

BRAZILIAN AGRO-INDUSTRY: THE SITUATION OF THE SECTOR AND PROJECTIONS FOR 2019

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EXECUTIVE SUMMARY

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RESUMO EXECUTIVO

The production of Brazilian agribusiness extends far beyond the production of raw materials derived from agricultural activities. This idea was present in the series of studies on the Brazilian agro-industrial chains produced until this moment. In this direction, in the previous studies, the following sectors of the agro-industrial chains were detailed:

- Milk and dairy products;
- Meat complex (beef, poultry and pork);
- Wheat and derivatives;
- Coffee;
- Juices and teas;
- Candies, peanuts and chocolate;
- Cachaça;
- Wines and beers.

In this report, which closes this series, will be presented the entire group of agro-industry from the Brazilian Food and Beverage through a collection of data with an unprecedented aggregation. That's not a new information that Brazil is a country with a strong and competitive agricultural activity in the international market. However, it is not released that Brazilian production of agro-industrial products (i.e. of those manufactured products whose main raw materials derived from agricultural activities) it is responsible for a significant fraction of Brazilian industrial production (35.6%), as well as being responsible for one robust balance of the national trade balance (US\$ 28.4 billion).

In this direction, through the data of the IBGE Monthly Industrial Survey, it was created the Brazilian Agro-industrial Production Index (IPAgro). This index, which allows monthly monitoring of the evolution of the national agro-industry since 2002, is composed of the two main segments of the agro-industry: Food and Beverage agro-industry; and Agro-industry of Non-Food products. The aim of this report is to present the agro-industry of Food and Beverages, presenting in detail the evolution in recent years, especially in 2018, as well as its interactions with international trade. Finally, once

described the macroeconomic variables that influence the performance of this sector have been made, this report, using econometric models, will also present projections for the agro-industry of Foods and Beverages for the next three years (from 2019 to 2021) considering three scenarios (baseline, optimistic and pessimistic).

In summary, this report demonstrate that the Brazilian agro-industry of food and beverages:

- It is responsible for a relevant fraction of national industrial activity;
- It follows the same trends observed for the general industry and, therefore, has less connection with the movements of agricultural markets;
- Due to the less elastic demand of its products, it tends to respond to economic fluctuations in a more modest way;
- Has a structurally surplus trade balance; and
- It should register expansion in the coming years; however, the intensity of this growth is strongly associated with the performance of the Brazilian economy, the confidence of the industrial entrepreneur and the level at which the exchange rate should operate.

The next paragraphs of these results will be presented in more detail.

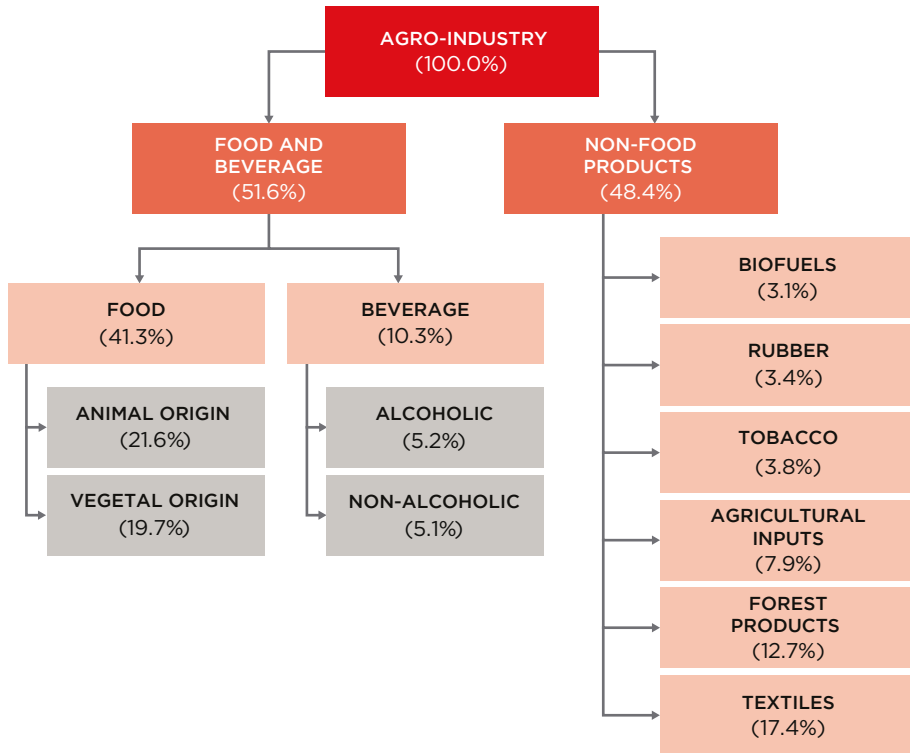
WHAT IS THE BRAZILIAN AGRO-INDUSTRY?

From the classic agribusiness definition from Davis and Rolemberg (1957)¹, this report delimits agro-industry as the group of activities related to (i) the transformation of raw materials used by agricultural production (such as inputs, tractors and other machinery and equipment) and (ii) the transformation of agricultural raw materials into manufactured products (such as food and beverage production). The evolution of the production from agro-industry products was measured based on data available with the national scope of IBGE's Monthly Industrial Survey (PIM). With this data, it was possible to construct the Brazilian Agro-industrial Production Index (IPAgro) composed of two main segments: Food and Beverages; and Non-Food Products. Figure I describes the IPAgro's breakdowns and shows the weight of each segment/sector within the index.

1 DAVIS, J. H.; GOLDBERG, R.A. A concept of agribusiness. Division of Research. Graduate School of Business Administration. Boston: Harvard University, 1957.

Figure I

STRUCTURE OF THE AGRO-INDUSTRIAL PRODUCTION INDEX



Source: Prepared by FGV.

* In parentheses, the weight of each sector in IPAgro.

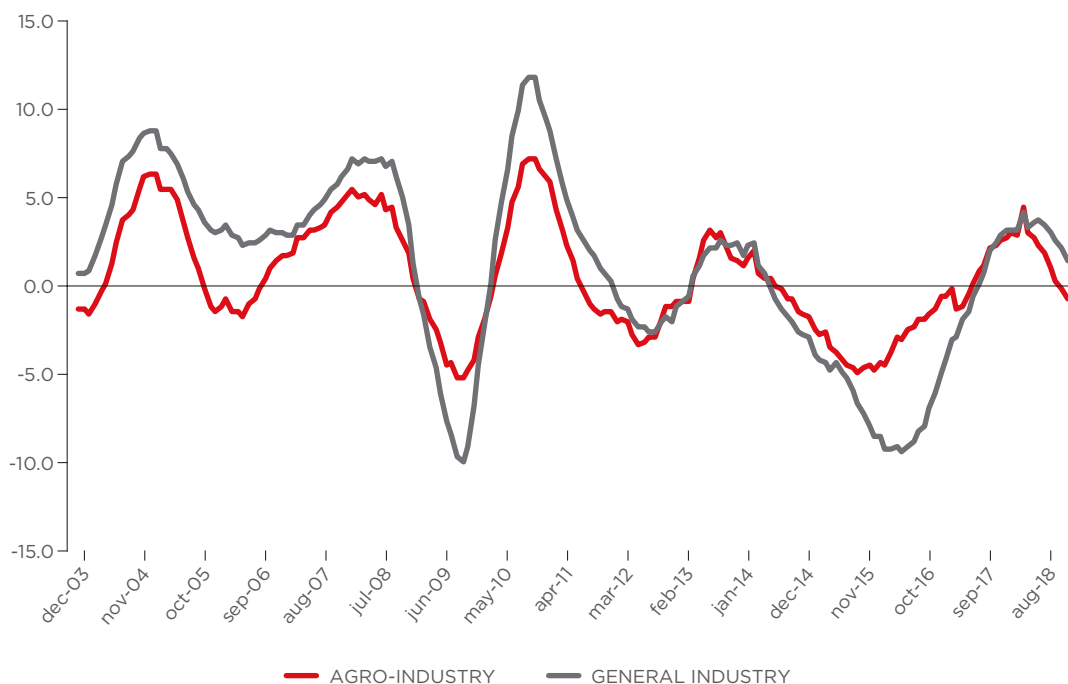
As can be observed from Figure I, all the main sectors that make up the agro-industry of foods and beverages were detailed in isolation in previous studies in this series. In this latest report, based on this unprecedented aggregation of the numbers available in the IBGE Monthly Industrial Survey, it was possible to analyze the performance of the Brazilian food and beverage agro-industry aggregate, comparing its evolution with some of the main macroeconomic variables and with the other large agro-industry segment, namely the production of non-food products.

HOW THE AGRO-INDUSTRY INTERACT WITH THE REST OF THE ECONOMY?

Once with the data available of agro-industry, it was clear that this sector follows the same trends as the Brazilian economy and the national industry (Graph I). In other words, the analyses about the scenarios for the Brazilian economy can be extrapolated to evaluate the trajectory of the agro-industry, but with one important note: economic fluctuations tend to be less intense in agro-industry. According to Figure III, behind this characteristic is precisely the behavior of the beverage food segment of the agro-industry; as the demand for these goods is, on average, more inelastic, it is natural that their response to economic fluctuations should be less intense. Still according to Graph II, it is worth to mention that the movements in the segment of non-food products of the agro-industry presented higher adherence to the oscillations of the Brazilian general industry.

Graph I

EVOLUTION OF AGRO-INDUSTRY AND GENERAL INDUSTRY (CUMULATIVE VARIATION IN 12 MONTHS -%)

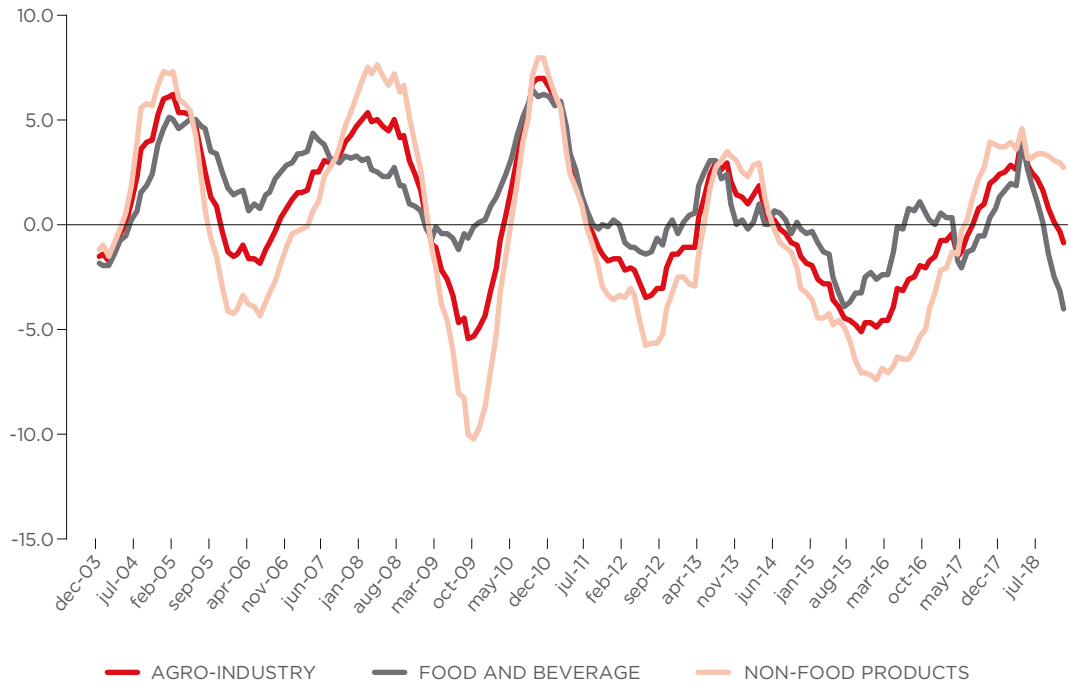


Source: IBGE². Prepared by FGV.

² Available at: <https://sidra.ibge.gov.br/tabela/3650>

Graph II

EVOLUTION OF AGRO-INDUSTRY, FOOD AND BEVERAGE AND NON-FOOD PRODUCTS (ACCUMULATED VARIATION IN 12 MONTHS -%)



Source: IBGE³. Prepared by FGV.

Finally, although the agro-industry, whether it be food and drink, whether it is non-food products, respond in the same direction as the national industry to the movements of the economy, this response occurs in different intensities. This information is crucial to analyze the performance of the sector in 2018 and to design scenarios for agro-industry for the coming years.

³ Available at: <https://sidra.ibge.gov.br/tabela/3650>

HOW WAS THE YEAR 2018 FOR THE AGRO-INDUSTRY?

In the previous section, it was clear that agro-industry, in its two main segments (food and beverages, and non-food products), goes in line with the national economic scenario. However, although they follow the same trend, each segment has particular characteristics that condition the intensity of its responses to economic shocks. This reflection is important to explain the performance of these segments during 2018.

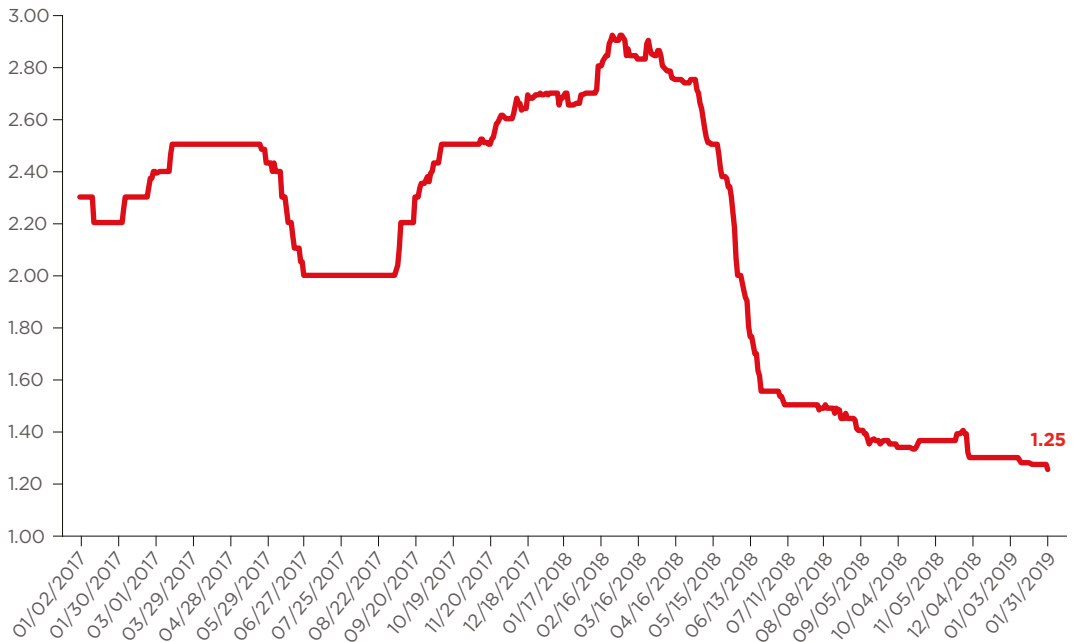
In 2017, the Brazilian economy showed consistent signs that it could return a growth trajectory more robust and sustainable. This dynamic even surpassed the year 2018, as illustrated by the evolution of Focus's projections for the growth of the Brazilian economy in 2018. As can be seen in Graph III, since the end of the third quarter of 2017, the market has been forming the expectation that the Brazilian economy would grow more and more rapidly in 2018. In March 2018, economic growth in the year reached almost 3.0% per year

However, from that moment on, two major events disrupted the economy and, consequently, retracted those projections:

- The proximity of the elections and the end of the term of President Michel Temer, the political capital of the government was eroding and undermining the expectation that it would be possible to approve in 2018 some of the most important economic reforms, with special emphasis on pension reform; and
- The truck drivers' strike that began in the third week of May, however, whose effects affected the performance of practically the economic sectors, including agro-industry and its segments.

Graph III

EVOLUTION OF THE FORECAST GDP GROWTH FROM 2018 (% YOY)



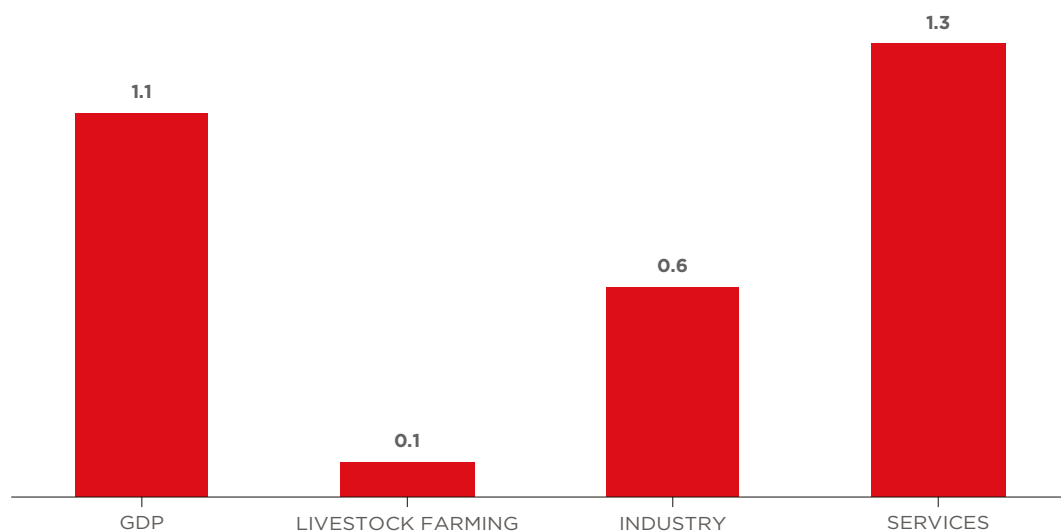
Source: Focus Bulletin⁴ from 02/01/2017 until 27/02/2019 – median.

Again, observing the evolution of Brazilian GDP growth expectations throughout 2018, it is clear how strong the truck drivers' strike affected the country's economy. The numbers practically "speak for themselves": on March 7, 2018, the Focus Bulletin showed a GDP growth projection of 2.9% for the year. On June 21, 2018, one month after the first day of the strike, the growth forecast of the Brazilian economy was only 1.6% YoY. At the end of the year, the median of the projections already operated at 1.3% YoY. Finally, from the official IBGE numbers released at the end of February 2019, the Brazilian GDP ended the year 2018 with an expansion of 1.1%; clearly below the value projected by the market prior to the truck strike (Graph iv).

4 - Available at: <https://www3.bcb.gov.br/expectativas/publico/consulta/serieestatisticas>

Graph IV

GDP GROWTH IN 2018, FROM THE PRODUCTION PERSPECTIVE (% YOY)



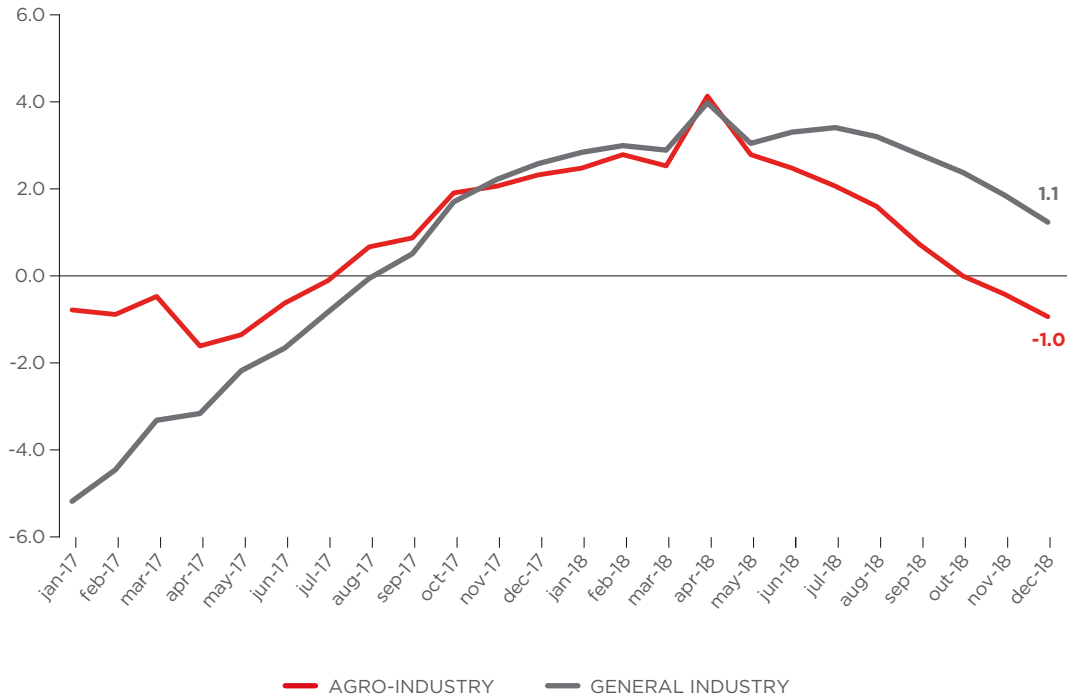
Source: IBGE⁵.

Like the Brazilian economy, both industry and agro-industry were catching up on their growth in 2017, but with a strong slowed during 2018, notably after the truck drivers' strike. However, each segment responded to this situation with different intensities: while the general industry slowed but ended the year with a positive growth of 1.1%, the agro-industry ended the year in the negative field, with a contraction of 1.0 % over 2017 (Graph V).

5 Available at: <https://sidra.ibge.gov.br/tabela/5932>

Graph V

**EVOLUTION OF AGRO-INDUSTRY AND GENERAL INDUSTRY BETWEEN 2017 AND 2018
(CUMULATIVE VARIATION IN 12 MONTHS -%)**



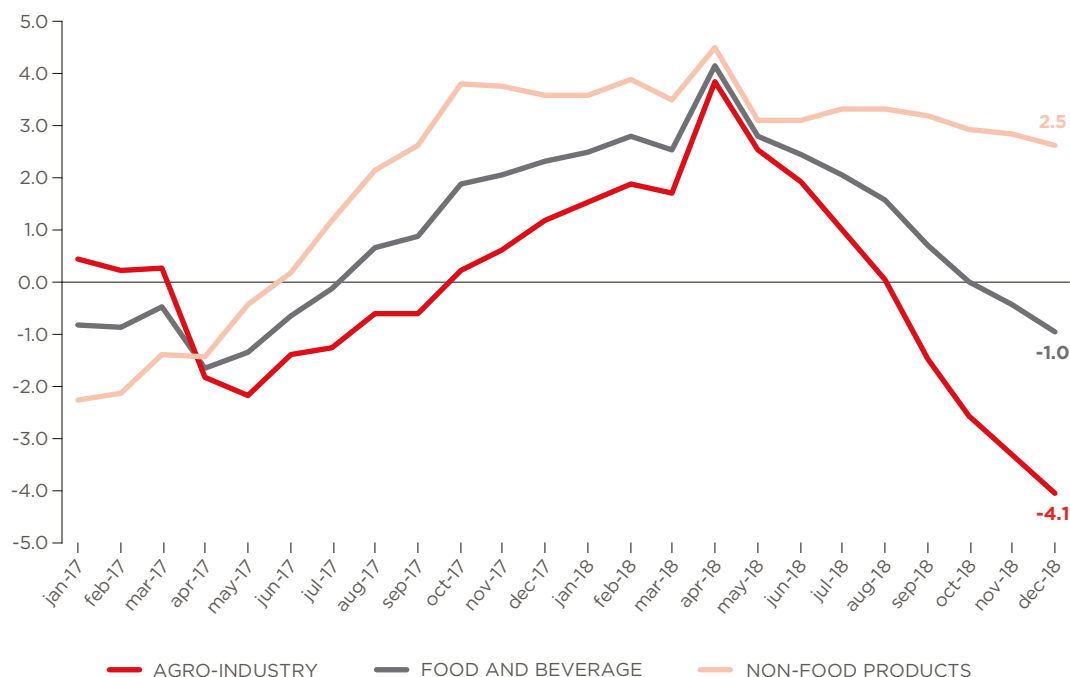
Source: IBGE⁶. Prepared by FGV.

As agro-industry is not a homogeneous unit, neither the food and beverage segment. By decomposing this segment into its main sectors - as its name suggests, on the one hand, food and, on the other hand, beverages - it is clear (Graph VI) that was food was for this reduction (in 2018, contraction of 5.1%), while the beverage sector was practically stagnant (slight contraction of 0.1%). In fact, even more detailed, the contraction of the agro-industry in 2018 was the sector of food of vegetable origin, with a decrease of 9.6%, since food of animal origin had a moderate decrease (-0.7 %).

6 Available at: <https://sidra.ibge.gov.br/tabela/3653> e <https://sidra.ibge.gov.br/tabela/3650>

Graph VI

EVOLUÇÃO DA AGROINDÚSTRIA, ALIMENTOS E BEBIDAS E PRODUTOS NÃO-ALIMENTÍCIOS ENTRE 2017 E 2018 (VARIAÇÃO ACUMULADA EM 12 MESES - %)



Source: IBGE⁷. Prepared by FGV.

THE IMPORTANCE OF TRUCK DRIVER'S STRIKE TO EXPLAIN THE PERFORMANCE OF 2018

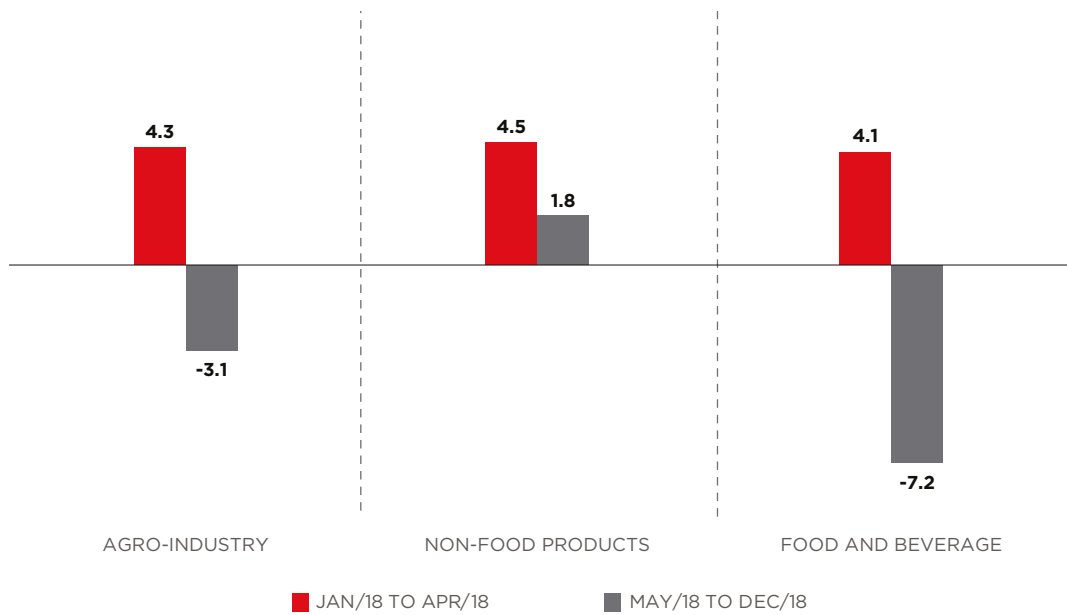
The truck drivers' strike, which began on May 21st in 2018, and was officially ended on May 30 of that year, severely affected the agro-industry, as well as the general industry and the Brazilian economy as a whole. In the case of agro-industrial production, the accumulated growth in the period between January 2018 and April 2018 (i.e. until the month immediately prior to the start of the strike) was 4.3% (Graph VII). However, in the period between May 2018 and December 2018, agro-industrial production accumulated a reduction of 3.1% in comparison with the same period of the previous year. That is, it is clear that the strike of the truck drivers affected the Brazilian agro-industry significantly.

⁷ Available at: <https://sidra.ibge.gov.br/tabela/3650>

This reduction on performance after the strike also occurred in the two segments of the agro-industry, but with greater intensity in food and beverage production than in the non-food segment (Graph VIII). Before the strike, the food and beverage segment accumulated growth of 4.1%, however, in the period after the strike, the production of this group reduced by 7.2%. In the case of non-food products, despite the notable deceleration caused by the standstill, accumulated growth in the post-strike period was not negative (1.8%).

Graph VII

AGGREGATE GROWTH IN THE PRODUCTION PERIOD OF AGRO-INDUSTRY, FOOD AND BEVERAGE AND NON-FOOD PRODUCTS (%)



Source: IBGE⁸. Prepared by FGV.

8 Available at: <https://sidra.ibge.gov.br/tabela/3650>

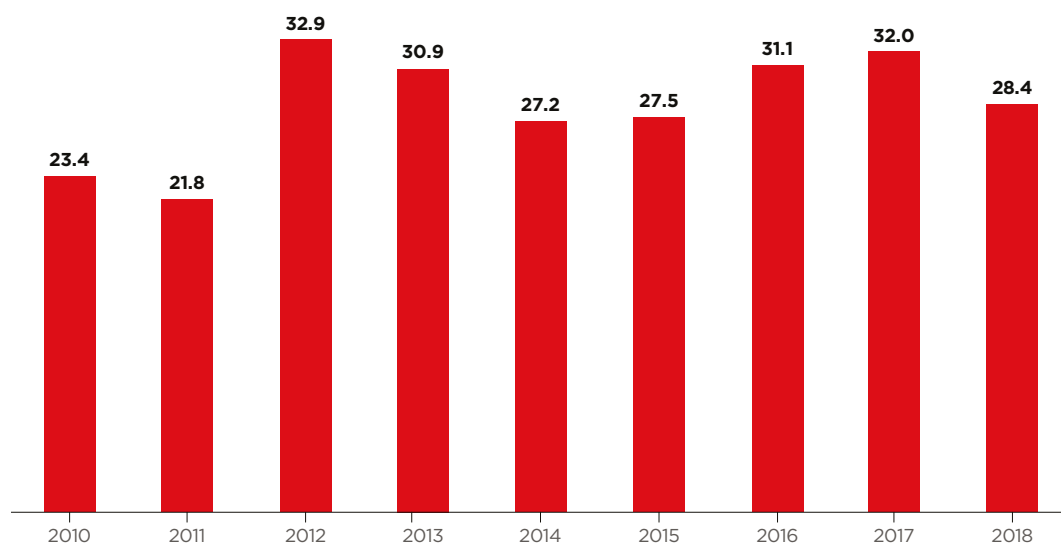
THE CONTRIBUTION OF THE EXTERNAL SECTOR TO THE PERFORMANCE OF AGRO-INDUSTRY

It is almost universally known that Brazil is a major exporter of products associated with agribusiness, accumulating persistent surpluses in the trade balance of the sector. However, in general, the complete numbers of the agro-industry are not counted in these analyzes. Therefore, does the agro-industry also have a surplus trade balance or is this positive balance restricted to agricultural products?

According to the Comex Stat numbers, and organized the same segments and sectors of the Agro-industrial Production Index, the Brazilian agro-industry trade balance has also been persistently surplus (Graph VIII). However, this surplus is not widespread within the agro-industry. While the food and beverage segment has been consistently in surplus, Brazil has recorded continuous deficits in the trade balance of non-food products (Graph IX). For example, in 2018, agro-industry exports surpassed their imports by US\$ 28.4 billion. In a disaggregated way, while the balance of trade in the food and beverage segment was a surplus of US\$ 28.7 billion, that of non-food products was a deficit of US\$ 269.6 million.

Graph VIII

BRAZILIAN AGRO-INDUSTRY TRADE BALANCE (IN US\$ BILLION)

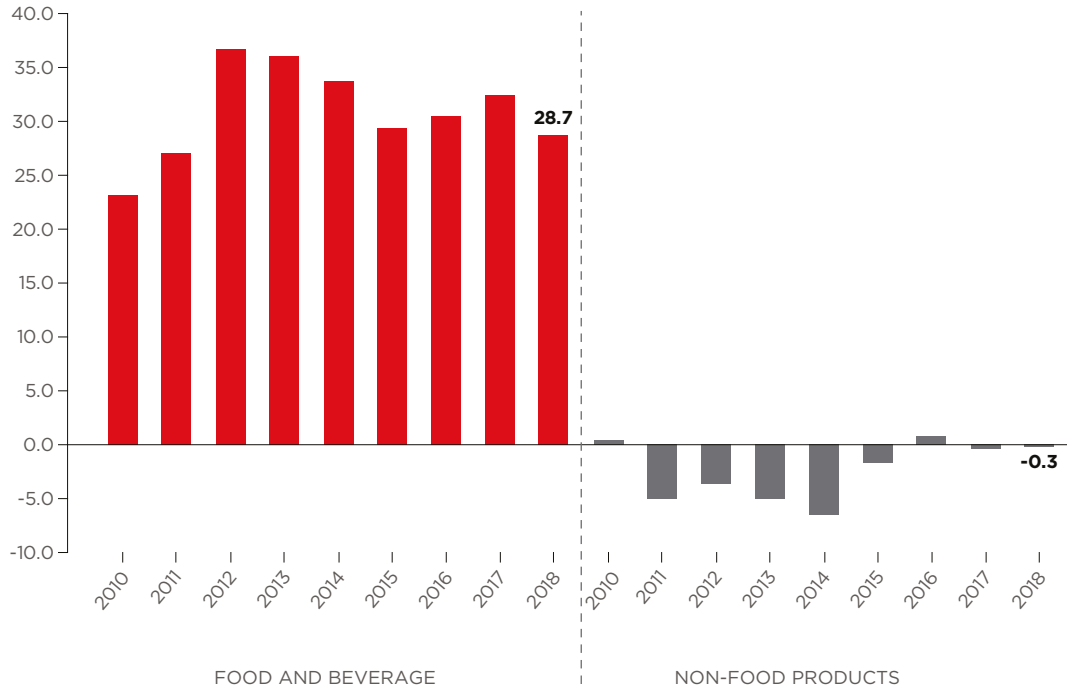


Source: Prepared by FGV based on data from Comex Stat⁹.

9 Available at: <http://comexstat.mdic.gov.br/pt/geral>

Graph IX

TRADE BALANCE OF THE FOOD AND BEVERAGE AND THE INDUSTRY OF NON-FOOD PRODUCTS (US\$ BILLION)



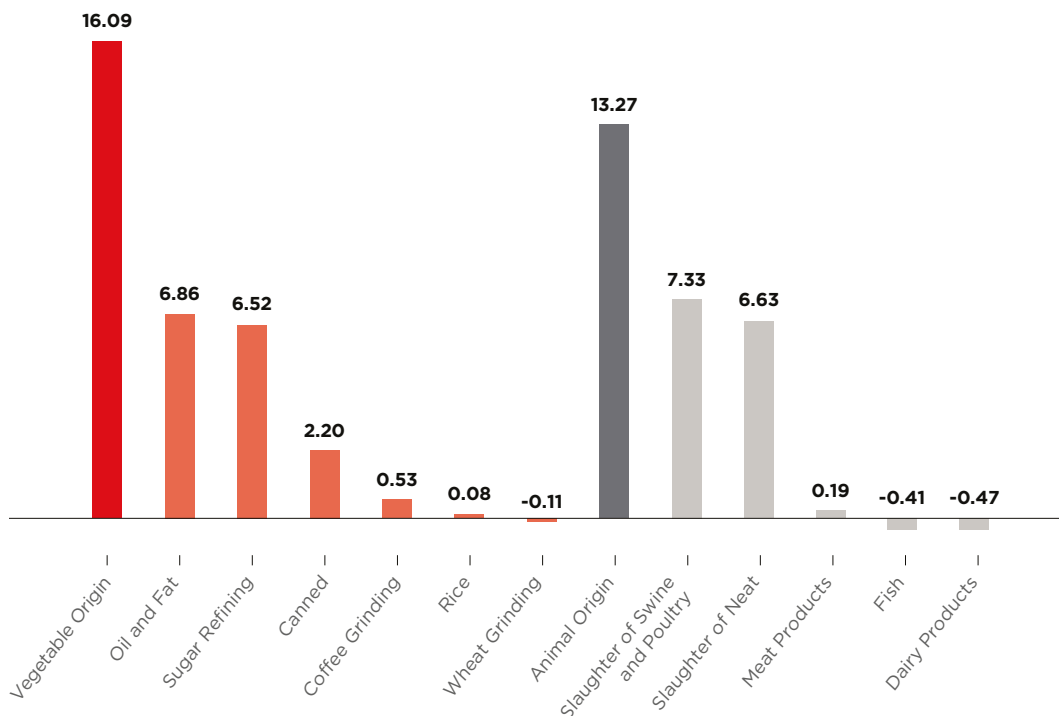
Source: Prepared by FGV based on data from the Comex Stat¹⁰.

Disaggregating the segment of food and beverages, it is observed that who really made positive the commercial balance of the agro-industry was the food sector (balance of US\$ 29.4 billion), since the beverage sector had a deficit of US\$ 676.4 million. By decomposing, the food sector, it is clear that both the food sub-sector of plant origin and that of food of animal origin have surplus balances (of US\$ 16.1 billion and US\$ 13.3 billion, respectively) (Graph X).

¹⁰ Available at: <http://comexstat.mdic.gov.br/pt/geral>

Graph X

TRADE BALANCE OF FOOD OF PLANT ORIGIN AND FOOD OF ANIMAL ORIGIN AND ITS ACTIVITIES (IN US\$ BILLION)



Source: Prepared by FGV based on data from Comex Stat¹¹.

Despite the accumulated surplus in 2018, compared to 2017, this balance was 11.4% lower. This retraction in the balance goes in the same direction of the contraction of the agro-industry production in the same year. That is, possibly part of the contraction of agro-industrial production (-1.0%) in 2018 occurred due to the reduction in exports of products related to the agro-industry, since while imports of these goods increased by 8.6%, exports declined by -2.8% in the year. Finally, the reduction in the production of food and beverage industry (-4.1%) may also be correlated with the reduction in exports (-10.0%) of the products of this group. The expansion of agro-industrial production of Non-Food Products (2.5%) should have been positively impacted by the increase in exports (13.2%) of the products of this group in 2018 (Graph XI).

11 Available at: <http://comexstat.mdic.gov.br/pt/geral>

Graph XI

ANNUAL VARIATION OF EXPORTS AND IMPORTS OF AGRO-INDUSTRY AND THEIR GROUPS IN 2018 (% YOY)



Source: Prepared by FGV based on data from Comex Stat¹².

WHAT ARE THE SCENARIOS FOR AGRO-INDUSTRY THE NEXT THREE YEARS (2019 TO 2021)?

Once an index was built that allows to follow the evolution of the food and beverage industry in Brazil, besides to be possible to compare its performance with that presented by the other segments of the national agro-industry, it was also possible to estimate a group of models to project the sector's trajectory to the next triennium (2019 to 2021) in three distinct scenarios (baseline, optimistic and pessimistic)¹³. From the estimated models, it was clear that the performance of the food and beverage agro-industry responds to the movements of three main variables:

¹² Available at: <http://comexstat.mdic.gov.br/pt/geral>

¹³ Details of the models and their estimation process will not be presented here in the Executive Summary but are described in Chapter 4 of this report.

- **Central Bank Economic Activity Index (IBC-Br):** This index is a contemporary monthly indicator of national economic activity and is used by analysts as a proxy for the behavior of Brazilian GDP. According to the estimated model, at each growth of 1% of GDP, the food and beverage agro-industry absorbs an expansion of, on average, 0.87%. It is important to highlight that this result was already present in Graph i, where it was clear that the food and beverage sector follows the fluctuations of economic activity, but in a less intense way;
- **Confidence Index of the Transformation Industry of the Getulio Vargas Foundation (ICI-FGV):** This index reflects the expectation of the industrial company for both the actual economic conditions and their perception of future conjuncture. On average, a 1% increase in the confidence of industrial business and reflects in an expansion of 0.17%, no volume of production of food and beverage agro-industry;
- **Exchange Rate:** according to the estimated model, there is a positive relation between the variation of the exchange rate and the volume of production of the food and beverage agro-industry. In other words, if the economic activity and the industrial entrepreneur's confidence are kept constant, the more the real is depreciated (the higher the value of the exchange rate), the greater the growth of this segment of the agro-industry. In numbers: at each 1% increase in the value of the exchange rate, the volume produced tends to grow, on average of 0.14%.

Based on these relationships (in reality, elasticities) between the variables described above and the production volume of the food and beverage agro-industry, three scenarios were assumed for the Brazilian economy:

- **Baseline scenario,** it was assumed that there would still be turbulence on the political side in 2019 and that the government would therefore have difficulty approving the necessary reforms and would be able to make more limited versions available. For the two subsequent years (2020 and 2021), it was assumed that, on the one hand, reforms, even if limited, would slightly boost the expansion of the economy, but on the other, the government's political capital will be running out in a reasonably accelerated. With this, the following values were assumed for the variables previously described:

The IBC-Br (proxy for GDP) is growing more rapidly in 2019 (2.28%) and 2020 (2.80%), but loses its breath in 2021 (2.50%). These values are in line with the projections available in the Focus Survey of the Central Bank and this dynamics is explained by the continuity of the slow recovery of the economy started in 2017;

Due to economic recovery and even limited approval of structural reforms, it was assumed that the industrial entrepreneur's confidence (ICI-FGV) should grow 10.0% in 2019 and 7.5% in 2020 and 2021. For these values, the ICI growth rates of 2017 (12.5%, more optimistic) and 2018 (6.6%, less optimistic) were used;

With the moderate recovery of the economy, Central Bank Focus Survey projections suggest that the real should continue its devaluation trajectory, but at a much more moderate pace than that observed in 2018 (14.5%). In light of this, Focus's projections point to an exchange rate growth of 1.37% in 2019, from 1.92% in 2020 and 2.74% in 2021.

- **Optimistic scenario**, it was assumed that the government could approve the reform agenda with relative ease. These results boost the economy more substantially and give President Jair Bolsonaro's team more lasting political capital. For the years 2020 and 2021, the optimistic scenario is associated with the "harvesting" of the fruits of this reform agenda. With this, the following values were assumed for the variables previously described:

The IBC-Br (proxy for GDP) has grown in the three years (2019 to 2021) at a pace similar to that observed in 2013, the last year in which the economy showed a more robust growth rate (above 3.0%). Thus, using the projection ceiling of the Focus Survey of the Central Bank, the IBC-Br is expected to grow by 3.13% in 2019, 3.70% in 2020 and 3.50% in 2021;

Due to the presumption of a somewhat more favorable pace of expansion of the economy and the maintenance of the strength of the government's political capital, the confidence of the industrial entrepreneur (ICI-FGV) increases again at a stronger pace, as observed in 2017 : 15% in 2019 and 10% in the next two years;

With the economy growing more robustly and the industrial entrepreneur's confidence showing significant expansion, the trend is that Brazil will become increasingly attractive to foreign investors and that, therefore, the real will appreciate. Thus, using the Focus Survey projections floor, in this scenario, the exchange rate is expected to shrink from 5.21% in 2019, from 10.41% in 2020 to 9.59% in 2021.

- **Pessimistic scenario**, was assumed that, given the difficulties of forming a majority with the Congress and due to the problems/denunciations involving people close to the president, the reform agenda did not advance and, finally, economic growth lost its breath. This situation would lead to stagnation in the labor market, the credit market and the expectations of the agents for the next three years (2019, 2020 and 2021). With this, the following values were assumed for the variables previously described:

Due to the deterioration of the political capital of the government, the necessary reforms do not evolve in Congress, the recovery of the labor market is compromised, as the credit market is stagnant, reflecting negatively the economic growth of the country. In this scenario, the IBC-Br (proxy for GDP) is expected to grow only 1.20% in 2019, and to maintain a constant growth of 2.0% in 2020 and 2021 - in line with the floor of the Focus Survey Central bank;

Given the dynamics of the slow recovery of the economy and the erosion of the government, the industrial entrepreneur's confidence (ICI-FGV) is expected to deteriorate, with a steady decline of 10.0% between 2019 and 2021;

Lastly, with the economy growing little and the industrial entrepreneur's confidence declining, the tendency is for the real to lose more and more value. In view of this, the exchange rate is expected to grow by 8.22% in 2019, from 19.73% in 2020 and by 25.75% in 2021 - again, in line with the projection ceiling of the Focus Survey of the Central Bank.

Table I presents an overview of the assumptions for each variable and that will be used in the projections detailed in the sequence.

Table I

**SUMMARY OF THE ASSUMPTIONS FOR THE SIMULATION OF THE SCENARIOS PROJECTS
FOR THE FOOD AND BEVERAGE AGRO-INDUSTRY**

PERÍODO	SCENARIOS		
	PESSIMISTIC	BASELINE	OPTIMISTIC
GDP (% YoY)			
2019	1.20	2.28	3.13
2020	2.00	2.80	3.70
2021	2.00	2.50	3.50
Trust of the entrepreneur			
2019	-10.00	10.00	15.00
2020	-10.00	7.50	10.00
2021	-10.00	7.50	10.00
Exchange rate (% YoY) (ref. 2018: R\$ 3.65 / US\$)			
2019	8.22	1.37	-5.21
2020	19.73	1.92	-10.41
2021	25.75	2.74	-9.59
Exchange rate (R\$ / US\$) (end of period)			
2019	3.95	3.70	3.46
2020	4.73	3.77	3.10
2021	5.95	3.88	2.81

Source: Research Focus Central Bank¹⁴, Prepared by FGV.

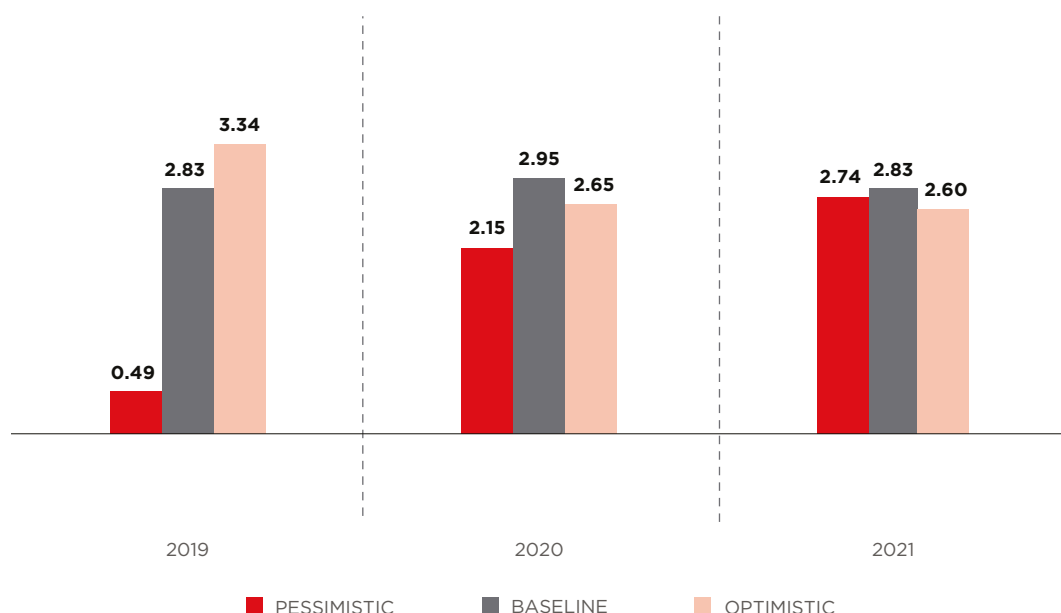
14 Available at: <https://www3.bcb.gov.br/expectativas/publico/consulta/serieestatisticas>

PROJECTIONS FOR AGRO-INDUSTRY OF FOOD AND BEVERAGE FOR THE NEXT THREE YEARS (2019-2021)

Considering the assumed model and the premises adopted, is estimated that, in the baseline scenario, food and beverage production is expected to grow by 2.83% in the baseline scenario in 2019 compared to the previous year. However, in a pessimistic scenario, the food and beverage industry may show a more modest expansion in 2019 (0.49%) and, in an optimistic scenario, the projection is strong (3.34%). For the years 2020 and 2021, it is projected that the food and beverage industry should grow at the same rate as in 2019, with a 2.95% expansion for 2020 and 2.83% YoY for 2021 (Graph XI).

Graph XI

PROJECTED VALUES FOR THE GROWTH OF THE INDUSTRIAL PRODUCTION OF FOOD AND BEVERAGES BETWEEN 2019 AND 2021 (% YOY)



Source: IBGE¹⁵. Prepared by FGV.

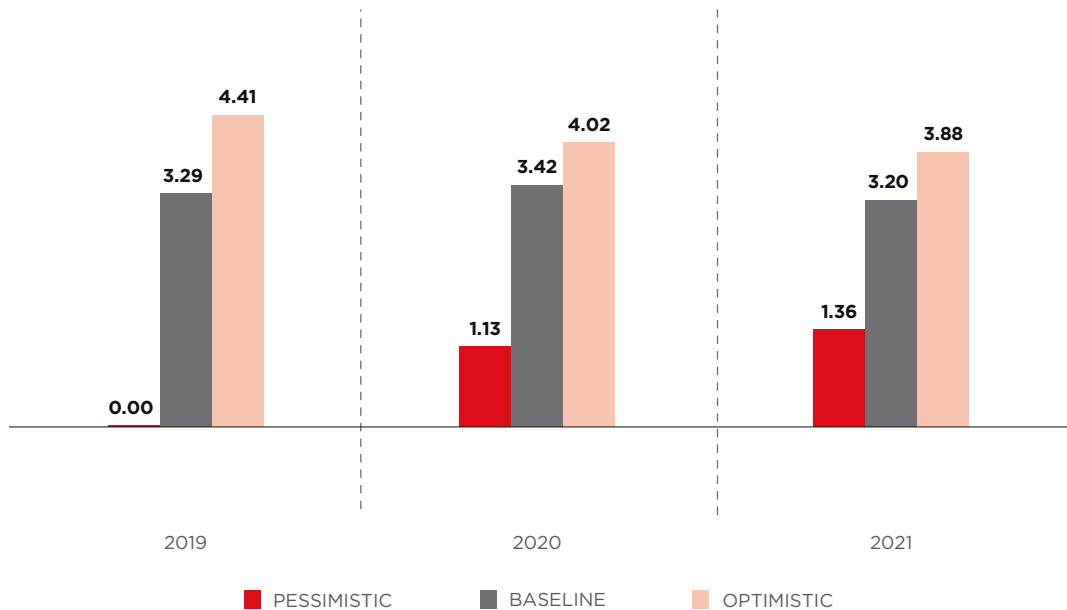
To put these growth rates in perspective, the same variables were used to model the performance of the total agro-industry and the same premises to simulate the same three scenarios (baseline, optimistic and pessimistic). From these numbers, is estimated that, in the baseline scenario, the total agro-industry production, in the baseline scenario, is expected to grow by

¹⁵ Available at: <https://sidra.ibge.gov.br/tabela/3650>

3.29% in the year 2019, when compared to the previous year. However, in a pessimistic scenario, the agro-industry may be stagnant in 2019 and, in an optimistic scenario, the projection is a growth of 4.41% YoY. In 2020 and 2021, it is estimated that agro-industry is expected to grow in the same proportion as in 2019, and in the baseline scenario, an expansion of 3.42% YOY is expected for 2020 and 3.20% YoY for 2021 (Graph XII).

Graph XII

PROJECTED VALUES FOR AGRO-INDUSTRY PRODUCTION GROWTH BETWEEN 2019 AND 2021 (% YOY)



Source: IBGE¹⁶. Prepared by FGV.

Therefore, what is expected for 2019 is that the food and beverage agro-industry continues to expand with less inelastically than the agro-industry as a whole, whatever the scenario considered, as already suggested by the analysis of historical values in the previous paragraphs. That is, the segment of food and beverages should show a trajectory of expansion in the next triennium (2019 to 2021), whose intensity is conditioned to the evolution of the Brazilian economy. In addition, this segment should continue to moderate the expansion of the agro-industry as a whole, either avoiding a more rapid deceleration (pessimistic scenario), or softening an excessively heated expansion (optimistic scenario).

16 Available at: <https://sidra.ibge.gov.br/tabela/3650>

1. THE BRAZILIAN AGRO-INDUSTRIAL PRODUCTION INDEX (IPAgro)

In the classic concept (Davis and Goldberg, 1957) the agribusiness is defined as the sum total of all operations and transactions involved from production operations, in agricultural and livestock units, to the processing, distribution and consumption of agricultural products *in natura* or industrialized.

From this definition, the agribusiness is usually divided in three parts:

- **Upstream** (or “before the farm gate”): represented by industry and commerce that provide inputs for rural production;
- **Agricultural and livestock** (or “inside the farm gate”): represented by rural producers; and
- **Downstream** (or “after the farm gate”): represented by the activities of purchase, transportation, processing and sale of agricultural products to the final consumer.

The agro-industry can be defined, in this study, as a group of activities related to the transformation of raw materials used both by agricultural production (such as inputs), as the transformation of raw materials from agriculture (e.g. production of food and beverages). Therefore, it is clear that agro-industry is a subset of a larger group called agribusiness, being rather a subset of agriculture. The agro-industry, in this study, is composed by the sectors presented in Table 1.1.

Table 1.1
AGRO-INDUSTRY SECTORS

SECTOR	LINK WITH AGRICULTURE
AGRICULTURAL SUPPLIES	Before the farm gate
FOODS	After the farm gate
BEVERAGES	After the farm gate
BIOFUELS	After the farm gate
RUBBER	After the farm gate
TOBACCO	After the farm gate
FORESTRY PRODUCTS	After the farm gate
TEXTILE	After the farm gate

Source: Prepared by FGV

1.1. HOW THE AGRO-INDUSTRIAL PRODUCTION INDEX WAS BUILT?

The Agro-industrial Production Index was constructed based on the Monthly Industrial Survey - Physical Production (PIM-PF) of the Brazilian Institute of Geography and Statistics (IBGE).

According to the IBGE, the PIM-PF¹ has the objective to serve as an approximate measure of the short-term evolution of the value added of the industry, presenting monthly data since January 2012. The scope of the PIM-PF is national; however, the estimation is performed considering information from only 14 units of the federation².

Because it is based on the PIM-PF, the Agro-industrial Production Index, in turn, it intends to be a measure of the short-term evolution of the added value of agro-industry; and has the characteristics that the research elaborated by the IBGE, that is, has monthly frequency, with data from January 2012 and national coverage, considering the same 14 units of the Federation for their estimation. In addition, the sectors that were incorporated into the Agro-industrial Production Index are a subset of the sectors disseminated by IBGE through the PIM-PF.

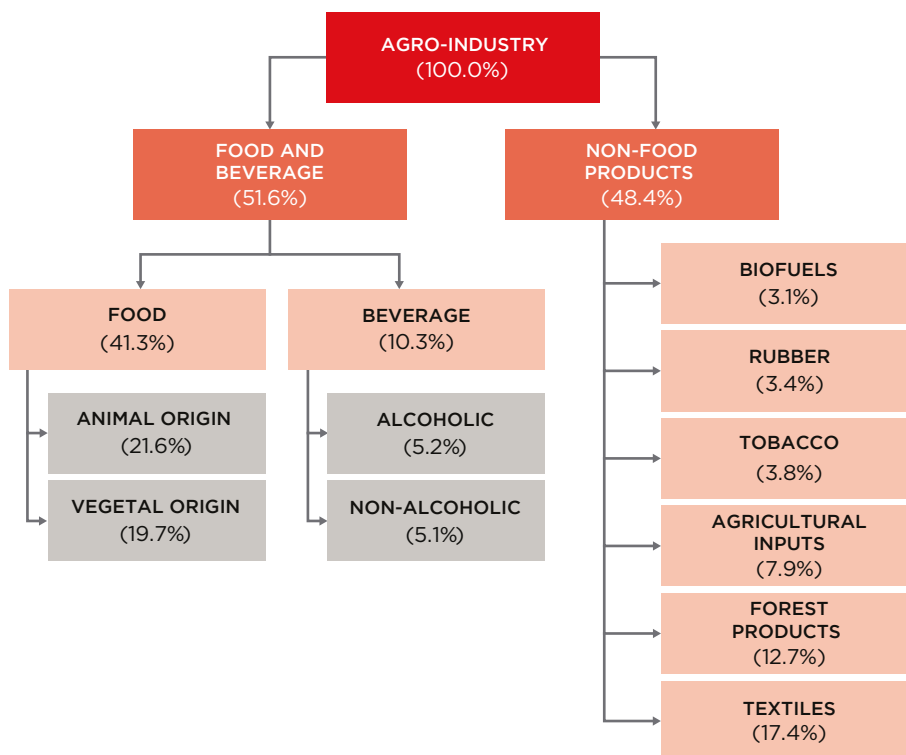
From this, the Agro-industrial Production Index is composed of two groups: (i) Food and Beverages; and (ii) Non-Food Products. The Food and Beverage group, is made up of two sectors (Food and Beverage), and the Food sector is subdivided into two subsectors (Foods of Animal Origin and Foods of Vegetal Origin) and the Beverages sector is subdivided into Alcoholic Beverages and Non-Alcoholic Beverages. The group of Non-Food Products is composed by the following sectors: Biofuels, Rubber, Tobacco, Agricultural Inputs, Forest Products and Textiles.

1 Available at: <https://www.ibge.gov.br/estatisticas-novoportal/economicas/industria/9294-pesquisa-industrial-mensal-producao-fisica-brasil.html?=&t=conceitos-e-metodos>

2 Brazil, is a union of 27 federal units and the 14 federal units with availed data are: Amazonas, Pará, Ceará, Pernambuco, Bahia, Minas Gerais, Espírito Santo, Rio de Janeiro, São Paulo, Paraná, Santa Catarina, Rio Grande do Sul, Mato Grosso and Goiás.

Figure 1.1

STRUCTURE OF THE AGRO-INDUSTRIAL PRODUCTION INDEX



Source: Prepared by FGV.

Each sector and subsector was composed of a group of codes of the National Classification of Economic Activities (CNAEs) published by IBGE through PIM-PF. The composition of each sector and subsector is presented in Attachment 1. The weighting structure used for the creation of the Agro-industrial Production Index followed the weighting structure used by the IBGE for the development of the index of the manufacturing industry. However, the weights used in the processing industry were normalized to the agro-industry. The weights considered are presented in Attachment 2.

Through the weighting structure used to construct the agro-industrial production indices it is clear, therefore, that the agro-industry is not only composed of food, since the Food and Beverage group has a weight of 51.6% in the Agro-industrial Production Index, while the group of Non-Food Products has a weight of 48.4%, as can be seen in Table 1.2.

Table 1.2

AGGREGATE WEIGHT STRUCTURE FOR THE COMPOSITION OF THE AGRO-INDUSTRIAL PRODUCTION INDEX

FOODS AND BEVERAGES	GROUP	51.6%
FOODS	Sector	41.3%
ANIMAL ORIGIN	Sub-sector	21.6%
VEGETABLE ORIGIN	Sub-sector	19.7%
BEVERAGES	Sector	10.3%
ALCOHOLIC	Sub-sector	5.2%
NON-ALCOHOLIC	Sub-sector	5.1%
NON-FOOD PRODUCTS	GROUP	48.4%
BIOFUELS	Sector	3.1%
RUBBER	Sector	3.4%
TOBACCO	Sector	3.8%
AGRICULTURAL SUPPLIES	Sector	7.9%
FORESTRY PRODUCTS	Sector	12.7%
TEXTILE	Sector	17.4%

Source: Prepared by FGV.

Based on the methodology presented for the construction of the Agro-industrial Production Index, it is possible to follow the performance of the Brazilian agro-industry since 2002.

2. WHAT HAPPENED TO THE PRODUCTION OF BRAZILIAN AGRO-INDUSTRY IN 2018?

2.1 AGRO-INDUSTRY AND BRAZILIAN ECONOMY

In 2018, the Brazilian agro-industry sector reduced 1.0% compared to 2017. To understand this performance, it is important to analyze what happened to the Brazilian economy, since the agro-industry is not disconnected from the economy as a whole.

The Brazilian economy was resuming a growth trajectory in 2017, however, in 2018, this recovery slowed, influenced, mainly, by two major events. By one hand, the political wear of the Michel Temer government increased, as the market lost its belief that some more substantial structural reform would be approved; and on the other hand, there was the truck drivers' strike, which was the decisive factor for the slowdown of the Brazilian economy in 2018.

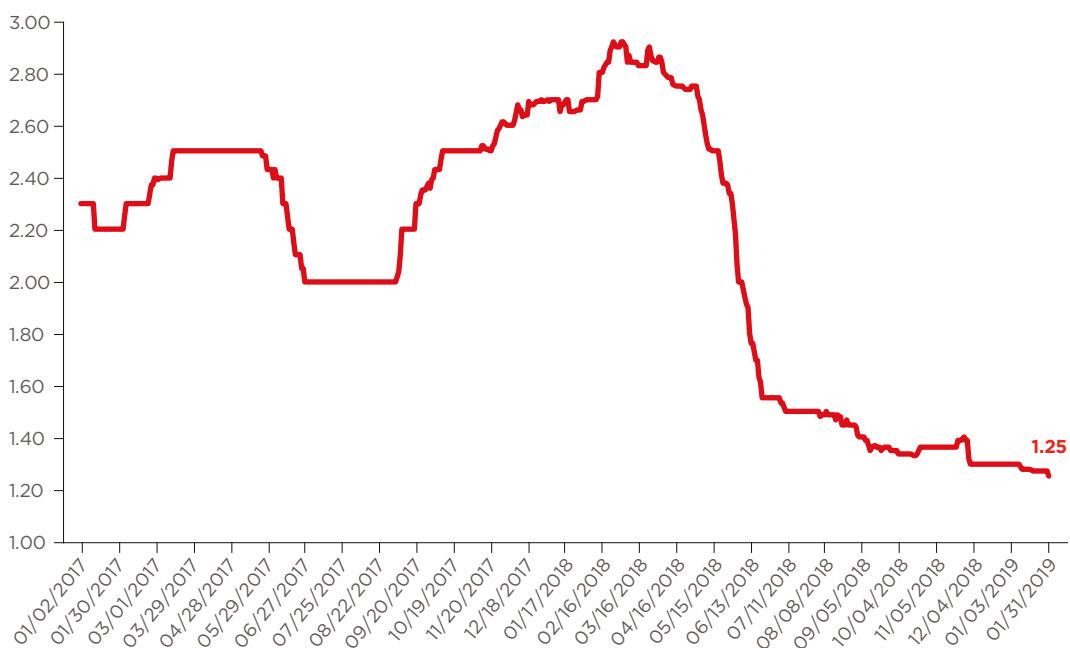
By observing the growth expectations for Brazil's GDP throughout 2018, it is clear how strong the truck drivers' strike impacted the country's economy. It is observed that from the last quarter of 2017 until the first quarter of 2018, the market projected an increasing growth of the Brazilian economy for the year 2018. However, from the middle of March/2018, this optimism began to lose strength and the market began to project a smaller growth than it had been projected and, in May/2018, the month in which the truckers' strike occurred, the growth projections dropped and did not recover again.

To illustrate, on March 7 of 2018, the Focus Bulletin presented a GDP growth projection of 2.9% for the year. On June 21 of 2018, one month after the first day of the truckers' strike, the Brazilian economy's growth projection was only 1.6% YoY. Clearly, the truck drivers' strike caused a structural break in the series of GDP projections for the year 2018 (Graph 2.1).

Finally, the Brazilian GDP ended the year 2018 with an expansion of 1.1%, a figure well below that projected by the market in the moments before to the truck drivers' strike (Graph 2.2).

Graph 2.1

EVOLUTION OF THE FORECAST GDP GROWTH OF 2018 (% YOY)

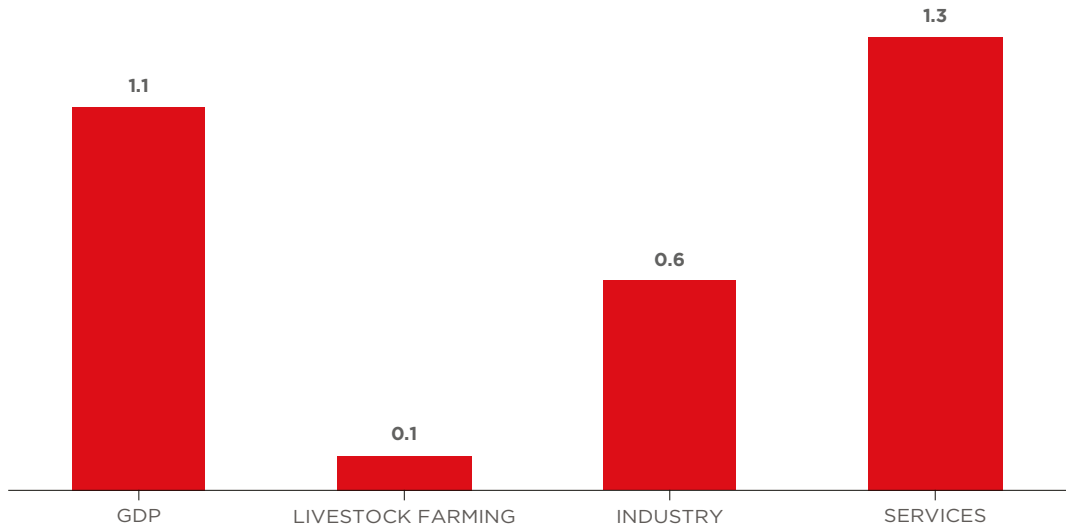


Source: Focus Bulletin¹ from 02/01/2017 until 27/02/2019 – median.

1 Available at: <https://www3.bcb.gov.br/expectativas/publico/consulta/serieestatisticas>

Graph 2.2

GDP GROWTH IN 2018, FROM THE PRODUCTION PERSPECTIVE (% YOY)



Source: IBGE².

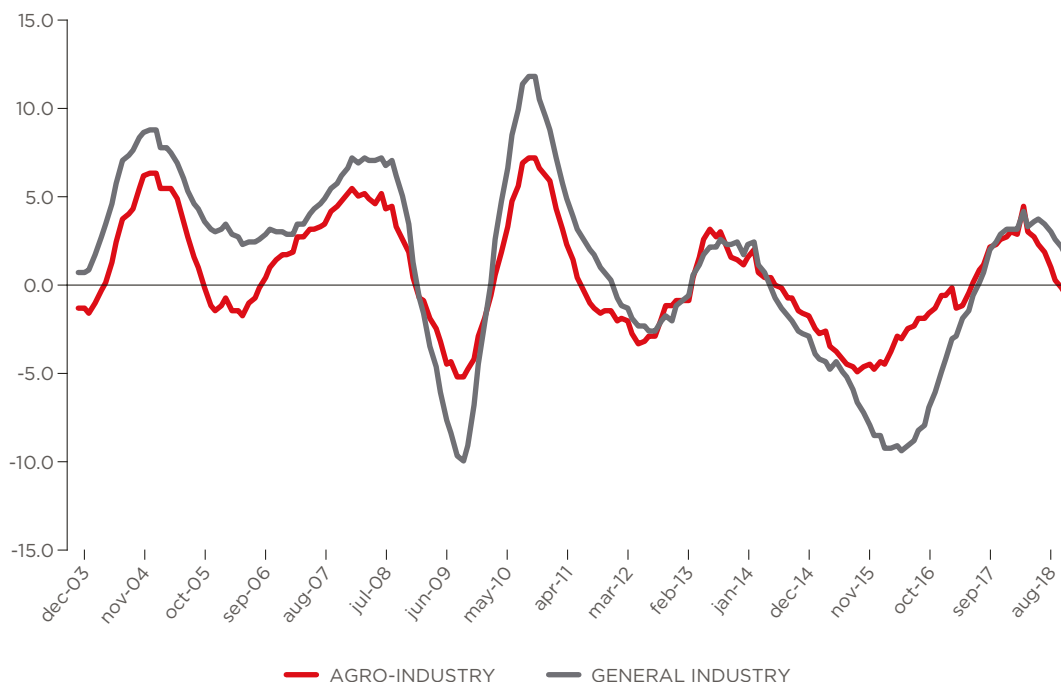
The truck drivers' strike impacted negatively several segments of the Brazilian economy, including industry and agro-industry. In view of this, it is important to note that, although industry and agro-industry are not equal, since agro-industry is a subset of industry, they follow the same standards.

This can be seen in Graph 2.3, which shows how the growth of agro-industry and industry, that generally presented the same pattern of behavior. However, it is noted that the production of agro-industry presents lower volatility than that of the general industry. The hypothesis to explain this lower agro-industry volatility is the greater participation of the food group, which tends to have a more inelastic demand in the Agro-industrial Production Index compared to the general industry.

Although agro-industry and general industry have the same pattern of behavior and be immersed in the same situation, they have particular dynamics and respond to shocks at different intensities. For example, in 2017, both had a tendency to grow, with the strike of the truckers both lost their breath, however, agro-industry decelerated much more intensely than the general industry. On face this, the general industry slowed its growth throughout 2018, but ended the year with growth of 1.1%. In turn, agro-industry decelerated its production expansion and ended the year in a negative field, with a reduction of 1.0%, compared to 2017 (Graph 2.3).

² Available at: <https://sidra.ibge.gov.br/tabela/5932>

Graph 2.3

EVOLUTION OF AGRO-INDUSTRY AND GENERAL INDUSTRY (CUMULATIVE VARIATION IN 12 MONTHS -%)

Source: IBGE³. Prepared by FGV.

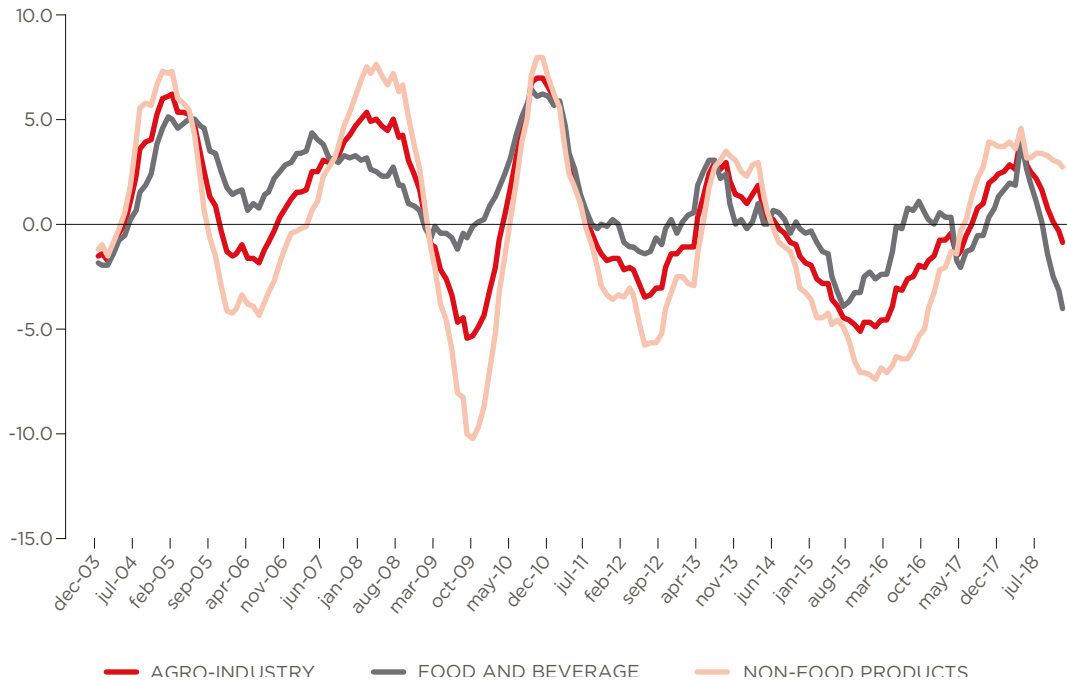
Notably, the agro-industry is not a homogeneous unit, on the face of it, an issue that arises is: who negatively and positively impacted the agro-industry in 2018?

According to the Agro-industrial Production Index, the agro-industry was negatively impacted by the Food and Beverage group, as in 2018 presented a 4.1% decrease in relation to the previous year. In turn, the Non-Food Products group presented a 2.5% expansion in its production (Graph 2.4).

³ Available at: <https://sidra.ibge.gov.br/tabela/3650>

Graph 2.4

**EVOLUTION OF AGRO-INDUSTRY, FOOD AND BEVERAGE AND NON-FOOD PRODUCTS
(ACCUMULATED VARIATION IN 12 MONTHS -%)**



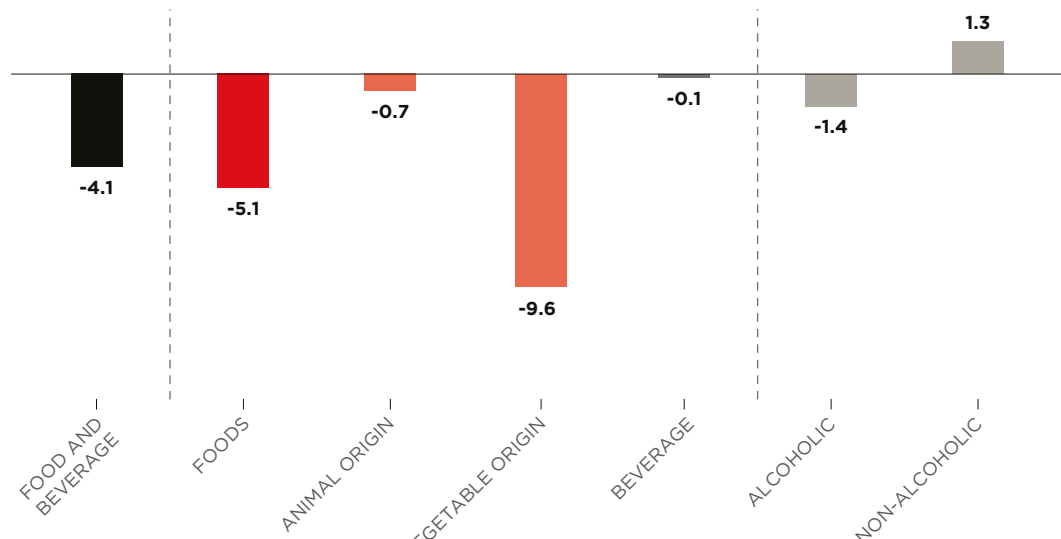
Source: IBGE⁴. Prepared by FGV.

Within the group of Food and Beverage group, the Food sector was the one that negatively impacted the agro-industry sector in 2018, while the Beverage sector presented a stable performance compared to 2017 (-0.1%), (Graph 2.5).

Within the Food sector, the sub-sector of Foods of Vegetal Origin declined significantly (-9.6%), while the sub-sector of Foods of Animal Origin little reduced (-0.7), sustained mainly by the good performance of Meat Products (CNAE 10.13) (9.18%) and slaughter of cattle, except pork (CNAE 10.11) (4.9%).

4 Available at: <https://sidra.ibge.gov.br/tabela/3650>

Graph 2.5

EVOLUTION OF THE FOOD AND BEVERAGE GROUP AND ITS SECTORS AND THE SUB-SECTORS (CUMULATIVE VARIATION IN THE YEAR -%)

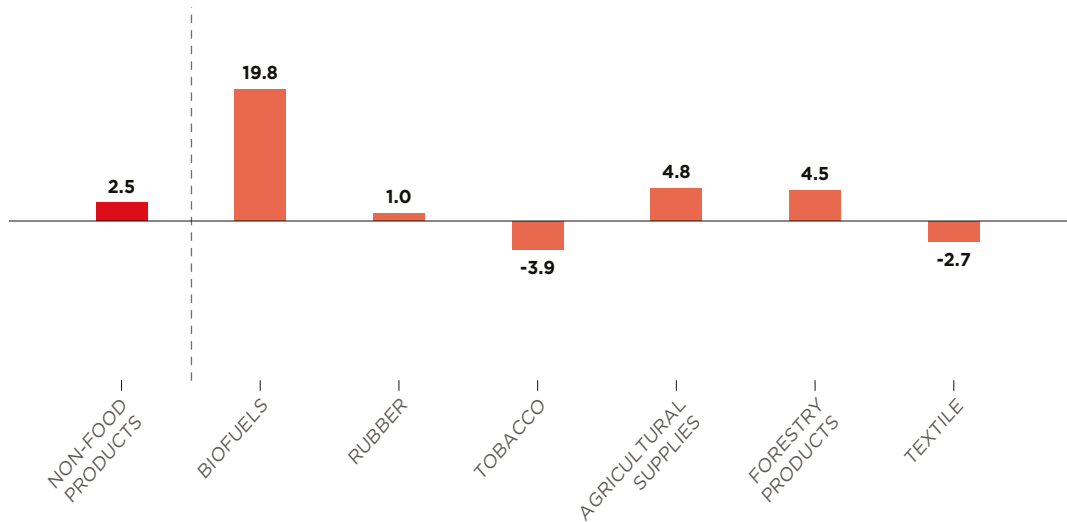
Source: Prepared by FGV.

Regarding the Non-Food Products group, only the sectors of Tobacco (-3.9%) and Textile (-2.7%) showed a decline in production in 2018, while the other sectors contributed positively to the performance of the agro-industry (Graph 2.6).

Therefore, it is clear that the result of agro-industrial production in 2018 was not worse because of the good performance of Non-Food Products and bovine protein (within the sub-sector of Foods of Animal Origin).

Graph 2.6

**EVOLUTION OF THE NON-FOOD PRODUCTS GROUP AND THEIR SECTORS
(ACCUMULATED VARIATION IN THE YEAR - %)**



Source: Prepared by FGV.

2.2. THE TRUCK DRIVERS' STRIKE

The truck drivers' strike, which began on May 21 of 2018 and was officially ended on May 30 of the same year, severely affected the agro-industry, as well as the general industry and the Brazilian economy as a whole.

In the case of agro-industrial production, the accumulated growth in the period between January/2018 and April/2018 (month immediately before the month of the strike) was 4.3%. However, in the period between May/2018 and December/2018, agro-industrial production accumulated a reduction of 3.1% in comparing with the same period of the previous year. That is, it is clear that the strike of the truck drivers affected the Brazilian agro-industry significantly (Graph 2.7).

This reduction in post-strike performance also occurred in the agro-industry groups, however, it occurred with greater intensity in the Food and Beverage group than in the Non-Food Products group.

Before the strike, the Food and Beverage group accumulated a growth of 4.1%. In the post-strike period, the production of this group reduced 7.2%. In the case of Non-Food Products, despite the notable impact of the strike, the accumulated growth in the post-strike period was not negative (1.8%) (Graph 2.7).

Graph 2.7

CRESCIMENTO ACUMULADO NO PERÍODO DA PRODUÇÃO DA AGROINDÚSTRIA, DE ALIMENTOS E BEBIDAS E PRODUTOS NÃO-ALIMENTÍCIOS (%)



Source: IBGE⁵. Prepared by FGV.

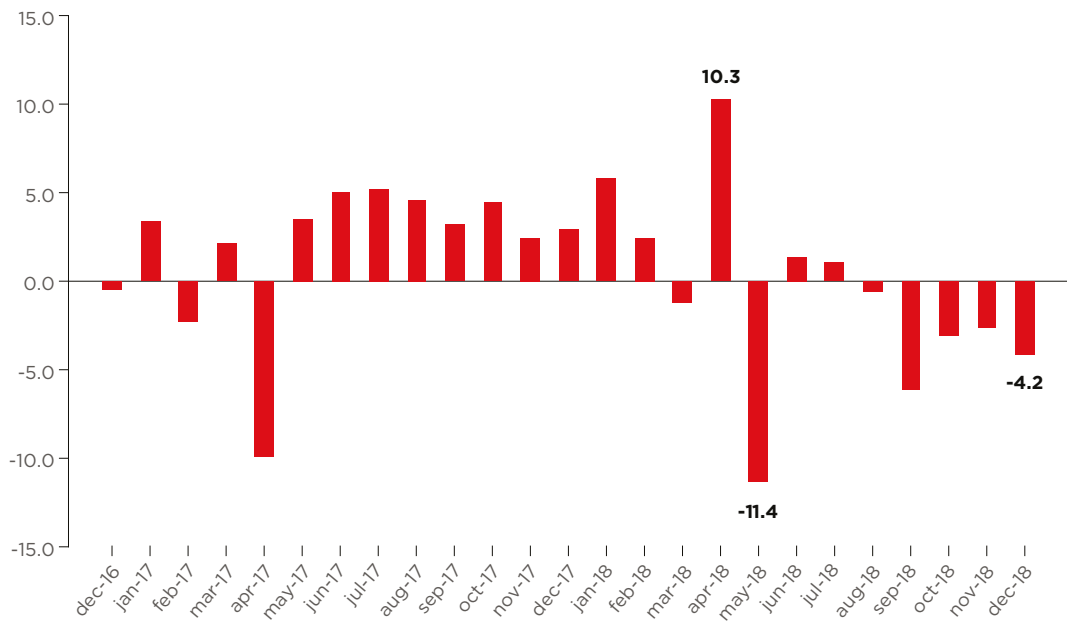
Another way for observing the impact of the truckers' strike on the production of the agro-industry and its sectors and sub-sectors, is to analyze the inter-annual variation (that is, comparing a month with the same month of the previous year), avoiding possible distortions of seasonality.

5 Available at: <https://sidra.ibge.gov.br/tabela/3650>

In April/2018, the month before the strike, agro-industrial production grew 10.3% in relation to the same month of the previous year, while in May/2018, the month of the strike, agro-industry showed a significant reduction of 11.4% for the same basis of comparison. The retraction presented in May/2018 is already impressive in itself, however, it also points attention to the fact that the strike of the truck drivers caused not only a punctual impact in May/2018, but a prolonged shock for the rest of 2018, a agro-industry started to show growth rates far below what it had been presenting and, subsequently, it showed successive retractions (Graph 2.8).

Graph 2.8

INTER-ANNUAL GROWTH (T-12) OF AGRO-INDUSTRY PRODUCTION (%)

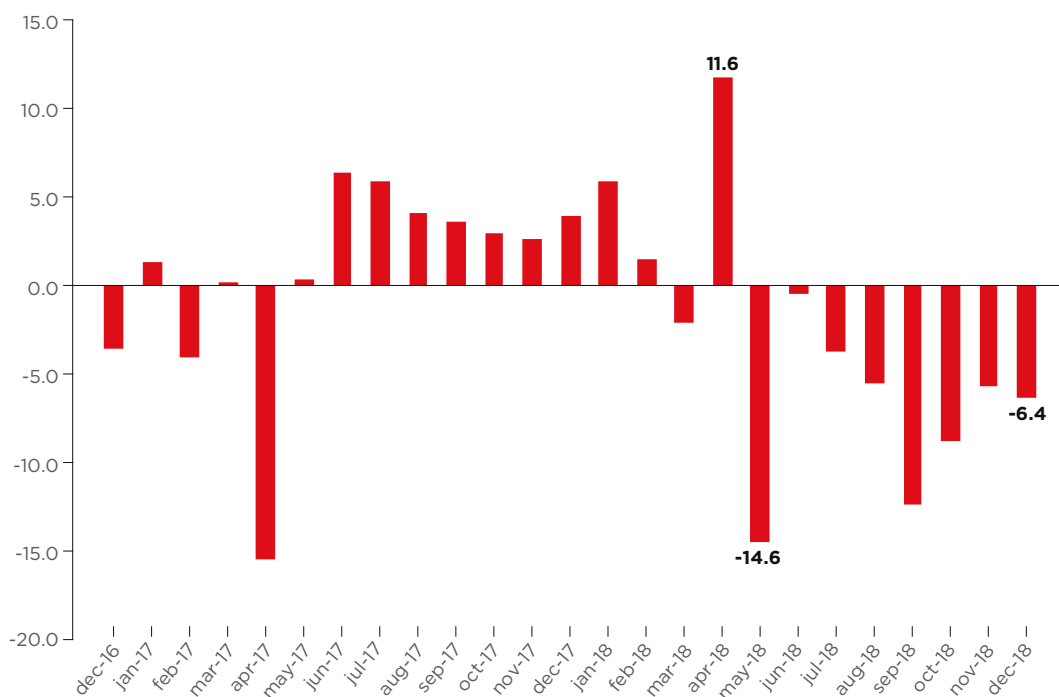


Source: Prepared by FGV.

The pattern of behavior observed in agro-industrial production, in the inter-annual comparison, can also be visualized in the Food and Beverage group. That is, in April/2018, the Food and Beverage group showed an increase of 11.6% in comparison with the same month of 2017. In May/2018, in turn, the production of this group reduced by 14.6 %. Finally, from May/2018 to December/18, the Food and Beverage group remained in the negative field, not being able to recover from the shock caused by the truckers' strike (Graph 2.9).

Graph 2.9

INTER-ANNUAL GROWTH (T-12) OF FOOD AND BEVERAGE PRODUCTION (%)



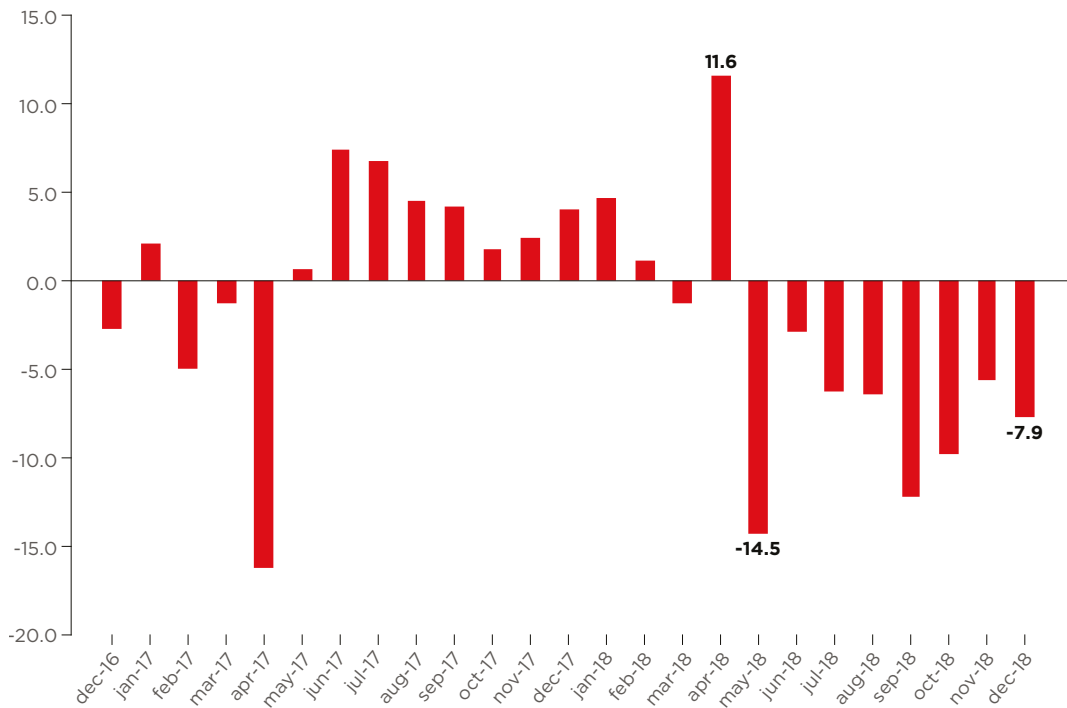
Source: Prepared by FGV.

By analyzing the Food and Beverage group in its sectors (Food vs. Beverage), it is verified that the impact of the truckers strike was more intense in the Food sector than in the Beverage sector. In April/2018, the Food sector grew 11.6% in relation to the same month of the previous year, however, in the month of the strike (May/2018), the sector's production reduced 14.5%, and since then the sector has suffered production decrease in all subsequent months of 2018 (Graph 2.10).

Regarding the Beverage sector, it clearly also that felt the effects of the truck drivers' strike, however, the sector had recovered in its production in the following two months, but has since retracted since then (Graph 2.11).

Graph 2.10

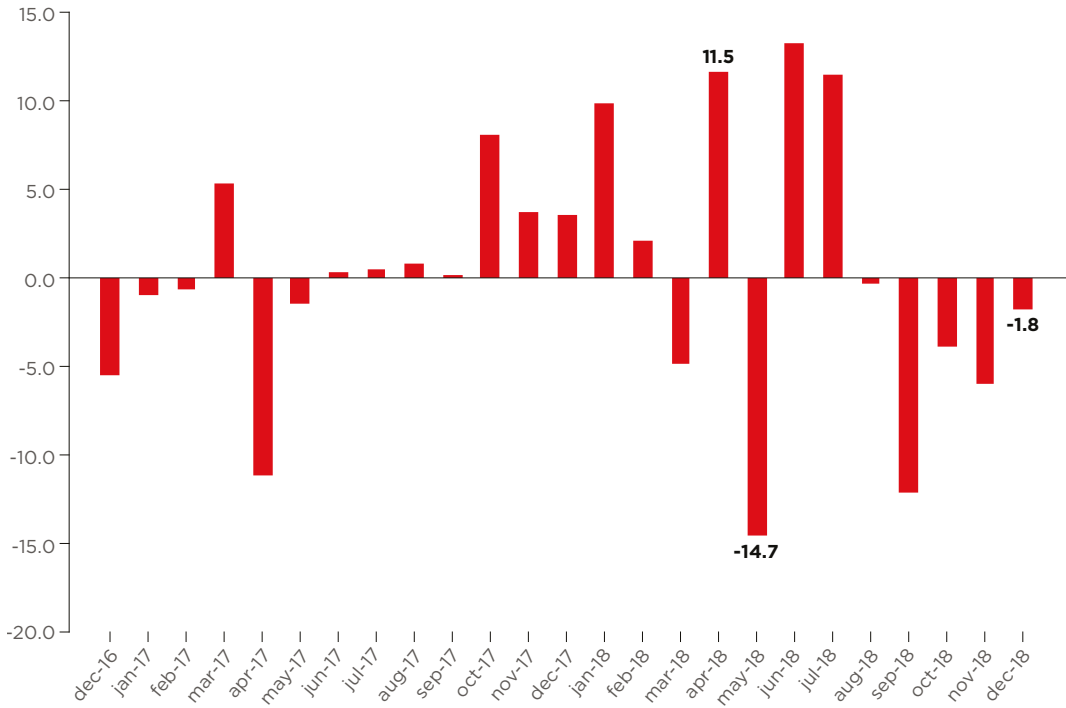
INTER-ANNUAL GROWTH (T-12) OF FOOD PRODUCTION (%)



Source: Prepared by FGV.

Graph 2.11

INTER-ANNUAL GROWTH (T-12) OF BEVERAGE PRODUCTION (%)

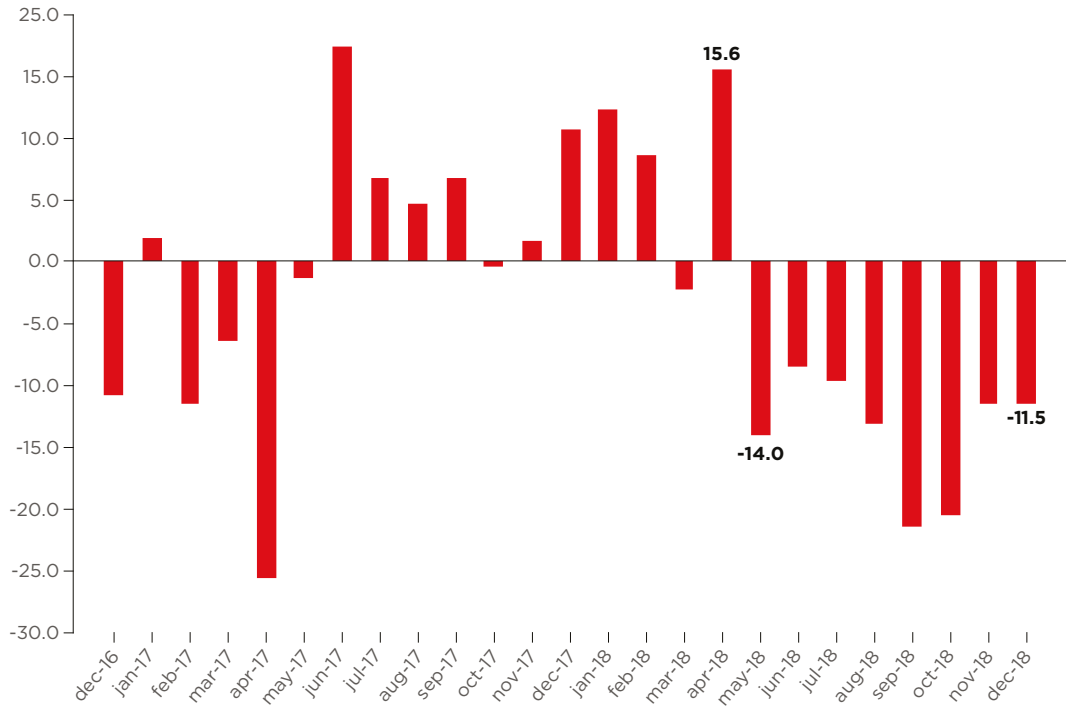


Source: Prepared by FGV.

When analyzing in more detail the Food sector, it is observed that the sub-sector most impacted by the truckers' strike was the Food of Vegetal Origin. In April/2018, in inter-annual comparison, the production of Food of Plant Origin showed an expansion of 15.6%. However, in May/2018, the sub-sector reduced 14.0% and remained in the negative for the rest of 2018 (Graph 2.12).

Graph 2.12

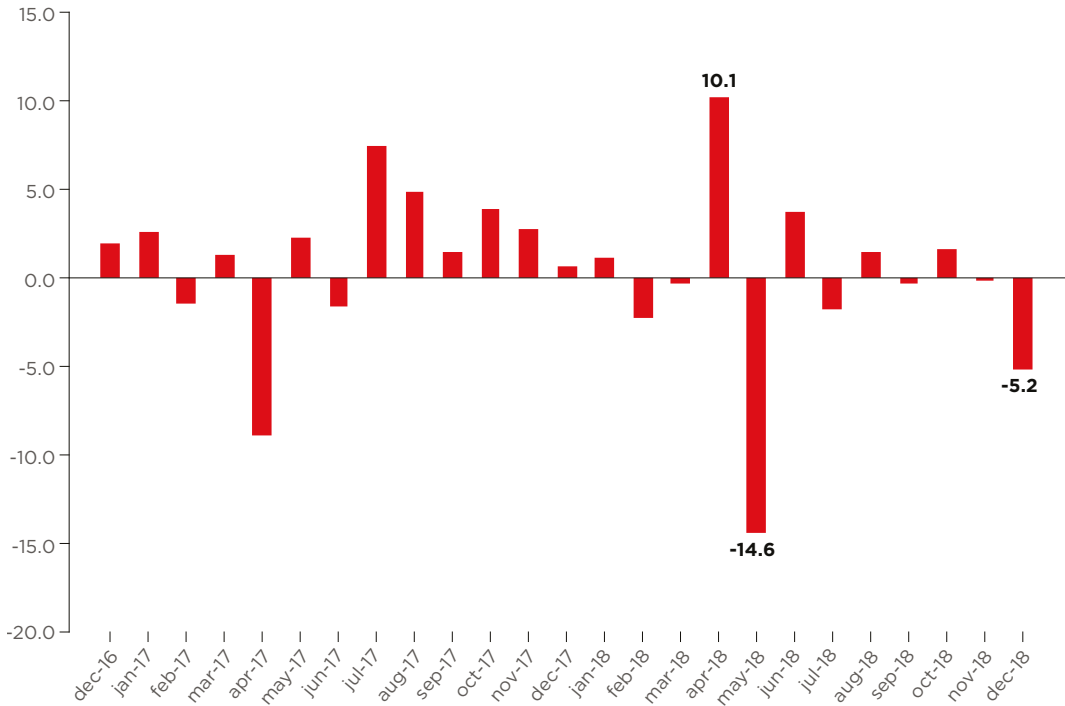
INTER-ANNUAL GROWTH (T-12) IN THE PRODUCTION OF FOOD OF PLANT ORIGIN (%)



Source: Prepared by FGV.

Regarding to the sub-sector of Food of Animal Origin, there is an impact of lesser intensity of the truck drivers' strike in their production, since after the retraction occurred in May/2018, the production of this sub-sector still tried some growth, albeit modest, in the remaining months of 2018 (Graph 2.13).

Graph 2.13

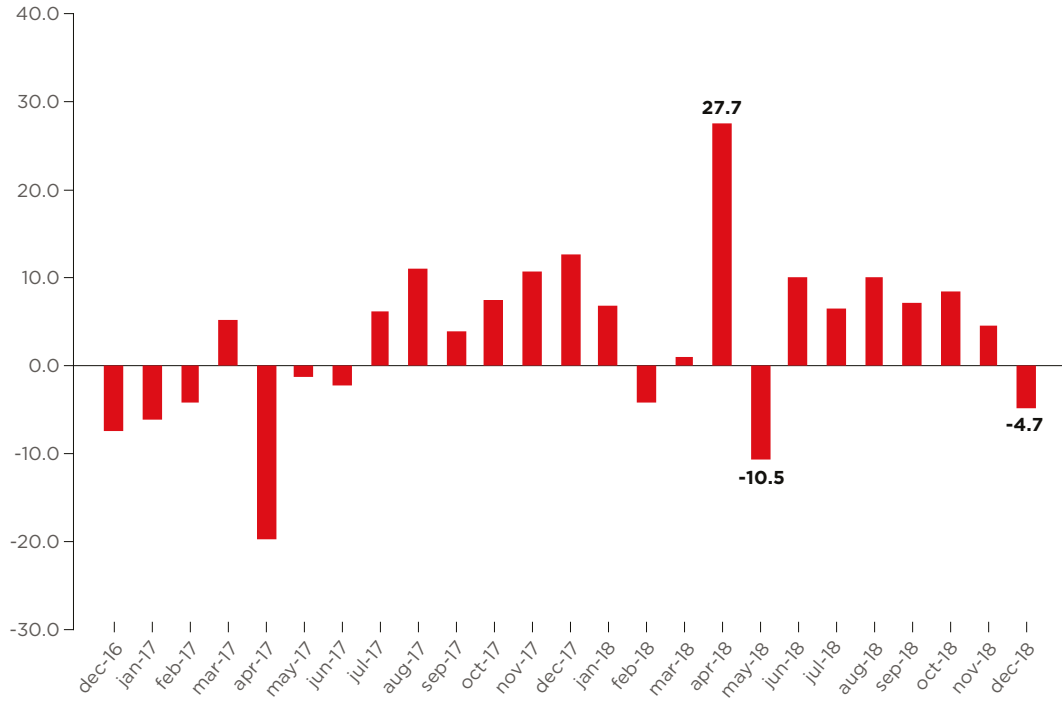
INTER-ANNUAL GROWTH (T-12) IN THE PRODUCTION OF FOOD OF ANIMAL ORIGIN (%)

Source: Prepared by FGV.

It is important to emphasize that the industrial production of Animal Food was not only more intensely affected by the strike due to the performance of the segments associated with bovine protein, since the segments of slaughter of cattle, except pork (CNAE 10.11) and Manufacture of Meat Products (CNAE 10.13) were able to recover after the shock caused by the truckers' strike. In contrast, the segment associated with the slaughter of pigs and poultry (CNAE 10.12) was strongly impacted by the strike, with successive and significant reductions in the rest of 2018 (Graphs 2.14, 2.15 and 2.16).

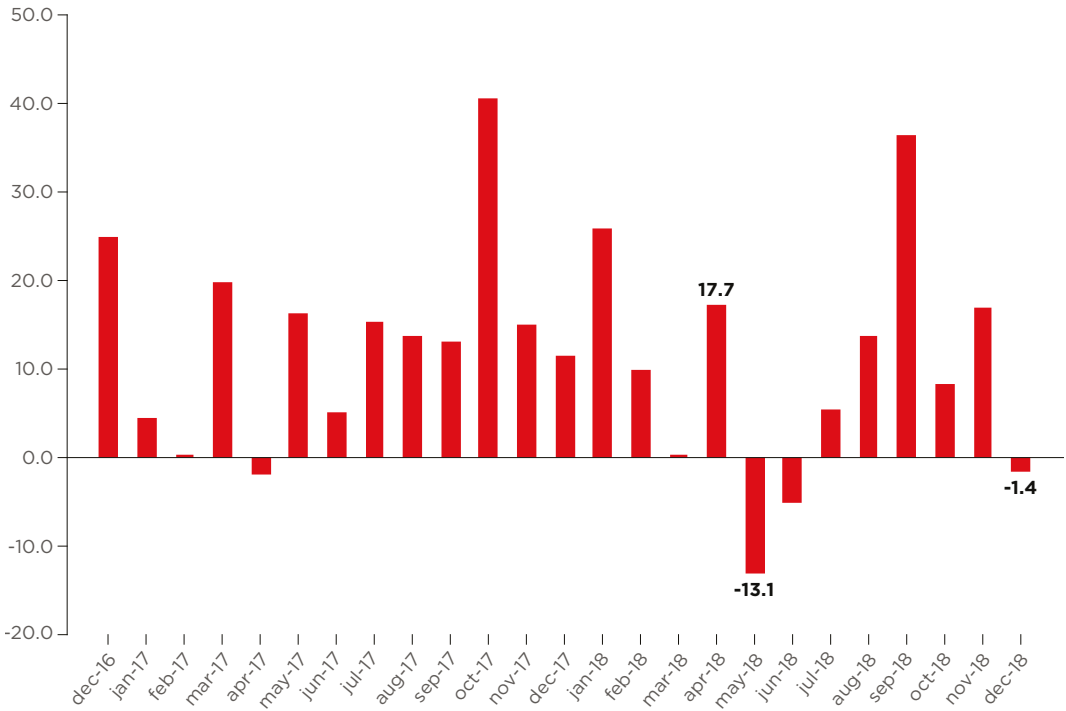
Graph 2.14

**INTER-ANNUAL GROWTH (T-12) IN THE PRODUCTION SLAUGHTER OF CATTLE,
EXCEPT PORK (%)**



Source: Prepared by FGV.

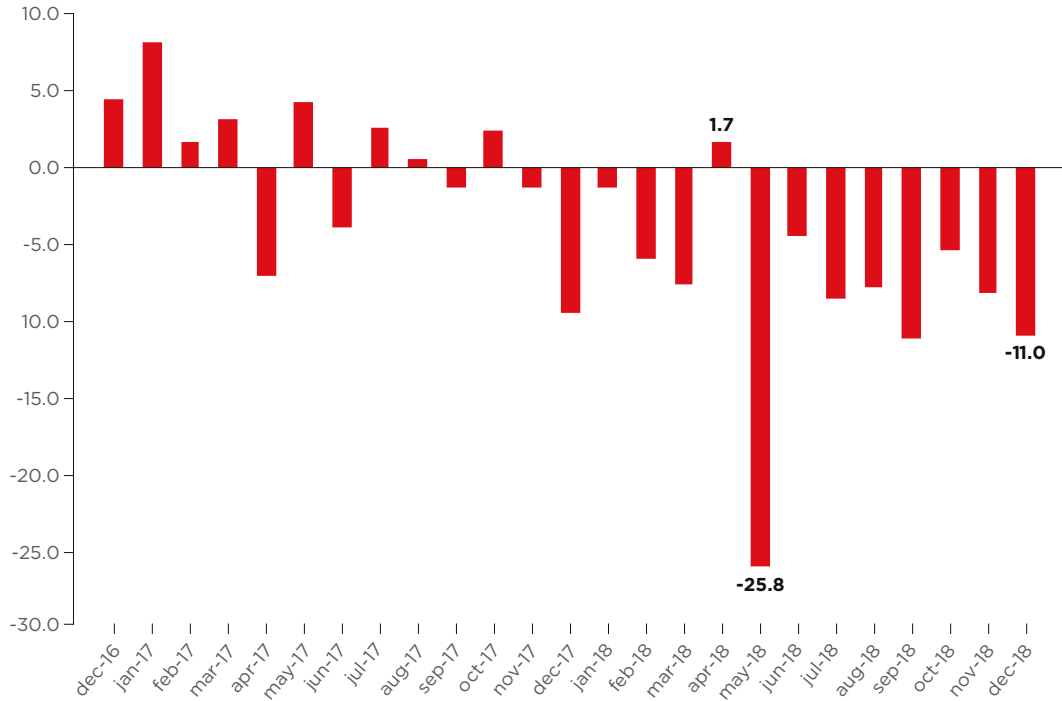
Graph 2.15
INTER-ANNUAL GROWTH (T-12) IN THE PRODUCTION OF MEAT PRODUCTS (%)



Source: Prepared by FGV.

Graph 2.16

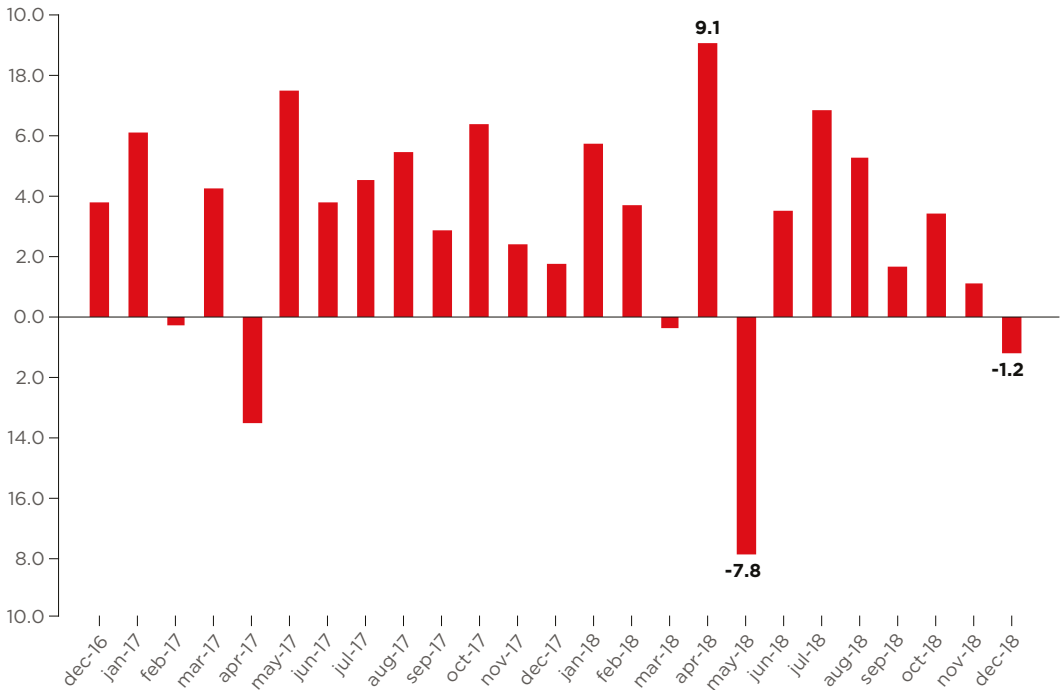
INTER-ANNUAL GROWTH (T-12) IN THE PRODUCTION OF PORK, POULTRY AND OTHER SMALL ANIMALS (%)



Source: Prepared by FGV.

Unlike the Food and Beverage group, the group of Non-Food Products was impacted by the truck drivers' strike in a less stronger way, since after a strong impact in the month of the strike (-7.8% in May/2018), the industrial production of this group increased again, in general (Graph 2.17).

Graph 2.17
INTER-ANNUAL GROWTH (T-12) IN NON-FOOD PRODUCTION PRODUCTS (%)



Source: Prepared by FGV.

Thus, in relation to the truck drivers' strike, it is clear that it had a significant impact on agro-industrial production in 2018. However, since the agro-industry is not a homogeneous unit, its sectors and sub-sectors were impacted in different ways by the strike.

Therefore, it is observed that the Food and Beverage group was impacted more intensely than the Non-Food Products group. Finally, within the Food and Beverage group, it can be seen that the segments that contributed the most to the result were not even worse were Foods of Animal Origin, especially those segments associated with the bovine protein.



3. THE INFLUENCE OF THE EXTERNAL SECTOR IN THE PERFORMANCE OF AGRO-INDUSTRY

3.1. HOW THE DATA WERE GENERATED?

In order to analyze the international trade of the agro-industry, data from the Ministry of Industry, Foreign Trade and Services (MDIC) available on the Comex Stat¹ portal was used. In order to select the products that are part of the export and import tariff of the Brazilian agro-industry, was made compatible² the CNAEs codes of the products used for the construction of the Agro-industrial Production Index with the Mercosur Common Nomenclature codes (NCM), which are used to generate foreign trade data through the Comex Stat.

3.2. THE BRAZILIAN TRADE COMMERCIAL OF AGRO-INDUSTRIAL HAVE SURPLUS OR DEFICIT?

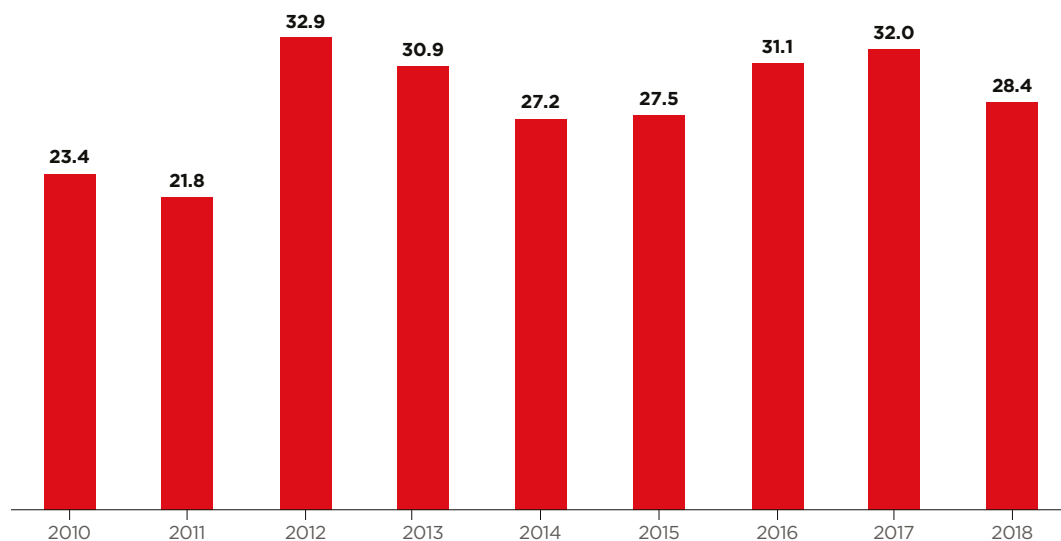
It is common sense that Brazil is a major exporter of products belonging to the Brazilian agribusiness, being a surplus in relation to its trade balance. However, in general, the complete numbers of the agro-industry are not considered in these analyzes. Therefore, it is important to know if the agro-industry has a deficit or surplus trade balance to carry out a more complete analysis of agribusiness numbers.

According to Comex Stat numbers in the period analyzed, the Brazilian agro-industry trade balance is, at least since 2010, systematically surplus. In 2018, agro-industry exports surpassed their imports by US\$ 28.4 billion, despite the decrease observed in relation to 2017 (of 11.4%) (Graph 3.1).

1 Available at: <http://comexstat.mdic.gov.br/pt/home>

2 For the make compatible the data, was used the table of correspondence between CNAE 2.0 and NCM made available by IBGE in the page of the National Commission of Classification, in the following address: <https://concla.ibge.gov.br/classificacoes/correspondencias/atividades-economicas.html>

Graph 3.1

BRAZILIAN AGRO-INDUSTRY TRADE BALANCE (IN US\$ BILLION)

Source: Prepared by FGV based on data from Comex Stat³.

3.3. WHO MOST CONTRIBUTED TO THIS BALANCE?

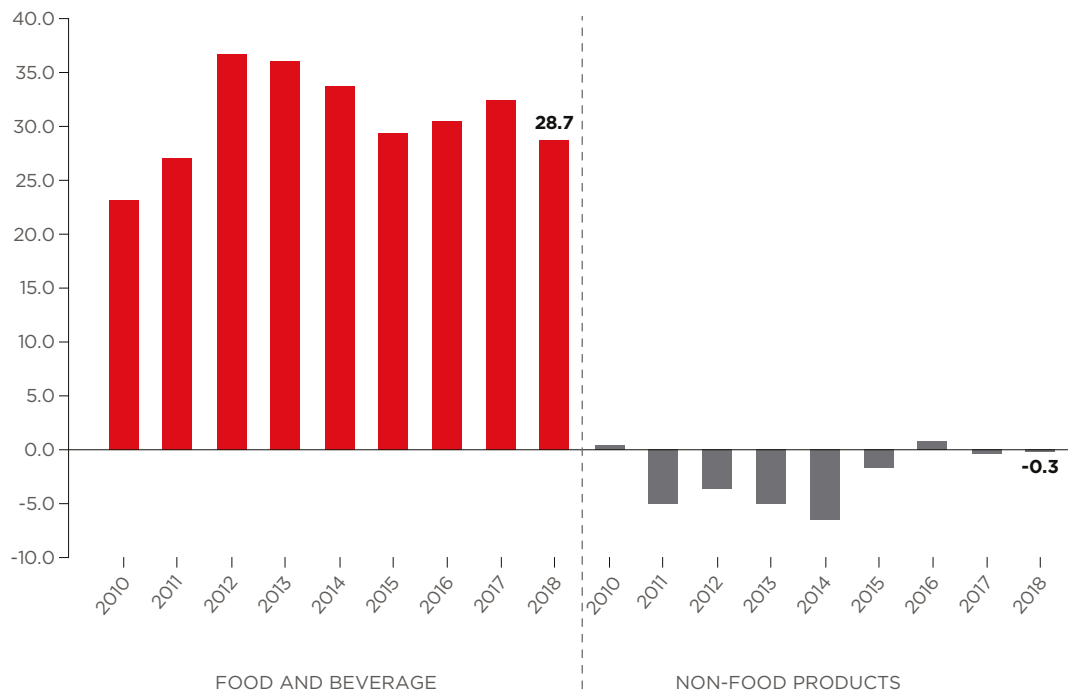
The agro-industry trade balance is a surplus, positively impacted only by the Food and Beverage industry, since the Non-Food industry is systematically in deficit. In 2018, while the balance of trade in Food and Beverages had a surplus of US\$ 28.7 billion, Non-Food products had a deficit of US\$ 269.6 million (Graph 3.2).

³ Available at: <http://comexstat.mdic.gov.br/pt/geral>

In other words, Brazil is a surplus not only in the production of raw material for food (agricultural and livestock), but also in minimally processed foods. In addition, it has such a substantial surplus that it can compensate for the deficit of the Non-Food Products industry, causing the agro-industry a whole to have a significant trade balance.

Graph 3.2

TRADE BALANCE OF THE FOOD AND BEVERAGE AND THE INDUSTRY OF NON-FOOD PRODUCTS (US\$ BILLION)



Source: Prepared by FGV based on data from the Comex Stat⁴.

Within the Food and Beverage group, the sector that leaves the positive trade balance is Food (US\$ 29.4 billion), since the Beverage sector is in deficit (-US\$ 676.4 million).

4 Available at: <http://comexstat.mdic.gov.br/pt/geral>

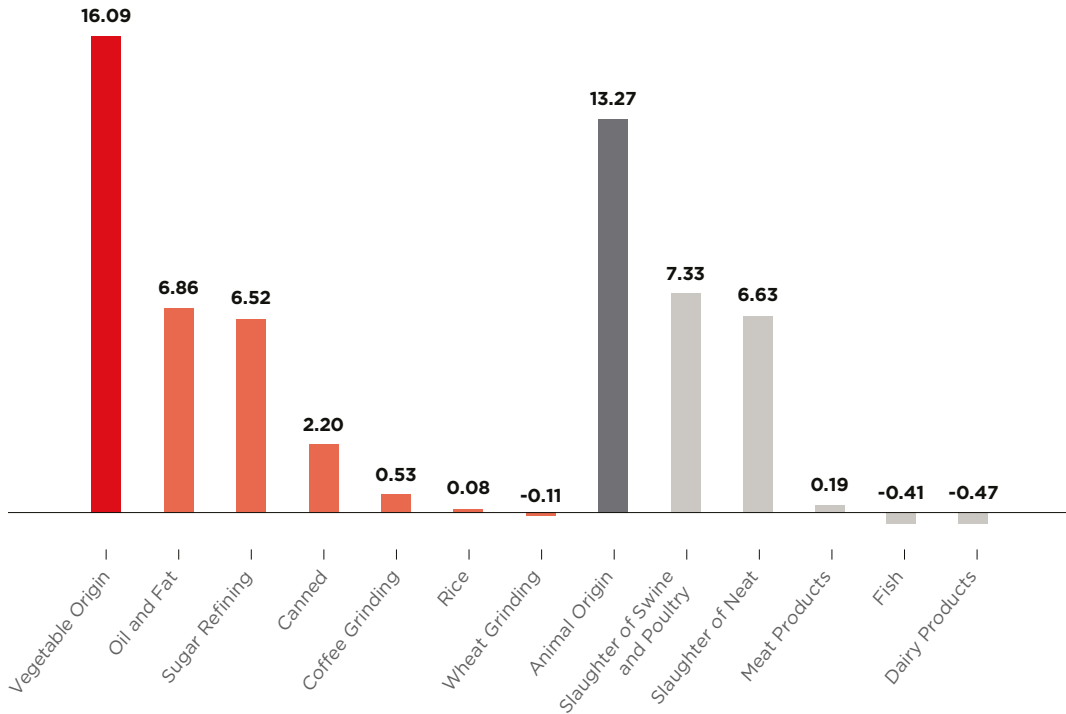
With focus on the Food sector, both the sub-sector of Vegetal Food (US\$ 16.1 billion) and that of Foods of Animal Origin (US\$ 13.3 billion) have a surplus trade balance, with the two sub-sectors being well representative in the commercial balance of Food, representing, respectively, 54.8% and 45.2% of the sector balance (Graph 3.3).

In agro-industry Food of Plant Origin, the only activity that has a deficit trade balance (-US\$ 105.2 million) is Wheat Milling and Derivative Manufacturing (CNAE 10.62). In contrast, the activities of Manufacture of Oils and Fats (CNAE 10.4) and Manufacture and Refining of Sugar (CNAE 10.7) are the activities that most positively impacted the trade balance of Foods of Vegetal Origin, with respectively US\$ 6.86 billion and US\$ 6.52 billion in trade balance (Graph 3.3).

Regarding Food of Animal Origin, only two activities have a deficit trade balance: Dairy products (CNAE 10.5) and Preservation of Fish, Manufacture of Fish Products and Other Food Products (CNAEs 10.2 and 10.9). However, the activities that most positively impacted the commercial balance of the Animal Foodstuffs agro-industry were Slaughter of Swine, Poultry and Other Small Animals (CNAE 10.12) and Slaughter of cattle, except Pigs (CNAE 10.11), with commercial balances of respectively, US\$ 7.33 billion and US\$ 6.63 billion.

Graph 3.3

TRADE BALANCE OF FOOD OF PLANT ORIGIN AND FOOD OF ANIMAL ORIGIN AND ITS ACTIVITIES (IN US\$ BILLION)



Source: Prepared by FGV based on data from Comex Stat⁵.

3.4. HOW DOES THE EXTERNAL SECTOR INTERACTED WITH THE PERFORMANCE OF AGRO-INDUSTRIAL PRODUCTION IN 2018?

Although the agro-industry trade balance is persistently surplus as seen previously, it showed a decrease in its balance in 2018, compared to 2017, of 11.4%. This retraction in the balance goes in the same direction of the contraction of the agro-industry production in the same year.

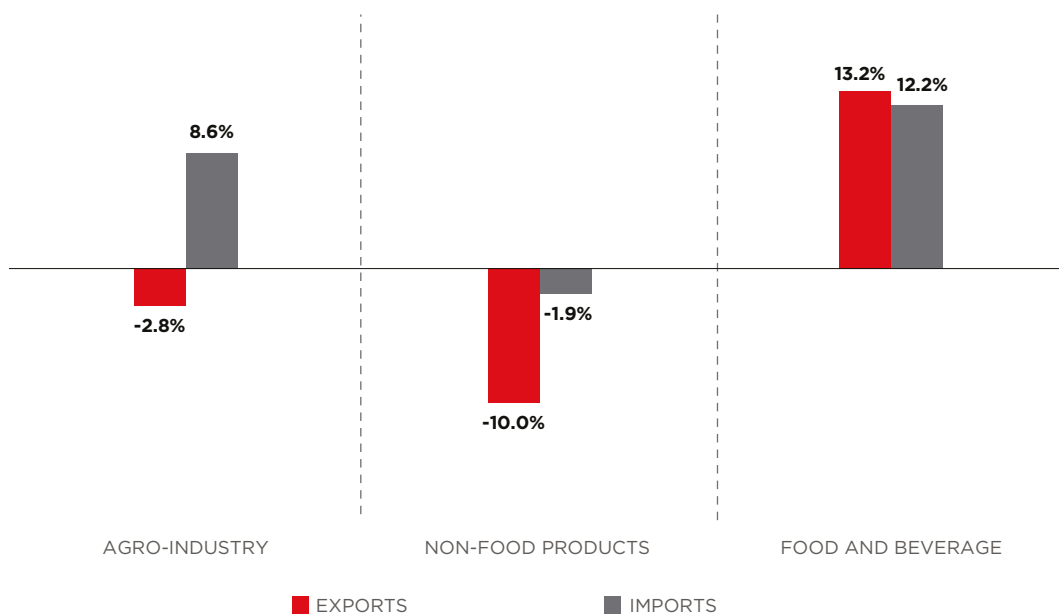
⁵ Available at: <http://comexstat.mdic.gov.br/pt/geral>

So that is probably part of the contraction of agro-industrial production (-1.0%) in 2018, occurred due to the reduction in exports of agro-industrial products, since while imports of these goods increased by 8.6%, the exports declined by -2.8% in the year (Graph 3.4).

Finally, the reduction in the production of the Food and Beverage industry (-4.1%) may also be correlated with the reduction in exports (-10.0%) of the products of this group. The expansion of agro-industrial production of Non-Food Products (2.5%) should have been positively impacted by the increase in exports (13.2%) of the products of this group in 2018 (Graph 3.4).

Graph 3.4

ANNUAL VARIATION OF EXPORTS AND IMPORTS OF AGRO-INDUSTRY AND OF THEIR GROUPS IN 2018 (% YOY)



Source: Prepared by FGV based on data from Comex Stat⁶.

6 Available at: <http://comexstat.mdic.gov.br/pt/geral>



4. PROJECTIONS FOR AGRO-INDUSTRY FOR THE NEXT THREE YEARS (2019 TO 2021)

To realize the growth projections of the production of agro-industry it was used the econometric method of Ordinary Least Squares (OLS), which aims to find the best adjustment for a set of data, seeking to minimize the sum of the squares of the differences between the estimated value and the observed data.

Three models of supply were built to carry out the projections, one for Agro-industry, another for Food and Beverage and another for Non-Food Products. The following variables were used for the models:

- **Central Bank Economic Activity Index (IBC-Br):** which is a contemporary monthly indicator of national economic activity, and can be considered a proxy of the behavior of the Brazilian GDP. This variable was chosen because it is expected that the increase in GDP will lead to the expansion of agro-industrial production.
- **Confidence Index of the Transformation Industry of the Getulio Vargas Foundation (ICI-FGV):** it is the synthesis¹ indicator of the Transformation Industry Survey, in which values above 100 indicate the satisfaction of the industrial sector with the business, while values below indicate a situation of dissatisfaction. It hopes that the increase of the confidence of the industrial entrepreneurs, will cause bigger investments in the sector, therefore, to increase the production.
- **Exchange Rate:** taxa de câmbio comercial (compra) divulgada pelo Banco Central, em R\$/US\$. Espera-se uma relação positiva entre o aumento da taxa de câmbio e a produção industrial, uma vez que a desvalorização do real inibe as importações e incentiva a produção industrial nacional.
- **Qualitative variable (*dummy*) for the truckers' strike:** binary variable (which assumes the value of 0 or 1) to indicate the presence and absence of the truckers' strike. Therefore, for months prior to May/2018, the variable assumes zero value, and for the months between May/2018 and December/2018 the variable assumes unit value. It is expected that the truck drivers' strike had a negative impact on the production of agro-industry and its groups (Food and Beverage and Non-Food Products).

¹ Composed of six items: Total demand level (internal and external), Inventory level, Current Business Situation and Production expectations (three months), Employment (three months) and Business Situation (six months).

Finally, it is worth to mention that the variables were transformed into natural logarithm (ln) so that the result of the model brings the elasticity between the explanatory variable and the dependent variable.

4.1. ASSUMPTIONS FOR THE SCENARIOS

In order to carry out projections for the production of agro-industry and its groups (Food and Beverage and Non-Food Products), three scenarios were constructed based on assumptions: baseline, pessimistic and optimistic.

- For the **baseline scenario**, it was assumed that in 2019 there are still turbulence on the political side and therefore the government has difficulty approving the necessary reforms and is able to enable more limited versions of these proposals. For the two subsequent years (2020 and 2021), it was assumed that, on the one hand, reforms, even if limited, would slightly boost the expansion of the economy, but on the other, the government's political capital will be running out in a reasonably accelerated manner ;
- For the **pessimistic scenario**, it was assumed that, given the difficulties of forming a majority with the Congress and the problems/denunciations involving people close to the president, the reform agenda did not advance and, finally, economic growth lost its breath. This situation would lead to stagnation in the labor market, the credit market and the expectations of agents for the next three years (2019, 2020 and 2021);
- For the **optimistic scenario**, it was assumed that the government could approve the reform agenda with relative ease. These results boost the economy more substantially and give President Jair Bolsonaro's team more lasting political capital. For the years 2020 and 2021, the optimistic scenario is associated with the "harvesting" of the fruits of this reform agenda.

The premises adopted in each scenario will be presented in more detail next. However, before proceeding, it is important to note that the assumed IBC-Br and exchange rate projections were based on the estimates made by the market published by the Focus Bulletin² of the Central Bank. For the pessimistic scenario, the minimum value was considered, for the base scenario the median was considered and, for the optimistic scenario, the maximum value of the Focus Bulletin projections was considered. The projections for the ICI-FGV, in turn, were performed by the authors of this study, since no market estimates for this variable were found.

- **BASELINE SCENARIO:** Based on the premises that make up the base scenario, the variations of the agro-industrial production as a whole were projected, from the food and beverage agro-industry and from the non-food products industry. Behind these projections is the perspective that:

The IBC-Br (proxy for GDP) is growing more rapidly in 2019 (2.28%) and 2020 (2.80%), but lost its breath in 2021 (2.50%). This dynamic is explained by the continuity of the slow recovery of the economy started in 2017;

Due to the economic recovery and the approval, even if limited, of the structural reforms, the industrial entrepreneur's confidence (ICI-FGV) is expected to grow by 10.0% in 2019 and 7.5% in 2020 and 2021, the growth of 2017 (12.52%) and 2018 (6.64%);

With the economy and the industrial entrepreneur's confidence expanding, the tendency is for the exchange rate to exhibit moderate growth rates, much lower than that observed in 2018 (14.5%). Given this, the exchange rate is expected to grow by 1.37% in 2019, from 1.92% in 2020 and 2.74% in 2021.

- **PESSIMISTIC SCENARIO:** Based on the premises that make up the pessimistic scenario (paralysis of the agenda of reforms and attrition of the political capital of the team of President Jair Bolsonaro), there is the perspective that:

Due to the political capital wear, the necessary reforms must not evolve in Congress, the recovery of the labor market is compromised, and the credit market is stagnant, reflecting negatively on the country's economic growth. Thus, in this scenario, the IBC-Br (GDP proxy) is expected to grow only 1.20% in 2019, and to maintain a constant growth of 2.0% in 2020 and 2021;

Given the dynamics of a slow recovery of the economy and the wear of the government, the industrial entrepreneur's confidence (ICI-FGV) is expected to remain on a downward trajectory, showing a steady decline of 10.0% between 2019 and 2021;

With the economy growing little and the industrial entrepreneur's confidence declining, the tendency is for the exchange rate to show increasing growth rates. Given this, the exchange rate is expected to grow by 8.22% in 2019, from 19.73% in 2020 and 25.75% in 2021.

■ **OPTIMISTIC SCENARIO:** Behind these projections in the optimistic scenario, there is the perspective that:

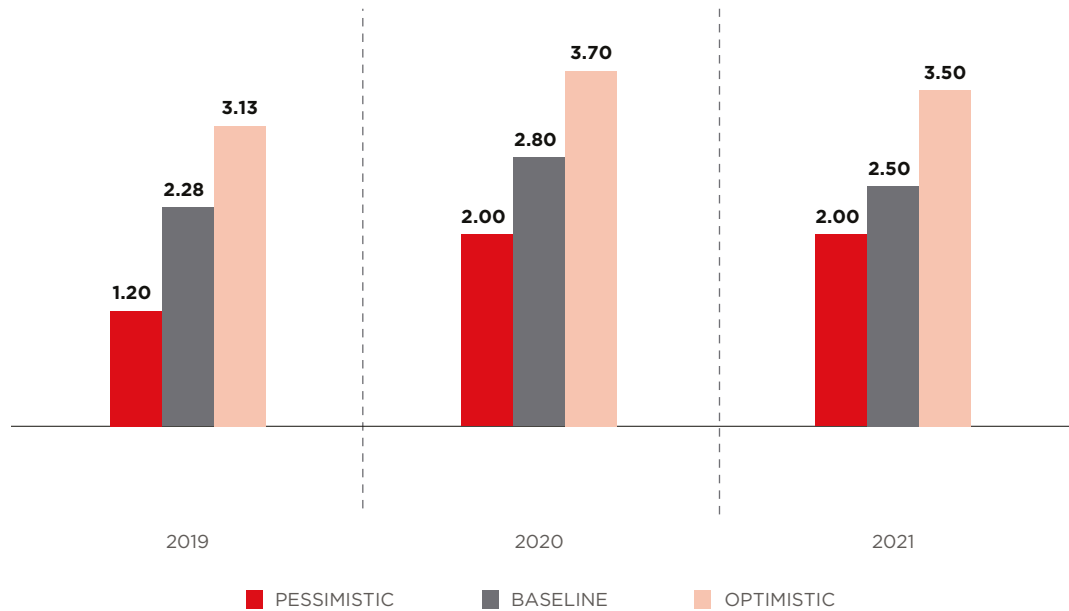
The IBC-Br (proxy for GDP) will grow in the three years (2019 to 2021) in a similar speed to that observed in 2013, the last year in which the economy showed a more significant growth rate (3.0%). As a result, IBC-Br is expected to grow by 3.13% in 2019, 3.70% in 2020 and 3.50% in 2021;

due to the presumption of a somewhat more favorable pace of expansion of the economy and the maintenance of the strength of the government's political capital, the confidence of the industrial entrepreneur (ICI-FGV) again increases at a stronger rate: 15.0% in 2019 and 10.0% over the next two years;

with the economy growing more robustly and the industrial entrepreneur's confidence showing significant expansion, the tendency is that the exchange rate will retreat in the coming years. Given this, the exchange rate is expected to reduce from 5.21% in 2019, from 10.41% in 2020 and 9.59% in 2021.

Graph 4.1

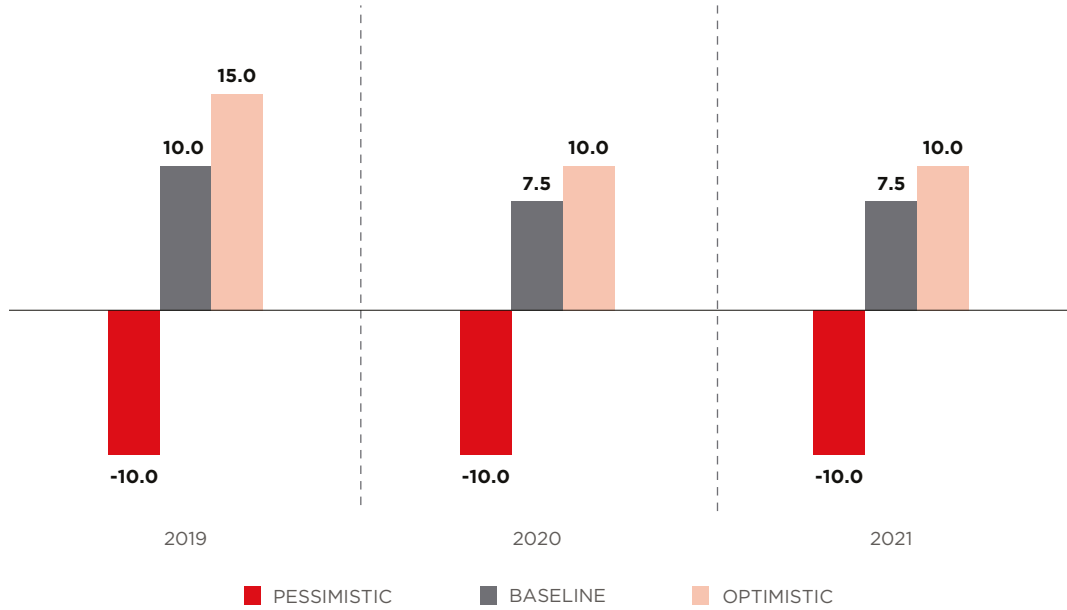
SCENARIOS FOR THE IBC-BR (% YOY) FOR THE TRIENNIUM 2019-2021



Source: Focus Bulletin of March 08, 2019.

Graph 4.2

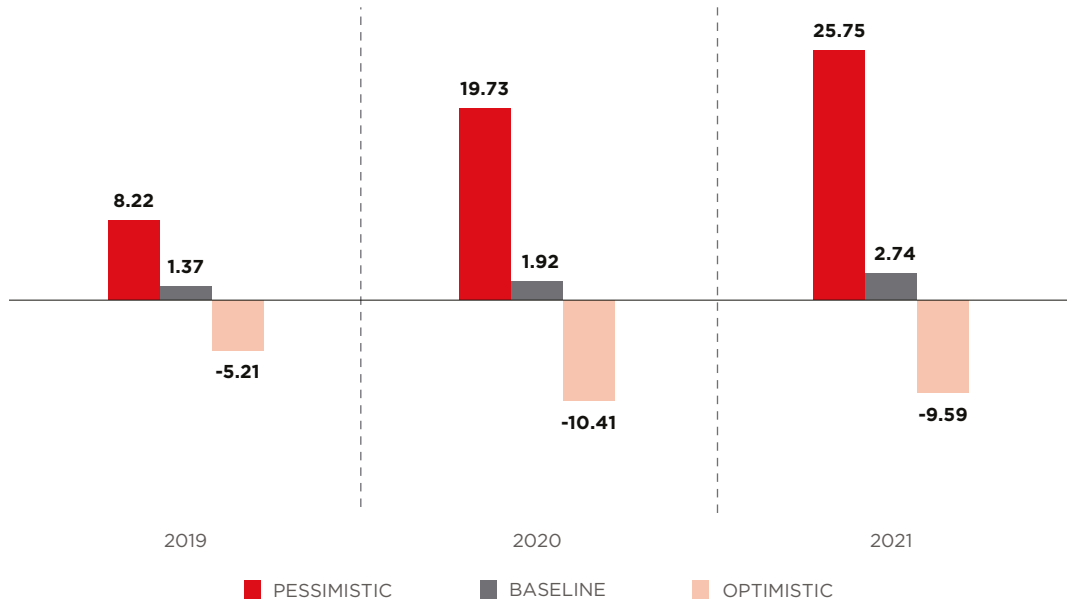
SCENARIOS FOR THE ANNUAL ICI-FGV (%) FOR THE TRIENNIUM 2019-2021



Source: Prepared by FGV..

Graph 4.3

SCENARIO FOR THE EXCHANGE RATE (% YOY) FOR THE TRIENNIUM 2019-2021



Source: Prepared by FGV.

4.1. THE MODEL FOR THE AGRO-INDUSTRY

The estimated model for agro-industry³ is presented in the equation 1:

$$\ln_agroind_t = 0,97 \times \ln_ibcbr_t + 0,17 \times \ln_ici_t + 0,07 \times \ln_cambio_t - 0,04 \times d_caminh \text{ (Eq.1)}$$

Where:

t : time unit of March/2012 and December/2018;

$\ln_agroind_t$: natural logarithm of the Agro-industrial Production Index at time t ;

\ln_ibcbr_t : natural logarithm of IBC-Br at time t ;

\ln_ici_t : natural logarithm ICI-FGV at time t ;

\ln_cambio_t : natural logarithm of the exchange rate; and

³ The specifications of the models and the tests performed are presented in the attachments of this study.

d_caminh : dummy for the truckers' strike, where:

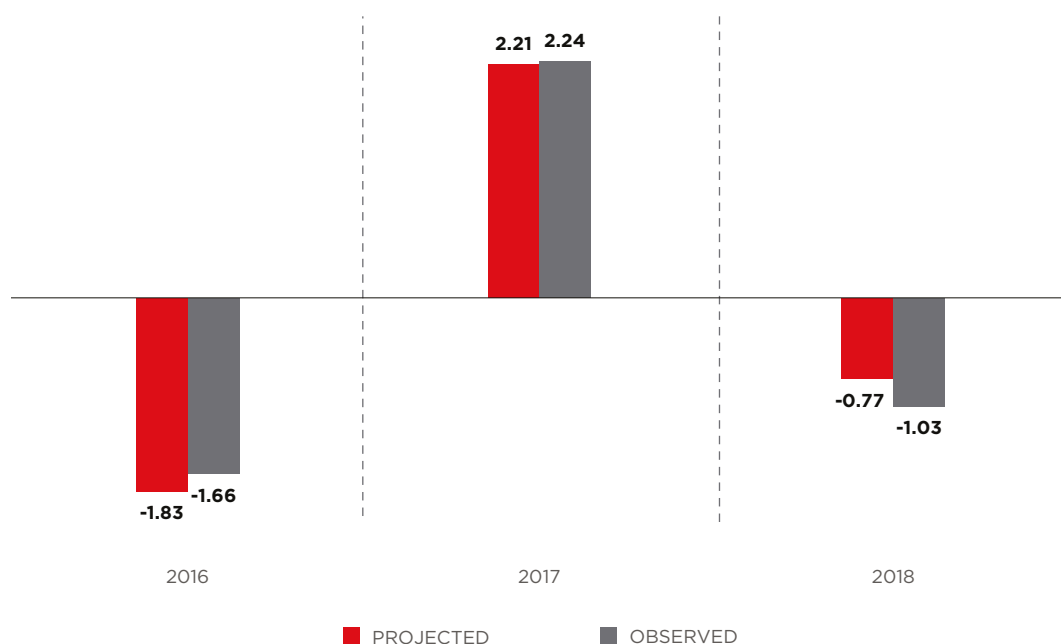
$d_caminh = 0$, for the months before May/2018; and

$d_caminh = 1$ for the months of May/2018 to December/2018.

The estimated model presented a good adjustment of the data, this can be observed when projecting the values of previous years (2016 to 2018), as can be seen in Graph 4.4.

Graph 4.4

OBSERVED VALUES AND PROJECTED VALUES FOR THE AGRO-INDUSTRY PRODUCTION GROWTH BETWEEN 2016 AND 2018 (% YOY)



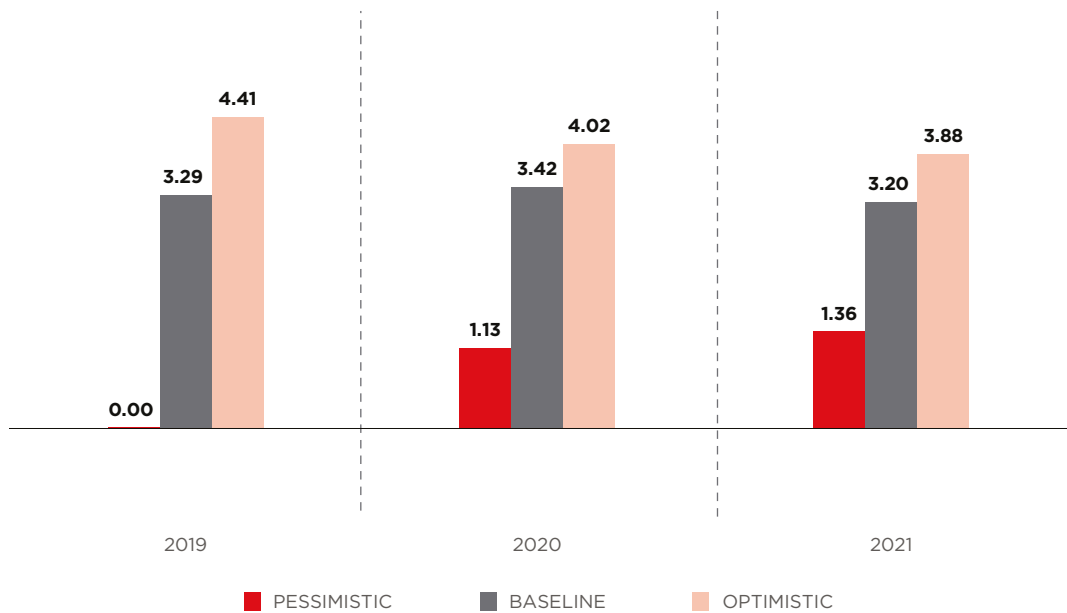
Source: Prepared by FGV.

Based on the assumed model and the premises adopted, it is estimated that, in the baseline scenario, the agro-industry production should show a variation in the baseline scenario of 3.29% in the year 2019, when compared to the previous year. However, in a pessimistic scenario, the agro-industry may not show growth in 2019, and in an optimistic scenario the annual projection is 4.41% of growth.

In 2020 and 2021, it is estimated that the agro-industry is expected to grow at the same rate as in 2019, and in the baseline scenario, an expansion of 3.42% per year is expected for 2020 and 3.20% YoY for 2021 (Graph 4.5).

Graph 4.5

PROJECTED VALUES FOR AGRO-INDUSTRY PRODUCTION GROWTH BETWEEN 2019 AND 2021 (% YOY)



Source: Prepared by FGV.

4.2. MODEL FOR THE FOOD AND BEVERAGE INDUSTRY

The estimated model for the Food and Beverage group is presented in equation 2:

$$\ln_alimbeb_t = 0,87 \times \ln_ibcbr_t + 0,17 \times \ln_ici_t + 0,14 \times \ln_cambio_t - 0,09 \times d_caminh \quad (\text{Eq.2})$$

Where:

t : time unit of March/2012 and December/2018;

$\ln_alimbeb_t$: natural logarithm of the Food and Beverage Production Index at time t ;

\ln_ibcbr_t : natural logarithm of IBC-Br at time t ;

\ln_ici_t : natural logarithm of ICI-FGV at time t ;

\ln_cambio_t : natural logarithm of the exchange rate; and

d_caminh : *dummy* for the truckers' strike, where:

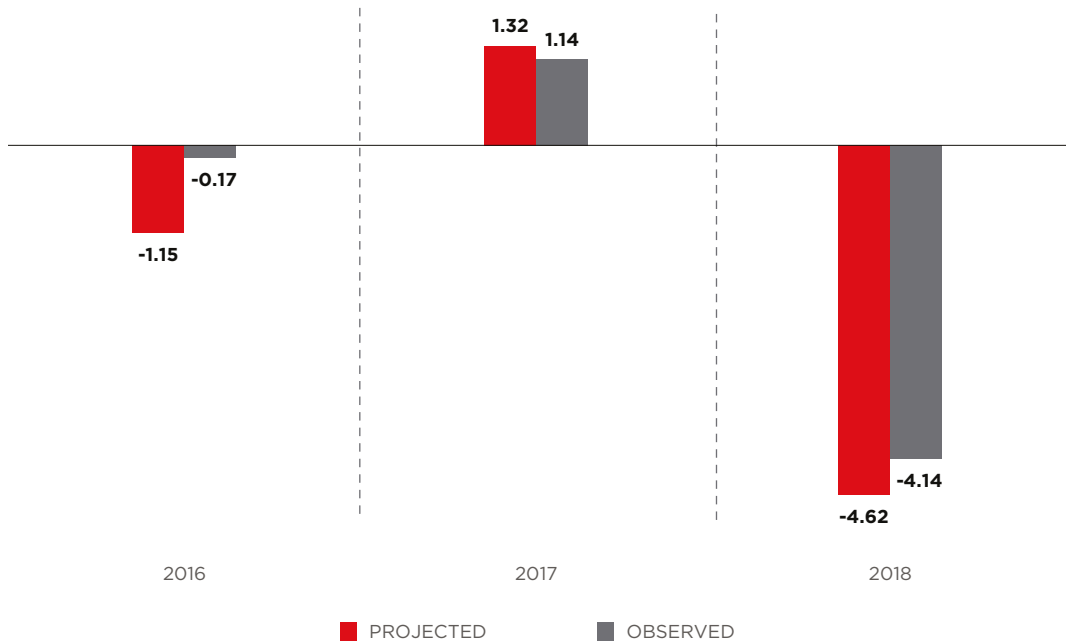
$d_caminh = 0$, for the months before May/2018; and

$d_caminh = 1$ for the months of May/2018 to December/2018.

The estimated model presented a good adjustment of the data, this can be observed when projecting the values of previous years (2016 to 2018), as can be seen in the Graph 4.6.

Graph 4.6

OBSERVED VALUES AND PROJECTED VALUES FOR THE GROWTH OF FOOD AND BEVERAGE BETWEEN 2016 AND 2018 (% YOY)



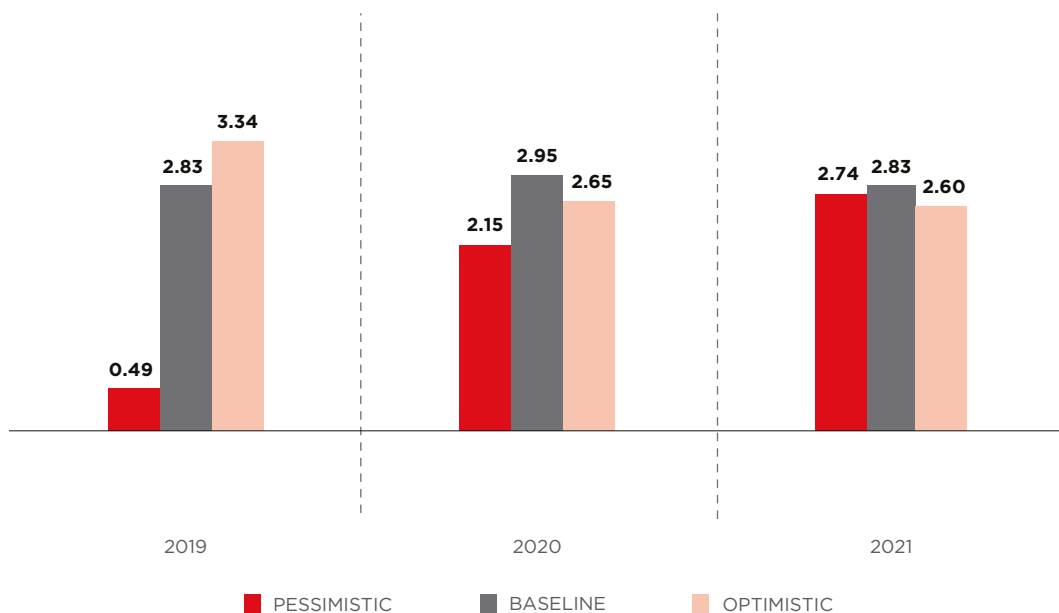
Source: Prepared by FGV.

Based on the assumed model and the premises adopted, it is estimated that, in the baseline scenario, Food and Beverage production should show a variation in the baseline scenario of 2.83% in 2019, comparing with the previous year. However, in a pessimistic scenario, the Food and Beverage industry may show very low growth in 2019 (0.49%), and in an optimistic scenario the projection is 3.34% YoY growth. Therefore, what is expected for 2019 is that the Food and Beverage industry continues to evolve below the Agro-industry as a whole, regardless of the scenario considered. That is, the Food and Beverage group should continue pulling down the Brazilian agro-industry, in terms of physical production.

In 2020 and 2021, it is estimated that the Food and Beverage industry will grow in the same proportion as in 2019, and in the baseline scenario, an expansion of 2.95% YoY is expected. by 2020 and 2.83% YoY for 2021 (Graph 4.7).

Graph 4.7

PROJECTED VALUES FOR THE GROWTH OF THE INDUSTRIAL PRODUCTION OF FOOD AND BEVERAGES BETWEEN 2019 AND 2021 (% YOY)



Source: Prepared by FGV.

4.3. MODEL FOR THE NON-FOOD INDUSTRY PRODUCTS

The estimated model for the Non-Food Products group is presented in the equation 3:

$$\ln_nao.aliment_t = 1,09 \times \ln_ibcbr_t + 0,19 \times \ln_ici_t \text{ (Eq.3)}$$

Where:

t : time unit of March/2012 and December/2018;

$\ln_nao.aliment_t$: natural logarithm of the Index of Production of Non-Food Products at time t ;

\ln_ibcbr_t : natural logarithm of IBC-Br at time t ; and

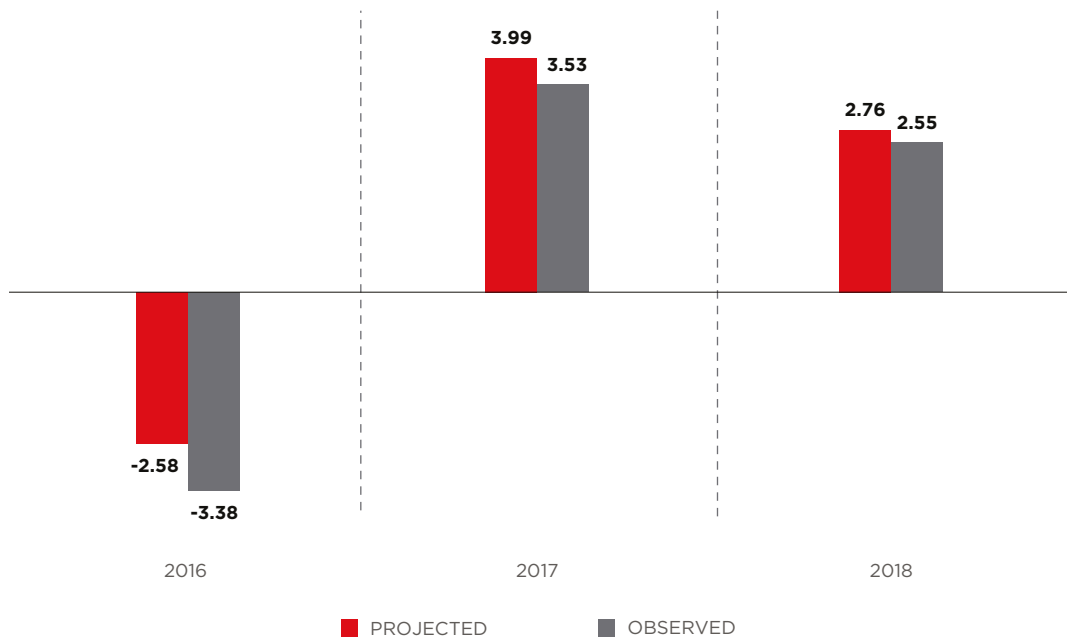
\ln_ici_t : natural logarithm of ICI-FGV at time t ;

As can be observed in the estimated model, unlike what was expected, it was not possible to capture the effects of the exchange rate and the strike of the truck drivers in the Non-Food products industry.

However, the estimated model presented a good adjustment of the data, this can be observed when projecting the values of previous years (2016 to 2018), see Graph 4.8.

Graph 4.8

OBSERVED VALUES AND PROJECTED VALUES FOR THE GROWTH OF NON-FOOD PRODUCTS PRODUCTION BETWEEN 2016 AND 2018 (% YOY)



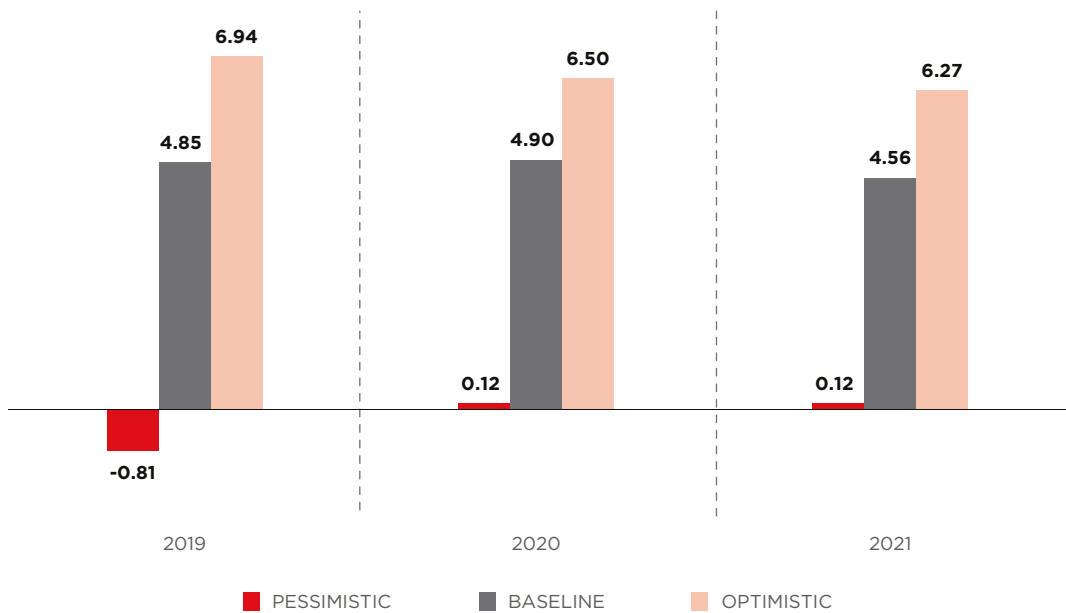
Source: Prepared by FGV.

Considering the assumed model and the premises adopted, it is estimated that, in the baseline scenario, Non-Food products production should show a base-year variation of 4.85% in 2019, compared to the previous year. However, in a pessimistic scenario, the Non-Food products industry may decline in 2019 (-0.81%), and in an optimistic scenario the projection is 6.94% YoY of growth.

In 2020 and 2021, it is estimated that the Non-Food Products industry will grow at the same rate as in 2019, and in the baseline scenario, an expansion of 4.90% YoY is expected for 2020 and 4.56% YoY for 2021 (Graph 4.9).

Graph 4.9

PROJECTED VALUES FOR THE GROWTH OF INDUSTRIAL PRODUCTION OF NON-FOOD PRODUCTS BETWEEN 2019 AND 2021 (% YOY)



Source: Prepared by FGV.

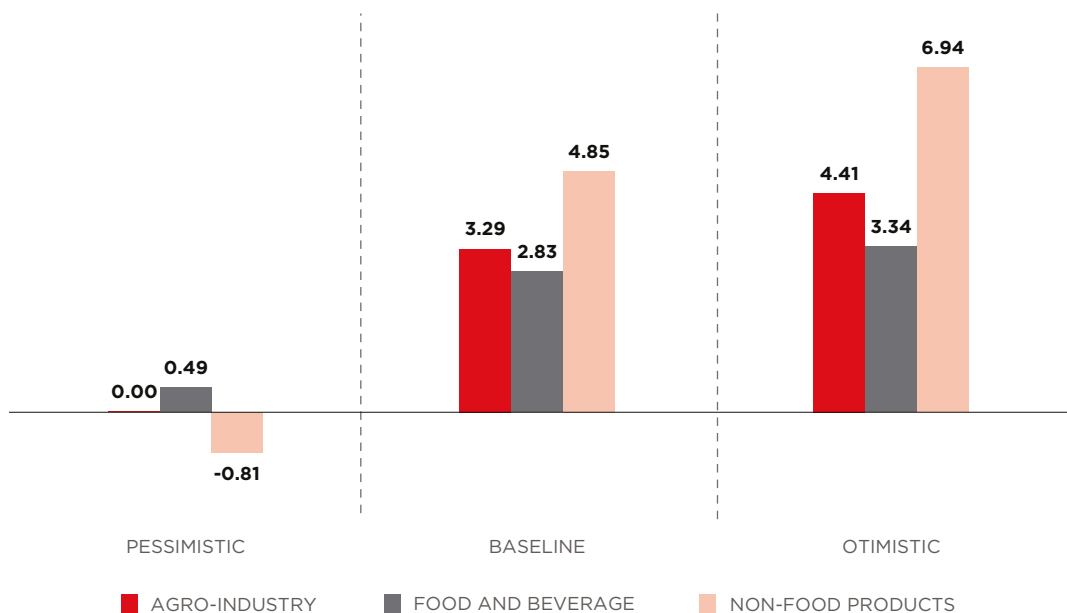
4.4. ABOUT THE RESULT FROM THE MODELS

4.4.1 LOWER INCOME ELASTICITY OF DEMAND IN THE FOOD AND BEVERAGE INDUSTRY

The projections for 2019 show that the Food and Beverage group, in the baseline and optimistic scenarios, will continue to evolve less than the Non-Food Products industry and, consequently, Agro-industry as a whole. In the pessimistic scenario, however, the result is worse for the Non-Food Products industry, reflecting the higher income elasticity of demand for these products compared to the Food and Beverage industry. That is, in a pessimistic scenario, it is the Food and Beverage group that should sustain agro-industrial production (Graph 4.10).

Graph 4.10

PROJECTED SCENARIOS FOR THE GROWTH OF AGRO-INDUSTRY, FOOD AND BEVERAGE AND NON-FOOD PRODUCTS PRODUCTION FOR 2019 (% YOY)



Source: Prepared by FGV.

4.4.2 WHO MOST SUFFERED WITH THE TRUCKERS' STRIKE?

Corroborating the ideas presented previously about the truckers' strike, the Food and Beverage industry suffered the most from the strike comparing with the Non-Food Products industry and the agro-industry as a whole, according to the econometric analysis carried out (Graph 4.11).

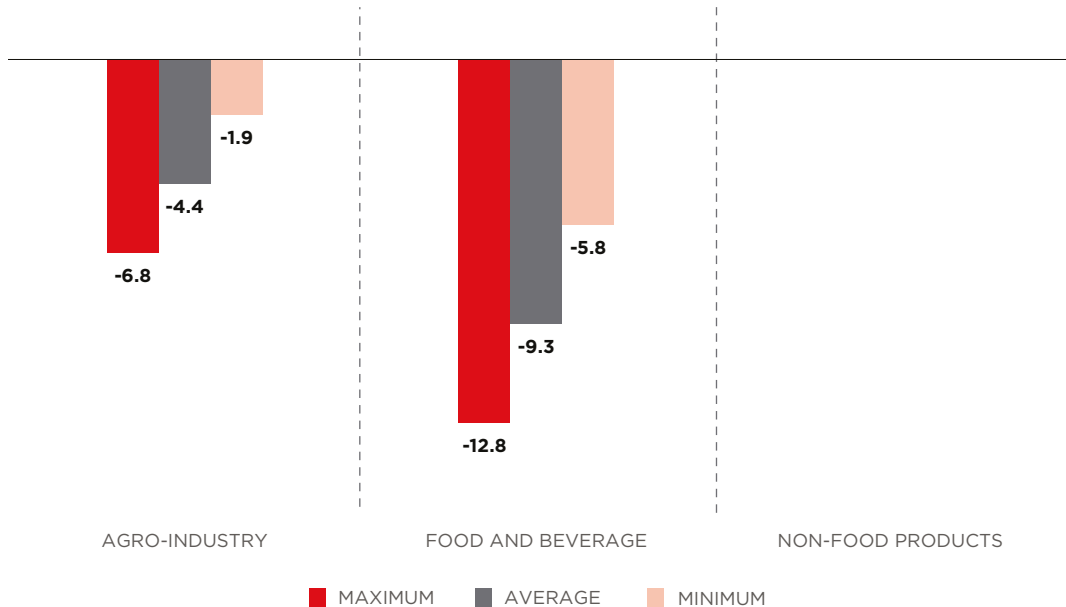
According to the econometric model for agro-industry, controlling for IBC-BR, ICI-FGV and exchange rate, the impact of the truck drivers' strike on agro-industry production is between -6.8 percentage points and -1.9 percentage points. Considering the average of the estimates, the strike of the truck drivers caused the result of the Brazilian agro-industry to be 4.4 percentage points lower if the strike had not occurred. In other words, agro-industrial production ended the year 2018 with a reduction of 1.0% YoY, but if the strike had not occurred, possibly agro-industrial production would have grown 3.4% YoY.

Regarding the Food and Beverage industry, the impact of the truck drivers' strike was even greater (between -12.8 percentage points and -5.8 percentage points). Thus, considering the average of the estimates, according to the model estimated for this group, controlling for IBC-BR, ICI-FGV and exchange rate, should the stoppage had not happened, the Food and Beverage industry would have presented a growth of 5.2% pa, instead of having declined by 4.1% per year. In other words, the strike caused the Food and Beverage industry to grow, on average, by 9.3 percentage points lower.

In the case of the Non-Food Products industry, it was not possible to capture the effect of the truckers strike, since the *dummy* for this episode did not appear statistically significant. However, this corroborates the previous data analysis, where it was seen that the impact of the truck drivers' strike in this agro-industry group was somewhat punctual, with more force in May/2018, with the dissipation of its effects soon after the end of the strike.

Graph 4.11

ESTIMATED EFFECTS OF THE TRUCK DRIVERS STRIKE IN THE PRODUCTION OF AGRO-INDUSTRY, FOOD AND BEVERAGE AND NON-FOOD PRODUCTS (PERCENTAGE POINTS)



Source: Prepared by FGV.

4.4.3 WHO CLOSELY FOLLOWS THE PERFORMANCE OF THE ECONOMY?

In all the econometric models estimated, the economy (represented by the IBC-Br) presented high statistical significance, indicating that its performance significantly impacts the production of both the agro-industry as a whole and its groups (Food and Beverage and Non- Food).

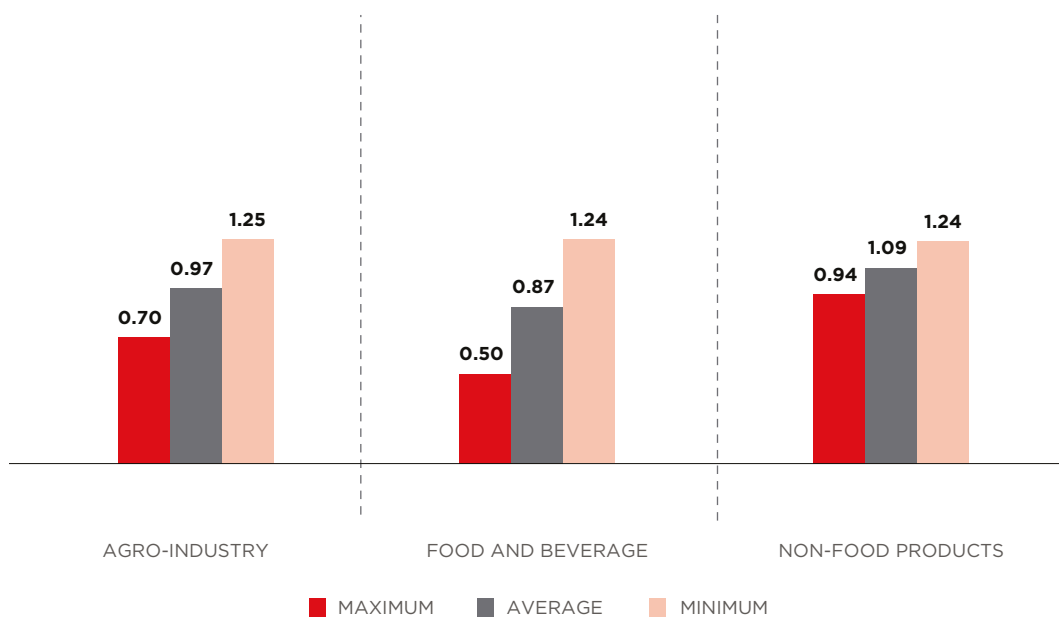
The Non-Food Products industry presented the highest elasticity between the IBC-Br and its production, between 0.94 and 1.24. Considering the average, the elasticity was 1.09, which means that when the IBC-br shows a growth of 1.0%, the Non-Food Products industry should grow 1.09%, *ceteris paribus*.

In the case of agro-industry, the elasticity between IBC-Br and production is between 0.70 and 1.25, *ceteris paribus*. Considering the average, the elasticity is 0.97, that is, the elasticity is neutral. Therefore, it is clear that agro-industry closely follows the performance of the economy.

Finally, in the case of the Food and Beverage industry, it was found that the elasticity between the IBC-BR and the production of this industry is between 0.50 and 1.24, *ceteris paribus*. In turn, the mean elasticity is 0.87. That is, as expected, the Food and Beverage group has the lowest elasticity among the three segments analyzed.

Graph 4.12

ELASTICITY BETWEEN IBC-BR AND AGRO-INDUSTRY PRODUCTION, FOOD AND BEVERAGE AND NON-FOOD PRODUCTS



Source: Prepared by FGV.

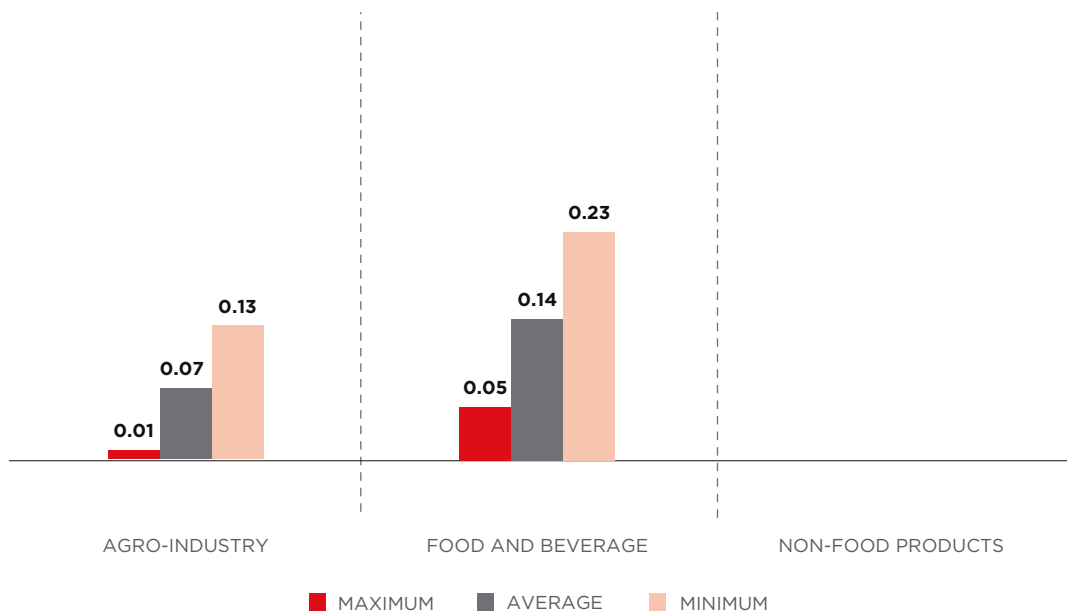
4.4.4 WHAT IS THE INFLUENCE OF THE EXCHANGE RATE?

According to the estimated econometric models, the exchange rate has a greater impact of the Food and Beverage industry than in the agro-industry as a whole, as well as in the Food Products industry (Graph 4.13).

In the Food and Beverage industry, the average elasticity of the exchange rate and output is 0.14. That is, the 1.0% increase in the exchange rate should lead to an increase of 0.14% in Food and Beverage production (this elasticity can vary between 0.05 and 0.23). The Agro-industry, meanwhile, the average elasticity between the exchange rate is one-half, of 0.07 (ranging from 0.01 to 0.13). Finally, it was not possible to capture the effect of the exchange rate of the production of the Non-Food Products industry.

Graph 4.13

ELASTICITY BETWEEN THE EXCHANGE RATE AND AGRO-INDUSTRY PRODUCTION, AND NON-FOOD PRODUCTS



Source: Prepared by FGV.

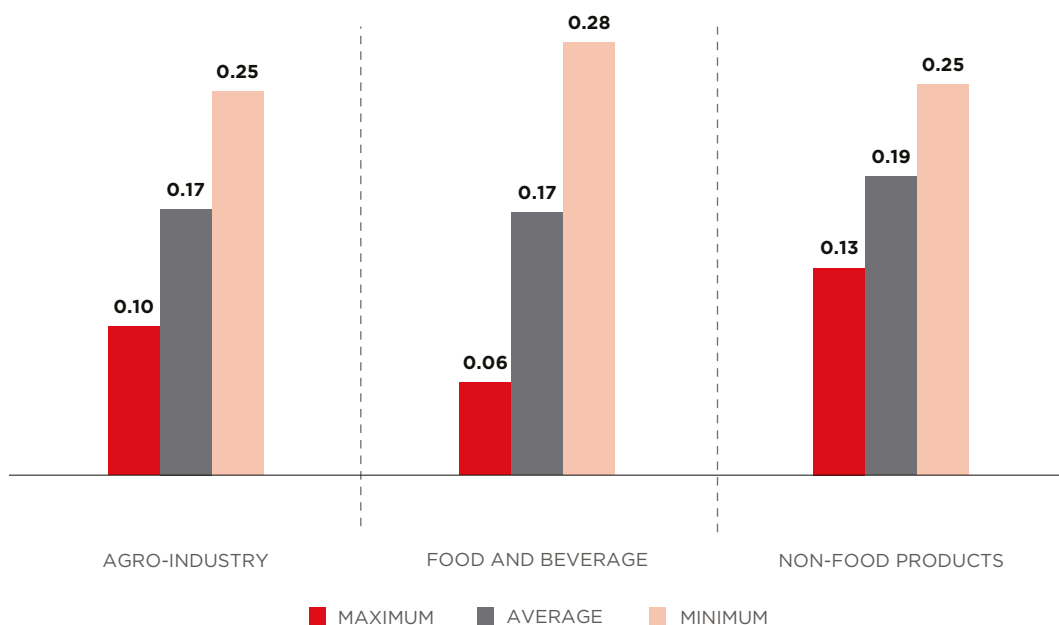
4.4.5 A THE IMPORTANCE OF INDUSTRIAL ENTREPRENEUR CONFIDENCE

Through the estimated econometric models, it is observed that the impact of a variation in ICI-FGV on the industrial production in any of the analyzed segments is similar.

That is, the average elasticity between the ICI-FGV and agro-industrial production is 0.17. In the case of the Food and Beverage industry it is 0.17 and in the case of Non-Food Products it is 0.19. That is, the 1.0% increase in ICI-FGV should cause an increase between 0.17% and 0.19% in the physical production of these segments.

Graph 4.14

ELASTICITY BETWEEN ICI-FGV AND AGRO-INDUSTRY PRODUCTION, FOOD AND BEVERAGE AND NON-FOOD PRODUCTS



Source: Prepared by FGV.



ATTACHMENT 1

COMPOSITION OF THE AGRO-INDUSTRIAL PRODUCTION INDEX - BY CNAE

FOOD AND BEVERAGE	
FOODS OF ANIMAL ORIGIN	10.11 Slaughter of cattle, other than pigs
	10.12 Slaughter of pigs, poultry and other small animals
	10.13 Manufacture of meat products
	10.5 Dairy products
	10.2 and 10.9 Preservation of fish, manufacture of fish and other food products
FOOD OF PLANT ORIGIN	10.3 Manufacture of preserved fruit and vegetables
	10.4 Manufacture of vegetable and animal fats and oils
	10.61 Processing of rice and manufacture of rice products
	10.62 Wheat flour and the manufacture of derivatives
	10.7 Manufacture and refining of sugar
	10.8 Roasting and grinding of coffee
ALCOHOLIC BEVERAGES	11.1 Manufacture of alcoholic beverages
NON-ALCOHOLIC BEVERAGES	11.2 Manufacture of non-alcoholic beverages

NON-FOOD PRODUCTS	
BIOFUELS	19.3 Manufacture of biofuels
RUBBER	22.1 Manufacture of rubber products
TOBACCO	12.0 Manufacture of tobacco products
AGRICULTURAL SUPPLIES	20.12 Manufacture of fertilizers intermediates
	20.13 Manufacture of fertilizers
	20.5 Manufacture of pesticides and household disinfectants
	28.3 Manufacture of tractors and machinery and equipment for agriculture and livestock
FORESTRY PRODUCTS	16.1 Wood splitting
	16.2 Manufacture of products of wood, cork and plaited materials, other than furniture
	17.1 Manufacture of pulp and paper pulp
	17.2 Manufacture of paper, paperboard and card stock
	17.3 Manufacture of paper, paperboard, corrugated board and card stock
	17.4 Manufacture of paper, paperboard, corrugated cardboard and other goods
TEXTILE	13.1 Preparation and spinning of textile fibers
	13.2 Weaving except knitting
	13.3 Manufacture of knitted and crocheted fabrics
	13.5 Manufacture of other textile products
	14.1 Manufacture of wearing apparel and accessories
	14.2 Manufacture of knitted and crocheted articles
	15.1 Tanning and other leather preparations
	15.3 and 15.4 Manufacture of footwear and parts of footwear of any material

Source: FGV.



ATTACHMENT 2

STRUCTURE OF WEIGHTS FOR THE COMPOSITION OF THE AGRO-INDUSTRIAL PRODUCTION INDEX

SECTORS AND SUBSECTORS	CNAE	WEIGHTS IN THE TRANSFORMATION INDUSTRY	PESOS NA AGROINDÚSTRIA
FOOD - ANIMAL ORIGIN	10.11 Slaughter of cattle, other than pigs	1.5%	4.1%
	10.12 Slaughter of pigs, poultry and other small animals	2.0%	5.6%
	10.13 Manufacture of meat products	0.2%	0.5%
	10.5 Dairy products	1.9%	5.4%
	10.2 and 10.9 Preservation of fish, manufacture of fish and other food products	2.1%	5.9%
FOOD - VEGETABLE ORIGIN	10.3 Manufacture of preserved fruit and vegetables	0.4%	1.2%
	10.4 Manufacture of vegetable and animal fats and oils	1.9%	5.2%
	10.61 Processing of rice and manufacture of rice products	0.3%	0.9%
	10.62 Wheat flour and the manufacture of derivatives	0.5%	1.4%
	10.7 Manufacture and refining of sugar	3.6%	10.2%
	10.8 Roasting and grinding of coffee	0.3%	0.8%
BEVERAGE - ALCOHOLIC	11.1 Manufacture of alcoholic beverages	1.9%	5.2%

SECTORS AND SUBSECTORS	CNAE	WEIGHTS IN THE TRANSFORMATION INDUSTRY	PESOS NA AGROINDÚSTRIA
BEVERAGE - NON ALCOHOLIC	11.2 Manufacture of non-alcoholic beverages	1.8%	5.1%
BIOFUELS	19.3 Manufacture of biofuels	1.1%	3.1%
RUBBER	22.1 Manufacture of rubber products	1.2%	3.4%
TOBACCO	12.0 Manufacture of tobacco products	1.4%	3.8%
AGRICULTURAL SUPPLIES	20.12 Manufacture of fertilizers intermediates	0.4%	1.0%
	20.13 Manufacture of fertilizers	0.8%	2.1%
	20.5 Manufacture of pesticides and household disinfectants	0.7%	1.9%
	28.3 Manufacture of tractors and machinery and equipment for agriculture and livestock	1.0%	2.8%
FORESTRY PRODUCTS	16.1 Wood splitting	0.4%	1.2%
	16.2 Manufacture of products of wood, cork and plaited materials, other than furniture	0.8%	2.1%
	17.1 Manufacture of pulp and paper pulp	1.0%	2.9%
	17.2 Manufacture of paper, paperboard and card stock	0.7%	1.9%
	17.3 Manufacture of paper, paperboard, corrugated board and card stock	1,2%	3,2%
	17.4 Manufacture of paper, paperboard, corrugated cardboard and other goods	1.2%	3.2%

SECTORS AND SUBSECTORS	CNAE	WEIGHTS IN THE TRANSFORMATION INDUSTRY	PESOS NA AGROINDÚSTRIA
TEXTILE	13.1 Preparation and spinning of textile fibers	0.4%	1.0%
	13.2 Weaving except knitting	0.8%	2.1%
	13.3 Manufacture of knitted and crocheted fabrics	0.2%	0.5%
	13.5 Manufacture of other textile products	0.5%	1.5%
	14.1 Manufacture of wearing apparel and accessories	2.5%	6.9%
	14.2 Manufacture of knitted and crocheted articles	0.1%	0.3%
	15.1 Tanning and other leather preparations	0.2%	0.7%
	15.3 and 15.4 Manufacture of footwear and parts of footwear of any material	1.6%	4.5%
AGRO-INDUSTRY		35.6%	100.0%

Source: FGV.

ATTACHMENT 3

ECONOMETRIC MODEL FOR AGRO-INDUSTRIES

```

AgroInd: MQO, usando as observações 2012:03-2018:12 (T = 82)
Variável dependente: l_agroindustria
Erros padrão HAC, largura de banda 3 (Núcleo de Bartlett)

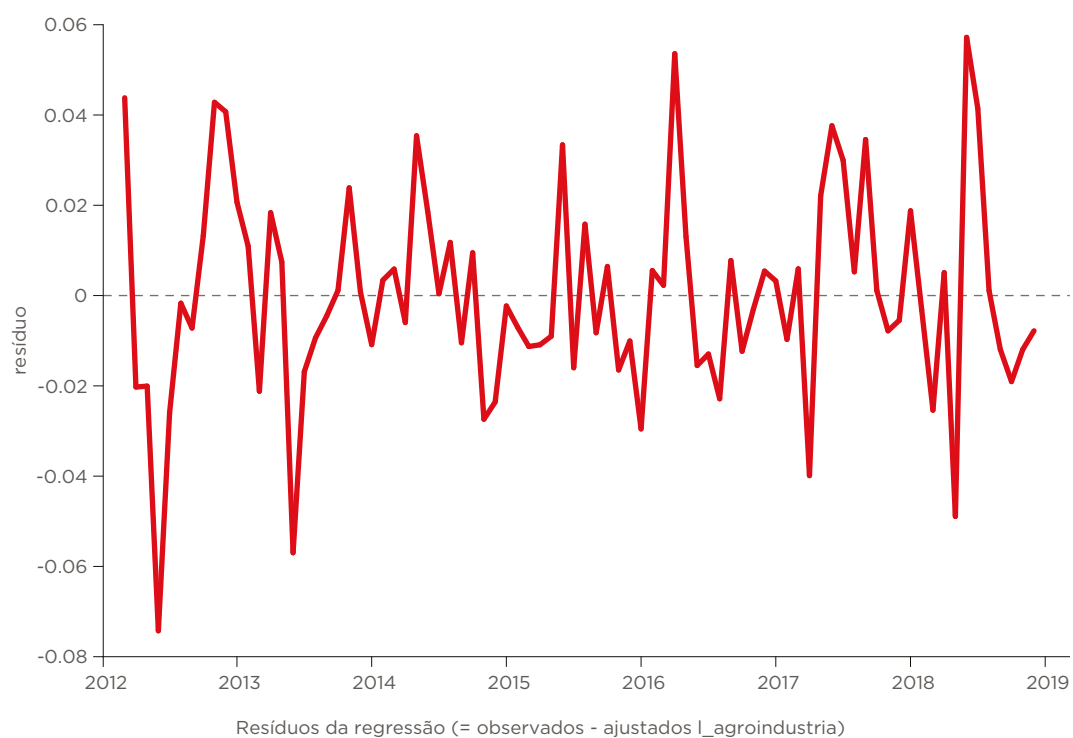
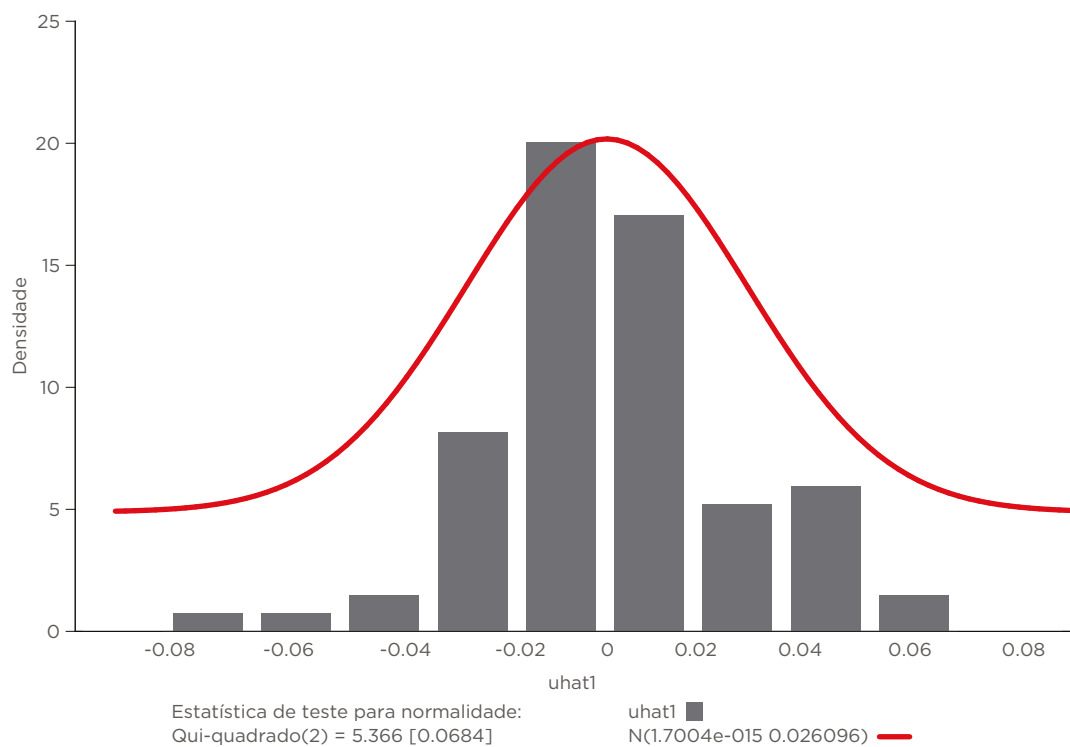

```

	coeficiente	erro padrão	razão-t	p-valor	
const	2,36779	1,73591	1,364	0,1773	
dm1	-0,0199956	0,00929542	-2,151	0,0352	**
dm2	-0,0592817	0,00865339	-6,851	3,18e-09	***
dm3	-0,0296478	0,0131799	-2,249	0,0279	**
dm4	0,0183279	0,0136894	1,339	0,1853	
dm5	0,137019	0,0122898	11,15	9,86e-017	***
dm6	0,165549	0,0190506	8,690	1,75e-012	***
dm7	0,210137	0,0115147	18,25	2,84e-027	***
dm8	0,243195	0,0109279	22,25	4,14e-032	***
dm9	0,218095	0,00973732	22,40	2,86e-032	***
dm10	0,227842	0,00889408	25,62	1,11e-035	***
dm11	0,155978	0,00651483	23,94	5,95e-034	***
l_ibc_br	0,974445	0,136159	7,157	9,17e-010	***
l_ICI_I	0,170293	0,0375431	4,536	2,53e-05	***
d_caminh	-0,0436604	0,0120855	-3,613	0,0006	***
l_cambio	0,0706409	0,0312117	2,263	0,0270	**
l_rend_pnad	-0,463411	0,269243	-1,721	0,0900	*
Média var. dependente	4,566263	D.P. var. dependente	0,128936		
Soma resid. quadrados	0,044266	E.P. da regressão	0,026096		
R-quadrado	0,967127	R-quadrado ajustado	0,959036		
F(16, 65)	734,0361	P-valor(F)	6,09e-67		
Log da verossimilhança	192,1416	Critério de Akaike	-350,2832		
Critério de Schwarz	-309,3690	Critério Hannan-Quinn	-333,8568		
rô	0,184863	Durbin-Watson	1,586037		

Excluindo a constante, a variável com maior p-valor foi 67 (dm4)

Teste da normalidade dos resíduos -
 Hipótese nula: o erro tem distribuição Normal
 Estatística de teste: Qui-quadrado(2) = 5,36622
 com p-valor = 0,0683502

Teste LM para autocorrelação até a ordem 12 -
 Hipótese nula: sem autocorrelação
 Estatística de teste: LMF = 1,15062
 com p-valor = $P(F(12, 53) > 1,15062) = 0,341854$





ATTACHMENT 4

ECONOMETRIC MODEL FOR THE FOOD AND BEVERAGE GROUP

AlimBeb: MQO, usando as observações 2012:03-2018:12 (T = 82)

Variável dependente: l_alim_bebidas

Erros padrão HAC, largura de banda 3 (Núcleo de Bartlett)

	coeficiente	erro padrão	razão-t	p-valor
const	4,04654	2,59193	1,561	0,1233
dm1	-0,0587060	0,0117856	-4,981	4,94e-06 ***
dm2	-0,144970	0,0100903	-14,37	7,55e-022 ***
dm3	-0,128246	0,0149149	-8,599	2,53e-012 ***
dm4	-0,0817407	0,0204266	-4,002	0,0002 ***
dm5	0,0662327	0,0145620	4,548	2,42e-05 ***
dm6	0,106469	0,0261468	4,072	0,0001 ***
dm7	0,161034	0,0159654	10,09	6,32e-015 ***
dm8	0,200797	0,0125550	15,99	3,23e-024 ***
dm9	0,178965	0,0143334	12,49	6,31e-019 ***
dm10	0,181115	0,0105127	17,23	6,37e-026 ***
dm11	0,0960466	0,00921587	10,42	1,68e-015 ***
l_abc_br	0,871065	0,186689	4,666	1,58e-05 ***
l_ICI_I	0,167913	0,0543988	3,087	0,0030 ***
d_caminh	-0,0928575	0,0173777	-5,343	1,25e-06 ***
l_cambio	0,141056	0,0438049	3,220	0,0020 ***
l_rend_pnad	-0,613325	0,403719	-1,519	0,1336
Média var. dependente	4,579596	D.F. var. dependente	0,135291	
Soma resid. quadrados	0,094289	E.F. da regressão	0,038087	
R-quadrado	0,936403	R-quadrado ajustado	0,920749	
F(16, 65)	283,8681	P-valor(F)	1,11e-53	
Log da verossimilhança	161,1397	Critério de Akaike	-288,2794	
Critério de Schwarz	-247,3652	Critério Hannan-Quinn	-271,8530	
ró	0,212237	Durbin-Watson	1,556872	

Excluindo a constante, a variável com maior p-valor foi 46 (l_rend_pnad)

Teste da normalidade dos resíduos -

Hipótese nula: o erro tem distribuição Normal

Estatística de teste: Qui-quadrado(2) = 6,53283

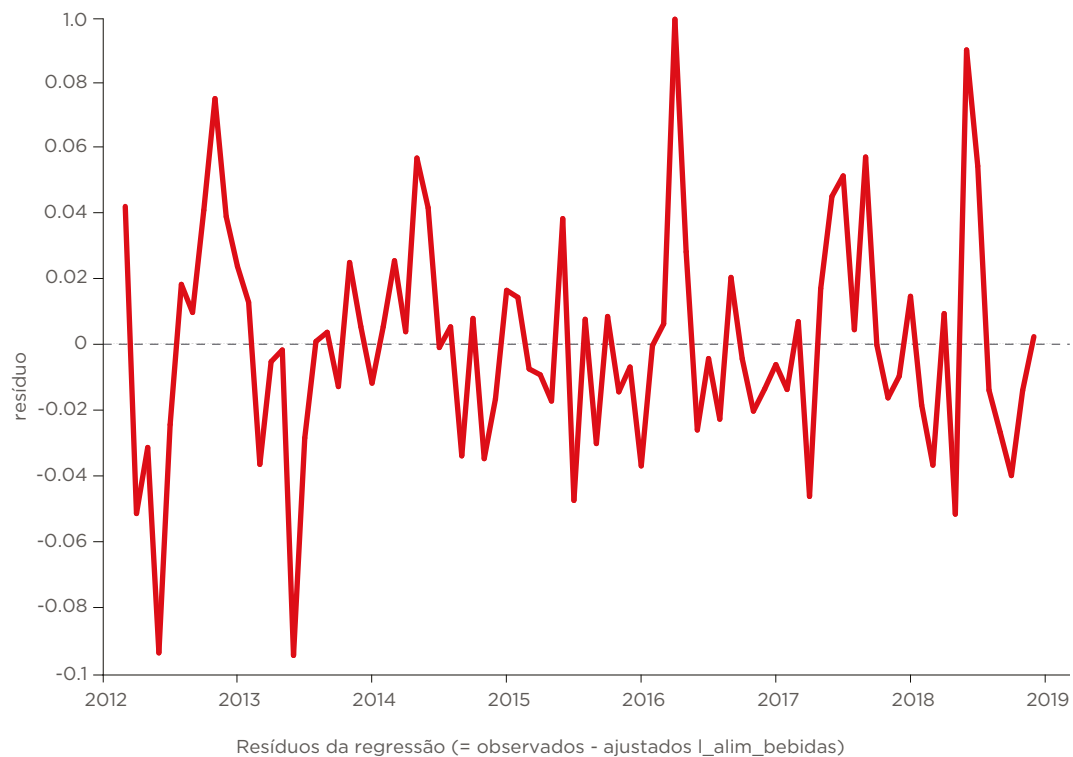
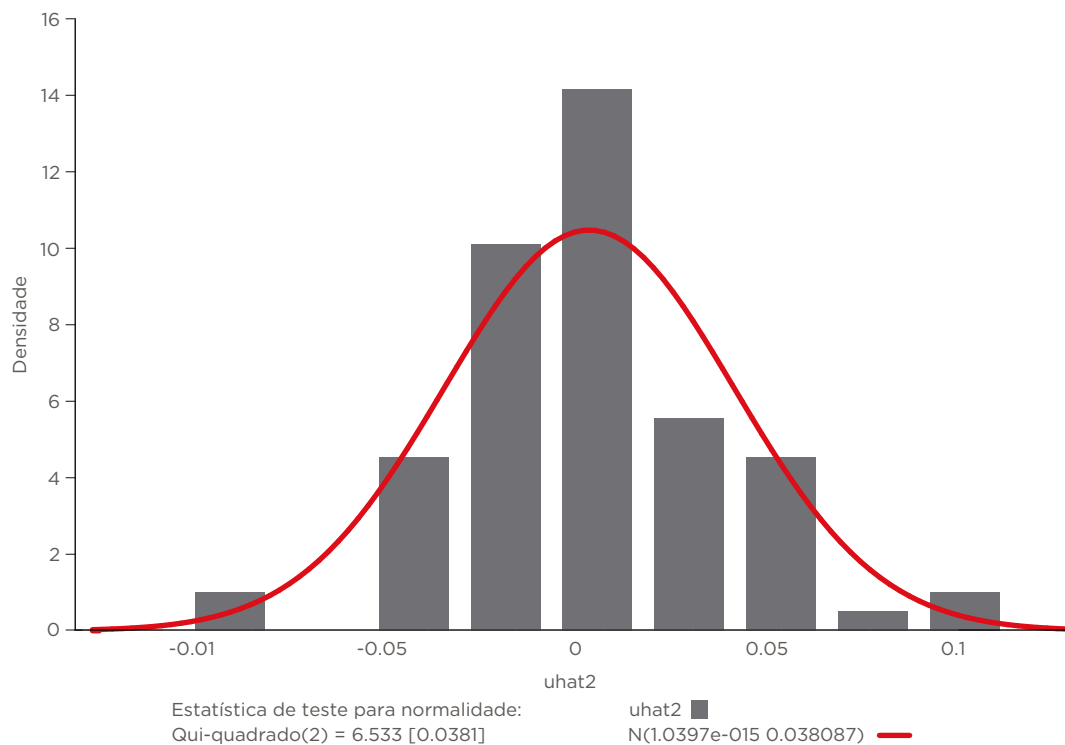
com p-valor = 0,038143

Teste LM para autocorrelação até a ordem 12 -

Hipótese nula: sem autocorrelação

Estatística de teste: LMF = 1,40612

com p-valor = P(F(12, 53) > 1,40612) = 0,19256





ATTACHMENT 5

ECONOMETRIC MODEL FOR THE NON-FOOD GROUP

NaoAlim: MQO, usando as observações 2012:03-2018:12 (T = 82)
 Variável dependente: l_prod_nao_aliment
 Erros padrão HAC, largura de banda 3 (Núcleo de Bartlett)

	coeficiente	erro padrão	razão-t	p-valor	
const	-1,86606	0,328356	-5,683	3,02e-07	***
dm1	0,0242643	0,00914047	2,655	0,0099	***
dm2	0,0361694	0,0121945	2,966	0,0042	***
dm3	0,0790719	0,0143672	5,504	6,12e-07	***
dm4	0,128334	0,0140756	9,117	2,07e-013	***
dm5	0,219752	0,0132335	16,61	1,27e-025	***
dm6	0,236720	0,0141063	16,78	7,13e-026	***
dm7	0,270810	0,0127525	21,24	1,01e-031	***
dm8	0,295731	0,0133701	22,12	8,94e-033	***
dm9	0,265444	0,0127316	20,85	2,99e-031	***
dm10	0,283432	0,0128837	22,00	1,24e-032	***
dm11	0,226927	0,00861286	26,35	2,08e-037	***
l_ibc_br	1,08720	0,0739246	14,71	8,29e-023	***
l_ICI_I	0,191217	0,0292910	6,528	9,93e-09	***
Média var. dependente	4,550240	D.P. var. dependente	0,135425		
Soma resid. quadrados	0,034010	E.P. da regressão	0,022364		
R-quadrado	0,977106	R-quadrado ajustado	0,972729		
F(13, 68)	352,5525	P-valor(F)	5,67e-57		
Log da verossimilhança	202,9473	Critério de Akaike	-377,8947		
Critério de Schwarz	-344,2006	Critério Hannan-Quinn	-364,3670		
rô	0,389567	Durbin-Watson	1,127402		

Teste da normalidade dos resíduos -

Hipótese nula: o erro tem distribuição Normal

Estatística de teste: Qui-quadrado(2) = 0,810562

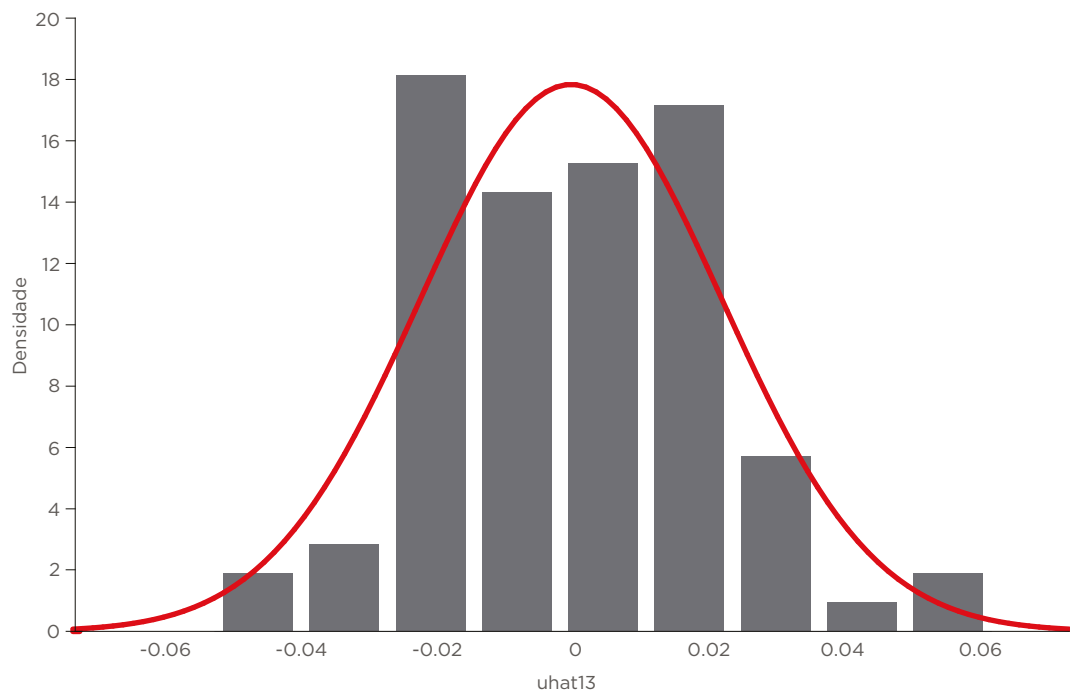
com p-valor = 0,666789

Teste LM para autocorrelação até a ordem 12 -

Hipótese nula: sem autocorrelação

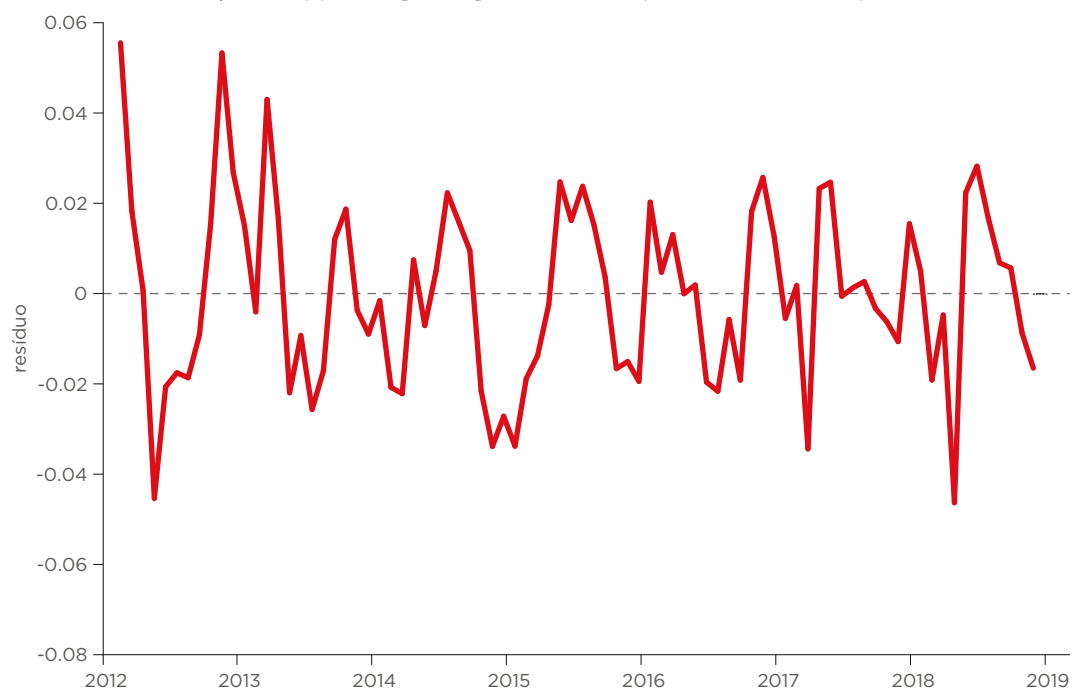
Estatística de teste: LMF = 1,99955

com p-valor = F(F(12, 56) > 1,99955) = 0,0414387



Estadística de teste para normalidade:
Qui-quadrado(2) = 0.811 [0.6668]

uhat13 ■
N(6.6097e-016 0.022364) —



Resíduos da regressão (= observados - ajustados l_prod_nao_aliment)









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