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What drives inflation expectations in Brazil? An empirical analysis

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What drives inflation expectations in Brazil? An empirical analysis

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This study examines the macro-economic determinants of survey inflation expectations in Brazil since the adoption of inflation targeting in 1999. The results suggest that the inflation-targeting framework has helped anchor expectations, with the dispersion of inflation expectations declining considerably, particularly during periods of high uncertainty. We also find that apart from the inflation target, the stance of fiscal policy, as proxied by the ratio of the consolidated primary surplus to GDP, has been instrumental in shaping expectations. The importance of past inflation in determining expectations appears to be relatively low, and the overall empirical evidence does not suggest the presence of substantial inertia in the inflation process.

I. Introduction

Since the mid-1990s, Brazil has successfully eradicated chronic high inflation. During the 1980s and early 1990s, median annual inflation in Brazil was 500%, primarily as a result of recurrently weak macro-economic fundamentals. However, with the implementation of the Real Plan in 1994, inflation decelerated markedly and has averaged about 9% per year since then. As argued by Rogoff (2003), the decline in global inflation over the past 10 years has taken place against a backdrop of significant reforms, particularly in monetary policy frameworks, in advanced and emerging market economies. In this regard, Brazil has been no exception. Comprehensive monetary, fiscal and structural reforms of the economy have contributed to a major disinflation during the past decade. Brazil stands out, however, in that it adopted inflation targeting when low inflation was seriously threatened by the move to a floating

exchange rate regime following the devaluation crisis of 1999.

As in other countries, much of the benefits from adopting inflation targeting in Brazil can be attributed to its impact on inflation expectations. While the merits of inflation targeting in Brazil have been extensively debated in the literature, there is broad agreement that its main benefits have hinged on its ability to anchor inflation expectations and minimize the output costs of disinflation, especially in the presence of large adverse shocks.[1] As stressed by Corbo (2001), inflation targets have been important commitment devices and coordination mechanisms in the presence of large shocks. Inflation targets have provided considerable information about monetary policy goals and the expected disinflation path, thus helping to shape inflation expectations. Under inflation targeting in Brazil, the central bank has conducted monetary policy in a forward-looking manner, reacting strongly to changes in inflationary

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[1] See Bogdanski *et al.* (2001) and Minella *et al.* (2003) for comprehensive analyses and evidence of Brazil's experience with inflation targeting in its early stages of implementation.

pressures and inflation expectations (Fraga *et al.*, 2003; Minella *et al.*, 2003).[2] Therefore, an understanding of the fundamental determinants of inflation expectations is critical in assessing the effectiveness of inflation targeting.

The ability of the inflation-targeting framework to influence expectations was necessarily rooted in comprehensive fiscal policy reforms. As noted by Sargent and Wallace (1986), the coordination of monetary and fiscal policies is critical for ensuring low and sustainable inflation, as no central bank has the ability to reduce inflation without assistance from fiscal policy.[3] Past stabilization attempts in Brazil had failed to address the problem of persistently high-budget deficits, but the adoption of inflation targeting as a nominal anchor for monetary policy was supported by comprehensive reforms that helped to achieve a significant improvement in the perceived sustainability of public finances. This has lessened deep-seated concerns about the implications of fiscal dominance and high indebtedness for inflation. Reforms accompanying the sharp adjustment in the consolidated public sector fiscal primary surplus in 1999 included the privatization of state-owned enterprises and banks, the re-negotiation of debts between the state and federal governments, pension reforms and the adoption of the Fiscal Responsibility Law. Nevertheless, a sustained improvement in public finances has coexisted with constitutionally mandated earmarking of federal revenues and a relatively inflexible structure of public spending.

This study aims to assess the role of fundamental determinants of survey inflation expectations in Brazil and their dynamics over time (Table 1)[3]. The study is mainly empirical and examines the period since the adoption of inflation targeting in 1999. In particular, the focus is on assessing how the credibility of targets has evolved over time, the extent to which expectations are formed in a backward-looking manner, and the role of macro-economic fundamentals, particularly fiscal policy, in shaping expectations.

The results suggest that the adoption of inflation targeting has helped anchor expectations, with the dispersion of inflation expectations declining considerably. The importance of the framework was particularly visible during the turbulent market conditions of 2002 and early 2003. The results also indicate that the framework has become more credible in the recent past, partly owing to the

Table 1. Brazil: inflation expectations short-run dynamics

Dependent variable: D (Expected inflation) Sample period: 2000:10–2006:07

Independent variables	Coefficient	*t*-statistics
Cointegration equation	−0.414	−2.357
D(Expected inflation (−1))	1.364	7.393
D(Expected inflation (−2))	−0.357	−1.472
D(Expected inflation (−3))	0.654	2.672
D(Expected inflation (−4))	0.080	0.343
D(Expected inflation (−5))	−0.127	−0.568
D(Expected inflation (−6))	0.691	3.066
D(Expected inflation (−7))	−0.326	−1.499
D(Expected inflation (−8))	0.232	1.216
D(Inflation(−2))	−0.037	−0.345
D(Inflation(−3))	0.079	0.642
D(Inflation(−4))	0.078	0.647
D(Inflation(−5))	0.131	1.007
D(Inflation(−6))	−0.143	−0.212
D(Inflation(−7))	0.348	2.967
D(Inflation(−8))	−0.155	−1.283
D(Inflation(−9))	0.225	2.317
D(Inflation target(−1))	0.539	0.351
D(Inflation target(−2))	0.216	0.122
D(Inflation target(−3))	−0.869	−0.497
D(Inflation target(−4))	−0.631	−0.357
D(Inflation target(−5))	−1.645	−0.947
D(Inflation target(−6))	3.164	1.863
D(Inflation target(−7))	−2.004	−1.144
D(Inflation target(−8))	2.448	1.703
D(Primary surplus(−4))	0.687	2.071
D(Primary surplus(−5))	0.162	0.561
D(Primary surplus(−6))	0.477	1.557
D(Primary surplus(−7))	−0.600	−1.946
D(Primary surplus(−8))	0.330	1.085
D(Primary surplus(−9))	−0.359	−1.355
D(Primary surplus(−10))	−0.022	−0.083
D(Primary surplus(−11))	−0.491	−2.092
Constant	0.087	1.969

Cointegration equation:
(Expected Inflation(−1) −0.170 × Inflation(−2) −1.92 × Inflation Target(−1) + 0.99 × Primary surplus(−4) −0.37)

sustained implementation of prudent macro-economic policies. We find that the stance of fiscal policy, as proxied by the ratio of the consolidated primary surplus to GDP, has been quite important in shaping inflation expectations. The relative importance of past inflation in determining expectations is fairly low, and the overall evidence does not suggest substantial inertia in the inflation process. The inflation target has also helped shape inflation expectations.

[2] The central bank does not target inflation expectations directly. For a discussion of inflation expectations targeting, see Bernanke and Woodford (1997).
[3] For the importance of fiscal policy in supporting an inflation targeting regime, see, for example, Mikek (2004). See Appendix for definition and sources.

Looking forward, further improvements in the inflation-targeting framework could be supported by institutional reforms to further strengthen its credibility. In particular, the Brazilian government has established the granting of full operational autonomy to the central bank as an important reform priority.[4] At the same time, further research on the issue of price stability and the long-run inflation target for an economy like Brazil, would help support a gradual narrowing of inflation target bands, beyond the envisaged reduction for 2006, and thus, help solidify the inflation-targeting framework.

II. Inflation Expectations in Brazil

Some background and evidence on inflation targeting in Brazil

Unlike the experiences of most inflation-targeting countries, the adoption of inflation targeting in Brazil occurred under unusual circumstances: in the midst of a crisis. The inflation-targeting regime was adopted in 1999. In February 1999, Arminio Fraga, the newly appointed central bank president, announced the adoption of inflation targeting shortly after the decision to let the real float and the resulting devaluation in January. In June, a presidential decree instituted the new monetary framework, which comprised: (i) inflation targets for 1999–2001, as well as a commitment to announce further targets 2 years in advance; (ii) the setting of inflation targets by the National Monetary Council; and (iii) the adoption of procedures to ensure transparency and accountability broadly consistent with other inflation-targeting countries.

Interestingly enough, many of the conditions that are usually regarded as 'prerequisites' for adopting inflation targeting were yet to be in place. As noted by Mishkin (2004), Brazil was confronted with a relatively weak fiscal policy and institutional framework (the Fiscal Responsibility Law had not been implemented), as well as with low credibility of monetary institutions (despite a remarkable inflation stabilization in the 1990s) associated with the lack of 'clear cut' independence of the central bank. These weaknesses raised concerns about the effectiveness of inflation targeting as a framework for monetary policy (Fig. 1).

Despite these weaknesses and large adverse shocks, inflation targeting has been implemented in a flexible,
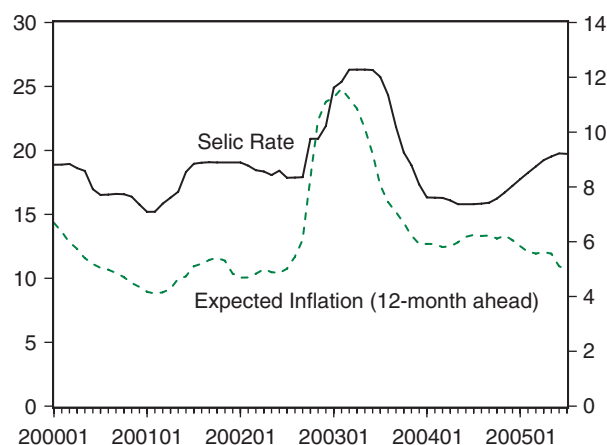
Fig. 1. Expected inflation and SELIC rate (in precent)
Source: Central Bank of Brazil.

transparent and accountable manner. Large adverse shocks have led to several upward revisions to the targets and wide tolerance bands (compared with other emerging markets) to support a flexible implementation of the inflation-targeting framework and minimize output costs. At the same time, the central bank demonstrated its willingness to raise policy interest rates quite sharply during 2002, to keep inflation in check. Moreover, the factors underlying revisions to targets have been explained in a transparent manner, mainly through 'open letters' from the central bank, as well as quarterly inflation reports, which have signalled the central bank's commitment to accountability.[5] These actions, together with the growing confidence in the reforms of public finances, have helped to strengthen the ability of the inflation-targeting framework to anchor expectations, particularly in its early stages of implementation (Fig. 2).

In fact, uncertainty about future inflation has declined substantially since, the adoption of inflation targeting and has remained relatively low even in the presence of large shocks. Consensus forecasts for inflation published for Brazil reveal that inflation expectations were highly volatile during the early stages of the Real plan, as well as during the crisis in 1999. However, the dispersion of inflation forecasts has declined sharply since 1999, not withstanding the fact that the economy was exposed to large adverse shocks, particularly during the political transition in 2002. While the decline in the level and dispersion of inflation mirrors, to some extent, global

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[4] See 'Reformas Microeconomicas e Crescimento de Longo Prazo,' Ministério de Fazenda, Secretaria de Politica Economica.
[5] A caveat worth mentioning in the context of this comparison is that, unlike in other countries, there are no 'escape clauses' regarding the fulfillment of the inflation target in Brazil.

developments, as noted by Rogoff (2003), the dispersion of inflation expectations has been low and relatively stable since 1999, and appears to have declined further in 2004 and 2005. This is likely to reflect the stronger perceived commitment and ability to achieve inflation objectives under the new framework (Fig. 3).

Since 1999, one conducive factor in reducing inflation uncertainty has likely been the remarkable fiscal adjustment. Up until the Real Plan in 1994, chronic high inflation was in large part of the result of persistently high-fiscal deficits financed through seigniorage, as well as widespread indexation practices that imparted considerable 'inertia' to inflation. The reliance on the inflation tax helped to keep public indebtedness at manageable levels. However, with the implementation of the Real Plan, the loss of

seigniorage and the prevalence of high real-interest rates made it increasingly more difficult to keep public debt from rising, especially during the late 1990s, highlighting the need for major reforms in public finances (Fig. 4). As a result, the government begun to restructure states 'and municipalities' debt from 1997 on and implemented the Fiscal Responsibility Law in 2000, which among other reforms, banned the federal government from refinancing the debt of states and municipalities in the future. As noted by Goldfajn and Guardia (2003), a strengthened institutional framework for controlling public finances at all levels of government paved the way for the comprehensive fiscal adjustment that has been in place since 1999.

An empirical model

A reduced-form inflation expectations equation was estimated to assess its fundamental determinants and changes in its dynamics, since the adoption of inflation targeting in 1999. The reduced-form equation builds on the work by Celasun *et al.* (2004a, b) and is derived from a structural price-setting model as described in Gali and Gertler (1999), allowing for both backward-and forward-looking price-setters. Following Calvo (1983), their model assumes that firms face exogenous constraints on their price changes. The average newly set price is a combination of prices posted by backward- and forward-looking price-setters. In the aggregate, inflation is driven by expectations about future inflation, past inflation and a term reflecting real marginal costs of production. The model suggests that expectations of future marginal production costs should be important in
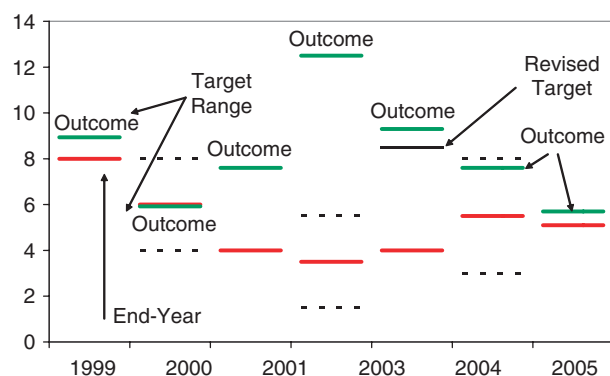
Fig. 2. Inflation: targets, tolerance bands and outcomes, 1999–2005
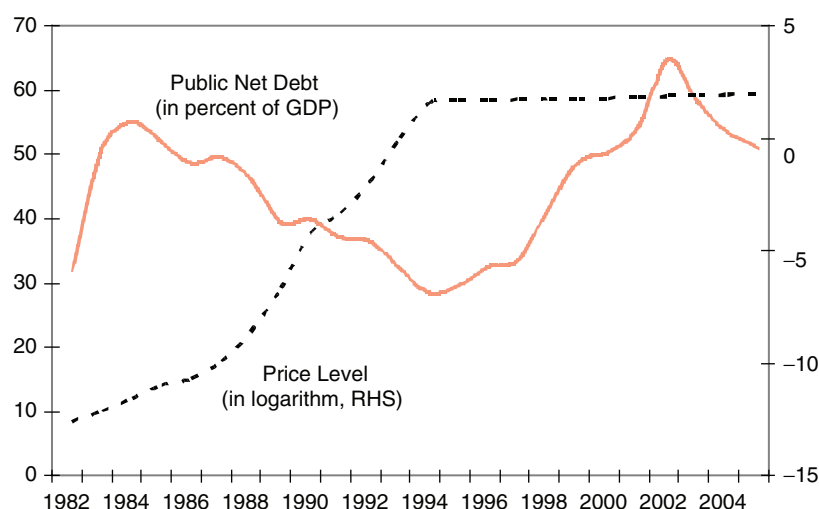*Source*: Author's calculations based on Central Bank of Brazil data.
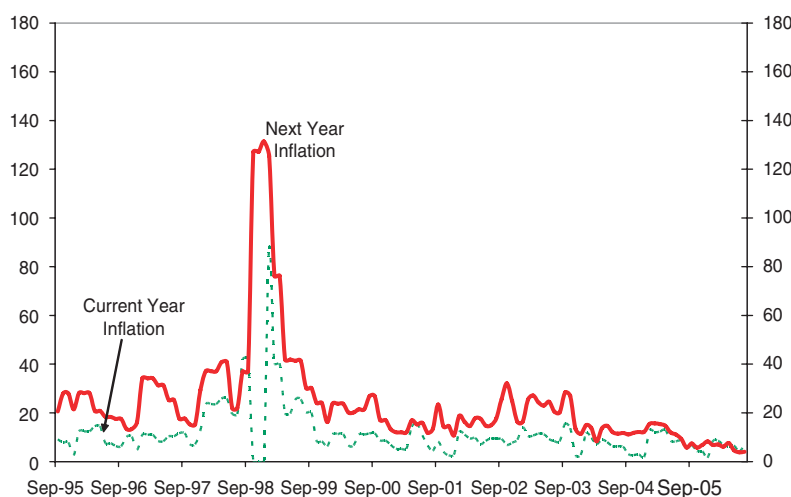
Fig. 3. Dispersion of Consensus inflation forecast (coefficient of variation)
Source: Author's calculations based on Consensus forecast data.

Fig. 4. Public indebtedness and inflation
Source: Author's calculations based on Central Bank of Brazil statistics.

driving inflation expectations. The specification of the inflation expectations equation estimated here uses deviations of the real effective exchange rate and real wages from their trend values as proxies for real marginal costs.

The scarce literature exploring empirically the determinants of inflation expectations in emerging market economies has either focused on target credibility (see, for example, Minella *et al.*, 2003), or, more recently on the role of fiscal expectations (as in Celasun *et al.*, 2004a, b). The specification presented in this study encompasses both of these aspects.[6]

Given the importance of fiscal policy for inflation, the primary fiscal balance for the consolidated public sector is also explicitly included in the estimations. In models with forward-looking behaviour, such as that of Sargent and Wallace (1986), the whole path of expected future deficits typically matters for the behaviour of today's inflation. The current stance of fiscal policy is likely to be used and interpreted as a signal for the governments' commitment to fiscal sustainability, and therefore, to provide a good proxy of the expected future path of fiscal balances, at least in the near-to-medium term. This is particularly the case during periods of high public indebtedness when

the government intends to signal its commitment to sustainable macro-economic policies (Drudi and Prati, 2000).

Seven variables were considered in order to be included in the model:

- π_t^e is the 12-month ahead expected inflation rate,
- π_{t-1} is the lagged 12-month inflation rate,
- π_t^T is the 12-month ahead inflation target rate,
- *pb* stands for the primary fiscal balance in percent of GDP,
- *r* is the real policy interest rate (to proxy for the stance of monetary policy) and
- *reer* and *wage* are deviations of the real effective exchange rate and real wages from their trend values (where the trend is approximated through a Hodrick–Prescott filter).[7]

The choice of lags for the independent variables is driven primarily by the availability of data for the public at time *t*.

Augmented Dickey–Fuller test on the series indicate that four of these variables appear to have a unit root: Inflation expectations, the Inflation rate, the inflation target and the primary surplus (Tables 2 and 3).[8] Applying the Johansen procedure

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[6] In their study, Celasun *et al.* (2004a) examine 11 disinflation episodes in emerging market countries, including Brazil's experience during 1994–1998. They find that expectations of future inflation play a much more important role than past inflation in shaping the inflation process and, similarly to the results presented in our study, that improvements in fiscal balances significantly reduce inflation expectations. The effect of fiscal variables is found to be more pronounced in the case of Brazil than in other countries. For the relationship between budget deficits and inflation in an emerging market, see for example Tekin-Koru and ÖZmen (2003).

[7] We also experimented with the 'ideal' band pass filter proposed by Ouliaris and Corbae (2005), which yielded similar qualitative results.

[8] See Table 2. Phillips–Perron tests yield the same qualitative results. For further evidence on the nonstationarity of the inflation process in Brazil, see Yoon (2003). For worldwide evidence, see Chremza *et al.* (2005).

Table 2. Augmented Dickey–Fuller unit root tests*

Variable	Number of unit roots.
Inflation expectations	1
Inflation	1
Inflation target	1
Primary surplus	1
Real interest rate	0
Real effective exchange rate gap	0
Real wage gap	0

Notes: (*) H0) Series studied has a unit root. Decisions on the number of unit roots were made according to the ADF test results on the best fitted especification for the alternative hypothesis, which in turn were detected by the ordinary criterions reported in the eviews test output and by graphed-series paths (Table 3).

(see Johansen 1988, 1990 and 1992) to this set of variables showed that they were cointegrated, with the trace statistic indicating the presence of one cointegration equation.[9]

In light of these results, we estimated a Vector Error Correction model (VEC) with only one cointegration equation relating explanatory variables that have a unit root. We found that the coefficient's vector in the cointegration equation is endogenously determined by three of the four integrated variables (only one of them – the primary surplus – was found weakly exogenous). Nevertheless, given the difficulties in distinguishing stationary and nonstationary time series in short samples, we also report results from OLS and GMM estimations (Table 4).[10]

For OLS and GMM, the estimated equation is:

$$\pi_t^e = \alpha_0 + \alpha_1 \pi_{t-1} + \alpha_2 \pi_t^T + \alpha_3 pb_{t-3} + \alpha_4 r_{t-3} + \alpha_5 reer_{t-3} + \alpha_6 wage_{t-3} + u_t$$

In the Johansen procedure, only cointegrated variables were included in the estimated long-run equation:[11]

$$\pi_t^e = \beta_0 + \beta_1 \pi_{t-1} + \beta_2 \pi_t^T + \beta_3 pb_{t-3} + \varepsilon_t$$

The econometric estimates indicate that the inflation target and fiscal policy have been important in driving inflation expectations.

In general, all the models track inflation expectations quite well. The fitted values from the VEC as estimated by the Johansen procedure are shown in Fig. 5.[12]

Similarly to other empirical studies of inflation targeting in emerging market economies, the relative importance of past inflation in determining expectations is relatively low, with the estimates ranging around 0.17–0.42. The inflation target is one of the most important determinants of inflation expectations, with estimates varying from 0.74 to 1.92. If the inflation target is fully credible, one would expect the coefficient on the target to be one, but this is not the case in any of the estimations suggesting a lower degree of credibility of the inflation target.

The results also confirm that another important factor is the stance of fiscal policy, as proxied by the ratio of the consolidated primary surplus to GDP. As expected, a rise in the primary surplus tends to lower inflation expectations; the estimates suggest that a one-percentage point increase in the ratio of primary surplus to GDP reduces inflation expectations by about 0.73–1 percentage point.

Our proxies for marginal costs, which are stationary variables, also enter the OLS and GMM estimations significantly. The lags for the *reer* and *wage* may affect inflation expectations with a positive or negative sign depending on the nature and

[9] The maximum eigenvalue statistic suggested the presence of two cointegrating relations, but the implied coefficients were difficult to interpret.

[10] Three different econometric methods were used to assess the robustness of the empirical results: ordinary least squares (OLS), GMM and full information maximum likelihood (FIML) method that is implicit in the Johansen procedure. To deal with potential endogeneity of certain regressors when using OLS, the model was estimated using the generalized method of moments (GMM). The instruments used were the 12-month inflation rate, the 12-month ahead inflation target, the real policy interest rate and the 12-month international inflation rate. Two and three periods backward of international inflation were used as instruments. The remaining instruments were lagged two periods (relative to the lags used in the equation), except for the real policy interest rate, which was lagged up to three periods. GMM is not well-suited for small samples and tends to be sensitive to the choice of instruments. The sample size is roughly 80 observations and the estimated coefficients under GMM were mostly robust to the choice of instruments. Finally, the Johansen procedure avoids the problem of endogeneity and also allows to test weak exogeneity. The first step was testing the stationarity of the variables. Next, we tested the existence of cointegration relations among the integrated variables, finding one cointegration relation among them. The third step was to fit a VEC model that also allowed to check weak exogeneity of variables. Only one variable was found weakly exogenous. See the Appendix for a list of data sources and Table 2 for stationarity tests results.

[11] Alternatively, the stationary variables (real wage gap, real interest rate and real effective exchange rate gap) were included as exogenous variables in the short-run specification; they did not enter the dynamics significantly.

[12] A VEC model allows to examine short-run dynamics. The estimation results show that in the short-run inflation expectations is highly determined by the adjustment process to long-run equilibrium, with the autoregressive terms up to the third lag being the most significant variables. The long-run imbalance correction coefficient is negative (−0.4), thus indicating that short-run path converges toward long-run dynamics ruled by the cointegration relation.

Table 3. ordinary criterions reported in the eviews test output and by graphed-series paths

Variable	Intercept or tend	Test statistic	Test critical value 1%	Test critical value 5%	Test critical value 10%
Expected inflation	None	−0.74	−2.60	−1.95	−1.61
	Intercept	−3.09	−3.52	−2.90	−2.59
	Trend and intercept	−3.07	−4.08	−3.50	−3.16
Inflation	None	−0.98	−2.59	−1.94	−1.61
	Intercept	−2.79	−3.50	−2.89	−2.58
	Trend and intercept	−2.69	−4.06	−3.46	−3.16
Inflation target	None	−0.64	−2.59	−1.94	−1.61
	Intercept	−3.07	−3.52	−2.90	−2.60
	Trend and intercept	−2.97	−4.06	−3.46	−3.16
Primary surplus	None	0.91	−2.60	−1.94	−1.61
	Intercept	−4.25	−3.51	−2.89	−2.58
	Trend and intercept	−3.23	−4.06	−3.46	−3.16
Real interest rate	None	−3.62	−3.59	−1.94	−1.61
	Intercept	−7.64	−3.51	−2.89	−2.58
	Trend and intercept	−7.17	−4.06	−3.46	−3.16
Real effective exchange rate gap	None	−3.95	−2.59	−1.94	−1.61
	Intercept	−3.93	−3.51	−2.89	−2.58
	Trend and intercept	−3.95	−2.59	−1.94	−1.61
Real wage gap	None	−2.90	−2.61	−1.95	−1.61
	Intercept	−2.87	−3.55	−2.92	−2.60
	Trend and intercept	−2.66	−4.13	−3.49	−3.18
d(Expected inflation)	None	−3.88	−2.59	−1.94	−1.61
	Intercept	−3.85	−3.52	−2.90	−2.58
	Trend and intercept	−3.85	−4.08	−3.47	−3.16
d(Inflation)	None	−2.92	−2.60	−1.94	−1.61
	Intercept	−3.89	−3.51	−2.89	−2.58
	Trend and intercept	−3.98	−4.06	−3.46	−3.16
d(Inflation target)	None	−1.87	−2.59	−1.94	−1.61
	Intercept	−1.76	−3.51	−2.89	−2.58
	Trend and intercept	−1.73	−4.06	−3.46	−3.16
d(Primary surplus)	None	−7.53	−2.59	−1.94	−1.61
	Intercept	−7.74	−3.51	−2.89	−2.58
	Trend and intercept	−8.25	−4.06	−3.46	−3.16
d(Real interest rate)	None	−6.67	−2.59	−1.94	−1.61
	Intercept	−6.77	−3.51	−2.89	−2.58
	Trend and intercept	−7.22	−4.06	−3.46	−3.16
d(Real effective exchange rate gap)	None	−8.64	−2.59	−1.94	−1.61
	Intercept	−8.59	−3.51	−2.89	−2.58
	Trend and intercept	−8.54	−4.06	−3.46	−3.16
d(Real wage gap)	None	−7.21	−2.61	−195	−1.61
	Intercept	−7.15	−3.56	−2.92	−2.60
	Trend and intercept	−7.39	−4.13	−3.49	−3.18

persistence of the deviations of these variables from trend.[13] In our estimations, the wage gap enters with a positive sign, signalling the impact of increased demand pressures. The real exchange rate gap also enters positively, consistent with the notion that a more depreciated real exchange rate implies an increase in the real costs of imported inputs and a pass-through link between depreciation and inflation in the near term. Longer lags tend to result in negative signs, suggesting that agents see deviations in *reer* and *wage* as 'transitory' and likely to reverse in the period ahead.

As for the stance of monetary policy, OLS and GMM estimates suggest that past increases in policy
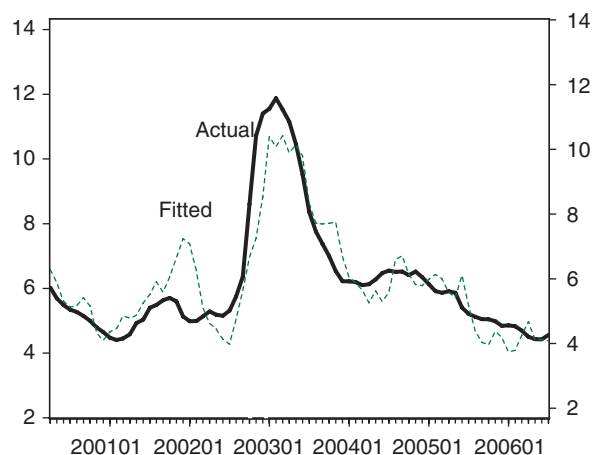
[13] An increase in our real exchange rate measure corresponds to a depreciation.

Table 4. Inflation-target bands in selected emerging markets

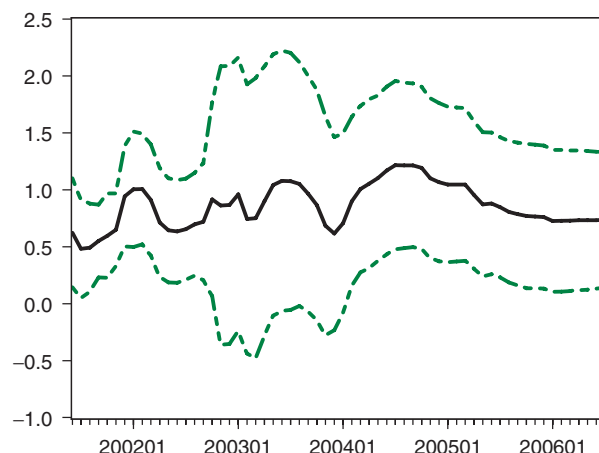| Country	Inflation target band
Brazil	2.5–6.5
Chile	2–4
Czech Republic	2–4
Israel	1–3
Peru	1.5–3.5
Philippines	4–5
South Africa	3–6

Sources: Countries' respective central banks.

Fig. 5. Expected inflation: actual vs. fitted (Johansen procedure-VEC model)
Source: Author's calculations.

Fig. 6. Inflation target coefficient: recursive estimation
Source: Author's calculations.

Fig. 7. Lagged inflation coefficient: recursive estimation
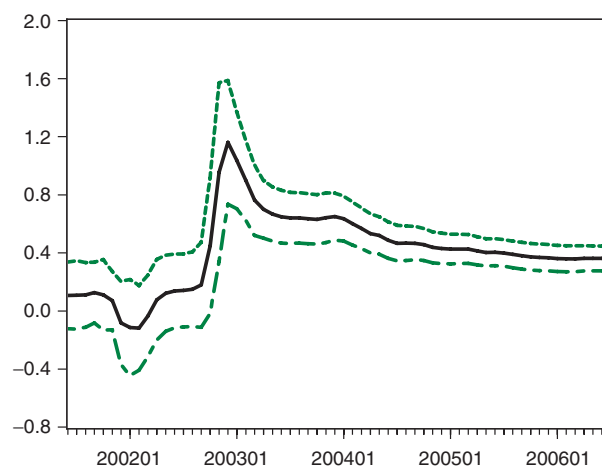*Source*: Author's calculations.

interest rates tend to increase inflation expectations, although these estimations are not statistically significant. Estimating the impact of changes in the policy rate on inflation expectations is complicated by the monetary policy lags involved. For example, the estimated positive coefficients may reflect the fact that interest rates tend to rise when actual inflation and inflation expectations are increasing. Allowing longer lags for the policy real-interest rate tends to produce negative coefficients with larger, but not significant *t*-statistics. However, as presented below, a recursive estimation of the model reveals significant changes in the dynamics of inflation expectations and the impact of their fundamental determinants within the sample period, largely associated with different episodes of financial market turbulence.

Since 2004, inflation expectations have become significantly less backward-looking and increasingly anchored in the inflation target.

Recursive OLS estimations indicate that the inflation target coefficient and the coefficient on lagged inflation have tended to stabilize (Figs 6 and 7). Three distinct periods regarding the formation of expectations can be distinguished.[14]

- In the first period, which runs from the earlier stages of implementation until around mid 2002, the new system seemed to have enjoyed substantial credibility, with a low coefficient on lagged inflation and the coefficient on the inflation target approaching one.
- Then, however, monetary policy was confronted with the significant impact of several external

[14] Recursive estimations allow to trace out the evolution of the coefficients, as more and more of the sample data are used for estimation.

Fig. 8. Primary surplus coefficient: recursive estimation
Source: Author's calculations.

and domestic shocks, which seem to have had an effect on the perceived credibility of the inflation-targeting framework. In line with Minella *et al.* (2003), the results show a marked deterioration in the credibility of the inflation-targeting framework, as expectations became more 'backward-looking'. This seems particularly pronounced in late 2002 and early 2003, reflecting concerns about the commitment of the new administration to inflation targeting.

- Since 2004, the demonstrated commitment to inflation targeting and prudent conduct of macro-economic has begun to pay off, as inflation expectations have become less dependent on past inflation and the coefficient on the inflation target has stabilized.[15]

- Fiscal policy has been instrumental in anchoring inflation expectations, particularly during periods of high uncertainty. The results indicate that in the early stages of inflation targeting, the impact of primary fiscal surpluses on inflation expectations were relatively weak (Fig. 8). This may reflect some uncertainty about the government's ability to sustain these surpluses despite the legal requirements under the Fiscal Responsibility Law and the Budget Guidelines Law. This uncertainty could have reduced the

signalling value of individual realizations of primary surpluses. However, as the fiscal adjustment was sustained, its impact on expectations became more pronounced. This is visible during the second half of 2002 and during 2003, when the new administration raised the primary surplus target, which amid widespread concerns about debt sustainability. The role of the primary surplus in anchoring inflation expectations might have been particularly important in Brazil due to the lack of full operational autonomy of the central bank. This result is consistent with Blanchard's (2004) view that fiscal policy is a critical instrument to decrease inflation in Brazil. However, the evidence also supports the view that a prudent conduct of monetary policy that has accompanied fiscal policy in recent years has been instrumental in having inflation expectations increasingly linked to the inflation target.

A closer look into the relative contribution of the main macro-economic determinants to the total variation of the estimated inflation expectations confirms the importance of fiscal policy, along with the inflation target and past inflation rate, in driving inflation expectations (Fig. 9). As noted earlier, the inflation and the primary surplus targets have provided an important coordination mechanism to inflation expectations during periods of high uncertainty, like in 2002, while the relative importance of past inflation in driving expectations seems to have risen in late 2002 and through early 2003, before declining until the middle of 2004 and before stabilizing thereafter.

Lagged inflation, inertia and the role of administered prices

The persistence of high inflation has been a recurrent theme in policy discussions during the 1980s and early 1990s in Latin America and particularly, in Brazil. During this period, Brazil was often cited as a typical example of a country where inflation was largely an 'inertial phenomenon', primarily associated with widespread indexation in the economy.[16] While the

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[15] In this study, we do not examine the question of whether inflation expectations are rational. Rationality tests of inflation expectations typically focus on whether expectations are unbiased predictors of future inflation. Typically, the hypothesis of unbiasedness tends to be rejected, particularly in small samples. Andolfatto *et al.* (2005) argue that incomplete information and learning about a few significant shifts in monetary policy can yield the expectations of rational agents to appear biased. An exploratory analysis of the Brazilian survey data on inflation expectations indicates a rejection of the unbiasedness hypothesis, which is not surprising in light of the small sample and the shifts occurring in the period analysed in this article.
[16] Dornbusch and Simonsen (1987) and Cardoso (1991) provide interesting analyses and policy insights to the issue of inflation inertia, the role of macro-economic fundamentals, and inflation stabilization strategies in Argentina, Brazil and Israel during the 1980s.
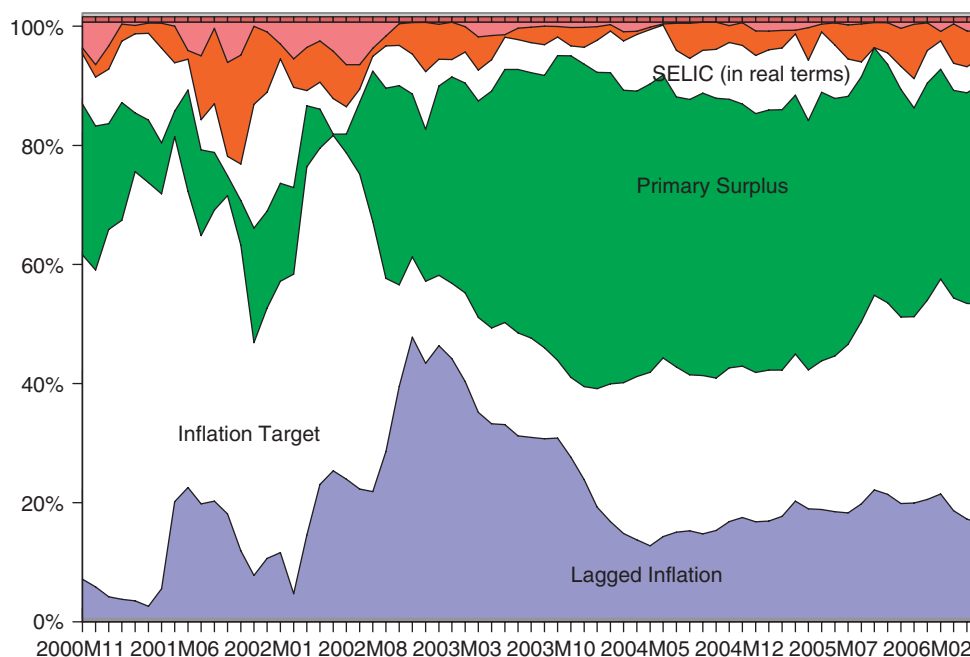
Fig. 9.   Contribution to total variation of fitted expected inflation (based on recursive estimation)
Source: Author's calculations.

empirical evidence on inflation inertia – in the sense of the prevalence of backward-looking price-setting in driving the inflation process – in Brazil remains elusive, some concerns have been recently voiced about the role played by administered prices in imparting 'inertia' and how these prices may affect inflation expectations.[17] For example, Minella *et al.* (2003) stress the difficulties confronting monetary policy during recent years in dealing with changes in relative prices, partly associated with administered prices that pushed up the overall inflation rate. They note that the dynamics from administered prices tend to differ from those of market prices, reflecting higher dependence on international prices (such as oil), greater pass-through from exchange rate changes, and a stronger backward-looking behaviour that tends to add to inflationary inertia.[18]

The moderate element of backward-looking behaviour found to be present in the expectation formation mechanism does not appear to stem primarily from inertia in administered prices, although there is a dynamic relation. Breaking down lagged inflation into market- and administered-price inflation reveals that there is a significant difference in the degree of pass-through from changes in these prices to inflation expectations, with the coefficient on administered price inflation being lower in almost all the sample period (Fig. 10).[19]

This result, however, does not imply that administered prices do not represent a source of inflationary inertia. Shocks to market-determined prices do affect administered prices with a lag. For example, impulse responses from a two variable VAR show that shocks to market-determined inflation feed into administered price inflation, with a one-percentage shock to free prices yielding $\approx 2.5\%$ inflation in administered prices after about 1 year (Fig. 11).[20]

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[17] Since, inflation in Brazil has a unit root in an univariate statistical sense, it is highly persistent. Such persistence may derive from backward-looking price-setting back can also be fully consistent with forward-looking behaviour if the variables driving inflation are highly persistent.

[18] Administered or 'monitored' prices comprise those for a range of public services, such as fixed telephone lines, electricity, transportation, as well as gasoline and alcohol, among others. Their weight in the consumer price index (IPCA) is roughly 30%. Adjustments to these prices are either made by private regulated companies or directly set by government agencies at various levels. Prices for oil products are set by state-owned Petrobras.

[19] Based on the weights in total inflation alone, one would expect the coefficient on market-determined prices to be about twice as large as that on administered prices.

[20] These results are based on a second-order VAR for market-determined and -administered price inflation rates, with a lag selection chosen based on the Akaike and Schwartz information criteria. The impulse response functions correspond to a one SD shock to the inflation rates based on a Choleski decomposition. The results are robust to different ordering of the variables in the VAR.
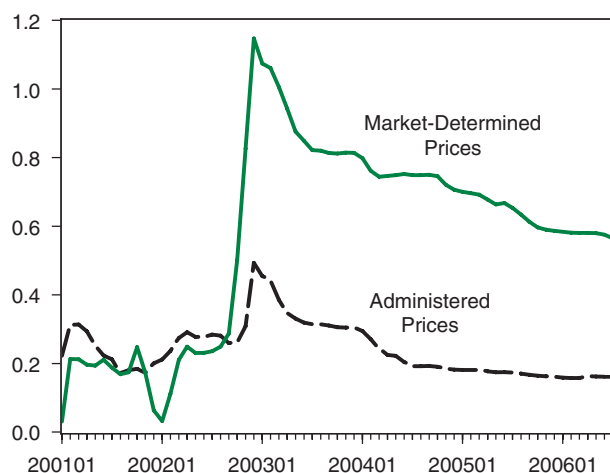
Fig. 10. Lagged inflation: recursive coefficients for market and administered price inflation
Source: Author's calculations.
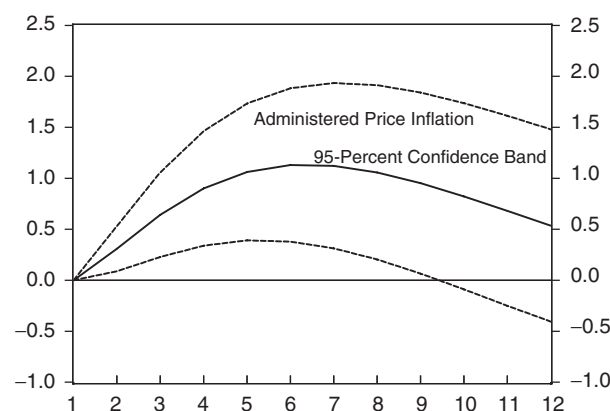
Fig. 11. Impulse response to shock in market-determined price inflation
Source: Author's calculations.

The degree of overall inflationary inertia, however, is small. For example, Celasun *et al.* (2004a) estimate Phillips-curve regressions with current inflation as a function of expected inflation, lagged inflation and a proxy for demand pressures for the period early nineties, finding that current inflation is largely driven by inflation expectations about future inflation, with a coefficient on future inflation of close to one.[21] Similar estimations conducted with more recent data confirm these results, which along with our findings on the limited role of past inflation in determining inflation expectations, indicate that the inflationary process in Brazil only has a limited backward-looking component.

Future considerations to strengthen the inflation targeting framework

The empirical results presented in this article provide support to the view that the experience with inflation targeting has been quite successful in Brazil. The empirical analyses show that inflation expectations have become less 'backward-looking', increasingly anchored around the inflation target in recent years, and that inflation inertia, particularly from administered prices, appears to have been rather small. Nonetheless, the estimated results also show that there is room to strengthen the credibility of the inflation-targeting framework, as the estimated coefficient on the inflation target, has been different from one on average.

In this regard, several options are being considered by the Brazilian authorities to further strengthen the effectiveness of the inflation-targeting framework. One important option is the granting of full operational autonomy to the central bank. In line with the findings in the literature, which supports the notion that the credibility of monetary policy is strengthened with an institutional framework that provides the central bank with '*de jure*' and '*de facto*' independence to pursue price stability, the Brazilian authorities have established such reform as a priority in their agenda.[22] In addition, with the sound macro-economic framework to remain in place and the economy's resilience to shock continuing to strengthen, the central bank has begun to gradually narrow the inflation target bands, which remain high in Brazil by emerging market standards (Table 5).[23] As inflation becomes more stable and the economy's resilience to shocks increases, continued narrowing of the bands and the establishment of a long-run inflation target may help in further anchoring expectations.

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[21] A substantial empirical literature tested for the existence of inflation inertia in several price indexes in Brazil based on time-series analysis. Novaes (1993) and Cati *et al.* (1999) have tested for inertia during 1970–1985 and 1974–1993, respectively, and found statistical evidence of inertia in Brazil's inflation process. However, more recent tests, such as those of Campêlo and Cribari-Neto (2003) and Reisen *et al.* (2003), find statistical evidence supporting low inertia, during the period of 1944 to 2000. In general, however, univariate time-series analyses are difficult to interpret, as an inflationary process can show strong persistence related to inflationary policies even in the absence of inertia and fully forward-looking behaviour.
[22] See Alessina and Summers (1993), Cukierman (1992) and Jácome and Vázquez (2005).
[23] The central bank has set the target bands at 2.5–6.5% for 2006.

Table 5. BRAZIL: estimated equations for inflation expectations

	Models					
	OLS		GMM		Cointegration equation	
Constant	2.52	(0.161)	−0.26	(0.921)	0.37	n.a.
Lagged inflation	0.36	(0.000)	0.42	(0.000)	0.17	(0.073)
Inflation target	0.74	(0.006)	1.26	(0.028)	1.92	(0.235)
Primary surplus $(t-3)$	−0.73	(0.035)	−1.01	(0.096)	−0.99	(0.243)
Real interest rate $(t-3)$	0.035	(0.695)	0.15	(0.244)	−	
Real effective exchange rate gap $(t-3)$	0.12	(0.000)	0.13	(0.000)	−	
Real wage gap $(t-3)$	0.04	(0.263)	0.27	(0.009)	−	
Adjusted R^2	0.77		0.53		0.69	

Sources: IMF staff estimates.
Notes: 1/Prob-values in parenthesis based on Newey–West HAC SEs denote the significance levels. For Johansen Procedure SDs of parameter estimations are reported in parenthesis. For OLS, the sample period is 2000:4–2006:7. For GMM and VECM, the sample periods are 2000:1–2006:7.

III. Conclusions

The empirical evidence presented in this study shows that inflation expectations in Brazil have become better anchored following the adoption of inflation targeting and that a prudent conduct of fiscal policy has helped in strengthening the credibility of the monetary regime. Inflation uncertainty, as proxied by the dispersion of inflation forecasts, has declined markedly, since the adoption of inflation targeting in 1999. In addition, the empirical results indicate that fiscal policy has had a substantial impact on inflation expectations, especially during episodes of large adverse shocks, such as those in 2002. The results also support the view that the credibility of inflation targeting has improved in recent years on the back of a prudent conduct of monetary policy and persistent adherence to a strong fiscal policy. These developments bode well for the prospects of achieving lower inflation in the years ahead.

Looking forward, granting full operational autonomy and further narrowing target bands would further consolidate the inflation-targeting framework and its credibility. The Brazilian authorities have recently indicated that central bank autonomy is one of their key 'structural' reform priorities. In our opinion, such a move would be highly beneficial to further strengthen the credibility of inflation targeting, thereby reducing inflation risk premiums. Continued adherence to prudent macro-economic policies would also make the economy less vulnerable to adverse shifts in market sentiment and less prone to large and volatile shocks. This would provide scope for better assessing an appropriate long-run inflation target and target bands.

References

Alessina, A. and Summers, L. (1993) Central bank independence and macroeconomic performance: some comparative evidence, *Journal of Money, Credit and Banking*, **25**, 151–62.

Andolfatto, D., Hendry, S. and Moran, K. (2005) Are inflation expectations Rational?, Université Laval (unpublished).

Bernanke, B. S. and Woodford, M. (1997) Inflation forecasts and monetary policy, *Journal of Money, Credit and Banking*, **29**, 653–84.

Blanchard, O. (2004) Fiscal Dominance and Inflation Targeting: Lessons from Brazil, National Bureau of Economic Research (NBER) Working Paper No. 10389, Cambridge, Massachusetts.

Bogdanski, J., de Freitas, P. S., Goldfajn, I. and Tombini, A. (2001) Inflation targeting in Brazil: shocks, backward looking prices, and IMF conditionality, Working Paper Series No. 110, Central Bank of Chile, Santiago.

Calvo, G. (1983) Staggered prices in a utility maximizing framework, *Journal of Monetary Economics*, **3**, 383–98.

Campêlo, A. K. and Cribari-Neto, F. (2003) Inflation inertia and inliers: the case of Brazil, *Revista Brasileira de Economia, Fundaçao Getulio Vargas*, **57**, 713–19.

Cardoso, E. (1991) From Inertia to Megainflation: Brazil in the 1980s in Lessons of Economic Stabilization and Its Aftermath, edited by M. Bruno, S. Fischer,

E. Helpman and N. Liviatan with L. Meridor. Cambridge, MA: MIT Press, 143–77.

Cati, R. C., Garcia, M. and Perron, P. (1999) Unit roots in the presence of abrupt governmental interventions with an application to Brazilian data, *Journal of Applied Econometrics*, **14**, 27–56.

Celasun, O., Gelos, R. G. and Prati, A. (2004a) Obstacles to disinflation: what is the role of fiscal expectations?, *Economic Policy*, **19**, 441–81.

Celasun, O., Gelos, R. G. and Prati, A. (2004b) Would 'cold Turkey' work in Turkey?, *IMF Staff Papers*, **51**, 493–509.

Charemza, W., Hrsitova, D. and Burridge, P. (2005) Is inflation stationary?, *Applied Economics*, **37**, 901–03.

Corbo, V., Landerretche, O. and Schmidt-Hebbel, K. (2001) Assessing inflation targeting after a decade of world experience, *International Journal of Finance and Economics*, **6**, 343–68.

Cukierman, A. (1992) *Central Bank Strategy, Credibility, and Independence: Theory and Evidence*, MIT Press, Cambridge, Massachusetts.

Drudi, F. and Prati, A. (2000) Signaling fiscal regime sustainability, *European Economic Review*, **44**, 1897–930.

Dornbusch, R. W. and Simonsen, M. H. (1987) Inflation Stabilization with Incomes Policy Support: A Review of the Experience in Argentina, Brazil and Israel, National Bureau of Economics Research (NBER) Working Paper No. 2153, Cambridge, Massachusetts.

Fraga, A., Goldfajn, I. and Minella, A. (2003) Inflation targeting in emerging market economies, National Bureau of Economic Research (NBER), Working Paper No. 10019, Cambridge, Massachusetts.

Gali, J. and Gerter, M. (1999) Inflation dynamics: a structural econometric analysis, *Journal of Monetary Economics*, **44**, 195–222.

Goldfajn, I. and Guardia, E. R. (2003) Fiscal rules and debt sustainability in Brazil, Banco Central do Brasil Technical Notes No. 39, Brasilia.

Jácome, L. and Vázquez, F. (2005) Any link between legal central bank independence and inflation? Evidence from Latin America and the Caribbean, IMF Working Paper No. 05/75, International Monetary Fund, Washington.

Johansen, S. (1988) Statistical analysis of cointegration vectors, *Journal of Economic Dynamics and Control*, **12**, 231–54.

Johansen, S. (1992) Cointegration in partial systems and the efficiency of single-equation analysis, *Journal of Econometrics*, **52**, 389–402.

Johansen, S. and Juselius, K. (1990) Maximum likelihood estimation and inference on cointegration – with applications to the demand for money, *Oxford Bulletin of Economics and Statistics*, **52**, 169–210.

Mikek, P. (2004) Inflation targeting and switch of fiscal regime in New Zealand, *Applied Economics*, **36**, 165–72.

Minella, A., de Freitas, P. S., Goldfajn, I. and Muinhos, M. K. (2003) Inflation targeting in Brazil: constructing credibility under exchange rate volatility, *Journal of International Money and Finance*, **22**, 1015–40.

Mishkin, F. S. (2004) *Can inflation targeting work in emerging market countries?*, Festschrift in Honor of Guillermo Calvo.

Novaes, A. (1993) Revisiting the inertial inflation hypothesis for Brazil, *Journal of Development*, **42**, 89–100.

Ouliaris, S. and Corbae, P. D. (2005) *Extracting Cycles from Nonstationary Data, forthcoming, Frontiers of Analysis and Applied Research: Essays in honor of Peter C. B. Phillips*, Cambridge University Press.

Reisen, V., Cribari-Neto, F. and Jensen, M. (2003) Long memory inflationary dynamics: the case of Brazil, *Studies in Nonlinear Dynamics & Econometrics*, **7**, 89–110.

Rogoff, K. (2003) Globalization and global disinflation, Paper Prepared for the Federal Reserve Bank of Kansas conference on 'Monetary Policy and Uncertainty: Adapting to a Changing Economy'.

Sargent, T. and Wallace, N. (1986) Some unpleasant monetarist arithmetic, in, *Rational Expectations and Inflation*, Harper & Row, New York.

Tekin-Koru, A. and Özmen, E. (2003) Budget deficits, money growth and inflation: the Turksih evidence, *Applied Economics*, **35**, 591–96.

Yoon, G. (2003) The time series behavior of Brazilian inflation rate: new evidence from unit root tests with good size and power, *Applied Economics Letters*, **10**, 627–31.

Appendix: Data sources and variable definitions

Inflation Target:	Weighted average of the mid points (or revised target) of current- and next year's inflation target bands (e.g. the figure for April 2003 is calculated as 8/12*(2003 midpoint or revised target) +4/12*(2004 midpoint or revised target)
Primary fiscal surplus:	Central Bank of Brazil
Real interest rate:	SELIC-12-month deflated by IPCA inflation (12-month rate)
Real effective exchange rate:	IPEA
Real effective exchange rate gap:	Deviation from trend (based on Hodrick–Prescott smoothing)
Real wage:	FIESP (Industrial wages in São Paulo)
Real wage gap:	Deviation from trend (based on Hodrick–Prescott smoothing)
Inflation expectations:	Private sector forecasts based on consensus economics (Fig. 3) and Central Bank of Brazil market survey (other references)