ECONOMIC ACTIVITY IN 2001 :
WHAT THE LEADING INDICATORS FORECAST
RS 048 – November 2000

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I - Introduction

Until late August, most economists were forecasting that the real Gross Domestic Product would increase between 3.9 and 4.2 % in 2000 and something around 4.5 until 5 %. The economic outlook for Brazil seemed to be the most favorable since the late 1997, boosted by the revival of the promises of the reforms, the inflation under control, the declining interest rate, the fiscal adjustment and the signs of new investments. Suddenly, the Argentina crisis, the run-up in oil prices, the higher interest rate expectations for the United States, the bad results in the trade balance and the slowdown in the world economy growth have changed the society's mood into a pessimistic outlook. From an expected expansion of 4.5-5 % in 2001, the most recent forecasts of GDP have fallen to a rate not higher than 4 %, and the less optimistic analysts are prone to announce a growth lower than that of 2000. But no matter the numbers, all forecasters blame the external scenario for the problems. It is important to note that the Federal Budget for 2001 has assumed a real GDP increase of 4.5 % and a lower rate means lower tax revenue.

No doubt, the external environment affects the Brazilian economy, for the best but also for the worse. However, the question is the relative role of the adverse external factors to the slowing down of the domestic activity.

These notes present the forecasts for the economic activity in 2001 using the leading indicators technique. Three reference variables – that is, the objective of the prediction – are examined : Gross Domestic Product; Construction Product; and Manufacturing Product. The first two variables are expressed in quarterly basis, and the former in monthly basis. All reference variables are computed by IBGE. We claim that – whatever the current changes in the external factors – there already exist signs that the Brazilian economy will face a turning point in the first quarter of 2001. The worsening of the external scenario only strengths the slowdown, in the same way as positive effects from the world economy would boost and favor the economic growth. Next section summarizes the leading indicators methodology. The details of the composite leading indicators and their forecasts are presented in section III. Section IV concludes the article.

II – The methodology of the composite leading indicator (CLI)

The technique of the leading indicators exploits 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), that is, by series that tend to shift direction in advance of the business cycle.

The ideal leading variable must conform to seven criteria :

1. Conformity, in the sense that the series must conform well to the cycle to be predicted,
2. Economic significance, that is the cyclical timing of the leader and the sign (positive or negative) of its association with the reference variable must conform to a "sound theory" or at least be economically logical,
3. Consistent timing, in which the series must exhibit a consistent timing pattern as a leading variable. There is no need that the basic series "causes" the movements of the reference variables (in Granger approach), although the causality is advisable.
4. Statistical adequacy and accuracy, in the sense that the statistical data must be collected and processed in a reliable way, and be accurate in reflecting the phenomenon.
5. Smoothness, since the very short run changes (as month-to-month changes) must not be too erratic,
6. Original information content, meaning that the cyclical information of a basic series should not be reflected in other basic series or in a combination of several basic series,

7. <u>Fast and easy access</u>, in the sense that the basic variable must be published on a reasonably prompt schedule and without late substantial revision.

Altogether the seven criteria are very severe, and if strictly applied few individual series pass muster. In the Brazilian case, no single time monthly series fully qualifies as an "ideal" leading variable. Therefore, in an effort to surmount the shortcomings of the individual series, the "best" – meaning those series that conform to the majority of criteria - are combined into a composite indicator. Since this indicator is formed by leading series, it predicts in advance the turning points of the cycle. The averaging process tends to smooth out a good part of the volatility and the erratic movements of the basic series. The composite leading indicator (CLI for short) reveals common turning point patterns in a clearer and more easily understandable manner than the boring and confusing analysis of the individual basic series and provides the best forecasts for the chronology of the turning points of the reference variable.

The CLI approach has a widespread use to forecast the dates of turning points of macroeconomic variables (such as GDP, Industry Production), and also, and increasingly, of non-aggregated variables, such as sales, production, employment and insolvency, and even as a tool for inflation targeting programs. In Brazil, the CLI technique is used since the late 70's, first as an aid for short-run economic policy and after the 80's, as an operational tool in corporations for monitoring the movements of their markets.[1] Since 1999, the current administration of the Central Bank is adopting leading indicators as part of the decision for the inflation targeting program.[2]

For the design of CLIs in Brazil, the potential basic variables are grouped into seven broad classes:

- Financial variables, such as monetary base, money concepts, credit, interest rates, stock price indices, inflation, and exchange rates.
- Labor market and capacity conditions, such as bills of wage, job openings, unemployment rates, labor productivity, hour worked, and labor earnings.
- Use of raw materials and factors of production, such as electricity, fuel, and gas, and production orders,

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[1] For a brief description see the footnotes in Contador, Claudio, "Inflation targeting and leading indicators: some notes", June 2000, paper presented at the Seminar "One Year of Inflation Targeting", Rio de Janeiro, July 10-11, 2000.
[2] Chauvet, Marcelle, "Leading indicators of inflation for Brazil", Working Paper Series, no.7, September 2000, Research and Studies Department, Central Bank of Brazil; and Contador, <u>op.cit.</u>

- Insolvency, such as checks without funds, Chapter 11 (*concordatas*) and bankruptcy (*falências*),
- Foreign market, such as foreign oil prices, commodities prices, international interest rates, exports and imports,
- Cost and commodity prices, such as energy prices, public utilities and services, and labor unit costs,
- Consumption measures, such as government expenditures, private sector expectations, sales of individual markets and investments.

The CLI approach follows four steps, and it is assumed that criteria 4,5 and 7 are already fulfilled. In the first step – and the most important - the lead-lag analysis between the reference variable and a large number of variables (in the same growth basis) identifies those leading series attending to criteria 1, 2 and 3. In the interest of stability of the lead structure, it is wise to use several periods for estimation instead of a just one large period.

The figure below shows a good example of the lead-lag estimation and the link between activity and real interest rates. The cycles of GDP are measured by the rate of growth of four-quarter moving average. The real interest rate is the four-quarter compound rate of the nominal discount rate of commercial bills deflated by inflation (IGP index). We should expect an inverse link between real interest rates and economic activity, that is cyclical movements in opposite direction: when real interest rates rise (fall) the activity goes down (up). Besides, real interest rate movements should lead activity.
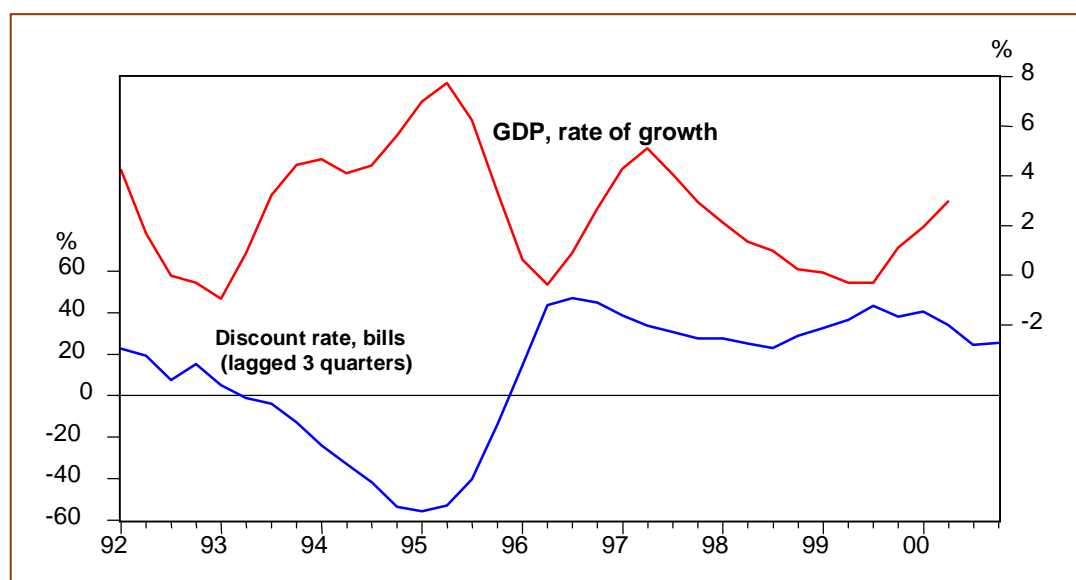

Figure 1 - Lagged interest rate and GDP growth.

Note that that the major changes are in opposite directions. The decline of real interest rate in IV-1992 till I-1995; from II-1996 to I-1997 and

since III-1999 predates in three quarters similar movements in the GDP growth. The same happens with the rises of interest rate in I-1995 to II-1996 and III-1998 to III-1999 that lead declines of GDP. The statistical analysis between interest rate and GDP growth suggests that the best relationship between the two variables is found with the real interest rate leading GDP by three quarters. The correlation is –0.65, significant at 5 % level and the causality test cannot reject the hypothesis that interest rate Granger cause GDP growth, but rejects that GDP cause interest rate.

　　　　Real Interest rates also affect other important variables such as the growth of the Construction Industry and Manufacturing. The graphs below despite the link of lagged interest rate (discount on commercial bills) and growth cycles, and the same conclusions remain.
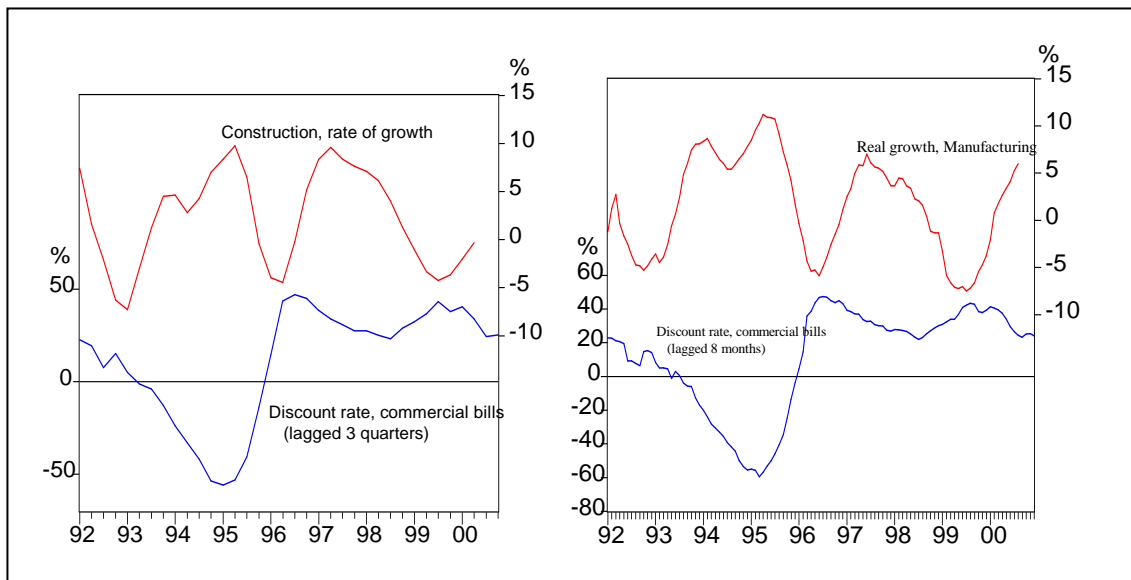

Figure 2 – Lagged real interest rate, Construction and Manufacturing

　　　　Therefore, the real interest rate (discount of commercial bills) is a good candidate to compose the CLI, unless it does not fulfill other criteria.

　　　　The second step for the construction of CLI is intended to avoid that the same kind of information be imposed into the CLI. For instance, it is well known that several money and credit concepts lead the business cycle. However, these series reflect roughly the same information (liquidity). Some of them, if not all minus one, are redundant. If all series were included into the CLI, the indicator would be biased by an excess of liquidity content and would lack other important pieces of information. The statistical test and procedures to correct redundancy are similar to those recommended in the case of severe multicollinearity.[3] The third step is aggregation of the

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[3] For a description of the statistical tests see Contador, C.R. & C.B. Ferraz, <u>Previsão com Indicadores Antecedentes,</u> (Rio, SILCON, 2000, 4th ed.) , chapter 3. All computations presented in this paper have used the software <u>Sistema de Indicadores Antecedentes,</u>

remaining basic series into a composite index. Each basic variables is normalized $N(0, \sigma)$, multiplied by its correlation with the reference series, and divided by the sum of the absolute value of the correlations. Since the index is a sum of normalized variables, its dimension is also a Normal series. The CLI is simply the de-normalization of the (normalized) composite index, using the mean and the standard variation of the reference series. Finally, the fourth step is to test the performance of the CLI in forecasting the cycles and the turning points.

III – The Composite leading indicators

For the period after 1990, there are 54 potential basic variables that lead the (quarterly) GDP growth, 42 that lead (quarterly) Construction Product and 89 series that predate (monthly) Manufacturing. Additional statistical tests eliminate those variables that evidence high co-linearity, and only 17 variables are left to compose the CLI of GDP growth; 20 basic series to Construction product, and 17 to Manufacturing. Tables 1, 2 and 3 present the composition of the CLIs. The CLIs of GDP and Construction have an average lead of three quarters and of Manufacturing, eight months.

Table 1 - Composition of the CLI, GDP

Group :	Number of variables	Leads, in quarters		
		Minimum	Maximum	Average[a]
Labor market	4	2	6	4
Consumption, sales	6	2	2	2
Money and financial	2	3	4	3
Raw materials	3	3	3	3
External factors	1	2	2	2
Insolvency	1	3	3	3
Total	17	2	6	3

[a] Weighted by the absolute value of correlation between the reference and the basic series.

Table 2 - Composition of the CLI, Construction Sector

Group :	Number of variables	Leads, in quarters		
		Minimum	Maximum	Average[a]
Labor market	5	2	5	3
Consumption, sales	6	2	3	2
Money and financial	5	2	4	3
Raw materials	4	3	6	4
Total	20	2	6	3

[a] Weighted by the absolute value of correlation between the reference and the basic series.

Table 3 - Composition of the CLI, Manufacturing

Group :	Number of variables	Leads, in months		
		Minimum	Maximum	Average[a]
Labor market	4	4	9	6
Consumption, sales	3	5	15	12
Money and financial	3	10	13	12
Raw materials	4	7	11	9
Insolvency	3	4	8	6
Total	17	4	15	8

[a] Weighted by the absolute value of correlation between the reference and the basic series.

Tables 4 to 6 compare the performance of the CLIs in predicting the turning points. The only CLI that shows an error is that of the GDP growth, that omits the cycle of II-1994 – II-1995, but all three indicators perform well in forecasting the major cycles. The chronological errors – the difference between the dates of turning points of the reference and CLI - are small, not larger than three months. Figures 3, 4 and 5 present the three CLI.

The striking conclusion is that all three CLIs forecast that the growth of the reference variables will face a downturn by the end of 2000 or at the beginning of 2001. It is important to emphasize that the main objective of the CLI approach is the prediction of the turning dates, not the dimension of the rate of growth itself. It means that we are not forecasting a negative rate of change in GDP, or in the two other sectors, but that the rate of growth in annual basis tends to decline by the end of 2000 or beginning of 2001. A closer look at Figure 5 with the CLI of Manufacturing, expressed in monthly basis, suggests that the downturn may take just few months, and a recovery may happen during the second semester of 2001.

Table 4

Performance in turning points, Gross Domestic Product

Phase	Duration, in quarters	Reversal dates		Errors, in quarters
		Reference	Indicator	
Recovery	4	1/91	1/91	0
Downturn	4	1/92	1/92	0
Recovery	4	1/93	1/93	0
Downturn	1	1/94	2/94	-1
Recovery[a]	4	2/94	-	-
Downturn[a]	4	2/95	-	-
Recovery	4	2/96	2/96	0
Downturn	4	2/97	2/97	0
Recovery	3[b]	2/99	3/99	-1
Downturn	Forecast		1/01	-

[a] Omitted turning point. [b] Forecast based on the reversal of the CLI
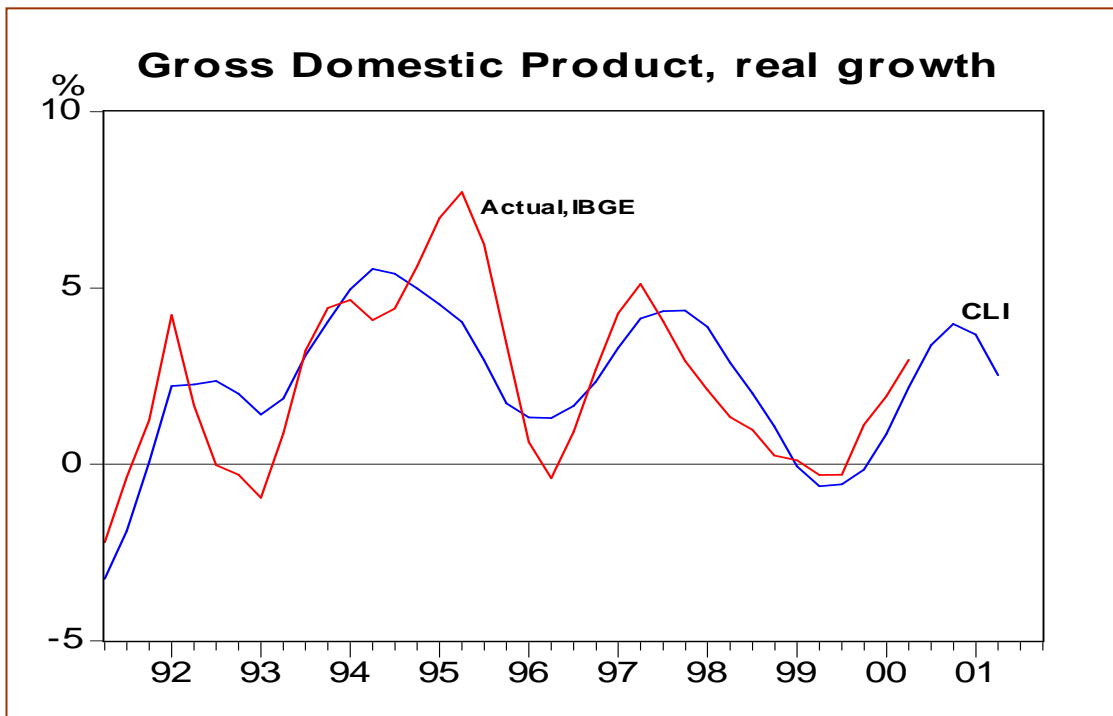

Figure 3 – Leading indicator

Table 5
Performance in turning points, Construction

Phase	Duration, in quarters	Reversal dates		Errors, in quarters
		Reference	Indicator	
Recovery	4	1/91	1/91	0
Downturn	4	1/92	2/92	-1
Recovery	4	1/93	1/93	0
Downturn	1	1/94	1/94	0
Recovery	4	2/94	4/94	-2
Downturn	4	2/95	2/95	0
Recovery	4	2/96	1/96	1
Downturn	9	2/97	2/97	0
Recovery	10[a]	3/99	4/99	-1
Downturn	Forecast		1/01	-

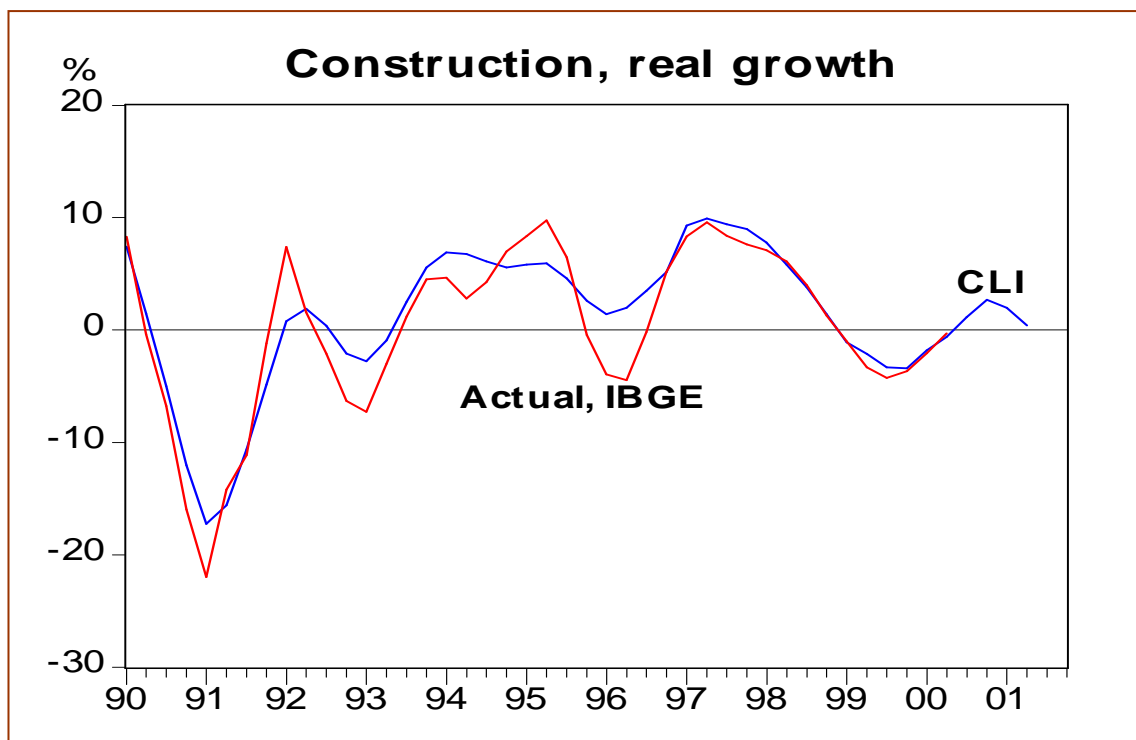[a] Forecast based on the reversal of the CLI

Figure 4 – Leading indicator

Table 6
Performance in turning points, Manufacturing Product

Phase	Duration, in months	Reversal dates		Errors, in months
		Reference	Indicator	
Downturn	12	3/90	1/90	2
Recovery	12	3/91	3/91	0
Downturn	7	3/92	5/92	-3
Recovery	15	10/92	11/92	-1
Downturn	6	1/94	11/93	2
Recovery	16	7/94	8/94	-1
Downturn	12	4/95	5/95	-1
Recovery	14	4/96	6/96	-2
Downturn	23	6/97	8/97	-2
Recovery	17[a]	5/99	4/99	1
Downturn	Forecast		10/00	-

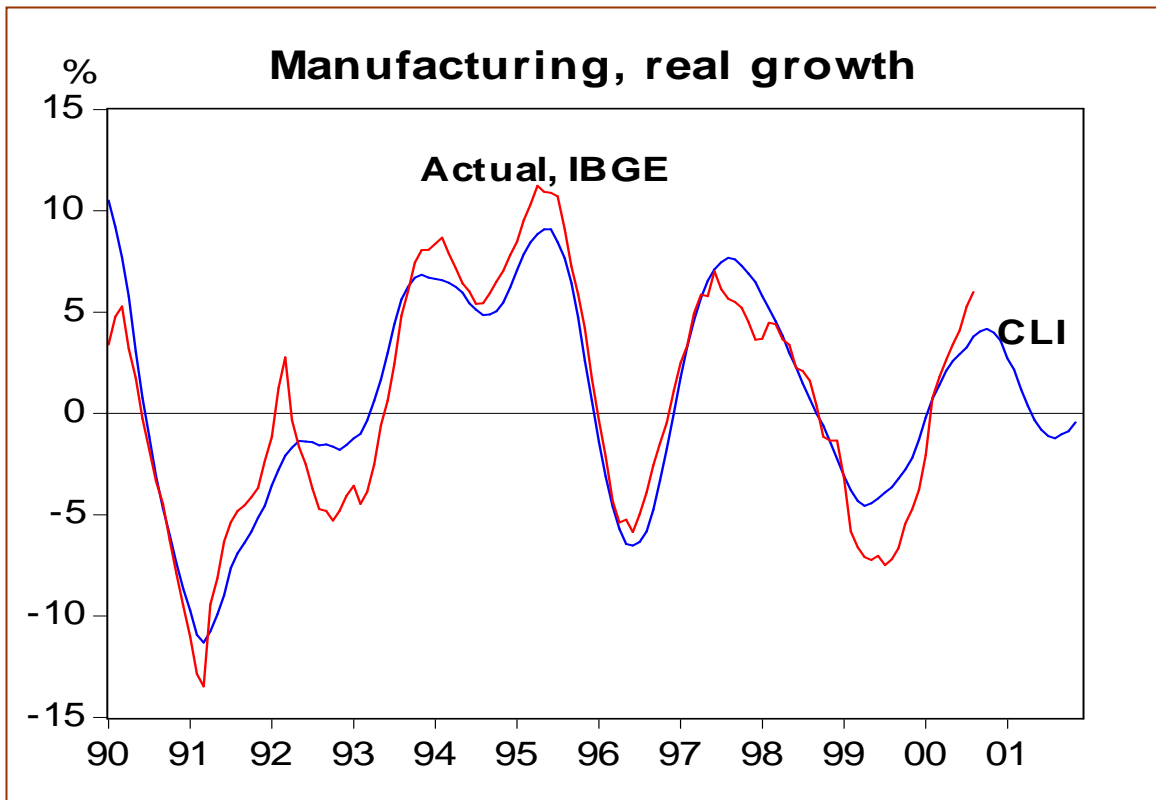[a] Forecast based on the reversal of the CLI

Figure 5 – Leading indicator

The details of the CLIs may help to discuss the argument that the foreign scenario is the great villain. The role of external variables on the coming downturn forecasting does not seem to be important. Only the CLI of GDP has one variable – total exports in US$ billion with a lead of two quarters - that reflects the behavior of the external sector. All the remaining 16 basic series reflect domestic factors. And even the exports are an weak sign to reflect the worsening of the external scenario. Therefore we may claim that most of the signs of the oncoming reversal are already reflected into the basic variables. The worsening of the Argentina crisis, the rise of the oil price etc. tend to strength the downturn of the rate of growth., but for while it is impossible to predict a true recession - that is a negative rate of change. Its occurrence still depends upon the severity of the external crisis. We may have to wait some months to confirm or reject a real recession.

What is the probability that the reversals occur ? One of the most popular indicator of performance is the Neftçi approach. The argument is very practical: a downturn (upturn) in the CLI presages an upcoming contraction (expansion) and it is based upon two assumption. First, the CLI is always operating under one of the two regimes: an upturn or a downturn regime. And the second assumption is that the probability of the CLI being in its downturn (upturn) regime is related to the probability of the reference variable going into a contraction (expansion).[4] Neftçi's approach 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 decision-rule we adopted imposes a discount factor of 0.2 in order to prohibit the probability of reversals from rising too quickly. The prior distribution assumes a probability starting with zero for the first four months and with an increase of 0.05 rate per month.

Figures 6 to 8 provide the probability of downturn applied to the reference variables. The bottom graph shows the probability and the other line the effective rate of growth of the reference variable. A close look confirms that the decision rule functions reasonably well. All downturn were predict, except that occurred in the GDP in 1994. The probability computation did not point out false alarms with the decision rule of accepting probabilities higher than 80 %.

Another 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

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[4] The literature is abundant and the reference is the path breaking paper by Salih N. Neftçi, "Optimal prediction of cyclical downturns", Journal of Economic Dynamics and Control, Vol.4, November 1982, pp.225-241.

a probability measure of a coming turning point.[5] Another forthcoming paper will discuss this methodology in details.
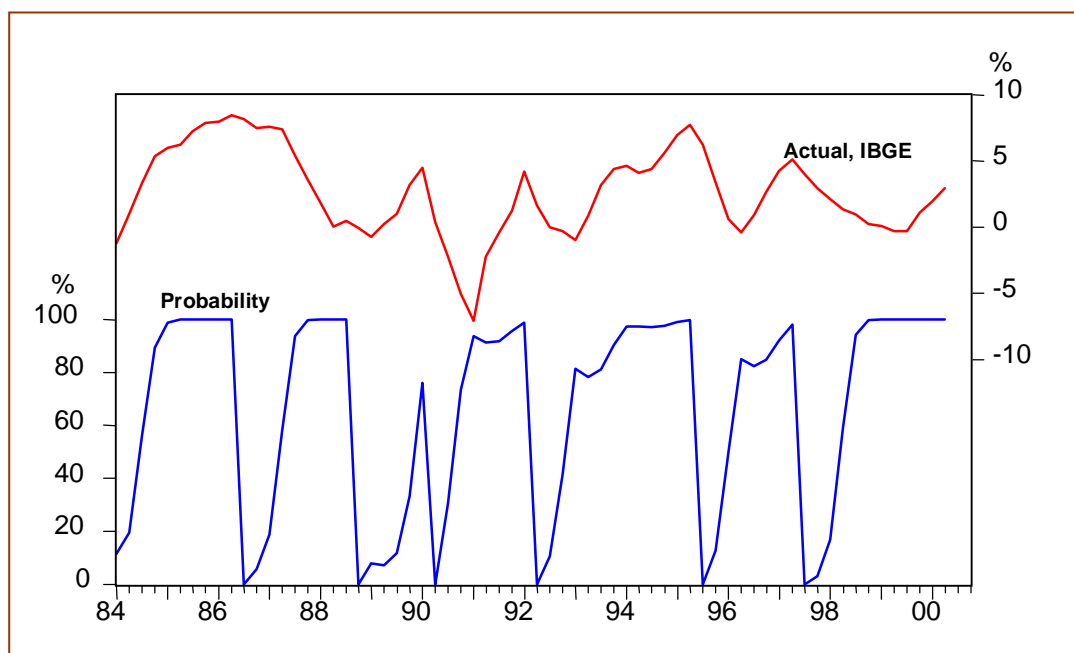

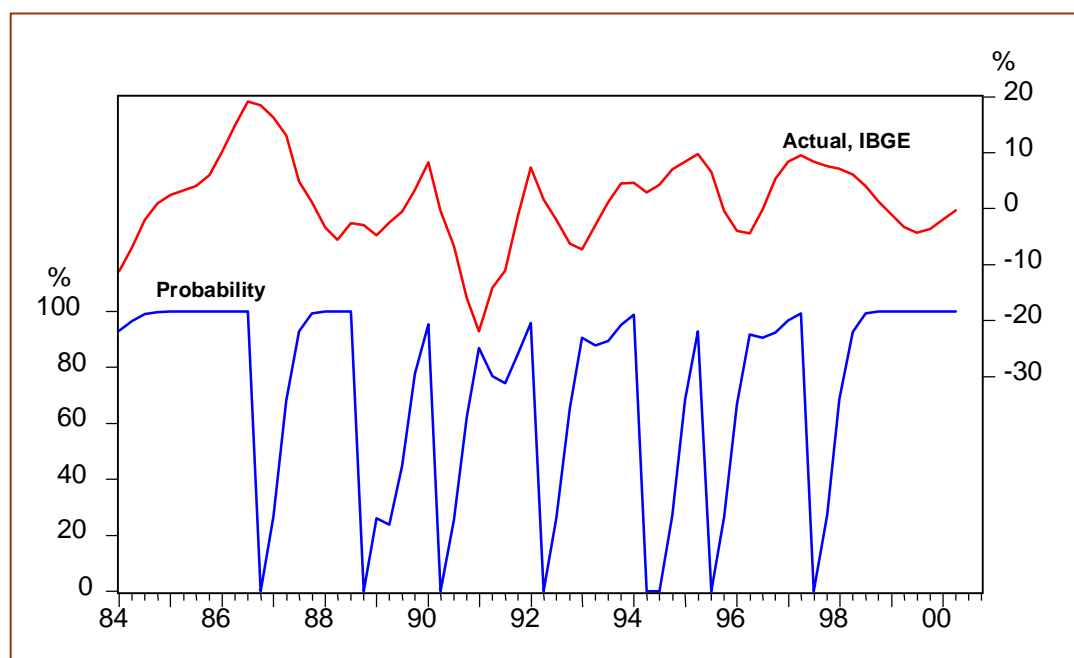Figure 6 – Probability of downturns in the GDP growth.

Figure 7 – Probability of downturns in the growth of Construction

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[5] The text is not available in English. Contador, C.R., "O desempenho dos indicadores antecedentes na cronologia das reversões cíclicas", <u>Relatório de Pesquisa 99</u>, August 1990, reprinted as <u>Relatório COPPEAD</u> 239, COPPEAD/UFRJ.
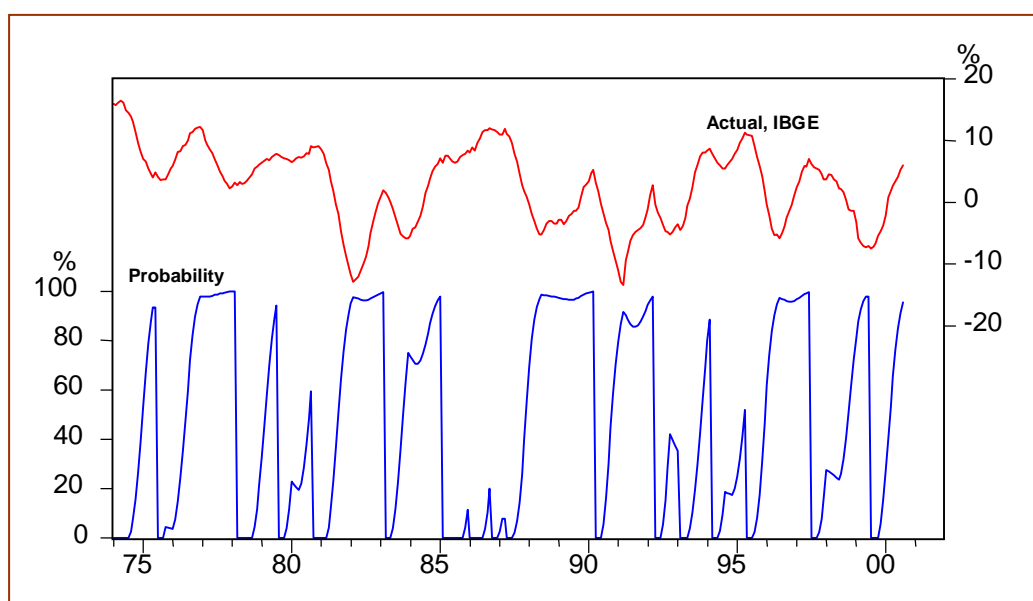
Figure 8 – Probability of downturns in the growth of Manufacturing

Another way of evaluating the past forecasting performance of CLI is to estimate how well it performs when current growth of the reference variable is explained by its past values and the CLI, following the traditional Granger-Sims causality test;[6]

$$y_t = \alpha + \Sigma \beta_i y_{t-i} + \Sigma \lambda_j CLI_{t-j} + \varepsilon_t \qquad (1)$$

and

$$y_t = \alpha + \Sigma \beta_i y_{t-i} + \varepsilon_t \qquad (2)$$

where y_t means the actual rate of change in the reference variable; CLI, the composite indicator; and ε_t, the serially uncorrelated random residuals. If the CLI does not contribute to forecasting, then the value of λ_j would be (not different from) 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.

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[6] 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 1990-2000, for both i and j equal to 3 quarters in the case of GDP and Construction Product, and 6 months for Manufacturing, are as follows.

- GDP growth (quarterly basis):

$$E(y_t) = -0.2892 + 0.4269 \ L(y_i) + 0.6823 \ L(CLI_j)$$
$$(-1.27) \qquad (2.79) \qquad\qquad (4.00)$$

$R^2 = 0.9187$
DW = 1.91
SER = 0.9547
F = 46.59

and

$$E(y_t) = 0.4948 + 0.7176 \ L(y_i)$$
$$(1.65) \qquad (6.76)$$

$R^2 = 0.7746$
DW = 2.05
SER = 1.5022
F = 31.78

where E(y) stands for estimated reference variable and L(.), the lag structure of past values. The numbers between brackets show the Student test.

- Construction growth (quarterly basis):

$$E(y_t) = -0.8351 + 0.1537 \ L(y_i) + 0.8406 \ L(CLI_j)$$
$$(-2.14) \qquad (0.89) \qquad\qquad (4.90)$$

$R^2 = 0.9368$
DW = 1.68
SER = 2.0380
F = 61.17

and

$$E(y_t) = 0.0238 + 0.7342 \ L(y_i)$$
$$(0.04) \qquad (7.01)$$

$R^2 = 0.7998$
DW = 2.16
SER = 3.4265
F = 36.95

- Manufacturing Industry growth (monthly basis):

$$E(y_t) = -0.0169 + 0.1917 \; L(y_i) + 0.8246 \; L(CLI_j)$$
$$\qquad\qquad (-0.23) \qquad (4.60) \qquad\qquad (22.41)$$

$R^2 = 0.9828$
$DW = 1.62$
$SER = 0.7752$
$F = 848.34$

and

$$E(y_t) = 0.0380 + 0.9376 \; L(y_i)$$
$$\qquad\qquad (0.45) \qquad (51.12)$$

$R^2 = 0.9732$
$DW = 1.55$
$SER = 0.9504$
$F = 1117.84$

In all three cases the null hypothesis is rejected at a significance level higher than 5 %, suggesting that the CLIs contain additional information that helps to forecast the cyclical movements of the reference variables. It could be argued possible that other choices of the lag orders would show different results. Bikker and Kennedy[7] point out that a large lag distribution for past values of the reference variable, incorporating more information about the history of the reference variable itself, would turn the test against the information content of CLI more severe. However, the F-test clearly favors the argument that the CLIs contain valuable information for prediction.

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[7] 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.

IV – Conclusions

This article presents composite leading indicators of business cycle for the Brazilian economy. Three reference variables are chosen: the Gross Domestic Product, the Construction Industry Product and the Manufacturing Industry Product. All three reference variables are expressed in annual rate of growth and the source is the IBGE Foundation. The lead-lag relationships were estimated for the period after 1990. The CLI of GDP is composed by 17 basic series and has a average lead of three quarters. The indicator of Construction Industry has 20 series and lead also of three quarter. Finally, the CLI of Manufacturing has 17 basic series and a lead of 8 months. The results show that the CLIs forecast quite well the turning points and the Granger-Sims causality test suggests that the CLIs improve the prediction, at a level of 5 % of significance. The Neftçi approach shows that the information contained in the CLIs can be applied to obtain statistical measure of the probability of cyclical turning points in the future.

The important conclusion rejects the optimistic official predictions for 2001. The rate of growth of the Brazilian economy will face a turning point by the end of 2000 or at the beginning of 2001. It is not a sign of recession, because the CLI approach may not deliver this type of information. We simply say that a <u>downturn of the rate of growth</u> will certainly occur. The Argentina crisis and the oncoming pessimistic external scenario can not be blamed alone by this downturn. But depending on its severity, the external variables may worsen the decline of the rate of growth. If these forecasts really happen, the CLI approach may convince the skeptical analysts and prove to be useful in predicting future aggregate cycle movements.

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Resumo :

Este texto apresenta indicadores antecedentes compostos do crescimento em base anual para três variáveis críticas : o Produto Interno Bruto; o Produto da Indústria de Construção Civil; e o Produto da Indústria de Transformação. Os indicadores antecedentes conseguem captar com antecedência de vários meses as datas das reversões cíclicas, e apontam uma breve fase de desaquecimento no início de 2001.

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