«FORECAST OF FUTURE ENERGY REQUIREMENTS BY THE MANUFACTURING SECTOR OF GREECE: A COMMENT»

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1. Introduction

This paper attempts to throw some light on the econometric structure of the model presented by P. Efthymoglou [1]. We shall first present two critical comments on Efthymoglou paper. On the one hand any econometrician would prefer his model to be based on sound grounds. In his paper have been safely ignored the econometric framework.

On the other hand, we should never forget that we donot work with deterministic relationships, consequently the crucial point is: how trustworthy are our estimates? and how reliable are our forecasting?

2. Model Specification

The Efthymoglou model has the following algebraic form:

where:

$$Z_t = aQ_i^b \tag{1}$$

Z_t = total energy consumption, in million GJ

Q_t = manufacturing output in thousand million drs.

a, b = coefficients to be estimated.

The error term in (1) is not specified. Thus, the error term in (1) is either specified to be additive:

$$Z_t = aQ_t^b + u_t \tag{1'}$$

or to be multiplicative :

$$Z_t = aQ_t^b \; e^{u\,t} \tag{1''}$$

in both cases we assume that $u_t \sim N\ (0,\ \sigma^2\ I)$.

The differences between (1′) and (1″) are several for details one can see [2] and [3].

If we assume that the error term represent omitted attributes, then it follows that the model (1″) ought to be specified, see [4]. Now, from (1″) it follows :

$$\log Z_t = \log a + b \log Q_t + u_t \tag{2}$$

or :

$$z_t = a' + bq_t + u_t$$

where :

$$z_t = \log Z_t$$

$$q_t = \log Q_t$$

$$a' = \log a$$

and u_t satisfies all the necessary assumptions if (2) is the correct specification.

From now, we call (2) model (I) and the second model (model (II)) can be stated as :

$$Z_t = a'' + \beta q_t + \gamma^1 l_t + \delta k_t + u_t \tag{3}$$

where :

$$l_t = \log L_t,\ k_t = \log K_t$$

Model (II) follows from the economic theory of production. The relationship between input and output of a producing sector is described in economic theory by a production function.

Such a function, generally, expresses the level of output as a function of the magnitudes of different inputs and it allows us to derive uniquely the demand for an input from the levels of output and the other inputs.

In terms of the economic theory of the firm, the fundamental assumption in the analysis of the demand for energy is that firms determine their demand of factors of production by findings the combination of factor inputs that will maximize profits subject to the production function.

Because the production function is the constraint for decisions to all factor inputs, individual factor demands must be interrelated. Therefore, each demand equation must contain parameters from this production function.

Here we assume that our production function has the Cobb - Douglas form.

It would be much realistic to use istead of Cobb - Douglas more general production function for the study of the demand for energy.

It is well known that the Cobb - Douglas production function has the property that each pair of inputs has a unity elasticity of substitution.

But the following Mukerji production function :

$$Q = \{ a_1 K^{-\rho_1} + a_2 L^{-\rho_2} + a_3 E^{-\rho_3} \}^{-1/\rho} e^u$$

has the property that each pair of inputs has distinct elasticity of substitution. This is more realistic than to assume that the elasticity of substitution between capital and energy is the same as between capital and labour.

Obviously, if we use the incorrect model to estimate the parameters by any econometric technique we commit a specification error. We can distinguish two well known cases : using (3) when (2) is correct amounts to including an irrelevant variable, while using (2) when (3) is the correct model then we have omitted a relevant variable.

Let us assume that (3) is the correct model but (2) is used in estimation (as Efthymoglou has done). What is then the consequences of the omitted variable?

The consequences of a misspecification in the form of an omitted variable yields biases that depend on the correlation between the omitted variable and the existing variables see [7, Kintis].

Now, $\operatorname{cov} (\log Q_t , \log L_t) = \operatorname{cov} (q_t , l_t) =$

$E (q_t l_t) - E(q_t) E(l_t)$ and if $E(q_t l_t) \neq E(q_t) E(l_t)$

then $\operatorname{cov} (q_t , l_t) \neq 0$ (similarly $\operatorname{cov} (q_t , k_t) \neq 0$) which implies :

$$\operatorname{cov} (\log Q_t , u_t) \neq 0$$

this will result in biased and inconsistent parameter estimates.

The estimates are :

$$\hat{b} = \frac{\widehat{\operatorname{cov}} (z_t , q_t)}{\hat{\sigma}^2 (q_t)} = \beta + \gamma \frac{\widehat{\operatorname{cov}} (q_t , l_t)}{\hat{\sigma}^2 (q_t)} + \delta \frac{\widehat{\operatorname{cov}} (q_t , k_t)}{\hat{\sigma}^2 (q_t)} + + \frac{\widehat{\operatorname{cov}} (q_t , u_t)}{\hat{\sigma}^2 (q_t)} \qquad (4)$$

$$\hat{a}' = \bar{z}_t - \hat{b}\,\bar{q}_t \text{ where bars denote sample means.} \tag{5}$$

It follows from (4) :

$$\underset{T \to \infty}{\text{plim}}\ \hat{b} = \beta + \gamma \frac{\widehat{\text{cov}}\,(q_t\,,\,l_t\,)}{\hat{\sigma}^2\,(\,q_t\,)} + \delta \frac{\widehat{\text{cov}}\,(\,q_t\,,\,k_t\,)}{\hat{\sigma}^2\,(\,q_t\,)}$$

and for given values of γ and δ will determine the bias in $\hat{b}$.

The inclusion of an irrelevant variable in the model is a trivial problem. It mainly presents problems in small samples where efficiency of the estimate is an important property.

Naturally if (3) is the correct model then :

(i) things have been left out from model (I) ;

(ii) we can't use the estimates of the parameters for forecasting :

(iii) the size of b is wrong since :

$$Q = AK^{\alpha}\ L^{\beta}\ Z^{\gamma} \qquad \alpha + \beta + \gamma = 1 \qquad \alpha, \beta, \gamma\ \varepsilon\ R^+ \text{ then :}$$

$$Z = a\ Q^{1/\gamma}\ K^{1/\alpha\gamma}\ L^{1/\beta\gamma} = a\ Q^b\ K^c\ L^d$$

where :

$$a = \frac{1}{A\gamma},\quad b = \frac{1}{\gamma},\quad c = \frac{1}{\alpha\gamma},\quad d = \frac{1}{\beta\gamma}$$

If, I take $0 < \gamma < 1$ then $b > 1$ but its .825 which is perhaps too small.

The other problem with the Efthymoglou paper is the Durbin - Watson Statistic. Let see analytically this problem.

3. The Durbin - Watson Statistic

The estimated by Efthymoglou energy ratio function has the following form :

$$\log\left(\frac{E}{F}\right)_t = -\,.430 \underset{(1.69)}{-.7603} \log\,(p^e\,/\,p^f\,)_t + \underset{(2.41)}{.5927} \log\,(E\,/\,f)_{t-1} \tag{6}$$

$\bar{R}^2 = .95$, D.W. $= 1.83$

The estimation of the model (6), or :

$$\log (E/F)_t = a_1 + a_2 \log \left(\frac{p^e}{p_f}\right)_t + a_3 \log (E/F)_{t-1} + \text{error} \tag{7}$$

implies that the original model has the form :

$$\log \left(\frac{E}{F}\right)_t = \frac{A(L)}{B(L)} \left(\frac{p^e}{p_f}\right)_t + u_t \tag{8}$$

where :

$\frac{A(L)}{B(L)}$ defines the lag structure and L is the lag operator.

Thus the error in (8) obey :

$$u_t = \frac{I}{B(L)} v_t \tag{9}$$

where v_t is i.i.d. (independent, identically distributed).

And if the error term in the original model (8) is not given by (9), application of OLS to (7) will yield incosistent estimators.

And as Dhrymes [5] point out «in such case, it is not clear what R^2 would mean and what judgmental determinations can be based on it». This problem is related to that raised by Nerlove and Wallis [6]. The authors indicate that «if one estimates b ($y_t = by_{t-1} tu_t$) by OLS and subsequently computes the D.W. Statistic then the probability limit of D.W. is 2». This implies that the D.W. is inappopriate.

4. Final Remarks on Efthymoglou paper * :

1. Causality or theory in (1) (of his paper) ? or Production function?
2. In equation (3), about u, its a very old specification, what justification?
3. Problem of accepting $H_1 : d_1 \neq 0$, very low.
4. The relationships (7) - (9) can be omitted as obvious.
5. Assumptions 1 and 2 of p. 120 require justification if this is mean samething.
6. D.W. of (5) is low, naturally if this is in fact a production function since things

*) Numbers (1), (3), (5), (7) - (9) refers to the original paper of Efthymoglou.

have been left out and according to Malinvaud [8] this is an indication of wrong specifications of the model.

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