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DOES VERDOON'S LAW SUPPORT TO OUTPUT GROWTH: AN EMPRICAL APPROACH

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Abstract:

This paper aims to investigate the long run relationship between labour productivity and output growth for textile industry in Tamilnadu during 1981 to 2009. The present paper utilised time series data it collected from annual survey of industries study period covers from 1981-82 to 2009-10. The present study used time series data and it formulates co-integration and granger causality between textile industry output growth and labour productivity. This analysis supports Verdoon's law. Therefore Verdoon's law hold good for textile industry in Tamilnadu.

Keywords: Verdoon's law, Labour Productivity, Output Growth, Time Series Analysis, Verdoon vs Kaldor.

1. INTRODUCTION

The study examines some aspects of Verdoon's law and its application to the supply side of the Indian economy and to compare with a more orthodox mainstream neo-classical approach. The orthodox approach is means that supply issues by production function and theories of the firm of neo-classical approach. The Dutch economist P.J.Verdoon published the results of research on productivity and output growth. Verdoon explains the statistical relationship between long run growth rates of output and labour productivity for manufacturing sector. The relationship is interpreted as being technical nature, reflecting the existence of both static and dynamic.

The Verdoorn law describes the manner in which rapid output growth in manufacturing leads to productivity growth owing to static and dynamic returns to scale. Furthermore, as a result of the increase in activity in manufacturing, labour is transferred into that sector from other sectors where there are either diminishing returns or no relationship between output and productivity. Hence, overall productivity growth is positively related to output and employment growth in manufacturing and negatively associated with growth of employment outside manufacturing. As opportunities for the transfer of factors begin to dry up, the driving role of manufacturing industry becomes weaker and the overall growth rate diminishes.

2. VERDOORN'S LAW

There is a statistical relationship between long run growth of labour productivity and growth rate of output for a manufacturing sector. Since Kaldor's seminal work in 1966 the relationship has been renamed Verdoorn–Kaldor's law. Afterward, Kaldor gives a new meaning to the original Verdoorn Law, which was based only on the assumption that it is productivity growth that determines output growth, by stating that this relationship is a dynamic rather than static one: since it involves "technical progress" it is not just a reflection of the economies of larger production. The importance of Verdoorn–Kaldor's law is that it highlights that industry is subject to increasing returns to scale, both static and dynamic.

The present study is an attempt to verify the Verdoorn's- Kaldor's law based on a time series data and formulates the law in terms of co-integration and Granger-causality between textile output and labour productivity.

$$P = \alpha + \beta Q + \varepsilon$$

$\beta > 0$

Where P is the labour productivity, Q is the output and β is Verdoorn's coefficient, which is positive suggesting that a rise in output causes an improvement in labour productivity and a fall in output results in a decline in labour productivity, ε is the error term.

Kaldor (1966)[1] tested the validity of the law for a cross section of industrial countries in the 1953-1964 periods, finding a value for Verdoorn's coefficient, i.e. the marginal elasticity of labour productivity with respect to output, of about 0.5. Since the marginal elasticity of employment, which by definition is the complement to that of the Verdoorn coefficient, had the same approximate value, Kaldor argued that a one percentage point increment in the growth of output required an increase in employment of only half that amount, while the rest was accommodated by an equal rise in productivity.

According to Kaldor (1975)[2], if β does not differ significantly from unity, then the hypothesis of "increasing returns to scale" is rejected. Kaldor emphasised the role of increasing returns to scale as the major source of differences in productivity growth rates.

3. EMPIRICAL APPROACH:

Several studies have analysed the existence of increasing returns across manufacturing sectors, for example: McCombie& Ridden (1984), McCombie (1985),Bernat (1996), Leon-Ledesma (2000), McCombie, Pugno&Soro (2002), and Angeriz, McCombie& Roberts (2009).

Harris and Liu (1999)[3] identify three other problems. The first is that the law ignores the contribution of capital, which can be substituted with labour, thus implying that the Verdoorn coefficient is not stable since the elasticity of capital with respect to labour is not constant. The second problem is whether output (employment or productivity) is endogenously or exogenously determined. The third problem is the apparent paradox when measuring static or dynamic scale economies. In fact, different values of the Verdoorn

[1]Kaldor, N. (1966)***Causes of the Slow Economic Growth of the United Kingdom,*** Cambridge University Press, Cambridge.
[2]Kaldor, (1975) Economic Growth and the VerdoornLaw AComment on MrRowthornArticle, ***The Economic Journal,***Vol. **85**(340), pp. 891-896.
[3]Harris R.I.D and Liu, A. (1999) Verdoorn's Law and Increasing Returns to Scale, **Applied Economic Letters,**Vol. 6(1), pp. 29-34.

coefficient (and thus increasing returns to scale) are often obtained when estimating a linear model in static terms (variables in levels) or dynamic terms (variables in first differences). McCombie (1982)[4] suggests that this may be because the true specification of the underlying static model should be a nonlinear (technical progress) function rather than the usually assumed linear Cobb–Douglas production function. This apparent static–dynamic paradox can also be related to the dynamic specification of the empirical model to be estimated when times series data is used. Whatever approach is adopted, it is necessary to ensure that the empirical model adequately captures the underlying dynamic processes in the data (especially for the static model), otherwise the results will be biased[5].

Castiglione (2011) this paper found the long run relationship between labour productivity and output growth. Granger and johanson procedures were followed. The results show the evidence in favour of co-integration between manufacturing output growth and labour productivity in manufacturing sector in USA.

Fase, Mmgand Huevel.P.J(1988)this paper used the causality test on manufacturing output and labour productivity to examine verdoon's law. This paper found granger test support the verdoon's law.

Deleidi, M. PaternesiMeloni, W.Salvati, L. and Tosi, F.(2020)they investigate the determinants of labour productivity in Italian regions by applying Panel Structural VAR modelling to 1981-2013 data. By explicitly considering the endogeneity among the studied variables, we find that labour productivity is stimulated by output growth and capital accumulation.

4. METHODOLOGY

The present study connected with some previous works, the previous studies may use different methodologies under the nature of the study. This paper reveals that related articles and working papers are reviewed. This paper also deals about tools of analysis, methodology namely unit root test, ADF test Cointegration test and Granger Causality test. Output growth and labour productivity growth were analysed. Labour productivity partially reflects the productivity in terms of the personal capacities of workers or the intensity of their effort. Industry specific gross value added whole sale price index has been used to deflate the nominal value of gross value added. Single deflated gross value added is used to the present paper. The present paper utilised time series data it collected from annual survey of industries study period covers from 1981-82 to 2009-10.

4. EMPIRICAL RESULTS

4.1 Unit root test

The unit root tests for the time serious data. Lag length for ADF test are determined by Augmented Dicky fuller test (ADF) test the regression equation is based on

$$\Delta y_t = \alpha + \beta t + \delta Y_{t-1} + \gamma_1 \sum \Delta Y_{t-1} + \varepsilon_t$$

The result suggests that all series contain a single unit root, which would require first differentially to active stationary.

[4]McCombie, J.S.L. (1982) Economic Growth, Kaldor'sLaws and the Static-dynamic VerdoornLaw Paradox, ***Applied Economics,*** Vol. 14(3), pp. 279-294.

[5]Jefferson, G.H. (1988) The Aggregate Production Function and Productivity Growth: Verdoorn's Law Revisited, ***Oxford Economic Papers,*** Vol. 40(4), pp. 671-691.

The ADF tests are first conducted on the level of labour productivity and output. The result for the levels and differences are given in the table and the result shows that the level of Labour Productivity in textile industry in Tamil Nadu.

4.2 Augmented Dickey-Fuller (ADF) Test for Unit Root Test

$$\text{General ADF Model: } \Delta Y_t = \alpha_0 + p_1 Y_{t-1} + \sum_{i=1}^{k} \alpha_i Y_{t-i} + u_t$$

u_t is a pure white noise error term and $\Delta Y_{t-1} = (Y_{t-1} - Y_{t-2})$, etc. k is the lagged values of ΔY, to control the higher-order correlation assuming that the series follow an AP(p). In ADF p=0 is still tested and follow the same asymptotic distribution as DF statistic. H_0: p1 =0(p1 ~I(1)), against H_a : p1 < 0(p1~ I(0)).

In practice, a DF or ADF value with less than its critical value shows that the underlying series is non-stationary. Contrarily, when DF or ADF value is greater than its critical value. It shows that the underlying series is stationary. However, the null hypothesis cannot be rejected about non-stationarity based on ADF test, since its power is not strong as such.

However, the Augmented Dickey-Fuller (ADF) test is considered superior of its popularity and wide application. The ADF test adjusts the DF test to take care of possible autocorrelation in the error terms by adding the lagged difference term of the dependent variable.

Table 2 presents the ADF test results for all the selected variables used in the analysis at levels and first difference. The Schwartz Bayesian information criterion (SIC) determines the number of lags used in the test. The computed test statistic values are compared with the critical values, and the probability values, they are used for rejecting the null hypothesis. If the computed value of the *t*-statistic is more than the critical value and probability values are less than 5 per cent, then the null hypothesis is rejected, and the variable is assumed to be stationary. From the table, it can be seen that the ADF test confirmed that the included foreign labour productivity and output are stationary at I(1) (integrated of order first difference).

4.1 Unit Root Test with Augmented Dickey Fuller Test

Variables	Level			First Difference			Remarks
	Intercept	Intercept with Trend	None	Intercept	Intercept with Trend	None	
Labour Productivity	-1.2614 (0.6315)	-2.2782 (0.4302)	1.6207 (0.9709)	-3.9464 (0.0060)	-3.8223 (0.0321)	-3.1295 (0.0029)	I(1)
Output	-0.8600 (0.7857)	-3.1039 (0.1248)	0.5404 (0.8266)	-6.2103 (0.0000)	-4.4762 (0.0080)	-5.9537 (0.0000)	I(1)

Note: The Values are estimated in level with First difference and second differ

5. CO-INTEGRATION TEST

The present study uses a co-integration test based on the maximum likelihood a method of MacKinnon-Haug-Michelis (1999) suggests two tests (trace test and the maximum Eigen values test) statistics to determine co-integration rank.

Table 5.1
Johansen Co-integration Test

Unrestricted Co-integration Rank Test (Trace Statistics Test)					
Hypothesized	**Eigen**	**Trace**	**Critical value**	**Prob****	**Decision**
None	0.2669	15.2154	25.87211	0.5567	reject
At most 1	0.2234	6.8295	12.5179	0.3626	Do not reject
Unrestricted Co-integration Rank Test (Maximum Eigenvalue Test)					
None	0.2669	8.3859	19.3870	0.7857	Do not reject
At most 1	0.2234	6.8295	12.25179	0.3626	reject

Note: CE(s)-Co-integrating Equations, The critical values are taken from MacKinnon-Haug-Michelis (1999) p-values

The results of the co-integration analysis were revealing that the null hypothesis of no Co-integration between labour productivity and output and it is rejected. This test may regard as long run relationship between both variables.

6. GRANGER CAUSALITY TEST

Engle and Granger (1987)[6] argue that as long as variables are cointegrated, causality has to exist at least in one direction. Following their methodology the direction of causality between output and productivity will be detected by using the error-correction model.

The causal relationship between output and labour productivity are estimated by granger causality test are given in table 4.1

6.1 Results of Causality Test

Direction of Causality	**F Value**	**P Value of F**	**Decision**
Output to LP	1.62678	0.2193	Accept
LP to Output	0.89456	0.4231	Accept

Granger causality test is done by using time series data from 1981-82 to 2009-10. The accepting null hypothesis in the first case implies that Ln Output does not cause the labour productivity growth. Whereas accepting of null hypothesis in second case shows that LnLabour productivity does not cause the output growth. It is evident that from this analysis that there is exist unidirectional relationship between LnOutput and LnLabour productivity. All the variables are accepting null hypothesis and it is unidirectional and long run relationship between both variables.

The hypothesis that output does not granger cause labour productivity cannot be rejected but hypothesis that labour productivity does not Granger cause output can be rejected. It appears the Granger causality runs from labour productivity to output but no other way.

[6]Engle,R.F. and Granger, C.W.J. (1987) Cointegration and Error Correction:Rrepresentation, Estimation and Testing, ***Econometrica,*** Vol. **55**(2), pp. 251-276.

6. Conclusion:

This paper aims to investigate the Verdoorn's law in order to find the relationship between labour productivity and output growth. In this view, Granger type causality test is used. The results of the tests imply that there is long-run relationship between labour productivity and output. The coefficient of output growth rate is positive and significant due to the skilled labours in textile industry in tamilnadu. Hence, the Verdoorn's law holds good for the textile industry for Tamil Nadu.

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