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Emerging Markets Queries in Finance and Business

Banking system: Three level Lotka-Volterra model

Călin-Adrian Comes[a,*]

[a] "Petru Maior" University, Nicolae Iorga 1, Tîrgu-Mureș, 540088, Mureș, Romania

Abstract

In ecological systems we have univoc biomass transfer from Herbivorous to Carnivores, and from Plants to Herbivorous, respective in financial system we have biunivoc capital transfer from Mother Bank to Subsidiary Bank, and from Subsidiary Bank to Individuals or Companies; in our approach we study the Individuals suppliers/clients. Three level Lotka-Volterra TLV model is a system of differential equations which analyzes the banking. Three Lotka-Volterra with regulators/decompozers - TLVRS is a system of stochastic differential equations that analyze the equilibrium of banking sector - solution of Fokker-Planck-Kolmogorov stochastic equation in idea to find the dinamical equilibrum point for the Banking System.

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Keywords: Banking System, Lotka-Volterra model, Stochastic Process, Wiener processes, Fokker-Planck-Kolmogorov equation;

1. Introduction

Banks are financial institutions and intermediaries that accept deposits, grant loans and actively participate in the stock market derivatives as an interface between customers / suppliers (individuals or companies) that have a shortage of capital and customers / suppliers (individuals or companies) that have a surplus of capital.

The earliest manifestations of "banking phenomenon" are: *Monte dei Paschi di Siena*, headquartered in Siena, Italy, continuously operating since 1472, followed by *Berenberg Bank of Hamburg* (1590), Germany, and *Sveriges Riksbank of Sweden* (1668), Sweden - Boland, 2009.

Banking regulations are governmental or non-governmental forms of regulation subject to certain requirements, restrictions and guidelines. This regulatory structure creates transparency between banks and individuals and corporations with whom they work. Financial institutions, especially investment banks have control over the economy with enormous consequences for national economies and global instability. The objectives of bank regulation are: avoiding misuse of banks, credit allocation, protect banking confidentiality, prudentiality, systemic risk reduction, providing the best customer service.

Thompson, 2011 argue that *conceives the financial system as akin to an ecological network*: in light of these axioms we considered the following three levels of organic nature with suitable food chain in Fig. **1**. where we have

* Corresponding author. Tel.: +40-745 399 337.
E-mail address: calin.comes@ea.upm.ro

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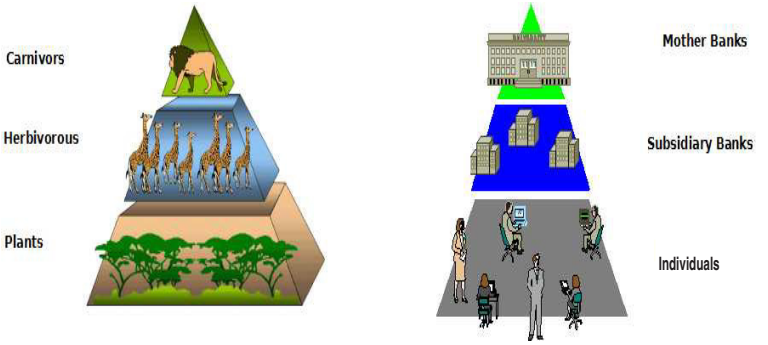

Fig. 1. Ecological System - versus - Banking System

the first level carnivores, herbivores and the next tier of biomass on the third level.

Table 1. Ecological System - versus - Financial System

	Transfer	$Level_1$	$Level_2$	$Level_3$
Ecological System	Biomass	Carnivores	Herbivorous	Plants
Financial System	Capital	Mother Bank	Subsidiary Bank	Individuals

In ecological systems we have univoc biomass transfer from Herbivorous to Carnivores, and from Plants to Herbivorous, respective in financial system we have biunivoc capital transfer from Mother Bank to Subsidiary Bank, and from Subsidiary Bank to Individuals or Companies; in our approach we study the Individuals suppliers/clients see Table **1**.

2. Three Lotka-Volterra TLV

Lotka-Volterra model belongs to the family of Prey-Predator population model that has the flow of biomass. Volterra, 1931; Lotka, 1920 see 1.

$$\begin{cases} x_1'(t) = x_1(t)(a - b \cdot x_2(t)), \\ x_2'(t) = -x_2(t)(c - d \cdot x_1(t)). \end{cases} \tag{1}$$

, where $x_1(t)$ is the number of prey, $x_2(t)$ is the number of some predator, $x_1'(t)$, and $x_2'(t)$ are growth rates of the two populations, and a, b, c, d are parameters.

The so-called TLV, which is studied in our paper, represent a tri-trophic capital chain which appears when a top predator **Mother Bank** "*feeds*" on an intermediate consumer **Subsidiary Bank**, which in turn "*feeds*" on a capital-resource **Individuals**

$$\begin{cases} x_1'(t) = x_1(t)(a_1 - b_1 \cdot x_2(t) + c_1 \cdot x_3(t)), \\ x_2'(t) = x_2(t)(-a_2 + b_2 \cdot x_1(t)), \\ x_3'(t) = x_3(t)(a_3 - b_3 \cdot x_1(t)). \end{cases} \tag{2}$$

, where $a_i, b_i, c_1, i \in \{1,2,3\}$ are positive constants. TLV nonlinear mathematical model of an ecosystem consisting of a herbivorous species (the number of individuals of which is $x_1(t)$), a carnivorous one $x_2(t)$, and of plants, the quantity of which is denoted x_3. For every initial value $(x_1(0); x_2(0); x_3(0))$; the above system has a unique solution $(x_1(t); x_2(t); x_3(t))$ which is continuous on $\rfloor 0; +\infty \rfloor$ Haimovici, 1980; Apreutesei, 2006.

We introduce in the banking system some control variables **u** and **v**; whose role is to separate (partially or totally) the three populations from each other.