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Hyperinflation in Brazil, Israel, and Nicaragua revisited

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HIGHLIGHTS

- Episodes of hyperinflation occurred in Brazil, Israel and Nicaragua are reanalyzed.
- The nonlinear feedback (NLF) model for hyperinflation was applied.
- Reasonable critical times t_c were predicted for Brazil and Nicaragua.
- Hyperinflation in Israel was too week for determining a t_c within the NLF model.

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ABSTRACT

The aim of the present work is to address the description of hyperinflation regimens in economy. The spirals of hyperinflation developed in Brazil, Israel, and Nicaragua are revisited. This new analysis of data indicates that the episodes occurred in Brazil and Nicaragua can be understood within the frame of the model available in the literature, which is based on a nonlinear feedback (NLF) characterized by an exponent $\beta > 0$. In the NLF model the accumulated consumer price index carries a finite time singularity of the type $1/(t_c - t)^{(1-\beta)/\beta}$ determining a critical time t_c at which the economy would crash. It is shown that in the case of Brazil the entire episode cannot be described with a unique set of parameters because the time series was strongly affected by a change of policy. This fact gives support to the "so called" Lucas critique, who stated that model's parameters usually change once policy changes. On the other hand, such a model is not able to provide any t_c in the case of the weaker hyperinflation occurred in Israel. It is shown that in this case the fit of data yields $\beta \to 0$. This limit leads to the linear feedback formulation which does not predict any t_c. An extension for the NLF model is suggested.

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1. Introduction

Inflation contribution is fundamental to reach the "economical numbers" quoted by Feynman (see data plotted below). But most importantly, when inflation surpasses moderate levels it affects real economic activities. Models of hyperinflation

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are especially suitable to emphasize that inflation implies bad “states of nature” in economy. Wars, states bankruptcies, and changes of social regulations are the characteristics of such inflation regimens. These issues are analyzed in textbooks on econophysics [1–3].

The model for hyperinflation available in the literature is based on a nonlinear feedback (NLF) characterized by an exponent $\beta > 0$ of a power law. In such an approach the accumulated consumer price index (CPI) exhibits a finite time singularity of the form $1/(t_c - t)^{(1-\beta)/\beta}$. This feature allows to determine a critical time t_c at which the economy would crash. Although this model has been successfully applied to many cases [4–8], the authors of Ref. [4] found difficulties in determining t_c for regimens of hyperinflation occurred in Brazil, Israel, and Nicaragua. Therefore, the present work is devoted to revisit these episodes. It is shown that after a revision of data is possible to predict reasonable values of t_c for Brazil and Nicaragua. However, in the case of Israel the difficulty persists, this feature would be plausibly attributed to permanent but partial efforts for stopping inflation. In order to follow better the evolution of inflation we provide brief historical descriptions for these countries.

The paper is organized in the following way. In Section 2 the NLF theory is outlined with details in order to present self-consistently the tools applied for analyzing regimens of hyperinflation. The episodes occurred in Brazil, Israel, and Nicaragua are revisited in Section 3. Finally, Section 4 is devoted to summarize conclusions.

2. Theoretical background

Let us recall that the rate of inflation $i(t)$ is defined as

$$i(t) = \frac{P(t) - P(t-\Delta t)}{P(t-\Delta t)} = \frac{P(t)}{P(t-\Delta t)} - 1, \tag{2.1}$$

where $P(t)$ is the accumulated CPI at time t and Δt is the period of the measurements. In the academic financial literature, the simplest and most robust way to account for inflation is to take logarithm. Hence, the continuous rate of change in prices is defined as

$$C(t) = \frac{\partial \ln P(t)}{\partial t}. \tag{2.2}$$

Usually the derivative of Eq. (2.2) is expressed in a discrete way as

$$\begin{aligned} C\left(t + \frac{\Delta t}{2}\right) &= \frac{[\ln P(t+\Delta t) - \ln P(t)]}{\Delta t} \\ &= \frac{1}{\Delta t}\, \ln\left[\frac{P(t+\Delta t)}{P(t)}\right]. \end{aligned} \tag{2.3}$$

The growth rate index (GRI) over one period is defined as

$$r\left(t + \frac{\Delta t}{2}\right) \equiv C\left(t + \frac{\Delta t}{2}\right)\Delta t = \ln\left[\frac{P(t+\Delta t)}{P(t)}\right] = \ln[1 + i(t+\Delta t)] = p(t+\Delta t) - p(t), \tag{2.4}$$

where a widely utilized notation

$$p(t) = \ln P(t), \tag{2.5}$$

was introduced. It is straightforward to show that the accumulated CPI is given by

$$P(t) = P(t_0)\, \exp\left[\frac{1}{\Delta t}\int_{t_0}^{t} r(t')\mathrm{d}t'\right]. \tag{2.6}$$

2.1. Cagan's model of inflation

In his pioneering work, Cagan has proposed [9] a model of inflation based on the mechanism of “adaptive inflationary expectation” with positive feedback between realized growth of the market price $P(t)$ and the growth of people's averaged expectation price $P^*(t)$. These two prices are thought to evolve due to a positive feedback mechanism: an upward change of market price $P(t)$ in a unit time Δt induces a rise in the people's expectation price $P^*(t)$, and such an anticipation pushes on the market price. Cagan's assumptions may be cast into the following equations:

$$1 + i(t+\Delta t) = \frac{P(t+\Delta t)}{P(t)} = \frac{P^*(t)}{P(t)} = \frac{P^*(t)}{P^*(t-\Delta t)}, \tag{2.7}$$

and

$$\frac{P^*(t+\Delta t)}{P^*(t)} = \frac{P(t)}{P(t-\Delta t)} = 1 + i(t). \tag{2.8}$$

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