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The Micro-Macro Economic Model: Stiffness and the GDP

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Abstract

Continuing with the theme of Physical Economics presented in previous papers by the same author, we develop a solution from the stiffness equation from Structural Engineering that allows us to calculate the GDP growth for a broad economy. It is important because this solution can be programmed into computer language to solve for the critical variables that need to be determined to manage the economy. Knowledge of Astrotheology Mathematics is helpful in understanding where some the variable come from and why the golden mean parabola is particularly important.

Keywords: Stiffness equation; Matrix methods of structural analysis; Golden Mean; GDP

Introduction

Physical Economics or Ecnophysics makes use of readily available solutions to Structural Engineering problems that can be applied in the solution to the parameters of the broad economy. The stiffness equation rom Matrix Structural analysis is used in this presentation to link the Supply Curve and Demand to the GDP growth. The key factor is k, the stiffness of the structure or economy [1]. This mathematics, which I call Astrotheology Math, or AT Math for short, is the solution to cosmology as well as economics. The Dampened cosine is used to model the trajectory for an economic project, such as wooden ship building production in the 19th Century Saint John The distance differential equation from basic Physics is used to solve for stiffness k as well. This is all linked together by the golden mean parabola which plots GDP vs. stiffness. We begin with the Stiffness Matrix Equation [2,3].

Stiffness Equation

$$F=ks \quad (1)$$

k=AE/l [1 -1 ....-1 1]

k=(1)(0.4233)/(12/2) [1 -1 ... -1 1]

k=0.8466~sin 1

But F=ks

sin 1=[sin θ][1].

The rate of change of k is its derivative

$$k=\sin\theta \quad (2)$$

$$k'=-\cos\theta \quad (3)$$

$\theta=\pi/4=45°$

$$\sin 45=\frac{1}{\sqrt{2}}=0.707$$

F=ks=sin 45=0.707

With a Multiplier Effect of 7X's

7(0.707)=1/0.202=1/Y where Y is the dampened cosine curve

$$Y=e^{-t}\cos(2\pi t). \quad (4)$$

Dampened Cosine Curve

Various Economic projects across the economy function on the inverse of the dampened cosine curve. Sales start out slow; build to crescendo, falloff; build again; and eventually collapse altogether [4,5].

Let t=1

Y=0.202.

We know that the US Economy Equation

$$Y=e^{0.1358}=e^{(1-\sin 1).} \quad (5)$$

Since the Efficient Economy is where Y=Y'=Y"

1/Y=1/Y'

$$1/e^{(1-\sin 1)}=1/e^{-t}\cos(2\pi t) \quad (6)$$

Take the derivative of Y=Y'=Y'

$[1/0.8534]\chi=-1/[e^{-t}\cos(2\pi t)]$

Let t=1

$117.18\chi=e^{t}$

$117.18\chi=e^{1}$

$[117.18/2.71828]\chi=1/0.232=1/\text{Ln}\,\pi$

$\chi=1/\text{Ln}\,t$

$\chi\text{Ln}\,1=1$

$\chi=1/0=1$

Y/Y'=1/0=1

Y=Y'.

Moment

$$e^{(1-\sin 1)}=e^{\text{Moment}}=1/e^{-t} \quad (7)$$

Moment=1-sin 1=t

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$F \times d = t$

$(ks) \times s = t$

$0.4233\ (s^2) = t.$

Let $t=1$

$0.4233 = 1/s^2$

$s = 1537.$

US Economy Equation

$Y = e^{0.1358} = e^s$ (8)

$F = ks$

$s = \text{Ln } Y$

$F = k \text{ Ln } Y$

$\sin 1 = k \text{ Ln } Y$

$k = \text{Ln } Y/\sin 1$

$k = 118.4 = \text{Mass } M$

$k = M = F = M\$$

$F = ks$

$s = 1$

$s = \text{Ln } Y = 1 = \text{Ln } Y$

$Y = e^1$

$2.718 = k$

$K = e^t = \cos\theta = \sin\theta$ (9)

$\theta = \pi/4 = 45°$

$$k = \frac{1}{\sqrt{2}} = 0.707$$

$0.707 \times 7 = 1/0.202 = 1/Y$ where $Y = e^{-t}\cos(2\pi t)$ & $t=1$

multiplier 7 X's × 7 Year cycle=49

$Y = e^{-4.9}\cos(2\pi(0.49)$

$= 7.447$

$= 1 - 0.13429$

$= 1 - \sin 1$

$=$ moment

$e^{(1-\sin 1)} = 1/\sin 1$

$e^{(\text{moment})} = 1/F$ (10)

$\theta = t = 1$

where F=Superforce.

The Figures 1 and 2 explains the curve projecting in the economic project.

Density

$k = \rho/c$ (11)

$\rho = \$/\text{Unit} = 1.27$

$Q = \text{Units}$

$Y = M\$ = 1.27\ (Q)$

$Y = e^{0.1358} = 1.27Q$

$Q = 0.111 = 1/c^2$ (12)

$0.888 \sim c^2 = 0.4233\ (2.1\%)$

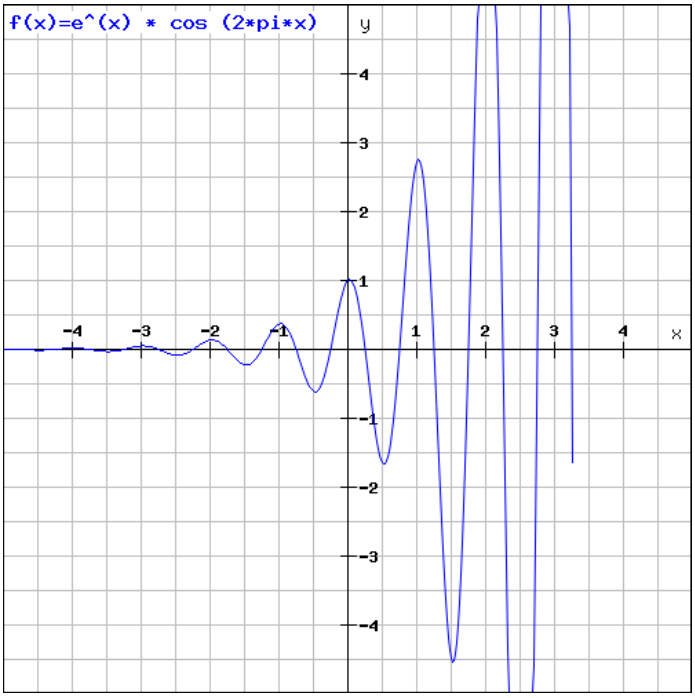

Figure 1: Dampened Cosine Curve showing trajectory of an economic project until collapse.

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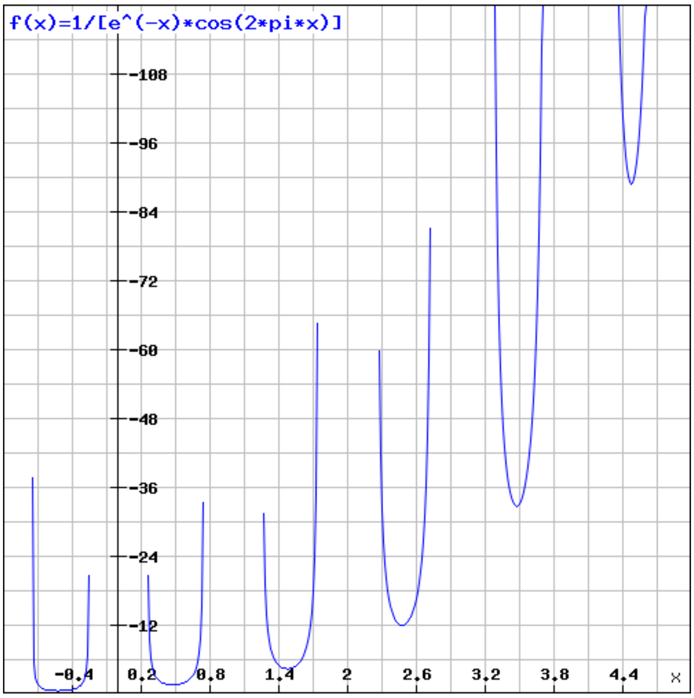

Figure 2: Inverse of the dampened Cosine Curve showing the time-span of an economic project.

c^2=k (ΔGDP)

Q=1/[k *ΔGDP] (13)

ΔGDP/c=7=c/k

ΔGDP=[Qk] (14)

Consider the distance equation from Mechanics:

So, -t=F×d

But F=ks & d=s.

Distance Equation

We know from basic Physics,

$d=v_i t+1/2\ at^2$ (15)

Aside:

$d=1/2\ at^2$

d'=2/2 at=at=st

But -t=ks

d=s(-ks)

$s=-s^2k$

$s^3=k$

s=1

k=1=t.

Back to the distance differential equation:

$s=(s(t)+1/2\ st^2$ (16)

$-s-st+1/2\ st^2=0$

$-s-k+k^2=0$

$k^2-k-1=0$ (17)

$x^2-x-1=0$.

Golden Mean Equation

The Golden Mean is optimized at y=1/2

$k^2-k-1=0$

2k-1=0

k=1/2

But

k=[F/A]/[[ΔL/L] (18)

=[1/1]/1/(1/2)]=1/2

k_{min}=1/2.

Consider the maximum Temperature Load, for a slender bar of Area=1:

Hooke's Law

σ=Eε (19)

F/A=k × ΔL/L

F> 0.4233 (1/(1/2))

F>0.8466

For a Bar of Area A=1

f=l/[AE] (20)

f=(1/2)/[(1)(0.4233)]

=118.12=Mass M

1/f=0.8466~sin 1 rad.

Pythagoras:

$\sqrt{[(0.8466)^2+(0.8466)^2]}=119.73>118.12=\text{Mass}$ (Periodic Table of the Elements)

Now, flexibility for a slender bar:

v=fF+ v (21)

(1/k)(s)+ kαT

[1/(0.4233)](ΔL)+(k(1/7)(F/A)

23.6+1

=336

~1/c

$E=Mc^2$ (22)

1/c=Mc

Mc=v=s=a (23)

(119(3)=354

$\Delta L/L=v/L=354(1/2)=708\sim 1/\sqrt{2}=\sin 45°=\cos 45°$.

Temperature or Cash Transfer to a Node

v=αTl (24)

118.12=(1/7)(1/2)

T=1653~1/6=1/F

1653-273 Kelvin=1453

=1-sin 1

=moment

=1/f

Therefore, too much cash transfer to a node causes instability in the structure. There is a limit to how much an efficient economy can withstand.

Conclusion

We see that the Stiffness Equation from Structural Engineering can be used to solve for broad parameters of the economy, for example the US Economy. The Stiffens coefficient determined from AT Mathematics, applies for Economics as well as for Cosmology. Knowledge of this solution provides an algorithm for computer solution to project important economic parameters to help in managing g the economy for a nation, or even the world.

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