Bureau
d'économie
théorique
et appliquée
(BETA)
UMR 7522

Documents de travail

« The monetary model of hyperinflation and the adaptive expectations : limits of the association and model validity »

Auteur

Alexandre SOKIC

Document de Travail n° 2007–**09**

Février 2007

Faculté des sciences économiques et de gestion
Pôle européen de gestion et d'économie (PEGE)
61 avenue de la Forêt Noire
F-67085 Strasbourg Cedex

Secétariat du BETA
Christine DEMANGE
Tél. : (33) 03 90 24 20 69
Fax : (33) 03 90 24 20 70
demange@cournot.u–strasbg.fr
http://cournot.u-strasbg.fr/beta

CNRS CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE
NANCY 2 UNIVERSITE
ulp UNIVERSITÉ LOUIS PASTEUR STRASBOURG

The monetary model of hyperinflation and the adaptive expectations: limits of the association and model validity

Alexandre Sokic
Ecole Supérieure du Commerce Extérieur
Pôle Universitaire Léonard de Vinci
92916 Paris La Défense
Email: alexandre.sokic@devinci.fr

Abstract:
This article highlights the strict association met in the literature between the adaptive expectations assumption and the correct running of the monetary model of hyperinflation. A complete resolution of the model is carried out under the adaptive expectations hypothesis. It is shown that the assumption of adaptive expectations is not sufficient to ensure the validity of the model for the explanation of monetary hyperinflation. This result raises the question of the field of validity of this model already posed by the introduction of rational expectations. The possibility of development of self-generating hyperinflationary bubbles strengthens the relevance of this question.

Key words*:* hyperinflation, seigniorage, hyperinflationary bubbles

JEL classification: E31

1 Introduction

Hyperinflation is an unstable dynamic process where inflation speeds up. The modelling of hyperinflation started with the seminal work of Cagan (1956) within the New Quantity Theory of Money. Cagan defined hyperinflation as a speeding up inflation process where inflation rates exceed 50% monthly. He considered hyperinflationary episodes as purely monetary phenomena that can be studied by focusing only on the money market. This approach implies that the model deals with monetary hyperinflation where both inflation and money growth rates accelerate and explode. Cagan proposed the explanation of monetary hyperinflation as the result of an excessive real fiscal deficit financed through money creation or seigniorage revenues. Nevertheless, this first modelling couldn't produce monetary hyperinflation paths. Later, Evans and Yarrow (1981) and Bruno and Fischer (1987) completed the model by modelling the money supply process. However, since the articles of Buiter (1987) and Kiguel (1989) it is known that in some of its configurations the model is unable to support the standard explanation of hyperinflation, especially under the assumption of rational expectations.

The possible failure of the monetary model of hyperinflation is an important issue. The model provides the theoretical framework for stabilization policies and for many empirical investigations on hyperinflationary experiences. Empirical investigations relying on the theoretical framework of the monetary model of hyperinflation have been being published on a regular basis. Recently, there were Slavova (2003) on the Bulgarian experience of 1996-

1997, Choudhry (1998) on the last Russian experience during the Nineties, Petrovic and Vujosevic (1996), Bogetic *et al* (1999) or Petrovic and Mladenovic (2000) on the Serbian experience during the decade 90, or Georgoutsos and Kouretas (2004) on the famous German experience in the early Twenties. Then, the possible failure of this model implies that empirical studies relying on the monetary model of hyperinflation should be very careful which configuration of this model they deal with. This issue is of great importance since the majority of empirical studies rely on a rational expectations version of the model.

The monetary model of hyperinflation has a relatively simple structure and a rich set of solutions. However, the wealth of possible solutions of this model isn't an asset for it. On the contrary, it results in restricting the field of validity of the model for the analysis of hyperinflation. The introduction of rational expectations into the model has often been at the origin of these validity problems as shown in Buiter (1987) or Kiguel (1989). Therefore, it comes out that the monetary model of hyperinflation is usually associated in the literature with the adaptive expectations assumption. This arises since the study of this configuration allows several authors like Bruno and Fischer (1987, 1990), for instance, to support the highlighting and the explanation of monetary hyperinflation. In the same spirit, Evans (1995) stressed that the assumption of adaptive expectations is a sufficient condition to ensure the validity of the model.

The present article aims at highlighting the strict association met in the literature between the assumption of adaptive expectations and the correct running of the monetary model of hyperinflation. With that aim, a complete resolution of the model is carried out under the assumption of adaptive expectations. This completes the analyses made in Bruno and Fischer (1987, 1990), taken up again in Blanchard and Fischer (1990) and still recently in Walsh (2003). The main purpose of the paper is to show that the validity of the model doesn't depend on the way in which inflationary expectations are formed. The crucial issue is the presence of a sufficiently large adjustment lag of real cash balances to actual inflation rates.

The analysis of the dynamics of the model carried out in the second section of the article leads to the distinction of two configurations under the adaptive expectations hypothesis. The first configuration, which is thoroughly analysed in the third section, corresponds to a relatively slow adjustment of inflationary expectations. The second configuration, not explored in the literature, corresponds to a relatively fast adjustment of inflationary expectations. The fourth section carries out the thorough treatment of it. The results obtained in the fourth section justify a deeper investigation of this case from the point of view of economic policy theory in fifth section. Section 6 concludes the article.

2 The model

The demand for real cash balances is the fundamental equation of the model. During hyperinflations real variables such as the real rate of interest and real output may be reasonably treated as constant since all the action involves money and prices. Therefore, since the demand for real cash balances depends on the nominal interest rate, it will depend only on the expected rate of inflation. Following Cagan (1956), we use a semi-logarithmic demand for real cash balances, known as Cagan demand for money. Then, expressed in real terms M_r^d, the demand for real cash balances can be written in the following way:

$$M_{r\,t}^{d} = e^{\gamma - \alpha \pi_t^e} \quad . \tag{1}$$

In this equation π^e represents the expected rate of inflation, α and γ are parameters. The role of constant γ is to describe the influence of real income and real interest rate, which are supposed to be constant in this analysis. The positive constant α, the semi-elasticity of money demand, describes the decreasing demand for real cash balances with respect to expected rate of inflation. In order to make more apparent the semi-logarithmic shape of the Cagan demand for money, equation (1) can be re-written as:

$$\log\left(M_{r\,t}^{d}\right) = \gamma - \alpha\pi_t^e . \qquad (1)'$$

Expected inflation is assumed to adjust adaptively to actual inflation:

$$\dot{\pi}_t^e = \beta \cdot (\pi_t - \pi_t^e) \ , \beta > 0, \qquad (2)$$

where π is the actual rate of inflation. We follow Cagan in using continuous time so that a variable with an upper point represents its derivative with respect to time. The parameter β, called « expectation coefficient » by Cagan, captures the speed of adjustment of expectations to observed actual inflation. A low β implies that expectations respond slowly to inflation forecast errors. A high β implies that expectations respond quickly to inflation forecast errors. At the limit where β tends to an infinite value we retrieve the perfect foresight case, which is in this determinist model equivalent to rational expectations hypothesis.

Concerning the adjustment between real cash balances and desired real cash balances we assume, like Cagan, instant clearing of the money market. Therefore, we have always equality between the level of holdings of real cash balances, M/P, and the level of desired real cash balances (where *M* is the nominal stock of money and *P* the general price level). Formally, we can write:

$$\left(\frac{M}{P}\right)_t = (M_r^d)_t . \qquad (3)$$

The model description is completed by stating the process explaining the money supply. The real fiscal deficit *d* is fully financed through money creation. Therefore, the process of money creation is driven by the following government budget constraint:

$$d_t = \frac{\dot{M}_t}{P_t} \qquad . \qquad (4)$$

As money creation from public authorities implies a transfer of real resources from the private sector to the government, seigniorage revenues can be interpreted as the outcome of a particular tax, the inflation tax. As long as the money issued by the public authorities is desired and used by private agents, the latter won't escape this inflation tax.
The later four equations make the monetary model of hyperinflation. In order to simplify the notations we omit, from there on, to write the index of time *t* to all variables.

From equation (4), the government budget constraint can be restated as follows:

$$d = \frac{\dot{M}}{P} = \frac{\dot{M}}{M} \cdot \frac{M}{P} \quad . \tag{5}$$

Following equation (3) describing the instant clearing of money market and according to the semi-logarithmic form of the demand for real cash balances given by (1), the government budget constraint can be re-written as:

$$d = \theta \cdot e^{\gamma - \alpha \pi^e} \quad , \tag{6}$$

where θ is the growth rate of the nominal stock of money. The constraint (6) can also be written in the following way after isolating the expected rate of inflation:

$$\pi^e = \frac{1}{\alpha} (\log \theta + \gamma - \log d) \quad . \tag{7}$$

The latter expression of the government budget constraint represents the equation of a curve *IS* in the framework (θ, π^e), named "iso-seigniorage curve". The curve *IS* derived from (7) shows, for each rate of money growth, the expected rate of inflation needed to generate the required seigniorage revenues given by *d*. The iso-seigniorage curve *IS* represents the path followed by the economy. According to the logarithmic shape of equation (7), the curve *IS* is an increasing curve with a decreasing slope. Curve *IS* intersects the horizontal axis at $\theta = de^{-\gamma}$.

Further understanding of the model requires the specification of the dynamics of the model. By differentiating equation (3) with respect to time we obtain:

$$\theta - \pi = -\alpha \dot{\pi}^e \quad . \tag{8}$$

Introducing the value of π extracted from (8) into equation (2) gives:

$$\dot{\pi}^e = \frac{\beta}{1 - \alpha\beta} \left(\theta - \pi^e \right) \quad . \tag{9}$$

This latter equation shows the dynamic properties of the economy in the framework (θ, π^e). In a steady-state equilibrium where the stock of real cash balances is constant we have:

$$\pi^e = \theta = \pi \quad , \tag{10}$$

At this stage any further investigation of the dynamics of the model requires the distinction of two cases:

- Case $1 - \alpha\beta > 0$ or $\beta < \alpha^{-1}$, corresponding to the case where expected inflation adjusts relatively slowly to actual inflation. This is the case usually presented and treated in the literature.

- Case $1 - \alpha\beta < 0$ or $\beta > \alpha^{-1}$, corresponding, on the contrary of the previous case, to a case where expected inflation responds relatively quickly to inflation forecast errors. This

case has not been explored in the literature. The treatment of this configuration is the focus of this article.

3 Adaptive expectations and hyperinflation

In this section we examine the traditional version of the model corresponding to a relatively slow adjustment of expected inflation to actual inflation. This is the configuration generally presented in the literature as in Walsh (2003). Focusing on the case $0 < \beta < \alpha^{-1}$ shows that the model dynamics are described by:

$$\left.\begin{array}{ll} \dot{\pi}^e > 0 & \text{if} \quad \theta > \pi^e \quad , \\ \dot{\pi}^e < 0 & \text{if} \quad \theta < \pi^e \quad . \end{array}\right\} \tag{11}$$

The intersection of the 45° line with the curve *IS* determines, in the framework (θ, π^e), the steady-state equilibrium points of the economy. The existence of steady-state equilibria depends of the size of the real fiscal deficit *d*. To see this, one should carry out the following analysis. In the framework (θ, π^e) the steady-state equilibrium of the economy occurs when $\theta = \pi^e$, that means, according to (7), when:

$$\theta = \frac{1}{\alpha}\left(\log\theta + \gamma - \log d\right) . \tag{12}$$

Therefore, determining the steady-state equilibrium requires solving equation (12). To solve equation (12), we build the following function $\Delta(\theta)$:

$$\Delta(\theta) = \frac{1}{\alpha}\left(\log\theta + \gamma - \log d\right) - \theta \quad , \tag{13}$$

with the aim to determine the number of solutions of $\Delta(\theta) = 0$ representing the number of steady-state equilibria. Function $\Delta(\theta)$ is defined on $]0\,;+\infty[$ and its limits at boundaries are respectively -∞ and -∞. Calculating the first derivative of $\Delta(\theta)$, $\Delta'(\theta)$, gives:

$$\Delta'(\theta) = \frac{1-\alpha\theta}{\alpha\theta} \qquad . \tag{14}$$

Then, the variations of $\Delta(\theta)$ are given by:

$$\Delta'(\theta)\begin{cases} > \\ = 0 \\ < \end{cases} \quad \text{according to} \quad \theta\begin{cases} < \\ = \alpha^{-1} \\ > \end{cases} \qquad . \tag{15}$$

According to the behaviour of function $\Delta(\theta)$, it appears that the existence of solutions to $\Delta(\theta) = 0$ will depend on the value of $\Delta(\alpha^{-1})$ which is given by:

$$\Delta\left(\alpha^{-1}\right) = \frac{1}{\alpha}\left(\gamma - 1 - \log(\alpha d)\right) . \tag{16}$$

If the value of $\Delta(\alpha^{-1})$ is strictly positive, which is the case when $d < \frac{e^{\gamma-1}}{\alpha} = d^*$, equation $\Delta(\theta) = 0$ has two solutions meaning that there are two distinct steady-state equilibria. For a zero value of $\Delta(\alpha^{-1})$, that is for $d=d^*$, there is a single steady-state equilibrium. If the value of $\Delta(\alpha^{-1})$ is strictly negative, that is when fiscal deficit exceeds d^*, there isn't any steady-state equilibrium for the economy.

These results come from the existence of a Laffer curve for the steady state seigniorage revenues. In the case of the Cagan demand for money, the curve representing seigniorage revenues is a bell-shaped curve. That's why it is called a "Laffer curve" for the seigniorage revenues. Therefore, there is a maximal level of real deficit, $\bar{d}$, consistent with a stationary inflation rate, on one hand, and the possibility for the government to finance the same real budget deficit with two different stationary inflation rates, one called "low" and the other "high", as long as the real budget deficit remains lower than $\bar{d}$, on the other hand. For the economy it means that there is the possibility of two different steady-state equilibria, one of "low inflation" and the other of "high inflation". There is duality of steady-state equilibrium as long as the budget deficit remains lower than $\bar{d}$.

Assessing $\bar{d}$ can be done in the following way. Calling *R* the steady-state amount of seigniorage revenues, the value of $\bar{d}$ is the maximal value of *R*. Using (6) and (10) this value is given by:

$$\bar{d} = \max_{\pi}\{R(\pi)\} = R^* = \max_{\pi}\left\{\pi \cdot e^{\gamma-\alpha\pi}\right\} = \frac{1}{\alpha} e^{\gamma-1} \quad , \tag{17}$$

and is exactly the value d^* showed previously: $\bar{d} = d^*$. The value of the stationary inflation rate corresponding to this maximum of seigniorage revenues is then:

$$\pi^* = \arg\max_{\pi}\left\{\pi e^{\gamma-\alpha\pi}\right\} = \frac{1}{\alpha} \quad . \tag{18}$$

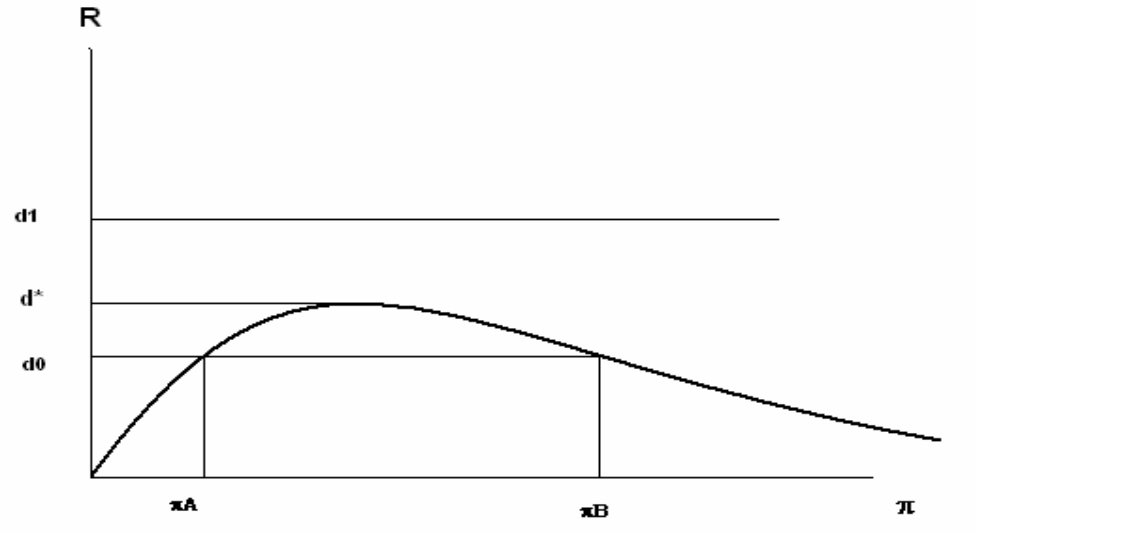

Figure 1: Laffer curve for the steady state seigniorage revenues

Figure 1 shows the "Laffer curve" for the stationary seigniorage revenues. The issue of duality of the steady-state equilibrium clearly appears and so does the issue of financing a real budget deficit higher than d^* like d_1 for instance. As can be seen on figure 1, there isn't any possibility to finance such a higher deficit with a stationary inflation rate. Therefore, this leaves the place for a non stationary way.

The iso-seigniorage curves IS_o and IS_1 represented in figure 2 correspond, respectively, to the budget deficits d_o and d_1 such that:

$$d_0 < d^* < d_1 \quad . \tag{19}$$

The intersection of the 45° line with the curve IS_o determines two steady-state equilibria, points A and B. The point B, the high inflation steady-state equilibrium, is unstable whereas A, the low inflation equilibrium, is locally stable. The public authorities are able to finance their real budget deficit d_o with two stationary inflation rates π_A and π_B. If the budget deficit is d_1 there isn't any steady-state equilibrium because the seigniorage revenues that can be reached with a stationary inflation rate are below the government needs. Financing this budget deficit will put the economy on a non stationary path. Figure 2 illustrates this point by showing the path followed by the economy on the curve IS_1 where inflation and money growth rates escalate and explode.

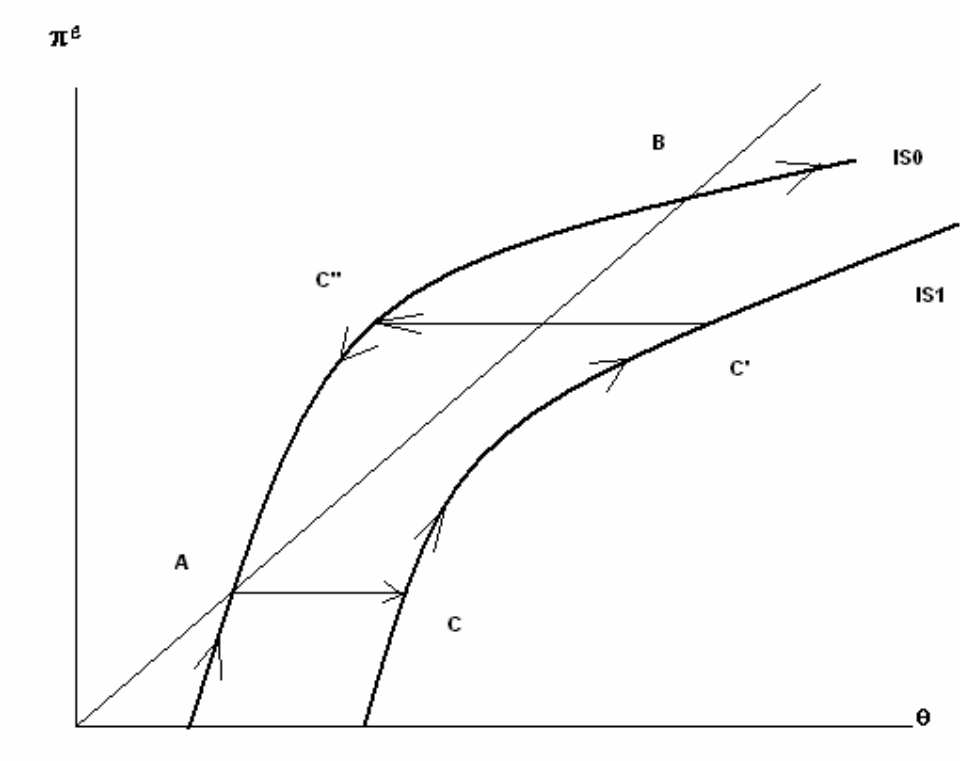

Figure 2: Monetary hyperinflation dynamics

Consider the case of an economy in steady-state equilibrium A on figure 2. At this equilibrium point the government succeeds to finance its real budget deficit d_o through

seigniorage revenues with a constant inflation rate of π_A. At point A actual and expected inflation rates and nominal stock of money growth rate are all equal:

$$\pi_A = \theta_A \quad . \tag{20}$$

Suppose that the budget deficit is increased to the level of d_1. The government needs a higher level of seigniorage revenues. Since the demand for real money balances depends on expected inflation, and because the adjustment process does not allow the expected inflation rate to jump immediately, the higher deficit can be financed by an increase in the rate of money growth. In terms of figure 2, since the expected inflation rate remains at its level immediately after the increase of the deficit, the higher monetary growth makes the economy jump from point A to point C on the new iso-seigniorage curve IS_1 associated with the higher deficit.

An accelerating money supply growth enables, at this first stage, the public authorities to generate the required amount of seigniorage revenues. Since the level of desired real cash balances has not changed yet, the sudden rise of the nominal stock of money implies, through the adjustment of real cash balances holdings to its desired level, an increase in actual inflation rate in the economy (this doesn't appear directly in figure 2 since the framework is (θ, π^e)).

In a second stage, as expected inflation adjusts gradually to higher actual inflation, demand for real cash balances starts to decline. This decline of real cash balances implies decreasing seigniorage revenues. Budget balance requires that the government replies with a new increase of money growth rate. The outcome is a new rise of inflation rate and the economy begins its evolution from point C on IS_1 towards "north-east" direction as shown in figure 2.

The accelerating process of money growth and expected inflation rates begins without having an end. Following the rise of money growth rate and the resulting rise of inflation rate, the government succeeds in financing its higher budget deficit because expected inflation adjust to actual inflation with a certain lag. During that lag the level of real cash balances will be higher than that that should prevail if actual inflation would have been correctly expected. As expected inflation adjusts to actual inflation, real cash balances decrease, then reducing seigniorage revenues. Budget balance requires the government to proceed with an accelerating money growth. Seigniorage revenues can be restored but only during the lag needed for expected inflation to adjust to actual inflation. The smaller is coefficient β the longer will be this lag.

By starting this process of accelerating money growth and inflation rates leading to monetary hyperinflation, public authorities take advantage from the imperfection of expected inflation adjustment. By misleading private agents systematically on their inflation forecasts, the government benefits from a higher level of seigniorage that should prevail otherwise. Public authorities can then benefit from a higher level of seigniorage than the level d^* by triggering monetary hyperinflation.

Concerning the design of a stabilisation program, suppose that following a budgetary crisis the economy experiences monetary hyperinflation and that the decision of stabilisation happens when the economy has reached point C' in figure 2. The aim of the government is to make the economy return on its initial steady state equilibrium A. Therefore, real budget deficit should be reduced to level d_o.

If government succeeds to reduce its deficit from d_1 to d_0 the economy will jump from C' to C" on IS_o. The escalating process of inflation and money growth rates is immediately interrupted. Following the expected inflation rate reached at point C' and the associated level of real cash balances, the reduction of seigniorage needs from d_1 to d_0 allows the reduction of the money growth rate from $\theta_{C'}$ to $\theta_{C''}$. This implies an equivalent reduction of actual inflation rate. As expected inflation adjusts gradually to this lower actual inflation, a second stage of decrease of money growth and inflation can begin.

As the reduction of expected inflation implies a rise in real cash balances, it allows the government to slowdown the growth of the nominal money stock. In terms of figure 2, this process is illustrated by the evolution of the economy from point C" to point A. The slowdown of monetary growth implies the immediate slowdown of inflation and the lagged slowdown of expected inflation. This process goes on till the economy has reached its previous steady-state equilibrium at A where money growth rate, actual and expected inflation rates are all equal and remain constant.

4 Adaptive expectations and model failure

The case not explored in the literature corresponds to a relatively fast adjustment of expected inflation to actual inflation. The case $\beta > \alpha^{-1}$ determines the following model dynamics:

$$\left.\begin{array}{lll} \dot{\pi}^e > 0 & \text{if} & \theta < \pi^e \quad , \\ \dot{\pi}^e < 0 & \text{if} & \theta > \pi^e \quad . \end{array}\right\} \tag{21}$$

The framework is the same as previously but dynamics are opposite. The curves IS'_o and IS'_1, represented in figure 3, are iso-seigniorage curves associated, respectively, with government budget deficits d_o and d_1 ($d_o<d^*<d_1$).

The same kinds of steady-state equilibria can be shown as those on figure 2. However, their dynamic properties are reverse: B', the high inflation equilibrium is locally stable, whereas A', the low inflation equilibrium, is unstable. In the literature, these properties are known as the "high inflation trap" issue. Confronted with the possibility to finance the same budget deficit with two different inflation rates the "high inflation trap" refers to the fact that the high inflation equilibrium is stable.

Suppose that initially the economy is at point B' experiencing the high inflation trap. If the budget deficit is increased to level d_1, the government needs for seigniorage revenues exceed the maximum level of seigniorage at steady-state. Therefore, budget balance will be reached in a non stationary way.

The rise of budget deficit to d_1 implies, in terms of figure 3, the jump of the economy from B' to D on IS'_1. Since expected inflation adjust adaptively, π^e remains, at a first stage, constant and the rise of money growth rate respond to the higher budget deficit.

From point D dynamic forces lead the economy to move down in the "south-west" direction on iso-seigniorage curve IS'_1. Money growth and expected inflation rates start to decline in a

process of continuous decrease of inflation. Buiter (1987) described such a process with the term "hyperdeflation" when he observed it within a similar framework under rational expectations. The operating mechanism is the same in this case as that described by Buiter (1987). In the case of the high inflation trap, the higher need of seigniorage requires a decrease of the inflation rate: this represents the "counter-intuitive" comparative static properties of the high inflation steady state equilibrium. The operating mechanism relies on a higher than unity elasticity of demand for money with respect to money growth rate. The process of continuous reductions of money growth and inflation rates allows the government to benefit from higher than d^* seigniorage revenues relying on this high elasticity of demand for real cash balances with respect to expected inflation. "Hyperdeflation" is the outcome of this process.

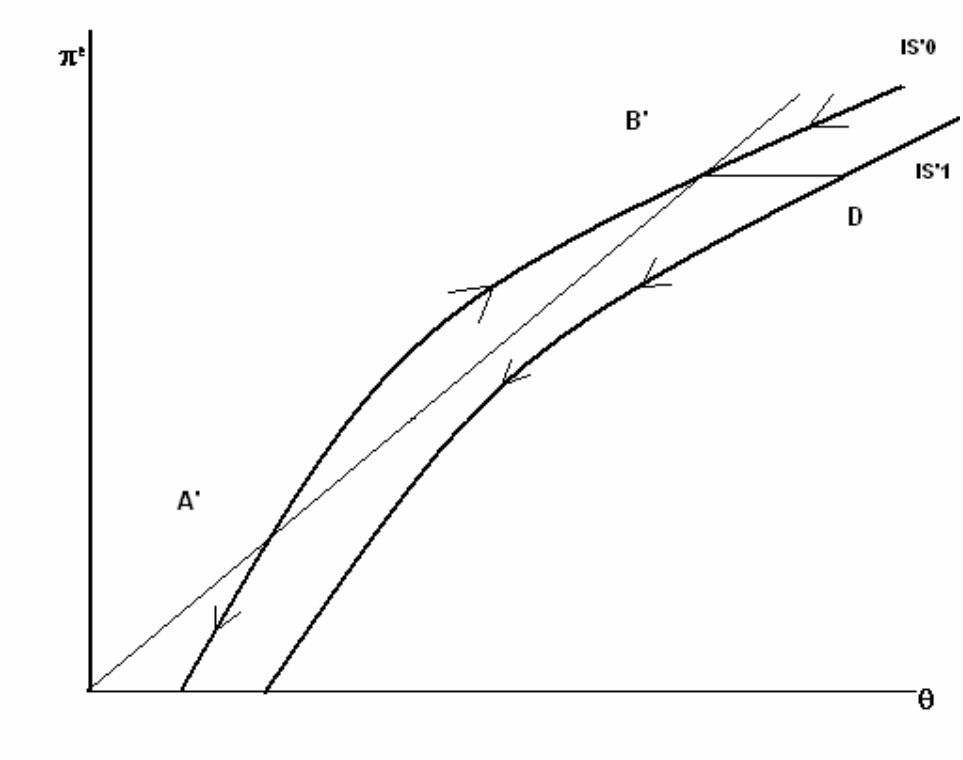

Figure 3: model failure

Nevertheless, it should be stressed that interpreting the triggering and development of this "hyperdeflation" is difficult because of the link between the initial required increase in money growth rate and the following triggering of "hyperdeflation". It is quite easy to understand the initial rise of money growth rate, but it is very difficult to explain the fact that this increase should be followed by a decline of expected inflation rate. That's why Bruno and Fischer (1987, 1990) wrote, about the "counter-intuitive" comparative static properties of the high inflation equilibrium, the following words:

> « *There is no very good explanation for the initial fall in the inflation rate. Given that the economy is on the wrong side of the Laffer curve, a decline in the inflation rate is needed to generate more revenue when the deficit rises.* »

In Blanchard and Fischer (1989) it is possible to find the same kind of trouble when the authors present the monetary model of hyperinflation. Using the work of Bruno and Fischer

(1987, 1990) the authors question the plausibility of adaptive expectations (Blanchard and Fischer (1989, note 39, page 209)). Since the rational expectations hypothesis leads to the same kind of result this remark isn't consistent.

Moreover, it isn't possible to use the explanation suggested by Evans and Yarrow (1981) under rational expectations which states that following the rise of real cash balances due to the initial acceleration of money growth, instant clearing on the money market requires a decline of expected inflation rate. Under adaptive expectations scheme no independent motion of expectations can't happen. Therefore, this "portfolio" approach is not working. Despite this difficulty to explain the start of this operating process, there is no place for any monetary hyperinflation in this case.

The impossibility of any monetary hyperinflation within this case of the model raises the question of the failure of the model in its ability to analyse hyperinflation. A better understanding of this problem requires looking at the reasons for the disappearance of hyperinflation.

We have shown that the triggering and development of hyperinflation are the means used by the government to take profit from the lag of expected inflation to actual inflation. The escalation of money growth and inflation rates allow to systematically mislead the agents on the actual values of inflation rates implying a continuous over-evaluation of the real cash balances level. The public authorities take benefit from the lag of adjustment of real cash balances to their level which should prevail if inflation would be correctly perceived.

The case being analysed here ($\alpha\beta > 1$) corresponds to a relatively fast adjustment of expected inflation to actual inflation. The corresponding lag during that the government is able to mislead the agents on the actual inflation rates is relatively short and in any case not sufficient to be exploited. That's why there is no place for monetary hyperinflation in this configuration.

This configuration ($\alpha\beta > 1$) presents the same dynamic properties as that studied by Buiter (1987) under rational expectations. It should be noticed that the rational expectations hypothesis is equivalent to the perfect foresight hypothesis in a determinist environment. Under the latter hypothesis there isn't any lag of real cash balances. Moreover, it is easy to verify that the case of perfect foresight is mathematically equivalent to the case of adaptive expectations with an infinite expectation coefficient. Re-writing equation (2) in the following way:

$$\frac{1}{\beta}\dot{\pi}^e = \pi - \pi^e \quad , \quad \beta > 0 \quad , \tag{22}$$

and considering an infinite value for the expectation coefficient β, equation (22) becomes:

$$0 = \pi - \pi^e \quad , \tag{23}$$

which is exactly the expression of perfect foresight:

$$\pi = \pi^e \quad . \tag{24}$$

Since the coefficient β measures the speed of adjustment of expected inflation to actual inflation, the perfect foresight hypothesis is, from a mathematical point of view, equivalent to the hypothesis of adaptive expectations without lag.

The analysis carried out in this section shows that the way of forecasting inflation, either adaptive or rational, is not the main factor responsible for the failure or the validity of the monetary model of hyperinflation. We clearly showed that assuming adaptive expectations is not sufficient to obtain hyperinflation in this model. This result is important not only for the understanding of the model, but also to dissipate the misunderstanding present in the literature. Evans (1995, page 47) writes, about the failure of the monetary model of hyperinflation, the following words:

> « [...] *replacing rational expectations with the assumption of adaptive expectations is sufficient to obtain the desired property in the model* [...] »

The current section has clearly shown that it is absolutely not the case. Beyond the specification of the adaptive expectations rule, the main factor for obtaining hyperinflation in this model is the lag of real cash balances caused by the latter. Then, when Blanchard and Fischer (1989, page 201) state that « *quite crucial to the results is the way in which expectations are formed* » we understand now that this statement should be much more precise. The way in which expectations are formed is important to obtain monetary hyperinflation in the model, but only because of the sufficient lag for real cash balances it may cause.

5 Model failure and public budget balance

The configuration $\alpha\beta > 1$ can't highlight nor explain any monetary hyperinflation as it was the case in the configuration $\alpha\beta < 1$. The monetary model of hyperinflation is simple but rich in solutions. We continue the analysis of the configuration $\alpha\beta > 1$ by considering the issue of stabilisation policy. The aim is to assess whether the model failure highlighted in that configuration has any consequences in the field of stabilisation policy theory affecting possibly the effectiveness of stabilisation policy.

We take the case previously studied where the economy is on curve IS'_1 following the rise of real budget deficit to an excessive level (see figure 4). On this curve the economy is experiencing a process of continuous decline of inflation rates. We called this process "hyperdeflation" following Buiter (1987). The question is whether the public authorities may be able to put back the economy on a convergent path.

Assume that the decision to stabilise the economy takes place at the precise moment when economy reaches point D' in figure 4. The rise of budget deficit from d_0 to d_1 being the cause of the evolution of the economy on the path IS'_1, public authorities may consider to reduce the deficit to its previous level d_0. Such a measure of public deficit reduction allows the economy to return on path IS'_0 by jumping from point D' to point E. At point E the economy is on a convergent path leading progressively to the high inflation steady-state equilibrium B'.

Stabilisation policy doesn't loose its effectiveness to put the economy on a path converging to the steady-state equilibrium. However, this result is quite different if one considers a zero budget deficit policy. Assume that rather than reducing the deficit from d_1 to d_0 public

authorities decide to reduce the budget deficit to zero. From the expression of the government budget constraint given by equation (6), it follows that a zero deficit implies:

$$\theta = 0 \tag{25}$$

In the framework $\left(\theta, \pi^e\right)$, this budget constraint is represented by the vertical axis. The dynamics of the configuration $\alpha\beta > 1$ remain determined by (21).

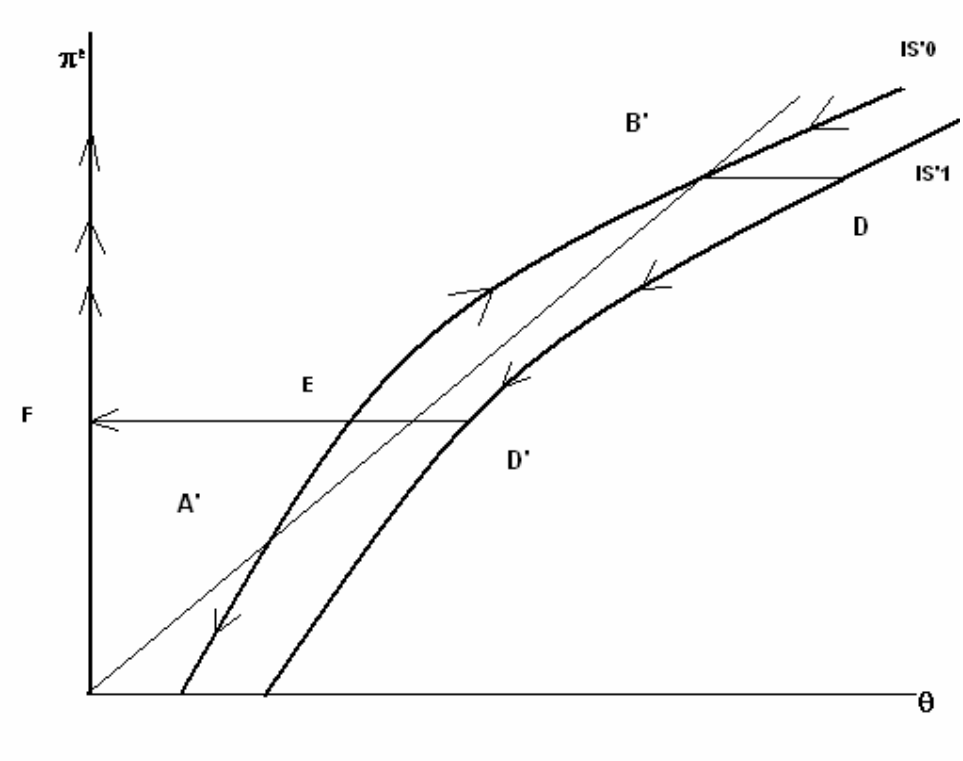

Figure 4: budget balance and hyperinflationary bubbles

Consider that when reaching point D' in curve *IS'*$_1$ on figure 4 the government implements a stabilisation policy to reduce the deficit to zero. Such a policy implies the jump of the economy from point D' to point F. From (21) the dynamic forces operating on the positive part of the vertical axis, and at point F in particular, are given by:

$$\dot{\pi}^e > 0 \quad . \tag{26}$$

The consequence of this drastic policy is the triggering of a process of accelerating inflation. The triggering and development of this process happens with a constant nominal stock of money according to (25). The path followed by the economy is a hyperinflationary bubble. The circumstances around the triggering of the explosive bubble after a period of decreasing inflation are unclear.

Registering the shift of inflation evolution, the inflation rates expectations adjust adaptively but quite quickly to the new trend of accelerating inflation. Assuming a coefficient α quite large (consistent with $\alpha\beta > 1$), meaning that the demand for real cash balances is very elastic, the increase of expected inflation rates implies a huge reduction of desired real cash balances.

As the nominal stock of money is unchanged, this leads to a large excess of real cash balances holdings compared to the desired level, implying a big increase in the general price level. This leads to a higher rate of inflation. The process goes on and keeps accelerating according to the same scheme. The process of general price level increase is amplified from one stage to another by joint action of expected inflation rates adjusting quickly to actual inflation rates and high elasticity of the demand for money.

The evolution of the economy along a path of hyperinflationary bubble raises the question of the design of a possible stabilisation program according to the facts that public budget is balanced and the nominal stock of money is constant. The proposal made within this configuration seems as counter-intuitive as is the triggering of the price level bubble. If the economy is moving, from point F in figure 4, on the hyperinflationary bubble path, any policy aiming at restoring the real deficit d_0 will put back the economy on a path converging to the high inflation steady-state equilibrium. By using paradoxical measures the government will succeed to stop the development of a paradoxical process in a model designed to explain monetary hyperinflation.

It is necessary to stress that the kind of hyperinflationary bubbles highlighted in this configuration isn't any rational bubbles since they have been produced under the adaptive expectations hypothesis. The kind of explosive bubbles produced in this configuration is the same one as that Cagan (1956) noticed the possibility for in its seminal article. Nevertheless, it should be reminded that the work initially developed by Cagan didn't model the endogenous money supply. Cagan considered the possibility of such explosive bubbles paths as the illustration of the capacity of his model to highlight accelerating inflation processes. However, these paths didn't correspond to the economic explanation brought by Cagan because the latter considered monetary hyperinflation. Some other authors like Goldman (1972) also showed the theoretical possibility of hyperinflationary bubbles by working on the original model of Cagan.

6 Conclusion

This article explores the strict association met in the literature between the monetary model of hyperinflation and the hypothesis of adaptive expectations. This association has its origin in the problems of the capacity of the model to explain monetary hyperinflation under rational expectations. These problems of the validity of the model, highlighted by the articles of Buiter (1987) and Kiguel (1989), caused some misunderstandings among economists as it appears through the article of Cagan (1987) for the dictionary Palgrave. That led some authors like Evans (1995) to consider the adaptive expectations hypothesis as sufficient to ensure the validity of the model.

The analysis of the dynamic properties of the model under adaptive expectations requires the distinction of two different configurations. The first configuration corresponds to a relatively slow adjustment of expected inflation to actual inflation. This configuration usually treated in the literature fully ensures the highlighting and the explanation of monetary hyperinflation. Monetary hyperinflation is the result of an excessive public deficit financed through money creation. The main underlying operating mechanism relies on the lag of real cash balances to actual inflation. This lag is caused by the relatively slow adjustment of inflationary expectations to the actual inflation characteristic for this configuration.

The second configuration of the model corresponds to a relatively fast adjustment of expected inflation to actual inflation. This configuration hasn't been explored in the literature. Bruno and Fischer (1987, 1990) approached this configuration only from the point of view of the stability properties of the steady-state equilibria and the high inflation trap issue. They didn't consider the consequences of an increase of the public deficit beyond the steady-state conditions. The thorough analysis of this configuration shows that the hypothesis of adaptive expectations is not sufficient to ensure the validity of the model for the explanation of monetary hyperinflation. This configuration doesn't produce any monetary hyperinflation when the public deficit exceeds the maximal value of seigniorage revenues reachable in stationary situation. A process of continuous decline of the inflation rate takes place. This is exactly the same kind of paradox as that of "hyperdeflation" described by Buiter (1987). Therefore, the way in which expectations are formed is important to obtain monetary hyperinflation in the model, but only because of the sufficient lag for real cash balances it may cause. If this lag is not sufficient the model can't produce monetary hyperinflation.

Within this second configuration the model is valid for neither highlighting nor explaining monetary hyperinflation. The failure of the model in its ability to explain monetary hyperinflation brings the problem on the field of economic policy theory. Public deficit reductions remain efficient to put back the economy on a convergent path when a reduction of public deficit to its steady-state level is considered. However, considering a drastic policy of zero public deficit shows that this configuration produces hyperinflationary bubbles paths.

The possibility of accelerating inflation processes while the nominal stock of money remains constant raises a second aspect of the dysfunction of this configuration of the model. The model has been designed to explain monetary hyperinflation processes and not hyperinflationary bubbles. The hyperinflationary bubble process is self-generating and may be explained by the joint action of expected inflation rates quickly adjusting to actual inflation rates and the high elasticity of the demand for money accelerating the inflation.

The evolution of the economy along a hyperinflationary bubble path raises the question of the design of a stabilisation program when public budget is balanced and the nominal stock of money is constant. The stabilisation policy proposal made within this configuration seems as counter-intuitive as is the triggering of the price level bubble. It has been shown that restoring the public deficit to its initial level put back the economy on a convergent path. Therefore, that means that by using paradoxical measures the government will succeed to stop the development of a paradoxical process in a model designed to explain monetary hyperinflation.

Hyperinflationary bubbles paths should be taken very seriously since microeconomic foundations of the demand for money stress the consistency of such phenomena. Obstfeld and Rogoff (1983, 1986), for instance, showed that hyperinflationary bubbles paths are consistent with the individual optimizing behaviour and should not then be ruled out.

References

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

Bruno M. and S. Fischer [1987], «Seigniorage Operating Rules and the High Inflation Trap», *NBER Working Paper*.

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, pp. 25-117.
Cagan P. [1987], «Hyperinflation», in The New Palgrave: A Dictionary of Economics.
Choudhry T. [1998], «Another Visit to the Cagan Model of Money Demand: the Latest Russian Experience», *Journal of International Money and Finance*, 17, pp. 355-376.
Evans J.L. [1995], «The Demand for Money: Hyperinflation or High Inflation Traps», *The Manchester School Supplement*, pp. 40-56.
Evans J. 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.
Goldman S. [1972], «Hyperinflation and the Rate of Growth in the Money Supply», *Journal of Economic Theory*, pp. 250-257.
Kiguel M. [1989], «Budgets Deficits, Stability and the Monetary Dynamics of Hyperinflation», *Journal of Money, Credit and Banking*, 21, pp. 148-157.
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 [1986], «Ruling Out Divergent Speculative Bubbles», *Journal of Monetary Economics*, 91, pp. 349-362.
Petrovic P., Z. Bogetic and Z. Vujosevic [1999], «The Yugoslav Hyperinflation of 1992-1994: Causes, Dynamics, and Money Supply Process», *Journal of Comparative Economics*, 27, pp. 335-353.
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.
Petrovic P. and Z. Vujosevic [1996], «The Monetary Dynamics in the Yugoslav Hyperinflation of 1991-1993: the Cagan Money Demand», *European Journal of Political Economy*, 12, pp. 467-483.
Slavova S. [2003], «Money Demand During Hyperinflation and Stabilization: Bulgaria, 1991-2000», *Applied Economics*, 35, pp.1303-1316.
Walsh C.E. [2003], *Monetary Theory and Policy*, Second Edition, Cambridge, The MIT Press.

Documents de travail du BETA

———

2000–**01** *Hétérogénéité de travailleurs, dualisme et salaire d'efficience.*
Francesco DE PALMA, janvier 2000.

2000–**02** *An Algebraic Index Theorem for Non–smooth Economies.*
Gaël GIRAUD, janvier 2000.

2000–**03** *Wage Indexation, Central Bank Independence and the Cost of Disinflation.*
Giuseppe DIANA, janvier 2000.

2000–**04** *Une analyse cognitive du concept de « vision entrepreneuriale ».*
Frédéric CRÉPLET, Babak MEHMANPAZIR, février 2000.

2000–**05** *Common knowledge and consensus with noisy communication.*
Frédéric KŒSSLER, mars 2000.

2000–**06** *Sunspots and Incomplete Markets with Real Assets.*
Nadjette LAGUÉCIR, avril 2000.

2000–**07** *Common Knowledge and Interactive Behaviors : A Survey.*
Frédéric KŒSSLER, mai 2000.

2000–**08** *Knowledge and Expertise : Toward a Cognitive and Organisational Duality of the Firm.*
Frédéric CRÉPLET, Olivier DUPOUËT, Francis KERN, Francis MUNIER, mai 2000.

2000–**09** *Tie–breaking Rules and Informational Cascades : A Note.*
Frédéric KŒSSLER, Anthony ZIEGELMEYER, juin 2000.

2000–**10** *SPQR : the Four Approaches to Origin–Destination Matrix Estimation for Consideration by the MYSTIC Research Consortium.*
Marc GAUDRY, juillet 2000.

2000–**11** *SNUS–2.5, a Multimoment Analysis of Road Demand, Accidents and their Severity in Germany, 1968–1989.*
Ulrich BLUM, Marc GAUDRY, juillet 2000.

2000–**12** *On the Inconsistency of the Ordinary Least Squares Estimator for Spatial Autoregressive Processes.*
Théophile AZOMAHOU, Agénor LAHATTE, septembre 2000.

2000–**13** *Turning Box–Cox including Quadratic Forms in Regression.*
Marc GAUDRY, Ulrich BLUM, Tran LIEM, septembre 2000.

2000–**14** *Pour une approche dialogique du rôle de l'entrepreneur/managerdans l'évolution des PME : l'ISO comme révélateur ...*
Frédéric CRÉPLET, Blandine LANOUX, septembre 2000.

2000–**15** *Diversity of innovative strategy as a source of technological performance.*
Patrick LLERENA, Vanessa OLTRA, octobre 2000.

2000–**16** *Can we consider the policy instruments as cyclical substitutes ?*
Sylvie DUCHASSAING, Laurent GAGNOL, décembre 2000.

2001–**01** *Economic growth and CO2 emissions : a nonparametric approach.*
Théophile AZOMAHOU, Phu NGUYEN VAN, janvier 2001.

2001–**02** *Distributions supporting the first–order approach to principal–agent problems.*
Sandrine SPÆTER, février 2001.

2001–**03** *Développement durable et Rapports Nord–Sud dans un Modèle à Générations Imbriquées : interroger le futur pour éclairer le présent.*
Alban VERCHÈRE, février 2001.

2001–**04** *Modeling Behavioral Heterogeneity in Demand Theory.*
Isabelle MARET, mars 2001.

2001–**05** *Efficient estimation of spatial autoregressive models.*
Théophile AZOMAHOU, mars 2001.

2001–**06** *Un modèle de stratégie individuelle de primo–insertion professionnelle.*
Guy TCHIBOZO, mars 2001.

2001–**07** *Endogenous Fluctuations and Public Services in a Simple OLG Economy.*
Thomas SEEGMULLER, avril 2001.

2001–**08** *Behavioral Heterogeneity in Large Economies.*
Gaël GIRAUD, Isabelle MARET, avril 2001.

2001–**09** *GMM Estimation of Lattice Models Using Panel Data : Application.*
Théophile AZOMAHOU, avril 2001.

2001–**10** *Dépendance spatiale sur données de panel : application à la relation Brevets–R&D au niveau régional.*
Jalal EL OUARDIGHI, avril 2001.

2001–**11** *Impact économique régional d'un pôle universitaire : application au cas strasbourgeois.*
Laurent GAGNOL, Jean–Alain HÉRAUD, mai 2001.

2001–**12** *Diversity of innovative strategy as a source of technological performance.*
Patrick LLERENA, Vanessa OLTRA, mai 2001.

2001–**13** *La capacité d'innovation dans les regions de l'Union Européenne.*
Jalal EL OUARDIGHI, juin 2001.

2001–**14** *Persuasion Games with Higher Order Uncertainty.*
Frédéric KŒSSLER, juin 2001.

2001–**15** *Analyse empirique des fonctions de production de Bosnie–Herzégovine sur la période 1952–1989.*
Rabija SOMUN, juillet 2001.

2001–**16** *The Performance of German Firms in the Business–Related Service Sectors : a Dynamic Analysis.*
Phu NGUYEN VAN, Ulrich KAISER, François LAISNEY, juillet 2001.

2001–**17** *Why Central Bank Independence is high and Wage indexation is low.*
Giuseppe DIANA, septembre 2001.

2001–**18** *Le mélange des ethnies dans les PME camerounaises : l'émergence d'un modèle d'organisation du travail.*
Raphaël NKAKLEU, octobre 2001.

2001–**19** *Les déterminants de la GRH des PME camerounaises.*
Raphaël NK AKLEU, octobre 2001.

2001–**20** *Profils d'identité des dirigeants et stratégies de financement dans les PME camerounaises.*
Raphaël NKAKLEU, octobre 2001.

2001–**21** Concurrence Imparfaite, Variabilité du Taux de Marge et Fluctuations Endogènes.
Thomas SEEGMULLER, novembre 2001.

2001–**22** *Determinants of Environmental and Economic Performance of Firms : An Empirical Analysis of the European Paper Industry.*
Théophile AZOMAHOU, Phu NGUYEN VAN et Marcus WAGNER, novembre 2001.

2001–**23** *The policy mix in a monetary union under alternative policy institutions and asymmetries.*
Laurent GAGNOL et Moïse SIDIROPOULOS, décembre 2001.

2001–**24** *Restrictions on the Autoregressive Parameters of Share Systems with Spatial Dependence.*
Agénor LAHATTE, décembre 2001.

2002–**01** *Strategic Knowledge Sharing in Bayesian Games : A General Model.*
Frédéric KŒSSLER, janvier 2002.

2002–**02** *Strategic Knowledge Sharing in Bayesian Games : Applications.*
Frédéric KŒSSLER, janvier 2002.

2002–**03** *Partial Certifiability and Information Precision in a Cournot Game.*
Frédéric KŒSSLER, janvier 2002.

2002–**04** *Behavioral Heterogeneity in Large Economies.*
Gaël GIRAUD, Isabelle MARET, janvier 2002.
(Version remaniée du Document de Travail n°2001–**08**, avril 2001).

2002–**05** *Modeling Behavioral Heterogeneity in Demand Theory.*
Isabelle MARET, janvier 2002.
(Version remaniée du Document de Travail n°2001–**04**, mars 2001).

2002–**06** *Déforestation, croissance économique et population : une étude sur données de panel.*
Phu NGUYEN VAN, Théophile AZOMAHOU, janvier 2002.

2002–**07** *Theories of behavior in principal–agent relationships with hidden action.*
Claudia KESER, Marc WILLINGER, janvier 2002.

2002–**08** *Principe de précaution et comportements préventifs des firmes face aux risques environnementaux.*
Sandrine SPÆTER, janvier 2002.

2002–**09** *Endogenous Population and Environmental Quality.*
Phu NGUYEN VAN, janvier 2002.

2002–**10** *Dualité cognitive et organisationnelle de la firme au travers du concept de communauté.*
Frédéric CRÉPLET, Olivier DUPOUËT, Francis KERN, Francis MUNIER, février 2002.

2002–**11** *Comment évaluer l'amélioration du bien–être individuel issue d'une modification de la qualité du service d'élimination des déchets ménagers ?*
Valentine HEINTZ, février 2002.

2002–**12** *The Favorite–Longshot Bias in Sequential Parimutuel Betting with Non–Expected Utility Players.*
Frédéric KŒSSLER, Anthony ZIEGELMEYER, Marie–Hélène BROIHANNE, février 2002.

2002–**13** *La sensibilité aux conditions initiales dans les processus individuels de primo–insertion professionnelle : critère et enjeux.*
Guy TCHIBOZO, février 2002.

2002–**14** *Improving the Prevention of Environmental Risks with Convertible Bonds.*
André SCHMITT, Sandrine SPÆTER, mai 2002.

2002–**15** *L'altruisme intergénérationnel comme fondement commun de la courbe environnementale* ***à la*** *Kuznets et du développement durable.*
Alban VERCHÈRE, mai 2002.

2002–**16** *Aléa moral et politiques d'audit optimales dans le cadre de la pollution d'origine agricole de l'eau.*
Sandrine SPÆTER, Alban VERCHÈRE, juin 2002.

2002–**17** *Parimutuel Betting under Asymmetric Information.*
Frédéric KŒSSLER, Anthony ZIEGELMEYER, juin 2002.

2002–**18** *Pollution as a source of endogenous fluctuations and periodic welfare inequality in OLG economies.*
Thomas SEEGMULLER, Alban VERCHÈRE, juin 2002.

2002–**19** *La demande de grosses coupures et l'économie souterraine.*
Gilbert KŒNIG, juillet 2002.

2002–**20** *Efficiency of Nonpoint Source Pollution Instruments with Externality Among Polluters : An Experimental Study.*
François COCHARD, Marc WILLINGER, Anastasios XEPAPADEAS, juillet 2002.

2002–**21** *Taille optimale dans l'industrie du séchage du bois et avantage compétitif du bois–énergie : une modélisation microéconomique.*
Alexandre SOKIC, octobre 2002.

2002–**22** *Modelling Behavioral Heterogeneity.*
Gaël GIRAUD, Isabelle MARET, novembre 2002.

2002–**23** *Le changement organisationnel en PME : quels acteurs pour quels apprentissages ?*
Blandine LANOUX, novembre 2002.

2002–**24** *TECHNOLOGY POLICY AND COOPERATION : An analytical framework for a paradigmatic approach.*
Patrick LLERENA, Mireille MATT, novembre 2002.

2003–**01** *Peut–on parler de délégation dans les PME camerounaises ?*
Raphaël NKAKLEU, mars 2003.

2003–**02** *L'identité organisationnelle et création du capital social : la tontine d'entreprise comme facteur déclenchant dans le contexte africain.*
Raphaël NKAKLEU, avril 2003.

2003–**03** *A semiparametric analysis of determinants of protected area.*
Phu NGUYEN VAN, avril 2003.

2003–**04** *Strategic Market Games with a Finite Horizon and Incomplete Markets.*
Gaël GIRAUD et Sonia WEYERS, avril 2003.

2003–**05** *Exact Homothetic or Cobb–Douglas Behavior Through Aggregation.*
Gaël GIRAUD et John K.–H. QUAH, juin 2003.

2003–**06** *Relativité de la satisfaction dans la vie : une étude sur données de panel.*
Théophile AZOMAHOU, Phu NGUYEN VAN, Thi Kim Cuong PHAM, juin 2003.

2003–**07** *A model of the anchoring effect in dichotomous choice valuation with follow–up.*
Sandra LECHNER, Anne ROZAN, François LAISNEY, juillet 2003.

2003–**08** *Central Bank Independence, Speed of Disinflation and the Sacrifice Ratio.*
Giuseppe DIANA, Moïse SIDIROPOULOS, juillet 2003.

2003–**09** *Patents versus ex–post rewards : a new look.*
Julien PÉNIN, juillet 2003.

2003–**10** *Endogenous Spillovers under Cournot Rivalry and Co–opetitive Behaviors.*
Isabelle MARET, août 2003.

2003–**11** *Les propriétés incitatives de l'effet Saint Matthieu dans la compétition académique.*
Nicolas CARAYOL, septembre 2003.

2003–**12** *The 'probleme of problem choice' : A model of sequential knowledge production within scientific communities.*
Nicolas CARAYOL, Jean–Michel DALLE, septembre 2003.

2003–**13** *Distribution Dynamics of CO_2 Emissions.*
Phu NGUYEN VAN, décembre 2003.

2004–**01** *Utilité relative, politique publique et croissance économique.*
Thi Kim Cuong PHAM, janvier 2004.

2004–**02** *Le management des grands projets de haute technologie vu au travers de la coordination des compétences.*
Christophe BELLEVAL, janvier 2004.

2004–**03** *Pour une approche dialogique du rôle de l'entrepreneur/manager dans l'évolution des PME : l'ISO comme révélateur …*
Frédéric CRÉPLET, Blandine LANOUX, février 2004.

2004–**04** *Consistent Collusion–Proofness and Correlation in Exchange Economies.*
Gaël GIRAUD, Céline ROCHON, février 2004.

2004–**05** *Generic Efficiency and Collusion–Proofness in Exchange Economies.*
Gaël GIRAUD, Céline ROCHON, février 2004.

2004–**06** *Dualité cognitive et organisationnelle de la firme fondée sur les interactions entre les communautés épistémiques et les communautés de pratique..*
Frédéric CRÉPLET, Olivier DUPOUËT, Francis KERN, Francis MUNIER, février 2004.

2004–**07** *Les Portails d'entreprise : une réponse aux dimensions de l'entreprise « processeur de connaissances ».*
Frédéric CRÉPLET, février 2004.

2004–**08** *Cumulative Causation and Evolutionary Micro–Founded Technical Change : A Growth Model with Integrated Economies.*
Patrick LLERENA, André LORENTZ, février 2004.

2004–**09** *Les CIFRE : un outil de médiation entre les laboratoires de recherche universitaire et les entreprises.*
Rachel LÉVY, avril 2004.

2004–**10** *On Taxation Pass–Through for a Monopoly Firm.*
Rabah AMIR, Isabelle MARET, Michael TROGE, mai 2004.

2004–**11** *Wealth distribution, endogenous fiscal policy and growth : status–seeking implications.*
Thi Kim Cuong PHAM, juin 2004.

2004–**12** *Semiparametric Analysis of the Regional Convergence Process.*
Théophile AZOMAHOU, Jalal EL OUARDIGHI, Phu NGUYEN VAN, Thi Kim Cuong PHAM, Juillet 2004.

2004–**13** *Les hypothèses de rationalité de l'économie évolutionniste.*
Morad DIANI, septembre 2004.

2004–**14** *Insurance and Financial Hedging of Oil Pollution Risks.*
André SCHMITT, Sandrine SPAETER, septembre 2004.

2004–**15** *Altruisme intergénérationnel, développement durable et équité intergénérationnelle en présence d'agents hétérogènes.*
Alban VERCHÈRE, octobre 2004.

2004–**16** *Du paradoxe libéral–parétien à un concept de métaclassement des préférences.*
Herrade IGERSHEIM, novembre 2004.

2004–**17** *Why do Academic Scientists Engage in Interdisciplinary Research ?*
Nicolas CARAYOL, Thuc Uyen NGUYEN THI, décembre 2004.

2005–**01** *Les collaborations Université Entreprises dans une perspective organisationnelle et cognitive.*
Frédéric CRÉPLET, Francis KERN, Véronique SCHAEFFER, janvier 2005.

2005–**02** *The Exact Insensitivity of Market Budget Shares and the 'Balancing Effect'.*
Gaël GIRAUD, Isabelle MARET, janvier 2005.

2005–**03** *Les modèles de type Mundell–Fleming revisités.*
Gilbert KOENIG, janvier 2005.

2005–**04** *L'État et la cellule familiale sont–ils substituables dans la prise en charge du chômage en Europe ? Une comparaison basée sur le panel européen.*
Olivia ECKERT–JAFFE, Isabelle TERRAZ, mars 2005.

2005–**05** *Environment in an Overlapping Generations Economy with Endogenous Labor Supply : a Dynamic Analysis.*
Thomas SEEGMULLER, Alban VERCHÈRE, mars 2005.

2005–**06** *Is Monetary Union Necessarily Counterproductive ?*
Giuseppe DIANA, Blandine ZIMMER, mars 2005.

2005–**07** *Factors Affecting University–Industry R&D Collaboration : The importance of screening and signalling.*
Roberto FONTANA, Aldo GEUNA, Mireille MATT, avril 2005.

2005–**08** *Madison–Strasbourg, une analyse comparative de l'enseignement supérieur et de la recherche en France et aux États–Unis à travers l'exemple de deux campus.*
Laurent BUISSON, mai 2005.

2005–**09** *Coordination des négociations salariales en UEM : un rôle majeur pour la BCE.*
Blandine ZIMMER, mai 2005.

2005–**10** *Open knowledge disclosure, incomplete information and collective innovations.*
Julien PÉNIN, mai 2005.

2005–**11** *Science–Technology–Industry Links and the 'European Paradox' : Some Notes on the Dynamics of Scientific and Technological Research in Europe.*
Giovanni DOSI, Patrick LLERENA, Mauro SYLOS LABINI, juillet 2005.

2005–**12** *Hedging Strategies and the Financing of the 1992 International Oil Pollution Compensation Fund.*
André SCHMITT, Sandrine SPAETER, novembre 2005.

2005–**13** *Faire émerger la coopération internationale : une approche expérimentale comparée du bilatéralisme et du multilatéralisme*.
Stéphane BERTRAND, Kene BOUN MY, Alban VERCHÈRE, novembre 2005.

2005–**14** *Segregation in Networks.*
Giorgio FAGIOLO, Marco VALENTE, Nicolaas J. VRIEND, décembre 2005.

2006–**01** *Demand and Technology Determinants of Structural Change and Tertiarisation : An Input–Output Structural Decomposition Analysis for four OECD Countries.*
Maria SAVONA, André LORENTZ, janvier 2006.

2006–**02** *A strategic model of complex networks formation.*
Nicolas CARAYOL, Pascale ROUX, janvier 2006.

2006–**03** *Coordination failures in network formation.*
Nicolas CARAYOL, Pascale ROUX, Murat YILDIZOGLU, janvier 2006.

2006–**04** *Real Options Theory for Lawmaking.*
Marie OBIDZINSKI, Bruno DEFFAINS, août 2006.

2006–**05** *Ressources, compétences et stratégie de la firme : Une discussion de l'opposition entre la vision Porterienne et la vision fondée sur les compétences.*
Fernand AMESSE, Arman AVADIKYAN, Patrick COHENDET, janvier 2006.

2006–**06** *Knowledge Integration and Network Formation.*
Müge OZMAN, janvier 2006.

2006–**07** *Networks and Innovation : A Survey of Empirical Literature.*
Müge OZMAN, février 2006.

2006–**08** *A.K. Sen et J.E. Roemer : une même approche de la responsabilité ?*
Herrade IGERSHEIM, mars 2006.

2006–**09** *Efficiency and coordination of fiscal policy in open economies.*
Gilbert KOENIG, Irem ZEYNELOGLU, avril 2006.

2006–**10** *Partial Likelihood Estimation of a Cox Model With Random Effects : an EM Algorithm Based on Penalized Likelihood.*
Guillaume HORNY, avril 2006.

2006–**11** *Uncertainty of Law and the Legal Process.*
Giuseppe DARI–MATTIACCI, Bruno DEFFAINS, avril 2006.

2006–**12** *Customary versus Technological Advancement Tests.*
Bruno DEFFAINS, Dominique DEMOUGIN, avril 2006.

2006–**13** *Institutional Competition, Political Process and Holdup.*
Bruno DEFFAINS, Dominique DEMOUGIN, avril 2006.

2006–**14** *How does leadership support the activity of communities of practice ?*
Paul MULLER, avril 2006.

2006–**15** *Do academic laboratories correspond to scientific communities ? Evidence from a large European university.*
Rachel LÉVY, Paul MULLER, mai 2006.

2006–**16** *Knowledge flows and the geography of networks. A strategic model of small worlds formation.*
Nicolas CARAYOL, Pascale ROUX, mai 2006.

2006–**17** *A Further Look into the Demography–based GDP Forecasting Method.*
Tapas K. MISHRA, juin 2006.

2006–**18** *A regional typology of innovation capacities in new member states and candidate countries.*
Emmanuel MULLER, Arlette JAPPE, Jean–Alain HÉRAUD, Andrea ZENKER, juillet 2006.

2006–**19** *Convergence des contributions aux inégalités de richesse dans le développement des pays européens.*
Jalal EL OUARDIGHI, Rabiji SOMUN–KAPETANOVIC, septembre 2006.

2006–**20** *Channel Performance and Incentives for Retail Cost Misrepresentation.*
Rabah AMIR, Thierry LEIBER, Isabelle MARET, septembre 2006.

2006–**21** *Entrepreneurship in biotechnology : The case of four start–ups in the Upper–Rhine Biovalley.*
Antoine BURETH, Julien PÉNIN, Sandrine WOLFF, septembre 2006.

2006–**22** *Does Model Uncertainty Lead to Less Central Bank Transparency ?*
Li QIN, Elefterios SPYROMITROS, Moïse SIDIROPOULOS, octobre 2006.

2006–**23** Enveloppe *Soleau et droit de possession antérieure : Définition et analyse économique.*
Julien PÉNIN, octobre 2006.

2006–**24** *Le territoire français en tant que Système Régional d'Innovation.*
Rachel LEVY, Raymond WOESSNER, octobre 2006.

2006–**25** *Fiscal Policy in a Monetary Union Under Alternative Labour–Market Structures.*
Moïse SIDIROPOULOS, Eleftherios SPYROMITROS, octobre 2006.

2006–**26** *Robust Control and Monetary Policy Delegation.*
Giuseppe DIANA, Moïse SIDIROPOULOS, octobre 2006.

2006–**27** *A study of science–industry collaborative patterns in a large european university.*
Rachel LEVY, Pascale ROUX, Sandrine WOLFF, octobre 2006.

2006–**28** *Option chain and change management : a structural equation application.*
Thierry BURGER–HELMCHEN, octobre 2006.

2006–**29** *Prevention and Compensation of Muddy Flows : Some Economic Insights.*
Sandrine SPAETER, François COCHARD, Anne ROZAN, octobre 2006.

2006–**30** *Misreporting, Retroactive Audit and Redistribution.*
Sandrine SPAETER, Marc WILLINGER, octobre 2006.

2006–**31** *Justifying the Origin of Real Options and their Difficult Evaluation in Strategic Management.*
Thierry BURGER–HELMCHEN, octobre 2006.

2006–**32** *Job mobility in Portugal : a Bayesian study with matched worker–firm data.*
Guillaume HORNY, Rute MENDES, Gerard J. VAN DEN BERG, novembre 2006.

2006–**33** *Knowledge sourcing and firm performance in an industrializing economy : the case of Taiwan in the 1990s.*
Chia–Lin CHANG, Stéphane ROBIN, novembre 2006.

2006–**34** *Using the Asymptotically Ideal Model to estimate the impact of knowledge on labour productivity : An application to Taiwan in the 1990s.*
Chia–Lin CHANG, Stéphane ROBIN, novembre 2006.

2006–**35** *La politique budgétaire dans la nouvelle macroéconomie internationale.*
Gilbert KOENIG, Irem ZEYNELOGLU, décembre 2006.

2006–**36** *Age Dynamics and Economic Growth : Revisiting the Nexus in a Nonparametric Setting.*
Théophile AZOMAHOU, Tapas MISHRA, décembre 2006.

2007–**01** *Transparence et efficacité de la politique monétaire.*
Romain BAERISWYL, Camille CORNAND, janvier 2007.

2007–**02** *Crowding–out in Productive and Redistributive Rent–Seeking.*
Giuseppe DARI–MATTIACCI, Éric LANGLAIS, Bruno LOVAT, Francesco PARISI, janvier 2007.

2007–**03** *Co–résidence chez les parents et indemnisation des jeunes chômeurs en Europe.*
Olivia ÉKERT–JAFFÉ, Isabelle TERRAZ, janvier 2007.

2007–**04** *Labor Conflicts and Inefficiency of Relationship–Specific Investments : What is the Judge's Role ?*
Bruno DEFFAINS, Yannick GABUTHY, Eve–Angéline LAMBERT, janvier 2007.

2007–**05** *Monetary hyperinflations, speculative hyperinflations and modelling the use of money.*
Alexandre SOKIC, février 2007.

2007–**06** *Detection avoidance and deterrence : some paradoxical arithmetics.*
Éric LANGLAIS, février 2007.

2007–**07** *Network Formation and Strategic Firm Behaviour to Explore and Exploit.*
Muge OZMAN, février 2007.

2007–**08** *Effects on competitiveness and innovation activity from the integration of strategic aspects with social and environmental management.*
Marcus WAGNER, février 2007.

2007–**09** *The monetary model of hyperinflation and the adaptive expectations : limits of the association and model validity.*
Alexandre SOKIC, février 2007.

La présente liste ne comprend que les Documents de Travail publiés à partir du 1er janvier 2000. La liste complète peut être donnée sur demande.
This list contains the Working Paper writen after January 2000, 1rst. The complet list is available upon request.

———