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Technical Efficiency of Unorganised Food Processing Industry in India: A Stochastic Frontier Analysis

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TECHNICAL EFFICIENCY OF UNORGANISED FOOD PROCESSING INDUSTRY IN INDIA: A STOCHASTIC FRONTIER ANALYSIS

Padmavathi N*

Abstract

The Indian food processing industry, which is labour-intensive in nature, plays a crucial role in the absorption of manpower essential for economic development of the country. The industry is, however, often labelled as a sink for unskilled masses to be absorbed without contributing substantially to the national income. Given this backdrop, the present study adopted the Stochastic Frontier Analysis (SFA) as part of examining the efficiency of the unorganised food processing industry using NSS 73rd (2015-16) round unit-level data. The analysis is carried out by grouping the entire industry under six sub-sectors. The study reveals that although capital plays a significant role in enhancing the output levels of firms, a disproportionate increase in the capital accumulation doesn't necessarily enhance the efficiency of the firms in terms of improved output levels. The efficiency scores reveal that the industry has been unable to realise its full potential. The inefficiency model suggests that lack of skilled labour handling capital goods, under-provision of credit and absence of full-time workers are the major sources of observed inefficiency of enterprises.

Keywords: Unorganised Food Processing Industry, Technical efficiency, Stochastic Frontier Analysis.

Introduction

Agro-processing industry in general, and food processing industry in particular, play a major role in promoting rural development in the view of their backward linkages with agriculture and allied activities. The industry helps the commercialisation process of agriculture and enhancement of factor income mainly through crop diversification (Bathla and Sharma, 2012). Recognising the relevance of the industry, GoI, has accorded a high priority status to the food processing industry by way of extending number of fiscal reliefs and incentive packages with a view to promote commercialisation and value addition (ASSOCHOM, 2017). Eleventh Five Year Plan (2007-12), while viewing the Food Processing Industry as a sunrise sector, proposed certain policies/programmes as part of ensuring the growth of the industry along with other manufacturing segments (Rao, 2009).

The Indian food processing industry is characterised by a dualistic structure like any other manufacturing industry *i.e.*, the presence of both the organised and unorganised segments.To state otherwise, the idiosyncratic nature of these two segments of the industry is reflected in the coexistence of both very small and larger firms with significant productivity differentials existing among them. Although the organised segment is relatively small in size (number of enterprises) it is capital-intensive in nature, whereas, the unorganised segment is large in size and is highly labour-intensive mostly located in the rural areas. It is important to note that the unorganised food processing industry is capable of catering to the employment needs, especially of the rural population with a larger presence

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of enterprises spread across the states, accounting for 98.40 percent of the enterprises, 74.24 percent of employment, however, only 28 percent of value addition of the total food processing industry (NSS, 2015-16). On the contrary, the organised food processing segment accounts for relatively lower share in enterprises and employment (1.60% and 27.76% respectively), but a whopping 72 percent share in the total industry's GVA generation (ASI, 2015-16). From this statistics, it is evident that the organised segment is directed towards value generation while the unorganised segment is focused on the provision of employment opportunities. However, either a massive (relatively) value generation of the organised segment without providing considerable employment opportunities or a high labour absorption of the unorganised segment without making a significant contribution towards value addition does not essentially align with the goals of a developing economy. Nevertheless, it is essential for labour-surplus economy like India to provide gainful employment, as it enables people to improve their quality of life and thereby have a decent standard of living.

However, it is often alleged that the unorganised food processing industry acts as a sink where people with no access to alternative employment opportunities are deposited (Mukharjee, 2004). Although, the contribution of the industry towards employment generation has been widely acknowledged, its role in contributing to the national income continues to raise apprehensions. It is also argued that the unorganised food processing industry operates at higher levels of inefficiency without utilising its full potential (Bathla and Sharma; Goladar, 2014). Hence, in the changing times, it is reasonable to expect the industry to generate its potential value add while providing adequate employment opportunities to the rural unskilled and illiterate population. Otherwise, the objectives behind encouraging this industry would remain unfulfilled.

Generally, there are two important factors that determine the productivity of any industry. First, the technological change that refers to technological progress through the process of invention, innovation and diffusion of technology. However, the technological change is most often considered external to firms in the sense that factors which influence technological changes may not be under the control of firms. The second factor is efficiency change that refers to achieving optimal use of inputs over which firms have control. Although, technological change may help in improving the situation within a given sector, it is considered to be expensive in the context of developing countries due to scarcity of capital (Raj, 2007). Hence, the only feasible option open to the food processing industry is to achieve desirable levels of technical efficiency with a view to enhancing aggregate productivity. Therefore, the present study is an attempt at understanding the efficiency levels of the unorganised food processing industry.

Setting-up the Context

Food processing industry in India is considered a potential source of driving the rural economy, as the industry is expected to increase farm gate prices, reduce wastages, ensure value addition, promote crop diversification, generate employment opportunities, etc (FICCI, 2010). India offers tremendous opportunities for the potential development of the food processing industry both from demand and supply sides. India is the second largest country in terms of food production and arable land, and is ranks 1st in the world in terms of the production of milk, banana, mango, guava, papaya, ginger, okra and buffalo meat, while occupying the second place in the world in the production of green pea, potato, tea, tomato, sesame and many other key commodities (MoFPI, 2016; ASSOCHAM, 2017). In view of its geographically strategic location and proximity to food-importing nations, India finds itself in a favourable position when it comes to export of processed food products besides an increased domestic demand. Upon realising the potential of the industry, the governments at the national and sub-national levels in India initiated extensive reforms such as rationalisation of food laws, amendment of Agriculture Produce Marketing Committee Act, implementation of National Horticulture Mission, National Mission on Food Processing, setting up of infrastructural facilities, 100 percent FDI flow into the food processing industry, cold chain infrastructure, and so on (FICCI, 2010).

Despite the presence of a strong raw material base, extended demand and continual efforts and initiatives on the part of governments, food processing in India continues to be in a budding stage with a relatively low penetration and under-utilisation of its potential along with a huge wastage in fruits, vegetables and other perishable food produces. Moreover, the processing of these produce continues to remain very low with fruits and vegetables accounting for close to merely 2 percent, poultry for 6 percent meat for 21 percent, marine products for 23 percent and dairy for around 35 percent with respect to their respective total production. Thus, there is a huge unexplored potential underlying the food processing industry of the country (MoFPI, 2016).

Second, like any other manufacturing industry, the Indian food processing sector also characterised by a dualistic structure as stated earlier. And the unorganised sector outnumbers the organised sector in terms of enterprises and employment opportunities (the unorganised sector accounts for 98.41 per cent and 74.24 percent of the total enterprises and workforce, respectively). However, the unorganised sector is often blamed for operating at lower levels of efficiency without utilising its full potential (Bathla, Sharma, 2014; Goldar, 2014). At the same time, the sector remains highly diversified with a range of varied processing activities suitable to the product being processed. This has led to the diversified levels of operation and utilisation of factors of productive inputs across the sub-sectors of the industry with an inseparable impact on its performance levels.

Third, the issues and challenges faced by the unorganised segment of the food processing industry vary significantly across the states in the country due to the quality of industrial activity that varies significantly across the states depending on the composition in terms of agro-climate conditions, share of industry type (registered and un-registered segments), initial levels of capacities and development, demography, policy and incentive mechanisms etc (Popola, *et al*, 2011).

Finally, regardless of its immensity, empirical research intended to assess the challenges and issues confronting the industry, with regard to efficiency, are very scanty. The literature on efficiency analysis mainly comprises of unorganised manufacturing sector as a whole and at different time points (Majumder, 2004; Yuko, 2004; Raj, 2007). A very few studies dealing with the technical efficiency of the food processing industry have focused on the industry at the aggregate level, but not at the disaggregate levels (State-wise and sector-wise). Hence, there is a severe dearth of empirical research that is exclusively focused on unveiling the efficiency levels and the factors determining inefficiency of the unorganised food processing industry in India at the disaggregated level.

Moreover, efficiency analysis seems to be a tailor-made instrument for understanding the performance of the unorganised food processing industry, given its diversified nature. The efficiency measures provide information on the rate at which the productive inputs are converted into outputs and the desirable levels of output, given the input levels. Hence, efficiency measures will explain the level of efficiency of enterprises by comparing their actual production levels to the maximum potential production levels. Therefore, the present study tries to explore the levels of technical efficiency and the role of firm-specific features in determining technical inefficiency of the industry. The analysis also helps in formulation of possible policy suggestion/measures towards achieving improved performance of the industry.

Review of Literature

The literature attributes two major sets of factors as the source of the inter-firm efficiency differentials. The first set of factors deals with firms' specific characteristics such as age, size, type, location, ownership, worker characteristics, access to credit, etc. The second set of factors refers to the macro level ecosystem that normally consists of a range of policy variables and other macro conditions.

Kalirajan and Tse (1989) observed that differences in the efficiency of factor use are attributable to differences in the entrepreneur talents of the individual firms and further, they said that, there can be wide variation in the performance of individual firms within the industry based on their specific features. The empirical literature, that deals with the nature of these firm level characteristics and their influence on firm level efficiency, is discussed below.

With respect to the impact of firm's size and age on efficiency, there are two prominent strand of argument. Agell (2004) argues that employees of small firms may be more motivated by competitive-based incentive schemes rather than financial schemes, thus making the small firms plausibly more efficient. On the contrary, large firms may enjoy labour specialisation as well as scale of economies (Williamson, 1970). Jovanovic (1982), who developed a firm growth model, came to the conclusion that larger firms are more efficient than smaller ones. This result is an outcome of a selection process in which efficient firms grow and survive, while inefficient firms stagnate or get extinct from the industry. There is an inter-linkage between the age and size of a firm in that as a firm becomes older and older, the capital accumulation takes place and, in return, it helps the firm become larger and efficient. The empirical findings of the studies carried out so far support both the propositions. Kumbhakar, Ghosh and McGuckin (1991) while investigating farm-level efficiency of US dairy farmers, estimated their technical and allocative efficiency. The results indicated that larger farms are more efficient than small and medium farms. Lundvall and Battese (2000) also found that the firm size has positive and significant effect on wood and textile sectors, while age effect is less systematic and insignificant in respect of all the Kenyan manufacturing firms, excepting the textile sector. Sinani, Jones and Mygind (2007), found that Estonian firms which are foreign and marginally owned, privatised large firms with labour quality show higher level of efficiency. On the contrary, studies by Sanchez and Diaz (2008); Nikaido (2004); Haron and Chellakumar (2012) and Aggery, Eliab and Joseph (2010) found that smaller firms are more efficient than their counterparts as they exhibited flexibility and simplicity in organisational structure that helps in decision making process. Margonoand Sharma (2004) found age and ownership contributing towards technical inefficiency in the case of Indonesian chemical and metal sectors. Hence, these deliberations indicate ambiguous conclusions with respect to the impact of age and size on firms' efficiency.

Along with this, there are several other firm-specific characteristics such as the nature of employment (skilled/unskilled worker), ownership, location, enterprise type, credit access, etc., that also influence the technical efficiency of firms. Studies conducted by Huang (2003); Regnier (2000); Admassie and Matambalya (2002); Zahid and Mokhtar (2007); Saleh and Ndubisi (2008) and Krasniqi (2007) found that skilled labour is positively associated with technical efficiency for SMEs across different countries. On the contrary, Charoenrat *et al* (2013) found that skilled labour is negatively associated with technical efficiency in respect to Thai small and medium-sized enterprises, and the author contemplated that the association could be the result of usage of obsolete labour-intensive technology.

Type of ownership is another variable influencing the efficiency of firms. Different studies have used different classifications of ownership type in order to assess its influence on efficiency. Onder *et al* (2003); Margono and Sharma (2006) used public-private ownership classification, whereas Pitt and Lee (1981); Goldar *et al* (2003) used foreign and domestically owned classification. These studies found that foreign-owned firms are more efficient than domestically-owned firms.

Geographical locational characteristics of firms are yet another variable in assessing the efficiency (Onder *et al*, 2003). Various studies have used different geographical classifications specified to their study areas. Raj (2007), while dividing Kerala state into South and Northern regions found that firms located in the Southern region are relatively inefficient *vis-a-vis* their counterparts in the northern region. The author cites the higher industrial sickness prevailing in the southern region as compared to the northern region as the possible reason for this variation. Minch *et al* (2007) used the industrial map of Vietnam being divided into eight regions and found heterogeneous efficiency levels across different regions as well as sub-industries.

It is argued that firms functioning throughout the year are relatively more efficient than firms whose operation is confined to a few months/seasons in a year, as the former enjoy the benefit of operating under the economies of scale (Raj, 2007). Rajesh Raj (2007), while examining the above premise by generating an enterprise dummy (the variable takes value 1, if enterprises are perennial and 0, otherwise), found perennial enterprises are more efficient than casual and seasonal enterprises.

Many studies have shown that investment and growth potential of firms would substantially diminish in the presence of credit constraints (Tybout 1983; Nabi 1989). The literature also shows that small firms are unable to operate at their potential efficiency level and to adopt new technology in the absence of working capital. On the other hand, some studies point out an inconclusive impact of subsidised credit on efficiency of firms. However, Hill (2001) and Raj (2007) found that credit availability has negative association with technical inefficiency, in that, firms' efficiency increased with capital borrowing, thereby increasing the working capital of firms.

Finally, there exist an ample number of studies examining the effect of policy variables on the efficiency of firms. These studies covered a range of policy variables such as market reforms, deregulations and delicensing, policies related to trade and Foreign Direct Investment (FDI), etc.

Mitra (2001) argues that the labour market reforms, like the process of casualisation and feminisation of labour, deregulation and de-licensing of economic activities have led to an increase in the efficiency of Indian manufacturing firms. Similarly, a study conducted by Karunaratne and Hossain (2004) reveals that trade liberalisation, export orientation and capital deepening have had a significant effect in terms of a reduction in the overall technical inefficiency of Bangladesh manufacturing firms. On the contrary, Mukhrejee and Ray (2004) found no major change in the efficiency ranking of states after the reforms or any evidence of convergence in respect of the distribution of efficiency across the Indian manufacturing sector in the post-reform period.

The findings of Mukhrejee (2004) revealed that factors like technology, access to resources and inputs, general macroeconomic atmosphere, etc. are the important determinants of productivity. Given the capital scarce nature of the country, augmentation of capital use by enterprises could enable them to complement the available labour force with improved machinery, which, in turn, helps them make an effective use of labour and thereby increased productivity levels. On the contrary, Majumder (2004) argues that effectiveness of labour for smaller units depends more on training, experience, and familiarity of workers, rather than the range of tools that complement them.

With regard to FDI, Amornkitvikai, Harvie and Charoenrat (2010) and Li and Hu (2013) argue that FDI improves not only technical efficiencies directly, but also indirectly enhances technical efficiencies through complementing R&D activities by significantly increasing the expenditure on R&D activities of large-size SMEs. On the contrary, Mazumdar *et al* (2009) found neither R&D, export expenditure nor the use of imported technology improved the technical efficiency of Indian pharmaceutical firms.

From the brief survey of literature, it is evident that hardly any study has exclusively addressed the issue related to the efficiency of the Indian unorganised food processing industry. Hence, keeping in view these limitations and considerations, the present study attempts to probe in detail the issue of efficiency of the unorganised food processing industry in India.

Data and Methodology

Data:

The National Sample Survey Organisation (NSSO) of India has designed a survey as part of collecting a detailed industry-wise information on the nature and status of activity, employment, ownership details, emoluments, inputs, outputs, inventory of fixed assets, working capital, outstanding loans, etc. of the unorganised sector across states. These variables explain the performance of the industry in the economy, its growth pattern, resource utilisation, employment and investment position. The current study has drawn relevant data and information from the unit-level records of the 73rd NSS round titled "Unincorporated Non-agricultural Enterprises (Excluding Construction) in India" conducted in the year 2015-16.This data follows NIC 2008 in classifying the industry wherein, Food products and beverages belong to 10 and 11 divisions, respectively. The survey was conducted across 30 States and 6 union territories of the country.

Sample size: 15, 865 enterprises belonging to the Food Processing sector have been surveyed in this round covering all the 18 sub-sectors of the industry spread across all the States and Union territories of the country. The 18 sub-sectors of the industry are further aggregated into 6 sub-sectors for a sub-sector level analysis - Bakery, Dairy, Distillery, Grain, Meat and others. The sub-sectors bakery products (1,071) and coca, chocolate and sugar confectionary (1,073) are clubbed to form one sub-sector called Bakery. Similarly, Distilling, rectifying and blending of spirits, ethyl alcohol production and fermented materials (1,101) and soft drinks, production of mineral waters and other bottled waters (1,104) are clubbed to form the Distillery sector. The remaining sub-sectors are clubbed to form a separate sub-sector named as 'others'. Thus, these 6 sub-sectors represent the overall industry.

Similarly, the study confined to only 15 major States (which include all the so-called non-special category States) out of 30 Indian States for a sub-national level analysis. These 15 major States of India, as mentioned in the literature, broadly represent the entire sub-national level scenario of any given indicators. Data pertaining to the State of Telangana has been merged with Andhra Pradesh for a better comparison with the previous rounds of NSS (if any), as the State of Telangana was formed in 2014.These adjustments of sub-sectors as well as States have been done in order to have a better representation and for research convince.

Methodology: Stochastic Frontier Analysis

There are two ways of estimating technical efficiency viz., Parametric and Non-Parametric approaches. Data Envelopment Analysis (DEA) is one of the extensively used methods under Non-Parametric approach. Similarly, Stochastic Frontier Approach (SFA) is widely used assessing the performance of firms/ enterprises within the parametric method. Basically, the Parametric method assumes the existence of an unobservable production function corresponding to a set of maximum attainable output levels for a given combination of inputs.

SFA was developed by Aigner, Lovell and Schmidt (1977) and Meeusen and Van den Broeck (1977). They proposed a single equation cross-sectional stochastic production frontier (SPF) model which assumes that establishment i uses input vector X_i to produce a single output Y_i based on the following:

$$Y_i = f(X_i\beta)\exp(\theta_i - \mu_i) \qquad \text{---------- (1)}$$

where i= I,2, 3, 4,...., N

The error term in the model consists of two components - a traditional symmetric random noise component (θ_i) and a new one-sided inefficiency component (μ_i). The first component accounts for measurement error, and other factors that are outside the control of firms. On the other hand, the one-sided inefficiency component captures the technical inefficiency which is a combined outcome of organisational factors that constrain a firm from achieving their maximum possible output, given a set of inputs and technology.

From the literature, it is understood that normally there exists a gap between firms' actual and potential levels of economic performance. The value of technical efficiency (TE) lies between 0 and 1. When a firm achieves a perfect technical efficiency, the value of TE is equal to 1 whileμ_i takes the value of zero. On the contrary, when a firm faces the constraints in the production process then 0< TE<1 and μ_i takes a value other than zero ($\mu_i \neq 0$). The magnitude of μ_i specifies the efficiency gap i.e., how far a firm's given output is from its potential output (Kathuria, Raj and Sen, 2013). Both θ_i and μ_i are assumed to be identically and independently distributed. In the Stochastic frontier function $(\mathfrak{f}(X_i\beta)\exp(\theta_i - \mu_i))$, $(\mathfrak{f}(X_i\beta))$ is deterministic part of the function which is common to all the firms and $(\exp(\theta_i))$ is the firm specific part. Hence, firms' specific Technical Efficiency (TE_i) is measured as the ratio of the observed output of firm to the potential output derived by the frontier function and expressed as:

$$TE_i = \frac{\mathfrak{f}(X_i\beta)\exp(\theta_i-\mu_i)}{\mathfrak{f}(X_i\beta)\ \exp(\theta_i)} = \exp(-\mu_i) \qquad \text{---------- (2)}$$

TE_i measures how close an establishment gets to its maximum achievable output, once the noise part is removed. Y_i achieves its maximum value of ($f(X_i\beta)\exp(\theta_i)$) and $TE_i = 1$ if μ_i=0. Stated differently, $\mu_i \neq 0$ reports the shortfall of observed output from the maximum potential output. To compute TE_i, one needs first to estimate equation (1), and then decompose the residuals into estimates of noise (θ_i) and technical inefficiency (-μ_i).

DEA envelops observed input-output data without requiring a-priori specification of the functional form. This measure gives a relative measure of performance rather than an absolute measure. The measurement error and statistical noise are assumed to be non-existent in DEA. The efficiency scores derived from SFA are essentially iids and can be employed in other econometric and statistical techniques for further analysis. This gives us a prospect to choose SFA over DEA for the current analysis.

Several studies have estimated stochastic frontiers and predicted firm level efficiencies using the production function and then regressed the predicted efficiencies upon the firm-specific variables, which is an attempt to identify some of the reasons for differences in the predicted efficiencies across firms within the industry. So far, this has been recognised as a useful exercise, however, this two-stage estimation procedure is inconsistent in its assumptions regarding the independence of the inefficiency effect in the two estimation stage. This issue was addressed by Kumbhakar, Ghosh and McGuckin (1991) and Reifschneider and Stevenson (1991) who proposed stochastic frontier models wherein, the inefficiency effects (U_i) are expressed as an explicit function of a vector of firm-specific variables and a random error. Battese and Collie (1995) proposed a model which is equivalent to the Kumbhakar, Ghosh and McGuckin (1991) specification with the exceptions, the allocative efficiency is imposed, the first-order profit maximising conditions removed and panel data is permitted. The Battese and Collie (1995) model specification may be expressed as:

$$Y_{it} = X_{it}\beta + (\theta_{it} - U_{it}) \qquad \text{---------- (3)}$$

i=1,2….,N; t=1,2….,T

where Y_i is (the logarithm of) the production of the i^{th} firm

X_i is a (kx1) vector of (transformations of the) input quantities of the i^{th} firm

β is a vector of unknown parameter

θ_i are the random variables which are assumed to be iids. N(0, σ_v^2), and independent of the μ_i which are non-negative random variables and are assumed to account for technical inefficiency in production and are assumed to be independently distributed as truncations at zero of the N(μ_i, σ_u^2), distribution, where,

$$\mu_i = \delta Z_i + \omega_i \qquad \text{---------- (4)}$$

Where Z_i is a (px1) vector of variables which may influence the efficiency of a firm, whereas δ is a (1x p) vector of parameters to be estimated.

We once again use the parameterisation from Battese and Corra (1977), replacing σ_v^2 and σ_u^2 with $\sigma^2 = \sigma_v^2 + \sigma_u^2$ and $\gamma = \sigma_u^2/(\sigma_v^2 + \sigma_u^2)$.

This specification of the model also encompasses a number of other model specifications as special cases. If we set T=1 and Z_i contains the value one and no other variables (i.e., only a constant term), then the model reduces to the truncated normal specification in Stevenson (1980), where δ_0(the only element in δ) will have the same interpretation as the μ parameter in Stevenson (1980; Collie,1996).

The computer program FRONTEIR version 4.1 has been used for obtaining the maximum likelihood estimates of a sub-set of the stochastic frontier production function and its determinants. The program can accommodate panel data, time-varying and invariant efficiencies, half-normal and truncated normal distributions and functional forms with a dependent variable in logged or original units.

Specification and Estimation

To estimate the technical efficiency of the unorganised food processing industry, the stochastic frontier production function proposed by Battese and Collie (1995) has been adopted. Cobb-Douglas and Translog models are the two common forms of production functions widely used in the literature for estimating the stochastic frontier production function. In the present study, Translog production function has been used, as the Cobb-Douglas function is embedded in Translog function.

$$lnY_i = \beta_0 + \beta_1 lnK_i + \beta_2 lnM_i + \beta_3 lnL_i + \beta_4 lnK_i^2 + \beta_5 lnM_i^2 + \beta_6 lnL_i^2 + \beta_7 lnK\ lnM_i + \beta_8 lnK\ lnL_i + \beta_9 lnL\ lnM_i + \theta_i - \mu_i \qquad \text{---------- (5)}$$

where *lnYi* is the log of gross value added; K_i, M_i and L_i are the log values of Capital, Raw Materials and Labour Days, respectively and $\beta's$ are the parameters to be estimated.

Determinants of inefficiency model:

$$\mu_i = \delta_1 + \delta_2 lnage_i + \delta_3 lnCI_i + \delta_4 lnSFTW_i + \delta_5 lnSFW_i + \Upsilon_7 Credit_i + \Upsilon_8 Prob_i + \Upsilon_8 Reg_i + \Upsilon_8 Rur_i + \Upsilon_8 OAE_i + \Upsilon_9 Urb\_Est_i + \Upsilon_9 Credit\_Est_i + \omega_i \qquad \text{---------- (6)}$$

Variables

Dependent Variable:

Gross Value Added (*lnGVA*): Gross Value Added (GVA) is the dependent variable. Gross Value Added is a better choice for the dependent variable than Gross Value of Output, because the former allows for a comparison between firms that use heterogeneous raw materials. Whereas, the use of gross output, that demands the inclusion of raw material also as an input variable in the model, might obscure the role of capital and labour in the measurement of technical efficiency. The value of the GVA is reported for the reference period in the survey (i.e., for the last 30 days) and this value is appropriated to the entire calendar year, using a relevant procedure.

Independent Variables:

Capital (*lnK*): Market value of the fixed assets is considered as a proxy to Capital. The variable is obtained in the following way,

$$Capital\ (K)_i = \ (Market\ Value\ of\ Fixed\ Asset\ Owned_i + Market\ Value\ of\ Fixed\ Assets\ Hired_i) - (Market\ Value\ of\ Capital\ in\ Progress_i) \quad \text{---------- (7)}$$

Raw Materials *(lnM)*: The total value of raw materials consumed by enterprises over the reference period. The value is appropriated to the year, using a relevant procedure.

Annual Labour days (*lnL*): It is calculated by multiplying the number of working hours of enterprises with the total number of days (annual) operated divided by a labour day *i.e.*, 8 hours. Notationally,

$$Annual\ Labour\ Days(L)_i = \frac{(Working\ Hours_i)*(Days\ Operated_i)}{8} \quad \text{---------- (8)}$$

This variable captures the working duration of the labour force and is important for assessing the efficiency.

Table 1: Notations and Explanations of Variables

Notations	**Variable Description**
$\boldsymbol{ln}$Yi	Gross Value Added in value terms
$\boldsymbol{ln\,K_i}$	Value of capital
$\boldsymbol{ln\,M_i}$	Value of Raw Material
$\boldsymbol{ln\,L_i}$	Labour days
lnAge	Age of the firm
$\boldsymbol{lnCI}$	Value of capital/Number of worker
$\boldsymbol{lnSFTW}$	Fulltime workers/Total workers*100
$\boldsymbol{lnSFW}$	Female workers/Total workers*100
Credit	1 if the firm has credit access, otherwise 0
Rural	1 if the firm belongs to rural, otherwise 0
OAE	1 if the type of the firm is OAE, otherwise 0
Prob	1 if the firm reported any problem, otherwise 0
Reg	1 if the firm is registered under any Act, Authority, etc., otherwise 0
Urb_Est	1 if the firm being establishment and belongs to urban, otherwise 0
Credit_Est	1 if the firm has credit access and establishment type, otherwise 0

Determinants of Inefficiency estimation

The potential determinants and their expected nature of relationship with the dependent variable (technical inefficiency) are explained below:

Age (*lnAge*): The survey doesn't report the age of enterprises directly, however, it provides information on the initiation year/ establishment year of enterprises. Hence, the age of enterprises is derived by subtracting the year of establishment from the surveyed year. There is a substantial evidence of age influencing positively the technical efficiency of firms (Batra and Tan, 2003; Bhandari and Mait, 2007; and Khan, 2017) Therefore, age is expected to have an inverse association with the inefficiency of firms.

Capital Intensity (*lnCI*): It is a measure of capital units available per worker and is expressed in natural log terms. The capital intensity is expected to have a positive impact on a firm's efficiency. The association between an improvement in capital-labour ratio and efficiency is assumed to indicate the effect of improved technology on production efficiency.

Share of Fulltime Workers (*lnSFTW*): This variable explains the percentage share of full-time workers in the total workforces of the enterprises. Enterprises employing labours with both part-time and full-time agreements display different working duration. Employing more part-time employees reduces the duration of working hours which in turn may result in a lower level of output generation. A reverse of this can be observed where enterprises employ more full-time workers. Therefore, a positive impact on the dependent variable is expected, as the full-time workers enjoy a better pay scale and other benefits as compared to part-timers.

Share of Female workers (*lnSFW*): This variable implies the gender composition of the work force in an enterprise and is obtained by dividing the total female workers by the total number of workers multiplied by 100 to indicate their percentage share. Here, it is intended to validate the impact of gender of labour on efficiency in the absence of a prior assumption regarding the impact of gender on inefficiency.

Credit-dummy (*Credit*): This variable is based on the outstanding loans of firms and is used as a proxy to credit accessibility of firms. The co-efficient of credit dummy is expected to indicate a negative sign as access to credit facility increases the firms' working capital and also facilitates capital formation.

Location dummy (*Rural*): This variable is created based on the location of enterprises i.e., rural and urban. The rural dummy is expected to have a positive impact on inefficiency of firms, as the rural enterprises face a relatively unfavorable situation in accessing technology, credit and well-established markets as compared to their urban counterparts.

Enterprise type (*OAE*): The unorganised sector has two types of enterprises viz., Own Account Enterprises (OAE) and Establishments based on the number of workers. The OAEs are usually self-owned/household-owned and are mostly located in rural areas. They are also less capital-intensive when compared to Establishments. Therefore, a positive relationship is expected between enterprises type dummy and firms' inefficiency.

Problem dummy (*Prob*): This variable is created based on the enterprises which reported any problem in their operation during the last 365 days. The enterprises are exposed to various kinds of problems like erratic power supply, shortage of raw materials, fall in demand, non-availability of or high cost credit, labour disputes, non-recovery of financial dues, etc. The enterprises which reported problems tend to display higher levels of inefficiency.

Registration dummy (*Reg*):This variable captures whether firms are registered under a certain Act/ Authority or not. The unorganised enterprises are usually registered under some local bodies or a certain Act/Authority. The firms which are registered are likely to be more efficient than the unregistered ones, as they are supposed to be following the rules and regulations laid down by the Authority.

Credit and Establishment dummy (*Credit_Est*): The interaction between establishment firms and credit access is been captured by this variable. The establishment firms are said to have a better access to credit facility, as they are mostly situated in urban areas with a good fund flow and investment. Therefore, these firms tend to show higher efficiency levels.

Urban and Establishment dummy (*Urban_Est*): This variable is created to capture the interaction between firms located in urban areas and those of establishment type. The urban firms, which are establishments, exhibit a greater efficiency than their counterparts, as these firms enjoy a better access to information, technical know-how, credit facility and established markets for their products.

Empirical Results

Table 2: Descriptive Statistics of Variables

Variable	No. of Observations	Mean	Std. Dev.	Min	Max
GVA	12993	12.02	1.21	0.00	18.01
Capital	12993	11.96	1.55	0.00	18.22
Raw material	12993	14.45	2.17	6.10	22.36
Labour days	12993	5.81	0.47	2.01	6.98
Age	12993	2.05	0.88	0.00	4.85
Capital labour ratio	12993	11.18	1.35	0.00	15.61
Fulltime workers	12993	4.51	0.44	0.00	4.60
Female Workers	12993	0.90	1.67	0.00	4.60

Source: Author's estimation using NSS 73rd unit level record

The total sample is subdivided into six sectors based on NIC classification i.e., Bakery, Dairy, Distilleries, Grain, Meat and others. The total number of valid observation has reduced from 15, 865 (total observations/Samples) to 12,993for the Stochastic Frontier Analysis, following a due process of elimination. The analysis calls for balanced data across variables and observations and many enterprises/ observations are found to have not reported the raw materials data. Therefore, those observations have been dropped from the analysis. Out of the total valid observations, Meat, Grain and Bakery have emerged as larger sectors with a share of 26.89, 26.80 and 24.66 percent, respectively in the total enterprises. Seven models have been estimated, one each for six sectors and one model for the entire unorganised food processing industry, using the same set of variables and specifications (both dependent and independent variables are the same across 7 different models). The findings related to the technical efficiency are also discussed based on the location and type of enterprises.

Stochastic Production Function-based Technical Efficiency Estimates

The maximum likelihood estimates of parameters for both the technical efficiency and inefficiency have been determinants obtained using stochastic frontier production function. The equations (5 & 6) have been estimated using the FRONTIER 4.1 computer program. The efficiency results and inefficiency determinants are presented in Table 3. The models estimated are highly-significant, as shown by their larger likelihood values.

The value of 'γ' indicates that the stochastic frontier production model is an appropriate specification, as its value is closer to 1 in almost all the models. The range of 'γ' scores (0.86 to 0.98) across the models suggest that a large portion of the residual variations in the output levels is explained by technical efficiency. This model, in other words, portrays that the difference between the actual and potential output is due to an inefficient use of the production frontier (Rajesh Raj, 2007); and also firm-specific factors are primarily responsible for this sort of inefficiency that are under the control of firms' management.

The results show that among the three factors of production, capital (lnK) is positively significant for all-India level as well as sectors like Bakery, Distillery and Others. The related positive coefficient value indicates that a one percent increase in capital leads to an increase in the output to the tune of 2.85 percent. However, a disproportionate increase in capital does not result in higher production levels for the industry as indicated by the coefficient value and the sign of lnK^2.On the other hand, the labour and capital interaction reveals that a proportionate increase in capital and labour is needed for achieving higher output levels. These findings, thus, indicate that the industry requires a skilled labour force to operate invested capital for achieving higher levels of output.

An altogether different pattern is evident in the case of raw material. The coefficient value of this variable indicates that a one percent increase in raw material leads to a decrease in the output to the tune of 5.59 percent. This finding is consistent with Grain, Meat and Other sub-sectors. On the other hand, linear terms of labour are not significant at 5 percent level. However, the positive impact of quadratic terms of these variables indicates that the association between these variables becomes positive with the dependent variable. The results pertaining to the interaction between factors of production reveal that a proportionate increase in both labour and raw material does not augment production, while raw material and capital interaction does yield larger output levels. This implies that technology/capital is more important for converting raw material into finished goods products.

Table 3: Efficiency and Inefficiency Models

Variables	Bakery		Dairy		Distillery		Grain		Meat		Others		All India	
Estimates of Translog Production Function														
	Coeff	**t value**	**Coeff**	**t value**	**Coeff**	**t value**	**Coeff**	**t value**	**Coeff**	**t value**	**Coeff**	**t value**	**Coeff**	**t value**
Constant	6.65**	6.63	2.24*	2.18	0.48	0.22	1.99	1.91	2.73**	2.73	5.72**	5.40	4.69**	8.27
lnK	3.23**	3.31	-2.19	-1.42	9.71**	6.94	1.28	1.21	0.24	0.26	2.16*	2.17	2.85**	3.10
lnM	-0.93	-0.72	14.23**	5.18	3.35*	2.16	-4.50**	-4.10	-4.42**	-4.92	-8.42**	-6.87	-5.59**	-6.22
lnL	-0.34	-0.35	8.55**	3.99	12.69**	11.56	-6.55**	-4.41	1.47	1.60	1.23	1.08	-1.81	-1.72
lnK2	-1.66**	-3.38	1.33	1.72	-4.94**	-7.12	-0.48	-0.90	-0.19	-0.42	-1.06*	-2.10	-1.44**	-3.14
lnL2	0.42	0.84	-4.02**	-3.68	-6.16**	-11.80	3.96**	5.29	-0.69	-1.47	-0.50	-0.87	1.07*	2.05
lnM2	0.49	0.76	-7.06**	-5.18	-1.14	-1.50	2.23**	4.08	2.56**	5.68	4.33**	7.04	3.01**	6.69
lnLlnM	-0.01	-0.74	0.02	0.78	-0.11**	-2.83	-0.03*	-2.54	-0.03*	-2.11	-0.01	-1.04	-0.04**	-7.97
lnKlnL	-0.02	-0.99	-0.06	-1.85	0.11**	3.73	-0.05**	-3.07	0.05**	3.18	0.01	0.36	0.04**	4.83
lnKlnM	0.03**	6.55	0.01	1.09	-0.01	-1.39	0.03**	9.22	0.00	-0.34	0.01**	2.84	0.01**	3.44
Inefficiency Model														
Constant	-7.61**	-9.29	-36.56**	-7.16	-20.19**	-18.68	-16.11**	-15.68	-10.27**	-15.87	-19.49**	-23.16	-13.72**	-27.90
lnAge	-0.22**	-3.37	2.07**	13.99	-0.28	-1.54	-0.27**	-4.73	-0.43**	-11.03	0.02	0.33	-0.56**	-9.82
lnCI	0.70**	24.09	1.99**	15.41	0.13	0.85	0.90**	16.18	0.12**	3.77	0.71**	23.60	0.24**	5.74
lnSFTW	-0.64**	-5.65	-1.56**	-5.80	0.44**	3.21	-0.70**	-10.79	-0.44**	-5.36	-0.57**	-5.22	-0.73**	-21.12
lnSFW	-0.07*	-2.39	0.16	1.07	0.16*	2.20	0.30**	7.72	0.06	1.90	0.06	1.78	0.27**	10.78
Reg	-0.15	-1.89	0.04	0.07	1.36*	2.32	-0.64**	-4.08	0.13	1.71	-1.51**	-7.20	-0.96**	-9.45
Problem	0.72**	5.46	1.21	1.91	-0.85*	-2.41	0.56**	4.80	1.15**	11.59	1.21*	6.66	0.61**	6.24

Credit	-0.14	-0.93	-2.29**	-2.71	-2.94**	-3.75	-1.48**	-4.67	-0.72**	-5.36	-0.03	-0.08	-1.20**	-9.35
OAE	2.09**	5.39	0.03	0.03	13.07**	8.04	4.44**	12.25	5.13**	12.93	10.58**	27.12	9.01**	16.97
Rural	0.22*	2.07	-1.98*	-2.26	-2.07**	-3.22	0.49**	3.41	1.16**	10.89	1.31**	7.25	0.41**	4.64
Credit_Est	-0.34	-1.59	-3.79**	-3.03	3.57**	3.01	-2.08**	-3.21	0.20	0.61	-0.21	-0.36	-0.18	-0.41
Urban_Est	-0.60**	-3.88	-2.33*	-2.10	3.86**	4.12	-1.06*	-2.15	-1.03**	-4.80	7.31**	24.04	0.15	0.74
Sigma squared	1.29**	8.06	11.41**	8.05	6.52**	8.76	3.84**	18.46	2.97**	16.33	4.13**	12.96	5.37**	25.49
Gamma	**0.86****	47.86	**0.98****	296.60	**0.94****	89.80	**0.94****	200.19	**0.95****	261.18	**0.92****	128.95	**0.95****	447.72
No of Observations	3204		442		669		3482		3494		1702		12993	
Log likelihood Function	-2591		-448		-821		-3647		-2584		-1975		-13410	
LR test Statistics	945		372		288		1637		1277		740		5056	
Mean Efficiency	**0.72**		**0.65**		**0.62**		**0.65**		**0.75**		**0.63**		**0.67**	

Source: Author's estimation using NSS 73rd unit level record

*0.05 level

** 0.01 level

Distribution of Technical Efficiency Scores

All-India Level: The mean technical efficiency level of the industry is 67 percent, implying that 33 percent of the potential output hasn't been achieved. Only 0.03 percent of firms have achieved perfect efficiency levels, while 0.79 percent of the total firms lie above 90 percent of efficiency. Around 63 percent of the total firms have achieved efficiency above the industry's mean efficiency level. Another 4.06 percent of firms have displayed lower levels of efficiency (less than 30%). Thus, firms operating at the extreme ends of efficiency i.e., perfectly efficient and highly-inefficient, are very few. The efficiency scores of most of the firms lie around the mean efficiency level of the industry, indicating thereby that enterprises do not differ much with respect to their efficiency levels.

The mean efficiency scores by location and type of enterprise (Table 4) reveal that enterprises located in the urban areas are more efficient than those located in the rural areas. On the other side, establishments irrespective of their location have certainly outperformed OAEs as for as achieving the potential output levels is concerned.

Sub-sector level Efficiency: The mean technical efficiency level of enterprises among the sub-sectors varies from a low of 62 percent for distilleries to as high as 75 percent in respect of meat sector (Table 5). The sectors like Meat and Bakery show higher mean efficiency levels, while distillery, dairy, grain and other sectors display lower mean efficiency levels in relation to the industry's mean efficiency level. Although, the grain sector accounts for the highest share in enterprises, its mean efficiency level is comparatively low. On the contrary, the meat sector exhibits the highest efficiency level (75%), which could be attributed to a high raw material conversion ratio, an indication of an efficient raw material use. In contrast, the Grain sector displays a low raw material conversion ratio, which could be due to the usage of outdated technology and indigenous methods of possessing raw materials (Reddy, 2006).

Table 4: Mean Efficiency Scores by location and Enterprises type

Particulars		No. of observations	Mean Efficiency (%)
Sector	Rural	7493	66
	Urban	5500	70
Ent. Type	Own Account Enterprises	6369	57
	Establishments	6623	77
Rural	Own Account Enterprises	4106	56
	Establishments	3386	77
Urban	Own Account Enterprises	2263	58
	Establishments	3237	78

Source: Author's estimation using NSS 73rd Unit level records

Table 5: Mean Efficiency Scores across Sectors

Sectors	Bakery	Dairy	Distillery	Grain	Meat	Others
Mean Efficiency Score (%)	72	65	62	65	75	63

Source: Author's Computation using NSS 73rd Unit level records

***State level efficiency*:** Table 6 indicates significantly varying mean efficiency levels across states. Among the 15 major States, the mean efficiency level ranges from as low as 59 percent for Odisha to 74 percent for Kerala. It is interesting note that out of 15 States, only 9States,such as, Andhra Pradesh, Gujarat, Haryana, Karnataka, Kerala, Maharashtra, Punjab, Tamil Nadu and West Bengal, show above the country's mean efficiency (Table 6).Food industry has a rich heritage in Kerala, especially in terms of food export. In fact, the state's association with food export dates back to the 16th century, thus, making it 'a leader State' in the processed food. At the same time, the government of Kerala has accorded a 'priority status to the food processing sector, considering its development potential. The state has also undertaken certain reforms besides offering some incentives (such as capital investment subsidies) and other initiatives for further development of the industry (MoFPI, 2017).

On the other hand, States like Odisha, Madhya Pradesh, Bihar and Assam account for lower mean efficiency scores as compared to other States, and further, around half of the enterprises in these States have attained lesser scores than their respective mean efficiency levels. Although Odisha is the country's leading producer of some food commodities, the food processing sector still remains largely untapped. High packaging cost, cultural preference for fresh food, seasonality of raw materials, lack of adequate infrastructure and quality mechanism in assuring quality processing of food are considered as major obstacles to the development of the industry in the State (Hindu, 2015). Added to the above all, the State of Odisha has since discontinued the centrally sponsored 'National Mission on Food Processing' (from April 2015), which is meant for promoting the infrastructural facilities in the State. Similarly, in the context of Bihar, poor infrastructural and institutional facilities, such as finance, land, bureaucracy, quality of electricity and so on are considered as important bottlenecks to the growth of food processing industry and further, smaller firms in the State have a worse perception regarding the risk of doing business *vis-a-vis* the larger firms (Gnaguly and Saha, 2017).In Madhya Pradesh, food processing units remain mainly unorganised with credit facility as the major problem. More than one third of the firms are not adequately equipped to handle the volume they are expected to produce. Moreover, advance facilities like ripening chambers and cold storages are absent in the state (State Government of MP, 2015).

Efficiency of the unorganised food processing sector at the State-level is dependent on various characteristics. It is argued, in the literature, that the demand for processed food products is higher in the higher-income States due to higher female workforce participation and a high standard of living.

Table 6: Mean Efficiency Scores across Major States

States	No. of Observations	Mean Efficiency Score (%)	% of firms above the National mean efficiency score
Andhra Pradesh	965	70	65.49
Assam	544	65	51.84
Bihar	709	64	53.88
Gujarat	402	69	65.17
Haryana	389	71	69.15
Karnataka	599	71	71.62
Kerala	609	74	77.18
Madhya Pradesh	417	62	50.84
Maharashtra	831	69	64.50
Orissa	487	59	44.56
Punjab	414	71	72.71
Rajasthan	461	65	56.83
Tamil Nadu	1101	70	71.03
Uttar Pradesh	1061	65	58.91
West Bengal	1086	69	62.71
All India	**12993**	**67**	**63.00**

Source: Author's Compilation using NSS 73rd Unit level records

In order to test this proposition, States are classified into high, middle and lower groups, based on income and efficiency levels. Later, a matrix of selected States is prepared in order to assess the relationship between States' income and efficiency levels. Per capita GSDP is used for grouping the States based on income. It is evident from the matrix (Table7) that three out of five high-income States show high efficiency levels while the remaining two States figure in the middle efficiency category. But it is interesting to note that no high-income State is placed in the low efficiency category, while exactly the opposite is observed with reference to low income States. Low-income States like Bihar, Odisha and Uttar Pradesh have also performed poorly in terms of efficiency. The remaining two States i.e. West Bengal and Assam have achieved middle efficiency levels, while no low-income State is figured in the high efficiency group. Hence, there is a slender evidence of States' income being positively associated with efficiency levels of the unorganised food processing industry.

Table 7: Association of Efficiency with States' Income

Efficiency/ Income	High	Medium	Low
High	Kerala, Karnataka, Haryana	Punjab, Andhra Pradesh,	
Medium	Gujarat, Maharashtra	Tamil Nadu	West Bengal, Assam
Low		Rajasthan, Madhya Pradesh	Bihar, Odisha, Uttar Pradesh

Source: Author's Computation using NSS 73rd Unit level records

Determinants of Inefficiency:

The present analysis has observed considerable differences across firms with respect to efficiency levels. Having found these wide variations, it is important to understand the source of inefficiency in terms of explaining the factors influencing inter-firm efficiency differentials. The inefficiency model is presented in Table 3**.**Several studies have assessed the impact of firm's age on efficiency (Batra and Tan, 2003; Bhandari and Mait, 2007 and Khan, 2017). Firms' age is expected to have a positive impact on efficiency, considering that older firms may have easy access to markets and superior quality inputs and may enjoy greater economies of scale through their quality organisation and managerial skills. The coefficient value, related to the age variable, is significant with a negative sign for all-India and for most of the sectors, excepting dairy and others. This implies that there is an inverse relationship between the age of firm and technical inefficiency. Hence, older food processing firms are relatively more efficient than younger firms. Of all the sectors, the coefficient value of age variable for dairy sector is the largest and positive, indicating thereby the possibility of older enterprises of dairy sector using outdated technology and hence, unable to cope with the dynamic requirements of the modern production process.

Lack of technology is considered as one of the important deterrents for achieving higher efficiency levels. Especially, in the case of the traditional unorganised manufacturing sector in the country. For the present analysis, we have considered capital-labour ratio as a proxy for technology. There are varied opinions on the role of technology in efficiency enhancement. Mukherjee (2004) observes that enterprises could perform well complimenting available labour force with improved machinery. On the contrary, Majumder (2004) argues that the effectiveness of labour for smaller units depends more on training, experience and familiarity of workers rather than the range of tools that complement them. However, the results of the analysis are quite supportive of the latter presumption, in that, per labour availability of capital is positively associated with inefficiency. This indicates that the Indian unorganised food processing industry is suffering from lack of skilled labour for effectively utilising the capital invested. Therefore, we argue that a mere increase in the capital-labour ratio may not lead to higher levels of efficiency and that what is required is a skilled labour force to handle the capital towards achieving higher efficiency levels.

The composition of the workforce by type of employment is also considered as one of the important determinants of technical inefficiency. For the above purpose, the share of full-time workers in the total workforce is computed for each of the firms. The study assumes a negative association of the share of full-time workers with inefficiency. Accordingly, firms with a higher share of full-time workers exhibit a higher levels of efficiency, as indicated by the corresponding coefficient value in that a one percent increase in the full-time workers leads to a 0.73 percent decrease in inefficiency. The value of the coefficient ranges from the lowest for Distilleries and Meat sectors (-0.43) to the highest (-0.56) for dairy sector.

The unorganised food processing industry in India provides employment opportunities for female workers, specially the rural women-folk. Hence, it is interesting to discern the impact of female employment on efficiency. The results indicate a positive co-efficient value of 0.27, indicating thereby that a one percent increase in the female worker share increases inefficiency to the tune of 0.27

percent. The positive association of female worker share is more discernible for grain sector and lowest in meat sector, whereas, bakery sector is the only exception in terms of displaying a negative association of female work force share with inefficiency. The female workforce in the industry is largely concentrated in the rural areas (62%), accounting for only 23 percent of the total fulltime employment (NSS, 2015-16). In other words, female workforce of the industry mostly work on part-time basis, especially during the agricultural offseason, and hence, serves as a possible reason for their inefficiency.

The industry consists of registered and unregistered enterprises. An enterprise is considered registered, if registered in any of the Acts or any of the Authorities. On the other hand, an unregistered enterprise is the one which is not registered under any Act or Authority, These unregistered enterprises are characterised by less productive small-sized units, non-hired labour base, typical household units, use of primitive technology, inability to integrate with the formal economy and shortage of capital (CP Chandrashekhar and Jayati Gosh, 2003). Hence, the present study also tried to understand the impact of registration status of enterprises on their performance. Empirical findings on this account suggest that efficiency of registered enterprises is superior to unregistered counterparts (excepting the case of distillery).

The unorganised food processing enterprises may face various problems like erratic power supply, lack of raw materials, non-recovery of financial dues, etc. These problems, in turn, may have an adverse effect on the efficiency of enterprises. The problem dummy tries to capture the impact of these problems on efficiency. Accordingly, enterprises reporting any problem during the last 365 days tend to display a lower efficiency than their counterparts. However, the present study finds itself unable to examine the impact of specific problems such as erratic electricity supply, problem of demand, problem of labour/skilled labour, etc on inefficiency of firms due to data impediments.

To capture the geographical/ locational variations, type of enterprises and credit accessibility with respect of firms of the industry, three dummy variables are created i.e., location, enterprise type (OAE) and credit dummy. The location dummy variable takes the value 1 if a firm is located in rural and 0 otherwise. The results go well with the assumption that there exists a positive association between a firms' location and inefficiency. The rural-based firms lack proper infrastructural and credit facilities, availability of skilled labour and easy access to market and technology. The combined effect of all these factors could hinder the efficiency of rural-based firms.

The enterprise type dummy takes the value of 1, if it is OAE type and 0 otherwise. OAEs are normally run in the household premises, usually with the support of household members and most of these enterprises undertake activities during the agricultural off-seasons. In addition, these enterprises also have poor access to capital and other infrastructural facilities. On the contrary, establishments usually operate in separate premises with hired workers and a better access to capital and other infrastructural facilities as compared to OAEs. Hence, the study assumes a positive association between the establishment type and inefficiency. The results also reveal a positive association, indicating that OAEs are inefficient as compared to establishments.

Studies have revealed that credit constraints substantially diminish the potential growth and investment of enterprises (Tybount, 1983; Nabi, 1989). Moreover, many empirical studies have confirmedthe positive impact of credit constraintsonthe inefficiency of firms (Alvarenzand Crespi, 2003;

Mukharjee, 2004; Raj,2007). These studies have argued that access to working capital is crucial to small scale enterprises for operatingonan efficient scale and adopting upgraded technology (Raj, 2007). The small scale enterprises mostly depend on credit services for their working capital and the limited credit facilities hamper the working capital stock of these enterprises. The present study tries to examine the impact of credit constraints on the inefficiency of food processing enterprises with the help of credit-dummy. The credit-dummy takes the value '1' if enterprises have access to credit facilities, otherwise, '0' and a negative sign for the corresponding coefficient is expected. The findings of the study affirm the positive impact of credit constraints on the inefficiency of firms. The coefficient of credit-dummy for all-India indicates that a one percent increase in credit facilities likely decreases the inefficiency of firms to the tune of 1.20 percent. Although a similar kind of association is observed for 4 out of 6 sub-sectors (Dairy, Distilleries, Grain and Meat) of the industry, the influence of credit is more influential in the case of Distilleries. Hence, the study finds a negative association between credit accessibility and inefficiency of firms. Only, 14 percent of the entire industry's enterprises have accessed credit facilities in India with a huge proportion of enterprises being kept out from the ambit of credit facilities.

Conclusions

The study reveals that capital plays an important role in generating the desired levels of output, *vis-a-vis* other inputs. However, a disproportionate increase in capital doesn't yield augmented output levels either. Further, the interaction between capital and labour indicate an increase in the output of the industry. This explains the importance of skilled labour for the industry to work on the capital invested. The results also reveal that the industry is operating at 67 percent of its potential output level, on an average, indicating, that there is a huge scope for realising its full potential. The Meat and Distillery sub-sectors exhibit highest and lowest level of mean efficiency, respectively, and these two sectors are driving the States' mean efficiency levels, given their large presence. Hence, an improvement in the technical efficiency of these sectors can elevate the performance of the industry across some of the States.

The study indicates that older firms are more efficient than younger ones, and also the adverse climate existing in the industry for new ventures. Certain start-up policy measures need to be introduced as part of supporting younger firms of the industry and enhancing their efficiency. The capital-labour ratio shows a positive association with inefficiency which runs against the popular perception. Further, the unorganised food processing industry requires skilled labour force that can handle the capital goods, which is more important than a mere possession of capital. The findings related to the share of full-time workers highlight the importance of regular employment for enhancing the efficiency of firms. The findings of registration dummy point to the inadequacies of unregistered enterprises in achieving their potential efficiency levels. Hence, a proper incentive mechanism must be developed to bring these unregistered firms under the ambit of registration.

Credit accessibility is one of the major determinants of higher efficiency levels of the industry. The study has proved that denial of credit is one of the major factors contributing to the inefficiency of firms. A major proportion of the firms is faced with tough restrictions when it comes to access the credit facilities and only 14 percent of the total enterprises have been able to avail credit. Reluctance on the part of financial institutions in extending credit facility to small/micro enterprises has been cited as one of the major reasons for this sort of under-provision of credit (Raj, 2007). The unwillingness shown by financial institutions may force these enterprises to be dependent on informal sources of credit. However, informal sources of credit may not be helpful as a long-term investment strategy, considering their higher interest rates (*Ibid*). Hence, creating an enabling system that exclusively caters to the financial needs of the unorganised food processing sector is much needed and seems highly-inevitable, given the present context.

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Appendix

1.a: Descriptive Statistics of Variables of Bakery sector

Variable	No. of Observations	Mean	Std. Dev.	Min	Max
GVA	3204	12.59	0.96	0.00	16.75
Capital	3204	12.29	1.25	0.00	18.22
Raw material	3204	15.41	1.15	7.96	19.78
Labour days	3204	6.02	0.39	3.11	6.98
Age	3204	0.93	0.93	0.00	4.85
Capital labour ratio	3204	1.09	1.09	0.00	15.44
Full-time workers	3204	0.21	0.21	0.00	4.60
Female Workers	3204	1.49	1.49	0.00	4.60

Source: Author's estimation using NSS 73rd unit level record

1.b: Descriptive Statistics of Variables of Dairy sector

Variable	No. of Observations	Mean	Std. Dev.	Min	Max
GVA	442	12.07	1.36	0.00	15.07
Capital	442	12.27	1.60	5.29	16.30
Raw material	442	15.03	1.49	9.45	18.91
Labour days	442	5.74	0.55	3.62	6.98
Age	442	1.94	0.93	0.00	3.76
Capital labour ratio	442	11.37	1.36	5.29	15.61
Full-time workers	442	4.49	0.51	0.00	4.60
Female Workers	442	0.75	1.51	0.00	4.60

Source: Author's estimation using NSS 73rd unit level record

1.c: Descriptive Statistics of Variables of Distillery sector

Variable	No. of Observations	Mean	Std. Dev.	Min	Max
GVA	669	11.56	1.47	0.00	15.64
Capital	669	11.61	2.22	0.00	16.72
Raw material	669	13.14	1.43	7.71	19.57
Labour days	669	5.63	0.53	2.70	6.98
Age	669	1.84	0.88	0.00	4.44
Capital labour ratio	669	10.88	1.80	0.00	14.58
Full-time workers	669	4.39	0.80	0.00	4.60
Female Workers	669	2.02	2.11	0.00	4.60

Source: Author's estimation using NSS 73rd unit level record

1.d: Descriptive Statistics of Variables of Grain sector

Variable	No. of Observations	Mean	Std. Dev.	Min	Max
GVA	3482	11.51	1.17	0.00	16.85
Capital	3482	12.09	1.30	0.00	16.98
Raw material	3482	12.43	2.19	6.10	22.36
Labour days	3482	5.73	0.44	2.01	6.98
Age	3482	2.22	0.81	0.00	4.51
Capital labour ratio	3482	11.57	1.18	0.00	15.15
Full-time workers	3482	4.47	0.54	0.00	4.60
Female Workers	3482	0.85	1.65	0.00	4.60

Source: Author's estimation using NSS 73rd unit level record

1.e: Descriptive Statistics of Variables of Meat sector

Variable	No. of Observations	Mean	Std. Dev.	Min	Max
GVA	3494	12.08	0.91	0.00	15.23
Capital	3494	11.25	1.47	0.00	15.43
Raw material	3494	15.73	1.09	9.14	19.47
Labour days	3494	5.83	0.41	2.01	6.57
Age	3494	1.88	0.85	0.00	4.61
Capital labour ratio	3494	10.72	1.38	0.00	14.91
Full-time workers	3494	4.53	0.34	0.00	4.60
Female Workers	3494	0.26	0.97	0.00	4.60

Source: Author's estimation using NSS 73rd unit level record

1.f: Descriptive Statistics of Variables of Others sector

Variable	No. of Observations	Mean	Std. Dev.	Min	Max
GVA	1072	12.01	1.56	0.00	18.01
Capital	1072	12.00	1.75	0.00	18.02
Raw material	1072	14.50	2.41	7.27	21.86
Labour days	1072	5.64	0.57	2.70	6.98
Age	1072	2.07	0.88	0.00	4.09
Capital labour ratio	1072	10.90	1.48	0.00	15.45
Full-time workers	1072	4.49	0.47	0.00	4.60
Female Workers	1072	2.23	2.04	0.00	4.60

Source: Author's estimation using NSS 73rd unit level record

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