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DISCUSSION PAPER
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Brasília, January 2015

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Antonio Fiorencio[2]
Ajax Moreira[3]

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DISCUSSION PAPER

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SUMÁRIO

RESUMO

O alto grau de indexação que caracterizou a economia brasileira por décadas é um fato passado ou pode ser facilmente reativado no caso de um importante choque nominal? Alternativamente, a economia está suficientemente estável para absorver uma grande desvalorização nominal do câmbio? Este artigo propõe e estima algumas medidas de estabilidade do sistema de preços utilizando as raízes características de um modelo auto-regressivo vetorial que foi estimado com parâmetros flutuando no tempo. A metodologia foi utilizada para avaliar a estabilidade dos sistemas de preços de países selecionados: Brasil, Argentina, Israel, México e Inglaterra.

ABSTRACT

Is the high degree of indexing that characterized the Brazilian economy for decades a thing of the past, or could it be easily reactivated in the event of some important price shock? Alternatively: is the economy sufficiently stable to absorb a large exchange rate nominal devaluation? This paper propose and estimates some measures of the stability of the price system using characteristic roots of time varying parameter VAR model. We used the proposed methodology to evaluate price system stability of selected countries: Brazil, Argentina, Israel, Mexico and United Kingdom.

1 - INTRODUCTION

There is now a widespread agreement that no stabilisation program can succeed if it is not backed by a consistent fiscal policy. Fiscal policy, however, is not the whole story. Choices have to be made concerning monetary and exchange-rate policies. Also, in countries with a long history of high inflation and widespread indexing mechanisms, an important component of the stabilisation program is the elimination of these indexing mechanisms, both formal and informal.

Part of this elimination can be mandated, at least in the short run. But part of it is a consequence of the success of the stabilisation program itself. Lower inflation leads to less indexation and further allows the inevitable changes in relative prices to happen with a lower impact on inflation.[1] A rise in inflation tends to reduce the interval between price changes, which may lead to more inflation. A key question is whether these changes in nominal prices lead to an explosive dynamics. The more close to explosive is the dynamics, the more vulnerable to exogenous shocks is the system.

A country that adopts an exchange rate based stabilisation program but does not adopt the fiscal policy necessary to give it full credibility is persistently faced with the question of whether or not to devalue. And, if so, when, and by how much.

The trade-offs associated with the timing of devaluation are clear enough. If you take too long to devalue, financing the deficit on the current account may become a binding constraint, to be respected only at the cost of high unemployment, if at all. If you devalue early on the stabilisation program, the inflationary impact may be enough to reintroduce indexing mechanisms too recently or incompletely deactivated. The nominal devaluation might be eroded by the rise in prices with little impact on the real exchange rate, and/or it might place the economy on an inflationary path again.

In Brazil, the Real Plan did not produce a consistent fiscal adjustment from its very beginning. As a result, the exchange rate anchor on which the Real Plan was based led, as expected, to a revaluation of the real exchange rate and to increasing current account deficits. Equilibrium of the balance of payments was obtained at the cost of high interest rates and rising unemployment. Discussions of economic policy frequently turned around the following question:

Is the high degree of indexing that characterised the Brazilian economy for decades a thing of the past, or could it be easily reactivated in the event of some important price shock? Alternatively: is the economy sufficiently stable to absorb a large nominal devaluation if this is deemed necessary to equilibrate the balance of payments? This paper describes and estimates some measures of the stability of the Brazilian price system.

[1] Indexation *per se* is not inflationary. It will be if prices are more flexible upward than downward.

Of course, similar questions apply to other countries. For instance, Argentina, Israel and Mexico also had experiences of high inflation during long periods. We briefly evaluate the stability of the price system of these countries. The United Kingdom is also included. It is a more “stable” country that, nevertheless, faced some turbulence as a member of the European Exchange Rate Mechanism.

This paper uses VAR models to evaluate the stability of price systems and is organised as follows. Section 2 presents the methodology adopted. Section 3 analyses the Brazilian case and, more briefly, the cases of Argentina, Israel, Mexico and the United Kingdom.

2 - MEASURING PRICE SYSTEM STABILITY

We assume that a VAR model comprising the relevant variables can describe the dynamic effects of nominal shocks. A VAR is a system of stochastic difference equations and its dynamics properties are given by its eigenvalues. If we are only interested on the stability of the system,[2] then we need consider only the eigenvalue with the largest absolute value. If this is less than or equal to one, the system is not explosive.

This is not the only possible measure of stability. The model was specified using a Bayesian approach where all system parameters and, thus, the system eigenvalues are random variables. Another measure of stability could be the probability that the largest eigenvalue is greater than one.

To analyse empirically how shocks are propagated through the price system, we need a short list of variables that determine, and are determined by, the price level. We assume that the price level (P), the nominal exchange rate (C), and the nominal interest rate (J) are a sufficient information set. Money and wages could also be considered, as well as unemployment or some measure of the level of activity.

We exclude money from the system for the following reasons. First, after a stabilisation program is launched, inflation falls and money demand increases fast. During the first periods, money is growing at temporarily explosive rates. A linear system including a monetary aggregate will exhibit an explosive root even if the price system is actually stable — and non-linear models are beyond the scope of this paper. Second, it is not always clear which monetary aggregates to choose if we want the results from different countries to be comparable. Third, in many situations, central banks have not attempted to control monetary aggregates, and there is no significant loss of information if they are excluded from a model that forecasts prices, interest rates and exchange rates.

[2] In an earlier version of this paper, we interpreted the largest eigenvalue as a summary measure of the degree of indexation of the price system. We refrain from it now. One of the reasons is that this model mixes together private sector pricing behaviour and public sector policies, as some commentators pointed out.

Including wages in the models raises issues of comparability, since the definition of nominal wages might vary substantially from country to country. Also, the variable "wages" might not be a good representative of labour remuneration on a nation-wide basis.

The exclusion of the level of activity from the model is far from obvious. It is well known that the level of slack capacity is one of the determinants of degree of passthrough from shocks to prices. But even though it would be desirable to include such a variable in the model, we decided not to for two main reasons.

First, in high inflation countries, nominal shocks are probably much larger than real shocks. If this is the case, real variables could be excluded from the model as a first approximation. Second, including a real variable in the model would greatly complicate its estimation. We postpone explaining exactly what would happen until we explain how the model was estimated in the first place.

Summarising, we decided to estimate a VAR model including the price level (P), the nominal exchange rate (C) and the nominal interest rate (R). Then the relationships between these variables are given by (1), where y=(P,C,J):

$$y_t = a+B_1y_{t-1}+B_2y_{t-2} + B_3y_{t-3} + e_t \qquad e_t \sim(0,\Sigma) \tag{1}$$

If: $(x_t=y_{t-1})$, $(z_t=x_{t-1})$, $Y_t=(y_t, x_t, z_t)$, $E_t=(e_t,0,0)$ and $B=\begin{bmatrix} B_1 & B_2 & B_3 \\ I & 0 & 0 \\ 0 & I & 0 \end{bmatrix}$, $A=\begin{bmatrix} a \\ 0 \\ 0 \end{bmatrix}$

(1) can be written as:

$$Y_t = A + BY_{t-1} + E_t = A + D\Lambda D'Y_{t-1} + E_t$$

where D and Λ=diag(λ_i) are, respectively, eigenvectors and eigenvalues of B.[3]

Since a VAR is a system of difference equations, its dynamic stochastic behaviour depends only on its eigenvalues or characteristic roots.[4] We do not want to fully characterise this dynamics, instead, we analyse only whether the system is explosive or stable. This property depends only on the characteristic root with the largest absolute value (λ). If $|\lambda|>1$, the system is explosive[5]; if $|\lambda|<1$, the system is stationary and shocks has only transitory effects; if $|\lambda|=1$, some shocks have permanent effects. This will be our proxy for the underlying degree of stability of the price system.

[3] These eingenvalues are the roots of the equation $|I-B_1z- B_2z^2- B_3z^3|=0$ which are different from the eingenvalues of the long run matrix given by $|I-(I- B_1-B_2-B_3)z|=0$.

[4] $Y_{t+k}=Ak+D\Lambda^kD'Y_t+D\Lambda^{k-1}D'E_t+.. + D\Lambda D'E_{t-k+1} +E_{t+k}$. Shocks do not affect the deterministic trend component (Ak).

[5] Note that if the price process (p) is explosive, so is theinflation process (Δp).

The VAR described in (1) has fixed coefficients, which might be a bad assumption for our sample. For instance, in the Brazilian case, the continuous evolution of indexing practices and successive stabilisation plans affected the dynamic interaction between nominal variables. So we should consider the possibility that the parameters of the model change as the economic system adapts to a changing environment. Model (1) can be re-parameterised as:

$$(y_t=\pi r_t+e_t) \text{ where: } \pi=(A,B_1,B_2,B_3) \text{ and } r_t=(1,y_{t-1},y_{t-2},y_{t-3}). \quad (2)$$

To allow (π) to be a function of time we specified (2) as a common components dynamic Bayesian regression model [see West and Harrison (1997)], where each element of (π) follows a random walk path.[6]

$$y_t=\pi_t r_t+e_t \quad ,$$

$$\pi_t = \pi_{t-1}+ \xi_t{}^{7} \quad \xi_t \sim N(0,\ I_{pn^2}\, W_t) \quad (3)$$

The scalar (W_t) determines how fast the parameters adjust to new information. This specification includes different situations as special cases. If (W_t=0) we have the classical recursive estimation. If (W_t=w*), we have a standard varying parameters model. Regime changes in selected periods (M) can be accommodated letting: $W_t=w\ \forall t\in M$, and zero otherwise. If (w=0) we are back to the first situation and if (w) is "big" we are ignoring information prior to each regime change.[8] We call φ=(w,w*) the hyperparameters of the model.[9]

2.1 - Estimation

Given (φ), the model can be estimated using the dynamic Bayesian model [see West and Harrison (1997)], and its marginal or predictive log-likelihood LVM (y|φ) can be calculated analytically.

6 All shocks have the same variance.

7 The notation means that each element (ij) in π equals its predecessor plus a specific random shock.

8 Since we estimate a VAR with three lags, we disregard observations on the three months following each regime change to avoid introducing possibly spurious data. So, it is the fourth month after each of these stabilization plans that enters the set M.

9 Including a real variable in the model would imply a larger number of hyperparameters for the model. In the model consisting only of nominal variables we assumed that the variability of all al variables was linked to the level of inflation and, thus, only specified two variances for the random walks: one for the change of regime periods and another one for the other periods. No such argument could be applied to the relationship between the nominal variables and the real variables. Thus, instead of considering two variances, we would have had to consider eight variances: the impact of the nominal variables and the real variables on themselves and each other, both for the change of regime periods and for the other ones.

The hyperparameters (φ) were estimated using Markov Chain Monte Carlo with rejection criterion (MCMC/Metropolis-Hastings) where each point is generated by an algorithm composed by an accept/reject criterion and a sample mechanism [see Gamerman (1997)]. After convergence, this procedure produces a sample from the posterior distribution $\varphi \sim (\varphi|D_T)$.[10]

To complete the model, we need the prior distributions for (π_0,φ). Our sample has approximately 400 elements, so the prior for the first period is not so important, and we assumed that $\pi_0 \sim N(0,1000I)$. The prior distribution for (φ) must be informative, especially for (w), the hyperparameter that controls the estimation of the moments of regime changes, which are very rare on the sample. Except for Brazil, the number of elements of (M) is one. The prior distribution for (φ) contains (φ^*), where ($\varphi^*=\text{argmax}_\varphi LVM(y|\varphi)$). This procedure suggests $w \sim N(0,0.1)$ and $w^* \sim N(0,0.01)$.

Under the Bayesian specification, (π) follows a Student-t distribution[11] for any value of the eingenvalues. It is interesting to note that under the classical paradigm[12] this is false. For instance, the (π) distribution has a discontinuity at the unit roots.

The MCMC method produces samples from ($\varphi|D_T$), and, given (φ), the VAR parameter (π) follows a Student-t matrix-variate distribution. So, the distribution of the greatest eigenvalue ($\lambda_t|D_T$) can be obtained by simulation methods.

Repeating the following procedure gives us a sample from ($\lambda_t|D_T$):

(1) Sample $\varphi^{(i)} \sim (\varphi|D_T)$;
(2) Sample $\pi_t^{(i)} \sim (\pi_t \,|\varphi^{(i)},D_T)$;
(3) Calculate $\Lambda_t^{(i)} = H(\pi_t^{(i)})$[13]for each (t) and (i).
(4) Choose $\lambda_t = \max_i \Lambda_t^{(i)}$
(5) The $\{\lambda_t\}$ obtained is a sample from ($\lambda_t|D_T$).

Since ($\lambda_t|D_T$) is the distribution of the maximum of the eigenvalues, it suffices to consider this distribution to access the explosive propriety of price system.[14]

[10] Gamerman (1998) estimated a VAR system like this one.
[11] See Hamilton (1994, pg. 532) for proofs for the case of unit roots. The same arguments could be used for the case of explosive roots.
[12]In this case it is very difficult to estimate systems that could be non-stationary because we only know which distribution has to be used after the estimation.
[13] Where $H(\pi)$ represents a eigenvalue extractor algorithmic for a non-symmetric matrix; [see Golub and Van Loan (1996)].
[14] If $Prob(\lambda_t>1)<\alpha$ than $Prob(\Lambda_t^{(i)}>1)<\alpha \ \forall i$

Taking account of the variability of (π) is not without costs, of course. We had to introduce new hyperparameters (φ) that can only be estimated after some regime change occurs. This implies that ($\lambda|D_T$) was obtained using the whole sample. In a dynamic model, this distribution is indicated by ($\lambda|T,V$).

If ($\varphi=0$), we have a fixed components model, and we can calculate the distribution of (λ) using data until the current period only ($\pi_t|D_t$). For comparison, we calculate the distribution of the eigenvalue for this case too. This is indicated by ($\lambda|t,F$).

Caution is thus needed when comparing results from the varying and the fixed parameter models, since the information sets are completely different.

Finally, in the Bayesian approach, the coefficients are random variables. Assuming that the model represents the price system, its stability depends on three inter-related aspects. The first is the dynamic properties of the system given (π), ($\lambda>1|\pi,\varphi$). The second is the uncertainty of λ due to uncertainty about (π,φ) at each period. And the third is the volatility of this path. The path of Prob($\lambda>1$) summarises theses aspects.

3 - EMPIRICAL RESULTS

The Brazilian economy has been through several periods of high inflation and several stabilisation plans. As a consequence, it has experienced periods when the price system seemed to display an explosive behaviour and periods of apparently stationary behaviour. Others countries with a similar experience are Argentine, Israel and Mexico, which we also analyse. The UK is used as a contrast. It is a "stable" country, but had important exchange rate regime changes recently.

For each of these five countries, we estimate our measure of stability using a VAR[15] model with three lags.[16] The set (M) of expected regime changes was defined rather arbitrarily by inspection of the data and information about economic policy.[17] Table 1 specifies the sample and the M set for each country.

[15] Numerical considerations led us to estimate model in the equivalent form:
$\Delta y_t = b_1\Delta y_{t-1} + b_2\Delta y_{t-2} + dy_{t-1} + e_t$.

[16] The choice is arbitrary.

[17] Unfortunately the set (M) is more detailed for Brazil than for the other countries.

Table 1
Samples and Intervention Dates

Country	Sample	M
Brazil	4/73-03/99	7/79,6/86,7/90,10/94
Argentina	4/77-10/98	4/90
Israel	4/75-12/98	7/85
Mexico	4/75-12/98	1/88
UK	4/75-12/98	-

Table 2 presents the values of the log-likelihood (LLKH)[18] for three alternatives: *a*) the LLKH of the most probable solution; *b*) the minimum value of LLKH for the 65% most probable solutions; and *c*) the LLKH of the static case φ=0. The results show *a*) that we can not reject the change of regime hypothesis for any of the five countries, and *b*) that for most of the countries, the 65% most probable solutions are almost equivalent to the most probable one, according to the LLKH scale. Table 3 shows the mode, mean and maximum density interval (MDI) at the 65% level for each hyper-parameter.

Table 2
Log-Likelihood

Country	Mode	65	φ=0
	1379.5	1376.2	-
Brazil	1380,6	1377.1	1375.1
Argentina	512.9	512.3	500.7
Israel	1475.0	1474.8	1459.3
Mexico	2019.8	2019.1	1973.0
UK	2018.1	2017.7	1995.0

Table 3 shows that the MDIs for Brazil and Mexico are larger than the MDIs for Argentina and Israel. Part of this uncertainty is in the data. But part is due to the estimation of the hyper-parameters and depends on the number of elements of the (M) set in each case.

Table 3
Hyper-Parameter (φ) Distributions

Country	w hyper-parameter				w* hyper-parameter			
	Mean	Mode	Inf65	Sup65	Mean	Mode	Inf65	Sup65
	.003	.000	.000	.006	.180	.017	.001	.035
Brazil	.003	.000	.000	.005	.184	.016	.001	.337
Argentina	.017	.015	.005	.012	.506	.277	.140	.992
Israel	.002	.000	.000	.005	.655	.642	.453	.938
Mexico	.077	.088	.065	.100	.680	.991	.531	.970
UK	.057	.055	.041	.072				

[18] In fact, it is the log density posterior.

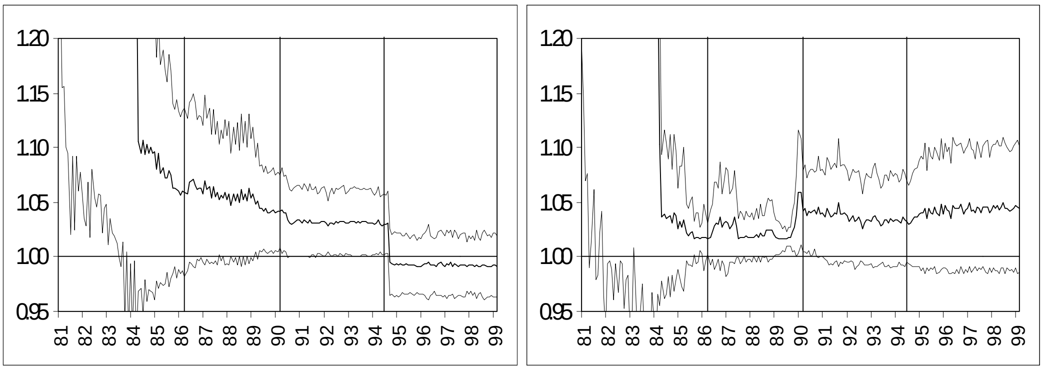
3.1 - Brazil

We assume that regime changes occurred in 1979, when the exchange rate and monetary correction were pre-announced; at the Cruzado Plan (1986.2); the Collor Plan (1990.3); and the Real Plan (1994.6). Figure 1 shows the (λ) distribution under two alternatives: the varying parameter model (λ|T,V) and the fixed parameter model (λ|t,F). Remember the difference between the two models. In the varying parameter case (first graphic) results for each period were calculated using the whole sample. In the fixed parameter model (second graphic) the results for each period use data until that period only.

Figure 1 shows how important it is to consider the stochastic model, or regime change, hypothesis. We think that the fixed coefficient model does not adequately describe Brazilian economic reality after the Real Plan. Also, note that the first graphic indicates the existence of three different regimes: before the Collor plan, between the Collor and the Real Plans, and after the Real Plan.

Figure 1

Brazil: (λ|T,V) (λ|t,F)



The varying parameter model indicates that before the Real Plan, the system is almost always explosive, in spite of numerous stabilisation plans. After 1995 the picture is not so clear, but the model indicates a clear regime change at the Real Plan.

Episodes that happened before the Real Plan appear more clearly on the fixed coefficients model. *a*) The Cruzado Plan in February 1986. *b*) The quasi-hyperinflation that accompanied the presidential election of late 1989, when the public feared financial assets may be confiscated after the election. This model indicates that the Real Plan did not increase the stability of the Brazilian price system. If anything, it indicates that the instability slightly increased.

We do believe that the varying parameter model tells a more coherent story than does the fixed parameter model, but that graphic was produced using the whole sample. Of course, a policy maker could not obtain these results before the Real Plan had happened. To simulate this situation we estimated the hyperparameters of the varying parameter model using a sample until 1994/12, and then we estimated (π_t|t,V) and (λ_t|t,V) using data until the current period only. These results are indicated by (λ_t| 94,V). Figures 2 shows the results.

Figure 2 suggests that the largest eigenvalue decreased smoothly after the Real Plan in July 1994, and it is possible that the system becomes stationary no later than the middle of 1996. The Mexican crisis of December 1994, the Asian crisis in the second half of 1997, and the Russian crisis in 1998 are not discernible in the graphic.

Figure 2
Brazil. Largest Eigenvalue (λ_t| 94,V)

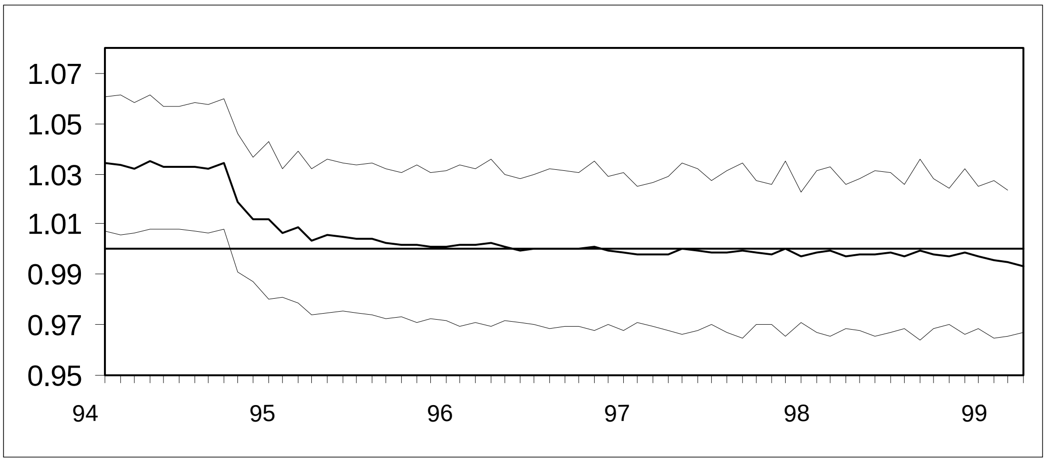
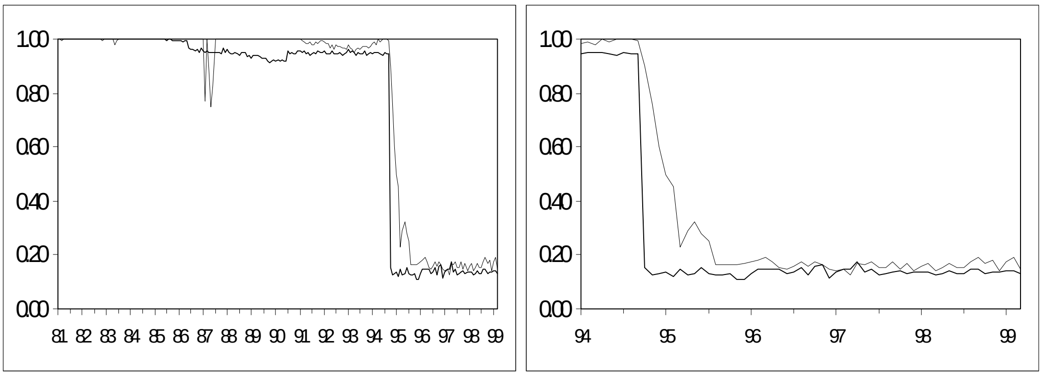


Figure 3 shows the other measure of stability, Prob(λ>1|T,V). We show it only for varying parameter model because for the fixed parameter model this probability is almost near one for the whole period. The second graphic in Figure 3 makes a zoom for the period after 1994. The two alternatives already mentioned Prob(λ>1|T,V), Prob(λ>1|1994,V) are represented by the two lines in each graphic. We can see the smooth path of the Prob(λ>1|1994,A). Results are qualitatively similar to those of Figure 2.

Figure 3
Brazil. Prob(λ>1|T,V) and Prob(λ>1|1994,V)



Assume Brazil had decided to devalue somewhere after the launching of the Real Plan. From the point of view of minimising inflationary risks, when should it have been done? The answer depends on many factors: the current phase of the business cycle; how devaluation is managed by policy makers; the degree of indexation of the price system; international conditions; domestic political conditions; etc. Figures 2 and 3 suggest there were two favourable moments for devaluation after the Real Plan.

The first favourable moment seems to have been 1996/1997. Before 1996 our measure of explosiveness still falls relatively fast and the marginal benefit of waiting is comparatively high. In the second half of 1997, there was the Asian crisis and its repercussions on emerging markets well into 1998. And, in the second half of 1998, the Russian crisis and the Brazilian general elections. Even though these two international crises had no appreciable impact on the dynamics of the Brazilian price system, it is clear that those were not favourable moments for a devaluation.

Apparently, early 1999 was another favourable moment. In January, our measure of stability was as low as ever; the president had just been comfortably re-elected and no new elections were shortly due; the economy was depressed; and leading industrial countries and international agencies were clearly willing to support the Brazilian stabilisation program.

If this is true, why was the initial turmoil so big? And why did prospects change so fast?

The way economic policy was handled is part of the answer to the first question. It is possible that much of the trouble was policy induced and not the reflex of a still high degree of explosiveness.

Reversal of policy is part of the answer to the second question. But there is more to it. It seems to have taken a major crisis to convince Congress to advance on fiscal adjustment. As an example, in the middle of the crisis, Congress got so worried that it approved changes on retirement legislation, which it had previously rejected on four different occasions. Apparently, besides the well-known expenditure reducing and expenditure switching effects, the Brazilian devaluation also included a (temporary) responsibility enhancing effect.

The high level of unemployment in the economy is probably yet another reason for the small impact of the devaluation on prices. If this were true, it could be argued that Brazil postponed the devaluation for fear that it would require a large recession to prevent the devaluation from triggering back inflation. Pegging the exchange rate, however, required high real interest rates, which depressed the economy and reduced the passthrough form the exchange rate to prices when the devaluation finally occurred. It would be interesting to analyse this issue further, but, since we opted for not including a measure of slack capacity in the model, we must abstain from it.

3.2 - Argentina, Israel, Mexico, United Kingdom

The previous section presented our estimates of the degree of explosiveness of the Brazilian price system. It might be useful to put these results in perspective by comparing them with those of some other countries. We chose four other countries. Argentina, Israel and Mexico were chosen because they underwent inflationary processes resembling the Brazilian one. The United Kingdom is a more “stable” country that, nevertheless, had some turbulent times as it entered and exited the European Exchange Rate Mechanism. We present our results with only minimal comments. Figure 4 shows the largest eigenvalue for these four countries. The eigenvalue path and its uncertainty were calculated with the same methodology adopted for Brazil.

The main points to note in Figure 4 are:

1 - The United Kingdom stands in contrast with the other countries, since its largest eigenvalue is always less than unity.

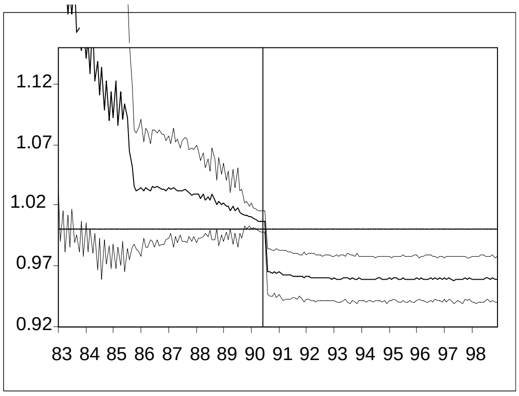
2 - In the case of Argentina, the varying parameter and the fixed coefficient models agree in some respects and disagree in other ones.

Both models suggest that the Austral Plan of June 1985 had an important impact but that it was insufficient to achieve even a temporary stabilisation. They also tell a similar story for the period after the Convertibility Plan of March 1991: the economy was successfully stabilised. A possible explanation for this similarity is that uncertainty about the parameters was so big before the change of regime that model could learn even with fixed parameters.

The two models tell different stories for the period between the Austral and the Convertibility Plan. The fixed parameter model suggests that no other structural change occurred after the Austral Plan until the Bonex Plan of January 1990, which involved a confiscation of part of the public’s time

Figure 4.A

Argentina (λ|T,V) (λ|t,F)



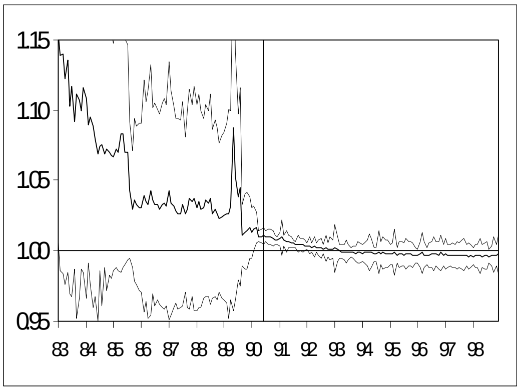
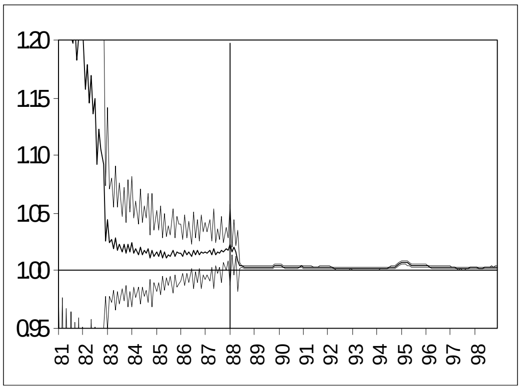


Figure 4.B

Mexico (λ|T,V) (λ|t,F)



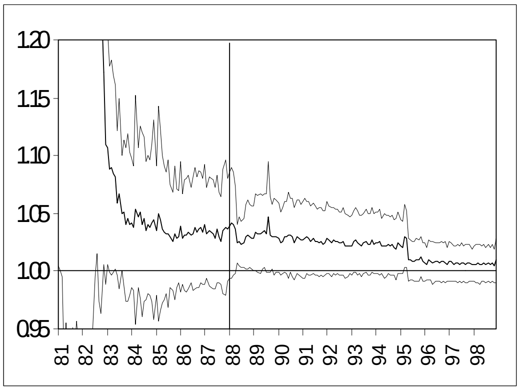
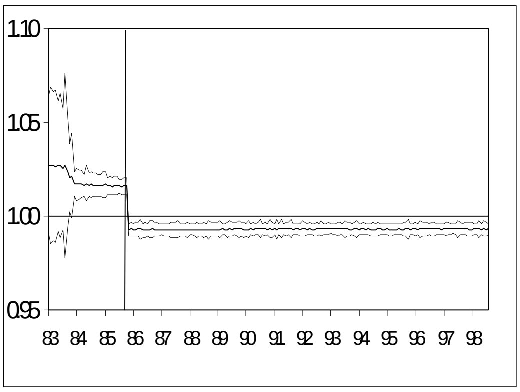


Figure 4.C

Israel (λ|T,V) (λ|t,F)



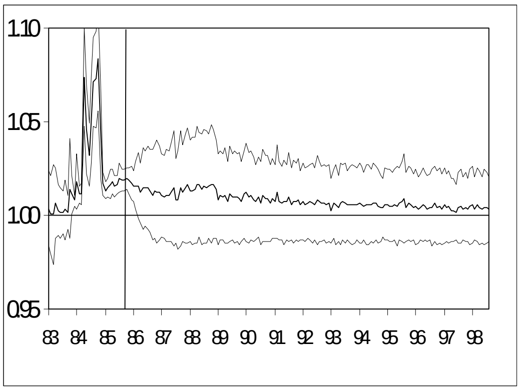
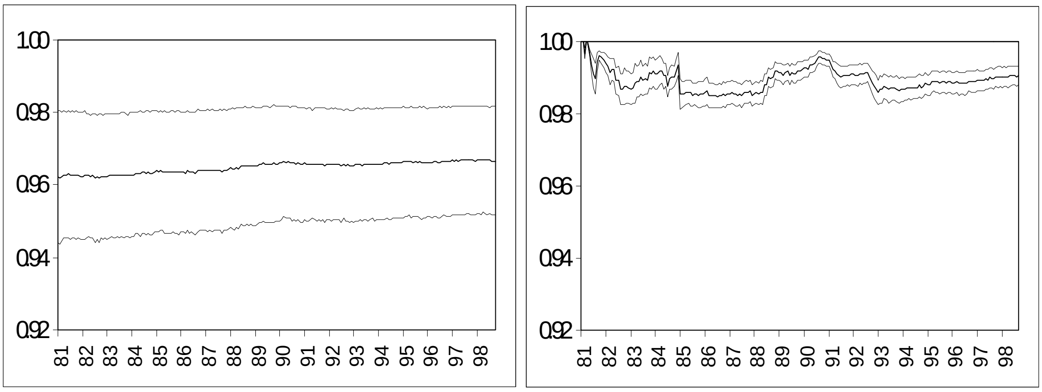


Figure 4.D

UK (λ|T,V) (λ|t,F)



deposits. Stability is then gradually obtained. The varying parameter model suggests the Argentinean economy was slowly tending to stability after the Austral and suffered a structural change at the Convertibility Plan.

The different behaviours between the Austral and the Convertibility Plans may be interpreted in two ways.

The first interpretation is that the structural change actually occurred at the Bonex Plan and not at the Convertibility Plan as we assumed. We cannot tell what would happen to the graphic of the varying parameter model if we changed the date of the intervention. Maybe the gradual decrease of the largest eigenvalue would disappear. Maybe it would not.

The second interpretation is that the structural change actually occurred at the Convertibility Plan, as we assumed, but the model is giving too much weight to post-Convertibility Plan information when estimating what happened before the Plan. In this case, the “real” graphic for the period before the Convertibility Plan would be somewhere between the two graphics we present. What should the relative weights be, we do not know, of course. But we suspect that the gradual increase in stability before the Convertibility Plan is somewhat misleading.

3 - The varying parameter model indicates a clear regime change for Israel at the Shequel Plan of June 1985. The fixed coefficient model indicates no such structural change, which is incorrect in our opinion.

4 - The Mexican Solidarity Pact started in December 1987. During the first months of the Pact, wages, prices and the exchange rate were frozen/controlled. Initially, these price freezes lasted for about two or three months and were successively renewed. We notice that the eigenvalue

remains constant during the first few months of the Pacto. It then falls, but remains above unity.

5 - All in all, the varying parameter model is the best one for Mexico, Israel and Argentina, since it indicates the regime changes that do seem to have occurred in these countries. The fixed coefficient model is the best one for the United Kingdom, since the change of regime hypothesis increases uncertainty.

6 - If there is no change of regime, the fixed parameter model must converge to the varying parameter model. Results for Mexico and, especially, for Israel show that the degree of convergence can be very low. Note that about 150 periods have elapsed since the assumed regime change in Israel. This is an argument in favour of the change of regime models.

7 - Successful stabilisation plans are, of course, associated with long-lasting reductions of the largest eigenvalue, which eliminate the explosiveness of the price system. They also tend to reduce the instability of the price system. Not only the price system moves from explosive to stationary, it also becomes more stable in the sense that the variability of the largest eigenvalue is greatly reduced. Thus, stabilisation makes it easier to forecast the behaviour of the price system.

Figure 5 shows the graphics of our second measure of stability: the probability that the largest eigenvalue is larger than unity, both for the fixed and varying parameter models. We do not show the results for the United Kingdom because, as figure 4D suggests, this probability is always very low.

Figure 5 tells a story similar to that of Figure 4: Argentina and Israel achieved successful stabilisation, Mexico did not and Brazil is in an intermediate situation. Note that "successful stabilisation" here only means the elimination the explosiveness of the price system. The sustainability of the stabilisation is not under consideration.

Figure 5A

Argentina Prob(λ>1|T,V) Prob(λ>1|t,F)

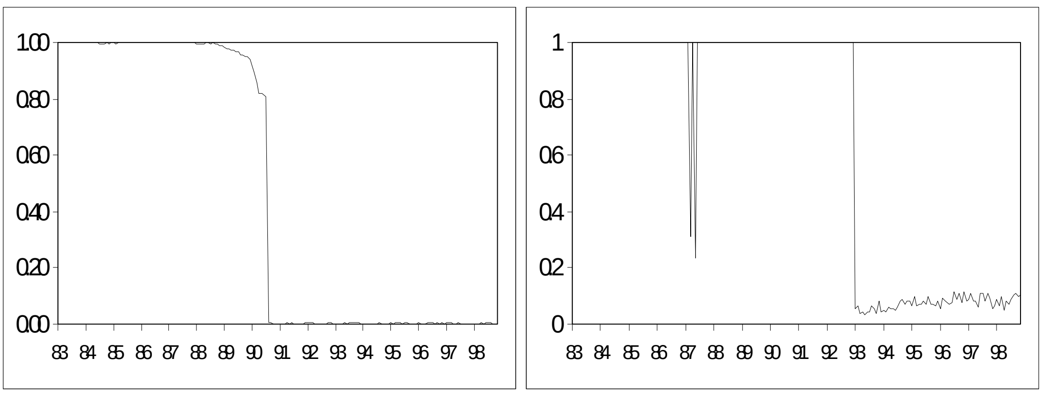


Figure 5B

Mexico Prob(λ>1|T,V) Prob(λ>1|t,F)

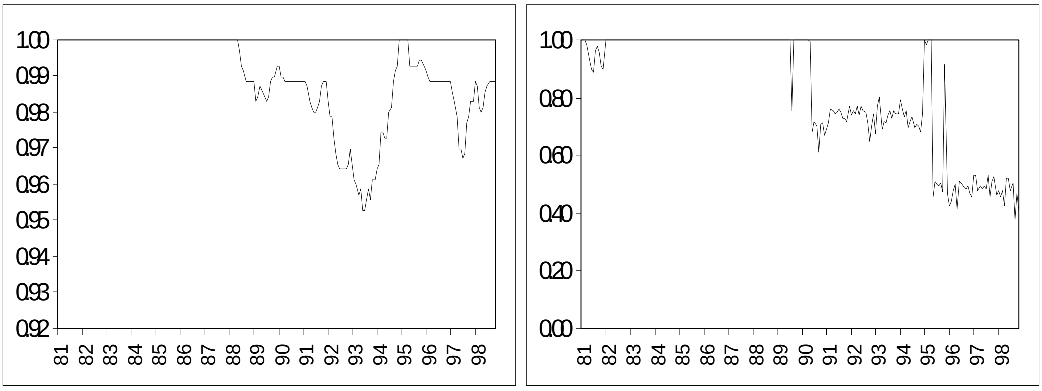
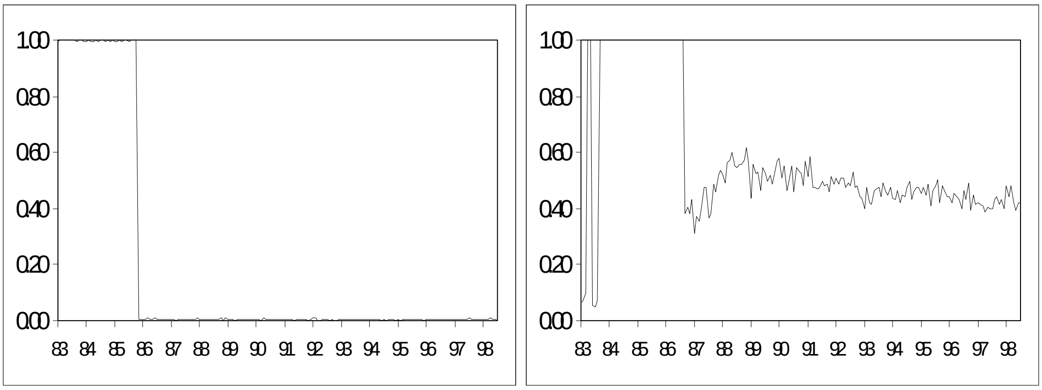


Figure 5C

Israel Prob(λ>1|T,V) Prob(λ>1|t,F)



4- CONCLUSION

In this paper we propose a possible measure of the degree of stability of price systems. The analysis suggests that this measure correctly pictures the historical experience of Brazil and Argentina, Israel, Mexico and the United Kingdom.

Our estimates indicate that in the "unstable" countries, inflation was not only high, but explosive as well. This measure of explosiveness was sharply reduced after each successful stabilisation plan.

In the Brazilian case, this measure of stability suggests that there was a change of regime at the Real Plan. It also suggests that, from the point of view of a risk-averting policy maker with a strong concern for inflation, the best moments for devaluation were probably 1996/1997 or early 1999. The large devaluation of January 1999 does not seem to have decreased the degree of stability of the price system.

This measure of stability also tends to track well the behaviour of the price systems of Argentina, Israel, Mexico and the United Kingdom, even though our analysis has been quite preliminary here.

If this measure of stability is found to be a useful one, it might be worthwhile to keep track of this indicator, as new data become available.

These results suggest that vector autoregressive time varying parameter model could be a useful tool to analyse regime changes, especially under the Bayesian approach. In this case, the distribution of the parameters does not depend on the values of the characteristic roots. This is important because in most cases we do not know a priori whether the VAR is stationary or not. Interestingly enough, in many cases, the hypothesis that the price system has a unity root seems to be a bad hypothesis.

ANNEX - Data Definition

Brazil

P: Consumer prices (IPC-SP, FIPE).
J: CDB nominal interest rate.
C: Exchange rate (R$/US$), monthly average, selling rate.
w: Index of the total amount of nominal wages, Fiesp.

Argentina

P: Consumer Prices (index numbers 1990=100).
C: Official exchange rate, monthly average (local currency units per US$)
J: Deposit Rate (percent per annum).

Israel

P: Consumer Prices (index numbers 1990=100)
C: Market Rate, monthly average (local currency units per US$)
J: Overall Cost of Unindexed Credit (percent per annum).
w: Wages, daily earnings.

Mexico

P: Consumer Prices (index numbers 1990=100).
C: Principal Rate, monthly average (local currency units per US$)
J: Average Cost of Funds (percent per annum).
w: Wages, monthly averages (index numbers 1990=100).

United Kingdom

P: Consumer Prices (index numbers 1990=100).
C: Market Rate, monthly average (local currency units per US$).
J: Lending Rate, clearing Banks (percent per annum).
w: Wages, monthly averages (index numbers 1990=100).

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