

## Exploratory analysis of food inflation in Brazil from 1996 to 2016

### ABSTRACT

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This article explores inflation and the possible causes of price increases in food and agricultural products in the last twenty years, divided into two decades. Between 2007 and 2016, food prices rose more than in the previous ten years and above the nationwide consumer price index (IPCA). Changes in the pattern of food inflation have already been reported but the real cause of price increases has not been addressed which is this paper's objective. Due to public policies of income rise with real gains in the minimum wage, family allowances, and retirement grants, the population did not perceive this silent crisis of food price increase. Because of China's economic boom and income rise in Brazil, there was a positive impact on domestic production and demand in the last decade. However, Brazilian agriculture did not present a significant increase in productivity, which may increase prices. Technology use and a consequent higher productivity could result in lower food prices, but this was not been observed recently in several Brazilian agricultural products.

**KEY WORDS:** Food price. Inflation. Input price. Productivity.

## INTRODUCTION

Inflation, expressed as a widespread rise in prices of goods and services, is harmful to the economy and individuals (CARDOSO, 2007). In Brazil, the first inflationary explosion occurred in the late nineteenth century, returning in the twentieth century, from the 1950s to the 1970s. The resurgence of inflation in recent years, mainly in food items, has been noted (BACCARIN et al., 2015, LAMEIRAS; CARVALHO, 2016).

In general, inflation is not identical across all consumer goods. According to the National Household Expenditure Study (ENDEF), between August 1974 and August 1975, households spent an average of 25.3% of their income on food and beverages, while the poorest 40% spent 53.29% of their income on these items (IBGE, 1981). Even in current years, inflation in food items has a significant role in people's well-being. In Brazil, families spend about 15.43% of their earnings on food expenses. In contrast, the poorest families, representing 39.04% of Brazilian families with income up to three minimum wages, spent 26.46% of their income on food expenses (IBGE, 2017). In comparison, the average food expenditure in the United States is close to 6.7%, and in the poorest 40%, it rises to 14.83%. In developed European countries, the average food expenditure in 2012 by the population of Germany, France, and Denmark was 10%, 13.2%, and 11.5%, respectively, with the poorest 40% consuming 14.63%, 16.79%, and 12.29% of their income on this item. Countries that are major Brazilian trading partners in agricultural products, like China, Thailand, Russia, India, and Vietnam, spent 25%, 25.7%, 28%, 30.5%, and 35% of their budget on food (USDA, 2017). Stable food prices play a significant role in consumer decisions and international trade and are essential to maintaining household budget buying capacity. Some studies have already underlined changes in the inflation pattern of food items. However, few of them have explored the possible causes of such a phenomenon, which is this article's objective.

## METHODOLOGY

### Theoretical framework

Agricultural commodity prices reflect the balance between supply and demand and can change by demand forces, such as variation in household income, or product value perception, modifying consumer-spending patterns. In the last decade, there has been a significant expansion of the population's income in Brazil, especially in the least favored groups. Policies of income transfer, minimum wage rise, and access to retirement were crucial for that. In addition, improvements in the trade of Brazilian exportable products favoring food and mineral export also played an important role. These changes led to an upward shift in the demand curve, which needed an expansion of the food supply in order not to cause an inflationary impact. According to the economic theory, in a closed economy country, the immediate consequence of demand increase is a product price rise due to a displacement within the pre-existing supply line. However, this may worsen by the need to expand production to new areas where marginal costs exceed those of the traditional regions.

Additionally, transport costs and access to inputs could be higher than this previous scenario. As a result, the supply expansion may not be sustainable, creating demand inflation. Sustainable economic growth requires an evolution of agriculture technology, allowing the supply curve to shift to the right, lowering the equilibrium price level to the same pattern as before the demand shock. The desirable outcome of demand and supply expansion is a society that attends to its population consumption needs without changing the price level, resulting in robust economic activity, growth in production, gross domestic product, employment, and consumer welfare. Brazil experienced food inflation in the 1950s due to systemic supply and demand imbalances. After World War II, efforts toward industrialization by import replacement overshadowed the agricultural sector when politicians and academics neglected agriculture policy plans.

According to Homem DE Melo (1985), the growth of Brazilian agricultural production due to new areas inclusion was 85% in the 1940s, 72% in the 1950s, and 65% in the 1960s. The new area locations are increasingly far, and the rising food demand in urban centers led to further pressure on the agricultural marketing system and the country's weak rural to urban transport network. The urban population increased about 5.4% per year in the 1950s due to intensive rural migration to urban areas. Food production growth was mainly through the inclusion of new cropland areas rather than due to productivity growth. The consequence was a rise of 35% in food prices in São Paulo between the 1940s and 1950s and 42% in the following decade. Political and academic discussions arose in the 1970s about the importance of productivity in increasing food supply at an affordable price to the population. It was striking also that the income distribution in Brazil worsened significantly, with the GINI index rising from 0.488 in 1960 to 0.574 in 1970 (HOFFMANN; DUARTE, 2012).

Alves & Pastore (1980) characterized the agricultural policy in the 1970s as a) production-oriented; b) based on increasing area and mainly productivity to ensure sustainability; c) minimum prices guarantee, rural credit and research & extension would cause modernization; d) agrarian reform limited to regions where the agrarian structure was preventing modernization.

Therefore, productivity became a target for production growth involving significant changes to the policy approach toward agriculture. Technology became crucial to enable this new strategy, and the question was about the existing knowledge and its potential transfer to farmers. According to Alves (1979), there is knowledge available for some agricultural activities and Brazilian regions, but there are limitations to transfer among areas and from other countries to Brazil. The focus on technological intensification to solve food supply problems proved correct (FARINA; NUNES, 2003; MARTHA JUNIOR et al., 2010).

### **Analytical framework**

This study covers the period between 1997 and 2016, divided into two decades, 1997 to 2006 and 2007 to 2016, to compare prices and productivity behavior. The period includes the years after 1995, of the country's hyperinflation control and economic stability, and 2016 when the current economic crisis began. The primary data is from the Brazilian Institute of Geography and Statistics (IBGE).

Indexes were built from the Wide Consumer Price Index (IPCA), to measure inflation in the food and beverages group and in 16 sub-groups listed ahead:

1) Cereals, pulses, and oilseeds; 2) Flour, starch, and pasta; 3) Tubercles and roots; 4) Sugars; 5) Vegetables and greens; 6) Fruits; 7) Beef and pork; 8) Fish; 9) Processed meat and fish; 10) Broiler and eggs; 11) Dairy products; 12) Bakery products; 13) Oil and fat; 14) Beverage; 15) Canned and preserved food and 16) Salt and seasonings.

The modernization of agricultural technology was influential in controlling food inflation, especially in the 1950s and 1970s. This paper explores the main products' annual average productivity gains from 1997 to 2006 and 2007 to 2016. Variation of input prices is also important to explain product prices, and its indexes were calculated and discussed. The data used to measure the productivity increase of agricultural products are from IBGE (2017), while data to estimate the variation of input and product prices are from the Institute of Agricultural Economics (IEA, 2019).

Inflation index for the period calculated according to equation 1:

$$Index_{t+1} = [1 + Inflation(Item)_{t+1}] * Index_t \quad (1)$$

Inflation without food and beverage group calculated as equation 2:

$$\frac{IPCA - [IPCA(ALIBEB) * WEIGHT(ALIBEB)]}{1 - WEIGHT(ALIBEB)} \quad (2)$$

Where:

IPCA (ALIBEB) = IPCA of Food and beverage group

The growth rate of agricultural area, production, productivity, input, and product prices used the geometric growth rate (TGC) as in equation 3:

$$TGC = (\text{antilog } B - 1) \times 100; \quad (3)$$

Where:

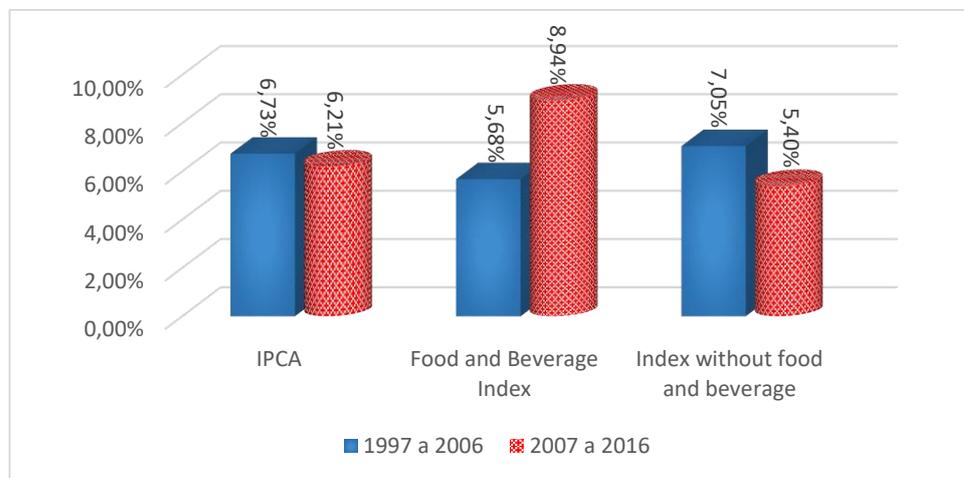
B = regression coefficient  $\log Y = a + bT$

Y= variable; a = regression constant; T= tendency.

## RESULTS AND DISCUSSION

According to IBGE data, unlike what happened between 1997 and 2006, the food and beverage group prices increased more than the IPCA in the 2007 to 2016 period. As a result, this group's annual average inflation index was 8.94% in the second decade and 5.68% in the first one, affecting the IPCA. In the case of removing the food and beverage index in the first decade, the IPCA would range from 6.73% to 7.05%, showing the contribution of this sector to reducing inflation. The opposite happened in the second decade, when the IPCA, including the food and beverage sector, was 6.21%, while without the food and beverage group, it would have been 5.4% (Figure 1).

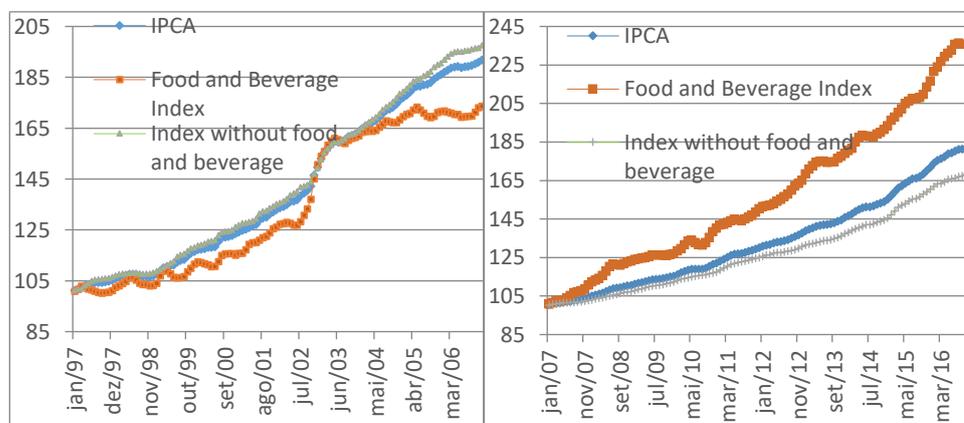
**Figure 1.** Inflation annual average tax in the periods of 1997 to 2006 and 2007 to 2016 for: general economy (IPCA), food and beverage group and IPCA index without the food and beverage group.



Source: Authors' calculation with IBGE data.

The IPCA rose 90.65% from 1997 to 2006, while the food and beverage group prices (ALIBEB) increased 72.81% (17.84% less than the IPCA). During the second period (2007 to 2016), while the IPCA was 82.18%, the prices of ALIBEB rose 134.51% or 52.33% above the IPCA (Figure 2). Therefore, in the first decade, the ALIBEB group was strategic in helping inflation control and keeping the purchasing power of wages and pensions. However, the food sector was a significant factor in increasing Brazilian inflation in the last decade. This silent crisis of higher food prices was unperceived by the poorer people as it was compensated by government policies of income increase in real terms through minimum wage, family allowances, and retirement pensions. The minimum wage, for instance, increased 209.37% and 151.43%, while electricity rose 169.09% and 47.88% in the first and second decade, respectively.

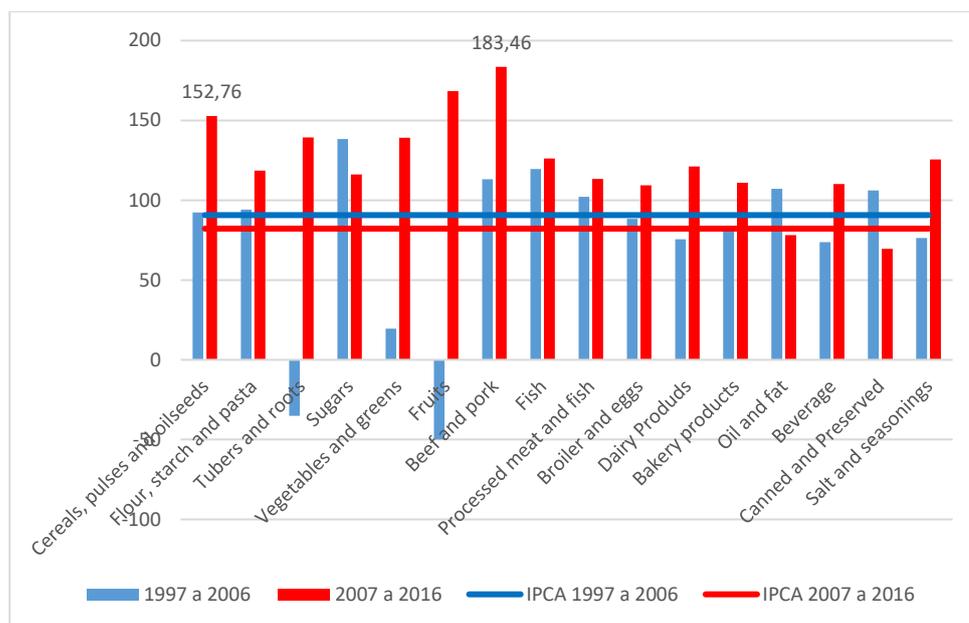
**Figure 2.** Inflation in Brazil (IPCA), food and beverage group and IPCA without the food and beverage group, periods of 1997-2006 and 2007-2016.



Source: Authors' calculation with IBGE data.

Prices variation for the primary food groups and IPCA in the two decades are in Figure 3. Particularly remarkable in the second decade is the sharp rise in prices of fruits, tubers and roots, as well as in the vegetables and greens. Significant increases also occurred in beef and pork, cereals- pulses and oilseeds, flour, starch and pasta, fish, salt and seasonings, and dairy products. Lower variations but above IPCA occurred in processed meat and fish, broiler and eggs, bakery products, and beverages. Most food groups increased prices in the second decade. Only sugars, oils and fats, and canned and preserved products increased less from 2007 to 2016.

**Figure 3.** Main food groups and IPCA cumulative inflation for 1997 - 2006 and 2007 - 2016.



Source: Authors' calculation with IBGE data.

In the animal protein sector, comparing the main groups' prices variation with IPCA in the first and the second decade, respectively, it is possible to observe a sharp increase, especially in the second decade for beef and pork (22.55% and 101.27%), fish (28.87% and 43.86%), and processed meat and fish (11.56% and 31.19%). On the other hand, groups like broiler and eggs (-2.32% and 27.07%) and dairy products (-15.18% and 38.90%) had lower than IPCA price increases in the first decade and increased higher than IPCA in the second decade.

Prices for the vegetable group oscillated from deflation in the first decade to significantly above IPCA, mainly in the second decade. It is the case of fruits (-140.47% and 86.15%), vegetables and greens (-71.08% and 57.03%), and items consumed by the low-income populations, like tubercles and roots (-125.79% and 57.17%). Similarly, flours, starches, and pasta with a price increase of (3.4% and 36.40%) were above IPCA.

Cereals, pulses, and oilseeds group presented price increases similar to IPCA in the first decade. However, in the second decade, their price rose above IPCA. These products changed their production systems by introducing new technologies, which allowed the planting of three crops per year with different sowing and harvesting time in each geographic area. It represents three planning periods, helping to match supply and demand changes. The new practice helps

reduce climatic risks and enables the optimization of machinery, stock, and labor use. It also allows for crop rotation, better land use, and cost reduction of other activities, increasing food security. Similarly, technological innovation in rice production, such as high-quality varieties adapted to the Midwest region, replaced traditional non-irrigated low-quality rice. This evolution began before 2007 and helped stabilize cereal prices from 2007 to 2016.

### Input prices

Production costs depend partially on input prices and contribute to the final product price. Thus, it is essential to examine the behavior of main input prices for agricultural production. Seed prices of rice, beans, corn, soybean, and sorghum showed variations above IPCA in both decades. Prices rose more in the first decade, a period of significant advances in seed technology and yield potential. Only the cost of beans seed had a higher increase in the second decade, which could be a consequence of a delay in new advances and sales. Interestingly, from 1997 to 2016, the price variation of the analyzed seeds exceeded IPCA and ALIBEB index (Table 1).

The Brazilian fertilizer market is dependent on imports, where almost all the phosphorus and potassium used in agriculture come from abroad. Nitrogenous fertilizers have their prices linked to energy prices. All fertilizer prices rose well above inflation in studied periods, although a higher increase occurred in the last decade. Some chemicals such as herbicides and fungicides, except for roundup, had higher variation in the first decade and lower in the second, reflecting probably the end of market protection or the surge of new products.

The wholesale price of soybean meal and corn, inputs for intensive animal production, moved in the opposite direction. Soybean meal prices rose more in the second decade, reflecting exchange rate liberalization and a stronger dollar. In turn, the lower corn prices in the second decade reflected lower exports and a production increase in Mato Grosso due to technological advances allowing higher production at the second and third annual crops. Electricity costs showed a significant reduction in the last decade as consequence of artificial government measures aiming at cost reduction and inflation control.

**Table 1.** Inflation on prices paid by producers for selected inputs in the periods of 1997-2006 and 2007-2016.

Periods	Seeds				
	Rice	Beans	Corn	Soybean	Sorghum
1997 – 2006	<b>210,00</b>	192,31	<b>252,38</b>	<b>325,00</b>	<b>311,17</b>
2007 – 2016	166,67	<b>276,00</b>	122,48	243,85	102,31
Periods	Fertilizers				
	02-30-10	04-14-08	04-20-20	Urea	Livestock Urea
1997 – 2006	<b>252,79</b>	<b>263,68</b>	257,84	229,87	342,86
2007 – 2016	247,04	261,31	<b>311,88</b>	<b>243,89</b>	<b>412,50</b>
Periods	Roundup	Tilt 250 EC	Decis 25 CE	Soybean meal	Corn wholesale
	1997 – 2006	32,72	<b>123,24</b>	<b>105,24</b>	63,97

2007 – 2016	<b>51,45</b>	-43,96	59,58	<b>134,32</b>	82,12
Periods	Minimum wage	Electricity	IPCA		
			ALIBEB	General	Without Agro
1997 – 2006	<b>209,37</b>	<b>169,09</b>	72,81	<b>90,65</b>	<b>96,45</b>
2007 – 2016	151,43	47,88	<b>134,51</b>	82,18	69,08

Source: Authors' calculation with data of IEA - Agricultural Economics Institute.

## Producer prices

Table 2 refers to the prices received by producers in the period with data from IEA (Agricultural Economics Institute, São Paulo State) and DERAL (Rural Economy Department, Paraná State). There are significant differences between products and decades. Price increases, in general, are higher than inflation in all periods, especially in the second decade. Higher prices to producers depend on several variables such as input prices or production costs, strong demand for internal consumption and exports, exchange rate, technology, and productivity.

**Table 2.** Inflation on prices received by producers for selected products in the periods of 1997 to 2006 and 2007 to 2016.

Periods	Soy bean	Corn	Wheat	Sorghum	Beans black	Beans colored	Rice irrigated
1997 - 2006	124,10	161,20	<b>210,92</b>	50,25	27,65	60,39	122,68
2007 - 2016	<b>338,97</b>	<b>287,34</b>	165,43	<b>103,24</b>	<b>348,18</b>	<b>539,92</b>	<b>227,38</b>
Periods	Cassava	Tomato	Onion	Potatoes	Peanut	Banana	
1997-2006	221,40	318,59	-13,62	-17,25	143,67	<b>447,01</b>	
2007-2016	<b>608,64</b>	<b>508,49</b>	<b>627,24</b>	<b>319,74</b>	<b>151,02</b>	245,51	
Periods	Sugar cane	Coffee	Milk	Eggs Type A	Beef	Pork	Broiler
1997-2006	<b>191,67</b>	<b>136,87</b>	86,96	105,83	119,91	71,00	79,45
2007-2016	43,15	131,84	<b>256,52</b>	<b>183,04</b>	<b>403,55</b>	<b>153,00</b>	<b>125,19</b>

Source: Authors' calculation with data of Agricultural Economics Institute (IEA).

The price of most products increased less in the first decade, except for bananas, tomatoes, and wheat. Nonetheless, most prices rose above 300% in the second decade, like beans, soybeans, cassava, tomatoes, onion, potatoes, and beef. Contrasting with the vegetal group, animal proteins, especially broilers, showed a modest price rise, near the IPCA level. Pork meat was the second in price increase, while beef, especially in the second decade, had a sharp price increase. This situation might explain the fast growth of the poultry chain and per capita consumption in Brazil.

## Productivity evolution

The evolution of Brazilian agricultural productivity is an important variable to explain supply increases and product prices. Data in Table 3 shows that the modest productivity growth, especially in the second decade, could partially explain food price increases in the country. In general, winter fruits like apples, oranges, and lemons showed higher productivity growth in the second decade. In contrast,

yields of tropical or subtropical fruits grew less in the last decade than in the previous one, except for a few cases like mango and papaya. Meanwhile, most products had higher productivity gains in the first decade in the temporary or annual crops. The increases in maize productivity in the last decade and the productivity stability for beans and rice in both decades are remarkable.

**Table 3.** Annual average productivity growth for selected products in Brazil, periods of 1997 to 2006, 2007 to 2016, and 1997 to 2016.

Period	Garlic	Sweet-potato	Potato	Onion	Pea	Cassava	Tomato
1997-2006	<b>6,98%</b>	1,54%	<b>4,77%</b>	<b>5,72%</b>	<b>2,52%</b>	<b>1,00%</b>	<b>3,59%</b>
2007-2016	2,84%	<b>2,00%</b>	2,30%	3,26%	1,19%	0,90%	1,04%
1997-2016	4,21%	1,39%	3,63%	4,06%	0,17%	0,75%	1,94%
	Annual Cotton	Rice	Bean	Maize	Soybean	Wheat	Sugar-cane
1997-2006	<b>9,94%</b>	3,80%	<b>2,98%</b>	2,88%	0,12%	<b>1,55%</b>	<b>1,10%</b>
2007-2016	0,06%	<b>4,17%</b>	2,63%	<b>3,48%</b>	<b>0,63%</b>	1,40%	-0,94%
1997-2016	4,18%	4,05%	2,76%	3,72%	1,32%	2,81%	0,55%
	Pine-apple	Oat	Rye	Barley	Sorghum	Water melon	Melon
1997-2006	<b>2,84%</b>	<b>1,85%</b>	2,16%	<b>2,91%</b>	<b>3,06%</b>	<b>1,07%</b>	<b>8,63%</b>
2007-2016	0,49%	1,40%	<b>3,83%</b>	2,06%	1,35%	0,52%	1,78%
1997-2016	1,22%	4,08%	2,63%	2,83%	2,54%	11,19%	3,79%
	Avocado	Perennial Cotton	Banana	Fig	Cocoa	Coffee	Persimmon
1997-2006	<b>2,81%</b>	<b>16,30%</b>	<b>4,13%</b>	0,39%	-1,47%	-5,38%	<b>0,17%</b>
2007-2016	0,49%	1,30%	0,80%	<b>3,80%</b>	<b>3,03%</b>	<b>5,25%</b>	-0,14%
1997-2016	-1,71%	0,00%	1,82%	-11,53%	0,71%	0,20%	3,27%
	Cashew nut	Indian tea	Coconuts	Palm oil	Mate herb	Rubber	Black Pepper
1997-2006	<b>7,36%</b>	<b>-0,67%</b>	<b>7,20%</b>	<b>2,69%</b>	-4,45%	2,09%	<b>2,98%</b>
2007-2016	-9,41%	-6,45%	1,50%	1,56%	<b>3,54%</b>	<b>6,35%</b>	-1,15%
1997-2016	-1,09%	0,50%	2,83%	1,54%	0,43%	2,88%	0,09%
	Guarana	Orange	Lemon	Guava	Papaya	Mango	Passion fruit
1997-2006	-4,00%	1,39%	2,25%	2,27%	<b>3,60%</b>	<b>6,22%</b>	-0,61%
2007-2016	<b>6,96%</b>	<b>2,09%</b>	<b>2,82%</b>	<b>2,33%</b>	-1,02%	0,14%	<b>0,25%</b>
1997-2016	-0,10%	1,44%	2,28%	-23,79%	3,47%	5,51%	-1,32%
	Apple	Quince	Nut	Palm heart	Pear	Peach	Tangerine
1997-2006	-0,32%	-1,01%	-3,34%	-0,41%	-0,06%	-0,23%	<b>2,38%</b>
2007-2016	<b>2,44%</b>	<b>1,00%</b>	<b>7,95%</b>	<b>4,96%</b>	<b>4,42%</b>	<b>4,55%</b>	-1,70%
1997-2016	2,53%	-6,83%	1,44%	1,04%	-6,53%	-7,64%	-7,28%
	Milk	Eggs of		Meat of			
		Chicken	Quail	Sheep	Beef	Pork	Broiler
1997-2006	1,28%	1,49%	<b>3,79%</b>	0,07%	<b>1,32%</b>	<b>5,33%</b>	<b>5,01%</b>

Period	Garlic	Sweet-potato	Potato	Onion	Pea	Cassava	Tomato
2007-2016	<b>3,63%</b>	<b>1,82%</b>	1,93%	<b>0,48%</b>	-0,30%	1,38%	1,12%
1997-2016	2,32%	1,37%	2,05%	0,09%	1,05%	2,48%	2,23%

Source: Authors' calculation with IBGE data for animals' stock and eggs/milk production and USDA for sheep, beef, pork and broiler production.

According to the Family Budget Survey for 2008 to 2009 (IBGE, 2010), Brazilian population expenses for groups vegetables and greens and tubercles and roots are led by potatoes with 20.7% of the total, followed by tomatoes (18.2%), onions (11.9%), cassava (6.5%), carrots (5.7%), and pumpkin (4.4%), which together account for 67.4% of the total.

Most components of the vegetable group had higher productivity growth in the 1997 - 2006 decade. However, the inflation of this group was significantly higher than the national economy. Cassava, for instance, an important food item for the poorest population, especially in the North and Northeast regions, had a small productivity growth in all periods. Yearly gains reached 1.0% in the first decade and even smaller, 0.90%, in the second. Inflation was significantly higher than the IPCA also in the fruit group. Spending order is banana (26.5%), orange (18.8%), watermelon (11.7%), apple (7.4%), papaya (7.1%), pineapple (5.1%), tangerine (4.1%), and mango (3.4%), which together account for 84.2% of Brazilian population spending on fruits. Only orange and apple had higher productivity growth in the second period than in the first one in this group.

The annual average productivity growth weighted by production at the end of the period for 30 temporary crops was 1.8% for the first and 1.3% for the second decade. The second decade's growth benefited from the significant increase in maize productivity noted mainly in the Midwest and Paraná state due to intensive use of technology. The production, however, had a reduction in the semiarid northeastern region. Excluding maize from the analysis, yield growth would be 1.45% per year in the first and 0.67% per year in the second decade. The scenario was similar for 32 permanent crops, where the annual weighted average productivity growth was -0.33% in the first and 1.12% in the second period. The second decade benefited from better coffee productivity, a product that represented about 37% of the group's gross production value. Excluding coffee from the analysis, the productivity growth would be 2.6% for the first and -0.52% for the second period.

In the first decade, productivity in the animal group, measured as a ratio between meat or milk production and the number of animals in stock, was over 5.0% for broilers and swine while the gains observed for Sheep, beef, and dairy were 0.07%, 1.32% and 1.28%, respectively. From 2007 to 2016, the productivity increased less for all animal groups, except for sheep (0.48%), milk (3.63%), and chicken eggs (1.82). Productivity growth was 1.12% for broilers, 1.38% for swine, and slightly negative for beef (- 0.30%). Indicators that depends on mortality, age, weight at slaughter and feed conversion ratio needs caution in its use. Despite these variables importance to production costs, they are not available in official Brazilian statistics for pigs and poultry.

For swine, the average annual increase of weaned piglets per sow was 2.20% in the first and 1.26% in the second decade (AGRINESS, 2022). The poultry chain

productive efficiency index increased 2.11% and 1.72% per year in the first and second decades, respectively (PATRICIO et al., 2012), adapted by Mendes (2014). Feed conversion ratio for broilers improved 0.99% in the first and 0.55% in the second decade. The lower productivity growth in the second period for poultry and pork did not objectively represent reduced Brazilian investments in technology. There is a clear role of technology in raising the output with the same level of inputs or maintaining the production level with less or cheaper inputs. The result is improved profitability and competitiveness. However, other factors like new diseases or regulations restricting antibiotics also affect yield and production costs.

Agricultural production does not relate only to price levels but also to the need to ensure product quality and competitiveness. For example, in the poultry chain, research carried out in recent years was crucial to support exports, even without directly affecting production costs. For instance, Embrapa Swine and Poultry National Research Center addressed questions about litter management in the Brazilian broiler production compared to systems used in European Union countries, proving that both practices were equivalent. Similarly, studies also showed the equivalence of processes in both regions related to welfare and stunning practices used in the broiler industry, avoiding trade barrier impositions against Brazil.

The Brazilian research system worked hard to improve agricultural productivity and increase the number of scientific publications and citations. However, no index shows the effectiveness of innovations in the production sector (STAUBD, 2001; REZENDE, 2011; OLIVEIRA JÚNIOR, 2016; SIDONE et al., 2016). Such effectiveness represents the contribution of research to solve real problems of the production system or promote economic and social development. It requires identifying agricultural research questions, generating or adapting technological solutions with public or private cooperation, and, finally, transferring the new knowledge to complete the process. Part of the Brazilian agricultural R&D effort still assumes the 1970's vision that the innovation mission is to provide quantity, quality, and cheap food for the population. However, priorities are now mainly family farming, agroecology, nutraceuticals, enriched foods, and environmental issues.

Research may have positively affected crop yields, but it is clear that Brazilian agricultural production has expanded to new regions, far from consumption areas, where logistic costs are higher, implying higher food prices. The Midwest's share of the agricultural area with temporary and permanent crops was 51.69% in the 1997 to 2006 period and 69.57% from 2007 to 2015.

Another issue refers to the reduction of the public technical assistance structure, which left part of the five million rural holdings unattended. Cooperatives, private companies and traders now offer most technical assistance. Nonetheless, some knowledge areas, like integrated pest and disease management or soil conservation, may not have the necessary attention. Part of high food prices may result from inefficient use of supplies and improper soil management, leading to fertility losses and water deficit. As example, Garcia et al. (2008), Ávila et al. (2013), Garcia et al. (2015a), Garcia et al. (2015b), revealed the possibility of reducing pesticides and fertilizers used in soybean, corn, and cotton.

In addition to the direct impact on household income, rising food prices also affect the national price index and, consequently, the country's monetary policy.

The country's average annual inflation from 1997 to 2006 was 6.67%, while it was 5.62% for the ALIBEB sector. If the ALIBEB sector had a tax similar to the economy, the inflation would reach 7.00%. On the other hand, from 2007 to 2016, the average annual inflation was 6.18% and 8.90% in the ALIBEB sector. If the country index did not include that ALIBEB rate, national inflation would be 5.39%. Thus, in the first period, food product prices increased less than other product prices, helping the reduction of Brazilian inflation. However, in the second period, the situation reversed, and food prices were higher than other economic items increasing the global inflation index. Therefore, if the food was a cushion for inflation in the first decade, it became an expansion factor in the second.

Rising food prices cause inflation and higher Brazilian basic interest rates (Selic). According to the impulse response function estimates, one standard deviation increase in the Selic rate (3.8 percentage points) results in one point IPCA decrease (FONSECA et al., 2010). In 2016, the Brazilian public debt was 3.113 trillion reais, of which 28.2% indexed to the Selic and 31.8% to the IPCA (BRASIL, 2017). So, if the food inflation were similar to the average economy, it would cause an IPCA drop of 0.79% and a decrease of 3.0% in the Selic rate. Consequently, the Federal Government would have direct savings of R\$ 34.15 billion only with the interest payments. This information reinforces the importance of food supply and prices to the country's economy and that productivity is a central question for Brazilian agriculture.

### FINAL CONSIDERATIONS

This study highlights the behavior of agricultural product prices and IPCA, comparing periods of 1997 to 2006 and 2007 to 2016. The main finding is that most of the food prices increased more in the second decade than in the previous one and above the IPCA.

The analysis of main inputs indicate a significant price increase, not offset by productivity growth, which favored the rise of agricultural product prices. The development and use of better technologies for agriculture production can help product price reduction and soften high price impacts on consumers. However, productivity growth of most agricultural products some had modest and variable gains suggesting that modernization failed to keep the price stability, especially in the second decade.

The increase in food and beverage prices above the IPCA index suggests the need for additional studies to explore and measure the causes. The development and use of modern technology, the influence of production costs on retail prices, the inclusion of new production areas and logistics, exchange rate, and export volumes are examples of subjects to be addressed.

# Análise exploratória da inflação dos alimentos no Brasil entre os anos de 1996 e 2016

## RESUMO

Este artigo explora as possíveis causas da inflação nos preços dos produtos alimentares e na agricultura brasileira nos últimos vinte anos, comparando os dados de duas décadas. Verificou-se que na década de 2007 a 2016 os preços dos itens da alimentação tiveram uma elevação maior que os da economia em geral medida pelo IPCA, Índice de preços amplo do IBGE. Ainda que outros trabalhos tenham estudado o comportamento da inflação dos alimentos, pouco foi explorado sobre as causas que determinaram este aumento, o que é objetivo deste trabalho. Esta crise silenciosa da elevação dos preços dos alimentos não foi percebida pela população devido às políticas públicas de crescimento da renda decorrente do aumento real do salário mínimo, dos valores da aposentadoria e da bolsa família. A grande expansão da demanda por produtos da agricultura, causada por um lado pelo boom mundial da China e por outro pelo aumento do consumo interno brasileiro consequência da elevação da renda na última década, não foi acompanhada por ganhos expressivos de produtividade, causando a elevação dos preços dos produtos agropecuários. O aumento da produtividade por meio da aplicação de melhor tecnologia poderia amenizar o impacto da demanda nos preços, contudo, no período mais recente, não foram obtidos ganhos de produtividade em vários produtos agrícolas no Brasil.

**PALAVRAS-CHAVE:** Preços dos alimentos. Inflação. Insumos. Produtividade.

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