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The Benchmarking in the official data in Mexico

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This paper explains how to improve the quality and the accuracy of quarterly GDP with the application of the Temporal Disaggregation-Benchmarking by way of the Denton technique in the accounts of Short-term and Regional in Mexico.

The Program Bench-México in the official data in Mexico with the Denton technique

Introduction

The main purpose of short-term economic statistics is the timely (opportunity) and accuracy/precision; even though the perception is: these words are contradictories. This paper explains the experience how the INEGI improved the quality of Short-term accounts with the application of the Temporal Disaggregation-Benchmarking with Denton Technique, without affecting the opportunity of the releasing.

When we considered to improve the quality of quarterly GDP, we took on account this new process should not expend so much time, because of we could not change the schedule of publication or change of days of releasing. Then it was necessary to automate the new technique.

At this moment, the Benchmarking is applied to the short-term indicators that are calculated and published by INEGI, such as the Monthly Indicator of the Gross Fixed Investment, Monthly Industrial Activity Indicator (IMAI), Global Economic Activity Indicator (IGAE), Quarterly Gross Domestic Product, and the tables of Quarterly Final Demand of Goods and Services. At more detail level, the benchmarking is applied at 737 NAICS classes.

Before the Benchmarking with the Denton technique in the short-term account we aligned the annual indexes to short-term indexes (monthly or quarterly) with a simple adjust technique prorate. With this technique we faced to the step problem, it refers to the discontinuity in the Short-term series, caused by the distribution of the difference that exists with the series of the annual. This same proportion was applied at short-time or sub-annuals estimates of the next year, where the annual data was not available, this caused break in the series.

With the Rebasing on the quarterly GDP some changes were introduced, among other changes, the classifier North American Industry Classification System (NAICS), moreover the benchmarking at level more detail way, in 737 NAICS.

The Benchmarking with the Denton technique

The basic version of the proportional Denton benchmarking technique, keeps the benchmarked series, as proportional to the indicator as possible, by minimizing (in a least-squares sense).

The main objective of the Benchmarking with the Denton technique, is to adjust the series of low frequency with the high frequency, in such way, that the existent differences between the series will be the smallest and moreover with the condition of satisfying the temporary restriction, this means, that the sum or average of the quarterlies is equal the annual value.

The above mention in Mathematic terms is:

$$\min_{(x_1 \ldots, x_{4\beta}, \ldots x_T)} \sum_{t=2}^{T} \left[\frac{X_t}{I_t} - \frac{X_{t-1}}{I_{t-1}} \right]^2$$

$$t \in \{1, \ldots (4\beta), \ldots T\}$$

$$\sum_{t=1}^{T} X_t = A_y, y \in \{1 \ldots \beta\}.$$

Where:

X_t is the short-term data of period t

I_t is the indicator in the period or quarter t

A_y is the annual data for year y

β is the last year for which an annual benchmark is available,

We can resolve with the first-order conditions for a minimum and Langrage function, in an example for two years with monthly data we have:

$$L(X_1 \ldots X_{12y}) = \sum_{t=1}^{12y} \left[\frac{X_t}{I_t} - \frac{X_{t-1}}{I_{t-1}} \right]^2 + 2\lambda_y \left[\sum_{t=12y-11}^{12y} X_t - A_y \right]$$

With quarterly data:

$$L(X_1 \ldots X_{4y}) = \sum_{\substack{t=1 \\ t \in \{1, \ldots (4,\beta), \ldots T\}, y \in \{1, \ldots, \beta\}}}^{4y} \left[\frac{X_t}{I_t} - \frac{X_{t-1}}{I_{t-1}} \right]^2 + 2\lambda_y \left[\sum_{t=4y-3}^{4y} X_t - A_y \right]$$

$$L\left(X_1 \ldots X_8\right) = \sum_{t=2}^{8} \left[\frac{X_t}{I_t} - \frac{X_{t-1}}{I_{t-1}} \right]^2 + 2\lambda_1 \left[\sum_{1}^{4} X_t - A_1 \right] + 2\lambda_2 \left[\sum_{5}^{8} X_t - A_2 \right]$$

Following first order conditions and equal to zero:

$$\frac{dL}{dx_1} = 2\frac{X_1}{I_1^2} - 2\frac{X_2}{I_1 I_2} + 2\lambda_1 = 0$$
$$\frac{dL}{dx_2} = 4\frac{X_2}{I_2^2} - 2\frac{X_1}{I_1 I_2} - 2\frac{X_3}{I_2 I_3} + 2\lambda_1 = 0$$
$$\frac{dL}{dx_3} = 4\frac{X_3}{I_3^2} - 2\frac{X_2}{I_2 I_3} - 2\frac{X_4}{I_3 I_4} + 2\lambda_1 = 0$$
$$\vdots$$
$$\vdots$$
$$\frac{dL}{d\lambda_1} = 2X_1 + 2X_2 + 2X_3 + 2X_4 = 2A_1$$
$$\frac{dL}{d\lambda_2} = 2X_5 + 2X_6 + 2X_7 + 2X_8 = 2A_2$$

This constitutes a system of linear equations. In matrix notation, I * X = A

$$I = \left[\begin{array}{cccccccc:cc}
\frac{1}{I^2} & \frac{-1}{I_1 * I_2} & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\
\frac{-1}{I_1 * I_2} & \frac{2}{I_2^2} & \frac{-1}{I_2 * I_3} & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\
0 & \frac{-1}{I_2 * I_3} & \frac{2}{I_3^2} & \frac{-1}{I_3 * I_4} & 0 & 0 & 0 & 0 & 1 & 0 \\
0 & 0 & \frac{-1}{I_3 * I_4} & \frac{2}{I_4^2} & \frac{-1}{I_4 * I_5} & 0 & 0 & 0 & 1 & 0 \\
0 & 0 & 0 & \frac{-1}{I_4 * I_5} & \frac{2}{I_5^2} & \frac{-1}{I_5 * I_6} & 0 & 0 & 0 & 1 \\
0 & 0 & 0 & 0 & \frac{-1}{I_5 * I_6} & \frac{2}{I_6^2} & \frac{-1}{I_6 * I_7} & 0 & 0 & 1 \\
0 & 0 & 0 & 0 & 0 & \frac{-1}{I_6 * I_7} & \frac{2}{I_7^2} & \frac{-1}{I_7 * I_8} & 0 & 1 \\
0 & 0 & 0 & 0 & 0 & 0 & \frac{-1}{I_7 * I_8} & \frac{1}{I_8^2} & 0 & 1 \\
\hdashline
1 & 1 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 1 & 1 & 1 & 1 & 0 & 0
\end{array}\right]
X = \begin{bmatrix} X_1 \\ X_2 \\ X_3 \\ X_4 \\ X_5 \\ X_6 \\ X_7 \\ X_8 \\ \lambda_1 \\ \lambda_2 \end{bmatrix}
A = \begin{bmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ A_1 \\ A_2 \end{bmatrix}$$

$$IX = A$$
$$X = I^{-1}A$$

In excel it is very hard to put in the correctly order this matrix; we checked different software (like The Ecotrim, Bench Program of Canadian Statistics Office). In order to resolve the benchmarking adjust for primary information in Mexico was developed the program Bench-Mexico.

The Program Bench-Mexico was designed at INEGI, to carry out the benchmarking, with the Denton technique, according the requirements of the raw data of the quarterly GDP in Mexico and the method of calculation. This program carries out the benchmarking at levels more detail. Each series is processed, series by series is an equation of quadratic minimization with the temporal restriction. Now days, in our office for doing the quarterly GDP, with the program Bench-Mexico, we can do the disaggregation of the 737 series in only few minutes.

Conclusions:

At INEGI are evaluating how to be more opportune in order to help to announce or send the correct signals of the crises without to made forecast with econometric models, because the INEGI could lose credibility. The discussion is, with the derived statistics might use the estimations of recent past of the raw data, (t-1), when these original data would not be available yet, moreover to improve the statistical quality of the short-term data.

The tasks to be solved into the Bureau of Short-Term and Regional Accounts is the multivariate Benchmarking, with temporal restrictions and aggregations restrictions; for example, the applications to the quarterly GDP by state, to get knowledge about the experience of the Institutes of Statistics that have developed this application, because we have knowledge of this issue only in theory, for example the investigation of Tomas Di Fonzo (of the University of Padua Italy), but it is not easy to know the experience and applications of the NSOs on this field. It's more accessible to get academic papers on multivariate benchmarking but it isn't the case in the applications in Institutes of official statistic.

Other point to take into account is the extrapolation. In periods of time *t+1* with short-term indicators and without annual data (or without temporal constraint), the handbook suggest different methods; how should we know which is the best? It's necessary to have standards for extrapolation. Moreover, in different countries, which is the most popular method for extrapolation? Is it correct to use the same method for quarterly data or annual data?