Box 1
SUPPLY SHOCKS AND THEIR IMPACT ON ECONOMIC ACTIVITY

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In an economic cycle, one sees supply and demand shocks that can affect how agents in the market decide to allocate resources. Determining the impact, transmission and nature (transitory or permanent) of those shocks poses a challenge to economists, and understanding them can be very useful in economic policy-making. Being able to fathom transmission channels allows us to appreciate to what extent shocks can be extended or restricted in the short term, and how these effects can influence the long term, as well as their propagation towards relevant variables such as prices and quantities (Campbell and Mankiw , 1987).

The Colombian economy has suffered several supply and demand shocks in recent years, the most notable being the shock related to the drop in the price of oil in 2014. This, in turn, affected terms of trade and national income during 2015 and 2016. However, our focus will be on several transitory supply shocks that affected economic activity in 2016, particularly those related to El Niño weather and the trucking strike. It is important to note that the concept of a transitory supply shock that we will attempt to evaluate in this section involves an exogenous change in certain relative prices and production that does not affect employment levels or medium- or long-term expectations. However, in some cases, it is reflected in a reduction in the extent to which companies use installed capacity.

The trucking strike [1] that paralyzed ground transportation activities between the second and third quarters of 2016 is a clear example and one that significantly and indirectly affected activities such as industry, commerce and agriculture. To show the impact of that event, we will use as the case of industry as an example. We will begin by examining the monthly data for the 33 sectors covered by the Monthly Manufacturing Survey, with monthly figures from January 2001 to December 2016.

The proposed exercise includes the following steps: 1) use of econometric methods to detect atypical data in order to identify shocks of considerable magnitude (Dixon, 1950)[2]; 2) a breakdown of the statistical series into trend-cycle, seasonality and irregular components, and 3) an assessment as to whether the dates of the trucking strike coinciding with those for which the method was able to identify atypical shocks.

Once this was done, a counterfactual exercise was proposed in which we tried to correct the series in each sector where the dates of the atypical data were in line with those of the trucking strike. With that in mind, each series for the 33 manufacturing sub-branches was seasonally adjusted, assuming additive seasonality. Then, in those sectors where a shock was identified, the irregular term estimated for the series was added to the original series and the seasonal adjustment process was performed again to see how the disruption would have affected the cyclic-trend component. Although this is a strong assumption, as 100% of the shock is presumed as attributable to the strike, it is part of the strategy to "clean" the series of such events.

A model of the type (Melo and Parra, 2014: Abril et al., 2016) is estimated in this way:

$$Y(t) = \sum_{i=1} \alpha_i D_i(B) d_i(t) + \sum_{i=1} \beta_i \, cal_t(t) + x(t) \qquad [1]$$

Where $Y(t)$ is the original series (to which the procedure is applied), B is the lag operator, $d_i(t)$ is a dummy variable that indicates the position of the ith atypical data (outlier), and $D_i(B)$ is a polynomial in which the type of

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1 The trucking strike lasted from the moment it was called, on midnight on June 6, 2016, until the early morning of July 22, 2016 when the truckers reached an agreement with the government.

2 Dixon's (1950) criterion for identifying extreme or atypical values is to compare the difference between the possible atypical data and its nearest neighbor to the remaining range of the sample; that is, to determine the fraction of the total range that is attributable to a supposed atypical value. This procedure is referred to as "the Q test" and is fairly reliable for small samples (Rorabacher, 1991). The ratio (Q) to calculate and compare the respective critical values, having ordered values so that $x_1 < x_2 < \ldots < x_{n-1} < x_n$, is:

$$Q = \frac{x_2 - x_1}{x_n - x_1} \left(0 \; \frac{x_n - x_{n-1}}{x_n - x_1} \right)$$

outlier is reflected.[3] With the variable, *cal*, the calendar effects are denoted as business days or Easter Week; β_i is the associated coefficient. Finally, the term $x(t)$ follows an Arima model [4] of the following type, which complies with the traditional assumptions.[5]

$$\varphi(B)\delta(B)x(t) = \theta(B)a(t) \qquad [2]$$

Where

$$\varphi(B) = (1+ \phi_1 B + \ldots + \phi_p B^p)\ (1+\Phi_1 B^S + \ldots + \Phi_P L^{SxP})$$

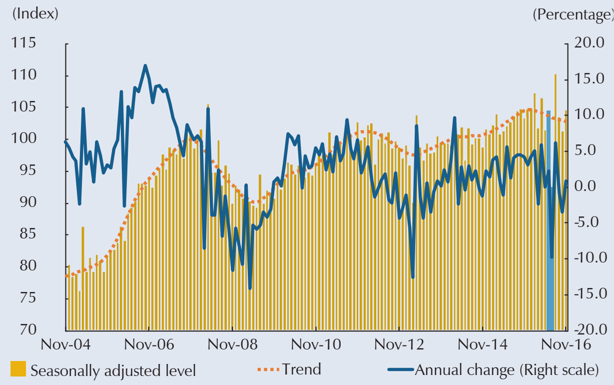
$$\delta(B) = (1 - B)^d (1 - B)^D$$

$$\theta(B) =(1+\theta_1 B+\ldots+\theta_q B^p)\ (1+\Theta_1 B^S+\ldots+\Phi_Q L^{SxQ}) \qquad [3]$$

Using this econometric exercise, statistical evidence was found to consider the data from sixteen sectors where statistically atypical values associated with the trucking strike. After the figures for these sixteen sub-branches are corrected and the result is added, the non-oil-refining industry would have fallen by 3.7% for the month of July 2016 (-9.8%, according to the official figures from DANE). Among the most affected manufacturing activities are those related to the production of beverages, leftover foods, wood processing, bakery products, nonmetallic mineral products and footwear (Graph B1.1 and B1.2).

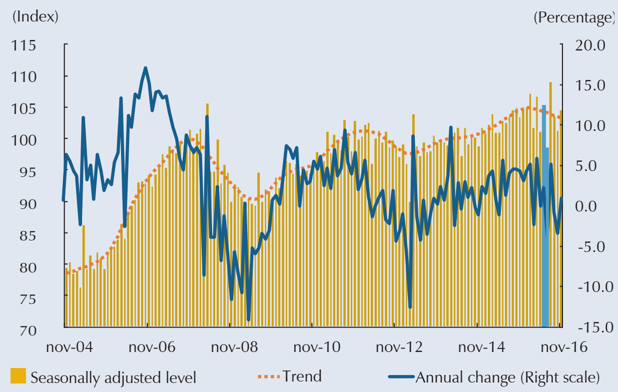
The previous exercise focused on the trucking strike, which was one of the most recent shocks. However, we must not forget the shock related to the severe bout of El Niño weather that affected the Colombian economy during the first half of the year.[6] It is important to remember the reduction in precipitation caused by El Niño led, in turn, to less agricultural supply, which had a transitory impact on food prices (Abril et al., 2016). Then again, this weather phenomenon also affected the behavior of sectors such as electricity, natural gas and water supplies. In fact, campaigns were conducted by the government and local authorities during the first half of 2016 to promote energy and water conservation as a contingency measure in the face of that situation (Table B1.1).

Graph B1.1
Industrial Production Index without Oil Refining
(Seasonally adjusted series, trend and annual change)



Sources: DANE.

Graph B1.2
Industrial Production Index without Oil Refining
(Modified by the proposed exercise)
(Seasonally adjusted series, trend and annual change)



Sources: DANE; authors' calculations

Using the same methodology as in the previous exercise, an estimate was done on the national accounts, according to branches of activity, with the presence of atypical data being found in the transport and electricity and water supply sectors for the second quarter. The exercise for the industry was included in the monthly survey and its impact on national accounts was estimated. The results of several exercises assuming different weights in the transmission of shocks suggest the negative effect on GDP growth (January- September 2016) would have been between 0% and 0.3% for the entire year (Table B1.2 and Graph B1.3).

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3 For an additive outlier (AO), Di (B) = 1; for a transitory change (TC), Di (B) = 1/(1 0.7B), and for a change in level (LS), Di (B)=1 / (1-B).

4 Autoregressive integrated moving average (ARIMA) model

5 Stationarity of the series (polynomials with stable roots) and white noise in model errors, among others.

6 According to the National Oceanic and Atmospheric Administration (NOAA), El Niño occurred in the last quarter of 2015 and was declared by NOAA as severe. The Oceanographic El Niño Index (ONI), which is produced by that agency, was used for the regressions in Table B1.1.

Table B1.1
Granger Causality Tests (1969)

	Annual change		
	1 lag	2 lags	3 lags
ONI does not Granger-cause agriculture	0.647	0.7901	0.2209
ONI does not Granger-cause manufacturing related to food	0.2115	0.1663	0.0074
ONI does not Granger-cause electricity, natural gas and water	0.4173	0.0986	0.1005

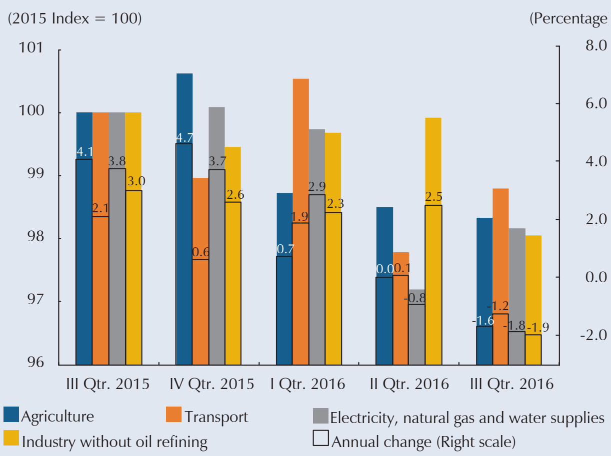
Note: The shaded values pertain to significant effects.
Source: DANE; authors' calculations.

Table B1.2
Growth in 2016 by the Third Quarter[a/]

Sectors	Participation	Original	Modified
Agriculture	6.2	(0.3)	1.8
Mining and quarrying	7.1	(5.9)	(5.9)
Manufacturing industries	10.9	3.9	4.7
Electricity, natural gas and water supplies	3.5	0.0	1.7
Construction	7.3	4.0	4.0
Commerce, repairs, restaurants and hotels	12.1	1.4	1.4
Transport	7.2	0.3	1.4
Financial establishments	20.1	4.3	4.3
Social, community and personal services	15.3	2.1	2.1
Total taxes	9.8	2.4	2.4
GDP		1.9	2.2

a/ The exercise was done with figures up to the third quarter of 2016, which were published by DANE in December 2016.
Note: The shaded values pertain to the series that were corrected with the methodology outlined in this section.
Source: DANE; authors' calculations.

Graph B1.3
Quarterly Index and Annual Change in Sectoral GDP on the Supply Side



Sources: DANE.

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