Sources of Output Growth in MSMEs in India : An Econometric Analysis.

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ABSTRACT

The MSME sector plays a dominant role in the Indian Economy. The present study aims at analyzing the sources of output growth in this sector in India, using time series data spanning over the period 1992-93 to 2012-13 drawn from Annual Reports of the Ministry of Micro, Small and Medium Enterprises (MSMEs), Government of India. The objective was accomplished through the estimation of Cobb-Douglas production function, with total annual production as output, and employment, fixed investment as the two inputs. As per the main finding, output has been more responsive to relative changes in employment than in investment, thereby suggesting the need for more attention to employment for acceleration of growth. The sector was found to exhibit increasing returns to scale. The data was also examined for structural break or parameter stability using both Chow test and Dummy variable approach in the light of major definitional/conceptual changes in the year 2006. Both the approaches reject the presence of structural break. Further it is observed from the dummy variable approach that the data may be affected by the problem of multi-collinearity.

Keywords: Cobb-Douglas production function, Chow test, Dummy variable approach, multi-collinearity.

AMS Classification 2010: 91BXX

Introduction: Micro and small enterprises play a dominant role in the economies of both developed and developing countries. The promotion of small scale industries has been widely recognized as one of the most appropriate means of developing industries in developing countries which are facing mounting pressure of population,
an acute shortage of investible capital funds and lack of entrepreneurial and managerial abilities (Bharti, 1978). Studies have affirmed that small industries not only provide immediate employment on a large scale [due to their high employment elasticity], raise income and living standards of people in lower income brackets, but also promote local entrepreneurship and indigenous capabilities, widen the industrial base, promote geographical dispersal of industrial activity based on local resources, and thereby reduce regional imbalances and promote equitable distribution of income and wealth. (Tandon and Kaur, 1981, Prasad, 1983, Desai, 2002). The Eleventh Five Year Plan of India documents, “MSMEs are more than just GDP earners; they are instruments of inclusive growth which touch upon the lives of the most vulnerable, the most marginalized people. Yet this sector in successive five year plans has not received its due.” (Patel 2010.)

A major breakthrough occurred in the small scale sector in India with the enactment of the MSMED Act, 2006. It broadened the scope and coverage of the sector, introduced the nomenclature MSMEs to represent the erstwhile Small Scale Industries (SSIs), and replaced the term ‘Industries’ by the concept of ‘Enterprises’. It classified enterprises into two classes: (a) Manufacturing (b) Services enterprises and revised the definition of the three tiers of enterprises viz., micro, small and medium, based on their investment. The investment limits are stated below:

**Definition of Micro, Small and Medium Enterprises**

<table>
<thead>
<tr>
<th>Investment in plant and machinery/equipment(excluding land and building)</th>
<th>Manufacturing Enterprises</th>
<th>Service Enterprises</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Micro</strong></td>
<td>Upto Rs. 25 lakh</td>
<td>Upto Rs. 10 lakh</td>
</tr>
<tr>
<td><strong>Small</strong></td>
<td>More than Rs. 25 lakh and up to Rs. 5 crore</td>
<td>More than Rs. 10 lakh and up to Rs. 2 crores</td>
</tr>
<tr>
<td><strong>Medium</strong></td>
<td>More than Rs. 5 crore and up to Rs. 10 crore</td>
<td>More than Rs. 2 crore and up to Rs. 5 crore</td>
</tr>
</tbody>
</table>

Source: Chapter 3, MSMED Act, 2006, Ministry of MSME, Govt. of India.
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This marks a complete overhauling and conceptual departure from the pre-2006 period. The MSME sector has emerged as a vibrant and dynamic sector of the Indian economy, providing the second largest employment after agriculture, and contributing significantly to GDP (28%), manufacturing output (37%), employment (110 million people) and exports (33%) as per Annual Report, 2015-16, Ministry of MSME, GOI. The sector has shown great resilience and impressive growth (around 12%) in recent years. Ever since the enactment of the MSMED Act of 2006, a series of promotional measures have been announced both by the Central and State Governments. At this critical juncture, it has become imperative to study intensively various aspects of this important sector. It is in the backdrop of the above that the present study is undertaken. The specific objectives of the study are:

(i) To analyze the sources of output growth in small scale industries in India during the period 1992-93 to 2012-13 with the help of Cobb-Douglas production function, and

(ii) To examine the time series data for structural break using Chow test and dummy variable approach.

Literature Review

Production functions occupy an important place in the theory of economic growth. A production function expresses the functional or mathematical relationship between physical inputs and physical outputs of a production process. They are widely used in economic literature to shed light on the ultimate sources of growth, responsiveness of output to different factor inputs, complementarity and substitutability between inputs, nature and rate of technological change, rewards of inputs etc. There are numerous studies that estimate sources of growth by applying different types of production functions in different regions, using cross sectional or time series data. [Berndt and Wood (1979), Kim (1992), Wang and Lall (2002), Tan (2012)].

In their study on growth, marginal productivities, marginal rate of substitution and factor substitution in small metal products industry in Coimbatore district, Ganesan and Anbumani (2002), estimated the Cobb-Douglas production function. Nine out of seventeen categories of industries studied were found to demonstrate increasing returns to scale and the marginal productivity of labour was higher than that of capital.

In order to analyze the impact of trade liberalization on manufacturing sector in India, Mahambare and Balasubramanyam (2005) studied the firm level technical efficiency in India in the post-economic reforms period. They estimated the Cobb-
Douglas production function for thirteen manufacturing sectors and found the average technical efficiency to have improved in eight out of thirteen firms studied, in the post-economic reforms period. This they concluded was due to better access to imported technology, efficient utilization of resources and development of infrastructure. Devi (2009) studied the production behaviour of fifty micro manufacturing enterprises of Lakhimpur District of Assam with the help of Cobb-Douglas production function. She found both capital and mandays to be significant determinants of output. Sahu and Narayanan (2011) estimated the translog production function for Indian manufacturing, and found that labour and material played a better role than capital and energy. Saikia (2012) estimated the Cobb-Douglas, CES and VES Production Functions for the SSIs of Assam. He found the CES production function to be best fitted to the data and the elasticity of substitution in SSIs of Assam was constant and less than one. Sethi and Kaur (2016) analysed the sources of growth in Punjab and Haryana vis-a-vis the overall Indian economy with the help of the translog production function. Output was found to be more responsive to relative changes in energy consumption than to capital and labour, thereby suggesting the need for concerted attention to this factor for accelerated economic growth.

The present study employs the most widely used production function, that is, the Cobb-Douglas production function. We use the old and new nomenclature i.e. Small Scale Industries (SSIs) and Micro, Small and Medium Enterprises (MSMEs) interchangeably.

**Data Source**

The study is based on secondary data on production, employment/labour and fixed investment/capital of MSMEs of India during 1992-93 to 2012-13 as available in the various Annual Reports of the Ministry of MSME, Govt. of India. Data on production is not available in the mentioned source after 2012-13 and so the analysis could not be done beyond this period. The time series data on the above four variables during the mentioned study period is presented in Table 1 below.
<table>
<thead>
<tr>
<th>Year</th>
<th>Production in Rs. Crores (Current Prices)*</th>
<th>Employment in Rs. Crores</th>
<th>Fixed Investment in Rs. Crores</th>
</tr>
</thead>
<tbody>
<tr>
<td>1992-93</td>
<td>84413</td>
<td>1.7484</td>
<td>109623</td>
</tr>
<tr>
<td>1993-94</td>
<td>98796</td>
<td>1.8264</td>
<td>115795</td>
</tr>
<tr>
<td>1994-95</td>
<td>122154</td>
<td>1.9140</td>
<td>123790</td>
</tr>
<tr>
<td>1995-96</td>
<td>147712</td>
<td>1.9793</td>
<td>125750</td>
</tr>
<tr>
<td>1996-97</td>
<td>167805</td>
<td>2.0586</td>
<td>130560</td>
</tr>
<tr>
<td>1997-98</td>
<td>187217</td>
<td>2.1316</td>
<td>133242</td>
</tr>
<tr>
<td>1998-99</td>
<td>210454</td>
<td>2.2055</td>
<td>135482</td>
</tr>
<tr>
<td>1999-00</td>
<td>233760</td>
<td>2.291</td>
<td>139982</td>
</tr>
<tr>
<td>2000-01</td>
<td>261297</td>
<td>2.3873</td>
<td>146845</td>
</tr>
<tr>
<td>2001-02</td>
<td>282270</td>
<td>2.4933</td>
<td>154349</td>
</tr>
<tr>
<td>2002-03</td>
<td>314850</td>
<td>2.6021</td>
<td>162317</td>
</tr>
<tr>
<td>2003-04</td>
<td>364547</td>
<td>2.7142</td>
<td>170219</td>
</tr>
<tr>
<td>2004-05</td>
<td>429796</td>
<td>2.8257</td>
<td>178699</td>
</tr>
<tr>
<td>2005-06</td>
<td>497842</td>
<td>2.9491</td>
<td>188113</td>
</tr>
<tr>
<td>2006-07</td>
<td>1198818</td>
<td>8.0523</td>
<td>868543.79</td>
</tr>
<tr>
<td>2007-08*</td>
<td>1322777</td>
<td>8.420</td>
<td>920459.84</td>
</tr>
<tr>
<td>2008-09*</td>
<td>1375589</td>
<td>8.8084</td>
<td>977114.72</td>
</tr>
<tr>
<td>2009-10*</td>
<td>1488352</td>
<td>9.2179</td>
<td>1038546.08</td>
</tr>
<tr>
<td>2010-11*</td>
<td>1653622</td>
<td>9.6515</td>
<td>1105934.09</td>
</tr>
<tr>
<td>2011-12*</td>
<td>1788584</td>
<td>10.1169</td>
<td>1182757.64</td>
</tr>
<tr>
<td>2012-13*</td>
<td>1809976</td>
<td>10.6140</td>
<td>1268763.67</td>
</tr>
</tbody>
</table>

*Projected
Methodology: To fulfill objective (i), the log-linear form of the cobb-Douglas production function is estimated. The general form of the Cobb-Douglas production function is

\[ Y_i = \alpha X_{1i}^{\beta_1} X_{2i}^{\beta_2} e^{u_i} \quad (1) \]

where \( Y_i \) = total production, \( X_{1i} \) = employment/labour, \( X_{2i} \) = fixed investment/capital, \( \beta_1, \beta_2 \), are parameters to be estimated, \( u_i \) is the stochastic disturbance/error term and \( \alpha \) is the intercept/constant term. To make it estimable we convert it to its log-linear form as in equation (2) and employ the OLS (Ordinary Least Square) method to estimate the values of the parameter.

\[ \log Y_i = \log \alpha + \beta_1 \log X_{1i} + \beta_2 \log X_{2i} + \mu_i \quad (2) \]

Here \( \alpha_i = \log \alpha \) may be interpreted as the relative (%) effect on \( Y \) of all variables omitted from the regression model. It is the efficiency parameter of the industry. \( \beta_1 \) and \( \beta_2 \) are the (partial) elasticity of output with respect to labour and capital respectively. Sum of the parameters \( (\beta_1 + \beta_2) \) in the CD production function implies returns to scale. If the sum is one, there are constant returns to scale. If the sum is less than one, there are decreasing returns to scale. If the sum is greater than one, there are increasing returns to scale (Gujarati and Sangeetha, 2005).

The overall significance of the model is examined by the F-test, which examines the hypothesis that all the slope coefficients are simultaneously zero. This would mean that there is no effect of regressors on the regressand. Significance of the individual regression coefficients is tested with the help of t-test, and the goodness of fit of the model is judged with the help of \( R^2 \); the coefficient of multiple determination. \( R^2 \) also judges the predictive power of the model.
To fulfill objective (ii), Chow Test and Dummy Variable Approach are used. In regression models involving time series data sometimes there is a structural change in the relationship between the regressand and regressor, which means that the values of the parameters of the model do not remain the same through the entire time period. This may be due to external forces, policy changes etc. (Gujarati & Sangeetha, 2005.). It is notable that in the year 2006 a major definitional change and extension of coverage of the MSME sector took place in India. This might have altered the relationship between the output and inputs during the sample period. We examine this with the help of two alternate econometric methods of testing parameter stability viz., the Chow test and the Dummy variable method, by dividing the data into two time periods 1992-93 to 2005-06 and 2006-07 to 2012-13, the pre and post 2006 definitional change period. The Chow test examines the null hypothesis that the regressions of the two time periods are statistically the same, that there is no structural break and the intercepts and the slope coefficients are same during the two time periods. Under the null hypothesis that there is no structural break, it can be shown that

\[
\frac{(RSS_R - RSS_{UR})}{(RSS_{UR})}/(n_1 + n_2 - 2k)
\]

follows the F distribution with \( k \) and \((n_1 + n_2 - 2k)\) degrees of freedom in the numerator and denominator respectively. If the computed F-value exceeds the critical F value, we reject the null hypothesis of parameter stability and conclude that the two regressions are different.

The Chow test tells us only if two regressions are different, but it does not tell us whether the difference is on account of the intercept or the slope or both. The Dummy variable approach traces the source of difference if any, by pooling all the observations and running one multiple regression. In our case the ANCOVA model is

\[
\text{Log}\, Y_i = \alpha + \alpha_i D + \beta_1 \text{log}\, X_{i1} + \beta_2 \text{log}\, X_{i2} + \beta_1 D \text{log}\, X_{i1} + \beta_2 D \text{log}\, X_{i2} + u_i
\]

Where \( Y_i = \) production, \( X_{i1} = \) employment, \( X_{i2} = \) investment

\( D(\text{dummy}) = 0, \) for the period 1992-93 to 2005-06

\( = 1, \) for the period 2006-07 to 2012-13,

\( \alpha = \) intercept, \( \alpha_i = \) differential intercept. They represent the relative percentage effect on \( Y \) of all variables omitted from the model in first and second period respectively.
\( \beta_1 \) and \( \beta_2 \) are the slope coefficients. They represent the relative effect on \( Y \) caused by \( X_1 \) and \( X_2 \), respectively, in the first period. The difference in the value of these coefficients in the second period is represented by \( \beta'_1 \) and \( \beta'_2 \), respectively, which are called differential slope coefficients. The single regression line (5) can be used to test a variety of hypotheses, viz., (a) the two regressions have the same intercepts that is the differential intercept coefficient \( \alpha \) is statistically insignificant (t test), (b) the two regressions have the same slope, that is, the differential slope coefficients \( \beta'_1 \) and \( \beta'_2 \) are statistically insignificant (t test) and (c) the entire regression represented by equation (4) is structurally stable, that is, \( \alpha = \beta'_1 = \beta'_2 = 0 \), which can be tested with the usual restricted least-squares F-test. If the hypothesis is accepted then the two regression lines will be coincident.

In this study, data is analyzed with the help of MS Excel.

Results and Analysis:

(1) Production function:
The estimated Cobb Douglas production function for the SSIs of Indian Economy during 1992-93 to 2012-13 is obtained as in equation (5) below:

\[
\log Y = \beta_0 + \beta_1 \log X_1 + \beta_2 \log X_2.
\]

where values within braces indicate corresponding \( p \) values.

In our model all the coefficients are statistically significant. \( \beta_1 = 7.123 \) or elasticity of output with respect to number of labour is more than one, which implies high elasticity. The coefficient of investment \( \beta_2 = -4.038 \) is statistically significant but with negative sign, which implies that marginal productivity of fixed investment or capital, \( MP_k \), is also negative, indicating that if the fixed investment is increased without increasing labour, then it will not have any positive impact on output, rather output will decline due to excess capital stock. It also means that there is complementarity between the two inputs. Thus employment/labour seems to be the most important factor affecting output in the MSME sector in India.

The sum \( (\beta_1 + \beta_2) \) give information about the returns to scale. In our case \( (\beta_1 + \beta_2) = 3.085 \), therefore there are increasing returns to scale. From a purely statistical
viewpoint, the estimated regression line fits the data quite well. Both the $R^2$ and adjusted $R^2$ values are very high at 0.998 and 0.996 respectively, which means that about 99% of the variation in the (Log of) output $Y$ is explained by the (Logs of) $X_1$ and $X_2$. Also the F value is highly significant. The above model is the unrestricted or unconstrained regression model. However there are occasions where economic theory may suggest that the coefficients in a regression model satisfy some linear equality restrictions. In our example, the slope coefficients $\beta_1, \beta_2$ add up to 3.085, pointing to the possibility of increasing returns to scale of the Indian economy during the study period. However we do not know whether 3.085 is statistically different from 1. To verify this, we impose the restriction of constant returns to scale or, $(\beta_1 + \beta_2) = 1$. We use the t-test approach to examine the null hypothesis $H_0 : (\beta_1, \beta_2) = 1$.

For that we need to calculate

(i) $t = \{(\beta_1' + \beta_2') - (\beta_1 + \beta_2)\}/se(\beta_1' + \beta_2')$

$= \{(\beta_1' + \beta_2') - 1\}/\sqrt{\text{var}(\beta_1') + \text{var}(\beta_2') + 2\text{cov}(\beta_1'\beta_2')}$, since $\beta_1 + \beta_2 = 1$ under the null hypothesis.

The Covariance matrix obtained is:

<table>
<thead>
<tr>
<th></th>
<th>$\alpha_1$</th>
<th>$\beta_1'$</th>
<th>$\beta_2'$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\alpha_1$</td>
<td>7.3275 = var($\alpha_1$)</td>
<td>0.9578 = cov($\alpha_1\beta_1'$)</td>
<td>-0.6831 = cov($\alpha_1\beta_2'$)</td>
</tr>
<tr>
<td>$\beta_1'$</td>
<td>0.9578 = cov($\alpha_1\beta_1'$)</td>
<td>0.1258 = var($\beta_1'$)</td>
<td>-0.0894 = cov($\beta_1'\beta_2'$)</td>
</tr>
<tr>
<td>$\beta_2'$</td>
<td>-0.6831 = cov($\alpha_1\beta_2'$)</td>
<td>-0.0894 = cov($\beta_1'\beta_2'$)</td>
<td>0.0637 = var($\beta_2'$)</td>
</tr>
</tbody>
</table>
The computed \( t \)-value using the above formula is 29.824. The tabulated \( t \)-value for 18 \( df \) and at 1% level of significance is 2.552. Since the computed \( t \)-value is greater than the tabulated \( t \)-value at 1% level of significance and 18 \( df \), we reject the null hypothesis. Thus we may conclude that the Indian economy was probably not characterized by constant returns to scale over the sample period. Therefore the unrestricted regression model is more appropriate in our case.

(II) Structural stability:

(i) Chow Test: First we check whether the Chow test is applicable or not. It is found that the error variances of the two periods are same and hence the assumption of Chow test is applicable in our case.

We construct three possible regressions models corresponding to the first period, second period and the whole period. The regression model for the whole time period consisting of 21 observations is as obtained in equation (5). This regression assumes that the intercept as well as the slope coefficients remain the same over the entire period.

The regressions for the two sub-periods are:

(a) Time period: 1992-93 to 2005-06

\[
\begin{align*}
\text{Log}Y &= 19.28 + 4.081 \text{Log}X_1 + (-0.872) \text{Log}X_2 - (6) \\
t &= 1.6307(0.1312) \quad t = 3.8713(0.0026) \quad t = -0.8158(0.4318) \quad F = 493.160
\end{align*}
\]

(b) Time period: 2006-07 to 2012-13

\[
\begin{align*}
\text{Log}Y &= 56.91 + 7.42 \text{Log}X_1 + (-4.27) \text{Log}X_2 - (7) \\
t &= 1.5013(0.2076) \quad t = 1.5450(0.1972) \quad t = -1.2182(0.2900) \\
F &= 119.78(0.0002)
\end{align*}
\]

where values within braces indicate corresponding p values.

The estimated regressions of the two sub-periods suggest that the relationship between output and the three inputs is not the same in them as indicated by the difference between the values of the coefficients in the two periods. However we cannot say if the difference is statistically significant or not. For this we conduct the
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Chow test. The Chow test examines the null hypothesis that the regressions (6) and (7) are statistically the same, that is, there is no structural break.

We have \( \text{RSS}_R \) (RSS over the whole period) = 0.078 \((df = 18)\)

\[
\text{RSS}_{UR} = \text{RSS}_1 \text{ (RSS of the first period) + RSS}_2 \text{ (RSS of the first period)}
\]
\[
= 0.041 + 0.002 = 0.043
\]

The computed F value is 4.0769.

The critical F value with 3 and 15 \( df \) in the numerator and denominator and 1% level of significance is 5.42.

Since the calculated F value is less than the critical value at 1% level of significance, we accept the null hypothesis of no structural break. The Chow test does not support our presumption that the relationship between output and the two inputs have undergone a structural change in India during the 21 year period of 1992-93 to 2012-13. It means that the regression line (5) or the pooled / common regression line is appropriate for the data.

(ii) The Dummy variable approach:

The estimated Dummy Regression Model is as follows:

\[
\text{LogY} = 19.3208 + (-1.0959)D + 4.0848 \log X_1 + (-0.8755)\log X_2
\]
\[
t = 1.8525(0.0837) \quad t = -0.6429(0.5299) \quad t = 4.3922(0.0005)
\]
\[
t = -0.9286(0.3677) + 0.0053D\log X_1 + (-0.00000094)D\log X_2. \quad \text{(6)}
\]
\[
t = 0.0080(0.9937) \quad t = -0.2231(0.8265) \quad F = 1476.86(00)
\]

where values within braces indicate corresponding p values.

Here the differential intercept coefficient \( \alpha \), is statistically insignificant, so we accept the hypothesis that the two regressions are concurrent, that is, have the same intercept. Also the differential slope coefficients \( \beta' \) and \( \beta'' \) are statistically insignificant, therefore we accept the hypothesis that the two regression lines are parallel, that is having the same slope.
This leads us to reject our presumption of structural break. Here both $R^2$ and $R^2$ (0.998 and 0.997 respectively) are very high, which means that the model is a good fit.

Conclusion:

In conclusion it may be said that both the inputs labour and capital have significant impact on output. While labour has a significant positive impact, capital alone has a significant negative impact on output. The sector was found to exhibit increasing returns to scale. Further both the methods of testing structural stability namely the Chow test and the Dummy variable approach reject our presumption of presence of structural break in the data. Thus it may be said that there has been no change in the relationship between output (production) on the one hand and labour (employment) & capital (fixed investment) on the other hand during the 21 years under study. However it must be pointed out that in the dummy variable model, both $R^2$ and adjusted $R^2$ are very high and F value is statistically highly significant, but all the individual t values are statistically insignificant. This points to the likely problem of multi-collinearity.

References:


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