ON THE STABILITY OF THE ENERGY EQUILIBRIUM PRICE MODEL USING A COMPUTATIONAL APPROACH

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ABSTRACT:
The stability of the energy equilibrium price model is one of the challenging scientific problems facing professional energy experts, mathematicians and economists. The qualitative trajectory of this formidable model over a longer trading period can provide a long-term economic planning strategy in a bid to monitor its sustainable development dimension. The full analysis of this problem is beyond an analytical approach; therefore, we have proposed a computational approach under some simplifying assumptions. The novel results of this pioneering problem that we have not seen elsewhere will be presented and discussed in this paper.

Keywords: *Energy Price Model, Stability, Numerical Simulation, Computational Approach.*

INTRODUCTION
One of the standard methods of studying the dynamics of energy price model depends on the process of a mathematical modelling (Lara,2014;Tao et al,2012;Askari and Krichene,2008;Salisu and Fasanya,2012;Moshiri and Foroutan,2006;Deng et at,2007;Tian and Qian,2010). We have calculated the semi-trivial steady-state solution of the energy price model and discover that it is stable under the popular sign method in which the real Eigen-values are both negative. However, it is important to test the stability of this system due to changes in the model parameter values. This is the aim of this study.

MATHEMATICAL FORMULATION
Following Lara (2010), we have considered the following simplified system of differential equations of first order.

$$\frac{dx(t)}{dt} = y(t) \quad \textbf{1}$$

$$\frac{dy(t)}{dt} = -u\alpha x(t) - u\beta x(t) - bux(t)y(t) - ucy(t) - rmy(t) + uD_0 - uS_0$$

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subject to the initial condition $x(0)=x_0>0$ and $y(0)=y_0>0$ where u, α,β,b,c,r,m,D_0 and S_0 are called positive constants. Here, x (t) and y (t) represent energy price dependent variables. For the purpose of this numerical simulation, we have assumed the following parameter values D_0 =2.5, S_0=0.5,α=0.04,β=0.02. Under some simplifying assumptions and substituting these parameter values, we have obtained the following semi-trivial steady-state solution (33.3333, 0). This steady-state solution is said to be stable having two real negative stable eigenvalues -0.00073 and -66.01200886

METHOD OF ANALYSIS

The present method of analysis goes beyond the popular analytical method of testing for the stability for a system of model differential equations. This method will involved a shorter variation of a chosen parameter value from which the stability behaviour can be study. The results that we have obtained upon using this method are presented and discussed next.

RESULTS AND DISCUSSION

In this section, we shall present and discuss the core results of this present study.
Table: Varying the percentage of the parameter value α from 0.0400 to 0.0392.

Example	α	x	y	λ_1	λ_2	TOS
1	0.0400	33.3333	0	-0.0007	-66.0120	Stable
2	0.0020	90.9091	0	-0.0003	-66.0125	Stable
3	0.0040	83.3333	0	-0.0003	-66.0124	Stable
4	0.0060	76.9231	0	-0.0003	-66.0124	Sable
5	0.0080	71.4286	0	-0.0003	-66.0124	Stable
6	0.0100	66.6667	0	-0.0004	-66.0124	Stable
7	0.0120	62.5000	0	-0.0004	-66.0123	Stable
8	0.0140	58.8235	0	-0.0004	-66.0123	Stable
9	0.0160	55.5556	0	-0.0004	-66.0123	Stable
10	0.0180	52.6316	0	-0.0005	-66.0123	Stable

11	0.0200	50.0000	0	-0.0005	-66.0123	Stable
12	0.0220	47.6190	0	-0.0005	-66.0122	Stable
13	0.0240	45.4545	0	-0.0005	-66.0122	Stable
14	0.0260	43.4783	0	-0.0006	-66.0122	Stable
15	0.0280	41.6667	0	-0.0006	-66.0122	Stable
16	0.0300	40.0000	0	-0.0006	-66.0121	Stable
17	0.0320	38.4615	0	-0.0006	-66.0121	Stable
18	0.0340	37.0370	0	-0.0007	-66.0121	Stable
19	0.0360	35.7143	0	-0.0007	-66.0121	Stable
20	0.0380	34.4828	0	-0.0007	-66.0120	Stable
21	0.0392	33.7838	0	-0.0007	-66.0120	Stable

Here λ_1 and λ_2 represent the eigenvalues and TOS stand for type of stability. We have found that irrespective of the variation of the model parameter α, the unique positive semi-trivial steady-state solution is dominantly stable.

CONCLUSION

When the model parameter α is varied from 0.0400 to 0.0392, we have obtained twenty one (21) trivial steady-state solutions which are dominantly stable. We did not consider the variation other model parameters and their impact on stability. This extended level of analysis will be the subject of our future publication.

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