single output Cobb Douglas cost function model. Data file named EG73.DAT.txt is created in the notepad format and the instruction file named EG73INS.txt is created by copying and making changes in the blank instruction file provided by the software manual itself. Logged files are created for data and instruction files. An Output file named EG73.OUT.txt is obtained through analysis. Maximum likelihood estimation technique is used to estimate

Table 3
Results of Maximum likelihood Estimation for a Panel of firms of Markfed

Coefficient	Value of Coefficient	Standard-error	t-ratio
?0	-0.7823	0.2439	-0.3207
?1	0.5028	0.7245	0.6941
?2	0.2467	0.3644	0.6771
2	0.2369	0.4494	0.5270
	0.7695	0.1198	0.6420
Value is Restricted to Zero	0.8669	0.9198	0.9425
Log Likelihood Function	0.27		
LR test of one sided error with no. of restriction equal to 20.19			

Source: Own elaboration obtained using Frontier 4.1 software.

the coefficients of the cost function. Coefficients measure the cost elasticity of output and inputs with respect to the variable 'cost of production'.

Table 3 reflected values of various coefficients obtained through maximum likelihood estimation technique by running frontier 4.1 software on data file named EG73.DAT.txt. It shows the results of grid search process which has highlighted that the value of gamma (γ) coefficient (0.29) has been found greater than zero (0), which means that there is an effect of random error on the value of estimates of cost function.

This finding further favours that analysis must be done through Maximum Likelihood estimation (MLE) technique and estimates obtained from estimation of Cost function through MLE technique must be considered as final estimates in order to estimate economies of scale for the plants of Markfed. In this Table value of coefficient beta 1 (β_1) and beta 2 (β_2) reflected cost elasticity of single output: sales and two inputs: labour and other inputs for a panel of three plants of Markfed with respect to variable cost of production of these plants.

Final estimation of economies of scale for a panel of three plants of Markfed is dependable on the sum of value of coefficients obtained for single output and two inputs or (single input price after normalization).

Table 4
Estimation of Economies of Scale through Coefficients of Cost Function

Sr. No.	Name and Type ( ) of variable	Value of Coefficient
1.	Sales (Output)	0.50 (β_1)
2.	Other Input Prices (Input)	0.24 (β_2)
3.	Sum of Coefficients	0.50 + 0.24
	Total	= 0.74

Note : β_1 = Coefficient for output (sales) and β_2 = Coefficient for input (other input prices).
Source : Own Elaboration Based on Research Results from Frontier 4.1 Software.

Table 4 reflects an estimation of economies of scale through sum of values of the coefficients for output and input prices which are obtained through single output Cobb Douglas cost function. Coefficients of cost function are estimated with the help of maximum likelihood estimation technique by following the sequence of insights generated from ordinary least square (OLS) method and grid search steps of output file EG73.OUT.txt, generated by frontier 4.1 software.

The Sum of coefficients reflected that the ratio of minimum feasible cost to observed expenditure. This ratio can attain maximum value equal to one (1) in order to achieve highest level of cost efficiency. Hence the obtained value for

this ratio is less than one (< 1) which reflected that plants of Markfed industry has exhibited economies of scale and could achieve higher cost efficiency by increasing the scale of production of their products with the same cost that would lead to reduction in per unit cost of production for their products. Thus, null hypotheses H0 has been rejected and alternate hypothesis has been accepted.

A number of studies have been analyzed by us in order to get an idea regarding estimation techniques. In most of the studies multi output economies of scale has been estimated with the help of cost functions but we have achieved, single output scale economies with the help of Cobb Douglas cost function. Our findings related to economies of scale are found consistent with the findings of Barros & Garcia (2001); Liu (2003); Kolawale and Ojo (2007); Oliver (2015) and Biam, Okorie & Nwibo (2016) because of the similar nature of their estimation techniques with our estimation technique. A Cobb Douglas cost or production function has been employed by these authors.

CONCLUSION, LIMITATIONS AND SUGGESTIONS

Conclusion

The results of this study revealed that economies of scale do exist for the panel of industrial units of Markfed. Sum of coefficients of cost function is 0.74 which is less than the highest level of economies of scale i.e. 1. This proves that Markfed could achieve cost benefits and a potential for the future growth of their industrial units by increasing the scale of production of their products with same cost of production. This way it could be helpful in reducing per unit prices of products of Markfed and that could be helpful in contributing towards increase in demand for these products in the consumer markets in comparison to other industries operational in markets. Increase in sales would eventually leads towards increase in revenues as well as profits for Markfed's firms. Insights revealed from this study emphasizes that if the operations of industrial units of cooperatives can be managed properly they may acts like a source of boon for the main stakeholder of these cooperatives i.e. for farmers in improving their economical condition in particular and of the nation in general.

Limitations

We are aware of some of the limitations of this study. First of all, data available from balance sheets of plants of Markfed have very limited information on various variables like outputs, input prices, product wise cost of production etc.

which are very important to estimate economies of scale. Secondly, panel data set for the study was limited to single firm only and could be more insight if panel was formed of data related to various other marketing cooperatives of our country.

Suggestions

This study has been conducted by considering the Markfed as a representative of other marketing cooperatives of Northern India. Insights received from this study could be helpful in guiding the management of other marketing cooperatives of northern India towards analyzing cost efficiencies of their Industrial units. Suggestion for future research is that this work can be extend up to national level by creating large panel dataset consisting of data of various marketing federation of cooperatives situated in different states of India like HAFED in Haryana' Markfed Orissa; HIMFED in Himachal Pradesh etc. This could be helpful in achieving broader picture regarding future growth potential of industrial units of various marketing cooperatives operational in India by focusing on the analysis of their cost efficiencies. Potential of marketing cooperatives can be harnessed properly as an investor owned firms by analyzing various policy reforms occurring in current scenario in context to the growth of agro-processing sector. Growth and efficiency enhancement of cooperatives would lead to more employment generation as around 54% population of our country is still engaged in agriculture and allied sector activites and accounts for 17.8% of the country's Gross Value Added (GVA) for the year 2019-2020 (at current prices). (Annual Report 2020-21)

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