

# Monitoring Regional Economies With Synthetic Indicators.

José Mondéjar-Jiménez, Ph.D., University of Castilla-La Mancha, Spain

## ABSTRACT

*The way regional economies change is an increasingly evident concern in developed economies. To meet this need for quantitative analysis of the economic situation, the starting point is analysis of a series of simple indicators in order to learn about the regional economies. But this provides a view of the particular sector described by the indicator used, not an overall view of the economy. For this reason, it becomes necessary to prepare a synthetic regional indicator showing the growth of a particular region with the as little delay and error as possible. For this purpose, the basic economic indicators need to be chosen and the relevant information extracted from them, and they need to be aggregated in such a way as to produce a synthetic indicator summarizing the features common to them all. This study explains the main procedures and techniques for the preparation of traditional synthetic indicators, and their empirical application to the autonomous region of Castilla-La Mancha, Spain.*

**Keywords:** Synthetic indicators, economic analysis, aggregation methods

## 1. INTRODUCTION

Measurement of economic development and definition of the factors conditioning growth are two of the subjects of most interest in recent decades, which is why they have captured the interest of scientists in general and economists in particular. Nowadays, economic development is closely linked to situational analysis; to monitor this, either a regional econometric model can be produced or the economic situation can be monitored using synthetic indicators of economic activity. Synthetic indicator is the term applied to any combination of individual indicators, called component or partial indicators.

The use of synthetic indicators to analyse growth of economic activity is not new, but goes back to the studies of Burns and Mitchell (1946), which were the basis for the construction of the indicators of the National Bureau of Economic Research (NBER) and of the Bureau of Economic Analysis (BEA). Since then, methodological contributions and, of course, applications at all levels of disaggregation have proliferated in this field.

Various criticisms are made of synthetic indicators. The most important is that they are a purely empirical approach to the problem of measurement of the level and pace of economic activity. The first criticism was to appear immediately when Koopmans (1947), in his famous article “Measurement without theory,” made the first criticism in reaction to the system of indicators proposed by Burns and Mitchell (1946). Their advantages include simplicity in terms of theoretical complexity and of the information required for estimates and forecasts to be made from synthetic indicators which would be much harder to produce from econometric models, as well as the speed with which results are obtained compared with alternative methods.

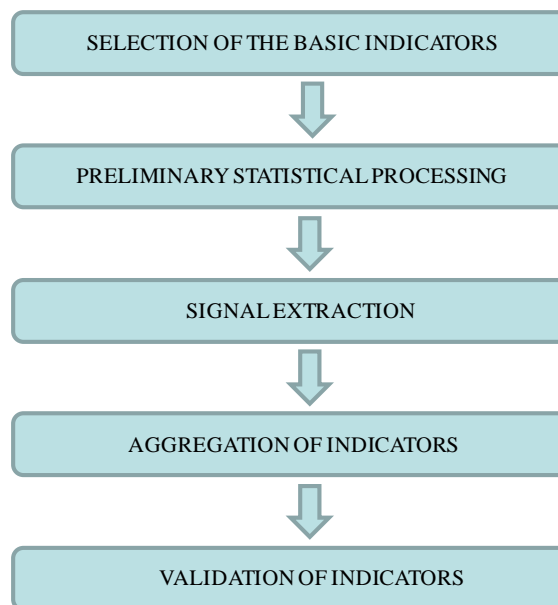
An indispensable requirement and the greatest difficulty for construction of a synthetic regional cycle indicator is the need for an ample database of regional economic data by month or quarter (partial indicators) allowing the short-term periodic fluctuations in the economy under analysis to be captured. Figure 1 is a diagram of the process showing the steps to be followed in our study, the purpose of which will be preparation of a synthetic indicator allowing analysis of the progress of regional economic activity.

The first step when it comes to building them is to select the partial indicators to be used in this aggregation. Their classification requires knowledge of the statistical sources available, as well as analysis of the quality of this available information. In addition, this information needs to be related with the scale on which the compound indicator is wanted – regional, national or international – it being difficult to choose different variables

applicable at all levels of disaggregation. Because of the many problems posed by this initial selection, a series of criteria applicable to these indicators has traditionally been taken into consideration:

- ✓ Economic significance.
- ✓ Smooth profiles.
- ✓ Immediacy of availability of the information.
- ✓ Similarity to economic progress.
- ✓ Reflection of the fluctuations of a relevant sector or subsector.
- ✓ Sufficient length for the kind of analysis to be carried out.
- ✓ No significant methodological changes in their preparation.
- ✓ Frequency equal to or greater than that of the synthetic indicator to be built.

**Figure 1: Preparation of regional indicators**



The next stage in the indicator building phase is filtration of individual indicators. The intention in this stage is to eliminate the noise inherent to each series from each simple indicator, as well as the seasonal component, so leaving the cycle-trend component that is to be related with the reference variable cycles, as well as the growth of the trend. Variables can be selected for inclusion in the final indicator according to the coherence of these trend developments. The third stage is aggregation of the relevant signal from the partial indicators developed in the second point.

## 2. METHODS OF AGGREGATION

When the filtration has been done, the partial indicators can be aggregated to produce the synthetic indicator. Synthetic indicator is the term applied to any combination of individual or component indicators (Cabrer, 2001). Various criticisms are made of synthetic indicators. The main one is that they are a purely empirical approach to the problem of measuring the level and pace of economic activity. Their most important advantages are their simplicity in terms of both theoretical complexity and the amount of information needed for estimates and forecasts to be made from them, as well as the speed with which results are obtained compared with alternative methods.

The biggest problem – and an indispensable requirement for synthetic indicator of the regional economic cycle to be built – is the need for an ample database of regional economic data, for monthly or quarterly periods (partial indicators) allowing short-term fluctuations in the economy under analysis to be captured. The most frequently used traditional aggregation methods are as follows (Mondejar, 2008).

- ✓ Simple methods: A compound indicator of economic activity is obtained by weighting and adding together changes in economic series.
- ✓ Methodology of the National Bureau of Economic Research and of the Bureau of Economic Analysis, proposed by Professors Burns and Mitchell (1946) of the Bureau of Economic Analysis (BEA) of the US Trade Department.
- ✓ Multivariate analysis: main component analysis and factorial analysis are the methods most often used to build synthetic indicators. Both are procedures designed for processing large amounts of data, transforming the original variables (partial indicators) in others (main components) which are not correlated.
- ✓ The simple procedure of Niemira and Klein (NIEM): the synthetic index of Niemira and Klein (1994) is obtained as the sum of growths of the signal of each partial indicator, but taking the importance and volatility of each into account.
- ✓ Procedure based on Fernández (1991): This procedure is an adaptation of the aggregation system followed by the NBER. Further on we explain this procedure following the explanation of Fernández (1991), but adapted for construction of a synthetic indicator of growth in economic activity.
- ✓ Procedure based on the P2 distance: The original application of the indicator based on the P2 distance was the field of social welfare measurement (Zarzosa, 1992).
- ✓ Construction of indicators in state spaces: a synthetic indicator can be interpreted as a “common factor” in the behaviour of the set of partial indicators, the growth of which to a certain degree conditions that of them. Within this framework, joint modelling of indicators in the state space (Mondéjar, 2007) is of great interest.

**3. EMPIRICAL WORK**

In the framework of regional economic analysis, the centre of attention is constantly occupied by situation analysis, to allow the state and rate of growth of the region's activity and their possible causes to be seen as early as possible. Use of synthetic indicators for this purpose is not new; as we have seen, it goes back to the studies of Burns and Mitchell (1946) which were the basis for the construction of the NBER's indicators. Since then, methodological contributions and their applications have proliferated in this field.

The biggest difficulty found in this sense and which is also an indispensable requirement for the construction of a synthetic indicator of the regional economic situation is the need for an ample database of regional economic data, collected monthly or quarterly (partial indicators) allowing short-term periodic fluctuations in the economy under analysis to be captured.

First we shall list the partial indicators (Table 1) selected because of their availability, frequency, delay, quality, etc., all related with the region of Castilla-La Mancha.

**Table 1: Partial indicators. Castila-La Mancha**

| <b>Indicators</b>            |                                      |
|------------------------------|--------------------------------------|
| Consumption of cement        | Total building area                  |
| Consumption of electricity   | Total recorded unemployment          |
| Total fuel consumption       | Hotel stays                          |
| Vehicle registrations        | Total number of placements           |
| Private sector loans         | Social security affiliates           |
| Industrial production index  | Total goods transport                |
| Vehicle registration         | Mean expenditure per person          |
| Gross electricity production | Wage cost per worker                 |
| Commercial balance           | Total retail price index             |
| Total working population     | Total official construction tendered |
| Total assets                 |                                      |

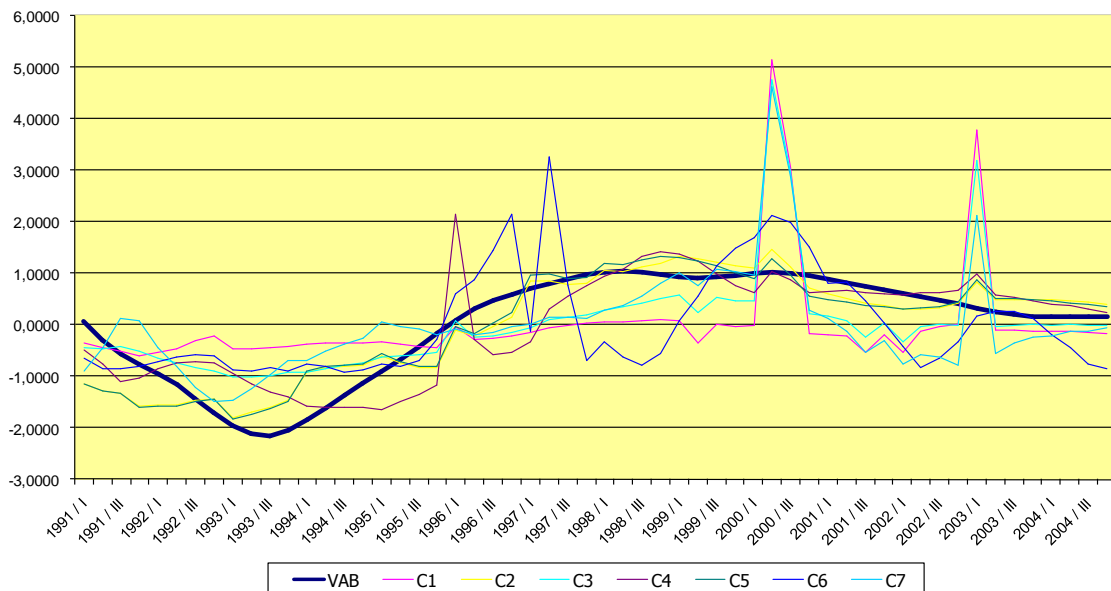
When the partial indicators have been selected according to the criteria of availability, frequency, volatility, economic significance, etc., the relevant signal is extracted from them. These signals are then aggregated based on one of the different criteria described in Point 2, except for the methodology proposed by the NBER and the procedure based on Fernández, because the purpose of these indicator aggregation methods is to detect when the economy changes direction, rather than monitor its growth.

When the synthetic indicators have been obtained, the indicators produced by each aggregation method need to be selected. For this purpose, the following criteria must be taken into account:

- ✓ Volatility of synthetic indicators, to avoid excess fluctuation or non-detection of existing changes.
- ✓ Adaptation of available series. Their length and frequency are two a priori conditioning factors when it comes to choosing aggregation methods.
- ✓ Correlation with reference variables. We have to measure the degree of correlation between synthetic indicators and the reference variable.
- ✓ Dating of synthetic indicators. Ideally, the synthetic indicator should be anticipatory.
- ✓ Delay structure. Its structure conditions the results obtained.
- ✓ Data availability. Prompt availability of data conditions use of synthetic indicators.

Analysis of correlation and the time delay are the two most important possibilities existing in terms of validation, although the rest are more criteria to take as starting points.

**Figure 2: Synthetic indicator of regional activity in Castilla-La Mancha**



As can be seen in Figure 2, synthetic indicators of activity provide a very good approximation to the economy of the region, multivariate methods and state-space methodology being those which give the best results. Other empirical applications with similar results are described in greater detail by Cabrer (2001), Fernandez *et al.* (1998), Mondéjar (2007 and 2008), Mondéjar, Vargas, Mondéjar and Gázquez (2007), Ramajo and Márquez (1996).

**4. CONCLUSIONS**

Growth in economic activity is the subject of debate by the different economic agents, especially national and supranational institutions, in order to anticipate the economic fluctuations which condition their decision-making. In situation analysis, application of different techniques gives results which are more or less costly to obtain because of their complexity or the availability of data. In this study, we have tried to develop a new method of aggregation for the construction of synthetic indicators of regional activity in order to get results quickly and simply, but with the lowest possible error.

The subject's increased interest in the field of applied economics is shown by the proliferation of studies in recent years with the sole aim of forecasting regional changes. In our country, this kind of study is especially interesting because of the lack of statistical information on the economic situation at the regional level. Use of a single method of filtration and aggregation and its application in the regional context can be very complex, as these are not mutually exclusive.

All aggregation methods reflect similar fluctuations, though what we are really interested in is making the synthetic indicators produced by the aggregation process capable of anticipating the economy's real growth. In this sense, based on correlation with the reference variable and their dating, the methods giving the best results are multivariate methods and state-space methods. The latter presents a methodological contribution in the use of this kind of indicator and means a valid, reliable alternative to traditional aggregation methods.

State-space methodology allows efficient estimation of this indicator without the need to use a weighted mean of the partial indicators, but modelling the correlation existing between the synthetic indicator and each of the partial indicators included in the H matrix.

This is why state-space indicators provide an alternative to traditional methods, because these synthetic state-space indicators register and reflect any change in partial indicators immediately, whereas traditional methods do not reflect alterations registered in partial indicators quickly. Therefore, these indicators can constitute an advance synthetic indicator, of vital importance to inform the economic agents involved.

## 5. REFERENCES

1. Burns, A. y Mitchell, W. (1946). "Measuring Business Cycle", *Studies in Business Cycles*, 2, New York, National Bureau of Economic Research.
2. Cabrer, B. (ed.) (2001). *Análisis Regional. El proyecto Hispalink*, Madrid, Mundiprensa.
3. Commandeur, J. F. y Koopman, S. J. (2007). *An Introduction to State Space Time Series Analysis*. Oxford University Press. London.
4. Dagum, E. B. (2002). *Analisi delle serie storiche: modellistica, previsione e scomposizione*, Springer Verlag, New York.
5. Fernández, J., Virto, J., Ibarra, L., Montoya, I. y Rosende, Z. (1998). "Indicadores Sintéticos de la actividad económica en Euskadi", *Ekonomiaz, Rev. Vasca Economía*, 42, 3, 173-183.
6. Fernández, F. (1991). "Indicadores Sintéticos de Aceleraciones y Desaceleraciones en la Actividad Económica", *Revista Española de Economía*, 8, 1, 125-156.
7. Frumkin, N. (2006). *Guide to economic indicators*, New York, Sharpe.
8. Koopmans, T. C. (1947). "Measurement without theory", *The Review of Economic Statistics*, 29, 161-172.
9. Lütkepohl, H. (2005): *New Introduction to Multiple Time Series Analysis*. Springer. New York
10. Mondéjar, J. (2007). *Análisis cuantitativo de la coyuntura económica, Una aplicación de la representación en espacio de estados de series temporales múltiples*, Tesis Doctoral, Ediciones de la Universidad de Castilla-La Mancha.
11. Mondéjar, J., Vargas, M., Mondéjar, J.A. y Gázquez, J.C. (2007). "Una aproximación a la evolución del sector turístico mediante indicadores sintéticos en Castilla-La Mancha", *Papers de Turisme*, 42, 7-15.
12. Mondéjar, J. y Vargas, M. (2008). "Indicadores sintéticos: una revisión de los métodos de agregación" *Economía, sociedad y territorio*, VIII, 27, 565-585.
13. Niemira, M. P. y Klein, P. A. (1994). *Forecasting Financial and Economic Cycle*, Nueva York, John Wiley & Sons.
14. Ramajo, J. y Márquez, M. A. (1996): *Elaboración de indicadores sintéticos para el seguimiento de la coyuntura económica de Extremadura*, Monográfico de la Consejería de Economía, Industria y Hacienda, Junta de Extremadura.
15. Wildi, M. (2005). *Signal extraction: efficient estimation, unit-root test and early detection of turning point*, Springer Verlag, Berlín.
16. Zarzosa, P. (1992). Aproximación a la medición del bienestar social, estudio de la idoneidad del indicador Sintético "Distancia P2", Tesis doctoral, Universidad de Valladolid.

## AUTHOR INFORMATION

**José Mondéjar-Jiménez:** European PhD in Economics and Degree in Business Administration by University of Castilla-La Mancha. Degree in Advanced Studies in Statistics at the same university. Assistant Professor in Statistics at Statistics Department. Faculty of Social Sciences of Cuenca. University of Castilla-La Mancha (Spain).

**Research Interest:** State-space models, regional analysis, educational and tourism.

NOTES