Economic fluctuations and possible non-linear relations between macroeconomic variables for Brazil

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Abstract

The correctness of the macroeconomic prospective evaluations for planning activities, mainly for capital intensive sectors, such as electricity supply, may represent the key between the success or failure of any kind of money-spending scheme. Macroeconomical results derived from government models exhibit, in general, excessive optimistic growth and do not take into account "natural" fluctuations and other "explicit time-dependent events" found in any economical system. Such "quasi-deterministic" phenomena are derived from non-linear systems properties, like biological and "highly viscous" systems. This paper shows how this kind of "natural" process can be represented by this approach, which embodies two distinct behaviours observed in Brazilian historical data: the systematic capital productivity decline and the oscillatory mechanism in the GDP production. This mathematical model represents one possible mechanism, which explain the macroeconomic variables behaviour. The oscillatory period obtained by this approach is close to that observed historically. For practical prospective purposes, an empirical model is also presented. © 2001 Elsevier Science B.V. All rights reserved.

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1. Introduction

In the beginning of 1980s, Brazilian economy continued to show, a relative level of exuberancy on its activities, despite the successive oil shocks and, at that time, some

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governmental forecasts [1] until 2000, were carried out. Such economic forecasts, performed in a highly optimistic environment, resulted in anticipation and over-estimation of investments, mainly in the basic framework, such as energy supply, which has been extremely damaging to society. Within the present globalized institutional context, in which electricity prices, reflecting both, market risks and pluvial uncertainness (hydropower represents 96% of Brazilian total electricity power generation), have shown high volatility, the correct short-term economic evaluation becomes vital for survival of the agents. From microeconomic point of view, Weron [2] has reported how this kind of worry can be dealt.

The usual macroeconomic variable used for prospective purpose is the Gross domestic product (GDP), and its evaluation represents the *focus* of the whole misunderstanding and the core of the whole question, in order to have an acceptable future economic activities knowledge. In order to avoid or at least, minimize undesirable events, such as the above, in the future, an analytical approach is proposed to handle "quasi-deterministic" aspects of macroeconomic behaviour. "Quasi" here understood in the "psycological deterministic" sense, defined by Popper [3], instead of "restrict" or "Newtonian" one. In this sense, a model dealing with the phenomenon existent in any country, concerning economic oscillations phenomenon, already known as *business cycles* [4,5] is proposed.

It was assumed that the individual "free-will" principle is of relatively low importance when collective behaviour of an economy as a whole is concerned. Some particular analogies between economies and "natural systems" such as *highly viscous fluid and biological systems*, as well as the employment of non-linear differential and difference equations to describe dynamic macroeconomical properties can be carried out due to the above-mentioned fact. In this sense, a mathematical alternative approach to escape the discussion connected to the unsolved aspects of the "theory of investment" [6] is presented or, in other words, the question how capital equipment grows through individual-choice decision is avoided. The approach adopted describes a simplified model on the dynamics of some macroeconomic phenomena, specifically for the fluctuations in the process of *goods and services* production.

2. Observed data and empirical fitting

By analysing the Brazilian historical macroeconomic data, since 1947, two distinct behaviours emerge clearly. First, the systematic decrease in the (Y/K) ratio (variable Y being the *gross domestic product* and K representing the *fixed capital equipments*). In others words, the capital efficiency or the *capital productivity* to generate *goods and services*, has declined through the years. Second, the presence of dynamic fluctuations in both Y and K variables, giving rise to the phenomenon known as *business cycles*, observed by Clement Juglar, since the beginning of the century. The historical macroeconomic data used in this paper refer to the period 1970/1997, although longer series are available in the IBGE [7] statistics. However, this longer series displays some