Documents
de travail

**« Theoretical support for a new class of demand
for real cash balances in explosive
hyperinflations »**

Auteurs

Alexandre Sokic

CENTRE NATIONAL
DE LA RECHERCHE
SCIENTIFIQUE

Nancy-Université
Université Nancy 2

ulp
UNIVERSITÉ LOUIS PASTEUR
STRASBOURG

Theoretical support for a new class of demand for real cash balances in explosive hyperinflations

Alexandre Sokic[1]
Ecole Supérieure du Commerce Extérieur, PULV, 92916 Paris La Défense, France
E-mail: alexandre.sokic@devinci.fr

March 2008

Abstract

This paper aims at providing some new theoretical support for money demand functions in monetary hyperinflation analysis given the well known failure of Cagan based inflationary finance models to produce explosive hyperinflation. An analytical approach is used to characterize the agents' preferences which are compatible with monetary hyperinflation. In the context of a MIUF model, we show that the possibility of explosive hyperinflation paths depends on a sufficient level of money essentiality in the sense of Scheinkman (1980) which is conveyed by the agents' preferences. This result emerges without any ad-hoc assumption implying the inclusion of some friction in the adjustment of some nominal variable. It suggests that monetary hyperinflation analysis under perfect foresight requires abandoning the Cagan money demand and adopting a demand for money respecting money essentiality. Theoretical support is brought to inelastic functional forms of money demand and specifically to the double-log schedule.

JEL classification: E31, E41

Keywords: money demand, monetary hyperinflation, inflation tax, money essentiality

---

1. Introduction

Hyperinflationary episodes are characterized by an unstable dynamic process where inflation speeds up, real money balances tend to vanish and the public deficit is financed by issuing money. These processes are monetary hyperinflations[2]. Any model of hyperinflation should be consistent with these former salient stylized facts. Traditional models of hyperinflation view hyperinflation as the result of an inflationary finance policy generating a speeding up inflation process driven by an accelerating rise in the money supply as a means of raising revenues for the government by using an inflation tax. Usual inflationary finance models, such as Evans and Yarrow (1981) or Bruno and Fischer (1990), rely on the famous Cagan (1956) money demand. These models are so influential in the literature that small variations of them can be found in several major textbooks, such as Blanchard and Fischer (1989), Obstfeld and Rogoff (1996), Walsh (2003) or Romer (2006) for instance. They imply the possibility of dual equilibria and the existence of an inflation tax Laffer curve.

However, since the 'surprising monetarist arithmetic' analysed in Buiter (1987) it is known that under perfect foresight these models are fundamentally flawed because they are not capable of generating accelerating inflation. It is now well recognized that all models which generate the high inflation trap defined by Bruno and Fischer (1990) have this fundamental flaw[3]. As most of the large empirical literature on hyperinflation (Petrovic and Mladenovic (2000), Slavova (2003) or Georgoutsos and Kouretas (2004) among recent works) relies on the Cagan model with rational expectations, this failure could cast doubt on several empirical studies. Evans and Yarrow (1981) and Bernholz and Gersbach (1992) already pointed out that the crucial condition for generating hyperinflation is that real money balances should not decrease more than inflation increases with high rates of inflation. The failure of the inflationary finance models of hyperinflation to produce explosive inflation processes under rational expectations or perfect foresight is the stimulus for a significant amount of new literature and some new specifications of this class of models.

These new specifications can be mainly separated in two different approaches depending on the kind of feature included in the basic inflationary finance model to guarantee the former crucial condition. In the first approach, the models include a sufficiently large friction in the adjustment of some nominal variable like expected inflation, money holdings or the exchange rate. Sufficiently slow adaptive expectations, as in Evans and Yarrow (1981) or Bruno and Fischer (1990), learning as in Marcet and Nicolini (2003), a crawling peg rule for the exchange rate as in Bruno (1989), or a sufficiently slow adaptive adjustment on the money market as in Kiguel (1989) can restore the correct running of this class of models. However, even if one can find arguments in favour of the use of adaptive expectations during hyperinflationary episodes, as Bruno and Fischer (1990) or Cukierman (1988) do for instance, it is hard to justify the persistent presence of behaviours involving either systematic forecast mistakes or maladjustments resulting in prohibitive costs for the agents in a hyperinflationary context. In the second approach, assuming that agents respond most likely instantaneously to changes in inflation during hyperinflation the models maintain perfect foresight but abandon Cagan money demand function. Ashworth and Evans (1998) look for empirical support for other functional forms than the Cagan money demand. Vazquez (1998), Gutierrez and Vazquez (2004) or Barbosa, Cunha and Sallum (2006) using analytical approaches resort to first principles in the framework of inflationary finance monetary optimizing models. The model proposed in this paper belongs to this second group.

---

[2] The point of this paper is on monetary hyperinflations and should be distinguished from that of other works such as Brock (1975), Obstfeld and Rogoff (1983), Barbosa and da Cunha (2003) focusing on speculative hyperinflations. Speculative hyperinflations, as defined by Obstfeld and Rogoff (1983), are explosive price-level paths unrelated to monetary growth.

[3] See Evans (1995) for a survey of this literature.

This paper addresses the issue of the replacement of Cagan money demand for the analysis of hyperinflation under perfect foresight. The aim of the paper is to provide theoretical support for alternative functional forms of money demand functions during hyperinflation in a perfect foresight environment. We use an analytical approach based on a perfect foresight optimizing model with money-in-the-utility-function (henceforth called MIUF model) drawing on Brock (1975) model. This model represents a way of capturing the role of money as a medium of exchange. Our precise aim is to characterize agents' preferences that are compatible with explosive monetary hyperinflation. The main contribution of this paper is to show that modelling monetary hyperinflation with perfect foresight is closely linked to the concept of money essentiality as defined by Scheinkman (1980). Explosive monetary hyperinflation is possible under perfect foresight only if money is sufficiently essential to the system. Cagan model can be considered as a special case of the MIUF model but Cagan money demand doesn't comply with the money essentiality requirement and should be abandoned in this framework. Using these results theoretical support is brought to a general class of inflation-inelastic money demand functional forms complying with the money essentiality requirement and especially to the double-log money demand function joining the empirical support brought by Ashworth and Evans (1998).

The paper is organized as follows: section 2 presents the MIUF model and shows that modelling monetary hyperinflation with perfect foresight requires a sufficient level of money essentiality; section 3 relates money essentiality to money demand inelasticity and provides specific theoretical support to the double-log functional form of the money demand during hyperinflation; section 4 summarizes the results.

2. Monetary dynamics of hyperinflation and money essentiality

The optimizing monetary model considered in this paper assumes a continuous time model where the economy consists of a large number of identical infinitely-lived forward looking households endowed with perfect foresight. Population is constant and its size is normalized to unity for convenience. There is no uncertainty. Each household has a non-produced constant endowment $y > 0$ of the non-storable consumption good per unit of time.

In the money-in-the-utility-function model the role of money as a medium of exchange is assumed to be captured by introducing real money balances into the household utility function. The set up draws on Sidrauski (1967) and Brock (1975).

The representative household utility at time 0 is

$$U_0 = \int_0^\infty \left[u(c_t) + v(m_t) \right] e^{-rt} dt . \tag{1}$$

The instantaneous utility function is additive and separable in c_t, the household's consumption at time t, and $m_t = \dfrac{M_t}{P_t}$ his holdings of real monetary balances, M is the nominal stock of money, P is the price level. The functions u and v are increasing in their arguments and strictly concave. r is the constant subjective discount rate, which, following Calvo (1987), is assumed to be equal to the real rate of interest. Financial wealth and the nominal interest rate are, respectively, defined as

$$\omega_t = m_t + b_t ,$$
$$i_t = r + \pi_t ,$$

3

where b_t denotes real per capita government debt, π_t is the inflation rate. The household's budget constraint is

$$\dot{\omega} = y_t - \tau_t + r\omega_t - \left(c_t + i_t m_t\right), \tag{2}$$

where a dot on a variable represents its first derivative with respect to time, and τ_t is a lump-sum tax assumed to be constant. The household's optimization problem leads to the following first-order condition:

$$r + \pi_t = \frac{v'(m_t)}{u'(c)}, \tag{3}$$

where c is time-invariant because the instantaneous rate of time preference is equal to the real rate of interest. Condition (3) requires that at each moment the nominal rate of interest be equal to the marginal rate of substitution of consumption for money. It implicitly defines a demand for money as a function of the nominal interest rate i. The strict concavity of v ensures that m and i are related in a negative fashion. The optimum solution must also obey the following transversality condition:

$$\lim_{t \to \infty}\left[e^{-rt}u'(c)\omega_t\right] = 0. \tag{4}$$

The latter first-order equation (3) and the transversality condition (4) can be re-written, after normalizing the constant value of $u'(c)$ to unity for convenience, as:

$$v'(m_t) = r + \pi_t, \tag{5}$$

$$\lim_{t \to \infty} e^{-rt}\omega_t = 0. \tag{6}$$

In usual inflationary finance models a constant per capita share of government's budget deficit, d, is financed by issuing high-powered money:

$$d = \frac{\dot{M}_t}{P_t} = \dot{m}_t + \pi_t m_t. \tag{7}$$

Substituting the value of π extracted from first-order equation (5) in the latter expression leads to the inflationary finance model dynamics described by the following law of motion for real cash balances where we drop time index t for convenience:

$$\dot{m} = d - \left(v'(m) - r\right)m. \tag{8}$$

The differential equation (8) provides a complete characterization of real per-capita money balances dynamics which will be studied by using the technique of phase diagram on $[0; +\infty[$. The main interesting point here is to examine whether this law of motion for real cash balances is able to produce monetary hyperinflation paths. A monetary hyperinflation path will be observed if the law of motion presents a path leading to a zero level of real cash balances. Therefore, the conditions for this kind of paths should be identified. As the mathematical function representing the law of motion

is continuous (which is true with standard assumptions on *u* and *v*) this kind of paths will be observed as long as

$$\lim_{m \to 0_+} \dot{m} < 0 . \tag{9}$$

The calculation of $\lim_{m \to +\infty} \dot{m}$ will assess the existence of any steady state. However, whatever the number of steady states, we are only interested in the paths starting at the left of the first one when the condition $\lim_{m \to 0_+} \dot{m} < 0$ is met.

At this stage a second highly important point should be made clear. According to Obstfeld and Rogoff (1983) in the context of speculative hyperinflations issue, any path leading to a zero value of real cash balances and crossing eventually the vertical axis at some finite point should be ruled out on grounds that such paths would not be feasible because the real stock of money would eventually become negative. However, we would rather follow the point made by Barbosa and Cunha (2003) who contested the Obstfeld and Rogoff (1983) approach by arguing that on such hyperinflationary paths when the real quantity of money reaches zero hyperinflation would have wiped out the value of money, the opportunity cost of holding money would have become infinite, and the economy would no longer be a monetary economy. Therefore, we follow the point made by Barbosa and Cunha (2003) and consider the monetary hyperinflation paths corresponding to the condition $\lim_{m \to 0_+} \dot{m} < 0$ as perfect foresight competitive equilibrium paths.

Moreover, it's important to stress that these possible hyperinflationary paths are monetary hyperinflations because along these paths the rate of growth of the money supply explodes. Rewriting government budget constraint as

$$\frac{\dot{M}}{M} = \frac{d}{m} ,$$

we see that along these paths of continuously declining *m*, given that $d > 0$, the growth rate of money supply increases continuously.

In this respect, according to the law of motion (8), the possibility of explosive monetary hyperinflation will depend on the condition

$$\lim_{m \to 0_+} \dot{m} = d - \lim_{m \to 0_+} \left[m v'(m) \right] < 0 , \tag{10}$$

which is equivalent to the following condition

$$\lim_{m \to 0_+} \left[m v'(m) \right] > d . \tag{11}$$

The latter condition is basically a condition about a sufficient level of money essentiality. Scheinkman (1980) related the condition $\lim_{m \to 0_+} m v'(m) > 0$ to the essentiality of money i.e. the fact that "money is very necessary to the system". The definition of money essentiality relates to the evolution of inflation tax collected by government when the rate of inflation explodes. Money is considered as essential if the inflation tax collected by the government does not tend to zero when the rate of inflation explodes. From (7) we see that seigniorage obtained by printing money can be

decomposed into two components, the change in the real stock of money and the inflation tax πm which can be written, according to equation (5):

$$\pi m = \left(v'(m) - r \right) m = mv'(m) - rm . \tag{12}$$

Then, when the rate of inflation explodes we have

$$\lim_{m \to 0_+} \pi m = \lim_{m \to 0_+} mv'(m) . \tag{13}$$

Therefore, when $\lim_{m \to 0_+} mv'(m) > 0$ then $\lim_{m \to 0_+} \pi m > 0$ and money is essential. These findings enable us to formulate a first proposition.

Proposition 1: *In a MIUF optimizing monetary framework with additive separable utility function, explosive monetary hyperinflations are possible only if money is sufficiently essential that is if* $\lim_{m \to 0_+} \left[mv'(m) \right] > d$.

Proof: The proof relies on the previous arguments and can be illustrated by the phase diagram depicted on Figure 1. The precise shape of the phase diagram depends on the first and second derivative of $\dot{m}$ with respect to m. Other shapes than that depicted below could be possible. The important point for the analysis conducted here is the condition for $\lim_{m \to 0_+} \dot{m} < 0$. If $\lim_{m \to +\infty} \dot{m} > 0$, the locus $\dot{m}$ will cross the horizontal axis at least once. We consider here a unique unstable steady state m^* but the qualitative analysis for hyperinflationary paths doesn't change in the case of more steady states. All paths originating at the right of $m*$ are hyperdeflationary paths that can be ruled out because violating the transversality condition (6). All paths starting to the left of $m*$ are monetary hyperinflations paths.∎
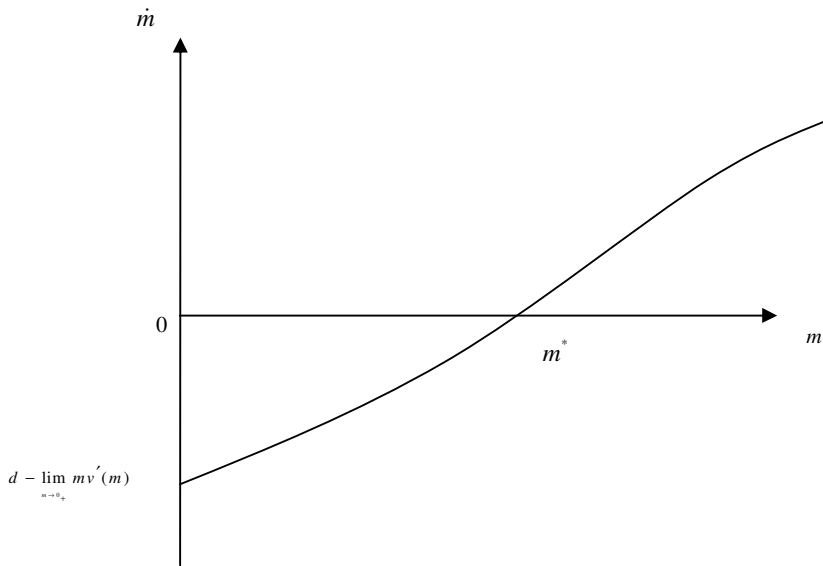

Figure 1: Monetary dynamics when $\lim_{m \to 0_+} mv'(m) > d$

Using a similar MIUF framework with a particular constant-relative-risk-aversion utility function Gutierrez and Vazquez (2004) point out that explosive hyperinflationary dynamics are more likely

when the transaction role of money becomes important. Our results confirm the point made by Gutierrez and Vazquez (2004) by relating, more generally, the possibility of monetary explosive hyperinflations to a sufficient level of money essentiality in the model.

At this stage it is important to stress that Cagan semi-logarithmic money demand schedule doesn't comply with money essentiality requirement. Then, according to Proposition 1, the failure of the Cagan inflationary finance model to produce monetary hyperinflations is not surprising.

Proposition 2: *Cagan money demand does not comply with money essentiality.*

Proof: The Cagan ad-hoc model relying on the Cagan money demand can be considered as a special case of the MIUF model developed here. Since Kingston (1982), it is known that the semi-log schedule is 'integrable'. In the terms of Kingston (1982) it means that the schedule 'can be generated by at least one optimizing framework'. The 'integrability' of Cagan money demand was shown again later by Calvo and Leiderman (1992). Thus, it is known that using a utility function for money services $v(m)$ such as :

$$v(m) = \alpha^{-1}(1 + \gamma + \alpha r - \log m)m \quad \text{for all } 0 < m < e^{\gamma + \alpha r}, \tag{14}$$

in the first-order equation (5) will found the famous semi-logarithmic Cagan money demand ($\log m = \gamma - \alpha\pi$, where γ is a constant and α a positive constant) and the current MIUF model will resume in the inflationary finance Cagan model. However, such a utility function for money services doesn't comply with money essentiality requirement since for the former utility function $\lim_{m \to 0_+} mv'(m) = 0$. Then, it won't allow the modelling of monetary hyperinflation as stated in Proposition 1.■

Modelling monetary hyperinflation under perfect foresight requires assuming money essentiality. This implies abandoning the Cagan money demand for the analysis of monetary hyperinflation in a perfect foresight environment and looking for candidate money demand functions complying with Proposition 1.

3. Money essentiality, money demand inelasticity and monetary hyperinflation

Money essentiality is closely related to the inelasticity of the demand for money with respect to the cost of holding cash balances. We define the function $s(m)$ measuring the cost of money services according to

$$s(m) = mi = m(r + \pi) = mv'(m). \tag{15}$$

The first derivative of $s(m)$ is

$$s'(m) = i\left(1 + \frac{m}{i}\frac{\partial i}{\partial m}\right) = i\left(1 - \frac{1}{|\varepsilon|}\right). \tag{16}$$

where ε represents the elasticity of the money demand with respect to the nominal interest rate. If the money demand is interest-rate inelastic, $|\varepsilon| < 1$, then $s'(m) < 0$.

Since $s(m) \geq 0$ and $s'(m) < 0$ when the money demand is inelastic, it follows that $\lim_{m \to 0_+} s(m) = \lim_{m \to 0_+} mv'(m) > 0$. Thus, when money demand is interest rate-inelastic, money is essential.

Proposition 3: *Any money demand function inelastic with respect to the cost of holding cash balances and such that* $\lim_{m \to 0_+} s(m) = \lim_{m \to 0_+} mv'(m) > d$ *will allow the modelling of monetary hyperinflation under perfect foresight.*

Proof: The proof relies on Proposition 1. More specifically, combining equations (15) and (8) leads to the law of motion describing monetary dynamics

$$\dot{m} = d + rm - mv'(m) = d + rm - s(m).$$

Given that $s'(m) < 0$ when money demand is inelastic with respect to the nominal interest rate it follows that the increasing locus describing $\dot{m}$ in Figure 1 represents the monetary dynamics for an inelastic money demand complying with a sufficient level of money essentiality because in this case we have

$$\frac{\partial \dot{m}}{\partial m} = r - s'(m) > 0. \blacksquare$$

Barbosa et al (2006), in a similar framework, point out the role of the inelasticity of money demand functions with respect to the nominal interest rate for the possibility of explosive inflation path but insist in the need of an increasing government deficit. Our results stress, rather, the role of money essentiality and are established with a constant government deficit without needing an increasing deficit.

Inelastic money demand function complying with a sufficient level of money essentiality can be candidates for replacing the famous Cagan money demand function to model successfully monetary hyperinflation under perfect foresight. Among them we may consider the double-log schedule:

$$\log m = \delta - \beta \log \pi, \qquad 0 < \beta < 1. \qquad (17)$$

This money demand functional form exhibits a constant elasticity lower than one with respect to the inflation rate.

Proposition 4: *The double-log schedule described by (17) is an appropriate candidate functional form to replace Cagan money demand function in the analysis of monetary hyperinflation under perfect foresight.*

Proof: As shown by Kingston (1982), the double-log schedule is 'integrable'. One can easily verify that using a utility function for money services *v(m)* such as

$$v(m) = rm + \frac{\beta e^{\frac{\delta}{\beta}}}{\beta - 1} m^{1 - \frac{1}{\beta}}, \qquad (18)$$

will found the double-log schedule. The money demand function described by the double-log schedule given by (17) complies with Proposition 1 as shown by the following calculation:

$$\lim_{m \to 0_+} mv'(m) = +\infty > d \; .$$

It therefore complies with the sufficient level of money essentiality requirement. Figure 2 represents the monetary dynamics derived from the double-log schedule under perfect foresight. All paths starting at the left of the unique unstable steady state m^* are monetary hyperinflations. The paths starting at the right of the unique steady state can be ruled out because violating the transversality condition (6).■
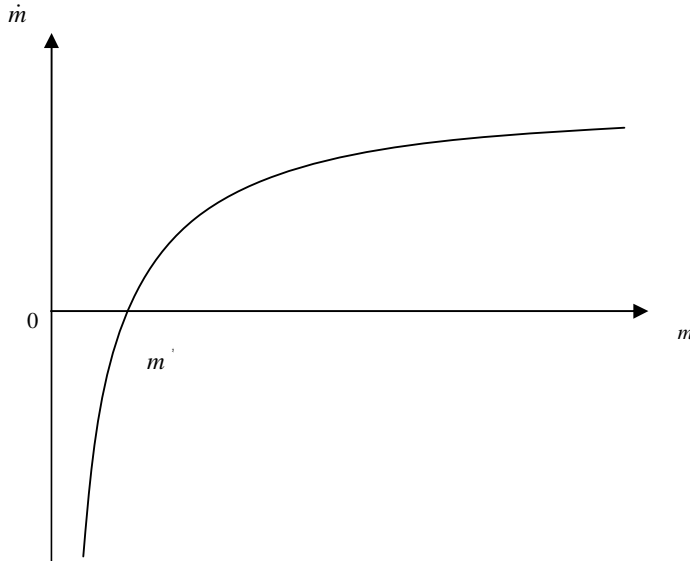

Figure 2: monetary dynamics with the double-log schedule

Proposition 4 provides theoretical support for the use of the double-log schedule for money demand in the modelling of explosive hyperinflation under perfect foresight.

4. Conclusion

This paper provides some new guidelines for investigation of monetary hyperinflation under perfect foresight given the well known failure of Cagan based inflationary finance models to produce explosive hyperinflation. We address the issue of the replacement of the famous Cagan money demand for the analysis of explosive hyperinflation under perfect foresight in traditional inflationary finance models. An analytical approach is used to characterize the agents' preferences which are compatible with monetary hyperinflation. In the context of a MIUF model, we show that the possibility of explosive hyperinflation paths depends on a sufficient level of money essentiality in the sense of Scheinkman (1980) which is conveyed by the agents' preferences. This result emerges without any ad-hoc assumption implying the inclusion of some friction in the adjustment of some nominal variable. Further research should be conducted to assess the robustness of this result to a MIUF model with a general utility function or to alternative ways of modelling the transaction role of money like a cash-in-advance economy.

This sufficient money essentiality requirement should not be surprising. As pointed out by Gutierrez and Vazquez (2004), money becomes more essential for purchasing goods during hyperinflation than during stable periods because extreme inflation dramatically decreases credit

transactions and in general the use of long term contracts[4]. Moreover, a sufficient level of money essentiality is crucial in inflationary finance models of hyperinflation since the government needs the money to be essential to the system in order to get sufficient inflation tax when inflation explodes. Cagan famous demand for money is shown not to comply with the money essentiality requirement explaining the failure of the Cagan inflationary finance model to produce monetary hyperinflations and justifying the issue of its replacement.

Money essentiality is shown to be closely linked to the inelasticity of money demand with respect to the cost of holding cash balances. A particular class of inelastic money demand functions is identified as appropriate candidates to replace the Cagan money demand function in the analysis of explosive hyperinflation in inflationary finance models. In this class of inelastic money demand functions, theoretical support is provided to the double-log schedule. Ashworth and Evans (1998) looking for alternative functional forms for money demand under hyperinflation provide empirical support for the double-log schedule. Therefore, the double-log schedule may be a possible and appropriate candidate functional form to give an alternative to the failure of Cagan based inflationary finance model for the analysis of explosive hyperinflation.

References

Ashworth, J., and L. Evans (1998), «Functional Form of the Demand for Real Balances in Cagan's Hyperinflation», *Applied Economics*, 30, pp. 1617-1623.

Bernholz, P., and H. Gersbach (1992), «The Present Monetary Theory of Advanced Inflation: a Failure? », *Journal of Institutional and Theoretical Economics*, 148 (4), pp. 705-719.

Barbosa, F.H., and A.B. Cunha (2003), «Inflation Tax and Money Essentiality», *Economic Letters*, 78, pp. 187-195.

Barbosa, F.H., A.B. Cunha, and E.M. Sallum (2006), «Competitive Equilibrium Hyperinflation under Rational Expectations», *Economic Theory*, 29, pp. 181-195.

Blanchard, O.J., and S. Fischer (1989), *Lectures on Macroeconomics*, Cambridge, The MIT Press.

Brock, W. (1975), «A Simple Perfect Foresight Monetary Model», *Journal of Monetary Economics*, 1, pp. 133-150.

Bruno, M. (1989), «Econometrics and the Design of Economic Reform», *Econometrica*, 57, 2, pp. 275-306.

Bruno, M., and S. Fischer (1990), «Seigniorage Operating Rules and the High Inflation Trap», *The Quarterly Journal of Economics*, 105, pp. 353-374.

Buiter, W. (1987), «A Fiscal Theory of Hyperdeflations? Some Surprising Monetarist Arithmetic», *Oxford Economic Papers*, 39, pp. 111-118.

Cagan, P. (1956), «The Monetary Dynamics of Hyperinflation», in M. Friedman (Ed), Studies in the Quantity Theory of Money, Chicago, The University of Chicago Press, pp. 25-117.

Calvo, G. (1987), «Balance of Payment Crises in a Cash-in-Advance Economy», *Journal of Money Credit and Banking*, 19, pp. 19-32.

Calvo, G., and L. Leiderman (1992), «Optimal Inflation Tax under Pre-commitment: Theory and Evidence», *American Economic Review*, 82, pp. 174-194.

Casella, A. and J.S. Feinstein (1990), «Economic Exchange during Hyperinflation», *Journal of Political Economy*, 98, pp. 1-27.

Cukierman, A. (1988), «Rapid Inflation: Deliberate Policy or Miscalculation», Carnegie-Rochester Conference Series on Public Policy, K. Brunner et A.H. Meltze (eds.), vol. 27, Amsterdam, North Holland, pp. 11-76.

Evans, J.L. (1995), «The Demand for Money: Hyperinflation or High Inflation Traps», *The Manchester School Supplement*, pp. 40-56.

---

[4]Casella and Feinstein (1990) and Tang and Wang (1993) provide anecdotal and empirical evidence on this specific issue.

Evans, J.L., and G. Yarrow (1981), «Some Implications of Alternative Expectations Hypotheses in the Monetary Analysis of Hyperinflations», *Oxford Economic Papers*, 33, pp. 61-80.

Georgoutsos, D.A., and G.P. Kouretas (2004), «A Multivariate I (2) Cointegration Analysis of German Hyperinflation», *Applied Financial Economics*, 14, pp. 29-41.

Gutierrez, M.J., and J. Vazquez (2004), «Explosive Hyperinflation, Inflation Tax Laffer Curve and Modelling the Use of Money», *Journal of Institutional and Theoretical Economics*, 160, pp. 311-338.

Kiguel, M. (1989), «Budgets Deficits, Stability and the Monetary Dynamics of Hyperinflation», *Journal of Money, Credit and Banking*, 21, pp. 148-157.

Kingston, G.H. (1982), «The Semi-log Portfolio Balance Schedule is Tenuous», *Journal of Monetary Economics*, 9, pp. 389-399.

Marcet, A., and Nicolini J.P. (2003), «Recurrent Hyperinflation and Learning», *American Economic Review*, 93, pp. 1476-1498.

Obstfeld, M., and K. Rogoff (1983), «Speculative Hyperinflations in Maximizing Models: Can We Rule Them Out», *Journal of Political Economy*, 91, pp. 675-687.

Obstfeld, M., and K. Rogoff (1996), *Foundations of International Macroeconomics*, Cambridge, MIT Press

Petrovic, P., and Z. Mladenovic (2000), «Money Demand and Exchange Rate Determination under Hyperinflation: Conceptual Issues and Evidence from Yugoslavia», *Journal of Money, Credit and Banking*, 32, pp. 785-806.

Romer, D. (2006), *Advanced Macroeconomics*, Third Edition, New York, Mc Graw Hill.

Scheinkman, J. (1980), «Discussion», in Kareken J. and Wallace N. (eds.), Models of Monetary Economies, Minneapolis, Federal Reserve Bank of Minneapolis, pp. 91-96.

Sidrauski, M. (1967), «Rational Choice and Patterns of Growth in a Monetary Economy», *American Economic Review Papers and Proceedings*, 57, pp. 534-544.

Slavova, S. (2003), «Money Demand during Hyperinflation and Stabilization: Bulgaria, 1991-2000», *Applied Economics*, 35, pp.1303-1316.

Tang, D., and P. Wang (1993), «On Relative Price Variability and Hyperinflation», *Economics Letters*, 42, pp. 209-214.

Vazquez, J. (1998), «How High Can Inflation Get During Hyperinflation? A Transaction Cost Demand for Money Approach», *European Journal of Political Economy*, 14, pp. 433-451.

Walsh, C.E. (2003), *Monetary Theory and Policy*, Second Edition, Cambridge, The MIT Press.