"The use of high frequency indicators in short-term forecasting models: the case of Latin America and Caribbean countries"

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August, 2015

Abstract

The estimation of short-term forecasts for quarterly GDP growth rates is an attaining topic to decision-making authorities and to the various agents involved in the economic analysis and the follow up of the short-term economic prospects. In this sense, the importance of sound and accurate early estimates of economic activity is of utmost importance to national economic authorities at the time of the decision-making process. In Latin America and the Caribbean an increasing amount of countries is producing high frequency economic data, and there has been an increasing interest by national authorities to use this data to improve economic analysis and short-term economic forecasts. This article discusses the use of the *nowcasting* methodology applied to Latin American and Caribbean countries with the objective of generating more accurate short-term GDP growth forecasts. The results show that, for the short-term, this methodology produces accurate and reliable estimates although results at the country level depend very much on the amount and quality of the available data, as well as on its timeliness.

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1. Introduction

The subject of short-term forecasts of Gross Domestic Product (GDP) is nowadays particularly attaining to the analysis of the economic activity in Latin America and the Caribbean countries. As shown by the performance of forecasting models in the aftermath of the economic and financial crisis of 2008-2009, whose effects are still present in many countries in different regions, the importance of sound economic analysis and economic modeling that provides authorities with relevant, accurate and timely information on the evolution of economic activity is of utmost importance in the decision making process, both at the national and at the regional level.

In the particular case of ECLAC, and in order to be able to do the follow-up of the economic situation and prospects of the world, regional and national economies, a thorough knowledge of up to date quantitative and qualitative statistical information available is required. The economic analysis done within ECLAC is used in the economic publications elaborated by the institution, in the assessments made of local and regional economic conditions, and also in the design and implementation of technical cooperation activities and the formulation of policy recommendations to national and regional authorities. These analysis, and the economic forecasts elaborated based on them, are used as inputs in a wide range of estimated indicators published by ECLAC such as poverty rates, the current account balance, the fiscal sector, monetary aggregates and unemployment and employment rates, among others.

In what refers to Latin America and the Caribbean, many countries in the region are publishing an increasing amount of high frequency indicators, and there is an interest by national authorities to improve the economic analysis and the short-term economic forecasts taking into consideration this information. However, the availability of high frequency data in Latin American countries is relatively recent, and this is even more so in the case of Caribbean countries; many countries in the region only in the last decade have started to publish a monthly indicator of economic activity, and in some cases the evolution of these indicators cannot be taken as an accurate leading indicator of the quarterly GDP growth rate.

In order to take advantage of this increasingly available information, an initial effort was made in 2010. Using the dynamic factor model methodology proposed by Camacho y Pérez-Quirós (2010a)[2] in the framework of *nowcasting* techniques, indicators of the evolution of the economic activity were elaborated for six Latin American countries (Argentina, Brazil, Chile, Colombia, México and Peru). At present, and based on this

[2] Maximo Camacho, Gabriel Pérez-Quirós, *"Latin STINGS: indicadores de crecimiento a corto plazo de los países de América Latina"*, Serie Macroeconomia del Desarrollo, N. 108, Santiago de Chile, January 2011.

methodology, indicators of aggregated economic activity are available for 17 countries of the region.[3] This work intends to document and discuss the application of the proposed methodology for Latin American and Caribbean countries, as well as difficulties encountered. Advantages and limitations of the proposed methodology are also discussed. Section 2 discusses the use of high frequency indicators for the short-term economic analysis in the countries of Latin American and Caribbean. Section 3 describes the methodology from an empirical point of view while section 4 argues on the advantages and disadvantages of applying this methodology to countries in the region. Section 5 concludes.

2. The use of high frequency indicators for short-term economic analysis and forecasting in Latin America and Caribbean countries

In the short-term the most widely used indicator to measure the economic evolution of a given country is the quarterly GDP growth rate. This variable measures economic activity from an aggregated, homogenous and relatively comparable perspective among countries, and, in most cases, is the best indicator available. At present, in Latin America and the Caribbean, 19 out of the 33 countries included in ECLAC's regional economic aggregates regularly publish quarterly GDP growth rate figures.

In recent years there has been an effort by national statistical offices and central banks to increase the quantity of the statistical information published concerning the evolution of the economic activity, as well as the scope and frequency of the data. In the majority of the countries this data is published with a delay that ranges from six weeks to three months and detailed methodology, publication criteria set out by national authorities, coverage, and publication calendar are all different depending on the country we are analyzing. Moreover, the availability of data to the overall public is very heterogeneous among countries and in many cases the amount of statistical information that is publically available is much lower than what is effectively produced and at the disposition of the economic authorities.

In Latin American and Caribbean countries the use of quarterly GDP growth rates as a leading indicator of the economic activity presents certain particularities that condition the economic analyses that can be done solely using this indicator. The first one is the small sample of data available as, with very few exceptions, only from mid-nineties

[3] Fernando Cantú and Seung-Jin Baek also worked, at different stages, in expanding the number of countries covered in this exercise, as well as in tasks related to the regular work concerning the maintenance of the models and the estimation of short-term quarterly GDP growth rate forecasts.

countries in the region started to regularly compile and publish quarterly GDP data. The second one relates to the timely availability of quarterly GDP data. In order to react in real time, in the event of abrupt changes in the evolution of the economic activity (as, for example, what occurred in the international economic and financial crisis of 2008-2009), economic authorities have to wait up to three months before new data referring to quarterly GDP growth rate is available. In addition, the availability of quarterly GDP data poses some challenges at the time of comparing its dynamics with those of monthly industrial production, consumer confidence indicators, trade balance, and retail sales, among others, as in many cases all indicators are published at the same time. The third one relates to the delay in the publication of actual figures in relation to the reference period. Finally, there are methodological issues such as changes in the base year of the GDP calculations, and "structural" changes that include modifications in methodologies used for GDP compilation, coverage of different sectors of the economy and valuation mechanisms. These modifications pose challenges because, in many cases, given the scope of the methodological changes incorporated, there may be a lack of comparability between different subperiods of the time series for a given indicator.

Therefore, a synthetic indicator that serves the purpose of following up the evolution of the economic activity is of relevance. Many times, economic authorities have to take policy decisions that will impact the near future, based on the information that is available today but that refers to what already happened. In this sense, economic authorities have not only to make assumptions about the evolution of the near future but also on what is the state of the economy today; therefore, accurate and timely estimates of the evolution and state of the economy are required. In this context, data available with a significant lag after the reference period looses relevance (Arouba, Diebold and Scotti, 2008).[4] In addition, in the elaboration of economic forecasts, even though most up to date tools are used, there is in many cases the possibility that these forecasts are partially based on judgments and methodologies used to compute forecasts are not always made explicit. As a consequence, forecasts are difficult to replicate and the interpretation of forecast failures is a challenging task.

In order to avoid many of these issues, this work discusses the application of the methodology proposed by Camacho and Pérez-Quirós (2008)[5] to countries in Latin America and the Caribbean, which is based on an algorithm in the framework of dynamic factor models and *nowcasting* techniques.[6] Given the fact that economic

[4] Arouba, S. Boragan, Diebold, F. and Scotti, C., *"Real-time measurement of business conditions"*, Working Paper 08-19, Research Department, Federal Reserve Bank of Philadelphia, September 2008.
[5] Maximo Camacho and Pérez-Quirós, Gabriel, *"Introducing the Euro-Sting: Euro Area Short-Term Indicator of Growth"*, Journal of Applied Econometrics, 2008.
[6] *Nowcasting* can be defined as the exercise of estimating the present, the very near future and the very recent past.

agents making decisions in real time want accurate and timely estimates of the evolution of the state of the economy, a relevant element in this process is the use of timely monthly information to produce estimates of quarterly variables that are published with long delays. This methodology was first implemented in 2003 in the Board of Governors of the Federal Reserve, and later at the European Central Bank and in the Central Banks of Ireland, Norway and Spain (Banbura et al., 2010).[7]

The specifications of these models are based on the assumption that the joint dynamics of GDP growth and the variables included in the estimation of the indicator of economic activity can be decomposed in two components: the first component refers to the common dynamics whereas the second component refers to its idiosyncratic dynamics. Economic activity indicators obtained through dynamic factor models for each economy are therefore highly correlated with activity indicators available in each country and with quarterly GDP growth. This algorithm has the same advantages than the judgmental forecast in terms of the ability to adapt to new information. This method is easy to interpret and to update, and is also easy to replicate.

3. The empirical models

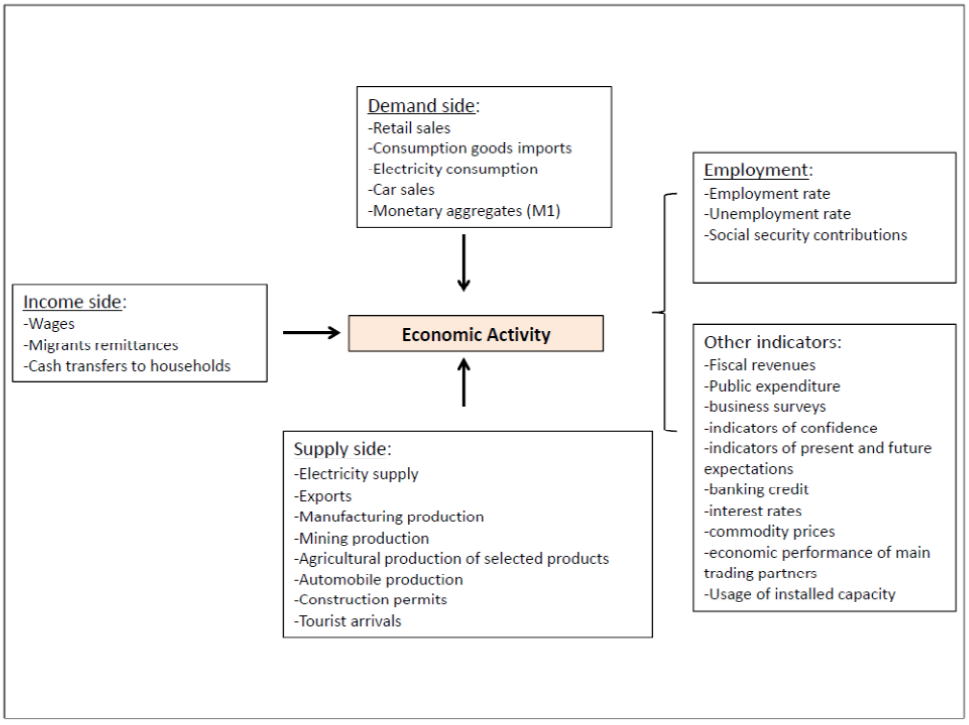
Besides GDP figures and sectoral economic activity indexes, many other indicators also measure directly or indirectly the evolution of economic activity. As a first step to define the indicators to be included, it is necessary to identify high-frequency series, published on a timely basis, whose evolution closely follows movements in economic activity. Economic activity can be measured according to three different dimensions: demand, supply and income. Indicators that relate to each of these dimensions are publically available with different releasing calendars and are published by different agencies. Notwithstanding these indicators provide information from different perspectives, all this information is relevant for the assessment of the evolution of the activity of a given economy. Therefore, in order to capture these dimensions, variables that relate to each of them should be included in the model, even though some indicators may relate to one or more dimensions, such as, for example, employment and monetary indicators (figure 1). Since one of the objectives of this exercise is to generate short-term forecasting models that can be easily replicated, data included should be publically available and accessed through documents published by official national authorities or through official databases.

Examples of indicators that are available on a timely basis are, among others:

[7] Marta Banbura, Domenico Giannone, Lucrezia Reichlin, *"Nowcasting"*, ECARES working paper 2010-021, May, 2010.

a) data on external trade: imports, exports, commodity prices, tourist arrivals;
b) indicators of economic activity by type of industry: manufacturing production, retail sales, mining production, agricultural production of selected products, automobile production, construction permits;
c) financial and monetary indicators: banking credit, interest rates, monetary aggregates;
d) employment, unemployment and labour market statistics: wages, social security contributions;
e) Sales: retail sales, consumption goods imports;
f) business surveys, indicators of confidence and indicators of present and future expectations;
g) economic performance of main trading partners;
h) fiscal sector statistics: fiscal revenues, public expenditure;
i) usage of installed capacity;
j) migrants' remittances;
k) electricity generation and consumption; and
l) cash transfers to households.

Figure 1
Dimensions of the economic activity and examples of timely available indicators



Source: Author's elaboration.

The general idea of the model is to decompose economic variables in two orthogonal components that are summed up: a common factor reflects the notion that the series dynamics are driven in part by common shocks, and a second component that captures the idiosyncratic behavior of each series. The methodology basically consists in the use of a dynamic factor model comprising a variety of stock and flow data observed at mixed frequencies (monthly and quarterly) based on the notion that the co-movements in many macroeconomic variables have a common element that can be captured by a single underlying and unobserved variable. In technical terms, in order to define this unobserved variable the formulation of a probability model is required to provide a mathematical definition of the unobserved state of the economy. The objective of these models is to estimate quarterly GDP on a monthly basis.[8]

The dynamic factor model is written in the space-state form[9], allowing for the use of the Kalman filter, which is a recursive procedure for computing the optimal estimate of the unobserved state vector based on the appropriate information set, assessing that the information used in the model is known. Depending on the information set used, the application of this procedure allows for the use of the basic filter (an estimate of the unobserved state vector based on the information available up to the time *t*) and the smoothing (an estimate of the unobserved state vector based on all available information in the sample through time *t*) (Kim and Nelson, 1999).[10] Following Stock and Watson (1988)[11], once the model is written in the state-space form, and given that variables used in the model are linear and independent, the Gaussian likelihood function can be constructed using the Kalman filter and the maximum likelihood function can be calculated in order to have estimators.

In general terms, the idea behind this type of models is to build an indicator of economic activity that synthesizes the information that is contained in many other

[8] Arango and Melo (2006) use the same methodology to estimate the industrial production index, as an indicator of the state of the economic activity. For an application of more traditional dynamic factor models with a large number of variables see Aiolfi, Catão y Timmermann (2006).

[9] State-space models were originally developed by control engineers and are useful tools for expressing dynamic systems that involve unobserved state variables. Consists of two equations: a transition equation (also sometimes called the state equation) – describes the dynamics of the state variables that has the form of a first order difference equation in the state vector; and a measurement equation – describes the relation between observed variables (data) and unobserved state variables. To write in the space-state form we need to have the transition equation and the measurement equation and have the following matrixes: F (the state transition model), H (the observation model), Q (the COV of the process noise), R (the COV of the observation noise) and B (the control input model for each time step k). For a discussion on state-space models and the Kalman filter see Kalman, R.E., *"A New Approach to Linear Filtering and Prediction Problems"*, Journal of Basic Engineering, 82 (Series D): 35-45, AMSE, March 1960. For a discussion on the use of these models in order to generate short term economic forecasts see Kim and Nelson (1999).

[10] Chang-Jin Kim and Charles R. Nelson, *"State-space models with regime switching, Classical and Gibbs-Sampling approaches with applications"*, The MIT Press, Cambridge, Massachusetts, 1999.

[11] Stock, J., Watson, M., *"A probability model of the coincident economic indicators"*, Working Paper N.2772, NBER, November 1988.

indicators (hard indicators and soft indicators) including the most up to date data available for each variable. The evolution of each of the indicators considered should be close to that of the indicator of overall GDP, as this is the most comprehensive indicator that measures the evolution of economic activity. Once this synthetic indicator of the economic activity is available, it is possible to generate short-term economic forecasts. In a very simple form, the idea of these models is reflected in (1).

$$\begin{pmatrix} GDP_t \\ Indicators_t \end{pmatrix} = \beta \cdot f_t + \begin{pmatrix} u_{1t} \\ u_{2t} \end{pmatrix} \qquad (1)$$

GDP_t and $Indicators_t$ correspond to the observable data, being GDP_t the quarterly GDP growth rate and $Indicators_t$ all hard and soft indicators included in the model. ft corresponds to the common factor and β corresponds to the values of the loading factors (the available information that is included in the model). Finally, u_{it} corresponds to the vector of the idiosyncratic components. With these small scale models that use a small number of variables covering different dimensions of economic activity it is possible to generate accurate forecasts of quarterly GDP growth also useful to follow up the evolution of economic activity.[12]

The proposed methodology by Camacho y Pérez-Quirós (2008[13] and 2009[14]) considers a short-term forecasting model which modifies somewhat the Stock and Watson (1988) strict dynamic factor model to allow for the particular data problems of real-time forecasting. Following the approximate Kalman filter suggested by Mariano and Murasawa (2003)[15], this methodology allows for the model to be able to handle indicators which are available at different frequencies, in particular monthly and quarterly frequencies and, as in Giannone, Reichlin and Small (2008)[16], the gaps that characterize the ragged edges behind the asynchronous data publication are also filled in by using the Kalman filter. Additionally, as in Evans (2005)[17] data revisions for GDP

[12] For a description of the state space representation of the dynamic factor model stated in this proposed methodology see the appendix included in Maximo Camacho, Gabriel Pérez-Quirós, *"Introducing the E-STING: SPAIN-Short Term INdicator of Growth"*, Bank of Spain Working Paper Series, 2009.

[13] Maximo Camacho, Gabriel Pérez-Quirós, *"Introducing the EURO-STING: Short Term INdicator of Euro Area Growth"*, Journal of Applied Econometrics, Volume 25, Issue 4, pages 663–694, June/July 2010.

[14] Camacho, M., Pérez-Quirós, G., (2009) *op.cit.*

[15] Roberto S. Mariano and Yasutomo Murasawa, *"New Coincident Index of Business Cycles Based on Monthly and Quarterly Series"*, Journal of Applied Econometrics, Vol. 18, No. 4 (Jul. - Aug., 2003), pp. 427-443.

[16] Domenico Giannone, Lucrezia Reichlin, David Small, *"Nowcasting: The real-time informational content of macroeconomic data"*, Journal of Monetary Economics 55 (2008) 665– 676.

[17] Martin D Evans, *"Where Are We Now? Real-Time Estimates of the Macroeconomy"*, MPRA Paper No. 831, posted 21 November 2006, Online at http://mpra.ub.uni-muenchen.de/831/.

growth are modeled assuming that preliminary estimates are equal to true GDP growth plus uncorrelated noise. In this sense, this methodology takes stock of mixed frequencies, missing data and data revisions.

The basic filter procedure is based on two steps: prediction and updating. Prediction is up to time *t-1*. After that the model generates the best possible prediction conditional on the available information. In the updating procedure, as the actual result of the observed variable is already available, it is possible to calculate the prediction error, and therefore to recalculate the estimate of the unobserved state vector in order to have better estimators. Therefore according to this recursive procedure the model automatically incorporates new information available. As uncertainty associated with estimate of the unobserved state vector increases, more weight is given to new information in the prediction error, and vice-versa.

Although there is some debate in the literature as to the relevance of using large-scale models compared to small-scale models[18], one of the advantages of using small scale models is that, given their small dimension, it is relatively easier to check the empirical implications of the violation of the theoretical assumptions. In addition, the asymptotic advantages of large-scale factor models are frequently far from being held in empirical applications (Boivin and Ng, 2006).[19] In order to allow for the comparative analysis of the forecasting accuracy of the models, and taking into account that this is highly dependent on the availability and quality of the data incorporated in the model, and bearing in mind that the objective of these models is to generate forecasts in real time, it is very important to keep vintage sets to keep track of the exact information that was available at each time of the forecast.

Since macroeconomic data are very collinear, it is reasonable to conjecture that including (probably more noisy) additional variables may not improve forecasting accuracy and that it might be worth focusing on some key variables by following some statistical selection procedure. For this purpose, having defined the set of core variables, a method is proposed to decide whether new indicators should be added to this core. The method, which is based on the assumption that the primary focus of the model is to provide forecasts of GDP growth, consists of adding a variable only when it increases the percentage of variance of GDP growth explained by the common factor. Accordingly, the method involves screening out those additional indicators that capture

[19] For a discussion of the pros and cons of large versus small scale models see Camacho and Pérez-Quirós (2009) and Watson (2000).

19 Jean Boivina, Serena Ng, *"Are more data always better for factor analysis?"*, Journal of Econometrics 132 (2006) 169–194.

idiosyncratic dynamics and that do not lead to better fit for GDP growth through the common component.

4. Usefulness, scope and challenges in the use of these models in the Latin American and Caribbean context

In the application of this methodology to the case of countries in the Latin America and the Caribbean region all publically available statistical information – both hard and soft indicators – was considered, and in order to ensure that models could be easily replicated, only publically available information was taken into consideration. In many countries of the region each organization produces its own statistical information and, in many cases, it is not easy for the general public to have full access to the information produced by some public organizations[20]. As a consequence, the public availability of statistical information may be, in some cases, much lower than what is actually produced by public organizations. Therefore, the possibility to expand this methodology to all countries in the region depends on the public availability of timely statistical information. In this sense, although the methodology is easy to replicate, the inclusion of specific indicators depends on their availability in each country, which also highlights the heterogeneity that exists among Latin American and Caribbean economies.

The quality of the available data poses some challenges. Often the starting point for the publication of the indicators is very recent, which limits their inclusion in the case we would like to have a model with long time series. In other cases, the time lag between the data release in relation to the reference period is considerable, which generates inconveniences at the time of making real time forecasts.

In order to address these issues, three criteria were established to include additional indicators: these should have data for at least 25 per cent of the total sample considered in the model; they should be significant, as measured by the degree of the dynamic correlation between the common component and each economic indicator and; bearing in mind that the objective of the model is to get quarterly GDP growth rate forecasts as accurately as possible, the inclusion of these indicators should not significantly reduce the proportion of the variance of the GDP explained by the common component. According to these criteria, those indicators that show a significant idiosyncratic component and whose inclusion in the model does not improve the

[20] In several cases, it is also very difficult for one public organization to have access to statistical information produced by another public organization, as statistical data is not integrated into one National Statistical System.

explanatory factor of the GDP of the common component should be left outside of the model.

There are several advantages in the use of this methodology in the context of Latin American and Caribbean countries to generate short term GDP growth rate forecasts compared to other methodologies. Given the characteristics of the statistical economic data available in the countries in the region already discussed, the use of this methodology allows for the generation of short-term estimations of the economic activity based on a small number of indicators whose evolution is highly correlated with the evolution of an indicator of economic activity. Second, it does so with a high degree of accuracy of the estimation of the economic evolution over the next months or quarters. Third, it allows working with data of different types and frequency, allowing dealing with common difficulties that arise when using high frequency data: the ragged ends problem, missing observations, different frequencies and series that have different samples. Fourth, the methodology used in these models is simple and has low maintenance cost. Fifth, this methodology can be implemented using data that is publically available, and that can be published by different sources. The requisite to include additional data is that it shows a strong correlation with the evolution of economic activity indicator. Moreover, this methodology is used by a significant group of institutions, mostly central banks, which generates comparable evidence.

Notwithstanding, this methodology also presents some shortcomings. First, these models don't have economic structure and therefore have limitations in what relates to make interpretations of different scenarios concerning the evolution of economic activity. It is possible though to make assessments of the impact on forecasts of the realizations of the economic variables included in the model, and how the deviation between expectations and realizations of such variables affects the GDP forecast. Second, forecasts are sensible to the information that is available in a given point in time.

This last issue is of particular importance because it acts also as an advantage as well as it poses limitations. The use of this methodology generates forecasts that incorporate all available information at any given point in time. In this sense, it can produce forecasts taking as inputs limited information and not the complete set of variables updated. Therefore, the weights of the different variables on the estimation adjust according to whether an update for a given variable is available or not, taking therefore in consideration if this variable was included or not in the generation of the forecast. These weight adjustments are a desired element because they allow for the generation of forecasts with a high degree of confidence. But they also pose a limitation because,

as the weights of each variable change according to their available updates included in the model, forecasts are modified accordingly.

In the case of Latin America and the Caribbean this methodology has been applied with different results to 17 countries in the region (Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Ecuador, El Salvador, Guatemala, Jamaica, Mexico, Nicaragua, Panama, Peru, Dominican Republic, Uruguay and Venezuela) with different results obtained among countries.

Only for a few countries in the Latin American and Caribbean region there is disaggregated high frequency statistical information related to activity sectors on a timely basis and with release calendar different from the one related to the publication of the monthly indicator of overall economic activity. This poses some challenges at the time of replicating this methodology to a greater number of countries in the region without taking in consideration an overall indicator of economic activity. The *nowcasting* methodology intends to anticipate the results of such overall synthetic indicator as in essence this indicator already incorporates the evolution of other indicators of economic activity referring to particular sectors relevant to these specific countries' economies. Also, the majority of the statistical information relating to the evolution of sectoral economic activity is incorporated at the same time which limits the benefit of incorporating additional variables (there are no intermediate steps: one gets from having very little information to have the information set complete). In these countries, although the forecast for next quarter is subject to small revisions, forecasts for the second and the third quarter ahead are subject to greater revisions. Examples of this are Bolivia, Costa Rica, El Salvador, Guatemala, Nicaragua and Dominican Republic, where monthly-desegregated statistical data on production sectors for a given reference period is published at the same time as the indicator for overall economy.

In other countries, the public release of statistical data has big lags in relation to the reference period (Jamaica, Panama and Venezuela). In this case, until all statistical data is included in the model and is incorporated with the same reference period the forecast is subject to considerable revisions. Finally, in some countries the quality of the statistical data included in the model varies considerably depending on the source of the statistical data. This also poses challenges at the time of generating forecasts, mostly for the second and third quarters ahead.

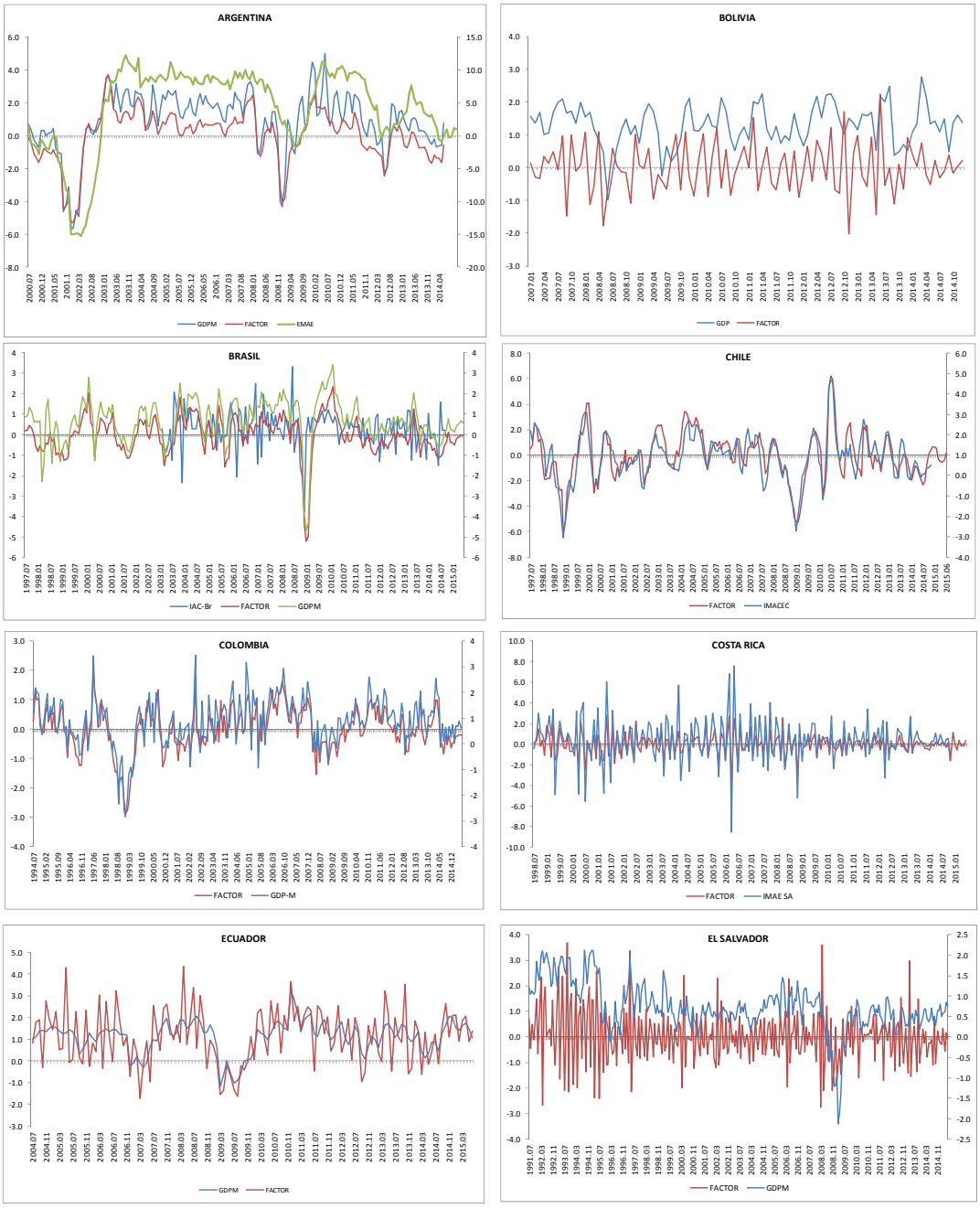
Notwithstanding the above, it is important to bear in mind that these challenges are valid for all forecasting methodologies applied to these countries based on high frequency data and statistical information publically available.

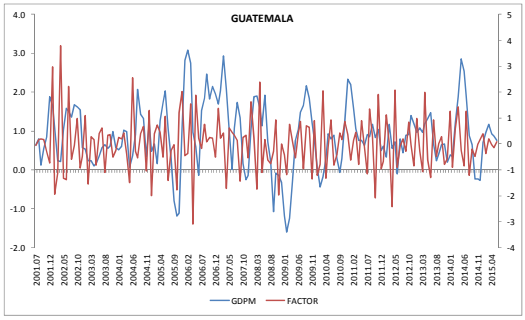
Figure 2 and table 1 show the results obtained for the countries included in this exercise. Country graphs in figure 2 show the comparison between the evolution of quarterly GDP growth rate and the series corresponding to the quarterly year-on-year growth rates of the common factor. An analysis of these graphics shows that there is a high degree of correlation of both series in the cases of Argentina, Brazil, Chile, Colombia, Mexico, Peru, Uruguay and Venezuela as opposed to the cases of Central American countries and Jamaica. These results reflect elements such as availability and opportunity of the statistical data. In many cases, even though there is a large number of high frequency data available, this data relates only to one or two dimensions of the economic activity (for example, many variables relate to the supply side of the economy and there is no data that relates to the income side) which also poses difficulties to capture information on the evolution of other variables relevant to assess the state of the economy.

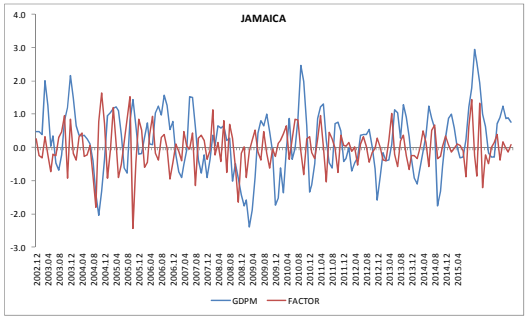
Figure 2

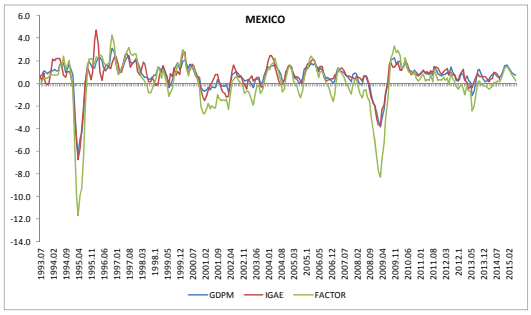
Latin America and the Caribbean (selected countries): year-on-year quarterly GDP and "common factor" series growth rates

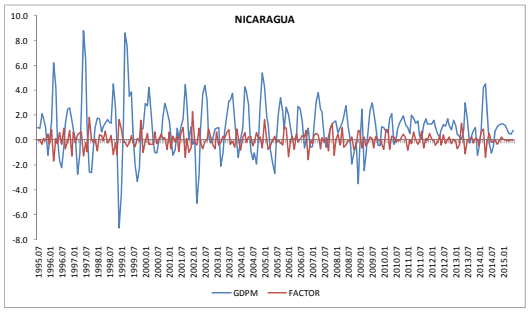
(In percentage)

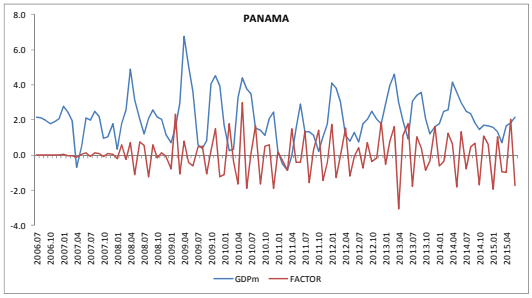


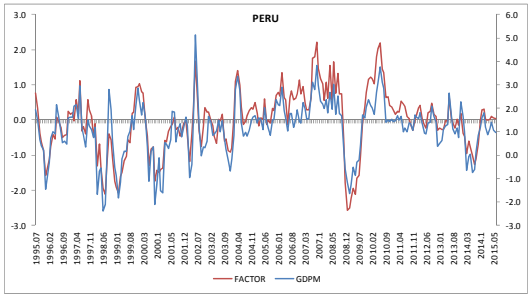


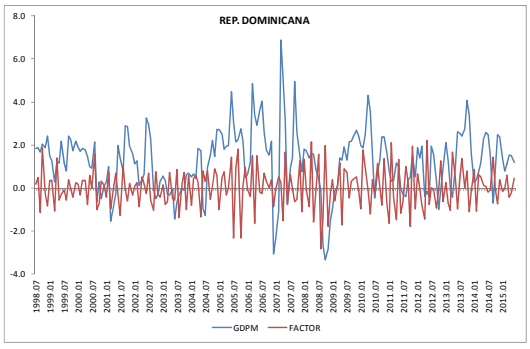


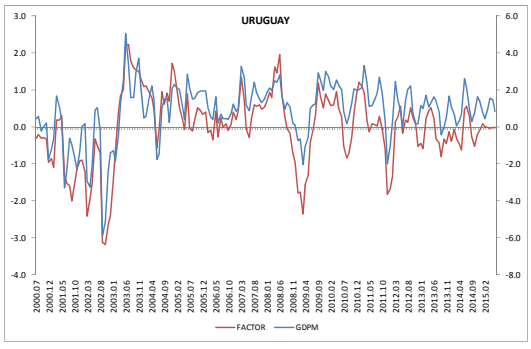


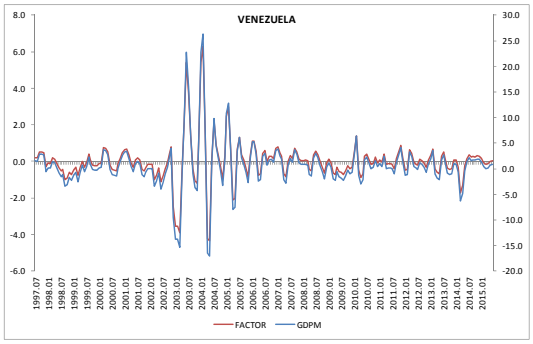












Source: Based on author's calculations.

On table 1 the combination of variables that allowed for best results for each country, measured as the highest value for the percentage of quarterly GDP growth rate explained by the evolution of the "common factor", is described. It is important to highlight that in the case of some Central American countries the value for the percentage of quarterly GDP growth rate explained by the evolution of the "common factor" is very high, which suggests that the quarterly GDP growth rate forecast for the next quarter would be relatively good. However, as can be seen from the comparison between the evolution of both series in figure 2 (quarterly GDP growth rates and the quarterly year-on-year growth rates of the series corresponding to the common factor), it is difficult to see a high degree of correlation. One possible explanation is that, as the majority of the data available has the same releasing calendar, forecasts are subject to strong revisions. Also, historical GDP growth rates are in many cases subject to revisions, which also have an impact in the estimations of the "common factor" quarterly year-on-year growth rate series.

Table 1

Latin America and the Caribbean (selected countries): selected variables included in quarterly GDP growth rates forecast

ARGENTINA — *% explained by common factor* 88.6883

Variables	*Frequency*		
Gross Domestic Product (GDP)	Q	*qoq*	SA
Unemployment	M	*yoy*	
Industrial production index	M	*yoy*	
Electricity generation	M	*yoy*	
Consumer confidence index	M	*yoy*	
Exports	M	*yoy*	
Imports (excluding oil and derivatives)	M	*yoy*	
Capacity utilization	M	*yoy*	
Industrial production index - Brazil	M	*yoy*	
Construction activity index	M	*yoy*	

Notes: Q - quarterly; M: monthly; *qoq:* quarter on quarter growth rate
yoy : year-on-year growth rate, SA: seasonally adjusted

BOLIVIA — *% explained by common factor* 94.4163

Variables	*Frequency*		
Gross Domestic Product (GDP)	Q	*qoq*	SA
Monthly indicator of economic activity (IMAE)	M	*yoy*	
Exports	M	*yoy*	
Imports	M	*yoy*	

Notes: Q - quarterly; M: monthly; *qoq:* quarter on quarter growth rate
yoy : year-on-year growth rate, SA: seasonally adjusted

BRAZIL — *% explained by common factor* 87.5470

Variables	*Frequency*		
Gross Domestic Product (GDP)	Q	*qoq*	SA
Industrial Production Index	M	*yoy*	
Retail Sales Index	M	*yoy*	
Employment	M	*yoy*	
Consumer confidence index	M	*yoy*	
Exports	M	*yoy*	
Imports (excluding oil and derivatives)	M	*yoy*	
Industrial electricity	M	*yoy*	
Banking credit to households	M	*yoy*	
Fiscal revenues	M	*yoy*	

Notes: Q - quarterly; M: monthly; *qoq:* quarter on quarter growth rate
yoy : year-on-year growth rate, SA: seasonally adjusted

CHILE — *% explained by common factor* 88.2454

Variables	*Frequency*		
Gross Domestic Product (GDP)	Q	*qoq*	SA
Industrial Production Index	M	*yoy*	
Employment	M	*yoy*	
Retail Sales Index (real)	M	*yoy*	
Monetary aggregate M1 (contants values)	M	*yoy*	
Exports	M	*yoy*	
Consumer confidence index	M	*yoy*	
Value added tax revenues	M	*yoy*	

Notes: Q - quarterly; M: monthly; *qoq:* quarter on quarter growth rate
yoy : year-on-year growth rate, SA: seasonally adjusted

COLOMBIA — *% explained by common factor* 77.5343

Variables	*Frequency*		
Gross Domestic Product (GDP)	Q	*qoq*	SA
Industrial Production Index	M	*yoy*	
Manufacturing employment	M	*yoy*	
Manufacturing salaries	M	*yoy*	
M1 (in constant values)	M	*yoy*	
Exports	M	*yoy*	
Imports (excluding oil and derivatives)	M	*yoy*	
Coffee production	M	*yoy*	

Notes: Q - quarterly; M: monthly; *qoq:* quarter on quarter growth rate
yoy : year-on-year growth rate, SA: seasonally adjusted

COSTA RICA — *% explained by common factor* 98.3955

Variables	*Frequency*		
Gross Domestic Product (GDP)	Q	*qoq*	SA
Manufacturing activity index	M	*yoy*	
Retail sales activity index	M	*yoy*	
Employment	M	*yoy*	
Exports	M	*yoy*	
Imports (excluding oil and derivatives)	M	*yoy*	
Industrial electricity (sales)	M	*yoy*	

Notes: Q - quarterly; M: monthly; *qoq:* quarter on quarter growth rate
yoy : year-on-year growth rate, SA: seasonally adjusted

ECUADOR — *% explained by common factor* 44.2934

Variables	*Frequency*		
Gross Domestic Product (GDP)	Q	*qoq*	SA
Economic activity index	M	*yoy*	
Unemployment	M	*yoy*	
Imports (excluding oil and derivatives)	M	*yoy*	
VAT revenue	M	*yoy*	
Fiscal expenditures	M	*yoy*	

Notes: Q - quarterly; M: monthly; *qoq:* quarter on quarter growth rate
yoy : year-on-year growth rate, SA: seasonally adjusted

EL SALVADOR — *% explained by common factor* 89.0278

Variables	*Frequency*		
Gross Domestic Product (GDP)	Q	*qoq*	SA
Agricultural sector activity index	M	*yoy*	
Manufacturing sector activity index	M	*yoy*	
Retail sales activity indicator	M	*yoy*	
Electricity generation	M	*yoy*	
Cement	M	*yoy*	
Maquila exports	M	*yoy*	
Imports (excluding oil and derivatives)	M	*yoy*	
Tax revenues	M	*yoy*	

Notes: Q - quarterly; M: monthly; *qoq:* quarter on quarter growth rate
yoy : year-on-year growth rate, SA: seasonally adjusted

GUATEMALA — *% explained by common factor* 99.6562

Variables	*Frequency*		
Gross Domestic Product (GDP)	Q	*qoq*	SA
Economic activity monthly indicator	M	*yoy*	
Exports	M	*yoy*	
Imports	M	*yoy*	
Migrants remittances	M	*yoy*	
Tourism revenues	M	*yoy*	
Private capital financial inflows	M	*yoy*	
Tax revenues	M	*yoy*	

Notes: Q - quarterly; M: monthly; *qoq:* quarter on quarter growth rate
yoy : year-on-year growth rate, SA: seasonally adjusted

JAMAICA — *% explained by common factor* 92.1248

Variables	*Frequency*		
Gross Domestic Product (GDP)	Q	*qoq*	SA
Exports	M	*yoy*	
Migrants remittances	M	*yoy*	
Tourists	M	*yoy*	
Alumina production	M	*yoy*	
Industrial electricity sales	M	*yoy*	

Notes: Q - quarterly; M: monthly; *qoq:* quarter on quarter growth rate
yoy : year-on-year growth rate, SA: seasonally adjusted

MEXICO *% explained by common factor* 97.4615

Variables	*Frequency*		
Gross Domestic Product (GDP)	Q	*qoq*	SA
Industrial production index	M	*yoy*	
Retail sales	M	*yoy*	
Employment	M	*yoy*	
Maufacturing salaries	M	*yoy*	
Consumer´s confidence index	M	*yoy*	
Exports	M	*yoy*	
Imports (excluding oil and derivatives)	M	*yoy*	
United States industrial production index	M	*yoy*	
Credit by commercial banks	M	*yoy*	

Notes: Q - quarterly; M: monthly; *qoq:* quarter on quarter growth rate
yoy : year-on-year growth rate, SA: seasonally adjusted

NICARAGUA *% explained by common factor* 64.0619

Variables	*Frequency*		
Gross Domestic Product (GDP)	Q	*qoq*	SA
Industrial production index	M	*yoy*	
Average salary social security contributions	M	*yoy*	
Exports	M	*yoy*	
Migrants remittances	M	*yoy*	
Electricity consumption	M	*yoy*	
Domestic consumption of gasoline	M	*yoy*	

Notes: Q - quarterly; M: monthly; *qoq:* quarter on quarter growth rate
yoy : year-on-year growth rate, SA: seasonally adjusted

PANAMA 87.1988

Variables	*Frequency*		
Gross Domestic Product (GDP)	Q	*qoq*	SA
Exports	M	*yoy*	
Imports (excluding oil and derivatives)	M	*yoy*	
Enectricity generation	M	*yoy*	
Panama canal toll revenues	M	*yoy*	
Colon Free Trade Zone	M	*yoy*	
Fiscal revenues	M	*yoy*	
Cement	M	*yoy*	

Notes: Q - quarterly; M: monthly; *qoq:* quarter on quarter growth rate
yoy : year-on-year growth rate, SA: seasonally adjusted

PARAGUAY *% explained by common factor* 34.1663

Variables	*Frequency*		
Gross Domestic Product (GDP)	Q	*qoq*	SA
Monthly economic activity indicator	M	*yoy*	
Exports	M	*yoy*	
Imports (excluding oil and derivatives)	M	*yoy*	
Business indicator - car sales	M	*yoy*	

Notes: Q - quarterly; M: monthly; *qoq:* quarter on quarter growth rate
yoy : year-on-year growth rate, SA: seasonally adjusted

PERU *% explained by common factor* 82.2391

Variables	*Frequency*		
Gross Domestic Product (GDP)	Q	*qoq*	SA
Industrial production index	M	*yoy*	
Retail sales	M	*yoy*	
Minimum salary	M	*yoy*	
Exports	M	*yoy*	
Imports (excluding oil and derivatives)	M	*yoy*	
Electricity generation	M	*yoy*	
Tax on production and consumption	M	*yoy*	
Fiscal capital expenditures	M	*yoy*	
Public investment	M	*yoy*	
Construction economic activity indicator	M	*yoy*	

Notes: Q - quarterly; M: monthly; *qoq:* quarter on quarter growth rate
yoy : year-on-year growth rate, SA: seasonally adjusted

DOMINICAN REPUBLIC *% explained by common factor* 99.9844

Variables	*Frequency*		
Gross Domestic Product (GDP)	Q	*qoq*	SA
Monthly economic activity index	M	*yoy*	
Employment	M	*yoy*	
Free Trade Zone exports	M	*yoy*	
Imports (excluding oil and derivatives)	M	*yoy*	
Tax on goods and services	M	*yoy*	
Fiscal capital expenditures	M	*yoy*	

Notes: Q - quarterly; M: monthly; *qoq:* quarter on quarter growth rate
yoy : year-on-year growth rate, SA: seasonally adjusted

URUGUAY *% explained by common factor* 78.5588

Variables	*Frequency*		
Gross Domestic Product (GDP)	Q	*qoq*	SA
Industrial production index	M	*yoy*	
Employment	M	*yoy*	
Exports	M	*yoy*	
Imports (excluding oil and derivatives)	M	*yoy*	
Bovine production	M	*yoy*	
Tax revenues	M	*yoy*	
Banking credit to the private sector	M	*yoy*	
Industrial production index - Argentina	M	*yoy*	

Notes: Q - quarterly; M: monthly; *qoq:* quarter on quarter growth rate
yoy : year-on-year growth rate, SA: seasonally adjusted

VENEZUELA *% explained by common factor* 99.9987

Variables	*Frequency*		
Gross Domestic Product (GDP)	Q	*qoq*	SA
Employment	M	*yoy*	
Imports (excluding oil and derivatives)	M	*yoy*	
Imports	M	*yoy*	
Oil production	M	*yoy*	
Banking credit to the productive and sales sector	M	*yoy*	

Notes: Q - quarterly; M: monthly; *qoq:* quarter on quarter growth rate
yoy : year-on-year growth rate, SA: seasonally adjusted

Source: Based on author's calculations.

5. Conclusions

The methodology described in this work allows to build a synthetic indicator of economic activity that incorporates information provided by several other indicators, including the most recent and up to date statistical information and whose evolution remains very close to that of GDP, as this is the indicator that best describes the behavior of overall economic activity. Once this synthetic indicator is available, it is possible to generate short-term economic forecasts for quarterly GDP growth rates. This methodology allows to include a greater number of publically available indicators and data related to the evolution of economic activity, including soft and hard indicators, and indicators with different release calendars. In this sense, the methodology described is a useful method to follow up the evolution of economic activity in the short-term.

Quarterly GDP growth rates are forecast for the following three quarters, although the quality of these forecasts depends on the quality and availability of the statistical data; notwithstanding, the accuracy of the quarterly estimates is higher for the next quarter. As these models have no economic structure, with this methodology it is not possible to access/quantify the impact of different variables in the economic activity. It is however possible to make some judgments based on the realizations of economic variables and their incorporation on the models.

Another important element is the timely availability of data on the evolution of economic activity. In the Latin American and Caribbean region, quarterly GDP growth rates are often published with an important time delay to the reference period. This methodology allows for timely and accurate estimates of economic activity, which are of utmost importance for decision making processes in national economies, using publically available economic data.

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