DOES SRI LANKA NEED UNRESTRAINED GROWTH IN ELECTRICITY CONSUMPTION FOR HER SUSTAINABLE DEVELOPMENT?

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Introduction

Unrestrained growth in electricity consumption per capita (ECpc) in a country is seen as a precursor to continual improvement in the standard of living of the people living in the country. Standard of living, on the other hand, is believed to be entwined with economic development, proxied by gross domestic product per capita (GDPpc). ECpc of India is, however, found to be not related to its GDPpc by a long-run equilibrium relationship (Ghosh, 2002). The nature of the relationship between Sri Lanka's ECpc and its GDPpc is the focus of this study. Since economic development is seen to be closely related to the percentage share of service sector GDP (SGDP), probable existence of a long-run (i.e., cointegrating) relationship among ECpc, GDPpc SGDP for Sri Lanka is researched for in this study.

Data used

Data on ECpc and GDPpc and % shares sector GDPs for Sri Lanka, obtained from World Development Indicators (World Bank, 2009) for the period 1971 to 2006, are shown in Figures 1 and 2. It could be seen that ECpc, GDPpc and SGDP are on the increase during the period of study, whereas the % share of agricultural GDP is not and the % share of industrial GDP has increased only marginally. Cointegrating relationships are, therefore, searched for among the natural logarithms of ECpc, GDPpc and SGDP, denoted by E, G and S, respectively.

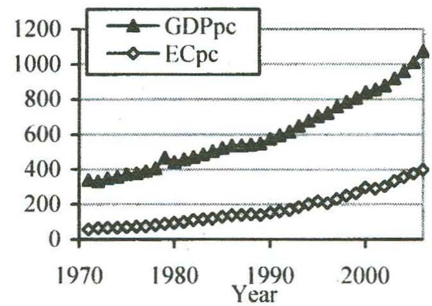

Figure 1. Sri Lanka's GDPpc in constant 2000 US$ and ECpc in KWh.

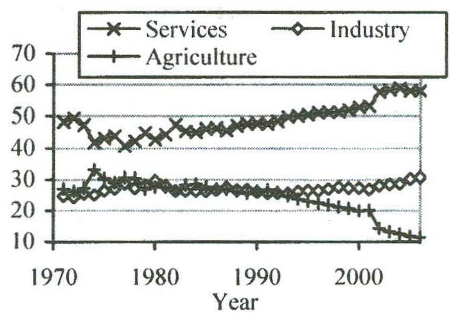

Figure 2. Percentage shares of Sri Lanka's agricultural, industrial and service sector GDPs.

Methodology

Investigating into the probable existence of a cointegrating relationship among variables Y, X and Z, according to the autoregressive distributed lag (ARDL) bound-testing approach to cointegration (Pesaran *et al.*, 2001), starts with the following general unrestricted error-correction model:

$$\Delta Y(t) = \alpha_0 + \beta_1 Y(t-1) + \beta_2 X(t-1) + \beta_3 Z(t-1) + \sum_{i=1}^{p} a_i \Delta Y(t\text{-}i) + b_0 \Delta X(t) + \sum_{i=1}^{p} b_i \Delta X(t\text{-}i) + d_0 \Delta Z(t) + \sum_{i=1}^{p} d_i \Delta Z(t\text{-}i) + \varepsilon(t) \quad (1)$$

where Δ denotes the first difference, α_0 is the unrestricted intercept, β_1 to β_3 are the coefficients of the lagged level variables, a_i, b_i and d_i are the coefficients of the respective first-differenced variables *Y*, *X* and *Z* with *p* specifying the maximum lag length, and $\varepsilon(t)$ are the serially uncorrelated residuals.

The first step in this approach is to establish the optimal value for lag length *p*, which is done using the Schwarz Bayesian Criterion. The subsequent test for existence of long-run equilibrium relationship among *Y*, *X* and *Z* requires calculating the *F*-statistic under the null hypothesis of $\beta_1 = \beta_2 = \beta_3 = 0$ (i.e. no cointegration) and the *t*-ratio under the null of $\beta_1 = 0$. If the *F*-statistic and the *t*-ratio lie below the lower bound critical values listed in Pesaran *et al.*, (2001) then the said null hypotheses of no cointegration could not be rejected. If the said *F*-statistic and the *t*-ratio values lie above the corresponding upper bound critical values then strong cointegration among *Y*, *X* and *Z* are established.

The long-run equilibrium relationship is then estimated using the ARDL approach. The residuals of the long-run equilibrium relationship, known as the error-correction term, pave the way for estimating the short-run equilibrium relationship via the error-correction model (ECM).

Results

Test statistics provided in Table 1 show that long-run equilibrium exits when *E* is taken as the dependent variables, and not when *G* is taken as the dependent variable.

The estimated long-run equilibrium relationship for *E* is as follows:

ARDL(1,0,0):

$$E(t) = \underset{[-11.9]}{-6.648} + \underset{[21.8]}{1.548}G(t) + \underset{[2.02]}{0.483}S(t) + \hat{v}(t) \quad (2)$$

where $\hat{v}(t)$ is the error-correction term, and the *t*-statistics given within the brackets prove the statistical significance of the coefficients.

Short-run equilibrium relationship corresponding to the *ARDL(1,0,0)* long-run model, estimated using the ordinary least square method, is as follows:

$$\Delta E(t) = \underset{[-7.58]}{-0.594}\hat{v}(t-1) + \underset{[4.33]}{0.581}\Delta G(t) + \underset{[2.60]}{0.353}\Delta S(t) + \varepsilon(t) \quad (3)$$

which has an adjusted R^2 of 51.3% and Durbin-Watson statistic of 2.13. Residuals of the above model, when tested, found to be normally distributed, have neither serial correlation, nor heteroskedasticity, and nor model misspecification.

Discussion

The result of this study that GDPpc does not drive ECpc should not come as a surprise since electricity accounts for only 10% of the secondary energy supply in Sri Lanka (Sustainable Energy Authority, 2009). The long-run equilibrium model reveals that 1% growth in GDPpc causes 1.55% growth in ECpc and 1% growth in the SGDP causes 0.5% growth in ECpc.

These high elasticity values could be explained by the possible growth in the electricity-consumption enhanced lifestyles of the households and the commercial sectors experienced by a developing country like ours that has only recently move into the middle-income economy class.

The equilibrium correction term $\hat{v}(t-1)$ of Eq. (3) has the expected negative coefficient, and is also highly significant. The coefficient of the equilibrium correction term therefore reveals that any deviation from the long-run equilibrium following a short-run disturbance is corrected by 59% in a year, which signifies a very strong cointegrating relationship among ECpc, GDPpc and the SGDP.

Conclusion

In Sri Lanka, Growth in ECpc is driven by growing GDPpc and SGDP, whereas there is no evidence for GDPpc being driven by growing ECpc and SGDP. The long-run income elasticity is 1.55, which is much higher than the corresponding income elasticity of unity prevailing in the technologically developed world. These results call for urgent initiation of serious energy policies towards minimizing wasteful electricity production and consumption practices that is imperative to make Sri Lanka follow an energy-wise sustainable economic development path. The significant long-run and short-run elasticities between ECpc and the SGDP signify that electricity consumption patterns in the service sector, such as artificial lighting, mechanical ventilation and air-conditioning, are avenues where introduction of alternative lifestyles could make a significant impact on conservation of ECpc, and thereby paving the way for the sustainable development of Sri Lanka.

Acknowledgement

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Table 1. Test statistics for long-run equilibrium relationship among *E*, *G* and *S*.

X	*Y*	*Z*	*p*	F_{III}	Critical values at *r* level of significance for F_{III}			t_{III}	Critical values at *r* level of significance for t_{III}		
					I(0)	*I*(1)	*r*		*I*(0)	*I*(1)	*R*
E	*G*	*S*	0	7.57	5.15	6.36	1%	-4.64	-3.43	-4.10	1%
G	*S*	*E*	0	3.67	3.79	4.85	5%	-3.19	-2.86	-3.53	5%

Notes: F_{III} is the *F*-statistic for testing $\beta_1 = \beta_2 = \beta_3 = 0$ and t_{III} is the *t*-ratio for testing $\beta_1 = 0$ in Eq. (1). Lower and upper bound critical values correspond to the *I(0)* and *I(1)* columns, respectively. Critical values for F_{III} and t_{III} are obtained from Tables CI(iii) and CII(iii) of Pesaran *et al.* (2001), respectively.