Impact of Organisation Structure on Productivity in Electrical Goods Industry of India

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Abstract

This paper examines the relationship between the organizational structure and productivity of 12 organisations in the Electrical Goods Industry of India. Structure of an organization is indexed by labour to capital, blue collar to white collar workers, and white collar workers to capital ratios. Estimates of productivity of both labour and capital are derived from Cobb-Douglous Production function. The findings suggest that organisation structure significantly determines productivity of both labour and capital in an organisation. Marginal as well as average productivities of labour, however, are adversely affected by structure.

Keywords: Productivity, Organisation Structure, Electrical goods, Cobb Douglous production function

Introduction

This paper evaluates the differences in Productivity of organisations with different structures in Electrical Goods Industry of India. Only few studies have been examined the relation between organization structure and productivity. However, either structure or productivity or their interrelations is not measured precisely. There is no theoretical base of the method of measurement of either structure or productivity in most of these studies. Determination of direction and degree of relationship between structure and productivity may therefore highlight the possible improvement in structure as the source in productivity growth or vice versa.

Conceptual Framework

Concepts of Organisation, Structure and Productivity are briefly discussed. The concepts of Organisation, structure and productivity are discussed jointly as well as separately.

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Organisation and Structure

The common-sense parlance of structure refers to a particular way something is made up of. There is a hierarchy in the arrangement of components and a well defined ordering. Structure comprises constraints, facilitators, strengths and weaknesses of a system. Structure also potrays certain essential features and facets of the system.

A social organization is a unit of society which has a collective goal and is linked to its internal dynamics and external environment. There are different types of organizations; Army, Hospital, School, Business, NGO etc. Our focus of study is on manufacturing organizations in the electrical goods industry. Individuals in an organization are located structurally. It limits the range of their experiences and behavior and their interrelations, all of which affect their performance and ultimately productivity.

Manufacturing organizations comprise a set of structures. Structure of a manufacturing organisation embodies its strengths and weaknesses, features and facets, opportunities and challenges, roles and functions, interrelations and their limitations. It may be therefore not too presumptive to assume that the structure of an organization directly affects its performance hence productivity.

This study focuses on relationship between productivity and structure of organization.

Analysts have been directly or indirectly concerned with organization structure for long. Charles Babbage (1832), highlighted the importance of the 'division of labour', 'size', 'need and interdependence between departments'. All of these are essentially associated with structure. He frequently used the word 'arrangement' which in our view loosely connotes the essence of the concept of organization structure. The tradition of Babbage was kept alive by Alfred Marshall. Marshall (1890) postulated enterprises and organisations as two independent factors of production. He paid great attention to analyse the structural differences in the organisations of business activities of different scales on the one hand, and highlighted the role of organisation in the efficiency and productivity of an individual business enterprise on the other.

Mintzberg (1979) defined organisational structure as "the sum total of the ways in which it divides its labour into distinct tasks and then achieves coordination among them". Each configuration contains six components: operating core: the people directly related to the production of services or products; strategic apex: serves the needs of those people who control the organisation; middle line: the managers who connect the strategic apex with the operating core; technostructure: the analysts who design, plan, change or train the operating core; support staff: the specialists who provide support to the organisation outside of the operating core's activities; ideology: the traditions and beliefs that make the organization unique. Perrow (1965) has defined it as the arrangement (formal system of relationship) which is necessary to pursue goals Another definition of organisational structure is "the way in which work is organised and control exercised" (Salaman, 1979).Westwood (1987) defines it as the metaphor for the power arrangement of an organization. Mullins (1996) suggests that organization structure enhances the economic and efficient performance of the organisation through equitable resource utilisation and monitoring of organisational activities.

In conclusion it may be stated that Organisation Structure is the arrangement of man and materials according to the principles of management in the pursuit of well defined goals of organisations. In organizations, like those in Electrical goods, manpower comprises blue collar and white collar workers. Blue collar workers constitute the main workforce; where as white collar workers take major decisions, lend support and control the blue collar workers. In a technology driven organisation, performance of blue collar workers can be enhanced only by better methods and systems of organisation, the responsibility of which majorly lies in the hands of the white collar workers. Hence, white collar workers become a differentiating factor in the structure of an organization.

Productivity

Productivity is an abstract concept and derived variable as it is defined as the ratio of Output to Employment or Capital. This is an outcome of inter-related decisions: which affect efficiency and performance. Output depends upon choice of scale of operations which relates to employment and investment in capital.

Productivity in a country, industry, or enterprise is determined by a number of factors. These include the available supplies of labour, land, raw materials, capital, and mechanical aids of various kinds. This also includes education and skills of labour force; technology in use; methods of organizing production, zeal and endeavours of managers and workers; A multiplicity of social, psychological, and cultural factors may also define attitudes, motivation and behaviour. Technology, labour and capital are considered to be the major determinants of productivity as the remaining factors may be taken as given by work environment.

According to Prakash and Balakrishnan, (2005, 2006) Productivity depends upon (i) structure of organisation, (ii) technology, (iii) managerial techniques, and (iv) improvement in quality of human capital. There are different approaches to measure productivity.

Alternative approaches to measure Productivity

The central problem of productivity analysis is in its measurement. Productivity is difficult to measure and can only be estimated indirectly.

There are four approaches for estimating Productivity.

i) **Data envelopment analysis (DEA):** DEA is a linear programming methodology to measure the efficiency of multiple decision-making units (DMUs) when the production process presents a structure of multiple inputs and outputs. Productivity or efficiency in the context of DEA deals with producing the maximum quantity of outputs for any given amount of inputs or the minimum use of inputs for any given amount of outputs. No particular production function is assumed. Instead, productivity is defined as the ratio of a linear combination of outputs over a

linear combination of inputs.

ii) **Input Output model approach.** In this approach, production possibilities are described by input-output matrices. An example is the input output model proposed by Mathur (1967) that has been used to estimate productivity (ShriPrakash and Balakrishnan, 2008).This model could be represented by the following equation: P'-P'A= V= wL +π , where P' is the price vector, A is the matrix of input coefficient, V is the valued added per unit of output, w is the uniform wage rate, π the vector of profits per unit of output and L is the vector of coefficients of labour.

iii) **Direct Method of Determination of Productivity:** The least effective method of estimating Productivity is direct method, in which average of averages is computed for estimating productivity.

iv) **Production Function Approach:** A production function is a function that specifies the output of a firm, an industry, or an entire economy for all combinations of inputs. This function is an assumed technological relationship. The estimation of total factor productivity may be analysed using a Cobb Douglas (1948) production function. The Cobb Douglous equation can be represented as below:

$Q=AK\alpha L\beta$ ..... equation 1

Where Q is the output, K is capital, L is labour employed and A is total factor productivity and $\alpha + \beta = 1$, α and β being the elasticities of output with respect to capital and labour. The logarithmic transformation of the production function provides a log-linear form which is convenient and commonly used in econometric analyses using linear regression techniques.

$\log Q = \log A + \alpha \log K + \beta \log L + Ut$ ..... equation 2

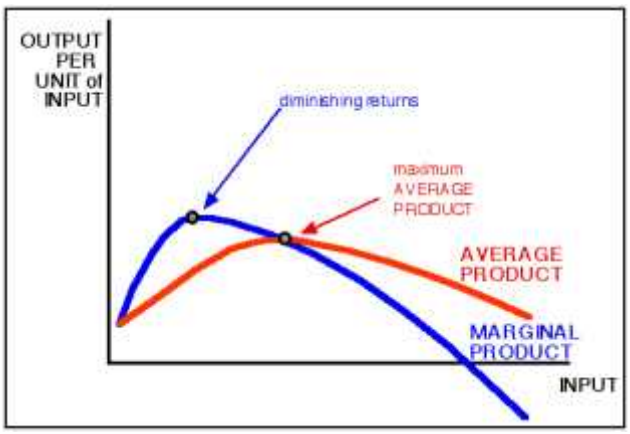
Another alternative of the production function approach is the Solow Production Function. To concentrate attention on what happens to Q / L or output per worker, Solow modified Cobb-Douglas production function as follows:

$\text{Log}(Yt/Lt) = \alpha o + \alpha 1 \log(Ft/Lt) + Ut$.....equation 3

This normalised C-D function by employment, therefore, Labour Productivity emerges as a function of capital per unit of labour.

Enterprises/Organisations are mostly interested in two types of Productivities: Marginal and Average. The calculation of both types often yields different answers as a result of the fundamental differences behind each measurement.

The relationship between Marginal and Average productivities is graphically represented below in Graph 1.



Graph 1

If marginal product is less than average product, then average product declines. If marginal product is greater than average product, then average product rises. If marginal product is equal to average product, then average product does not change.

Literature Review

Studies conducted on relationship between organisation structure and performance is discussed below:

Akintayo and Babalola (2008) observed that the size of organization is significantly correlated with workers behaviour with peculiar pattern in large scale and small-scale organizations. Thus effective management of people and other resources in an organization requires consideration for affective behaviour that could be of consequence to size and structure of an organization. Also, central and co-ordination of the task structure of an organization with implications on goal achievement require organizational support system that could lead to reduction of tension and stress, but facilitate attraction to organization among the workers.

Nagappan, Brendan Murphy & Basili (2008), have investigated the relationship between organizational structure and software quality. They propose eight measures that quantify organizational complexity. These eight measures provided a balanced view of complexity of an organizational from the computer program coding viewpoint. These eight measures are

1. **Organization Intersection Factor (OIF):** A measure of the number of different organizations that contribute greater than 10% of edits, as measured at the level of the overall organisational owners.
2. **Overall Organization Ownership (OOW):** This is the ratio of the percentage of people at the DMO level making edits to a binary relative to total engineers editing the binary.
3. **Level of Organizational Code Ownership (OCO):** The percent of edits from the organization that contains the binary owner or if there is no owner then the organization that made the majority of the edits to that binary.
4. **Percentage of Organisation contributing to development (PO):** The ratio of the number of people reporting at the DMO level owner relative to the Master owner org size.
5. **Depth of Master Ownership (DMO):** This metric determines the level of ownership of the binary depending on the number of edits done. The organization level of the person whose reporting engineers perform more than 75% of the rolled up edits is deemed as the DMO. The DMO metric determines the binary owner based on activity on that binary.
6. **Edit Frequency (EF):** This is the total number times the source code, that makes up the binary, was edited. An edit is when an engineer checks code out of the VCS, alters it and checks it back in again. This is independent of the number of lines of code altered during the edit.

Though the above study's focus is on software development company, it becomes useful as in the above study the organizational structure has been determined and assessed primarily on the basis of Size, Division of labour and its overlap, Ownership and Frequency of Interaction. Moreover, it has been found that the structure does affect performance, and in this case, software quality.

Based on organization theory and the work of Roemer and Friedman, Shortell and T E Getzen (1979) proposed seven dimensions of hospital medical staff organization structure and examined them. The data was based on a 1973 nationwide survey of hospital medical staffs conducted by the America Hospital Association. Factor analysis yielded six relatively independent dimensions supporting a multidimensional view of medical staff organization structure. The six dimensions included 1) Resource Capability, 2) Generalist Physician Contractual Orientation, 3) Communication/Control, 4) Local Staff Orientation, 5) Participation in Decision Making and 6) Hospital-Based Physician Contractual Orientation.

Carillo (1996) has examined the relationship between three structural variables (size, vertical complexity, and administrative intensity) and the operating efficiency of all 234 metropolitan branches of a financial services company. Negative relationships were found between (a) size and productivity and (b) vertical complexity and productivity. On average, the smallest branches were found to be approximately 31% more efficient than the largest ones.

Oldham and Hackman (1981) created a formalisation index by averaging 5 items (existence of rules manual, completete written job description, written record of everybody'd job performance, formal orientation programme, large number of rules and procedures). Centralisation idex was created by averaging two items ('only top people can take decision' and 'this organisation can be characterized as highly centralised') Items were measured using likert scale of very inaccurate/ accurate type.

Meijaard et al (2005) combined 22 items on organizational structure to nine factors in an unrestricted principal component analysis. In order to arrive at more easily interpretable results Varimax rotation was used. The nine empirically derived components captured variations in organizational structure in small firms.

Chaston (1997) has used Coven and Slevin model (1986) to classify firms into different types on the basis of organicity and style

Data Description

The data are secondary in nature and have been obtained from 2012 publication of Indian Electricals and Electronics Association of India (IEEMA). There are twelve companies whose relevant data were accessible to us. 6 were large enterprises, 5 are small enterprises and 1 is a micro enterprise. This is according to the e definitions of MSME Act 2006, which has classified Micro, Small and Medium Enterprises in the following way: a micro enterprise is one where the investment in plant and machinery does not exceed twenty five lakh rupees; a small enterprise is one where the investment in plant and machinery is more than twenty five lakh rupees but does not exceed five crore rupees; and a medium enterprise, where the investment in plant and machinery is more than five crore rupees but does not exceed ten crore rupees. The data is of the year 2010. The units of data are as follows: Output in Million Rs, Capital in Million Rs, and Employment in No. of Employees.

Methods and Models

i) **For calculating the estimates of Average and Marginal Productivities:** We estimated the relationship between Output, Labour and Capital using a Cobb-Douglous production function $\log O = \beta_0 + \beta_1 \log L + \beta_2 \log K$. Cobb-Douglas production function is used due to its relative simplicity and convenience in specification and interpretation. The average productivity (AP) is calculated for each company by dividing Output by Labour (O/L) and Output by Capital (O/K). The Cobb-Douglas production function has also facilitated the estimation of marginal productivity on the basis of entire data taken together. It captures the trend of changes in the values of output and manpower of different levels and type of education. The AP of Labour and Capital is multiplied by the respective Output elasticities (α and β coefficients) to determine the Marginal productivities. $MP_L = AP_L \cdot e_L$ and $MP_K = AP_K \cdot e_k$.

ii) **For formulating Index of Structure:** This study uses employment of blue collar to white collar workers in workforce as a broad indication of structure. Scale of operation, denoted by level of output and stock of capital are the basic indicators of the size of the organization. Greater the scale of operation, greater is the capital requirement and more is the number of people in workforce. It is assumed that as scale of operations increases, division of labour also becomes finer than what is associated with small and medium scale. It also implies that there is an organic relationship between worker per unit of capital and Output per unit of Capital and output per unit of labour. Therefore the indicator of structure is composite index of Labour per unit of capital (L/K), number of blue collar workers per white collar worker(L1/L2) and white collar workers per unit of capital(L2/K). The mean of the three ratios for each organization is taken as the index of its structure

Empirical Findings and Conclusion

Table 1: Estimates of CD function

Equation	α (t-stat.)	β coeff for L (t-stat.)	β coeffi for K (t-stat.)	R^2	F
$\log O_j = \alpha + \beta \log L_j + (1-\beta)\log K_j + U_j$	-0.019 (0.91)	0.88 (2.9)	0.39 (2.5)	**.71**	9.9

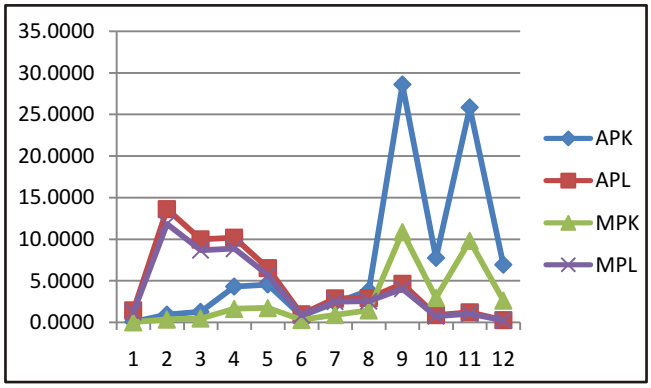
The above function reveals that i) both capital and labour significantly influence output of companies. ii) Corresponding to 1 % change in employment, output increases by 0. 88 %, where as output increases by only 0.39 % in case of 1 % change in Capital. The function taken as a whole explains 71 % of total change in output; remaining 29% change in output is explained by random factors. These results show that labour is a more decisive determinant of output than capital. This is logical and conforms to commonsense understanding also. Fixed Capital equipment is installed for once and all and its use in production depends upon the variation in employment and intermediate inputs.

The estimates of output elasticity with respect to labour and capital are used to determine marginal productivity of companies. Naturally, marginal productivities of labour and capital vary according to the corresponding average productivities. Higher the average productivity, greater shall be the marginal productivity of Labour and capital. The results are depicted in table 2 below:

Table 2: Variation in AP & MP

	Average Productivity of Capital	Marginal Productivity of Capital	Average Productivity of Labour	Marginal Productivity of Labour
Organisation	AP_K	MP_K	AP_L	MP_L
1	0.0661	0.025115	1.4375	1.250625
2	0.9277	0.352524	13.6000	11.832
3	1.2612	0.479249	9.9633	8.6681
4	4.3006	1.634247	10.1892	8.864631
5	4.5522	1.729853	6.5222	5.674333
6	0.7875	0.29925	0.9844	0.856406
7	2.3671	0.899494	2.8769	2.502923
8	3.8184	1.450977	2.9325	2.551275
9	28.5769	10.85923	4.6438	4.040063
10	7.7419	2.941935	0.8727	0.759273
11	25.8235	9.812941	1.2194	1.060917
12	6.9221	2.63039	0.2747	0.239026

The variation of average and marginal productivities of the organisations is shown graphically in graph 2:



Graph 2

Table 3: Descriptive statistics of productivities

	Average Productivity of Capital	Average Productivity of labour	Marginal Productivity of Capital	Marginal productivity of Labour
Mean	7.262106	4.626396	2.7596	4.024964
Standard Error	2.781114	1.283773	1.056823	1.116882
Median	4.059504	2.904712	1.542612	2.527099
Standard Deviation	9.634063	4.44712	3.660944	3.868994
Sample Variance	92.81517	19.77687	13.40251	14.96912
Kurtosis	2.063211	-0.3047	2.063211	-0.3047
Skewness	1.800774	0.97714	1.800774	0.97714
Range	28.51083	13.32526	10.83412	11.59297
Confidence Level (95.0%)	6.121192	2.825565	2.326053	2.458242

A perusal of the above table (table 3) based on application of descriptive statistics reveals that i) Both average and marginal productivities of labour as well as capital vary greatly between the companies, but average productivity varies 5 times more than marginal productivity; ii) As expected average productivity in both cases is higher than the corresponding marginal productivity; iii) Mean of both average as well as marginal productivities is almost two times larger than their corresponding mediums. It implies that distribution of both average and marginal productivities diverges from normal distribution.

Table 4: OLS estimates of regression functions, used in the study

Equation	Intercept (t-stat) (P-value)	Coeff of Index (t-stat) (P-value)	R square	F
$MP_K = \alpha_0 + \alpha_1 I_j + U_j'$	1.17 (.98) [.34]	.72 (2.1) [.06]	.30	4.4
$MP_L = \alpha_0 + \alpha_1 I_j + U_j'$	5.6 (4.4) [.0012]	-.74 (-2.04) [.007]	.30	4.1
$AP_K = \alpha_0 + \alpha_1 I_j + U_j'$	3.1 (.9) [.34]	1.8 (2.1) [.06]	.30	4.4
$AP_L = \alpha_0 + \alpha_1 I_j + U_j'$	6.5 (4.4) [.0012]	-.8 (-2.04) [.068]	.30	4.1

The above results show that 1) MP of both labour and Capital is significantly affected by Organisation Structure. However, MP_L is adversely affected by structure. This indicates that non optimal combination of white and blue collar workers in the organization. 2) Organisation Structure significantly affects average productivity of both labour and capital. Like marginal productivity, average productivity of labour is adversely affected by Organisation Structure. The findings of this study suggest that organisation structure significantly affects the productivity of an organization. Since there exists a relationship between structure and productivity, improvement in structure may help in raising productivity. Government policy and concept of small and medium enterprises implicitly assumes homogeneity of structures within manufacturing organisations, irrespective of employment, turnover or investment. This is reflected in the definition of SMEs. Recognizing the structural differences may result in initiatives and policies which are optimally successful.

References

1. *Akintayo, Dayo and Babalola, S.S. (2008), "Size Of Industrial Organization: Impact On Workers' Behaviour", International Business & Economics Research Journal, Volume 7, Number 2*
2. *Babbage, Charles (1835). On the Economy of Machinery and Manufactures (4 ed.). London: Charles Knight.*
3. *Greg R. Oldham and J. Richard Hackman /Relationships Between Organizational Structure and Employee Reactions: Comparing Alternative Frameworks Source: Administrative Science Quarterly, Vol. 26, No. 1 (Mar., 1981), pp. 66-83, Johnson Graduate School of Management, Cornell University Stable*
4. *Ian Chaston, (1997),"Small firm performance: assessing the interaction between entrepreneurial style and organizational structure", European Journal of Marketing, Vol. 31 Iss: 11 pp. 814 - 831*
5. *Joris Meijaard, Maryse J. Brand and Marco Mosselman /Organizational Structure and Performance in Dutch small Firms/Small Business Economics (2005) 25: 83–96 _ Springer 2005.*
6. *Lau, Agnes and Snell, Robin (2006), "Structure and growth in small Hong Kong enterprises" International Journal of Entrepreneurial Behaviour & Research, Vol. 2 No. 3*
7. *Mintzberg, Henry (1979), The Structuring of Organizations: A Synthesis of the Research. University of Illinois at Urbana-Champaign's Academy for Entrepreneurial Leadership Historical Research Reference in Entrepreneurship*
8. *Perrow, Charles B. and Maniha John (1965) "The Reluctant Organization and the Aggressive Environment," Administrative Science Quarterly , , 238-57.*
9. *Perrow, Charles B. (1966) "Technology and Organizational Structure," P r oceeding s of the 19th Annual Meeting of the Industrial Relations Research Association, 156-63.*
10. *Prakash, Shri and Balakrishnan. Brinda (2008), "Input Output Modelling of Labour Productivity and its Human Capital and Technology components in Indian Economy", Bulletin of Political Economy.*
11. *Prakash, Shri and Balakrishnan. Brinda (2006), "Managerial Approach to Conceptualisation of Development and Growth-Convergence to Macro and Micro Theory", Business Perspective*
12. *Sandesara, J.C. (1993) "Modern Small Industry, 1972 and 1987-88: Aspects of Growth and Structural Change." Economic and Political Weekly, 28 no. 6.*