Box 1: A Weekly Indicator of Economic Activity for Colombia

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The diagnosis of economic activity is one of the main inputs used in the forecasting process of *Banco de la República's* technical staff. This process employs diverse sources of information, including sectoral indicators, information derived from surveys and, more recently, series published by various commercial banks on household spending.

Nevertheless, part of this dataset suffers from relatively large time lags, which in some cases can be up to several months. While lags in series such as the unemployment rate, industrial production, or the economic tracking indicator, may not be of great consequence under slowly evolving conditions, they acquire relevance in situations of high uncertainty and rapid and substantial changes. Under such conditions, the use of traditional indicators may be uninformative or could even be the source of significant forecast errors.

The purpose of this Box is to present the weekly economic tracking indicator (hereinafter ISAE for its Spanish acronym), a new high-frequency indicator that seeks to overcome these limitations by combining series with different periodicities. A detailed explanation of this indicator and its diagnostic and predictive properties can be found in the document by Cote-Barón *et al.* (2022).

1. Structure of the weekly economic tracking indicator estimate (ISAE)

The ISAE is based on a simple idea: although very good indicators exist to assess the behavior of aggregate economic activities, they all have idiosyncratic components that introduce diagnostic distortions (i.e., measurement errors, historical revisions, or particular events in a productive branch). Consequently, the ISAE aims to treat economic activity dynamics as a latent factor common to a large number of variables, while also allowing for missing values in many of these series. The latter is convenient, given that the most precise information often has the greatest publication lag. To this end, the objective is to extract the indicator from 32 variables of different frequencies and lengths: 10 weekly series, 19 monthly series and 3 quarterly series (Table B1.1).

The methodology used for this purpose is a mixed-frequency dynamic factor model. This type of model has been widely used in its different versions in economic literature for both diagnostic and forecasting purposes (Stock & Watson, 2012). Specifically, the indicator proposed considers three frequencies (quarterly, monthly, and weekly) that require the aggregation relationships to vary over time, given calendar irregularities. To this end, the estimation follows Baumeister *et al.* (2021).

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Table R1.1
Variables employed in the dynamic factor model

Frequency	Variable	Source
Quarterly	Real GDP	DANE (National Administrative Department of Statistics)
	Total area: finished and in process construction works	DANE, Census of Buildings (CEED)
	Industry installed capacity utilization	Fedesarrollo, Entrepreneurial Opinion Survey (EOE)
Monthly	Tons of solid freight transported by road	Ministry of Transport
	Unemployment rate	DANE, Integrated Household Survey (GEIH)
	Number of unemployed	DANE (GEIH)
	Real industrial production	DANE, Monthly Manufacturing Survey, territorial focus (EMMET)
	Index of real retail sales without vehicles and fuels	DANE, Monthly Trade Survey (EMC)
	Real income of hotels	DANE, Monthly Hotel Survey (EMA)
	Economic Monitoring Indicator (ISE)	DANE
	Amount of transactions in ACH Colombia (deflated with CPI)	ACH-Colombia and *Banco de la República*
	Consumer Confidence Index	Fedesarrollo, Consumer Opinion Survey (EOC)
	Industrial Confidence Index	Fedesarrollo (EOE)
	Commercial Confidence Index	Fedesarrollo (EOE)
	Index of business climate in 5 regions	*Banco de la República*, monthly survey of economic expectations (EMEE)
	Number of passengers transported by air	Civil Aviation Authority
	Industrial Production Index (IPI) - Mining	DANE
	Total exports index	*Banco de la República*
	Total imports index	*Banco de la República*
	Cardboard box index	*Banco de la República*
	Risk perception index (IDOAM)	*Banco de la República*
	Regional economic pulse	*Banco de la República*
Weekly	Google mobility reports	Google
	Fuels dispatches	SICOM, National mining and energy information system
	Unregulated Energy Demand	XM, Colombian power system operator and wholesale energy market administrator
	Google Trends: food & beverages	Google
	Google Trends: unemployment	Google
	Google Trends: real estate market	Google
	Google Trends: restaurant	Google
	VAT Collection	*Banco de la República*
	Consumer credit disbursements	Office of the Financial Superintendent of Colombia
	Monetary offer M2	*Banco de la República*

At a general level, the model assumes a latent weekly factor f_t common to the body of information used, and whose treatment of the series, according to the frequency, is as follows:

Weekly variable:
$$y_{i,t}=\lambda_i f_t+u_{i,t}$$

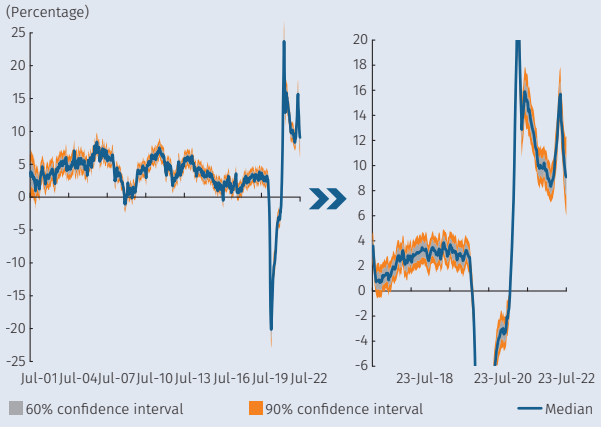
Monthly variable:
$$y_{i,t}=\lambda_i\,[c(m_t)]^{-1}\,(f_t+f_{t-1})+\ldots+f_{t-c(m_t)+1} +[c(m_t)]^{-1}\,(u_{i,t}+u_{i,t-1})+\ldots+u_{i,t-c(m_t)+1}$$

Quarterly variable:
$$y_{i,t}=\lambda_i\,[d(q_t)]^{-1}\,(f_t+f_{t-1}+\ldots+f_{t-d(q_t)+1}) +[d(q_t)]^{-1}\,(u_{i,t}+u_{i,t-1}+\ldots+u_{i,t-d(q_t)+1})$$

where the months index is $m=1,\ldots,M$ with M being the total number of months in the database; the quarters index is $q=1,\ldots,Q$, where Q is the total number of quarters in the sample, and $c(m)$ and $d(q)$ refer to the number of weeks in month m and in quarter q. Note that $c(m)$ may equal 4 or 5, and $d(q)$ could be 12, 13 or 14. Moreover, it is assumed that:

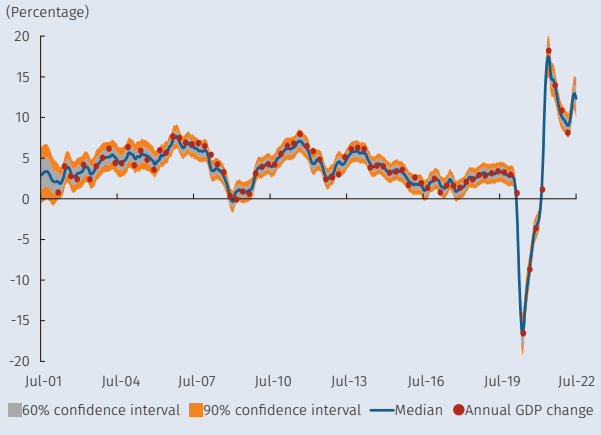
$$f_t=\phi_1 f_{t-1}+\phi_2 f_{t-2}+\phi_3 f_{t-3}+\phi_4 f_{t-4}+\epsilon_t \qquad \epsilon_t\sim N(0,w^2)$$
$$u_{i,t}=\varphi_{i,1}\,u_{i,t-1}+\varphi_{i,2}\,u_{i,t-2}+\varphi_{i,3}\,u_{i,t-3}+\varphi_{i,4}\,u_{i,t-4}+\varepsilon_{i,t} \qquad \varepsilon_{i,t}\sim N(0,\sigma_i^2)$$

Graph R1.1
Weekly economic tracking indicator (ISAE)
(Annual variation)



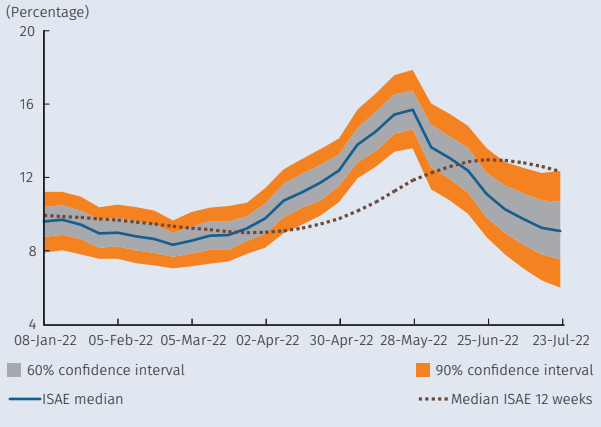
Source: *Banco de la República.*

Graph R1.2
ISAE twelve-week moving average and GDP
(Annual variation)



Source: *Banco de la República.*

Graph R1.3
ISAE in 2022
(Annual variation)



Source: *Banco de la República.*

The state-space form of this system allows us to jointly estimate the model parameters, the common factor and the missing observations using the Kalman filter in a Bayesian framework. We define the ISAE as the factor f_t factor normalized such that its mean and variance are equal to those of the annual GDP growth.

2. Main findings

The ISAE estimation approach allows for construction of confidence intervals from the results of the different draws. For practical purposes, we will take the median thereof as the ISAE point estimate. This estimate, based on the information available by the end of the week of July 23, 2022, is shown in Graph B1.1, which also displays the 90% and 60% confidence intervals around it.

This estimate captures the trend changes between 2007-2008 and 2014-2015, as well as subsequent recoveries in economic activity. Additionally, the health crisis resulting from the Covid-19 pandemic is associated with a marked ISAE contraction and its ensuing recovery, exhibiting high annual growth rates due to the very low comparison bases in multiple indicators.

In order to assess the relevance of the ISAE as an indicator of economic activity, it is useful to compare its dynamics with those of the GDP. Although the latter is one of the variables considered in the estimation, the underlying concept of the ISAE is that it is based on a latent factor common to all variables and therefore, technically, its dynamics should not be identical to those of the GDP. For comparative purposes, we will use the ISAE twelve-week moving average. Graph B1.2 displays this comparison, revealing that the differences between the twelve-week ISAE and the annual GDP change are quite small.[1]

For the second quarter of 2022, the ISAE suggests annual growth would have accelerated since the end of April, reaching its peak in the week ending May 28. This is consistent with the low comparison base resulting from the road blockades experienced last year. The ISAE's twelve week moving average suggests an annual expansion of close to 13% in the second quarter of this year (Graph B1.3).

3. Final considerations

The past two and a half years have been particularly uncertain, characterized by rapid and profound changes in economic growth trends. Given the lags in the usual macroeconomic series, it is useful to construct high-frequency indicators that make it possible to provide precise descriptions of economic conditions with a modest delay. The ISAE seeks to be a tool to help in this respect and complement the battery of models used by the technical staff of *Banco de la República*. Out-of-sample forecasting performance and revisions to estimates due to new data releases will be presented in Cote-Barón *et al.* (2022).

1 Since 2002, the average absolute difference between the annual GDP change and the twelve-week ISAE median at the end of the quarter is 0.48 pp.

References

Baumeister, C., Leiva-León, D. & Sims, E. R. (2021). *Tracking Weekly State-Level Economic Conditions*. Working Paper 29003, National Bureau of Economic Research. https://doi.org/10.3386/w29003

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