

## ANALYSING CREDIBILITY IN HIGH-INFLATION COUNTRIES: A NEW APPROACH\*

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The role of credibility factors in the design of a disinflation programme has been a major focus of research in macroeconomics over the past decade.<sup>1</sup> Nevertheless, there have been limited attempts to examine empirically the evidence relating to regime changes. In this paper we describe a new, simple procedure for estimating the size and diffusion of credibility effects in the context of stabilisation policies in high-inflation countries. As an applied example, we examine the Cruzado Plan implemented in Brazil during 1986.

### I. TESTING FOR CREDIBILITY EFFECTS: A BRIEF REVIEW

Most empirical analyses of policy credibility published to date have made use of the prediction-error method.<sup>2</sup> This consists of estimating a model of the inflationary process over the pre-reform period and predicting over the post-reform period. Evidence of a downward shift in inflation expectations – and hence of policy credibility – is inferred if the model overpredicts inflation in the post-reform period. Note, however, that model instability may be symptomatic of general model inadequacy, so this method can provide only weak evidence of credibility effects.

An alternative procedure is to include a ‘credibility variable’ in the regression model explicitly, and to test for its significance and stability over time (e.g. Christensen (1987*b*, 1990), who uses exchange rate variability). Difficulties associated with the use of proxy variables for credibility involve arbitrariness in their definition or failure to recognise their endogenous nature.

Another approach is to formulate a Bayesian learning procedure and derive explicitly the probability that a disinflationary programme will collapse (Baxter, 1985): credibility is deemed high when the probability of failure is low. Weber (1991) uses Bayesian univariate time-series analysis to evaluate credibility effects. It is difficult, however, to distinguish between changes in the goodness-of-fit of the time-series model generating expectations and changes in the credibility of policy, because potentially relevant variables are excluded from the model. This can be a serious problem if policy announcements are correlated with some of the omitted variables, especially if these correlations change during the sample period.

Time-varying parameter and switching regression techniques have also been used to test for credibility effects (e.g. Mankiw *et al.* (1987)). A general

\* The views represented in this paper are those of the authors and are not necessarily those of the International Monetary Fund or of its member country authorities.

<sup>1</sup> See Blackburn and Christensen (1989) for a recent review of the literature.

<sup>2</sup> See e.g. Blanchard (1984), Christensen (1987*a*) and Kremers (1990).

difficulty with switching-regression approaches is that, with a single switch point, it is only useful for examining regime shifts which are both credible and permanent within the data sample period. In many cases, stabilisation programmes may achieve credibility for a limited period before breaking down. Extending the analysis to allow for two or more switch points would be technically cumbersome. A closely related technique involves use of the Markov process model for regime shifts, developed by Hamilton (1988). In practice, however, estimation of the Markov switching process has met with considerable technical difficulties (e.g. Driffill (1990)).

## II. AN ALTERNATIVE APPROACH

We now present an alternative technique, which is less vulnerable to some of the limitations of the procedures described above. This procedure, which involves utilising information on the difference between the official foreign exchange rate and the black market or parallel market exchange rate (the parallel market premium), rests on two key assumptions. First, inflation is, because of inertial forces (wage contracts, financial indexation, etc.) a serially correlated process. Further, because wage and price setters negotiate contracts partly on the basis of their assessment of the authorities' ability to control inflation, the degree of inflation persistence is assumed to be inversely related to the degree of policy credibility. The negative relationship between the perceived degree of monetary and exchange rate policy stringency and the degree of inflation persistence is demonstrated theoretically and empirically by Alogoskoufis (1992), using a simple open-economy macroeconomic model with overlapping wage contracts of the Fischer–Taylor variety and data on the majority of OECD economies in the post World War II period (see also Agénor and Taylor (1991)).<sup>3</sup> Our second (testable) assumption is that an appropriate proxy by which to measure the degree of credibility of a stabilisation package is that part of the parallel market premium which is orthogonal to movements in the 'market fundamentals'.<sup>4</sup> When a disinflationary programme lacks credibility, agents anticipate a resumption in inflation. Thus, to avoid the inflation tax on real domestic monetary balances, they switch to foreign-currency denominated assets. For given supply, the parallel market exchange rate depreciates, and the premium rises, other things equal. However, the premium is an endogenous variable, and its level will also reflect the behaviour of 'fundamentals' – domestic credit, past domestic inflation, foreign prices, etc. It is therefore important to 'purge' the variable to account for this endogenous component – i.e. to maintain the other things equal assumption and avoid simultaneity bias as far as possible. The parallel market premium is, however, highly sensitive to market expectations regarding current and future

<sup>3</sup> Specifically, Alogoskoufis concludes: 'What is required for low inflation persistence is a credible commitment that price shocks will not be accommodated.' (1992, p. 478).

<sup>4</sup> It is important, in empirical implementation, that past inflation be included in the set of market fundamentals, in order to avoid simultaneity bias – i.e. the parallel market premium may itself depend fundamentally on the level of inflation (for example, higher inflation may lead to increased rationing in the official exchange market and a higher parallel premium).

government policies, and is thus a natural choice for examining credibility effects.<sup>5</sup> The presumption is thus that if movements in the parallel premium cannot be explained by movements in the market fundamentals, then the remaining variation must be due to variation in the perceived degree of policy credibility.

The procedure we are suggesting is thus as follows. We suggest that variation in that part of the parallel market premium which is orthogonal to movements in the fundamentals – including past movements in inflation itself – will be heavily influenced by perceptions of policy credibility, to the extent that it can be used as an index of credibility. Further, the usefulness of this index can be gauged by examining whether it covaries negatively and significantly with the degree of inflation persistence.

The first step in empirical implementation is thus to decompose the parallel market premium,  $\rho_t$ , into a ‘fundamental’ component and a ‘non-fundamental’ component which will be the basis for a measure of credibility, using a regression framework which includes ‘fundamental factors’ in the vector of predetermined variables  $\mathbf{z}_t$ :

$$\left. \begin{aligned} \gamma(L)\rho_t &= \delta(L)\mathbf{z}_t + u_t, \\ \delta(L) &= \delta_1 L + \delta_2 L^2 + \dots + \delta_n L^n, \\ \gamma(L) &= 1 + \gamma_1 L + \gamma_2 L^2 + \dots + \gamma_n L^n, \end{aligned} \right\} \quad (1)$$

where the  $\gamma_i$  denote scalar coefficients, the  $\delta_i$  denote conformable coefficient vectors,  $L$  is the lag operator, and  $u_t$  the residual process. Equation (1) can be interpreted as the first equation in a vector autoregressive system for  $\rho_t$  and  $\mathbf{z}_t$ .

The credibility variable,  $c_t$ , is then formed as the complement of  $u_t$ :

$$c_t = -u_t. \quad (2)$$

By construction, the residuals from (1) have zero mean over the estimation period. It is therefore important to consider a sample large enough (relative to the period of interest) if one is to avoid imposing inappropriate restrictions on the credibility variable.<sup>6</sup> It is also important to note that any decomposition of an observable variable into systematic and unsystematic components depends on the choice of information set, that is, on the choice of the conditioning variables  $\mathbf{z}_t$ : white noise on one information set can be predictable using another. Thus, there is an inherent lack of uniqueness in using white noise residuals as a criterion for data coherency, although non-random residuals do indicate data ‘incoherency’. The autoregressive distributed lag (ARDL) framework allows us, however, to control for the environment to some extent without imposing ‘too many’ *a priori* restrictions on parameters.

The second step is to estimate a backward-looking process for inflation with parameters varying with the non-fundamental component of the parallel

<sup>5</sup> For some industrialising countries, stock prices might be an alternative variable on which to concentrate.

<sup>6</sup> This situation is very similar to the ‘peso problem’ analysed by Krasker (1980), in which agents attach a non-zero probability to an event which does not occur within the sample period. As in the present case, this is a small-sample problem.

market premium, using a Kalman filter approach. Assuming that inflation,  $\pi_t$ , is driven by a first-order autoregressive process,<sup>7</sup> the system to be estimated is given by

$$\pi_t = \alpha_t \pi_{t-1} + \epsilon_t, \quad (3)$$

$$\alpha_t = \alpha_{t-1} + \gamma c_t + \eta_t, \quad (4)$$

where

$$\begin{bmatrix} \epsilon_t \\ \eta_t \end{bmatrix} \sim N \left\{ \begin{bmatrix} 0 \\ 0 \end{bmatrix}, \begin{bmatrix} \sigma_\epsilon^2 & 0 \\ 0 & \sigma_\eta^2 \end{bmatrix} \right\} \quad (5)$$

and  $\pi_t$  is in mean-deviation form. Equation (3) represents the *measurement* equation and equation (4) the *transition* equation. The disturbances  $\epsilon_t$  and  $\eta_t$  are serially uncorrelated disturbances with zero mean and constant variances, and are assumed uncorrelated with each other in all time periods. Equations (3), (4) and (5) represent a state space form, in which the unknown parameters  $\gamma$ ,  $\sigma_\epsilon^2$  and  $\sigma_\eta^2$  can be estimated by maximum likelihood techniques (Cuthbertson *et al.* (1992)). The Kalman filter recursions can then be applied to yield optimal estimates of the state variable sequence  $\{\alpha_t\}$ . The resulting estimate of  $\gamma$  should be negative: the higher credibility is, the lower the 'inertial' effect on inflation. Consequently, the coefficient  $\alpha_t$  should *fall* after the implementation of a credible disinflation programme.

### III. CREDIBILITY OF THE BRAZILIAN CRUZADO PLAN, 1986–87

The Brazilian Cruzado Plan, introduced at the end of February 1986, consisted of a general freeze of prices, the exchange rate, and tariffs for public services.<sup>8</sup> In addition, the government removed indexation, provided an upward adjustment of wages to their average real value over the previous six months, and established provisions for automatic adjustment of wages to be triggered when accumulated inflation exceeded 20%. However, key public sector prices (with the exception of electricity rates) and controlled private sector prices were not adjusted prior to implementation of the plan, as originally planned. The first months of the plan were highly successful. Monthly inflation rates were between 1 and 2%, industrial output increased by 40% between February and October of 1986, and in November 1986 real wages were 9% higher than the average attained in 1985. But by late August 1986 the plan was becoming unsustainable. The price freeze was not consistent with the increase in domestic demand generated by the initial wage increase and the larger operational deficit of the public sector, which turned out to be 3.7% of GDP rather than the 0.5% projected early in the year. Excess demand developed in goods and labour markets. Imports rose sharply while exports fell, and the trade surplus diminished substantially in September 1986 – turning into a deficit between October and December of that year. The combination of excess demand with misaligned relative prices (resulting from price controls) and

<sup>7</sup> The procedure can easily be adapted to allow for higher-order processes, although diagnostics applied to the estimated state space form in the application reported below indicated that a first-order approximation was adequate.

<sup>8</sup> See Agénor and Taylor (1991) for further discussion and references.

large fiscal deficits led to unsustainable macroeconomic imbalances that finally undermined the stabilisation attempt.<sup>9,10</sup> Price controls were abandoned in December 1986, and inflation rose to monthly rates of between 10 and 15% until March 1987 and accelerated even further from April 1987 to reach a monthly rate of 26% in May and June of that year. This precipitated the adoption of the Bresser Plan.<sup>11</sup>

In the light of this outline of policy developments, we now examine whether the technique outlined above can adequately capture the 'credibility pattern' during this period, as suggested by opinion polls (Agénor and Taylor (1991)) and intuition: rapid gains in credibility at the inception of the Cruzado Plan, followed by a rapid erosion in the following months.

Monthly data on the relevant time series were obtained for the period January 1982 to December 1989.<sup>12</sup> For the estimation of the ARDL, the variables considered were the rate of growth of the money stock, changes in output, domestic and US inflation rates, and the rate of depreciation of the official exchange rate.<sup>13</sup> Seasonal dummy variables were also included as independent variables in the regressions. Fig. 1 shows the credibility measures – that is, the negative of the residuals series – derived from a first- and second-order ARDL systems.<sup>14</sup> For the period of interest – the period which covers the adoption to the abandonment of the Cruzado Plan – both measures display a fairly similar pattern: credibility rose sharply at the inception of the programme and fell rapidly in the following months.

Maximum likelihood estimates of the parameters of the model (3)–(5) using the credibility index derived from the first-order ARDL system are as follows (asymptotic standard error in parentheses):

$$\hat{\gamma} = -0.00035, \quad \hat{\sigma}_\epsilon^2 = 0.0015, \quad \hat{\sigma}_\eta^2 = 0.0029, \quad (6)$$

(0.00007)

while Fig. 2 shows the behaviour of the coefficient  $\alpha_t$ . The coefficient  $\gamma$  is negative, as predicted by the model, and highly significant. Also, as suggested by the analysis, the persistence effect (which increased steadily from the end of 1985 to reach an all-time high in April 1986) started to fall dramatically until approximately June 1987 – right after the Plan collapsed – and increased

<sup>9</sup> The political cycle also hampered the stabilisation effort by encouraging overexpansionary policies intended to increase public support for the government at the time of upcoming elections. The Brazilian economy experienced an expansionary cycle before the parliamentary elections in November 1986, at a time when the Cruzado plan was under way. Corrective action to counteract the boom was delayed until after the elections.

<sup>10</sup> The government introduced fiscal measures to restrain consumption in July (the 'Cruzadinho' package) and November 1986 (the 'Cruzado II' package), but with little success.

<sup>11</sup> See Agénor and Taylor (1991) for further details.

<sup>12</sup> Data on the official exchange rate were taken from the International Monetary Fund's *International Financial Statistics (IFS)* data tape; data on the parallel market exchange rate were obtained from the *Centro de Estudios Económicos*.

<sup>13</sup> Data on money supply (narrowly defined) were taken from *Conjuntura Económica*, and the series on Brazilian industrial output was obtained from the *Fundacao Instituto Brasileiro de Geografia e Estadística*. All other series were taken from the *IFS* data tape.

<sup>14</sup> Higher-order systems were also estimated. They provided the same picture for 1986–7 as Fig. 1, but we were unable to derive convergent parameter estimates for the whole sample period using the Kalman filter procedure.

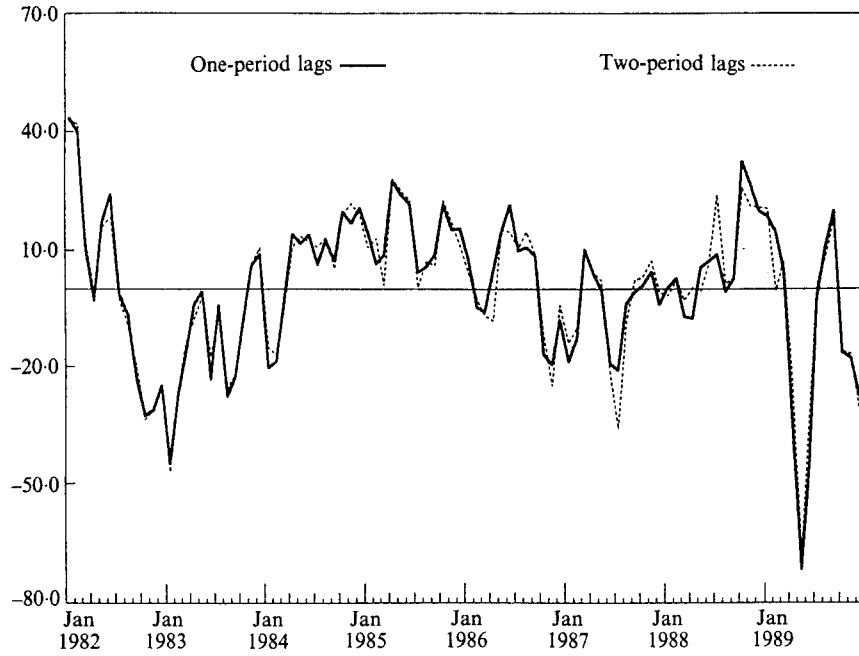


Fig. 1. Credibility variables, 1982-9.

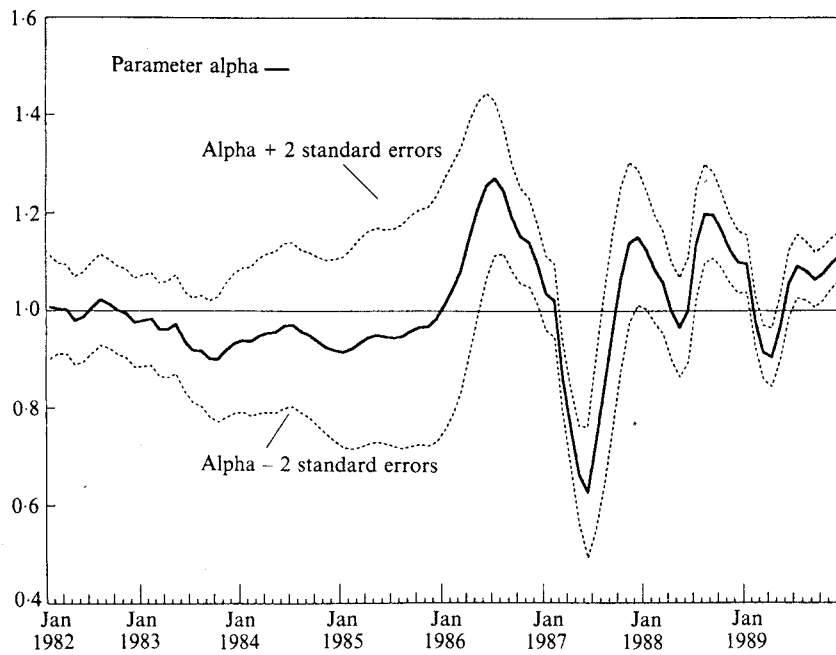


Fig. 2. Credibility and inflation persistence, 1982-9.

rapidly to its pre-programme value, reflecting the explosive behaviour of prices when policy credibility is low.

#### IV. CONCLUDING COMMENTS

In this paper we have suggested a simple, new procedure to estimate the size of, and the diffusion effect of, credibility factors in the context of disinflation programmes. The method relies on a decomposition of the parallel foreign exchange market premium into a 'fundamental' component (the part which is correlated with the market fundamentals) and a 'non-fundamental' component (the part which is orthogonal to the market fundamentals). It is the latter, 'non-fundamental' component which we suggest may be used as a 'credibility variable' and which we suggest will be negatively correlated with the degree of inflation persistence. We should stress here the importance of obtaining an orthogonalisation of the premium with respect to the fundamentals, since otherwise the analysis may be subject to spurious correlations and simultaneity bias. A preliminary study in which the new approach was applied to the Cruzado Plan implemented in Brazil during 1986 yielded promising results which were broadly in accordance with evidence from opinion polls.

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