# Macro Vision

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## BRAZIL – Estimating the indirect impact of basic goods on CPI

- A common issue when estimating the impact of commodities and other basic products on consumer inflation is that these goods are often more intensively (or fully) used as inputs rather than final products. Thus, much of the effects of their price changes occur along the value chains, only indirectly affecting the final prices in the consumer basket that is tracked by the IPCA (Broad Consumer Price Index).

- These indirect effects, in addition to being quite relevant for cost formation, can far exceed the direct effect determined by their weight in the household consumption basket. An example is diesel, which is not widely used directly by households and therefore has a very low weight (around 0.2%) in the IPCA, but whose price changes have a significant impact on other prices in the economy due to its importance for freight and urban transport costs. There are also other inputs like iron ore and soybeans that are obviously relevant but do not appear in the index basket because they are not directly sold to the consumer.

- To capture the indirect impacts of the most relevant inputs on the prices of goods and services in general, we calculated the usage intensity of each product in others based on the intermediate consumption data from the IBGE's Resources and Uses Table (TRU, in the Portuguese acronym). With this tool, we were able to compute the indirect weight of various commodities on inflation. For instance, a 10% increase in diesel at the pump has a direct impact of about 0.02 percentage points (p.p.) on the IPCA, while the indirect impact on market-set prices can reach up to 0.23 p.p. In the case of electricity, which has a direct effect of 0.39 p.p. for every 10% increase, we found an additional indirect effect of up to 0.46 p.p. For soybean, which is not directly considered in the IPCA, we estimate that every 10% increase raises market set prices by up to 0.17 p.p.

- We emphasize that these effects still depend on the degree of pass-through, and the estimates presented represent the maximum potential, i.e., they assume full pass-through of input price variations. Naturally, the actual degree of pass-through to final prices depends on structural factors, such as the configurations of each value chain, and on conditions that can affect the ability to adjust prices cyclically, such as the degree of activity in a given market and in the economy as whole.

**A common criticism regarding the calculation of the impact on inflation from price variations in products that are also inputs is that most of the time, we can only calculate the direct impact on prices based on the weight of these items in household budgets as considered by the IPCA.** Thus, we do not capture the indirect impact that price changes in these items can have on the price of other products. Common examples of this type of questioning fall on diesel and soybeans. Although the former is important in determining freight and urban transport prices, it weighs only about 0.2% in the IPCA. Meanwhile, the latter, despite not being directly considered in the inflation index, is an important input for the production of various foods such as meats, oils, and others.

**With this in mind, we calculated the consumption of different inputs for each product based on the information obtained from the IBGE's Resources and Uses Table (TRU) to identify the indirect impact of variations in these on consumer inflation.** Similarly to the study "The Weight of Wages: A Core by Reweighting the IPCA", we first identified the weight of each product (j) in the production of the sector (i) as follows:

$$p_{ji} = \frac{value\ of\ production_{ji}}{value\ of\ production_{i}}$$

**In the TRU, we can check how much each sector (i) consumes of product (j) in its production.** Using the above relationship, we can perform the analysis at the product level:

$$c_{jk} = \sum_i p_{ji} * CI_{ki}$$

where $c_{jk}$ is the consumption of input (k) for the production of product (j), and $CI_{ki}$ is the consumption of input (k) in the production of sector (i).

Thus, we constructed a matrix (C) with the intermediate consumption of all products, dividing by the total production of (j):

$$C = \begin{matrix} \lambda_{11} & \dots & \lambda_{1n} \\ \dots & \dots & \dots \\ \lambda_{n1} & \dots & \lambda_{nn} \end{matrix}$$

Where,

$$\lambda_{jk} = \frac{c_{jk}}{value\ of\ production_j}$$

Using the national input-output model (see appendix) and the Leontief inverse matrix, we obtained the total coefficients (direct and indirect).

$$\boldsymbol{B = (I - C)^{-1}}$$

Since we are interested in the indirect impact of these commodities on the IPCA, we define $A = (B - I)$, where I is the identity matrix. Finally, we mapped the TRU products to the IPCA items.

**In this way, we were able to capture the indirect impact of commodities on the price index.** By using the intermediate consumption of inputs (k) for each item (j) in the IPCA ($a_{jk}$) and multiplying it by the item's weight in the IPCA, we obtained the following summarized table:

**Indirect Weight of Commodities in the IPCA (or impact per each 1% increase)**

| Product | Direct weight | Indirect weight | | | | | Total weight (direct + indirect) |
|---|---|---|---|---|---|---|---|
| | | Total | Food at home | Industrials | Services | Total ex. regulated | |
| Diesel | 0.2 | 3.3 | 0.8 | 0.9 | 0.6 | 2.3 | 3.5 |
| Iron ore | - | 1.1 | 0.1 | 0.5 | 0.2 | 0.8 | 1.1 |
| Electricity** | 3.9 | 5.5 | 1.1 | 1.6 | 2.0 | 4.6 | 9.4 |
| Corn | - | 1.0 | 0.7 | 0.1 | 0.1 | 1.0 | 1.0 |
| Soybeans | - | 1.9 | 1.1 | 0.3 | 0.2 | 1.7 | 1.9 |

*the TRU does not allow to separate electricity from gas and other utilities

Source: IBGE, Itaú

**Interpretation: every 10% adjustment in diesel at the refinery has an indirect impact on the IPCA, excluding administered prices, of 23 basis points (bps), of which 8 bps come from food at home, 9 bps from industrial goods, and 6 bps from services, and so on.**

**It is interesting to extend this exercise to some products and services that are not exactly commodities but are also widely consumed across value chains.** Among the inputs with the greatest indirect effect on other prices, we highlight "road freight transport," which has a total impact of 2.8 bps on the IPCA for every 10% increase, considering only goods and food.

**Finally, we used different econometric approaches to evaluate the robustness of the estimated impacts and to identify the lag most relevant to each input.** While this exercise of composing indirect weights via TRU does not provide significant information about when exactly these effects manifest on inflation, VAR models that reach similar impacts in terms of magnitude yield the lag estimations reported below.

**Indirect impact of commodities on the IPCA: effect for every 10% increase in prices**

| Commodities in BRL | VAR | | TRU |
|---|---|---|---|
| | bps | lag | bps |
| Oil | 6 | 3 - 6 months | 33 |
| Iron ore | 13 | 3 - 9 months | 11 |
| Corn | 3 | 3 - 6 months | 10 |
| Soybeans | 16 | 3 - 6 months | 19 |

Source: Itaú

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## Annex

**To proceed, it is worth recalling the national input-output model.** Suppose the economy is divided into $n$ sectors such that the total production of sector $i$ is given by:

$$x_i = z_{i1} + z_{i2} + \cdots + z_{ii} + z_{in} + y_i \quad (1)$$

Where $z_{ik}$ represents the inter-industrial sales of sector (i) and $y_i$ the sales to final demand agents. Assuming a Leontief production function, we have:

$$a_{ik} = \frac{z_{ij}}{x_k} \quad (2)$$

Where $a_{ik}$ is known as the input-output ratio. It is worth noting that these coefficients are fixed, meaning we assume that sectors use inputs in fixed proportions. Thus, we can rewrite equation (1) as follows:

$$x_i = \sum_j a_{ij} x_j + y_i$$

In matrix form, we have:

$$\boldsymbol{X} = \boldsymbol{AX} + \boldsymbol{Y}$$

Performing algebraic manipulations:

$$\boldsymbol{X} - \boldsymbol{AX} = \boldsymbol{Y}$$
$$(\boldsymbol{I} - \boldsymbol{A})\boldsymbol{X} = \boldsymbol{Y}$$
$$\boldsymbol{X} = (\boldsymbol{I} - \boldsymbol{A})^{-1}\,\boldsymbol{Y}$$

Where, $I$ is the identity matrix, and $(I - A)^{-1}$ is the Leontief inverse matrix representing total intermediate consumption (direct and indirect).

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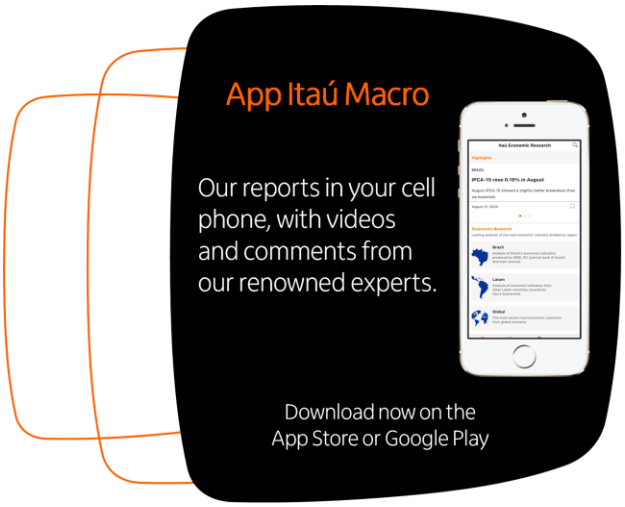


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