ISSN 1518-3548

BANCO CENTRAL DO BRASIL

Working Paper Series 11

A Note on the Efficient Estimation of Inflation in Brazil

Michael F. Bryan and Stephen G. Cecchetti

March, 2001

ISSN 1518-3548
CGC 00.038.166/0001-05

Working Papers Series	Brasília	n. 11	Mar	2001	P. 1 – 26

Working Paper Series

Edited by:

Research Department (Depep)
(e-mail: conep.depep@bcb.gov.br , workingpaper@bcb.gov.br)

Reproduction permitted only if source is stated as follows: Working Paper Series n. 11.

Authorized by Ilan Goldfajn (Director of Economic Policy)

General Control of Subscription:

Banco Central do Brasil
Demap/Disud/Subip
SBS – Quadra 3 – Bloco B – Edifício-Sede – 2º subsolo
70074-900 - Brasília (DF)
Telefone (61) 414-1392
Fax (61) 414-3165

Number printed: 450 copies

Banco Central do Brasil Information Bureau

Address:	Secre/Surel/Dinfo Edifício-Sede, 2º subsolo SBS - Quadra 3, Zona Central 70074-900 - Brasília (DF)
Phones:	(61) 414 (....) 2401, 2402, 2403, 2404, 2405, 2406
DDG:	0800 992345
FAX:	(61) 321 9453
Internet:	http://www.bcb.gov.br
E-mail:	cap.secre@bcb.gov.br dinfo.secre@bcb.gov.br

A NOTE ON THE EFFICIENT ESTIMATION OF INFLATION IN BRAZIL[1]

Michael F. Bryan[2]
&
Stephen G. Cecchetti[3]

Abstract

This paper[4] investigates the use of trimmed-mean estimators and time-series averaging as techniques for improving the signal-to-noise ratio in high-frequency price data. We show that trimmed-mean estimators substantially increase the efficiency of the aggregate estimator compared to the more standard mean-measures. In this way, these estimators also reduce a central bank's need to time-series average the monthly inflation estimates which greatly improves the timeliness of the inflation statistic.

In the case of Brazil, we find that asymmetrically trimming 24 percent from the tails of the price-change distribution reduces the RMSE of the monthly inflation statistic as a measure of the inflation trend by 23 percent, making it as accurate as the 3-month average growth rate of the mean retail price measure. We also demonstrate that a 3-month lagged moving average of the optimal (asymmetrically) trimmed mean is as efficient an estimator of the 24-month centered moving-average retail price growth trend as the mean inflation rate averaged over any horizon.

---

[1] The views expressed herein do not necessarily reflect the views of the Federal Reserve Bank of Cleveland or of the Board of Governors of the Federal Reserve System.

[2] Federal Reserve Bank of Cleveland; email: michael.f.bryan@clev.frb.org.
[3] The Ohio State University and NBER; email: cecchett@econ.ohio-state.edu.

[4] The authors wish to thank Francisco Marcos R. Figueiredo for providing the data and other important background information used in this study. Special thanks is also owed to the participants of the Banco Central do Brazil's conference "One Year of Inflation Targeting in Brazil," July 10-11, 2000, and especially to Paulo Picchetti of the Universidade de Sao Paulo and Jack Schechtman of the Fundacao Getulio Vargas/Instituto Brasileiro de Economia.

A note on the efficient estimation of inflation in Brazil

I. Introduction

On June 21, 1999, the president of Brazil directed the Banco Central do Brasil to adopt multiyear inflation targets. Specifically, the central bank was asked to set explicit numerical targets for the 12-month inflation rate for the years 1999 through 2001 and to extend that target outwards annually two years in advance beginning in 2000.[5]

A renewed interest in inflation measurement has accompanied the rise in the number of the world's central banks that set specific inflation targets. In this paper, we investigate whether trimmed-mean estimators can improve the central bank's ability to hit its inflation target by increasing the signal-to-noise ratio between the incoming, high-frequency, price data and the longer-term inflation trend. We show that such estimators measure aggregate retail price movements more efficiently than the more standard mean-measures at high frequencies. Indeed, we find that asymmetrically trimming 24 percent from the tails of the price-change distribution reduces the RMSE of the monthly inflation statistic as a measure of the inflation trend by 23 percent—making it as accurate as the 3-month average growth rate for the mean retail price measure. Further, we demonstrate that a 3-month lagged moving average of the optimal (asymmetrically) trimmed mean is as efficient an estimator of the 24-month centered moving-average retail price growth trend as the mean inflation rate averaged over *any* horizon.

[5] Among the other requirements of this action, the National Monetary Council (in conjunction with the Minister of Finance) is assigned the responsibility of setting the inflation targets and tolerance ranges. Moreover, the central bank is given full responsibility for implementing the policies needed to achieve the targets, is expected to show accountability for achieving of the targets, and must make the central bank's policies transparent, which includes issuing a quarterly *Inflation Report*. For a more complete discussion of this program, see Mishkin and Savastano (2000).

We believe these results are important, as they suggest that trimmed-mean estimators substantially reduce the time required to identify changes in the inflation trend and thus significantly improve the central bank's chances of successfully hitting its inflation target.

Section II provides a brief description of the Brazilian retail price data. In section III, we discuss the sampling noise inherent in the calculation of aggregate price statistics and the use of trimmed mean estimators as a method for reducing that noise. In section IV, we combine the use of trimmed mean estimators with another popular noise-reduction technique, time series averaging, to produce the optimal inflation-trend estimators for the Banco Central do Brazil over monthly horizons from 1 to 12 months. We make some concluding observations in section V.

II. Inflation in Brazil: A Preliminary Look

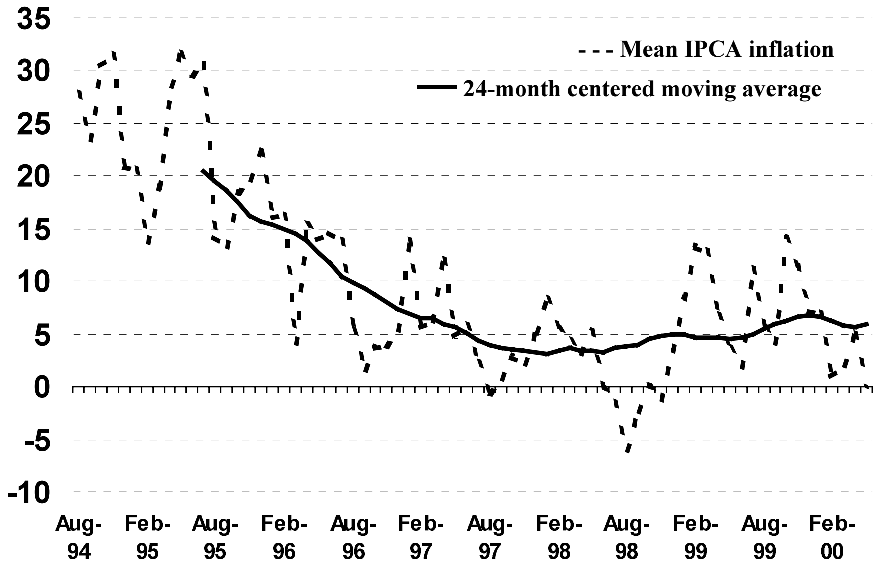
The inflation statistic chosen as the target for the Banco Central do Brazil (Brazil's central bank) is a broad measure of retail prices, called the Extended Consumer Price Index (Indice de Precos ao Consumidor Amplo, or IPCA), similar in construction to the Consumer Price Index produced by the U.S. Department of Labor. The IPCA, calculated by the Brazilian Institute of Geography and Statistics (Instituto Brasileiro de Geografia e Estatistica, or IBGE), is a comprehensive price statistic measuring price changes in eleven metropolitan areas. It became available beginning in 1979. The central bank's IPCA target was 8 percent in 1999, falling to 6 percent, 4 percent, and 3½ percent in 2000, 2001, and 2002, respectively. The bank has been given a tolerance range of plus-or-minus 2 percentage points around these targets.

In this study, we explore between 48 and 53 components of the Brazilian retail price index (sample size varies due to data availability over the full sample period, 1994 to 2000). Table 1 reports the average expenditure weight for each component and its time-series variance. Note that food and energy represent a disproportionate share of the commodities that demonstrate above-average variance. This is a common finding and the reason these goods are excluded when calculating the central bank's "core" inflation statistic. We think excluding certain items from the retail market basket is problematic for several reasons. Clearly, once we systematically alter the market basket in such a way, we are no longer measuring a representative expenditure-weighted cost-of-living statistic. Indeed, given the underlying price-change distribution, it is probable that such an altering of the weights will systematically introduce a bias in the re-weighted price aggregate so that it will no longer track the IPCA over time. Moreover, we have altered the price statistic's weights such that the resulting aggregate price change answers a fundamentally different question than the more traditional measures were designed to answer. And what question the modified price index answers is not always clear.

Second, there is no reason to believe that this broad exclusionary technique is justified for all commodities across all economies. For example, in the case of the Brazilian data, some food items show less-than-average volatility, such as canned foods, beverages, flour and prepared flour mixes, spices, and processed meats and fish. On the other hand, several commodities exhibit excessive volatility from month to month which will not be accounted for if only food and energy are excluded, such as communications, domestic services, rent, and public transportation.

The variability of the components in the IPCA are reflected in its extreme month-to-month movements (figure 1.) Although the disinflation trend over the period is clear, fluctuations around that trend are large, often five percentage points or more above and below the centered 24-month moving-average trend growth rate. This high-frequency

Figure 1: Brazilian Inflation Estimates
(Monthly percent changes, August 1994 to May 2000)



variation introduces a problem for an inflation-targeting central bank, as it makes it difficult for the bank to disentangle transitory movements in the price data from the inflation trend it hopes to control. In the section that follows, we discuss the use of trimmed-mean estimators as a technique for reducing some of the month-to-month variation in the aggregate price data.

III. Sampling Noise in Price Statistics

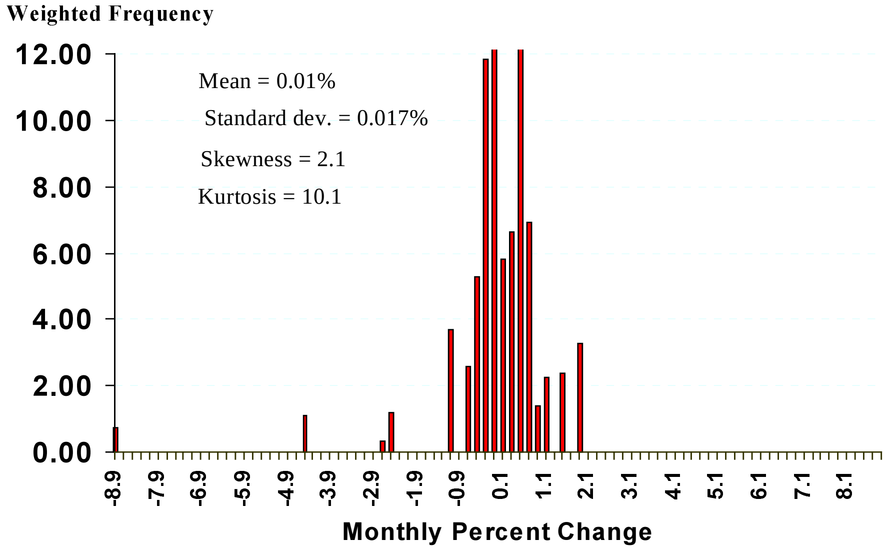
In earlier research (Bryan and Cecchetti [1994, 1999b] and Bryan, Cecchetti, and Wiggins [1997]), we have investigated the advantages of trimmed-mean estimators as measures of high-frequency inflation. These estimators can be described as

(1) $$\bar{x}_{\alpha} = \frac{1}{1-2(\frac{\alpha}{100})} \sum_{i \in I_{\alpha}} w_i \pi_{it} \ .$$

The estimators, $\bar{x}_{\alpha}$, are computed by ordering the component price-change data, π_{it}, and their associated weights, w_i, as defined by expenditure or value-added criteria. The set of observations to be averaged, I_{α}, is the set of price changes for which the cumulative weights, $W_i = \sum_{i=1}^{j} w_i x_i$, are centered between $\alpha/100$ and $1-\alpha/100$. We refer to these as the "α trimmed-mean estimators", for which the weighted mean ($\alpha = 0$) and the weighted median ($\alpha = 50$) are special cases.

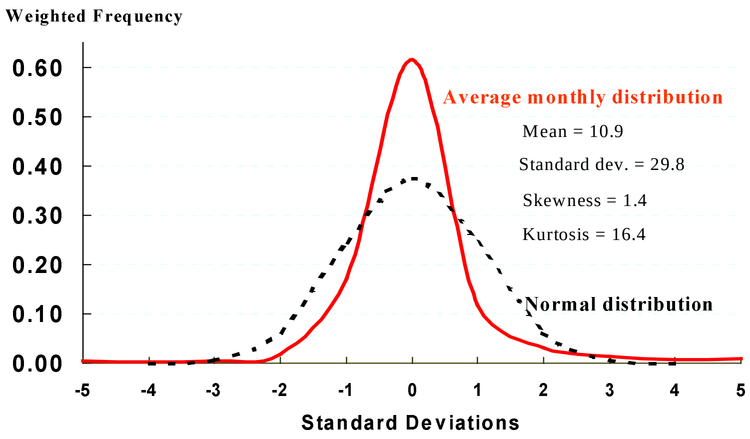
In large part, these estimators are motivated by a statistical anomaly in aggregate price-change estimation. Specifically, price-change distributions have a tendency to be exceptionally leptokurtic—that is, they have "fat tails."

Figure 2: Brazilian Price Changes
(Retail prices, May 2000)



To see what we mean, consider the distribution plotted in figure 2, price changes for the IPCA in May 2000. For this particular month, the mean price change was nearly zero, but there was substantial dispersion among the components. Furthermore, this month was not atypical.

Figure 3: The Distribution of Brazilian Price Changes
(Retail prices, July 1994 to May 2000)



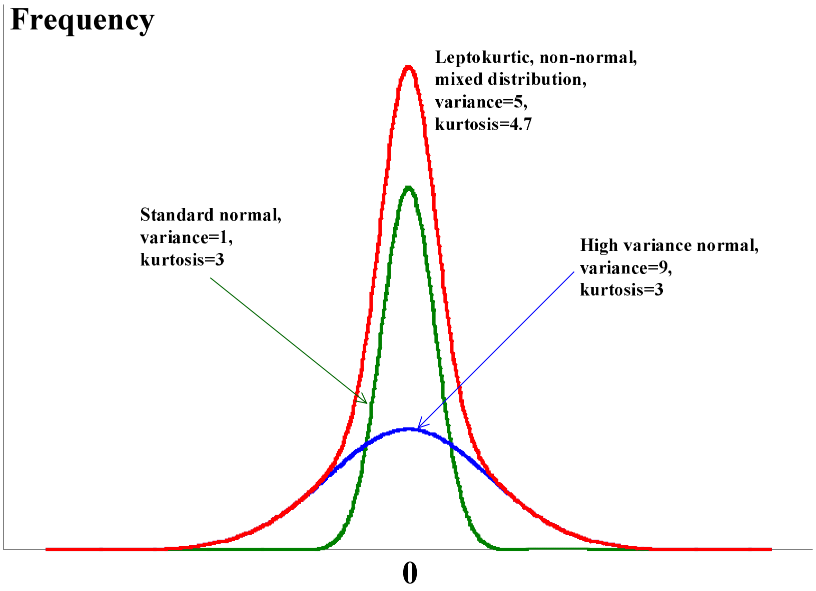
To show this, figure 3 plots the average distribution of retail price changes for the period since Brazil's monetary reform (July 1994 to May 2000.) For our purposes, the most important point to note is that the price-change distributions have unusually elongated and fat tails compared to a standard normal distribution, which we also plot on the figure for reference.

Such a price-change distribution appears to be common across a broad range of countries. In table 2 we report the distributional characteristics of retail-price data for eleven countries including Brazil. In the set of countries for which we have data, the average kurtosis is 22.5, more extreme than the average for Brazil (16.4).[6]

The reason for such unusually shaped distributions is unknown, but we would note that they could easily occur by mixing together price data with widely differing variances (figure 4). A leptokurtic aggregate price-change distribution could be produced this way.

[6] Data of different frequencies are not directly comparable as underlying price-change distributions become less variable and less kurtotic as the data are averaged.

Figure 4: Hypothetical Mixed Normal Distribution

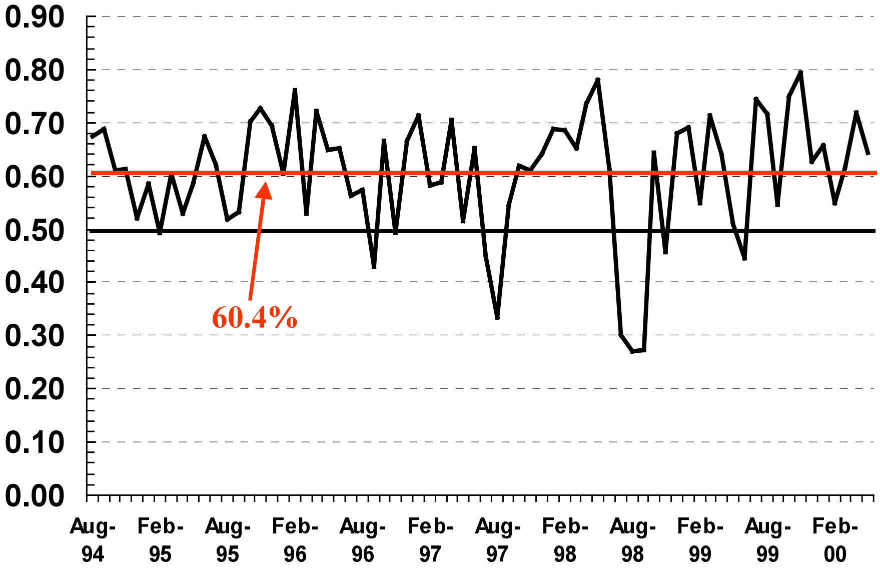


The presence of fat-tailed price-change distributions may have a structural economic explanation. It may be, as Ball and Mankiw (1995) suggest, that such distributions are reflections of price stickiness resulting from menu costs, where the more extreme the market pressures, the more likely a price change will result. Their model was a primary motivation for our early work on the subject. More recently, Balke and Wynne (2000) have demonstrated that these distributions can also be generated by model economies with flexible prices and sectoral technology shocks.

Regardless of the source, the statistical estimation implications are clear—when individual price-change data are drawn from fat-tailed distributions, measuring aggregate price changes using a weighted mean is unlikely to be efficient. The occasional draw from one tail of the distribution is unlikely to be balanced by an equal draw from the opposite tail, resulting in skewed samples and producing unnecessarily large swings in the mean price data. By trimming the tails of the distribution, we improve the statistical efficiency of the aggregate statistic.

While this is usually a straightforward procedure, in the case of Brazil the retail price data suffer from unusually persistent positive skewness, such that a disproportionate number of price changes are on the positive tail of the distribution. Some have given economic meaning to these positive outliers in the data, although in the United States we have seen that a purely statistical explanation, using arithmetic rather than geometric averaging techniques, can be important. Figueiredo (2000) suggests these outliers may result from the existence of intermittent price adjustment by a significant subcomponent of the retail price set. This is similar in spirit at least to the sticky-price explanation of Ball and Mankiw (1995) referred to earlier. The statistical consequence is that the set of trimmed-mean statistics will be biased estimators of the central tendency of price changes. That is, the trimmed estimators will tend to be too small, containing a persistent negative bias. As a result, they will not directly correspond to the central bank's target, which is based on the behavior of the mean index.

Figure 5: Brazilian Price Asymmetry
(Mean percentile of the price-change distribution)
August 1994 to May 2000



Our strategy is to consider a generalization to the symmetric trimming procedure, in which we trim asymmetrically, thereby preserving an unbiased estimator. To do this, we begin by finding the percentile of the price-change distribution that yields average inflation equal to that of the official (mean) inflation index. We refer to this as the mean percentile, and in the case of Brazil it occurs at slightly above the 60^{th} percentile (see figure 5). Although the mean percentile of the Brazilian retail price-change distribution is variable from month to month, there appears to be little systematic movement from the 60^{th} percentile during the post-monetary-reform era (from June 1994 on).

Following our earlier work, we now proceed to examine the efficiency of the full set of asymmetrically trimmed means. Specifically, we compare the efficiency of the mean IPCA to each of the trimmed-mean estimators centered on the 60^{th} percentile of the price-change distribution. That is, we trim the tails of the price-change distribution such that 60 percent of every percentage point is trimmed off the lower tail of the distribution relative to 40 percent off the upper tail of the distribution. In that way, we assure that the distribution remains centered on the 60th percentile of the data and that our estimators are unbiased. We compare these estimators to the 24-month centered moving average of the IPCA growth rate, a proxy for the central bank's inflation target, measuring efficiency using the root-mean-squared error (RMSE). [7]

Figure 6: Asymmetric Trimmed Mean Estimators in Brazil
(Historical observations, benchmark= 24-month centered average)

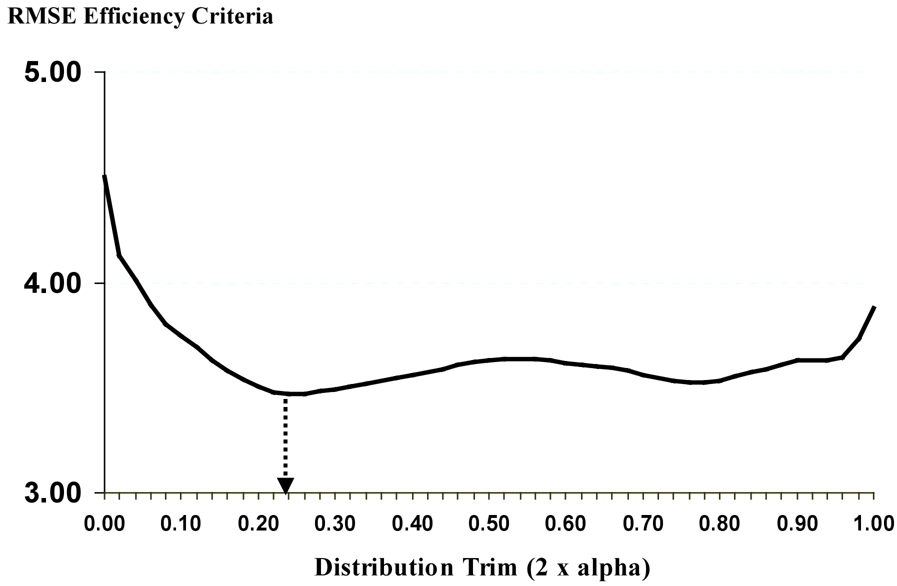


Figure 6 plots the RMSE for all of the asymmetrically trimmed means. The decline in the RMSE is a measure of the efficiency gains obtained by trimming. Large efficiency gains are achieved from relatively small trims of the data. The most efficient estimator, the one with the minimum RMSE, is the 24 percent trim. The efficiency gain from using the 24 percent asymmetrically trimmed mean is about 23 percent of the simple mean IPCA (RMSE of 3.47 versus 4.51 percent.) But all of the estimators with trims between 16 percent and 96 percent produce similar levels of efficiency.

[7] This is a shorter time trend than in our earlier work (typically 36 months.) This change was required due to the relatively short period for which consistent data are available (June 1994 to present).

IV. Reducing Transitory Noise by Time-Series Averaging

The sampling problems discussed so far are only one source of a "noisy" inflation statistic. Other factors, such as transitory shocks to either the demand or the supply sides of the marketplace, can also obscure the aggregate-price-change trend that a central bank hopes to measure.[8] Most central banks and government statistical agencies have adopted methods for reducing the influence of these factors on the inflation measure. Seasonal adjustment, for example, is commonly employed to eliminate within-year variations in component prices. Other popular techniques include various moving averages of the data. Indeed, most central banks that currently target "inflation," including Brazil, use 12-month trends.

We investigate two candidate methods for removing this time-series noise. Both use the asymmetric trimming procedure we have already considered and involve the use of 1- to 12-month time-series averages of the data. In the first, we compute the asymmetrically trimmed means as before, and then take the time-series average. We refer to this as "post-trim" averaging. We then examine the consequences of reversing these two operations, computing time-series averages of the components and then trimming the price-change distribution. We refer to this as "pre-trim" averaging.

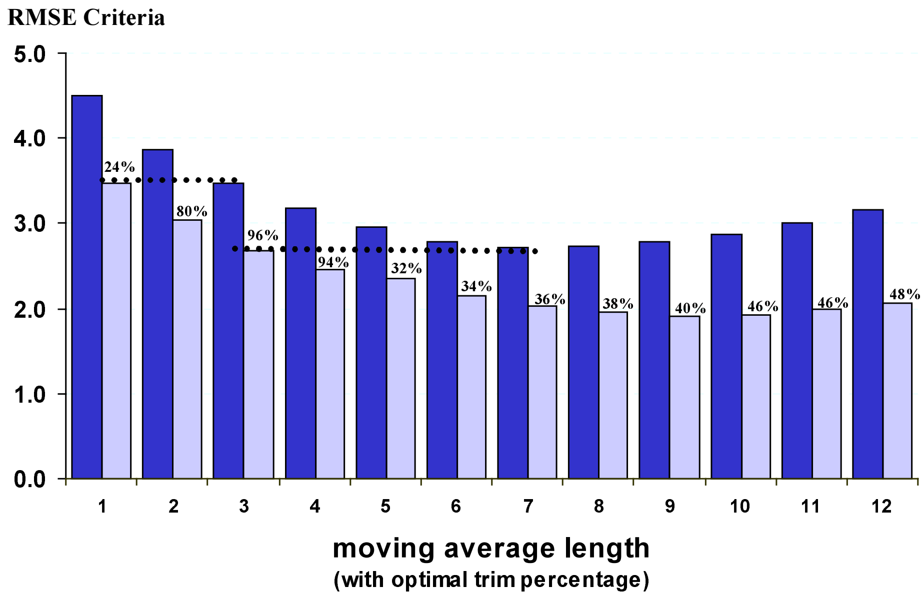
---

[8] Why such transitory events, insofar as they stem from real events, are not worthy of the central bank's attention is not entirely clear. Certainly they can have important, although impermanent repercussions on a region's cost of living, or value of production. However, to the extent that the costs of inflation are usually thought to be associated with the inflationary expectations of the agents operating in an economy

The results for post-trim averaging are presented in figure 7. We report the most efficient trimmed mean for each post-trim horizon (the light bar) together with the RMSE of the time-series average of the actual monthly inflation data (the dark bar).[9] Looking at the results, we first note that the monthly asymmetric 24 percent trimmed-mean of the IPCA is as efficient an estimator of the benchmark as the three-month trend in the mean IPCA. That is, by using the 24 percent trimmed mean the central bank learns about movements in the inflation trend two months earlier. This would seem to

Figure 7: Efficiency Gains over Mean Brazil Inflation

(August 1994 to May 2000, benchmark = 24-month centered average)



be an important saving for policymakers who hope to identify changes in the inflation trend before its influence becomes imbedded in the economy.

Continuing to look at the figure, we also note that the most efficient 3-month estimator (a 96 percent asymmetrically trimmed mean) is as efficient an estimator of the centered IPCA trend as the IPCA averaged over any horizon up to 12 months. The most efficient

and the transitory nature of these shocks is unlikely to affect those expectations, their elimination from the central bank's inflation statistic seems desirable.

[9] Again from a 24-month-centered-moving-average benchmark.

estimator in the entire set of post-trim averages was found to be the 40 percent trimmed mean, averaged over a nine-month period. However, the efficiency gains of this estimator compared to other estimators, such as the 34 percent trimmed mean averaged over a 6-month period is small.

Next we move on to study pre-trim averaging. Here we time-average each of the component-price changes over monthly horizons from 1 to 12 months and then compute the asymmetrically trimmed means with the lowest RMSE. In all of the experiments reported thus far, we have considered only monthly percent changes in the component-price data, or pre-trim averages of length 1. We combine pre-trim averaging of component-price data with the post-trim averaging described earlier. For example, estimators with a pre-trim of 6 and a post-trim equal to 12 represent estimators based on component-price-change data that is computed over the past 6 months, trimmed, and then averaged over a 12-month period.

By computing the estimators in this way, we hope to account for two different types of noise in the data-generating process. Noise that is component specific might best be addressed through pre-trim averaging of the component-price-change data. However, transitory shocks that are offset by price adjustments elsewhere in the price-change distribution (and are therefore correlated across components) might be more effectively reduced through post-trim averaging of the estimators.

Table 3 reports the RMSE and the optimal asymmetric trim, centered at the 60th percentile, for the *most* efficient estimators for all candidate pre-trim and post-trim averages. The RMSEs are in panel (a) and the trims in panel (b). For monthly data (pre-trim and post-trim equal to 1), the minimum RMSE from the 24-month centered moving average benchmark is 3.47 percent, obtained by trimming 14.4 percent from the lower tail and 9.6 percent from the upper tail (total trims equal to 0.24).

In general, we find that pre-trim averaging of the Brazilian component price-change data offers little net improvement in efficiency over post-trim averaging. Indeed, for all but 1- and 2-month post-trim averages, pre-trim averaging actually reduced the efficiency of the optimal estimators. This is interesting, as it suggests that transitory variations in the component-price data are negatively correlated across components. Consider that the RMSE of the most efficient trimmed-mean estimator derived from 12-month changes in component data is 44 percent less efficient than the most efficient monthly estimator averaged over a 12-month period (2.96 percent vs. 2.06 percent).

The most efficient estimator for this data was found by asymmetrically trimming 40 percent of the *monthly* price-change data, and averaging over 9-months (RMSE = 1.91), although 6 to 8-month averages of the monthly data produced similar results.

IV. Conclusion

In this paper, we have investigated ways in which the central bank can compute a reduced-noise estimator of the Brazilian IPCA, the focal point of the Banco Central do Brazil inflation targeting strategy. We demonstrate that the most efficient monthly estimator of the 24-month IPCA trend is the 24 percent asymmetrically trimmed mean (14.4 percent off the bottom tail of the distribution and 9.6 percent off the upper tail).

This produces an efficiency gain of 23 percent over the monthly mean IPCA. In other words, we can significantly improve upon the high-frequency signal the bank uses to monitor the trend of its chosen inflation statistic.

We extended the analysis of the trimmed-mean estimators to include every combination of pre-trim averaging of the component data and post-trim averaging of the trimmed-mean estimator to gauge the efficiency gains available by time-series smoothing. We find that of the two techniques, post-trim averaging of the estimators provided superior results for the Brazilian inflation data. Moreover, relatively small time-series averages of the optimal trimmed-mean estimators were better measures of the IPCA growth trend than the monthly IPCA price change over any lagged horizon up to 12 months.

References

1. Ball, L, and Mankiw, N.G., 1995. Relative price changes as aggregate supply shocks. *Quarterly Journal of Economics* 110, 161-193.

2. Balke, Nathan S. and Wynne, Mark A, 2000. An equilibrium analysis of relative price changes and aggregate inflation. *Journal of Monetary Economics* 45, 269-292.

3. Bryan, Michael F. and Cecchetti, Stephen, 1993. The consumer price index as a measure of inflation. NBER Working Paper no. 4505.

4. --, 1994. Measuring Core Inflation. Chapter 6 in N. G. Mankiw, <u>Monetary Policy</u>, University of Chicago Press.

5. --, 1999a. Inflation and the distribution of price changes. *The Review of Economics and Statistics* 81. 188-196.

6. --, 1999b. The monthly measurement of core inflation in Japan, *Monetary and Economic Studies*, Institute for Monetary and Economic Studies, Bank of Japan, Vol. 17. No. 1, May 1999.

7. Bryan, Michael F., Cecchetti, Stephen, and Wiggins II, Rodney, 1997. Efficient inflation estimation. NBER Working Paper, no. 6183.

8. Cogley, Timothy, 1998. A simple adaptive measure of core inflation. Manuscript, Federal Reserve Bank of San Francisco.

9. Dow, James P., Jr., 1994. Measuring inflation using multiple price indexes. Unpublished manuscript, Department of Economics, University of California-Riverside.

10. Figueiredo, Francisco Marcos R., 2000. Evaluation of a measure of core inflation. Manuscript, Studies and Research Department, Central Bank of Brazil.

11. Mishkin, Frederic S. and Miguel A. Savastano, 2000. Monetary Policy Strategies for Latin America. National Bureau of Economic Research Working Paper, no. 7617, March 2000.

12. Picchetti, Paulo and Toledo, Celso, 2000. How much to trim? A methodology for calculating core inflation. Manuscript, Conference on One Year of Inflation Targeting in Brazil, Central Bank of Brazil, July 10-11, 2000.

13. Quah, Danny and Vahey, Shaun P. 1995. Measuring core inflation. *Economic Journal* 105, 1130-1144.

14. Roger, Scott, 1995. Measures of underlying inflation in New Zealand, 1949-96. Reserve Bank of New Zealand Discussion Paper Series, G95/5.

15. Wynne, Mark A., 1999. Core inflation: A review of some conceptual issues. Proceeding of the Workshop of Central Bank Model Builders, Bank for International Settlements, February 1999.

Table 1: Alternative Brazilian Retail Price Weights
(Food and energy commodities in bold type.)

	Expenditure Weight	Variance
Communication	1.66	101.40
Vegetables	**0.29**	**85.27**
Potatoes	**0.74**	**71.43**
Fruits	**1.12**	**31.05**
Cereals	**1.26**	**26.18**
Electricity	**1.74**	**23.74**
Fish	**0.39**	**20.00**
Household fuel	**0.68**	**12.51**
Poultry and eggs	**1.23**	**11.55**
Meat	**2.96**	**11.43**
Domestic services	4.95	10.56
Motor fuel	**4.15**	**9.81**
Housing rent and taxes	10.81	7.87
Public transportation	5.42	7.76
Fats and oils	**0.51**	**6.50**
Bakery products	**2.14**	**6.49**
Tobacco products	1.37	5.90
Health insurance	0.88	5.17
Women's apparel	2.49	4.86
Men's apparel	2.28	4.67
Sugar and sweets	1.20	4.35
Tuition, other school fees and childcare	2.96	4.33
Dairy products	**2.71**	**4.29**
Food away from home	**6.88**	**4.16**
Processed meat and fish	**0.67**	**4.11**
Spices, seasoning, condiments and sauces	**0.54**	**3.66**
Professional services	3.18	3.43
Flour and prepared flour mixes	**0.77**	**3.40**
Beverages	**1.56**	**3.35**
Canned food	**0.24**	**3.14**
Bedding and bath clothes	0.57	3.13
Children's apparel	1.23	3.08
Jewelry	0.53	2.67
Television, sound equipment and	1.28	2.60
Reading materials	0.74	2.39
Drugs	2.60	2.19
Decorator items	0.39	2.16
Footwear	2.13	2.15
Hospital and other medical care services	0.95	1.81
Furniture	1.66	1.37
Household appliances	1.56	1.36
Household cleaning products	0.98	1.30
Vehicles	8.00	1.26
Entertainment services	3.76	1.21
Maintenance and repair commodities	0.81	1.11
Sewing materials	0.48	1.11
Eyeglasses	0.45	0.90
Personal care services	1.82	0.80
Prepared food	0.07	0.54
Maintenance and repair services	1.41	0.36
Photograph and film	0.36	0.40
Educational supplies	0.45	0.30

Table 2: Weighted, Cross-Sectional Descriptive Price-change Statistics by Country (Data annualized, standard deviations in parenthesis)

Country	Mean	Std. Dev.	Skewness	Kurtosis
1. Canada	3.4	19.3	0.41	22.0
	(3.8)	(7.3)	(3.2)	(15.8)
2. Japan	4.5	24.8	0.76	32.9
	(7.1)	(14.6)	(4.3)	(40.8)
3. United Kingdom	8.1	24.7	0.78	20.1
	(9.0)	(14.2)	(3.0)	(21.2)
4. Mexico	42.8	82.4	2.62	46.2
	(37.8)	(42.1)	(3.3)	(38.8)
5. Colombia	23.2	33.5	1.04	10.1
	(11.6)	(15.1)	(2.0)	(7.3)
6. United States	5.2	9.0	0.28	11.6
	(3.7)	(5.1)	(2.2)	(10.1)
7. Australia *	7.6	12.1	0.49	10.8
	(5.1)	(11.2)	(2.1)	(9.5)
8. New Zealand *	7.2	7.8	0.66	6.9
	(6.1)	(4.3)	(1.6)	(7.9)
9. Sweden	6.1	25.8	1.05	19.1
	(7.9)	(16.6)	(2.6)	(18.6)
10. Germany	2.7	15.3	-0.02	26.3
	(3.5)	(7.7)	(4.0)	(14.1)
11. Brazil	**206.2**	**60.0**	**0.58**	**14.64**
	(381.74)	**(44.36)**	**(2.51)**	**(11.76)**
(full sample, January 1991- May 2000)				
11a. Brazil	**10.9**	**29.8**	**1.39**	**16.4**
	(9.5)	**(16.7)**	**(2.42)**	**(13.5)**
(post-monetary reform, July 1994-May 2000)				

* Quarterly data.

Table 3: RMSEs and Optimal Asymmetric Trim Percentages for the Most Efficient Estimators

(24-month centered moving average benchmark)

Panel a: RMSE Minima

Pre-trim	Post-Trim Averaging											
Aver.	1	2	3	4	5	6	7	8	9	10	11	12
1	3.47	3.04	2.67	2.46	2.35	2.16	2.03	1.95	1.91	1.93	1.99	2.06
2	3.17	2.90	2.73	2.63	2.51	2.40	2.36	2.37	2.41	2.52	2.63	2.75
3	2.86	2.88	2.91	2.85	2.75	2.70	2.67	2.68	2.74	2.85	2.97	3.06
4	2.75	2.94	3.00	3.01	3.02	3.03	3.05	3.11	3.21	3.35	3.42	3.52
5	2.81	2.99	3.08	3.14	3.18	3.23	3.30	3.40	3.54	3.64	3.75	3.86
6	2.77	2.92	3.04	3.14	3.24	3.36	3.48	3.63	3.78	3.87	3.97	4.07
7	2.72	2.88	3.03	3.18	3.33	3.48	3.62	3.76	3.89	4.01	4.13	4.23
8	2.74	2.91	3.09	3.27	3.45	3.62	3.77	3.92	4.06	4.17	4.26	4.37
9	2.78	2.99	3.19	3.38	3.55	3.71	3.87	4.02	4.14	4.24	4.35	4.48
10	2.82	3.03	3.22	3.42	3.60	3.78	3.95	4.09	4.22	4.34	4.47	4.62
11	2.85	3.07	3.28	3.48	3.68	3.87	4.03	4.17	4.31	4.46	4.61	4.76
12	2.96	3.19	3.41	3.63	3.83	4.00	4.16	4.32	4.47	4.63	4.78	4.92

Panel b: Trim Percentages

Pre-trim	Post-Trim Averaging											
Avg.	1	2	3	4	5	6	7	8	9	10	11	12
1	0.24	0.80	0.96	0.94	0.32	0.34	0.36	0.38	0.40	0.46	0.46	0.48
2	0.82	0.80	0.78	0.76	0.76	0.74	0.72	0.70	0.68	0.58	0.56	0.56
3	0.78	0.78	0.78	0.76	0.76	0.76	0.56	0.58	0.58	0.58	0.56	0.56
4	0.28	0.82	0.82	0.80	0.80	0.78	0.70	0.66	0.64	0.56	0.56	0.60
5	0.26	0.84	0.82	0.82	0.00	0.82	0.82	0.82	0.82	0.82	0.70	0.70
6	0.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.82	0.60	0.60	0.58
7	0.00	0.00	0.00	0.00	0.00	0.86	0.88	0.88	0.88	0.88	0.88	0.56
8	0.00	0.00	0.00	0.00	0.00	0.92	0.92	0.92	0.92	0.56	0.56	0.56
9	0.00	0.00	0.00	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
10	0.48	0.48	0.48	0.48	0.52	0.52	0.58	0.58	0.58	0.58	0.58	0.58
11	0.48	0.48	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
12	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.44	0.44	0.44	0.44

Working Paper Series
Banco Central do Brasil

1	Implementing Inflation Targeting in Brazil	Joel Bogdanski, Alexandre Antonio Tombini, and Sérgio Ribeiro da Costa Werlang	07/2000
2	Política Monetária e Supervisão do SFN no Banco Central	Eduardo Lundberg	07/2000
	Monetary Policy and Banking Supervision Functions on the Central Bank	Eduardo Lundberg	07/2000
3	Private Sector Participation: A Theoretical Justification of the Brazilian Position	Sérgio Ribeiro da Costa Werlang	07/2000
4	An Information Theory Approach to the Aggregation of Log-Linear Models	Pedro H. Albuquerque	07/2000
5	The Pass-through from Depreciation to Inflation: A Panel Study	Ilan Goldfajn and Sérgio Ribeiro da Costa Werlang	07/2000
6	Optimal Interest Rate Rules in Inflation Targeting Frameworks	José Alvaro Rodrigues Neto, Fabio Araújo, and Marta Baltar J. Moreira	09/2000
7	Leading Indicators of Inflation for Brazil	Marcelle Chauvet	09/2000
8	Standard Model for Interest Rate Market Risk	José Alvaro Rodrigues Neto	09/2000
9	Estimating Exchange Market Pressure and Intervention Activity	Emanuel-Werner Kohlscheen	11/2000
10	Análise do Financiamento Externo a Uma Pequena Economia	Carlos Hamilton Vasconcelos Araújo e Renato Galvão Flôres Júnior	03/2001
11	A Note on the Efficient Estimation of Inflation in Brazil	Michael F. Bryan and Stephen G. Cecchetti	03/2001
12	A Test of Competition in Brazilian Banking	Márcio I. Nakane	03/2001
13	Modelos de Previsão de Insolvência Bancária no Brasil	Marcio Magalhães Janot	03/2001
14	Evaluating Core Inflation Measures for Brazil	Francisco Marcos Rodrigues Figueiredo	03/2001
15	Is it worth tracking dollar/real implied volatility ?	Sandro Canesso de Andrade and Benjamin Miranda Tabak	03/2001