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Abstract

This study investigates the Economies of Scale. The Return to scale is a property of the production function that indicates the relationship between proportionate change, in all inputs and resulting change in output. Returns to scale are applicable only in the long run, since all inputs are being changed. The estimated value of the coefficient of returns to scale at aggregate level is 1.017. It means that one percentage point change in all input quantities results in 1.017 percent change in output. It turns out that manufacturing sector of Pakistan is characterized by almost constant returns to scale at aggregates and disaggregate level.

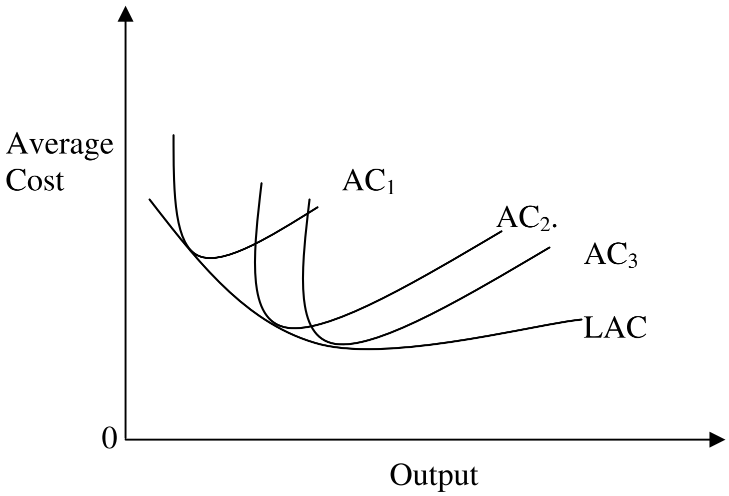
JEL Codes: E, E
Keywords: Scale Economies, Distortion, Pakistan

I. Introduction

The scale properties of production technologies are of vital importance for understanding of market structure, such as productivity and economic growth within factor analysis. Economies of Scale is an important indicator for barrier to entry and its properties help in the understanding of ex-post evolutionary structure of manufacturing sector. Usually is analyzed by applying both the primal and dual approach, to assume constant return to scale technology.

Recently more flexible functional forms have been developed and used Burki and Mehmood (2004). One of the most common is the transolg form, which is an approximation of quadratic second order taylor series. It has linear and non-linear output terms. Translog form can estimate a U-shaped cost curve reflected by data, dualistically well behaved in production relation.

Figure 1



U-shaped cost curve will estimate, scale economies at smaller firms and diseconomies at larger ones. Unlike Cobb Douglas form quadratic forms detains variation of scale across large scale manufacturing sector of Pakistan at different sizes. Studies such as Humphrey (1982) Sirocco and Marshall (1984) Lawrence and Shay (1986) and Benston Hanweck and Humphrey (1990) found that bank cost curves are weakly one reason could be because of engineering costs in banking sector U-shaped, scale economies in banking seem to be relatively limited in comparison with smaller banks. EOS in particular coupled with output composition adjustments seem to be the primary driving factor for economic performance. Scale economies appear as an average cost curve indicating low costs variation with output, for example short run average cost curve for different sized firms each producing different levels of output, enveloped by long run cost. A downward sloping long run average cost curve reflects scale economics, otherwise diseconomies. Since higher average costs are incurred when more output is produced over the assumption of cross section of different sized firms at a point in time, suppose public limited firms, reveals an appropriate long run curve derived from measure of scale. Thus as smaller firms expand its outputs and costs are likely to look like larger firms.

II. Model

For translog cost function we denote factor prices by p quantities by x and level of output by y and total cost denoted by c, which is given by $c = \sum p_i x_i$ translog cost function defined as tailor series second order twice-differential cost. It turns out the scale economies derived from the elasticity of cost with respect to proportional change in output holding the input prices unchanged. Thus by differentiating we have scale economies λ. If $\lambda \succ 1$ cost increases more than proportionately with scale implying diseconomies, Similarly $\lambda = 1$ implies constant returns to scale, while $\lambda \prec 1$ means economies of scale. From elasticities economies of scale can be derived as $eos = 100(1-\lambda)$, where c is the observed total cost taking in consideration $\beta_{ij} = \beta_{ji}$ the symmetry restriction. The regularity conditions are $\sum_{i-1}^{3} \alpha_i = 1$, $\sum_{i=1}^{3} \beta_{ij} = \sum_{i=1}^{3} \beta_{ji} = \sum_{i=1}^{3} \beta_{iy} = 0$. These regularity conditions provide unique correspondence between the cost function and the underlying production function, accordingly cost function must be homogenous and concave in factor prices finally, the translog function reduces to Cobb-Douglas under certain restrictions.

One potential problem however is that parameters β_y and β_{yy} cannot be estimated, in share equations. Recently, more flexible functional forms have been developed and used. One solution of existing problem is the transformation, such as quadratic transformation as developed by Lawrence (1991) by adding the possibility of multiple outputs either loans or loans plus certain types of deposits in banking sector both the single output translog and single output Cobb Douglas form even with adjustment rejected in favor of multiple output translog. Thus it appears that both the possibilities of U-shaped cost curves and complementarities among different banks outputs Humphrey (1990) are important generalizations of the single output specification. A functional form that permits the estimated average cost curve to be U-shaped rather monotonic is preferable.

III. Data

The Census of Manufacturing Industries (CMI) is the only major source of data on different aspects of manufacturing industries in Pakistan, however suffers from severe drawbacks such as, under coverage of firms, changes in definitions of variables over time, gaps and irregularity of survey publications. Most of the data are taken from its sixteen most recent publications (1969-71, 1970-71, 1975-76, through 1987-88, and 1990-91). Some supplementary information is collected from Monthly Statistical Bulletin and Economic Survey of Pakistan. The pooling of provincial level data for Punjab and Sindh is done, assuming implicitly that the firms in both the provinces are characterized by similar production technology. This methodology has been supported by Battese and Malik (1987, 1988), Malik and Nazli (1989) Khawaja (1991) Lawrence and Humphrey (1991) Burki *et al* (1997) Zafar (2000) Burki and Mehmood (2004) Zafar and Ahmad (2005). Karaomerlioglu (1999) showed the in impact of process control technology on economies of scale in the chemical industry using unit cost reduction as a measure of economies of scale on a snow ball sample of 14 industries. The economies of mass resources were found to decline. The prices of capital is estimated by perpetual inventory method. $P_k = P_{k_{ind}}(r + \delta - \pi_{k_{ind}})$. Where P_k is the user cost of capital $P_{k_{ind}}$ is price index of capital goods r is the real rate of interest δ is the capital depreciation rate and $\pi_{k_{ind}}$ is defined as $\pi_{k_{ind}} = (P_{k_{ind}t} - P_{k_{ind}t-1}) / P_{k_{ind}t-1}$. The Price of labor is computed by division of value of labor with labor indexed at 1969-70. Price of raw material is computed by dividing the value of raw material with raw material used and data is normalized at 1969-70.

IV. Results

The coefficient of scale economies, for the manufacturing sector as a whole is eos = 1.7% as shown in table 1, which is almost same for overall manufacturing sector of Punjab in comparison with manufacturing sector in Sindh. It depicts neither economies nor diseconomies of scale. The growth level thus appears to enhance both scale and technical efficiency. The scale economies in particular associated with output composition adjustments seem to be the primary driving factor for economic performance for example N is the number of projects to be financed and risk is a decreasing function of N which leads to increasing return to scale Mannonen (1998). Analysis is restricted to the Manufacturing sector of Sindh and Punjab as almost 80% of the firms located in these province.

We estimate system of equations by Zellners Efficient Method and examine for monotonicity see appendix table 6 and curvature properties we find that calculated input cost shares are positive at the mean as well as for each observation. The calculated factor shares at the mean of the data confirm monotonicity in factor prices at aggregates, as well as at disaggregates. The curvature condition checked by computing the eigen values for each ownership status of firms while the estimates of cost constrained to satisfy symmetry and homogeneity. The results of scale economies and return to scale are shown in table-1 and table-2. The coefficient

Table 1

Returns to Scale

Manufacturing's	Sindh	Punjab	Pooled
Public limited Firms	1.012	1.068	1.021
Private limited Firms	1.019	1.05	1.027
Individual Ownership	0.985	0.823	0.534
Partnership	0.951	1.068	0.805
All Clauses	1.028	1.028	1.017

Convergence at 0.01% level of significance.

Table 2

Scale Economies

Manufacturing's	Sindh	Punjab	Pooled
Public limited Firms	-1.20%	-6.80%	-2.10%
Private limited Firms	-1.90%	-5.00%	-2.70%
Individual Ownership	1.50%	17.80%	46.60%
Partnership	4.90%	-6.87%	19.50%
All Clauses	-2.80%	-2.80%	-1.70%

Convergence at 0.01% level of significance.

of scale economies for cost function is almost unity for public limited firms in Punjab indicating almost constant return to scale and decreasing returns to scale in individual ownership in Punjab, it can be attributed to loss of control of the top management once the firm has surpassed an optimum size. Large farms gain a cost advantage by taking advantage of scale Cathrine *et al* (2004) and diversification of economies increase competitiveness of large enterprises. Thus decisions of the top management will not be optimal if the information on which they are based is inaccurate or matched by time lags, during which crucial changes in the environment of the firms may take place see Podinovski (2004) such as strategic decision of mergers of units or splitting into smaller units. Secondly the uncertainty, from the market conditions and the reaction of competitors increases the competition with in large size firms leading to diseconomies. The private limited firms operate at constant returns to scale and eos for the firms in partnership is 19.5% which is more then public or private limited firms. Any increase in scale let the expectation for new technologies reduce barrier to entry for small and medium sized firms but it does not hold for large scale industries large scale industries which enjoy more advantages of increased scales, more competitive due to reduced prices increased production performance and high quality production. Thus we infer from our result that technological development in the Manufacturing sector of Pakistan.

There is evidence of constant return to scale every where, except individual ownership in Sindh. This result seems to suggest that firms in the manufacturing sector of Sindh are still developing being at an early stages of development in the manufacturing sector of Pakistan. It had to produce a more varied output mix in order to remain in competition It does not pay for the firms to become specialized capital intensive in production. Scale nor scope economies justify monopoly argument Green *et al* (2004) shows that scale economies are not sufficient for monopoly to be least cost production. As a whole manufacturing sector of Pakistan seem to operate at reserve capacity of technology in the manufacturing units. In manufacturing sector such as Pakistan employees prefer to work for larger firms even if they can earn more from the small firms Shea's argument have important implications in this context. Larger scale allows division of labor and specialization of the labor force β_{iy}. The intensity of labor is 1.07 in public limited firms while the estimate is negative for individual ownership and partnership.[1] The intensity of capital is negative for individual ownership –0.013. It means capital as well as labor are not intensive factor inputs.

The magnitude of λ for individual ownership is slightly low. One reason could be the mismanagement since most firms do not support their technologies and investment complementarities. Its lag in capacity utilization, in particular economies associated with composition of output adjustments could be the primary factor for economic efficiency of inputs.

[1] See appendix Table 1-5

V. Conclusion

Return to scale is a property that indicates the relationship between a proportionate change in all inputs and the resulting change in output. The coefficient of returns to scale is 1.017 for the manufacturing sector of Pakistan which is characterized by almost constant returns to scale seemingly operating at reserve capacity, at the disaggregate level results are consistent for Punjab and Sindh. From results some practical conclusions may be inferred. First there seem to be little evidence of decreasing return to scale a cost enhancing nature, in the manufacturing sector either at disaggregates or at aggregates. There are important economic issues related to the size of scale economies such as reduction of profitability in production units beneath their full potential. Further research could shed light on eos with distortion effects.

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Appendix

Table 1

Parameter Estimate at Disaggregates Level in the Manufacturing Sector of Pakistan

	Punjab		Sindh		Pooled	
Public Limited Firms						
α_0	Estimates	t-statistics	Estimates	t-statistics	Estimates	t-statistics
α_k	14.4821	234.135*	14.7005	246.162*	14.6022	305.390*
α_l	0.16813	3.32510*	0.28991	5.59415*	0.24474	6.12299*
α_m	0.14433	5.73070*	0.13952	8.98201*	0.16592	7.62358*
β_{ll}	0.68754	17.4206*	0.57057	0.9082	0.58934	12.3836*
β_{kk}	-0.0767	-4.3315*	0.03492	3.45329*	-3.30E-03	-0.1725
β_{mm}	0.50625	2.04498*	0.10893	4.40986*	0.08699	4.42518*
β_{ml}	-0.025	-0.8761	1.64676	4.24618*	0.11798	3.12385*
β_{lk}	0.07615	3.74500*	-0.0453	-3.3504*	-0.01385	-0.6045
β_{mk}	5.32E-04	0.42986	0.01041	1.40736	0.01715	1.59401
α_y	-0.0512	-2.6024*	-0.1193	-3.9745*	-0.1041	-4.4032*
β_{yy}	1.07088	11.5912*	0.84178	15.7491*	0.93882	15.8533*
β_{yl}	0.02024	0.17740	0.12084	2.36749*	0.0583	0.93832
β_{yk}	5.86E-03	0.53349	-0.0528	-7.8465*	-0.0391	-3.4798*
β_{ym}	0.01127	1.00902	-0.0375	-3.0630*	-0.0284	-2.6855*

*: Significant at 5% level of significance

Table 2

Parameter Estimate at Disaggregates Level in the Manufacturing Sector of Pakistan

	Punjab		Sindh		Pooled	
Private Limited Firms						
	Estimates	t-statistics	Estimates	t-statistics	Estimates	t-statistics
α_0	13.9215	445.85*	14.2793	284.93*	14.0417	273.978*
α_k	0.133583	8.10572*	0.140195	4.01136*	0.1469	6.83185*
α_l	0.053967	3.84425*	0.113726	6.65665*	0.110307	7.27328*
α_m	0.81245	29.6112*	0.746079	15.6561*	0.742793	26.1719*
β_{ll}	0.00665	0.477032	0.05902	9.88966*	0.068736	7.98568*
β_{kk}	0.045477	5.44717*	0.052148	3.14048*	0.053398	5.03335*
β_{mm}	0.006061	0.208855	0.106609	3.30951*	0.125675	5.67016*
β_{ml}	0.016383	0.894986	-0.05674	-5.05139*	-0.07051	-5.98585*
β_{lk}	-0.02303	-3.20869*	-0.00228	-0.28031	0.00177	0.24178
β_{mk}	-0.02244	-1.60183	-0.04987	-2.22976*	-0.05517	-4.01773*
α_y	1.00143	13.8609*	0.569249	6.18746*	1.03123	8.723*
β_{yy}	0.089417	0.946585	0.584205	5.33117*	0.028036	0.185108
β_{yl}	-0.02226	-3.17601*	-0.05098	-6.43033*	-0.05475	-7.68114*
β_{yk}	0.008663	1.56714	0.008278	0.606018	-0.00045	-0.06281
β_{ym}	0.013599	1.22177	0.042702	2.11874*	0.055199	4.52453*

*: Significant at 5% level of significance

Table 3

Parameter Estimate at Disaggregates Level in the Manufacturing Sector of Pakistan

	Punjab		Sindh		Pooled	
Individual Ownership						
	Estimates	t-statistics	Estimates	t-statistics	Estimates	t-statistics
α_0	12.4851	226.031*	11.4843	146.34*	11.9584	165.462*
α_k	0.1749	13.2981*	0.1462	4.0179*	0.1135	5.2058*
α_l	-5.91E-03	-0.3248	0.1694	4.6944*	0.0693	4.0761*
α_m	0.831	32.7392*	0.6845	12.261*	0.8171	33.9385*
β_{ll}	-0.0219	-1.1018	0.0656	1.7456	-0.0106	-0.6847
β_{kk}	0.0688	8.3628*	0.0496	2.6568*	0.0379	3.2868*
β_{mm}	-0.0398	-0.877	0.1789	0.1789	6.58E-03	0.222
β_{ml}	0.0652	2.1918*	-0.0974	-2.2018*	0.021	1.0484
β_{lk}	-0.0433	-4.0852*	0.0318	1.7387	-0.0104	-1.1599
β_{mk}	-0.0255	-1.53	-0.0814	-2.8192*	-0.0275	-1.9297*
α_y	0.5616	5.7686*	0.7555	6.2733*	0.4101	5.9418*
β_{yy}	-0.4383	-5.4207*	0.1831	1.9048	0.1988	2.2016*
β_{yl}	-0.0201	-1.0086	-0.0547	-2.8507*	3.40E-03	0.5265
β_{yk}	-0.0131	-1.1728	-0.0269	-2.2848*	4.43E-03	1.1937
β_{ym}	0.0333	1.1523	0.0815	3.2281*	-7.83E-03	-0.8644

*: Significant at 5% level of significance

Table 4

Parameter Estimate at Disaggregates Level in the Manufacturing Sector of Pakistan

	Punjab		Sindh		Pooled	
Partnership						
	Estimates	t-statistics	Estimates	t-statistics	Estimates	t-statistics
α_0	13.7651	443.071*	13.3217	402.039*	13.6351	238.648*
α_k	0.034342	1.29963	0.078929	5.30725*	0.070088	5.48324*
α_l	3.21E-03	0.104888	0.082167	7.0669*	0.055644	3.97737*
α_m	0.962447	17.4893*	0.838903	34.6268*	0.874269	34.5862*
β_{ll}	-5.76E-03	-0.21568	0.015947	2.17177*	0.019653	1.58968
β_{kk}	3.98E-03	0.268675	0.025922	3.33488*	0.022888	3.27184*
β_{mm}	-0.06646	-0.92462	0.031958	1.35127	0.024346	0.775194
β_{ml}	0.038102	0.888727	-0.01099	-0.8877	-0.01056	-0.5576
β_{lk}	-0.03234	-1.85592	-4.96E-03	-0.79953	-9.10E-03	-1.18941
β_{mk}	0.028359	0.910646	-0.02097	-1.62907	-0.01379	-0.99152
α_y	1.09141	31.0228*	0.996303	28.4785*	0.893906	11.9474*
β_{yy}	-4.14E-03	-0.05194	-0.05402	-0.74154	-0.15347	-1.44925
β_{yl}	-0.02588	-1.44725	-0.04001	-8.92083*	-0.03326	-3.98088*
β_{yk}	8.20E-03	0.635621	-7.49E-03	-1.56618	-4.71E-03	-0.88865
β_{ym}	0.01768	0.591957	0.047503	5.51789*	0.037963	2.93549*

*: Significant at 5% level of significance

Table 5

Parameter Estimate at Aggregates Level in the Manufacturing Sector of Pakistan

	Punjab		Sindh		Pooled	
All						
	Estimates	t-statistics	Estimates	t-statistics	Estimates	t-statistics
α_0	15.4633	431.205*	15.3808	209.913*	15.4379	363.45*
α_k	0.196047	10.9118*	0.205616	4.01468*	0.198134	6.45465*
α_l	0.069496	6.0188*	0.094919	5.66443*	0.078693	7.72247*
α_m	0.734456	57.1321*	0.699465	11.2313*	0.723173	20.3542*
β_{ll}	0.045116	3.33687*	0.040898	3.2051*	0.057418	5.64329*
β_{kk}	0.066736	7.61592*	0.079264	3.4161*	0.071369	4.83114*
β_{mm}	0.059719	4.0756*	0.096166	2.6167*	0.087717	3.93044*
β_{ml}	-0.01905	-1.40378	-0.0289	-2.04657*	-0.03688	-3.52754*
β_{lk}	-0.02607	-4.73127*	-0.012	-1.49993	-0.02054	-4.16682*
β_{mk}	-0.04067	-6.45317*	-0.06727	-2.36528*	-0.05083	-2.95376*
α_y	0.738345	9.99075*	0.900541	10.4149*	0.800242	13.5719*
β_{yy}	0.425874	4.58333*	0.167708	2.02175*	0.288369	4.61247*
β_{yl}	-0.0556	-6.02307*	-0.04709	-5.21051*	-0.05802	-8.45203*
β_{yk}	9.19E-03	1.77924	0.014095	0.872966	0.013328	1.49617
β_{ym}	0.046411	5.00306*	0.032994	1.61416	0.044688	3.82924*

*: Significant at 5% level of significance