SILCON Estudos Econômicos Ltda
Av. 13 de Maio, 23 grupo 2029-31
CEP 20031-007 Rio de Janeiro, RJ

INFLATION TARGETING AND LEADING INDICATORS : SOME NOTES

RS 046 – abril de 2000

Claudio R. Contador*

Second version**

I – INTRODUCTION

Controlling inflation requires a high degree of foresight the effects of economic actions and of other disturbances. The main reason is that, at least for Brazil, policy measures to curb inflation take effect only after a lag of five-seven months, such as for the monetary and fiscal instruments, and less than four months for real shocks, such as the increase of energy prices.

Three issues arise. First, the empirical link between inflation – in particular, the price index used as the political target - and several groups of variables; second, the trade-off among inflation and the other policy goals; and third, the identification and use of the more appropriate policy steps – if they do exist – to curb inflation spurs in Brazil. This paper deals with the first question, and explores the use of composite leading indicators (CLI) to forecast inflation trends and reversals in Brazil.

Section II explains briefly the CLI methodology applied to inflation in Brazil and discusses the advantages of using CLI as a complementary tool to predict inflation reversals. Section III presents the CLI for IGP-M

* Professor of Economics, Federal University of Rio de Janeiro, Ph.D. in Economics, University of Chicago. E-mail : contador@npoint.com.br.

** Paper to be presented at the Seminar "One Year of Inflation Targeting", Rio de Janeiro, July 10-11 2000.

(General Price Index, Market), expressed in 12-month changes, and some statistical tests. This section shows that although the inflation target framework adopts the IPCA (Broad Consumer Price Index, FIBGE), our results for the IGP-M changes are encouraging, and suggest that a similar procedure be applied to IPCA. Section IV concludes the paper.

II – CLI AS A POLICY INFORMATION

Two quantitative methods enjoy the preference for forecasting economic variables. One method is based on theory to build structural models, to be submitted to empirical estimation. These models can provide forecasts, but in most applications they are designed for testing hypotheses. The other approach follows the Koopmans' argument of "measurement without theory", that dates half century ago.[1] The CLI approach belongs to this second group, and dates back to 1919, by the National Bureau of Economic Research, in United States. Leading indicators exploit the empirical evidence that cyclical movements of some important variables (the so-called reference series) are predated by movements of other variables (basic or input series). Composite leading indicators are simply the aggregation of the leading series and provide the best forecasts for the turning points of the reference variable. Today, the CLI approach has a widespread use in several countries to forecast the dates of turning points of in macroeconomic variables (such as GDP, Industry Production), and also in non-aggregated variables, such as sales, employment and insolvency. More recently, the CLI approach has been used for forecasting inflation.

In Brazil, the use of CLI is recent and dates back to 1974. Several studies and policy papers were developed at IPEA/Ministry of Planning until 1978[2], and since 1980, by private institutions and research centers.

[1] Koopmans, Tjalling C., "Measurement without theory", Review of Economics and Statistics , vol.29, August 1947, pp.161-172. For an update revival, see Auerbach, A.J., "The index of leading indicators : `*measurement without theory*' thirty-five years later", Review of Economics and Statistics, vol. 64, 1982, pp.589-595.

[2] The bibliography in Brazil is mostly in Portuguese. In IPEA, the references of CLI in Brazil are those of Contador, C.R., Ciclos econômicos e indicadores de atividade, (Rio, INPES/IPEA, 1977), 237 p.; "Indicadores de atividade no Brasil : uma revisão", Documentos de Política Econômica, no.30, July 1976, INPES/IPEA; "O emprego de indicadores de atividade econômica no Brasil : um estudo preliminar", Documentos de Política Econômica, no.25, December 1975, INPES/IPEA; and "Leading indicators for the industrial sector", Brazilian Economic Review, no.5, 1979, pp.1-32. Since 1973, the Getulio Vargas Foundation has been publishing one-quarter ahead forecasts of industrial activity using

During a short period in 1992, leading indicators for Industry and GDP growth were used by the Minister of Finance as a supplementary information for economic policy. Since 1980, forecasts using the CLI approach are supplied on commercial basis to corporations and private institutions.[3]

The interest on using CLI for inflation forecasts is relatively new, and dates back to the early 1986,[4] for the United States and to the 90s, for other industrialized economies. In Brazil, so far as I am aware of, the CLI of inflation has attracted attention in mid 1999, first by banks and financial private business, and later, by the Central Bank after the adoption of inflation targeting.[5]

Most of the studies on CLI of inflation use smoothed rates (core or underlying inflation) to avoid the effects of transitory and violent disturbances. Unfortunately, these smoothed inflation data are very recent in Brazil and still in preliminary estimation process by IPEA and Getulio Vargas Foundation.[6] In our study, we avoid this procedure and the

---

dispersion measures from business survey. Other contributions are found in Markwald, R.A; R. B. Moreira & P.L.V. Pereira, "Previsão de produção industrial: indicadores antecedentes e modelos de série temporal", Pesquisa e Planejamento Econômico, vol.19,no.2, August 1989, pp.233-254; Melo Souza, Mary de & Moyses Tenenblat, "Indicadores antecedentes para as exportacões e importacões totais brasileiras", Sociedade Brasileira de Econometria, Anais, XIII Encontro Brasileiro de Econometria, Curitiba, 3-6 December 1991, pp.551-558; Oliveira, Aricio X. de & Francisco Alberto Pino, "Indicador antecedente para a industria de transformação: uma proposta alternativa", III Escola de Séries Temporais e Econometria, FGV/RJ, 25-28 July 1989.

[3] Boletim Indicadores Antecedentes, a quarterly bulletin published by AMR Editora (São Paulo) since 1991. CLI forecasts are also provided by SILCON Estudos Econômicos, a private consulting firm.

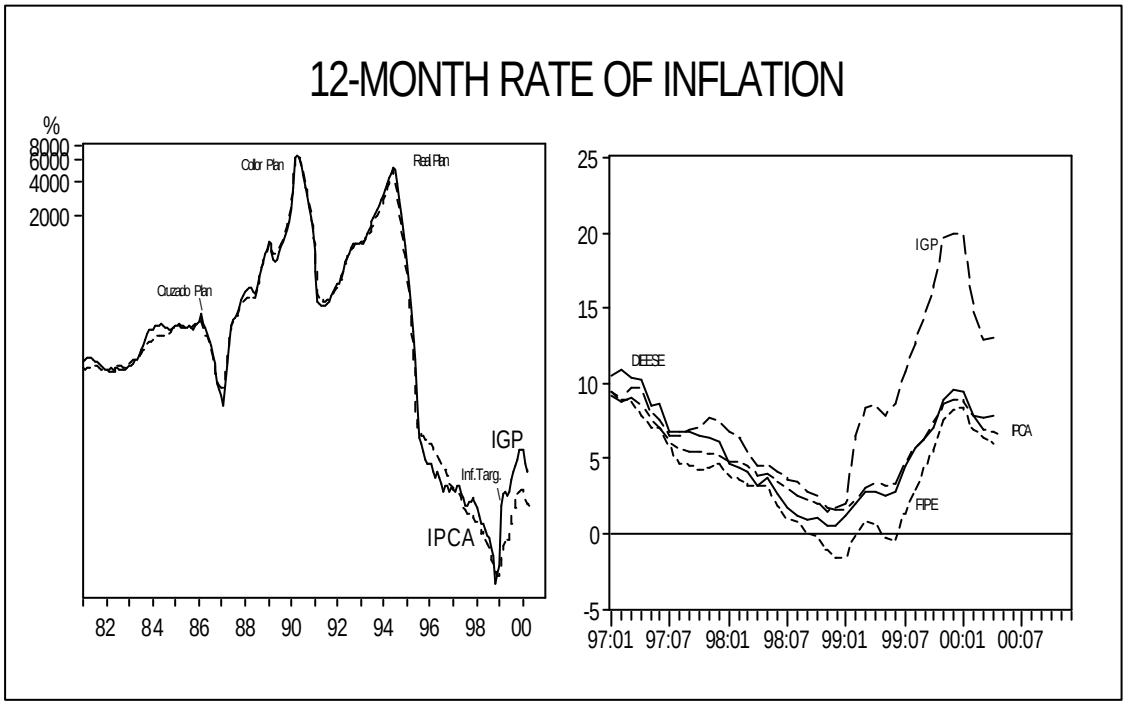
[4] P.A Klein, "Leading indicators of inflation in market economies", International Journal of Forecasting, Vol.2, 1986, pp.403-412. See also several studies in Lahiri, K. and Moore, G.H. (eds), Leading Economic Indicators: New Approaches and Forecasting Record, (Cambridge, MA. Cambridge University Press, 1991)

[5] For a description of the implementation of the inflation targeting in Brazil see Central Bank, Monetary Policy Committee (Comitê de Política Monetária - Copom), Relatório de Inflação, March 2000, Cap. 6, and Bogdanski, Joel; Alexandre Antonio Tombini e Sérgio Ribeiro da Costa Werlang, Implementing inflation targeting in Brazil, Working Paper, Central Bank, February 2000.

[6] The so-called core inflation excludes food, energy and indirect taxes. It is different from the smoothed underlying inflation that eliminates the large (positive and negative) changes of prices of any component of the index. See Pôrto Gonçalves, Antônio Carlos; Jack Schechtman e Rebbeca Barros, "Núcleo de inflação", Conjuntura Econômica, vol. 50, no.3, March 2000, pp.16-19 and Moreira, Ajax Reynaldo Bello e Leonardo Carvalho,

reference variable is simply the rate of change on 12-month basis of the General Price Index-Market, computed by the Getulio Vargas Foundation since 1990. The 12-month change eliminates the seasonal cycles, flats the short term disturbances and (probably) shows the same cycle pattern.

In a broad view, the inflation cycles identified by different price indices in Brazil have similar properties, in terms of turning points. This means that our CLI of GDP-M inflation may also be useful to forecast reversal dates of other aggregate indices, although is not appropriate to predict levels of inflation. The graph below shows the 12-month rate of inflation according to several broad indices: IGP-DI; IPCA; ICV-FGV; and ICV-DIEESE. The IGP-DI index is an weighted average of consumer prices, wholesale prices and building costs, and its main difference from the IGP-M is due to the collection period. The other three indices represent traditional consumer price indices, in national cover (IPCA and ICV) and in São Paulo. The violent (and non-negative) rate of inflation during the 80s and 90s allows the use of logarithm scale for the IGP and IPCA.



The picture at the left shows the history of the Brazilian inflation since 1980, and the picture at right, the inflation in the period after 1997.

"Indicadores IPEA de tendência da inflação no Brasil", Nota Técnica, Boletim Conjuntural no.48, January 2000, pp.41-44.

There is no significant difference among the cyclical movements and in the levels of the series, in particular those of the consumer price indices. The IGP shows a rate of inflation in 1999 higher than that of other indices, because of the impact of the wholesale component. The dates of the stabilization plans are marked in the graph at the left.

III – THE COMPOSITION OF THE CLI OF INFLATION

For the design of CLIs in Brazil, we group the potential basic variables into four broad classes:

- Financial variables, such as monetary base, money concepts, credit, interest rates, stock price indices, and exchange rates.
- Commodity prices, such as raw materials, energy prices, public utilities and services, labor unit costs.
- Consumption measures, such as government expenditures, consumers insolvency, private sector expectations and investments.
- Capacity conditions, such as industry capacity utilization, unemployment rates, labor productivity, hour worked, and labor earnings.

The CLI approach follows four steps. First step, the lead-lag analysis between the 12-month rate of inflation and a large number of variables (in the same growth basis when necessary) identifies leading series. In the interest of stability of the lead structure, it is wise to use a shorter period for estimation instead of a large interval, with different inflation regimes and with the influence of the several stabilization plans (based on price and exchange freezing, break of contracts and of institutional rules) and probably several structural breaks. For the period after 1994, there are 98 potential basic variables that lead the IGP-M in up to 8 months, but several of these candidates are closely related (co-linear) with each other. Additional tests eliminate those variables that evidence high co-linearity. Only 11 variables are left to compose the CLI of inflation. The average lead is five months, reduced to four months considering the lag in obtaining the statistics of the basic series. In the process of estimating the lead-lag relationships, few variables have proved to have significant (and with the right sign from the "theoretical" point of view) correlations for leads higher than 12 months.

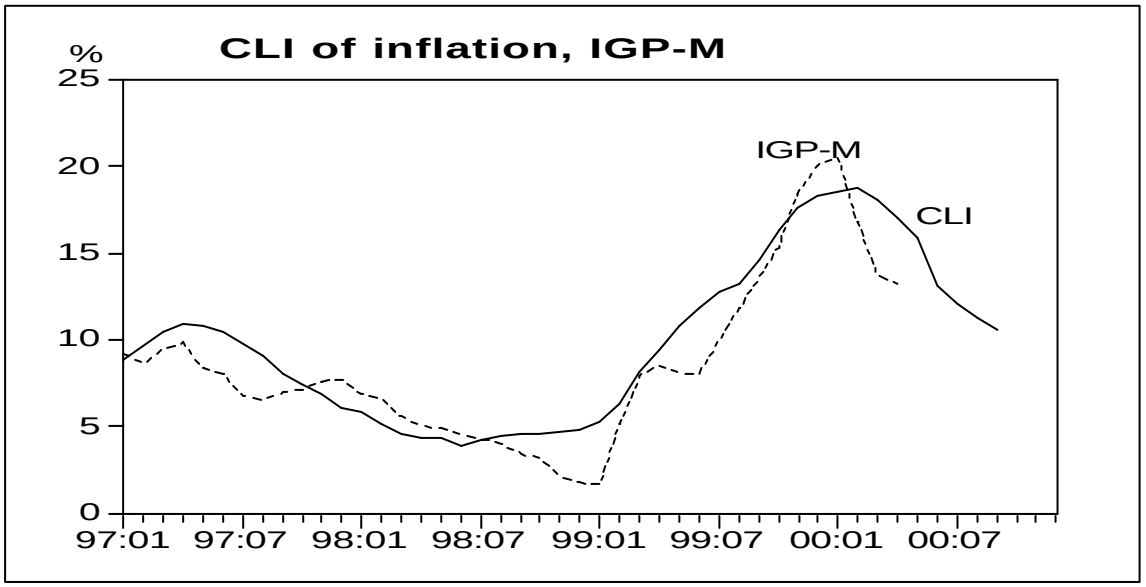
The second step is the aggregation of the selected basic series into a composite index. Each basic variables is normalized $N(0, \sigma)$ and then

multiplied by its correlation with the reference series, and divided by the sum of the absolute value of the correlations. The third step is simply the de-normalization of the (normalized) composite index, using the mean and the standard variation of the reference series.

The fourth and final step is to test the performance of the CLI in predicting the turning points. Unfortunately, the period available of non-explosive inflation for the empirical tests is too short and has only three marked reversals: one peak in July 1994 (in response to the implementation of the Real Plan), a trough in January 1999, and another peak in January 2000. Three observations of turning points are insufficient in terms of cycle analysis, but unfortunately the alternative would be to consider the whole history of inflation, which is contaminated by short-lasting plans, price freezes, break of contracts and rules, change of monetary units, forced deindexation and so on. The estimation of lead-lag relationship between variables might simply show spurious links and prove to be useless. Our believe is that some information is better than none, and the CLI of inflation is a preliminary evidence, to be improved with a larger number of basic variables and a longer lead.

Table 1 - Composition of the CLI, IGP-M

Group :	Number of variables	Average lead, in months		Interval of correlations
		Empirical	Operational	
Policy instruments	3	4	3	73-81 %
Consumption, sales	2	6	4	66-75 %
Costs	4	7	5	70-82 %
Capacity utilization	2	5	2	40-65 %
Total	11	5	4	95,3 %



The performance of the CLI of inflation is illustrated in the graph above. The CLI of IGP-M index forecasts that the 12-month inflation reached a peak in February 2000 against the actual peak in January, and the second semester of 2000, so far the lead structure holds – tends to be of declining rates.

The leading indicator assigned correctly the peak of April 1997, lagged by one month the peak of January 2000, anticipated too early (by three months) the trough of January 1999, and omitted the cycles occurred in August-December 1997 and in April-June 1999. The CLI does not present any "false alarm" (that is, forecasting a turning point which did not subsequently occur). The evidence is not very strong, but these records suggest that our CLI is useful to predict the reversals of cycles longer than 4-5 months, and, at least for while, we can say nothing about the chances of false alarms in the future.

Another way of evaluating the forecasting performance of CLI is to estimate how well the CLI perform when current inflation is explained by past inflation and the CLI, following the traditional Granger-Sims causality test;[7]

$$p_t = a + \Sigma \beta_i p_{t-i} + \Sigma \lambda_j CLI_{t-j} + \varepsilon_t \qquad (1)$$

and

$$p_t = a + \Sigma \beta_i p_{t-i} + \varepsilon_t \qquad (2)$$

where p_t means the actual rate of inflation; CLI, the composite indicator; and ε_t, the serially uncorrelated random residuals. If the CLI does not contribute to inflation forecasting, then the value of λ_j would be zero for all lag j. Otherwise, if the CLI contributes to prediction, then some λ_j or their sum would be significantly different from zero. The F-statistic tests if the difference between the sum of squared residuals of the two regressions is significant or not, assuming errors normally distributed.

[7] Granger, C.W.J., "Investigating causal relationships by econometric and cross spectral methods", Econometrica, Vol.37, no.3, July 1969, pp.424-438; Granger, C.W.J., "Some recent developments in a concept of causality", Journal of Econometrics, vol.39, no.1-2, 1988, pp. 199-211; and Sims, C. A., "Are there exogenous variables in short run production relations?", Annals of Economic and Social Measurement, vol.1, no.1, June 1972, pp. 17-36.

The regressions for the period January 1997-April-2000, for both i and j equal to 6 months, are,

$$E(p_t) = -2.8807 + 0.6428\ L(p_i) + 0.8655\ L(CLI_j)$$
$$\qquad\quad (-2.37) \qquad (5.54) \qquad\quad (2.61)$$

$R^2 = 0.982$
DW = 1.85
SER = 0.3859

and

$$E(p_t) = 0.2449 + 0.9503\ L(p_i)$$
$$\qquad\quad (1.39) \qquad (31.68)$$

$R^2 = 0.969$
DW = 1.82
SER = 0.4598

where E(p) stands for estimated inflation and L(.), the lag structure of past inflation and CLI. The numbers between brackets show the Student test.

The value of the F-test statistic (for 6 and 25 degrees of freedom) is 3.34, significantly different from zero at 10 % level, near to the 5 % critical (3.58). The null hypothesis is rejected at 10 % level (at least), and the CLI contains additional information that and helps to forecast inflation in the following months. It is quite possible that another choices of the lag orders would show different results. Bikker and Kennedy[8] point out that a large lag distribution for past inflation, incorporating more information about inflation history itself, would turn the test against the information content of CLI more severe. On the other hand, higher lags for the CLI are not expected to improve the forecast performance of inflation. But, it is important to note that the CLI approach focus primarily on the forecasting of turning points, while the traditional models such as equation (2) are supposed to predict better the level of inflation. In this sense, the approaches are complementary.

Another interesting issue is to test the probability of CLI to predict turning points. CLIs are supposed to offer the best timely prediction of turning points and the probability approach provides a summary measure of the probability of a turning point occurs in the next months. Two

[8] Bikker, J.A & N.O Kennedy, "Composite leading indicators of underlying inflation for seven EU countries", Journal of Forecasting, vol.18, 1999, pp. 225-258.

approaches are used. One is the approach suggested by Neftçi,[9] which uses three pieces of information : the forecast of the CLI regarding the future cyclical phase of the reference variable; the length of the current cycle in comparison to the average phase; and the estimate of the last period's probability. The other approach uses the distribution of chronological errors (that is, the number of months between the dates of actual and predicted reversals) committed by the CLI in forecasting past peaks and troughs. This information is combined with the frequency of false alarm signals to provide a probability measure of a coming turning point.[10] Unfortunately, the experience of few reversals in the period of more stable inflation does not allow testing these approaches.

IV – SUMMARY AND SUGGESTIONS

This short paper presents a composite leading indicator of inflation for the Brazilian economy. The lead-lag relationships were estimated for the period after 1994. The CLI uses the General Price Index – Market (IGP-M) as the reference variable, expressed in 12-month rate of growth. The CLI is based on 11 basic series and has an average lead of four months. The Granger-Sims causality test suggests that the CLI contributes to the forecasting of future inflation, at a level of 10 % of significance. Although the inflation targeting framework adopts the IPCA (Broad Consumer Price Index), the results reveal that it is possible to design a CLI of IPCA inflation that certainly helps monetary actions.

Should the CLI approach substitute the structural models that the Central Bank are designing ? The answer is certainly negative. First, because the CLI approach and the structural models are complementary. The CLIs are designed to predict the turning dates, while the structural models, the level of inflation. Together, the techniques are useful for the decision process in the Central Bank.

Persistent one-digit annual inflation is a recent phenomenon in Brazil. Several stabilization plans before 1994 that failed broke the structural process of inflation in Brazil. Therefore, we do not have a long history of inflation cycles that can help to estimate the lead-lag relationships between variables. The reliable use of CLI of inflation for economic policy

[9] Neftçi, S., "Optimal prediction of cyclical downturns", Journal of Economic Dynamics and Control, vol.4, November 1982, pp. 225-241

[10] Unfortunately the text is not available in English. Contador, C.R., "O desempenho dos indicadores antecedentes na cronologia das reversões cíclicas", Relatório de Pesquisa 99, August 1990, reprinted as Relatório COPPEAD 239, COPPEAD/UFRJ.

needs an assessment of the robustness of the forecasting power of the approach in several periods. For while, there is not we can do, besides to wait for a longer experience.

If the CLI of inflation performs better than any other forecast technique, we – and the Central Bank – are faced with the paradox that the CLI success may turn out to be the root of its future failure as a reliable forecasting technique. If the Central Bank and other policy makers take seriously a prediction of rising inflation in the next months, and in response adopt appropriate stabilizing policies, then the actual acceleration of prices may not occur. However, the average lead of the CLI is only four months, and this horizon is too short for economic policies offset completely the forecast of rising inflation. One must recognize that the usefulness of CLI of inflation – at least in Brazil – is related to short term movements. Controlling inflation is always a long term policy commitment.

ANNEX I
Cross chronology between IGP-M and IPCA, 12 month-change

	IGP-M	IPCA		Errors
TURNING POINTS				
PEAKS :	-	08-1981		-
	-	01-1986		-
	11-1990	11-1990		0
	06-1994	06-1994		0
	12-1999	12-1999		0
TROUGHTS :	-	03-1982		-
	-	02-1987		-
	09-1991	09-1991		0
	11-1998	01-1999		+2
DURATION, IN MONTHS				
	1990-2000	1990-2000	1981-2000	
UPTURNS (TROUGH-TO-PEAK)				
Average	17	17	30	
Minimum	11	35	34	
Maximum	54	46	46	
DOWNTURNS (PEAK-TO-TROUGH)				
Average	21	20	17	
Minimum	10	8	7	
Maximum	34	54	54	

ANNEX 2
Correlation among monthly rates of change of several price indices
Period : July 1994 - March 2000

	1	2	3	4	5	6	7	8	9	10
1 – IPCA:	1.00	0.38	0.26	0.77	0.63	0.68	0.72	0.76	0.74	0.83
t-2	-0.43	-0.17	0.11	-0.33	-0.45	-0.28	-0.26	-0.65	-0.35	-0.54
t-1	0.04	-0.43	-0.14	0.20	0.08	0.20	0.35	-0.14	0.09	-0.02
t+1	0.04	-0.12	-0.17	0.27	0.50	0.16	0.26	0.33	0.36	0.24
t+2	-0.38	0.02	-0.01	-0.30	-0.13	-0.35	-0.33	-0.13	-0.26	-0.47
2 – IPCA[a]	0.38	1.00	0.88	-0.08	-0.24	-0.15	-0.25	0.05	-0.10	0.07
3 – IPCA[b]	0.26	0.88	1.00	-0.08	-0.30	-0.16	-0.24	-0.09	-0.16	-0.09
4 – INPC	0.77	-0.08	-0.08	1.00	0.89	0.95	0.92	0.63	0.71	0.80
5 – IGP-DI	0.63	-0.24	-0.30	0.89	1.00	0.86	0.91	0.64	0.78	0.80
6 – IGP-DI[c]	0.68	-0.15	-0.16	0.95	0.86	1.00	0.84	0.55	0.63	0.81
7 – IGP-M	0.72	-0.25	-0.24	0.92	0.91	0.84	1.00	0.60	0.77	0.75
8 – DIEESE	0.76	0.05	-0.09	0.63	0.64	0.55	0.60	1.00	0.67	0.76
9 – FIPE	0.74	-0.10	-0.16	0.71	0.78	0.63	0.77	0.67	1.00	0.74
10–ICV-FGV	0.83	0.07	-0.09	0.80	0.80	0.81	0.75	0.76	0.74	1.00

[a] IPCA excluding food and energy.

[b] IPCA excluding food. energy and public utilities. Source : Central Bank.

[c] Core – IGP/DI. Source : FGV

RELATÓRIOS SILCON

A consultoria SILCON Estudos Econômicos produz duas séries de relatórios, distribuídos aos seus clientes:

1 - Carta Mensal - Cenários & Previsões, publicação mensal com análise de temas conjunturais, cenários macroeconômicos, e previsões baseadas na técnica de indicadores antecedentes. Disponível apenas aos clientes da SILCON e aos assinantes cadastrados.
2 - Relatórios SILCON (RS), com a divulgação de pesquisas sobre temas diversos, elaboradas pela equipe da Consultoria.

SILCON Estudos Econômicos Ltda
C.R. Contador & Associados
Av. 13 de Maio, 23 – grupo 2029-31
CEP 20031-007 Rio de Janeiro, RJ

Para informações sobre as publicações e os serviços prestados pela nossa empresa, acesse a nossa *home-page* : www.silcon.ecn.br
ou nos contate pelo e-mail : diretoria@silcon.ecn.br
Telefone : (0xx21) 2240 2656 – fax: (0xx-21) 2210 1035.