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# How to deflate federal tax revenues? A proposal for a price index for taxes

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## Abstract

The present study proposes the creation of a federal tax revenue deflator, based on data classified by CNAE industries and type of tax, made available by the Brazilian Federal Revenue Secretariat (RFB-ME). The starting point are industry-specific deflators and weights for specific taxes in each industry that are multiplied by the change in industry indices. The total deflator is the weighted sum of each tax deflator. The deflated results showed that tax revenues increased from R$ 1.3 trillion in 2016 to R$ 1.437 trillion in 2021, with a real increase of 8.8% in the period, which is equivalent to a growth of 1.7% a year. In the second part of the study, simulations are carried out to identify the effects of changes in prices on the tax revenue. Results show that a drop in 12% on commodity prices impacts the tax revenue in 0.4%, due to an exchange rate devaluation of 5% in relation to a base scenario. However, in the absence of an exchange rate compensation, the impact on the tax revenue will be of -1.4%.

**Keywords:** deflator, tax revenue, tax, inflation, industries.

**JEL:** C53, E31, E62

# SUMÁRIO

## 1. Introduction

Studies on taxation generally simplify the analysis for the collection in real terms using the IPCA as a deflator. When it comes to the analysis of total collections, the simplification shows satisfactory results. It can be observed, for example, that in the National Treasury Results, the disclosure of the evolution of central government revenue and expenditure is presented in current values in Reais and deflated by the IPCA. For more detailed disclosure, Brazilian government agencies usually publish reports and studies in which the tax collection in real terms is deflated by the IPCA, or by the IGP-DI or by the implicit GDP deflator, or even by a combination of these indicators. This procedure aims to capture more accurately the movements of tax collection in the various taxes. However, a greater refinement of the deflator is necessary when one seeks to analyze the components of tax collection by class of tax, by economic sector, or by region, among other details.

In this paper we first present a methodology that makes it possible to calculate an index to deflate the federal collection, according to the different taxes and their breakdown by sectors. It is observed, beforehand, that the implicit deflator of tax collection is more related to the GDP deflator[1] than other price indexes, such as IPCA and IGP-DI. In this context, after correcting for inflationary effects, it is possible to analyze the variation in tax collection, which encompasses changes arising from economic growth, tax changes and deferrals. Based on the proposed deflator, we present a simulator, using econometric models, which allows us to evaluate the fiscal performance in scenarios with price changes, such as changes in commodity prices.

Inflation affects nominal values throughout the economy, and government tax collection is no exception. The most widely discussed impact of inflation on public finances by economists is the so-called "inflation tax", which impacts tax collection in a positive way. However, the nominal values of tax revenues also lose value with currency devaluation, and they do so in a very particular way, as described and analyzed by Neumark (1978).

As previously mentioned, the correlation between inflation and tax collection occurs mainly with the GDP deflator. Furthermore, historically, the GDP deflator is higher than the IPCA. Using the average annual variations since 1997, the deflator exceeds, on average, 1.3 p.p. the IPCA. Another characteristic is that the deflator was exceeded by the IPCA in 2000, 2003 and between 2015-17, recessionary periods.

Within this debate, Silva et al. (2017) suggest that the relationship between the GDP deflator and the IPCA seems to be implicitly associated with the exchange rate and the output gap. In recessionary periods, there is a lower relationship between the GDP deflator and the IPCA, due to the

1 Many statistical agencies use the GDP deflator when it comes to determining real values of variables. The Bureau of Economic Analysis - BEA, in the USA, calculates the implicit GDP deflator, following international methodology and standard. According to the BEA, the GDP deflator is a measure of inflation in the prices of goods and services produced in the United States, including exports, assessing in a broad way the effect on the price of the various sectors that produce in the economy. The IBGE follows the same approach as the IMF manuals, seeking to integrate the different surveys, such as balance of payment, national accounts.

greater difficulty of firms to pass on the increased costs resulting from an exchange rate depreciation to the final consumer. In times of economic recovery, the IPCA is expected to be below the GDP deflator. Another possibility is the dynamic rise in commodity prices, which impacts the GDP deflator more since it considers the intermediate and wholesale sector. In short, when considering the IPCA, the implicit inflation of the federal collection is apparently underestimated.

The article by Gadelha et al. (2017) uses tax collection data deflated by IPCA and the authors acknowledge that, "it is known that the choice of a single deflator for the macroeconomic variables is not the most appropriate measure, since each of them has implicit deflators in the basket of products. This analysis by decomposition will be followed for the analysis of the rates on income, labor and capital".

However, when using general price indicators, such as the IGP-DI, there are indications that the value could be overestimated. In the period under analysis, the annual variation of the IGP-DI exceeds the GDP deflator 50% of the time, being, on average, 1.4 p.p. higher.

This debate has already occurred in other periods. In 2001, the BCB had already analyzed the issue and found that one of the implications of these results was that the nominal GDP projection, prepared by the Bank itself and which uses the IGP-DI as a proxy of the deflator, was higher than that effectively disclosed by the IBGE. The choice of the IGP-DI was due to the wider range of products in its methodology, which historically would bring it closer to the GDP price variation.

A study by DAS, A. & SENAPATI, M. GDP (2007) from the Reserve Bank of India also debates the issue of using the implicit GDP deflator and other measures of inflation. The authors argue that inflation, which is an increase in the general price level, is not easy to measure. Many price statistics are available, such as the Wholesale Price Index (WPI), which tracks commodity prices and wholesale markets, and the price index for consumer (retail) goods and services. There are also the broader indexes, based on GDP, which suggest a greater suitability for deflating federal tax revenues. The authors show that while each of the measures has advantages and disadvantages, the index selected should broadly capture the interaction of the various sectors and products at various stages of the economy.

In this context, this study seeks to present a more detailed alternative for the deflator of federal collection, combining price variation indexers specific to the sectors related to the taxes researched and weighting them by the percentage of each sector in each of the federal taxes or contributions. In other words, we seek to collaborate with this debate for the choice of a composite deflator based on the specific deflator for each tax and its aggregation into a deflator for the total collection.

The first part of this work proposes the elaboration of a deflator of federal tax collection, based on tax collection data by National Classification of Economic Activities (CNAE) and Taxes, made available by the Special Secretariat of Federal Revenue of the Ministry of Economy. The period analyzed was from 2016 to May 2022, for 24 economic sectors. Initially, deflators were defined for each of the economic sectors in the collection, seeking an adherence of the indicator to the economic activity

represented in that sector. Next, the weights of the specific taxes in each sector were weighted and multiplied by the variation of sectorial indicators. Finally, a second weighting was carried out for the construction of the total deflator of federal collection, based on the weights of taxes and contributions in total collection multiplied by the deflators of each tax or contribution.

In section 5, simulations and forecasts, we present a model that addresses the discussion about the effect of changes in domestic and international inflation on the tax collection projections made by the Brazilian Federal Revenue Service (RFB). A system of equations with recursive models is proposed for the effects of changes in commodities, foreign exchange, wholesale and consumer prices. Subsequently, given an alternative scenario of the nominal indicators listed, the difference in the trajectory of the price indexes is calculated in relation to the base scenario contained in the Parameter Grid. These new scenarios change the projections of the deflators of each collection line item and consequently the value added. With the RFB's annual projections, it is possible to sensitize this estimate with the alternative scenario. As an example, we estimate a monthly linear reduction of 1 p.p. of the commodities in 12 months and the effect on federal collection.

## 2. Data used

The database used was the collection by CNAE and Taxes, made available on the website of the Special Secretariat of Federal Revenue (RFB) of the Ministry of Economy. The period made available was January 2016 to May 2022, for 24 economic sectors, according to the CNAE classification. Table 1 shows the federal tax collection by sector:

- Agriculture, livestock, forestry, fishing, and aquaculture.
- Extractive Industry.
- Manufacturing Industry.
- Industrial Utility Services: divided into Electricity and Gas and Water, Sewerage, Waste Management Activity and Decontamination.
- Construction.
- Trade, repair of motor vehicles and motorcycles.
- Services: divided into Transportation, storage, and mail. Accommodation and food. Information and communication. Professional, administrative, and complementary services. Financial, insurance, and related services. Real estate activities. Other service activities.
- Public administration, defense and social security.
- Health and education.
- Individual.
- Other, composed of the sectors Domestic Services; Invalid; Uninformed and International Organizations and other extraterritorial institutions.

The collection of federal revenues totaled R$ 1.357 trillion in 2016 and R$ 1.927 trillion in 2021. In this period, there was a nominal growth of 41.9% in federal revenues. The sector with the largest share in the total collected is the Manufacturing Industry (26.0%), followed by Trade, repair of motor vehicles and motorcycles (16.8%), Financial activities, insurance and related services (16.3%) and Professional, administrative and complementary services (7.1%).

In the aggregate result by sectors, services is the sector whose collection is closest to its share of GDP. This sector accounted for 63.7% of total federal revenue collection, while its share of GDP reached 59.4% in 2021. Agriculture, on the other hand, collected 0.6% of federal taxes and contributed 6.9% of the added value of the GDP. Industry, in turn, was the sector that collected the most in proportion to federal revenues (35.7% of revenues and 8.9% share of GDP).

**Table 1** - Federal revenue collection (at current prices)

| Sector | 2016 | 2021 | Participation in 2021 | Growth (%) |
|---|---|---|---|---|
| **TOTAL AGRICULTURE** | **4.222** | **11.505** | **0.6%** | **172.5%** |
| Agriculture, livestock, forestry, fishing | 4.222 | 11.506 | 0.6% | 172.5% |
| **TOTAL INDUSTRY** | **445.543** | **687.615** | **35.7%** | **54.3%** |
| - Extractive Industries | 12.716 | 76.039 | 3.9% | 498.0% |
| - Transformation Industries | 329.022 | 501.781 | 26.0% | 52.5% |
| Electricity and gas | 28.657 | 44.025 | 2.3% | 53.6% |
| Water, sewage, waste management activity | 9.425 | 18.943 | 1.0% | 101.0% |
| Construction | 65.722 | 46.828 | 2.4% | 28 7% |
| **TOTAL SERVICES** | **908.117** | **1.227.971** | **63.7%** | **35.2%** |
| Trade; repair of motor vehicles | 153.755 | 323.763 | 16.8% | 110.6% |
| Transportation. warehousing and mailing | 78.360 | 72.450 | 3.8% | 7.5% |
| Accommodation and meals | 13.953 | 15.592 | 0.8% | 11.7% |
| - Information and Communication | 71.515 | 79.247 | 4.1% | 10.8% |
| Professional, administrative and complementary services | 78.143 | 136.023 | 7.1% | 74.1% |
| Financial activities, insurance and related services | 212.340 | 313.600 | 16.3% | 47.7% |
| Real Estate Activities | 9.835 | 17.032 | 0.9% | 73.2% |
| Other service activities | 7.566 | 11.086 | 0.6% | 46.5% |
| Public administration, defense and social security | 138.285 | 101.317 | 5.3% | 26. 7% |
| Health and Education | 46.977 | 80.035 | 4.2% | 70.4% |
| Individual | 93.988 | 74.321 | 3.9% | 20.9% |
| Other | 3.401 | 3.506 | 0.2% | 3.1% |
| **TOTAL** | **1.357.882** | **1.927.091** | **100.0%** | **41.9%** |

Source: RFB/ME

Table 2 shows the collection by tax revenues, totaling the same values as Table 1. The following taxes and contributions are included in this table:

- **Social Security Contribution:** contributions that are levied on the salaries or on the gross revenue from the commercialization of the production, in the case of the rural producer as an individual and the specially insured.
- **Contributions to the Social Integration and Public Service Employee Savings Programs - PIS/PASEP (Pis):** a tax calculated monthly by the legal entities, based on billing or gross revenue.
- **Contribution for the financing of Social Security (Cofins):** a tax calculated monthly by legal entities, based on billing or gross revenue.
- **Withholding Income Tax (IRRF):** levied on the income and earnings of taxpayers residing in the country or resident abroad who receive income from sources in Brazil. It is levied on income (salaries, benefits, and remuneration for services rendered), capital gains, interest, and other income (such as rents and copyrights) or proceeds (such as retirement).
- **Personal Income Tax (IRPF):** tax levied on individuals' income and capital gains.
- **Corporate Income Tax (IRPJ):** levied on legal entities in general, based on profit, which can be actual, presumed, or arbitrated.
- **Social Contribution on Net Profit (CSLL):** a tax that is also levied on the profit of legal entities in general.
- **Unified payment:** refers to the payments of federal taxes of distinct types of taxes in a single collection document. It may aggregate collections of IRPJ, PIS, Cofins, CSLL, IPI, and the employer's social security contribution.
- **Revenues not managed by the Internal Revenue Service:** this item includes mainly oil royalties and special participations from oil.
- **Tax on Industrialized Products (IPI):** a tax levied on domestic and foreign industrialized products, the triggering event of which is the import and the exit of the product from the industrial establishment in internal operations.
- **Import tax:** a tax levied on foreign goods when they enter the national territory.
- **Tax on Credit, Exchange, and Insurance Operations or Operations Related to Securities (IOF):** levied on credit operations, exchange, insurance operations carried out by insurance companies, operations related to securities, and operations with gold, financial assets, or foreign exchange instruments.
- **Contribution to the Public Servants' Social Security Plan (CPSSS):** levied on the remuneration of civil public servants of the federal government, independent government agencies, and public foundations.

- **Contribution for Intervention in the Economic Domain (Cide):** levied on the importation and sale of oil and its derivatives, natural gas and its derivatives, and ethyl alcohol fuel. in addition to the amounts paid or remitted as royalties or remuneration, in the supply of technology, provision of technical assistance, technical and administrative assistance services, assignment and licensing of use of trademarks, and patent exploitation.
- **Rural Land Tax (ITR):** a tax that has as its generating fact the ownership or possession of real estate located outside the urban zone of the municipalities.
- **Export Tax (IE):** levied on the exit of national products from the national territory.

**Table 2** - Federal revenue collection (at current prices)

| Recipes | 2016 | 2021 | % in 2021 | Growth (%) |
|---|---|---|---|---|
| Social Security Contribution | 382.134 | 481.156 | 25.0% | 25.9% |
| IRRF | 193.279 | 256.692 | 13.3% | 32.8% |
| Cofins | 176.459 | 255.357 | 13.3% | 44.7% |
| IRPJ | 128.531 | 235.232 | 12.2% | 83.0% |
| CSLL | 58.117 | 113.809 | 5.9% | 95.8% |
| Unified Payment | 115.659 | 104.986 | 5.4% | -9.2% |
| Unmanaged Revenues | 41.488 | 93.669 | 4.9% | 125.8% |
| IPI | 44.078 | 73.806 | 3.8% | 67.4% |
| PIS/Pasep | 48.355 | 72.920 | 3.8% | 50.8% |
| II | 31.457 | 62.072 | 3.2% | 97.3% |
| IRPF | 30.319 | 55.981 | 2.9% | 84.6% |
| IOF | 33.650 | 48.625 | 2.5% | 44.5% |
| CPSSS | 30.701 | 40.864 | 2.1% | 33.1% |
| Other Administered Revenues | 33.912 | 20.854 | 1.1% | -38.5% |
| Cide | 8.498 | 8.730 | 0.5% | 2.7% |
| ITR | 1.225 | 2.337 | 0.1% | 90.7% |
| IE | 19 | 2 | 0.0% | -90.4% |
| TOTAL | **1.357.882** | **1.927.091** | **100.0%** | **41,9%** |

Source: RFB/ME

Besides this, this database allows an intersection of tax collection by economic sector and federal tax revenues, which makes it easier to visualize the most collected taxes and contributions by economic sector or the most relevant economic sectors in the collection of each tax , as can be seen in Table 3.

**Table 3** - Participation of economic sectors in federal tax and contribution collection from 2016 to 2021 (in %)

| Sector | II | IE | IPI | IRPF | IRPJ | IRRF | IOF | PIS/ Pasep |
|---|---|---|---|---|---|---|---|---|
| Agriculture, livestock, forestry, fishing and aquaculture | - | 0.6% | - | - | - | - | - | - |
| Extractive industries | - | 1.9% | - | - | 5.5% | 1.0% | - | - |
| Transformation Industries | 51.5% | 75.5% | 57.0% | - | 20.1% | 12.1% | - | 28.3% |
| Electricity and gas | - | - | - | - | 4.4% | 15% | - | 5.0% |
| Water, sewage, waste management activity and decontamination | | | | | 13% | | | 14% |
| Construction | - | - | - | - | 2.8% | 12% | - | 2.1% |
| Trade; repair of motor vehicles and motorcycles | 38.7% | 14.7% | 25.5% | - | 15.4% | 5.2% | - | 14.8% |
| Transportation, Warehousing and Mail | 2.1% | - | - | - | 4.3% | 2.3% | - | 3.3% |
| Accommodation and meals | - | - | - | - | - | - | - | - |
| Information and communication | 1.0% | - | 1.1% | - | 3.9% | 5.9% | - | 3.4% |
| Professional, administrative and complementary services | 4.3% | 14% | 4.9% | | 9.5% | 5.8% | | 5.3% |
| Financial activities, insurance and related services | - | 2.5% | - | - | 22.7% | 37.2% | | 8.2% |
| Real Estate Activities | - | - | - | - | 2.5% | - | | 10% |
| Other service activities | - | - | - | - | - | 13% | - | - |
| Public administration, defense and social security | - | - | - | - | 2.4% | 15.5% | - | 22.7% |
| Health and Education | - | - | - | - | 3.1% | 7.3% | - | 2.4% |
| Individuals | - | 14% | - | 100.0% | - | - | - | - |
| Other | - | - | - | 0.0% | - | - | - | - |
| **TOTAL** | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **100.0%** |

Source RFB Note: Values lower than 1% were disregarded.

| Sector | ITR | Cofins | CSLL | Cide | Social Security Contribution | CPSSS | Unified Payment | Other Managed Revenues | Unmanaged Revenue |
|---|---|---|---|---|---|---|---|---|---|
| Agriculture, livestock, forestry, fishing and aquaculture | 16.2% | - | - | - | - | - | - | - | - |
| Extractive industries | 15% | 1.0% | 6.0% | 2.3% | 1.1% | - | 1.9% | - | 19.2% |
| Transformation Industries | 35% | 36.3% | 19.0% | 53.7% | 26.5% | - | 17.6% | 211% | |
| Electricity and gas | - | 6.4% | 4.6% | 0.8% | 1.2% | - | 1.5% | - | |
| Water, sewage, waste management activity and decontamination | - | 1.6% | 1.3% | | 1.2% | - | - | | 1.5% |
| Construction | - | 2.7% | 2.9% | - | 5.9% | - | 5.3% | 3.7% | 4.4% |
| Trade; repair of motor vehicles and motorcycles | - | 19.2% | 15.1% | 10.6% | 14.8% | - | 29.4% | 85% | - |
| Transportation, Warehousing and Mail | - | 4.3% | 3.8% | 1.6% | 9.4% | - | 4.6% | 15% | - |
| Accommodation and meals | - | - | - | - | 1.3% | - | 4.2% | - | - |
| Information and communication | - | 4.4% | 3.2% | 9.9% | 7.2% | - | 3.5% | 1.6% | - |
| Professional, administrative and complementary services | - | 6.5% | 7.8% | 15.0% | 7.7% | - | 10.2% | 45% | - |
| Financial activities, insurance and related services | 35% | 13.0% | 29.036 | 4.5% | 8.1% | 2.1% | 7.2% | 316% | 1.1% |
| Real Estate Activities | 3.7% | 1.3% | 2.4% | - | - | - | - | - | - |
| Other service activities | - | - | - | - | - | - | 1.7% | - | - |
| Public administration, defense and social security | - | - | - | - | 2.5% | 69.7% | 3.2% | 20.3% | 15.0% |
| Health and Education | - | 1.8% | 2.9% | - | 3.9% | 27.2% | 6.4% | 12% | 2.2% |
| Individuals | 67.4% | - | - | - | 7.2% | - | - | 2.4% | 1.6% |
| Other | - | - | - | - | - | - | - | - | - |
| **TOTAL** | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **100.0%** |

Source RFB Note: Values lower than 1% were disregarded.

## 2.1 Database limitations

Despite allowing the visualization of federal revenues in a differentiated way, this database presents some limitations. For example, the revenue Unified Payment does not appear in the Federal Revenue Collection Bulletin, because this item represents the collection of taxes in a single tab, as in the Simples Nacional. Subsequently, the Special Secretary of Inland Revenue divides the taxes and aggregates them into the correct classification.

In the revenues administered by other organs, only the oil royalties, the special oil participations and some revenues from active debt (not very representative) are considered. This fact differs from the collection of revenues not managed by the RFB that are included in the National Treasury Collection Bulletin, which has a broader base.

In the social security revenue, however, lay the greatest limitation of this database, which caused some changes to be made. In this item, it is provided only by Federal Revenue Collection Document (DARF) and not by GPS (Social Security Guide). In the years from 2016 to 2018, the social security contribution revenue by DARF was small if compared to the collection by GPS, which has been changing in the subsequent period. For example, in 2016, the collection by DARF was 6% of the total social security contribution collection. Thus, based on the total social security contribution collection, available in another bulletin from the Special Secretariat of the Federal Revenue, an extrapolation of these new values was made for the entire original base, maintaining the original sector participations.

## 3. The federal tax collection deflator

Based on these considerations, this study presents the systematic elaboration of the proposed federal tax collection deflator. Initially, deflators were defined for each of the economic sectors in the tax collection, seeking an adherence of the indicator to the economic activity represented in that sector. The selected indicators came from the Extended Producer Price Index - IPA and the National Index of Construction Cost - INCC, produced by the FGV; the Extended Consumer Price Index - IPCA, the Monthly Services Survey - PMS and the Monthly Trade Survey - PMC, produced by the IBGE, as can be seen in Table 4. After this, the variation of the sectorial indicators was built.

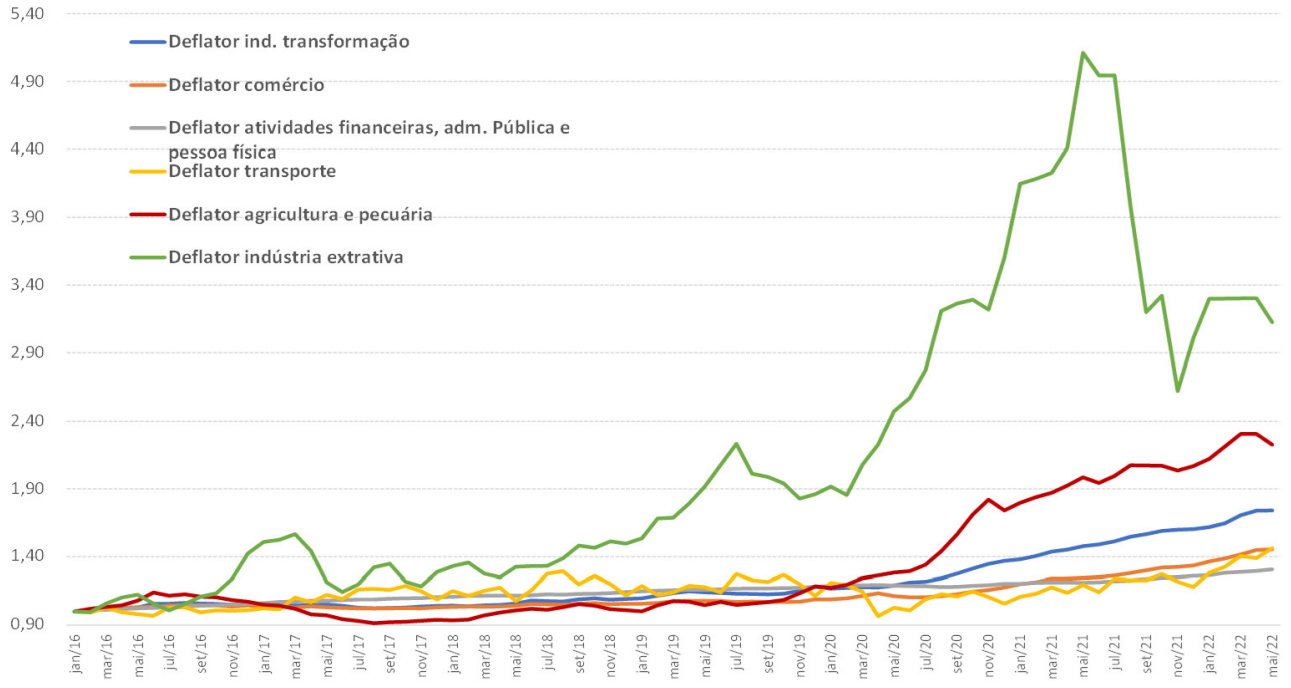
**Table 4**

| CNAE Section | Name | Deflator Index |
|---|---|---|
| A | Agriculture, livestock, forestry, fishing and aquaculture | IPA agricultural products |
| B | Extractive Industries | IPA extractive industry |
| C | Transformation Industries | IPA Finished Goods |
| D | Electricity and gas | IPCA Fuel and Energy |
| E | Water, sewage, waste management activity and decontamination | IPCA Water and Sewage Rate |
| F | Construction | INCC materials and services |
| G | Trade: repair of motor vehicles and motorcycles | Implicit PMC deflator |
| H | Transportation, Warehousing and Mail | PMS whistleblower transportation |
| I | Accommodation and meals | PMS Accommodation and meals |
| IN | Invalid | IPCA |
| J | Information and Communication | FMS information and communication services |
| K | Financial, insurance and related services activities | IPCA services |
| L | Real Estate Activities | FCA services |
| M | Professional, scientific and technical activities | PMS Professional, Administrative and Complementary Services |
| N | Administrative activities and complementary services | PMS Professional, Administrative and Complementary Services |
| NI | Not Informed | IPCA |

| | | |
|---|---|---|
| 0 | Public administration, defense and social security | IPCA services |
| P | Education | IPCA services |
| PF | Individual | IPCA services |
| Q | Human health and social services | IPCA services |
| R | Air, Culture, Sport and Recreation | IPCA services |
| S | Other service activities | PMS - other services |
| T | Domestic services | IPCA services |
| U | International organizations and other extraterritorial institutions | IPCA services |

The deflators constructed for selected economic sectors are presented in Graph 1. The extractive industry deflator was the one that registered the highest variation (37.3% between Dec/21 and July/22) throughout 2021, due to successive increases in mineral and agricultural commodity prices. The agriculture, livestock, forest production and fishing deflator showed the second highest variation and went from 1.0 in Jan/2016 to 2.23 in May/2022, indicating a percentage variation of 122.7% over the period. The transformation industry deflator, in turn, was the one that showed the third highest increase (74.0%).

**Chart 1** - Sector Deflators (Index: Jan/2016 = 1)

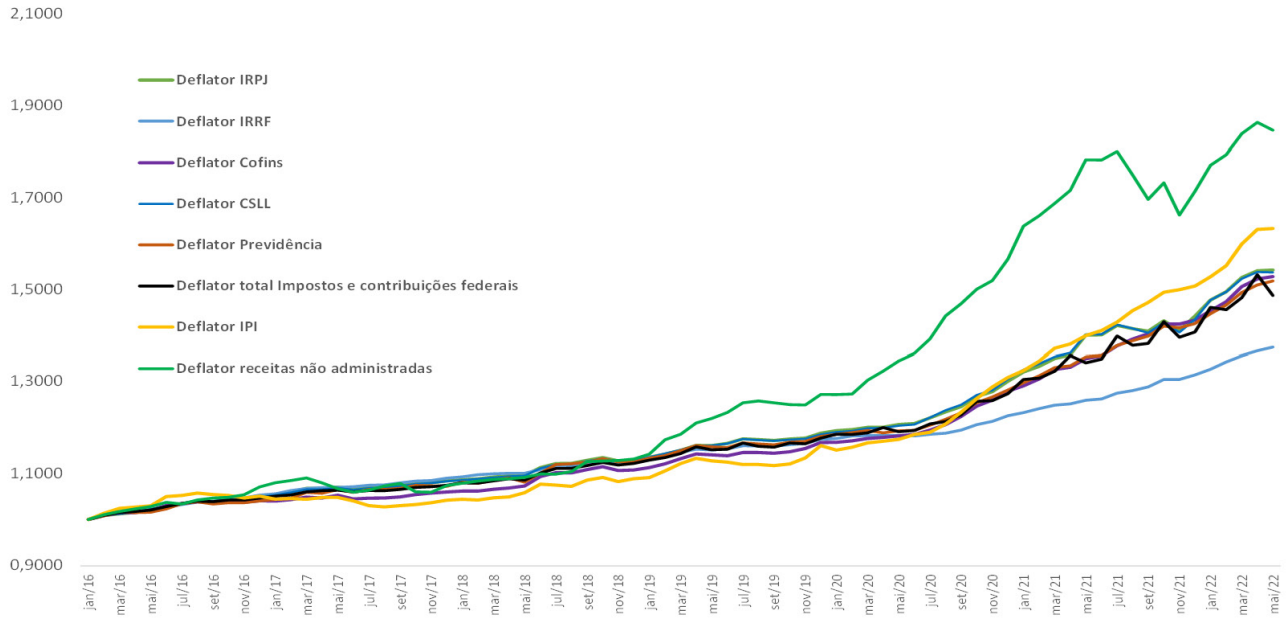



Deflator Transformation index / Trade Deflator / Financial Activities, Public Administration and Individuals Deflator / Transport Deflator / Agriculture and Livestock Deflator / Extractive Industry Deflator

Source RFB/ME Preparation SPE/ME

Some of the deflators by taxes and contributions are presented in Graph 2, where it can be seen that a large portion of the deflators registered a behavior similar to the total aggregate deflator. The set of Non-Managed Revenues was the one that registered the highest percentage variation (84.6% between May/22 and January/16), due to the increase in oil prices. The second largest increase was seen in the variation of the IPI deflator (63.3%). The deflator with the smallest variation was the one referring to the IRRF (37.4%). A large portion of the deflators registered a behavior similar to the total aggregate deflator.

**Graph 2** - Tax Deflators (Index: Jan/2016 - 1)




IRPJ Deflator / IRRF Deflator / CSLL Deflator / Social Security Deflator / Total Deflator Federal Taxes and Contributions / IPI Deflator / Deflator Unmanaged Revenues

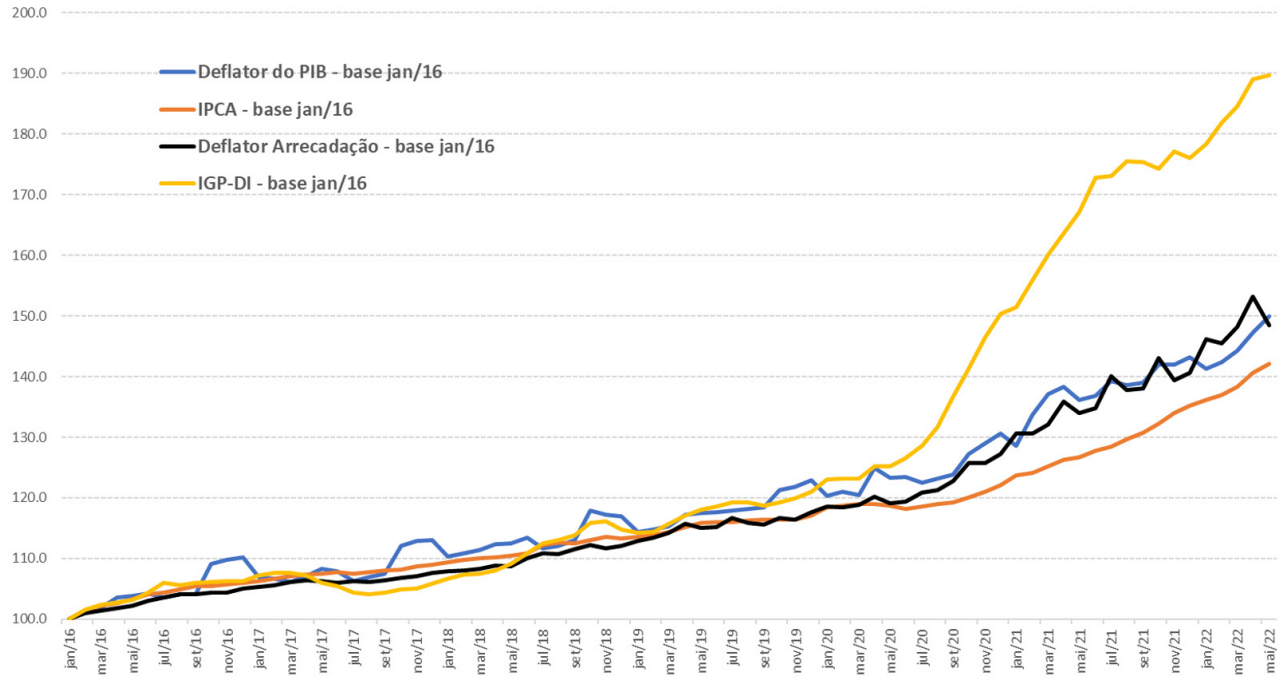
Source RFB/ME Preparation SPE/ME

After determining the deflators by sector and by type of tax, the weights of the specific taxes in each sector were weighted and multiplied by the variation of sectorial indicators. Finally, a second weighting was carried out to construct the total deflator of federal collection, based on the weights of the taxes and contributions in total collection multiplied by the deflators of each tax or contribution.

Chart 3 shows a comparison of the tax collection deflator with other inflation indexes. As can be seen, the estimated deflator is very similar to the GDP deflator, since both are very comprehensive. Like the GDP deflator, which considers the price variation of the value added of all production flows in a given period, the federal tax collection deflator considers the price variations of all economic sectors in a proportional way in tax collection. Besides this, the accumulated IPCA index was lower than the variation of the deflator index of federal tax collection in this analyzed period. The accumulated index of the IGP-DI, on the other hand, was the one that registered the greatest variation in the analyzed

period, mainly due to the greater influence of the exchange rate on this indicator, as pointed out in the introduction of this text.

**Graph 3** - Inflation indexes




GDP Deflator - Jan/16 basis / IPCA-base Jan/16 / Collections Deflator - Jan/16 basis / IGP Dl -base Jan/16

Source: IBGE, FGV and SPE Prepared by SPE/ME

## 4. Deflated tax collection

The results found show that deflated federal revenues grew from R$1.3 trillion in 2016 to R$1.437 trillion in 2021, which represents a growth of 8.8% over the period and 1.7% per year (Table 5). The taxes that had the highest increases were the IRPF (9.2%), Import Tax (8.2%), ITR (8.1%) and CSLL (7.5%). The biggest drops were in Export Tax (41.2%), Other Revenues (-13.4%), and Unified Payment (-6.4%).

**Table 5** - Federal revenue collection (deflated values)

(R$ Million)

| Taxes and social contributions | 2016 | 2021 | % in 2021 | Growth Accumulated (%) | Growth annual average (%) |
|---|---|---|---|---|---|
| Social Security Contribution | 372 690 | 364.071 | 253% | -2% | -0,5% |
| IRRF | 187.744 | 203.480 | 142% | 8.4% | 1,6% |
| Cofins | 172071 | 189.482 | 132% | 10,1% | 1.9% |
| IRPJ | 125.112 | 167.638 | 11,7% | 34.0% | 6.0% |
| CSLL | 56.803 | 81.695 | 5,7% | 433% | 7,5% |
| Unified Payment | 112427 | 80.558 | 5.6% | -283% | -6.4% |
| PIS/Pasep | 47.118 | 55.333 | 3,8% | 17.4% | 3.3% |
| Unmanaged Revenues | 40.048 | 54.930 | 3.8% | 372% | 6.5% |
| IPI | 42469 | 52.304 | 3.6% | 232% | 4.3% |
| IRPF | 29.470 | 45.720 | 3.2% | 55,1% | 9.2% |
| II | 30.396 | 45.111 | 3.1% | 48.4% | 8.2% |
| IOF | 32 684 | 39.520 | 27% | 205% | 3.9% |
| CPSSS | 29.747 | 33.291 | 23% | 113% | 2.3% |
| Other Revenues | 32576 | 15.883 | 11% | -512% | -13.4% |
| Cide | 8.206 | 6.565 | 0.5% | -20,0% | -4.4% |
| ITR | 1166 | 1.723 | 0.1% | 47.7% | 8.1% |
| IE | 18 | 1 | 0.0% | -93,0% | -41.2% |
| **TOTAL** | **1.320.747** | **1.437.306** | **100,0%** | **8,8%** | **1,7%** |

Source: SERFB/ MC

**Table 6** - Federal revenue collection by CNAL sectors (deflated values)

(R$ Million)

| Sectors | 2016 | 2021 | % in 2021 | Accumulated growth (%) | Average annual growth (%) |
|---|---|---|---|---|---|
| **TOTAL AGRICULTURE** | **3.928** | **5.821** | **0.4%** | **48.2%** | **8.2%** |
| - Agriculture. livestock, forestry, fishing | 3.928 | 5.821 | 0.4% | 48.2% | 82% |
| **TOTAL INDUSTRY** | **431.491** | **428.653** | **29.8%** | **-0.7%** | **-0.1%** |
| - Extractive Industries | 11.708 | 19.432 | 1.4% | 68.0% | 10.7% |
| - Transformation Industries | 316 229 | 333.072 | 23.2% | 5.3% | 1.0% |
| - Electricity and gas | 30.254 | 33.044 | 23% | 9.2% | 1.8% |
| - Water, sewage, waste management and decontamination | 8.421 | 12194 | 0.8% | 44.8% | 7.7% |
| - Building & Construction | 64880 | 30.911 | 22% | -52.4% | -13.8% |
| **TOTAL SERVICES** | **885.328** | **1.002.831** | **69.8%** | **13.3%** | **2.5%** |
| - Trade; repair of vehicles and motorcycles | 149.074 | 255.112 | 17.7% | 71.1% | 11.3% |
| - Transportation, Warehousing and Mail | 78078 | 61.134 | 4.3% | -21.7% | -4.8% |
| - Accommodation and meals | 13713 | 12634 | 0.9% | -7.9% | -1.8% |
| - Information and Communication | 71.493 | 74.476 | 5.2% | 4.2% | 0.8% |

| | | | | | |
|---|---|---|---|---|---|
| - Professional, administrative and complementary services | 76043 | 109.279 | 7.6% | 43.7% | 7.5% |
| - Financial activities, insurance and related services | 208.378 | 255.983 | 17.8% | 24.0% | 4.4% |
| - Real Estate Activities | 9.571 | 13.899 | 1.0% | 45.2% | 7.7% |
| - Other service activities | 7.350 | 9 007 | 0.6% | 225% | 4.1% |
| -Public administration, defense and social security | 133.520 | 82592 | 5.7% | -38.1% | -9.2% |
| - Health and Education | 45578 | 65.210 | 4.5% | 43.1% | 7.4% |
| - Individual | 91.228 | 80.655 | 4.2% | -33.5% | -7.8% |
| - Other | 3.304 | 2850 | 0.2% | -13.7% | -29% |
| **TOTAL** | **1.320.747** | **1.437.306** | **100.0%** | **83%** | **1.7%** |

Source: SERFB/ME

In an aggregated way, it was noticed a higher growth of federal collection in agriculture, with an average annual growth of 8.2%. The services sector registered the second highest growth rate in tax collection, with an average annual increase of 2.5%, influenced mainly by the performance of Commerce (average annual growth of 11.3%), Furniture activities (7.7%), Professional administrative and complementary services (7.5%), and Health and education (7.4%). Industry, on the other hand, registered a drop in real collection, despite the good performance of collection in the extractive industry (10.7%). In the general picture, the sectors with the greatest retraction were Construction (-13.8%), Public administration, defense, and social security (9.2%) and Individuals (-7.8%).

In a comparison with the performance of the GDP described in Table 7, one can see a direct association of the real variations found between the deflators of tax collection and the real growth of the GDP. For GDP, as well as for the agriculture, industry and services sectors, there are similar results, which, however, diverge in magnitude.

**Table 7**

| | **% in 2021** | **Accumulated growth (%)** | **Average annual growth (% )** |
|---|---|---|---|
| **GDP** | **100.0%** | **5.0%** | **1.0%** |
| - Agriculture | 6.9% | 20.2% | 3.7% |
| - Industry | 18.9% | 0.5% | 0.1% |
| - Services | 59.4% | 4.6% | 0.9% |

## 5. Simulations and predictions

The second part of this paper performs simulations for federal tax and contribution revenues for the coming years. Before obtaining the regressions of the variables related to the tax revenues themselves, we project the CRB commodity index and the monthly GDP indicator according to the method of Chow and Li (2006) with different auxiliary variables with monthly frequency, which transforms low frequency series into high. Since the data for these variables goes until mid-2022, it is necessary to project them from that date until the end of the projection horizon.

To get the projection for the CRB commodity index, a linear regression is estimated by ordinary least squares of the previous 12-month variation of the CRB against the previous 12-month variation of the international price of coffee, meat, soybeans, wheat, and Brent oil, in addition to the previous 12-month variation of the dollar rate.

The projection of monthly GDP results, first, from the linear regression of the interannual variation of monthly GDP in relation to its first lag, the 12-month change in the real SELIC rate, the interannual change in the occupied population, non-fuel imports, and the PIM-industry, plus an MA(1) component.

The stepwise combinatorial method is used to select the variables that would compose the final model. This method consists of adopting an automated method for choosing the final model specification from a generic specification. In the combinatorial version, the stepwise method compares all model specifications with combinations of L variables from a total of K variables, where L < K, choosing the model which gives the highest R Square. Once the coefficients from this regression are obtained, we use them to obtain a projection of monthly GDP.

Once the forecasts for monthly GDP were obtained, regressions of the deflators constructed for each type of tax against inflation indices and control variables were estimated. In particular, combinatorial stepwise regressions were estimated in which the dependent variable is the interannual change of the deflator of a particular tax against its first lag. Other dependent variables are the interannual changes in the IGP-DI, the IPCA, commodity prices and their lags (up to 12 months), and the dollar. Not all regressions include all these regressors. To choose the best model, we use the stepwise combinatorial algorithm from 3 to 5 variables with coefficient restriction, depending on the equation. The equations for the deflators can be described by the equation:

$$\Delta_{12} Defl_{i,t} = \beta_{0i} + \beta_{1i}\Delta_{12} Defl_{i,t-1} + \beta_{2i}\Delta_{12} IGPDI_t + \beta_{3i}\Delta_{12} IPCA_t + \beta_{4i}\Delta_{12} Cambio_t + \sum_{k=5}^{13}\sum_{j=0}^{12} \beta_{ki}\Delta_{12} Commodity_{k-4,t-j} + \varepsilon_t + \beta_{14i}\varepsilon_{t-1}$$

where $Defl_{i,t}$ is the observation for the tax deflator i in the month t, $IGPDI_t$ corresponds to the observation relating to the IGP-DI index for the month t, $IPCA_t$ corresponds to the observation relative to the IPCA index for the month t, $Cambio_t$ corresponds to the dollar rate at the end of the month t, e $Commodity_{kt}$ corresponds to the price of the commodity k in the month t or the CRB index. The commodities considered for the study were: sugar, coffee, meat, iron, wheat, soybeans, corn, meal and Brent oil. The operator $\Delta_{12}$ corresponds to the percentage difference taken between the observation in question and its value in 12 lags. The term $\varepsilon_t$ term corresponds to the model error. Table 8 shows the results obtained for the estimation of the above equation.

Once the model chosen by the algorithm was obtained, we eliminated variables from the final equation whose coefficients did not make economic sense. This model was used to obtain projections for the deflators in the expected scenario.

Once this is done, projections are also made for alternative scenarios. In particular, the effect of shocks to selected variables on our deflators and, by extension, on tax collection is evaluated. To obtain forecasts of the behavior of our variables in these scenarios, we need a model that presents the dynamics of shock diffusion through the relevant variables. To find a complete prediction of the impact of a shock on the variables of interest, it would be necessary to have a complete model of our economy, in which the occurrence of a temporary shock could disturb the equilibrium of the economy, spreading through the various variables and changing their values until we reach a new steady state. This is beyond the scope of this paper, which is interested in making simple forecasts for the deflators of tax collection and tax collection itself. Therefore, we prefer to estimate a Vector Auto Regression (VAR) model in which we impose restrictions on the parameters so that the system is a recursive or triangular system. The recursive system is composed of five equations which, due to the recursive nature of the model, can be estimated by ordinary least squares equation by equation (Gujarati and Porter, 2008 - Chap. 20).

**Table 8** - Deflators x price, exchange rate and commodity indexes

| | cte | AR(1) | IGP-DI | IPCA | ex-change | sugar | meat | iron | Brent | MA(1) | R2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CIDE | -0.001 | 0.359 | 0.185 | 0.363 | 0.039 | 0.021 | - | - | - | 0.568 | 0.987 |
| p-value | 0.662 | 0.001 | 0.000 | 0.000 | 0.000 | 0.034 | - | - | - | 0.001 | |
| CO-FINS | -0.006 | 0.059 | 0.228 | 0.850 | - | - | - | - | - | 0.674 | 0.991 |
| p-value | 0.008 | 0.572 | 0.000 | 0.000 | - | - | - | - | - | 0.000 | |
| CPSSS | -0.003 | 0.975 | - | 0.093 | - | - | - | - | - | - | 0.970 |
| p-value | 0.001 | 0.000 | - | 0.000 | - | - | - | - | - | - | |
| CSLL | 0.009 | -0.011 | 0.272 | 0.579 | - | - | - | - | - | 0.914 | 0.978 |
| p-value | 0.007 | 0.922 | 0.000 | 0.000 | - | - | - | - | - | 0.000 | |
| IE | -0.014 | 0.192 | 0.228 | 0.549 | 0.037 | 0.033 | - | - | - | 0.513 | 0.989 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| p-value | 0.000 | 0.028 | 0.000 | 0.000 | 0.000 | 0.000 | - | - | - | 0.000 | |
| II | -0.016 | 0.151 | 0.214 | 0.960 | 0.046 | 0.046 | - | - | - | 0.531 | 0.995 |
| p-value | 0.000 | 0.149 | 0.000 | 0.000 | 0.002 | 0.000 | - | - | - | 0.001 | |
| IOF | -0.001 | 0.868 | -0.030 | 0.165 | 0.009 | - | - | - | - | - | 0.969 |
| p-value | 0.827 | 0.000 | 0.021 | 0.000 | 0.021 | - | - | - | - | - | |
| IPI | -0.021 | 0.201 | 0.250 | 0.767 | 0.071 | - | - | - | - | 0.451 | 0.993 |
| p-value | 0.000 | 0.054 | 0.000 | 0.000 | 0.000 | - | - | - | - | 0.002 | |
| IRPJ | 0.006 | 0.307 | 0.182 | 0.425 | - | - | - | - | - | 0.385 | 0.977 |
| p-value | 0.028 | 0.016 | 0.000 | 0.001 | - | - | - | - | - | 0.071 | |
| IRRF | 0.004 | 0.322 | - | 0.447 | 0.014 | - | - | - | - | 0.387 | 0.991 |
| p-value | 0.070 | 0.054 | - | 0.000 | 0.000 | - | - | - | - | 0.049 | |
| ITR | 0.010 | 0.720 | 0.062 | - | - | - | 0.022 | - | - | - | 0.932 |
| p-value | 0.000 | 0.000 | 0.001 | - | - | - | 0.007 | - | - | - | |
| OTHER | 0.004 | 0.404 | 0.059 | 0.448 | - | - | - | - | - | 0.545 | 0.988 |
| p-value | 0.005 | 0.000 | 0.000 | 0.000 | - | - | - | - | - | 0.000 | |
| PAGU-NIF | 0.004 | 0.312 | 0.206 | 0.199 | - | - | - | - | 0.005 | 0.192 | 0.991 |
| p-value | 0.008 | 0.000 | 0.000 | 0.000 | - | - | - | - | 0.006 | 0.398 | |
| PREV | 0.003 | 0.308 | 0.136 | 0.548 | - | - | - | - | - | 0.297 | 0.982 |
| p-value | 0.145 | 0.032 | 0.000 | 0.000 | - | - | - | - | - | 0.145 | |
| REC. NON ADM. | 0.008 | 0.451 | 0.373 | - | - | - | - | 0.054 | - | 0.456 | 0.972 |
| p-value | 0.153 | 0.000 | 0.000 | - | - | - | - | 0.000 | - | 0.011 | |

Note: exchange rate with 5 lags for II; and with 6 lags for IOF, IPI and IRRF

The first equation of the recursive model puts the interannual change in the CRB index as a function of the 12-month changes in the prices of coffee, meat, soybeans, wheat, and Brent oil, plus an MA(1) component.

The second equation of the recursive model puts the previous 12-month change in the exchange rate (dollar exchange rate) as a function of its one-month lag, the 12-month change in the CRB, and an MA(1) component.

The third equation of the recursive model puts the previous 12-month variation of the IGP-DI as a function of its one-month lag and the 12-month variations of the exchange rate, the CRB and the IGP-DI expectation given by FOCUS for three years ahead. The restriction is imposed that the sum of all coefficients different from the intercept is equal to one, following Bogdanski et al (2000). This equation is similar to the Phillips Curve for free prices adopted by these authors and present in the methodology adopted by the Central Bank of Brazil (Banco Central do Brasil, 2017). The output gap variable is not included here given that modeling macroeconomic equilibrium is beyond the scope of this paper.

The fourth equation of our recursive model puts the IPCA inter-annual variation as a function of its lag, the one-month lag of the IGP-DI inter-annual variation, the level of the CRB and the exchange rate, and the expected IPCA inflation given by FOCUS, again imposing the constraint that the non-constant coefficients add up to one.

The fifth estimation is an auxiliary system equation that estimates the interannual variation of the IPA-DI Fumo as a function of its one-month lag, and the interannual variations of the IGP-DI, the 3-year ahead IGP-DI expectation given by FOCUS, and the CRB.

The system of equations can then be represented by:

$$\begin{cases} \Delta_{12}CRB_t = \alpha_0 + \alpha_1\Delta_{12}Cafe_t + \alpha_2\Delta_{12}Carne_t + \alpha_3\Delta_{12}Soja_t \\ +\alpha_4\Delta_{12}Trigo_t + \alpha_5\Delta_{12}Brent_t + \varepsilon_{1t} + \alpha_6\varepsilon_{1t-1} \\ \vdots \\ \Delta_{12}Cambio_t = \beta_0 + \beta_1\Delta_{12}Cambio_{t-1} + \beta_2\Delta_{12}CRB_t + \varepsilon_{2t} + \beta_3\varepsilon_{2,t-1} \\ \vdots \\ \Delta_{12}IGPDI_t = \gamma_0 + \gamma_1\Delta_{12}IGPDI_{t-1} + \gamma_2\Delta_{12}Cambio_t + \gamma_3\Delta_{12}CRB_t \\ +(1-\gamma_1-\gamma_2-\gamma_3)IGP3_t + \varepsilon_{3t} \\ \vdots \\ \Delta_{12}IPCA_t = \delta_0 + \delta_1\Delta_{12}IPCA_{t-1} + \delta_2\Delta_{12}IGPDI_{t-1} + \delta_3 Cambio_t * CRB_t \\ +(1-\delta_1-\delta_2-\delta_3)IPCA3_t + \varepsilon_{4t} \\ \vdots \\ \Delta_{12}IPADIF_t = \theta_0 + \theta_1\Delta_{12}IPADIF_{t-1} + \theta_2\Delta_{12}IGPDI_t + \theta_3\Delta_{12}Cambio_t \\ +\theta_4 IGP3 + \theta_5\Delta_{12}CRB_t + \varepsilon_{5t} \end{cases}$$

where $Cafe_t$ is the price of coffee in the month t, $Carne_t$ is the price of meat in the month t, $Soja_t$ corresponds to the soy price for the month t, $Trigo_t$ corresponds to the price of wheat in the month t, $Brent_t$ corresponds to the Brent oil price in the month t, $IPADIF_t$ corresponds to the IPA-DI Fumo value for the month t, $IPCA3_t$ corresponds to the market expectation in the month t relative to the IPCA three years ahead given by FOCUS, and ⟦IGP3⟧_t corresponds to the market expectation in the month t relative to the IGP-DI three years ahead given by FOCUS. Table 9 shows the results obtained with the estimation of the triangular or recursive model.

Once in possession of the estimated model parameters, we generate forecasts for the series in our model and, from these, generate the forecasts for month-to-month percentage changes for each of them, as well as the ratios between forecasts for the alternative scenario and the base scenario. Obtaining estimates for the ratios between forecasts for the alternative scenario and the base scenario is convenient. This is because if the analysis is done at the level, if the alternative scenario comes from forecasts obtained by other models, the forecast errors generated by the model presented above will compound with the errors of the original model that generates the scenario under analysis. If this model is unknown, the statistical properties of the forecast are unknown, including the asymptotic

properties of the estimators. When calculating ratios between scenarios, we force the initial value of the variable of interest to be 1, and thus waive the need to know the model that generated these scenarios.

Note that the model assumes a specific way in which a commodity price shock spreads across the variables of interest. A commodity price shock first affects the commodity index CRB, as specified in the first equation. Then, the change in the CRB affects the exchange rate, as specified in the second equation. Finally, changes in the CRB and exchange rate affect the inflation indices IGP-DI, IPCA and IPA-DI Fumo, as specified in the third, fourth and fifth equations of the model, respectively.

**Table 9** - Triangular Model

**Panel A: CRB vs. commodity prices**

| Variable | Coef. | Dev. Default | Stat. T | p-value |
|---|---|---|---|---|
| café | 0.175 | 0.033 | 5.354 | 0.000 |
| carne | 0.250 | 0.099 | 2.513 | 0.015 |
| soja | 0.110 | 0.053 | 2.062 | 0.044 |
| trigo | 0.221 | 0.056 | 3.936 | 0.000 |
| Brent | 0.336 | 0.030 | 11.098 | 0.000 |
| cte. | -0.055 | 0.016 | -3.418 | 0.001 |
| MA(1) | 0.368 | 0.144 | 2.558 | 0.013 |
| sigma2 | 0.003 | 0.000 | 5.677 | 0.000 |
| R2 | 0.961 | | F-stat. | 199.3 |
| | | | P(F-stat.) | 0.000 |

**Panel B: Exchange x CRB**

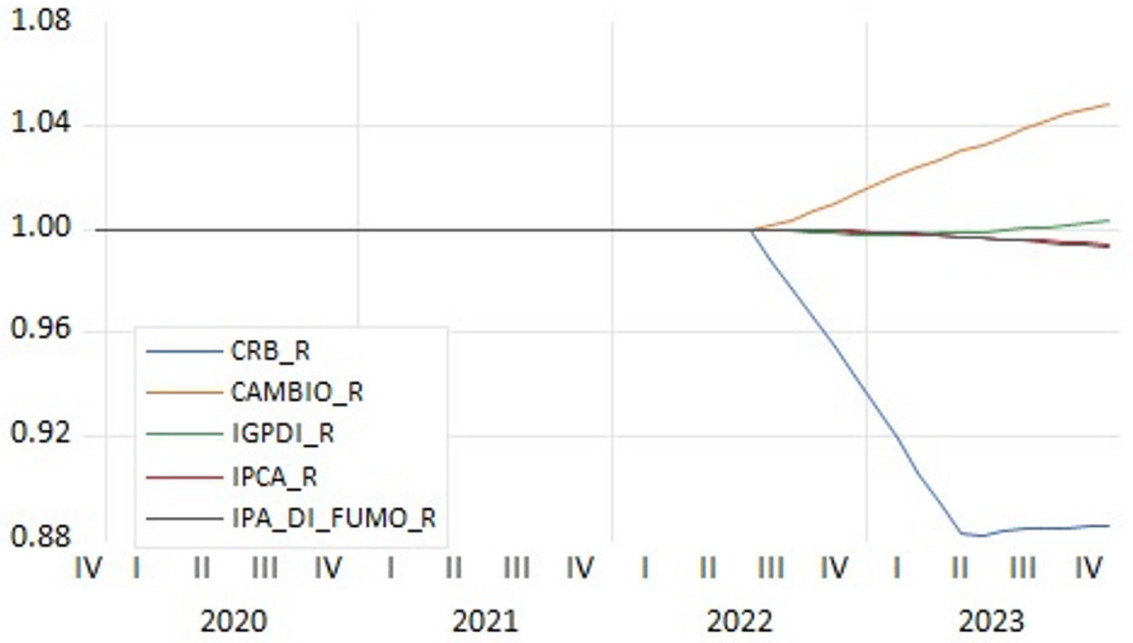
| Variable | Coef. | Dev. Default | Stat. T | p-value |
|---|---|---|---|---|
| câmbio(-1) | 0.822 | 0.060 | 13.769 | 0.000 |
| CRB | -0.103 | 0.033 | -3.112 | 0.003 |
| cte. | 0.028 | 0.012 | 2.385 | 0.020 |
| MA(1) | 0.244 | 0.152 | 1.601 | 0.115 |
| sigma2 | 0.002 | 0.000 | 4.632 | 0.000 |
| R2 | 0.907 | | F-stat. | 144.2 |
| | | | P(F-stat.) | 0.000 |

### Panel C: Price Indexes x CRB and Exchange Rate

| | IGP-DI | IPCA | IPA-DI Fumo |
|---|---|---|---|
| AR(1) | 0.905 | 0.947 | 0.951 |
| p-valor | 0.000 | 0.000 | 0.000 |
| câmbio | 0.082 | 0.000 | -0.024 |
| p-valor | 0.000 | 0.077 | 0.372 |
| CRB | 0.029 | 0.000 | -0.001 |
| p-valor | 0.064 | 0.077 | 0.947 |
| IGP 3 Anos | -0.017 | - | -0.004 |
| p-valor | - | - | 0.826 |
| IPCA 3 Anos | - | 0.053 | - |
| IGP-DI | - | - | 0.018 |
| p-valor | - | - | 0.641 |
| cte. | 0.067 | -0.001 | 0.025 |
| p-valor | 0.041 | 0.754 | 0.770 |
| R2 | 0.974 | 0.975 | 0.929 |
| F-Stat. | 757.0 | 792.5 | 152.5 |
| P(F-Stat.) | 0.000 | 0.000 | 0.000 |

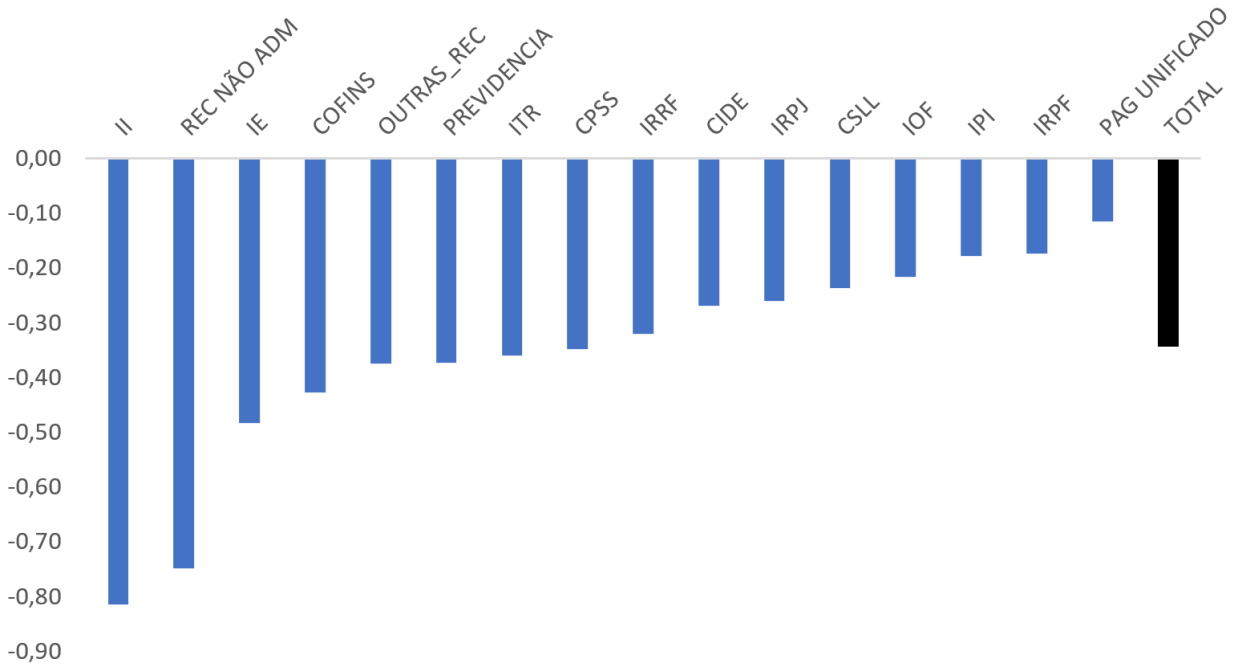
With these projected series in this alternative scenario, the first model is re-estimated, which places the deflators of each tax as functions of the variables estimated in the second model - the recursive triangular model. With this, new coefficients are obtained and thus new series of projected deflators are generated for the alternative scenario. With these projections in hand, series of monthly variations of the projected deflators are generated. Estimates of the impacts of shocks are then obtained through regressions of the deflators and the ratios. To calculate the effect on tax collection, two scenarios, merely illustrative, are suggested. In the first scenario, we reduce commodities by 1% in the next 12 months, allowing, according to the recursive system explained above, changes in the exchange rate and in the general and consumer price indexes. As can be observed in the graphic below, the drop of commodities is compensated by the rise of the exchange rate, maintaining the IGP-DI practically stable and with a slight disinflation of the IPCA.

**Graph 4**



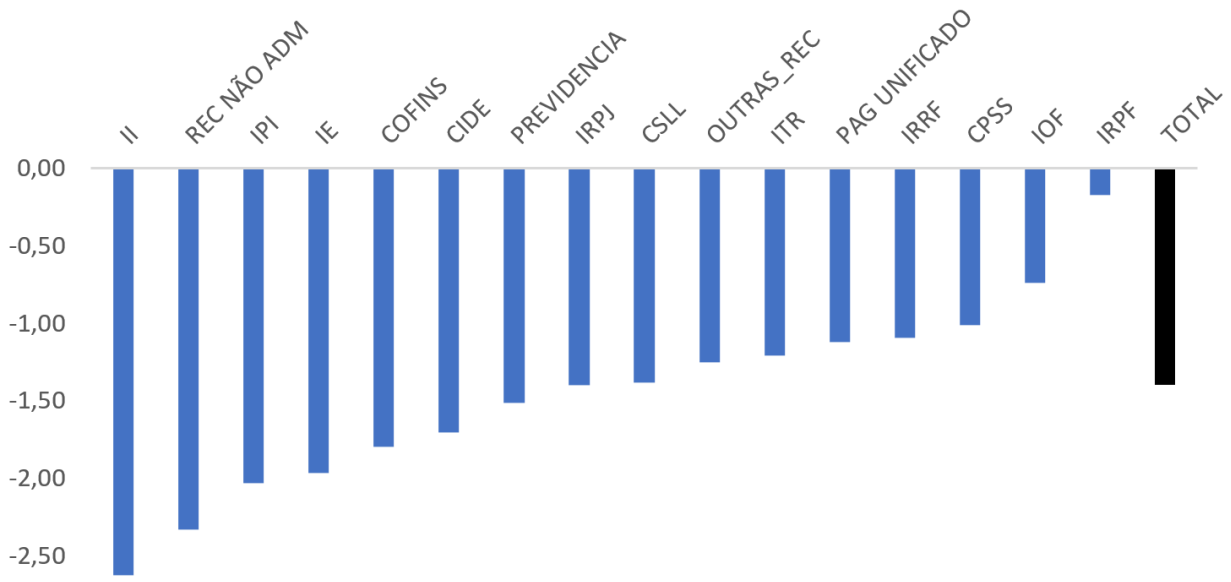

Consequently, the effect on the ratios of the collection series is not so significant, since the deterioration of commodity prices is offset by the exchange rate depreciation, when compared to the baseline scenario. The graph below shows the variations in tax collection by type of tax. Thus, the impact of the simultaneous recursive equation system and the projection of the deflators will produce a drop of 0.4% in total tax collection.

**Graph 5** - Impact on total revenue



However, considering a second scenario in which the IGP-DI falls 1.5 p.p. in 12 months, relative to the base scenario, and the exchange rate is maintained, the 12% reduction in commodities will be much more relevant, with a 1.4% drop in total revenue.

**Graph 6** - Impact on total revenue




## 6. Conclusion

In this work, a methodology was presented that makes it possible to calculate an index to deflate the federal tax collection, according to the different taxes and their decompositions by sectors. It was found that the implicit deflator of tax collection is more closely related to the GDP deflator than other price indexes, such as the IPCA and the IGP-DI. In this context, an alternative was sought for the correction of inflationary effects in order to analyze more reliably the variation of tax collection, which encompasses changes arising from economic growth, tax changes and deferrals. Based on the proposed deflator, a simulator was presented, based on econometric models, in order to evaluate the fiscal performance in scenarios with price changes, such as changes in commodity prices.

The proposal of the federal tax collection deflator was based on tax collection data by National Classification of Economic Activities (CNAE) and Taxes, made available by the Special Secretariat of Federal Revenue of the Ministry of Economy, for the period from 2016 to 2022, for 24 economic sectors. Deflators were defined for each of the economic sectors in the collection, weighted by the weights of the specific taxes in each sector and multiplied by the variation of sectorial indicators. The total deflator of federal collection was constructed from the weights of taxes and contributions in total collection multiplied by the deflators of each tax or contribution.

The deflated results showed that the variation of the federal collection deflator index in this analyzed period was above the IPCA and close to the implicit GDP deflator. The accumulated index

of the IGP-DI, on the other hand, was the one that registered the greatest variation in the analyzed period, mainly due to the greater exchange rate influence on this indicator. Using the proposed deflator, federal revenues will grow from R$ 1.3 trillion in 2016 to R$ 1.437 trillion in 2021, with a real increase of 8.8% over the period, equivalent to an increase of 1.7% per year.

The simulations performed using econometric models allowed us to identify the effect of price changes on tax collection. Among the results of the simulations, we highlight that if commodities decrease 12%, 1% per month in the next 12 months, the impact on tax collection will be 0.4%, due to the exchange rate depreciation resulting from lower international prices. However, if the exchange rate depreciation does not occur and commodities reduce their prices by 12%, leading to a decrease of 1.5% in the IGP-DI, the federal collection will have a retraction of 1.4%.

## REFERENCES

BANCO CENTRAL DO BRASIL. GDP Deflator and Average IGP-DI, in Inflation Report - March/2001, Brasília, 2001. Available at: https://www.bcb.gov.br/htms/relinf/port/2001/03/ri200103b2p.pdf. Accessed on: sep/22.

_____. Small Aggregate Model 2017 - June/2017, Brasília, 2017. Available at: https://www.bcb.gov.br/htms/relinf/port/2017/06/ri201706b7p.pdf. Accessed on: sep/22.

BOGDANSKI, J.; TOMBINI, A.A.; and WERLANG, S.R.C. (2000). "Implementing Inflation Targeting in Brazil." BCB Working Paper Series, no. 1.

DAS, A. & SENAPATI, M. GDP deflator vis-à-vis other price indices in india: an exploratory study, Journal of Income and Wealth, Vol. 29, No. 1, Jan/jun 2007, New Delhi, 2007.

FUNDAÇÃO GETÚLIO VARGAS. IGP-DI - General Price Index - Domestic Availability - Methodology, IBRE/FGV, Rio de Janeiro, May/2014. Available at: https://portalibre.fgv.br/sites/default/files/2020-03/metodologia-igp-di-atualizado-em-maio-2014-edt291014.pdf. Accessed on: sep/22.

GADELHA, Sérgio et all. Average Effective Tax Rates for the Brazilian Economy: A Macroeconomic Approach, in Revista Brasileira de Economia - RBE/FGV, v. 71 n. 2 (2017): APR-JUN. Available at: https://bibliotecadigital.fgv.br/ojs/index.php/rbe/article/view/65654. Accessed on: sep/22.

GUJARATI, Damodar N.; PORTER, Dawn C.. Basic Econometrics, Ed. McGraw-Hill, 2007, 5th Edition.

MINISTRY OF ECONOMY. Carga Tributária no Brasil - 2020 (Análise por Tributo e Bases de Incidência), Secretaria Especial da Receita Federal do Brasil, Brasília, 2021. Available at: https://www.gov.br/receitafederal/pt-br/centrais-de-conteudo/publicacoes/estudos/carga-tributaria/carga-tributaria-no-brasil-2020/view. Accessed in jul/2022.

_____ Boletim Estimativa da Carga Tributária Bruta do Governo Geral - 2021, Secretaria do Tesouro Nacional Brasília, April/2022. Available at: https://www.tesourotransparente.gov.br/publicacoes/carga-tributaria-do-governo-geral/2021/114?ano_selecionado=2021. Accessed in jul/2022.

_____ Boletim de Finanças dos Entes Subnacionais, Secretaria do Tesouro Nacional Brasília, October/2021. Available at: https://www.tesourotransparente.gov.br/publicacoes/boletim-de-financas-dos-entes-subnacionais/2021/114?ano_selecionado=2021. Access in aug/2022.

_____ National Treasury Results, National Treasury Secretariat. - v. 28, n. 08 (August, 2022). - Brasília, September/2022. Available at: https://www.tesourotransparente.gov.br/publicacoes/boletim-resultado-do-tesouro-nacional-rtn/2022/8. Accessed in: oct/2022.

_____ System of National Accounts - Brazil - 2010, IBGE, National Accounts Coordination. - 3. ed. - Rio de Janeiro, 2016. Available at: https://biblioteca.ibge.gov.br/visualizacao/livros/liv98142.pdf. Accessed in: sep/2022.

NEUMARK, F. Revenue and Expenditure. Inflation Theory and Anti-Inflation Policy, p. 338, 1978.

U.S. BUREAU OF ECONOMIC ANALYSIS. GDP Price Deflator, BEA, Washington, Sept/2022. Available at: https://www.bea.gov/data/prices-inflation/gdp-price-deflator#:~:text=The%20gross%20domestic%20product%20implicit,Prices%20of%20imports%20are%20excluded. Accessed on: Oct/22.