

The Impact of Fiscal Modernization Programs on Municipal Own Revenues in Northeast Brazil: evidence from a staggered DiD approach¹

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ABSTRACT: The objective of this study is to evaluate the impact of the National Program to Support Administrative and Fiscal Modernization (PNAFM), financed by the Inter-American Development Bank (IDB) through the Ministry of Finance, and the Program for the Modernization of Tax Administration and Management of Basic Social Sectors (PMAT), financed by the National Bank for Economic and Social Development (BNDES), on the collection of own tax revenue of municipalities in the Brazilian Northeast, from 1994 to 2023. Data from BNDES, IDB, the Brazilian Public Sector Accounting and Fiscal Information System (SICONFI) and the Brazilian Institute of Geography and Statistics (IBGE) were used. The identification of the causal effect was performed using the difference-in-differences method with multiple periods according to Callaway & Sant'Anna (2021), aiming to estimate the average effects of the treatment by group and time. The results indicate that the municipalities benefiting from the programs showed statistically significant increases, at the level of 1%, in the collection of their own tax revenues, when compared to municipalities with similar characteristics that did not participate in the PNAFM or PMAT.

Keywords: Impact Assessment; Public policy; Municipal Taxation.

O Impacto dos Programas de Modernização Fiscal sobre as Receitas Próprias Municipais no Nordeste do Brasil: evidências a partir de uma abordagem de diferenças em diferenças escalonada

RESUMO: O objetivo deste estudo é avaliar o impacto do Programa Nacional de Apoio à Modernização Administrativa e Fiscal (PNAFM), financiado pelo Banco Interamericano de Desenvolvimento (BID) por intermédio do Ministério da Fazenda, e do Programa de Modernização da Administração Tributária e da Gestão dos Setores Sociais Básicos (PMAT), financiado pelo Banco Nacional de Desenvolvimento Econômico e Social (BNDES), sobre a arrecadação da receita tributária própria dos municípios do Nordeste brasileiro, no período de 1994 a 2023. Foram utilizados dados do BNDES, do BID, do Sistema de Informações Contábeis e Fiscais do Setor Público Brasileiro (SICONFI) e do Instituto Brasileiro de Geografia e Estatística (IBGE). A identificação do efeito causal foi realizada por meio do método de diferenças em diferenças com múltiplos períodos conforme Callaway & Sant'Anna (2021), visando estimar os efeitos médios do tratamento por grupo e tempo. Os resultados indicam que os municípios beneficiados pelos programas apresentaram aumentos estatisticamente significativos, ao nível de 1%, na arrecadação de receitas tributárias próprias, quando comparados a municípios com características semelhantes que não participaram do PNAFM ou do PMAT.

Palavras-chave: Avaliação de Impacto; Política Pública; Tributação Municipal.

JEL Classification: H71, H72, H79, H83, C21.

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1. INTRODUCTION

Brazil is a Federative Republic, politically and administratively organized into three levels of government: the central level, represented by the Federal Union; the regional level, comprising the 26 member states and the Federal District; and the local level, consisting of 5,570 municipalities. As established by the Federal Constitution (Brazil, 1988), all three levels are granted independent taxing powers and autonomy to design and implement their own public expenditure policies.

In the field of governmental action, each level of government enjoys administrative autonomy, both in organizing general public services and in managing its own finances (Brazil, 2004). The financial autonomy of each level is expressed through the formulation of budgetary laws, the authority to exercise its own tax competencies, and the capacity to fund and invest in public administration. This autonomy, however, must comply with the fundamental constraints set forth in Articles 150 to 152 of the 1988 Federal Constitution, particularly regarding legality (Art. 150, I), equality (Art. 150, II), non-retroactivity (Art. 150, III, "a"), the principle of anteriority (Art. 150, III, "b"), prohibition of confiscation (Art. 150, IV), freedom of movement (Art. 150, V), tax immunities (Art. 150, VI), and other limitations (Arts. 151 and 152) (Ishida; Martelli, 2015).

Regarding the National Tax System, the Constitution clearly defines the authority to establish taxes at each level of government. Within this framework, federal law sets the general framework for the tax system, while regulatory details are governed by specific state and municipal laws. At the municipal level—the geographic focus of this study—the main taxes are: Urban Property and Land Tax (IPTU), Service Tax (ISSQN), Real Estate Transfer Tax (ITBI), as well as various Fees and Improvement Contributions. The system is also structured in such a way that a portion of federal tax revenues is transferred to states and municipalities through mechanisms such as the State Participation Fund (FPE) and the Municipal Participation Fund (FPM), along with other intergovernmental transfers. Similarly, part of state tax revenues is redistributed to municipalities, following criteria established by law.

This federative structure, characterized by a high degree of decentralization, highlights the profound socioeconomic, demographic, and territorial disparities that exist both among states and among municipalities in Brazil. These disparities are reflected in significant inequalities in development and, consequently, in the fiscal capacity of the different levels of government (Brazil, 2004).

Thus, alongside regional disparities, concerns over budgetary imbalances and the fiscal health of subnational governments have gained prominence. In Brazil, fiscal balance has been established as one of the key objectives of macroeconomic policy since the announcement of the Real Plan in July 1994, in conjunction with currency stabilization, fiscal and monetary control, economic de-indexation, the exchange rate anchor, and trade liberalization (Schwartz, 1999).

In the wake of the Real Plan, two programs were launched with the specific aim of maximizing efficiency in the fiscal management processes of Brazilian municipalities: the Program for the Modernization of Tax Administration and the Management of Basic Social Sectors (PMAT), developed by BNDES, and the National Program to Support the Administrative and Fiscal Management of Municipalities (PNAFM), formulated by the Inter-American Development Bank (IDB) in partnership with the Ministry of Finance. The primary objective of these programs was to enhance the administrative capacity of municipal governments, with a focus on improving fiscal efficiency. This study seeks to test the hypothesis that participation in PMAT and PNAFM is associated with improved governmental performance in terms of fiscal balance, driven by increased own-source revenue collection without changes in tax rates. Moreover, it is believed that the revenue-raising

capacity fostered by these programs has played a fundamental role in strengthening the administrative efficiency of municipal governments.

To define the scope of this study, the analysis was restricted exclusively to the Northeast region of Brazil. A total of 1,794 municipalities from this region were selected as the unit of analysis. The observation period covers the years from 1994 to 2023, resulting in a total of 49,725 observations. Within this sample, 74 municipalities were designated as the treatment group, having received funding from PMAT and/or PNAFM, either jointly or independently.

More specifically, this study aims to assess the potential outcomes resulting from loans contracted by municipalities in Brazil's Northeast region through the Ministry of Finance, with funding provided by the IDB and BNDES. As indicated in the names of the programs, it is expected that participating municipalities will demonstrate, by the end of the PMAT and PNAFM implementation periods, some improvement in their own-source revenue collection, reflected in a significant increase in these revenues. In this context, the research seeks to answer the following question: *Did participation in these programs have a positive and significant impact on municipal own-source revenue collection?*

To this end, the empirical strategy relies on the application of the Difference-in-Differences (DiD) method with multiple time periods. This approach is based on the principle that, in the presence of an exogenous event, it becomes possible to estimate the impact of the event by comparing two groups — treatment and control—through the calculation of double differences: the first between groups and the second across time periods (Callaway e Sant'Anna, 2021a).

The inference results indicate that municipalities receiving funds from the programs experienced positive and statistically significant increases—at least 1%—in tax revenue collection compared to similar municipalities that did not participate in the programs. Therefore, the evaluation conducted here suggests that, had the participating municipalities not joined the programs, their tax revenue performance would have been statistically lower than observed after treatment adoption.

In addition to this introductory section, the study is organized into four further sections, each addressing specific objectives. Section 2 provides an overview of PNAFM and its development between 1994 and 2023. Section 3 outlines the methodological framework and describes the dataset. Section 4 presents the empirical results. Finally, Section 5 offers concluding remarks, highlighting the study's contributions, methodological limitations, and suggestions for potential future improvements, applications, and extensions.

2. THEORETICAL FRAMEWORK

This section provides a brief review of the literature related to public sector economics, focusing on both macroeconomic and microeconomic studies that address the concept of public budgets—whether balanced, surplus, or deficit. The purpose of this review is to establish a solid theoretical foundation for understanding the principles underlying balanced budgets and their implications for public administration. Additionally, the empirical framework is explored by highlighting relevant research that has investigated programs similar to those examined in this study.

Within the empirical review, an effort was made to gather studies specifically addressing the Brazilian context and participation in programs such as PMAT and PNAFM. This selection of research aims to provide contextualization for the Brazilian economy and related experiences, as well as comparable studies. At the end of the review, the ways in which this study differs from previously cited works are highlighted, emphasizing its innovative aspects and the relevance of its approach within the context of fiscal modernization programs.

2.1 Public Budget

For the theoretical foundation of this study, key references include Buchanan e Musgrave (1960) on the theory of public finance; Mckenzie, Buchanan and Wagner (1977) in *Democracy in Deficit: The Political Legacy of Lord Keynes*; Barro (1979) on the determinants of public debt; Lucas and Stokey (1983), who investigated optimal fiscal and monetary policy in a capitalless economy; Alesina e Tabellini (1987), who developed a positive theory of fiscal deficits and government debt; and Roubini and Sachs (1989), who analyzed the political and economic determinants of budget deficits in industrial democracies. More recent contributions include Tabellini (1990), who updated the positive theory of deficits; Tabellini (1991), who studied intergenerational redistribution policy; and Alesina and Perotti (1995), who provided a critical review of the literature on the political-institutional determinants of government budgets.

Economic literature explores various factors that explain the dynamics of the public sector fiscal balance, whether in surplus or deficit (Sakurai, 2014). In their work, Buchanan and Musgrave (1960)

pay particular attention to the existence of taxation and the role of government. According to these authors, the government performs three main functions: *i)* adjusting resource allocations; *ii)* making adjustments to the distribution of wealth and income; and *iii)* ensuring economic stability.

The first responsibility arises in cases of market failures, when the market fails to achieve optimal outcomes, exhibiting imperfections such as barriers to market entry, abnormal prices, among other issues. Therefore, government intervention is necessary to correct these market failures.

Regarding the second function, it involves public actions carried out by the government to serve the population or promote welfare. It is important to note that income distribution is not only related to the availability of production factors but also to productivity.

The third function concerns financing public costs through the equitable distribution of the tax burden, aiming to maintain a balance between revenues and expenditures (the equity approach). Thus, these functions are interconnected in several respects, including the issue of budgetary balance.

Law No. 4,320 (Brazil, 1964) marked a milestone by standardizing public accounting and setting general principles of financial law. The 1967/69 Constitution (Brazil, 1967) introduced the Multi-Year Plan (PPA) as a planning instrument, and the Fiscal Responsibility Law No. 101 (Brazil, 2000) strengthened fiscal responsibility rules by establishing limits on public spending and guidelines for fiscal management.

According to Barbosa Filho (2013), the pinnacle of improvements and institutional strengthening in public management was consolidated with the Fiscal Responsibility Law (Brazil, 2000), Complementary Law No. 101, dated May 4, 2000, which regulated the Federal Constitution (Brazil, 1988) regarding taxation and budget rules (Title VI). Chapter II of this law establishes the general norms for public finances to be observed by the three levels of government: federal, state, and municipal.

Specifically, the Fiscal Responsibility Law complied with the provisions of Article 163 of the 1988 Constitution concerning public finances, external and internal public debt—including that of autarchies, foundations, and other entities controlled by the government—granting guarantees by public entities, issuance and redemption of public debt securities, financial oversight of direct and indirect public administration, foreign exchange operations conducted by bodies and entities of the Union, States, Federal District, and Municipalities, and the alignment of the functions of official credit institutions of the Union, while preserving the full operational characteristics and conditions of those focused on regional development and debt sustainability.

According to Barbosa Filho (2013), the Fiscal Responsibility Law (LRF) also complied with the provisions of Article 165 of the Federal Constitution regarding the preparation of Budget Laws. With the LRF, the budgetary process became clearer due to the synergy between the Multi-Year Plan (PPA), the Budget Guidelines Law (LDO), and the Annual Budget Law (LOA).

The law that establishes the PPA sets, in a regionalized manner, the guidelines, objectives, and targets of the federal public administration for capital expenditures and related expenses, as well as for ongoing programs, over a four-year period. The LDO encompasses the goals and priorities of public administration, establishes fiscal policy guidelines and corresponding targets aligned with a sustainable public debt trajectory, guides the preparation of the Annual Budget Law, regulates changes to tax legislation, and establishes the investment policy of Official Development Financial Agencies. Thus, the LDO serves as the link between the PPA and the LOA, aiming to reduce the gap between planning and budgeting.

Finally, the LOA specifies in greater detail the revenues and expenditures, ensuring compatibility with the PPA and following the guidelines established in the LDO.

2.2 Empirical Experiences

This subsection presents a synthesis of the bibliographic review of empirical studies focused on the context of Brazilian fiscal federalism. It is important to emphasize from the outset that the works examined and analyzed in this review are strictly related to the Brazilian reality, as the present research concentrates on understanding the challenges and strategies for fiscal rebalancing and administrative modernization within the national context. Therefore, the scope excludes comparative analysis with other countries regarding fiscal federalism.

What follows is a more detailed profile of these studies, highlighting their contributions and main conclusions for understanding fiscal issues in Brazil.

Within the context of the present research, other studies in the literature address administrative modernization and fiscal rebalancing. For example, Bast (2015) and Bast and Sakurai (2015) conducted an empirical evaluation of the effect of PMAT loans to Brazilian municipal governments (2000 to 2010). Their results indicate that the program's effect on the tax revenue of participating municipalities is null—that is, the effect of participation in the program is statistically insignificant.

Ferreira Filho (2016) carried out an empirical assessment of the results of PNAFM I (2001 to 2012). His findings show that the PNAFM program produced positive and significant results (at the 1% level in most cases, or at least at 5%). However, the author notes that when the sample is refined using more sophisticated methods, similar to the procedures applied by Bast and Sakurai (2015) for PMAT, the impacts appear modest or null.

On the other hand Pereira (2018) focused his analysis on the impact of the National Program for Administrative and Fiscal Management Support of Brazilian Municipalities (PNAFM) on the fiscal efficiency of city halls (2001 to 2012). The results indicate that the hypothesis that PNAFM produced positive outcomes for participating municipalities lacks statistical support based on the data used. On the contrary, the data allow inference with 99% confidence that participation in PNAFM did not contribute to improving the fiscal performance of the municipalities.

Finally, Martini, Zylberberg e Machado (2023) evaluated the impact of PMAT on Brazilian municipalities between 1998 and 2021. Their assessment results show that PMAT was effective in positively impacting the revenue collection of supported municipalities, fulfilling its main objective.

Thus, this study differs from the previously mentioned works by evaluating both programs in a single research, as well as by employing the Differences-in-Differences (DiD) method within a unified framework aimed at estimating average treatment effects in settings with multiple periods, variation in treatment timing, and under the condition that the parallel trends assumption holds only after conditioning on observable covariates. This strategy allows for a more robust analysis, considering that in the canonical DiD formulation there are only two periods and two groups: in the first period, no unit is treated; in the second, some units become treated while others remain as the control group.

Compared to previous studies, this research advances by integrating the PMAT and PNAFM programs into a single analysis, covering a broader time horizon (1994–2023) and using more recent and robust estimation methods of differences-in-differences for multiple periods.

3. EVALUATED PROGRAMS

The programs evaluated here are part of a Federal Government initiative, launched in the second half of the 1990s, aimed at providing technical assistance to states and municipalities in the area of fiscal administration.

The promulgation of the 1988 Federal Constitution promoted the decentralization of fiscal revenues in Brazil, accompanied by an expansion of the powers of state and municipal entities. However, based on the premise that resource decentralization would allow subnational governments to overcome their difficulties autonomously, the administrative reform that followed the new Constitution eliminated several federal agencies responsible for providing technical support to other levels of government (Agostini Martini Raphael Simas Zylberberg Luciano Machado and Daniel Willcox de Souza, 2023; Martini, Zylberberg and Machado, 2023)

Despite this, technical limitations persisted that prevented municipalities from fully exploiting their revenue-raising potential. The capacity for revenue collection remained concentrated in state capitals and the largest cities in the country, especially in the more developed regions. Thus, even with the growth in the volume of taxes collected, most municipalities continued to depend on transfers of resources from other federative entities (Brazil, 2004; Martini, Zylberberg and Machado, 2023).

3.1 Tax Administration and Basic Sector Management Modernization Program (PMAT – BNDES)

The PMAT from BNDES was launched by the Ministry of Planning in 1997, with the objective of modernizing tax administration and improving public spending management, increasing tax collection and reducing the unit cost of services in general administration, health, and education. The program operated directly (when financing occurs directly via BNDES) or indirectly (through accredited financial institutions) (Bast and Sakurai, 2015).

The BNDES Automatic PMAT was created in 2010, with the same objectives as the BNDES PMAT, but serving only municipalities with a population under 150,000 inhabitants and granting loans only through indirect means.

According to information extracted from the BNDES electronic portal BNDES (2023), in 2013, the institution restructured these programs by dividing them into three types of operations, all aimed at modernizing tax administration. The specific characteristics of each modality are detailed as follows: *i*) BNDES Automatic PMAT – Investment: has the same initial objectives as the BNDES PMAT, namely to support municipal public administration investment projects aimed at modernizing tax administration and improving the quality of public spending. To qualify for this modality, the operation amount must not exceed R\$ 20

million, and support is indirect; *ii*) BNDES Automatic PMAT – Machinery and Equipment: supports the acquisition of equipment and machinery related to investment projects aligned with the PMAT objectives. In this case, the granting is also indirect, and there is no limit on the volume of resources involved; *iii*) BNDES Non-Automatic PMAT: has the same objectives as the “BNDES Automatic PMAT – Investment,” but covers projects exceeding R\$ 20 million and is carried out either directly or indirectly.

The actions eligible for financing under the modalities described above include hiring specialized consulting services, training staff for updating movable, real estate, and multifunctional registries, acquiring computer equipment and document control systems, purchasing furniture, creating a website, and acquiring inspection equipment, among others related to the general objectives.

From the moment of contracting, the municipality must periodically submit a performance report for monitoring purposes, as specified in the financing agreement. Additionally, the institution’s technical team may conduct on-site inspections of the investments made (Bast, 2015).

3.2 National Program for Supporting Administrative and Fiscal Management of Brazilian Municipalities (PNAFM – MF/IDB)

The PNAFM was characterized as a multi-phase programmatic loan originally designed and approved for execution in three phases. The program was approved by the Executive Board of the Ministry of Finance on August 11, 1999, with financing of US\$ 1.1 million from the Inter-American Development Bank (IDB), to be executed across the phases. The general objective of PNAFM was to support the Brazilian government in its pursuit of macroeconomic stability through a self-sustained fiscal balance, backed by an efficient and transparent public policy in the management of municipal public revenues and expenditures (BID, 2018).

The program’s sizing was based on the calculation of the resources needed to cover a large share of municipalities. Thus, participation in the program was set at 69.98% of Brazilian municipalities (3,854), which allowed the estimation of a total program value of US\$ 2.2 million, with US\$ 1.1 million (50%) financed by the IDB and US\$ 1.1 million (50%) to be jointly funded by the Federal Government and the municipalities benefiting from the operation (Brazil, 2004).

According to the BID (1999), the main objective of the Program was to support the Brazilian government in its pursuit of macroeconomic stability through a self-sustained fiscal balance, backed by an efficient and transparent public policy in the management of municipal revenues and public spending.

The specific objectives pursued during the implementation of the PNAFM were as follows: Regarding the efficiency of municipal public management: *i*) increasing the level of financing of municipal public expenditure with own-source revenues; *ii*) improving the efficiency of municipal public administration; and *iii*) ensuring the availability of quality municipal services for citizens. Regarding the transparency of municipal public management: *i*) periodic disclosure to society of budget execution, public accounts, as well as the achievements of the municipal public administration; *ii*) effective citizen participation in the planning and definition of the municipal budget and investment plan; and *iii*) evaluation and revision of municipal government actions, taking into account citizens' feedback.

With the aim of comparing the conditions for contracting, implementation, monitoring, control, and payment of the PNAFM and PMAT, Table 1 lists the main differences between the programs of the Ministry of Finance and the BNDES:

Table 1 – Main Differences Between PNAFM and PMAT

Criterion	PNAFM*	PMAT
Grantor	Ministry of Finance – IDB	Banco Nacional de Desenvolvimento Econômico e Social (BNDES)
Recipient	Brazilian Municipalities	Brazilian Municipalities
Minimum financing amount	R\$ 900.000,00	R\$ 20.000.000,00
Category	Credit Operation	Credit Operation
Grantor’s Participation	Up to 90% of the total project value	Up to 90% of the total project value
Municipal Counterpart Contribution	At least 10% of the total project value	At least 10% of the total project value
Execution Term	Up to 4 years	Up to 8 years
Grace Period	Up to 4 years (including the execution period). During this time, corresponding interest will be charged.	Up to 2 years (including the execution period). During this time, corresponding interest will be charged.
Amortization Period	Up to 19 years. The total financing term will be determined based on the size, complexity, and nature of the project, as well as the client's payment capacity, and will be evaluated on a case-by-case basis during the operation analysis phase.	Up to 24 years, including the grace period. The total financing term will be determined based on the size, complexity, and nature of the project, as well as the client’s payment capacity, and will be evaluated on a case-by-case basis during the operation analysis phase.
Payment Method	Semiannual and consecutive amortizations. Constant Amortization System (SAC).	Semiannual and consecutive amortizations. Constant Amortization System (SAC).
Interest Rate	Determined by the IDB and reset quarterly, based on the London Interbank Offered Rate (LIBOR).	Determined by BNDES and reset monthly, based on the Long-Term Interest Rate (TJLP)
Indexing Agent	Exchange rate variation based on the United States Dollar (USD).	TJLP
Guarantees	Guarantee by the Union or quota shares from the Municipal Participation Fund (FPM) and/or revenues from ICMS or ICMS- Exportation	Guarantee by the Union or quota shares from the Municipal Participation Fund (FPM) and/or revenues from ICMS or ICMS- Exportation

Source: Ministry of Finance and BNDES (2023).

Note: * criteria considered refer to the conditions for contracting subloans under PNAFM III.

The program rules were applicable to all federative entities in Brazil; however, for the present research, a specific focus was made on analyzing the resources allocated to the Northeast region of the country.

4. DATA AND METHODS

4.1 Database and Variable Description

The data used for the impact evaluation of the PMAT and PNAFM programs on tax revenue essentially came from four main sources: the Brazilian National Bank for Economic and Social Development (BNDES), the Ministry of Finance, the Brazilian Public Sector Accounting and Fiscal Information System (FINBRA) (2023), and the Demographic Censuses and population estimates from the Brazilian Institute of Geography and Statistics (IBGE) (2023). The observation period covered the years from 1994 to 2023, totaling 49,725 observations. Within this sample, 74 municipalities were designated as the treatment group, with 47 receiving funds from the PNAFM and 35 from the PMAT, including 6 municipalities that were part of the intersection group and benefited from both programs. The variables selected for the research are listed in Table 2 below.

Table 2 – Variables used in the construction of the database (1994 to 2023)

Variables	Description	Expected Sign	Source
<i>RECTRIB_{pc}</i> (R\$)	Total Tax Revenues <i>per capita</i>	+	SICONFI
<i>IPTU_{pc}</i> (R\$)	Urban Property Tax <i>per capita</i>	+	SICONFI
<i>ITBI_{pc}</i> (R\$)	Real Estate Transfer Tax <i>per capita</i>	+	SICONFI
<i>ISSQN_{pc}</i> (R\$)	Tax on Services of Any Kind <i>per capita</i>	+	SICONFI
<i>RECAGRO_{pc}</i> (R\$)	Agricultural Revenue <i>per capita</i>	+	SICONFI
<i>RECINDUST_{pc}</i> (R\$)	Industrial Revenue <i>per capita</i>	+	SICONFI
<i>FIRST.TREAT</i>	First Year of Treatment (PNAFM Enrollment)	+	BID/BNDES
<i>FIRST.TREAT.PMAT</i>	First Year of Treatment (PMAT Enrollment)	+	BNDES
<i>FIRST.TREAT.PNAFM</i>	First Year of Treatment (PNAFM Enrollment)	+	BID
<i>TREAT</i>	Dummy variable equal to 1 if the municipality participated in the PMAT and/or PNAFM Programs, 0 otherwise	+	BID/BNDES
<i>TREAT.PMAT</i>	Dummy variable equal to 1 if the municipality participated in the PMAT Program, 0 otherwise	+	BNDES
<i>TREAT.PNAFM</i>	Dummy variable equal to 1 if the municipality participated in the PNAFM Program, 0 otherwise	+	BID

Source: Authors' own elaboration.

Thus, with the objective of evaluating the impact of PMAT and PNAFM, the following dependent variables were selected for the model estimation:

- Own Tax Revenue is ($RECTRIB_{i,t}$), the revenue derived and established by public law entities, comprising taxes, fees, and contributions according to the Constitution and current financial laws, with its proceeds intended to cover general or specific activities carried out by these entities, as provided in Article 9 of Law 4,320/64 (Brazil, 1964) (STN, 2023);
- Urban Property and Land Tax ($IPTU_{i,t}$), is a tax established in the National Tax Code (CTN) (Brazil, 1966), specifically in articles 32 to 34. Its constitutionality is provided for in Article 156, item I, of the Federal Constitution (Brazil, 1988) (STN, 2023);
- Property Transfer Tax ($ITBI_{i,t}$), is a tax provided for in the National Tax Code (CTN) (Brasil, 1966) in Article 35. Its constitutionality is established in Article 156, item II, of the Federal Constitution (Brazil, 1988). It is a mandatory tax charged to the buyer of a property by the municipality where the property is located (STN, 2023);
- Service Tax on Any Nature ($ISSQN_{i,t}$), is a tax whose taxable event is the provision of services listed in the annex to Complementary Law 116/2003 (Brazil, 2003). The maximum tax rate was set at 5% by Article 8, item II, of the aforementioned law (STN, 2023);
- Agricultural Revenue *per capita* ($RECAGRO_{i,t}$), refers to revenues from activities involving the organized exploitation of natural plant resources in natural and protected environments (STN, 2023);
- Industrial Revenue *per capita* ($RECIND_{i,t}$), refers to revenues originating from industrial activities carried out by the public entity, such as the extraction and processing of raw materials and the production and commercialization of goods related to mechanical, chemical, and general manufacturing industries (STN, 2023); e

For the DiD estimation, the following variables were used: the first year of treatment $FIRST.TREAT_{i,t}$, and its program-specific variations $FIRST.TREAT.PMAT_{i,t}$ and $FIRST.TREAT.PNAFM_{i,t}$, which refer to the initial year in which the treatment group receives the treatment; these take the value 0 if the municipality did not participate in the programs, and the years from 1998 to 2023 indicate the first year of exposure to treatment, corresponding to the signing of

financing contracts; and the treatment dummy $TREAT_{i,t}$, which takes the value 1 if the municipality participated in the programs, along with its program-specific variations.

Table 3 is responsible for presenting the descriptive statistics of the variables selected for the panel estimation.

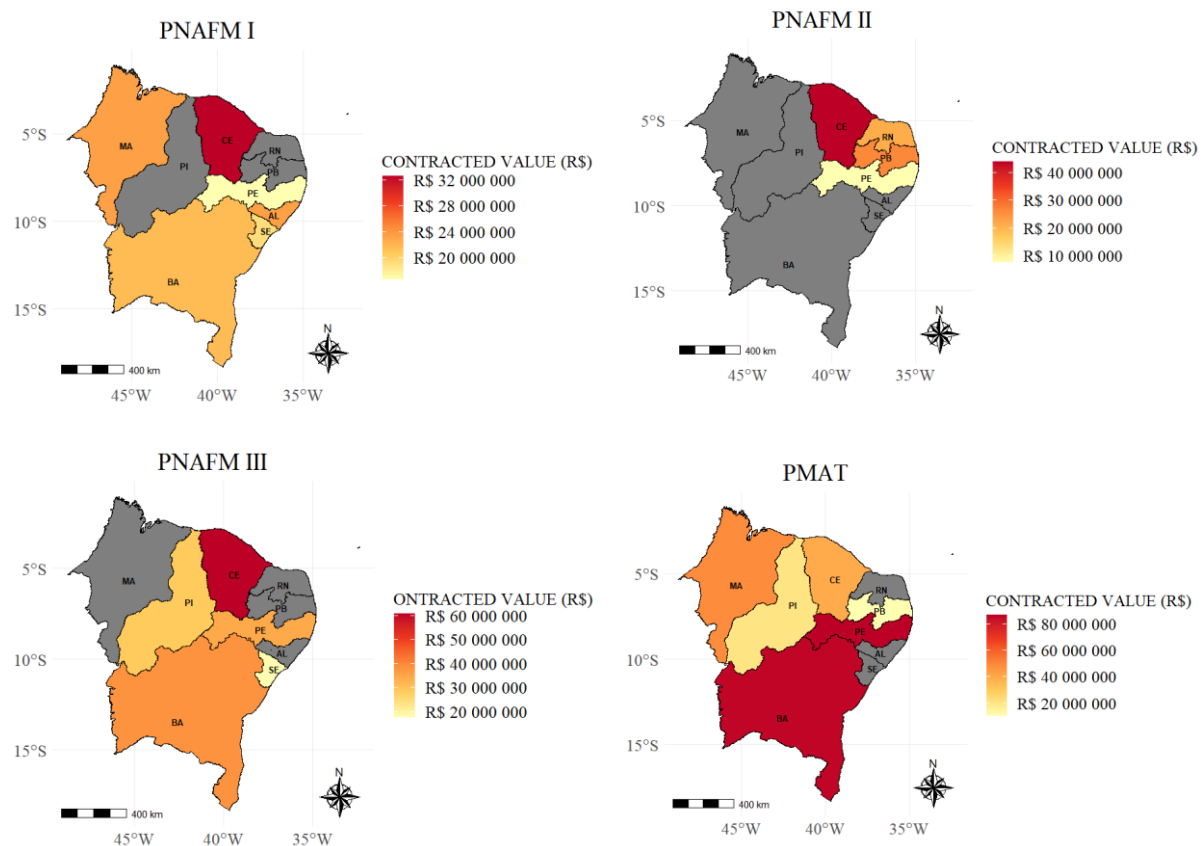
Table 3 – Descriptive Statistics of the Selected Variables (1994 – 2023)

Dimension	Variable	Treat		Control	
		Mean	Standard Deviation	Mean	Standard Deviation
Own Revenues	<i>RECTRIB_{pc}</i> (R\$)	572.49	708.33	168.72	344.32
	<i>IPTU_{pc}</i> (R\$)	108.44	199.35	11.33	54.00
	<i>ITBI_{pc}</i> (R\$)	48.02	85.84	8.35	38.72
	<i>ISSQN_{pc}</i> (R\$)	260.06	322.11	80.43	240.36
	<i>RECAGRO_{pc}</i> (R\$)	0.00	0.00	0.02	0.99
	<i>RECINDUST_{pc}</i> (R\$)	0.90	11.41	0.32	9.38

Source: Authors' own elaboration based on data from SICONFI (2023).

The monetary values addressed in this work were updated to 2023, deflated by the Extended Consumer Price Index (IPCA), calculated by the Brazilian Institute of Geography and Statistics (IBGE). Figure 1 aims to illustrate, using a scale of red, orange, and yellow, the Federative Units that received the most resources from the evaluated Programs.

Figure 1 – Adherence of Brazilian Northeast Municipalities to PMAT and PNAFM (1999 – 2023)



Source: Authors' own elaboration based on data from BNDES (2023) and the Ministry of Finance (2023).

Table 4 presents the list of the 74 municipalities included in the Treatment Group, organized by Federative Unit (UF):

Table 4 – Average Treatment Effect of Programs Participation on All Treated Municipalities

UF	Municipalities Belonging to the Treatment Group
Alagoas (AL)	Arapiraca, Maceió
Bahia (BA)	Alagoinhas, Camaçari, Castro Alves, Eunápolis, Guanambi, Ilhéus, Lauro de Freitas, Salvador, Senhor do Bonfim, Tapiramutá and Vitória da Conquista.
Ceará (CE)	Acopiara, Aquiraz, Araripe, Arabutã, Aurora, Bela Cruz, Camocim, Canindé, Cascável, Crato, Eusébio, Fortaleza, Guaraciaba do Norte, Horizonte, Icó, Iguatu, Iracema, Itapipoca, Maracanaú, Massapê, Novo Oriente, Pindoretama, Quixadá, Senador Sá, Sobral, Solonópole, Tauá, Tejuçuoca and Uruoca.
Maranhão (MA)	Imperatriz, São Jose De Ribamar and São Luís.
Paraíba (PB)	Cabaceiras, Campina Grande, Gurjão, Joao Pessoa, Livramento, Patos, Sumé and Uiraúna.
Pernambuco (PE)	Belo Jardim, Cabo de Santo Agostinho, Caruaru, Garanhuns, Gravata, Olinda, Paulista, Petrolina and Recife.
Piauí (PI)	Buriti dos Lopes, Campo Maior, Joaquim Pires, Monsenhor Gil, Monsenhor Hipólito, Parnaíba and Teresina.
Rio Grande do Norte (RN)	Mossoró and Natal.
Sergipe (SE)	Aracaju, Nossa Senhora do Socorro and São Cristóvão.

Source: Authors' own elaboration based on data from BNDES (2023) and the Ministry of Finance (2023).

4.2 Empirical Model

To identify the effect of PMAT and PNAFM on municipal own-source tax revenues $RETRIB_{i,t}$, $IPTU_{i,t}$, $ITBI_{i,t}$ e o $ISSQN_{i,t}$, the Differences-in-Differences (DiD) method for multiple periods is employed. The implementation of these programs occurred gradually and permanently in the participating municipalities, creating a source of heterogeneity that the canonical DiD model does not adequately accommodate. Contemporary econometric literature shows that this traditional and widely used model produces biased estimates when the treatment effect is heterogeneous (Athey and Imbens, 2022; Callaway and Sant'Anna, 2021a; Goodman-Bacon, 2021; Sun and Abraham, 2021)

Therefore, the canonical DiD estimator tends to be biased, especially in the presence of large variations in weights, since this formulation is applied in contexts with information over multiple periods and where individuals iii may begin treatment at different times. This requires a homogeneity assumption of the impact both across treated unit groups and over time elapsed since the start of the programs. Recent studies by De Chaisemartin and D'Hartifulle (2020), Borusyak, Jaravel and Spiess (2021) e Goodman-Bacon (2021) show that not only is this assumption overly restrictive, but also that applying the canonical method can lead to seriously biased estimates (Meireles, Freguglia and Corseuil, 2022). To overcome this problem, it became necessary to adopt an econometric strategy with an estimator robust to treatment heterogeneity (Goodman-Bacon, 2021; Sun and Abraham, 2021).

Thus, the econometric strategy proposed by Callaway and Sant'Anna (2021) was adopted, which allows estimating the average treatment effect in a flexible, consistent, and robust manner in the presence of heterogeneity and multiple periods. This method is robust even under the assumptions of conditional and unconditional parallel trends in the pre-treatment period. In this research, the basic model assumes the condition of unconditional parallel trends (Callaway and Sant'Anna, 2021a; Sun and Abraham, 2021).

The causal inference problem considers T periods, with $t = 1, 2, \dots, T$, and D_t is a binary variable equal to 1 if a municipality adopts at least one of the Programs in year t , and 0 otherwise. Define G_g as an indicator equal to 1 if the municipality is first treated in period g within the analysis horizon, and 0 otherwise. Additionally, C is assigned the value 1 for municipalities that are never treated (i.e., never participate in the Programs). Each municipality in the sample has exactly one value equal to 1 among G_g or C , ensuring it belongs to only one group — either treated at a specific period or never treated.

Among the proposed formulations more appropriate for this broader context, it is common to start with estimates of the average treatment effect on treated ($ATT_{g,t}$) disaggregated for each combination of treated subgroups and time periods. This ATT is a function of the treatment group g and the period t in which municipalities first implement the Programs. In this study, there are twenty-five distinct groups of units first treated between 1998 and 2023, and time t . Assuming conditional or unconditional parallel trends, staggered treatment adoption, treatment irreversibility, and covariate overlap, the group average treatment effect is defined as follows:

$$ATT_{(g,t)} = E[Y_t(g) - Y_t(0) | G = g] \quad (1)$$

Considering the balanced panel data structure, the ATT for group g at time t can then be estimated semi-parametrically as expressed in equation (1). To obtain a more intuitive and easily interpretable causal effect parameter, Callaway e Sant'Anna (2021) propose aggregating each estimated $ATT_{(g,t)}$ from equation (1).

In the context of PMAT and/or PNAFM adoption by municipalities in the Northeast region, there are some drawbacks regarding the aggregation of $ATT_{(g,t)}$. First, the estimate may be biased due to self-selection into treatment, since each municipality chose the timing to sign the loan contract. In other words, municipalities that adhered to the programs earlier may experience the treatment effects sooner. In this sense, a simple average aggregation of $ATT_{(g,t)}$. would likely assign greater weight to the effect of the group that received treatment most recently, i.e., with more observations in the post-treatment period (Teixeira and Venter, 2021). To address this category of problem, Callaway and Sant'Anna (2021) suggest measuring the group-specific $ATT_{(g,t)}$. and then calculating their average over the post-treatment period as follows:

$$\tilde{\theta}_s(g) = \frac{1}{T-g+1} \sum_{t=2}^T \{t \geq g\} ATT_{(g,t)} \quad (2)$$

$$\theta_s = \sum_{g=2}^T \tilde{\theta}_s(g). P(G = g) \quad (3)$$

Equation (2) denotes the specific effect of each treated group in the post-treatment period, while equation (3) provides the overall treatment effect θ_s , that is, the aggregation of the group-specific treatment effects across groups. This latter equation reports a summary measure of the impact of program adoption on municipal own-source revenues, free from the problems of treatment selectivity. This parameter reflects the group effect, which is an unbiased and robust estimate of the policy impact on each treated group (Teixeira e Venter, 2021). According to Callaway and Sant'Anna (2021), the parameter θ_s is analogous to the ATT in the canonical case with two groups and two periods.

Although θ_s is an appropriate measure of the causal effect, the impact of program adoption on own-source revenues may be dynamic. Here, the interest lies in observing the dynamics of the treatment effect. In this sense, it is natural to expect increasingly larger effects of the policy on revenue growth during the post-treatment period.

To analyze how the effects of the Programs vary with the elapsed treatment time, the average of $ATT_{(g,t)}$ is calculated to highlight the dynamics of the intervention effect over different durations of exposure to the treatment, as follows:

$$\tilde{\theta}_D(e) = \sum_{g=2}^T \sum_{t=2}^T 1 \{t - g + 1 = e\} ATT_{(g,t)} P(G = g | t - g + 1 = e) \quad (4)$$

Where (e) is the exposure time to the treatment. Note that (e) corresponds to the event time, that is, the elapsed time since the first treatment period. Then, the average is aggregated over all values of (e) as follows:

$$\theta_D = \frac{1}{T-1} \sum_{e=1}^{T-1} \tilde{\theta}_D(e) \quad (5)$$

Equation (5) corresponds to the summarized measure of the dynamic effect (event study). The main difference between θ_D and θ_s lies in the weights: θ_D places more weight on

$ATT_{(g,t)}$ when g is less than t . This means that groups with greater exposure to the policy are given more weight (Teixeira and Venter, 2021). In this research, the preferred intervention result is the dynamic effect (event study) under the condition of unconditional parallel trends and with a control group composed of never-treated units.

5. EMPIRICAL RESULTS

This section presents and discusses the results obtained from the data treatment applied.

The estimations of the effect of adherence to PMAT and/or PNAFM are based on the *per capita* dependent variables of: Own Tax Revenue ($RECTRIB_{g,t}$), Urban Property Tax ($IPTU_{g,t}$), Real Estate Transfer Tax ($ITBI_{g,t}$), and Service Tax ($ISSQN_{g,t}$) of the beneficiary municipalities, as well as on the duration of treatment.

Heterogeneous effects, as well as isolated results, will be analyzed through specific estimations for each Federative Unit in the Northeast region of Brazil. In other words, the impacts of the programs will be assessed for the treatment and control groups in municipalities belonging to the Federative Units of Alagoas (AL), Bahia (BA), Ceará (CE), Maranhão (MA), Paraíba (PB), Pernambuco (PE), Piauí (PI), Rio Grande do Norte (RN), and Sergipe (SE).

The Northeast region of Brazil is composed of the nine states mentioned above and accounts for approximately 18% of the national territory, covering an area of 1,561,177 km². Demographically, it concentrates about 26.9% of the Brazilian population, with over 57 million inhabitants, according to 2022 estimates. Despite its significant population share, the region accounts for only 13.9% of the national Gross Domestic Product (GDP), with the Northeast's *per capita* GDP being the second lowest among Brazilian regions, around R\$ 20,301.00, below the national average of R\$ 40,696.00. This mismatch between population and economic production reflects historical and structural inequalities that impact regional development and the own-revenue capacity of municipalities in the Northeast (IBGE, 2023a; b).

Finally, a placebo test will be conducted to evaluate whether the selected control group represents a good counterfactual for the treated group. The procedure consists of using, as outcome variables, measures that, a priori, should not be directly affected by the actions financed by PMAT and/or PNAFM. Accordingly, Agricultural Revenue ($RECAGRO_{i,t}$) and Industrial Revenue ($RECIND_{i,t}$) were selected as dependent variables. If the control group is a valid counterfactual, which is equivalent to the validity of the parallel trends assumption, no significant treatment effects should be observed in these variables (Martini, Zylberberg and Machado, 2023).

5.1 Effects on *Per Capita* Revenues

The basic method for Estimating Group-Time Average Treatment Effects reveals as outcomes the isolated treatment impact for each group in each period, based on bootstrap. The respective treatment groups and periods are indicated in the columns *group* and *time*. Under the assumptions of no anticipation and parallel trends, the average treatment effects by group and time are identifiable in periods where $t \geq g$ (i.e., in the post-treatment periods for each group) (Callaway e Sant'Anna, 2021b).

However, in this study, a scenario with small-sized groups was considered, which can sometimes cause difficulties in estimation using the did package (R Core Team, 2025). Moreover, statistical inference — especially regarding the average treatment effect in group-time — can become fragile when the number of units per group is small. For example, the effective sample size to estimate the variation in outcomes over time for individuals in a given

group equals the number of observations in that group, and it is unlikely that asymptotic results provide good approximations of the sampling distribution of average treatment effects when there are few units per group.

Thus, a reasonable alternative approach in this case is to focus only on the aggregated treatment effect parameters. To this end, dynamic aggregation was applied. Table 5 aims to present the estimation results of the dynamic aggregation for own-source revenues in *per capita* terms for the municipalities in the analyzed region that were beneficiaries of the Programs:

Table 5 – Event-Study Estimation with Dynamic Aggregation for *per Capita* Revenues

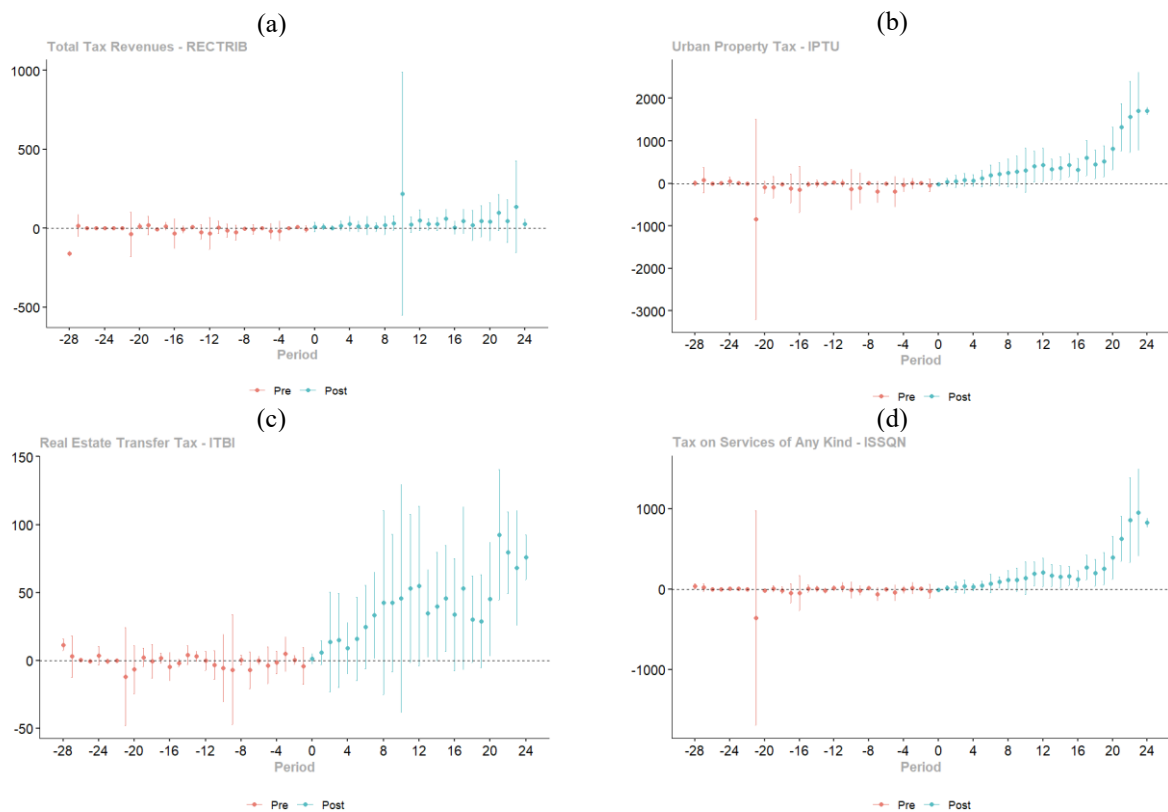
	$RECTRIB_{g,t}$	$IPTU_{g,t}$	$ITBI_{g,t}$	$ISSQN_{g,t}$
<i>Treatment Effect</i>	40.44*** (14.81)	501.54*** (74.79)	39.37*** (8.43)	242.64*** (36.44)
[95% Conf. Int.]	11.4156 - 69.481	354.955 - 648.131	22.846 - 55.900	171.220 - 314.066
<i>Treated Units</i>	74	74	74	74
<i>Groups</i>	19	19	19	19
<i>Observações</i>	49725	49725	49725	49725

Legend: * = 10%; ** = 5%; *** = 1%; () Standard Deviation.

Source: Authors' own elaboration.

The analysis of Event-Study Graph 1 allows the disaggregation of the effects presented in Table 5 over time, checking: (i) the validity of the parallel trends assumption in the pre-treatment periods, and (ii) the temporal dynamics of the post-implementation impacts:

Graph 1 –Dynamic Aggregated Event-Study *per Capita*



Source: Authors' own elaboration.

According to Table 5, the results of the dynamic aggregated event-study estimation show that the PNAFM and PMAT programs had positive and statistically significant impacts (at the 1% level) on the own-source tax revenue of municipalities in the Northeast region. The

average treatment effect indicated an increase of R\$ 40.44 *per capita* in tax revenues, with notable increases of R\$ 501.54 *per capita* for IPTU, R\$ 39.37 for ITBI, and R\$ 242.64 for ISSQN, suggesting that the programs were particularly effective in modernizing property taxation and service taxes. The narrow confidence intervals and robust significance reinforce the reliability of the findings, indicating the effectiveness of the programs in expanding municipal revenue capacity.

In Graph 1, the X-axis represents the duration of exposure to the treatment, using dynamic aggregation. The zero value on the axis corresponds to the period when the groups were initially exposed to the treatment, reflecting the immediate effect of the intervention. A duration of -1 indicates the period prior to the groups' first participation, represented by red points, while the value 1 corresponds to the first period following initial exposure, indicated by blue points. The Y-axis shows the variation in revenues, in Brazilian reais (R\$). Based on the graphical analysis, it is observed that the variables of interest—Own-Source Tax Revenue (a), Property Tax (IPTU) (b), Real Estate Transfer Tax (ITBI) (c), and Tax on Services (ISSQN) (d) — showed positive and statistically significant variation after the implementation of the Administrative and Tax Modernization Programs.

5.2 Heterogeneous Effects by Program

Following Callaway & Sant'Anna (2021), heterogeneous effects were estimated for each program (PMAT and PNAFM) and by Federative Unit (UF), allowing an assessment of whether impacts differ according to policy design or state context. This approach is crucial to identify which groups benefit most from the interventions, guiding resource targeting. As detailed in the results of Tables 6 and 7:

Table 6 – Dynamic Aggregated Event-Study *per Capita* – PMAT

	<i>RECTRIB</i> _{g,t}	<i>IPTU</i> _{g,t}	<i>ITBI</i> _{g,t}	<i>ISSQN</i> _{g,t}
<i>Treatment Effect</i>	31.83*** (12.49)	506.69*** (101.31)	40.71*** (13.36)	247.35*** (48.29)
[95% <i>Conf. Int.</i>]	7.3361 - 56.333	308.126 - 705.267	14.521 - 66.907	152.693 - 342.019
<i>Treated Units</i>	47	47	47	47
<i>Groups</i>	14	14	14	14
<i>Observações</i>	49725	49725	49725	49725

Legend: * = 10%; ** = 5%; *** = 1%; () Standard Deviation.

Source: Authors' own elaboration.

According to Table 6, the results from the dynamic aggregated event-study estimation show that, individually, the Tax Administration and Basic Social Sectors Modernization Program (PMAT), financed by the National Bank for Economic and Social Development (BNDES), had positive and statistically significant impacts on the own tax revenue of municipalities in the Northeast region. The average treatment effect indicated an increase of R\$ 31.83 *per capita* in tax revenues, R\$ 506.69 *per capita* for *IPTU*_{g,t}, R\$ 40.71 for *ITBI*_{g,t}, and R\$ 247.35 for *ISSQN*_{g,t}.

Table 7 – Dynamic Aggregated Event-Study *per Capita* - PNAFM

	<i>RECTRIB</i> _{g,t}	<i>IPTU</i> _{g,t}	<i>ITBI</i> _{g,t}	<i>ISSQN</i> _{g,t}
<i>Treatment Effect</i>	46.86 (27.27)	402.55** (97.43)	32.96** (9.05)	197.27** (54.00)
[95% <i>Conf. Int.</i>]	-6.59 - 100.3283	211.582 - 593.524	15.220 - 50.714	91.425 - 303.117
<i>Treated Units</i>	35	35	35	35
<i>Groups</i>	16	16	16	16
<i>Observações</i>	49725	49725	49725	49725

Legend: * = 10%; ** = 5%; *** = 1%; () Standard Deviation.

Source: Authors' own elaboration.

According to Table 7, the results from the dynamic aggregated event-study estimation show that the National Program for Administrative and Fiscal Modernization Support (PNAFM), financed by the Inter-American Development Bank (IDB) through the Ministry of Finance, exhibits less robust effects on own tax revenues when analyzed in isolation. However, the other accounts showed statistically significant responses, with variations of R\$ 402.55 *per capita* for $IPTU_{g,t}$, R\$ 32.96 for $ITBI_{g,t}$, and R\$ 197.27 for $ISSQN_{g,t}$.

To conclude the heterogeneity analyses, aggregated impacts and isolated results of each program (PMAT and PNAFM) will be evaluated, stratified by Northeastern Federal Units. Although these states share the same geographic region, they exhibit marked socioeconomic and institutional differences (Lima, 2017, 2009; Silva, 2022).

5.3 Placebo Test

A strategy to test the validity of the control group as a counterfactual is to use a placebo variable — that is, a measure that, by its nature, should not be directly influenced by PMAT and/or PNAFM. If the control group is indeed appropriate (i.e., if the parallel trends assumption holds), no significant treatment effect should be detected on this placebo variable. For this purpose, a vector of agricultural revenue variables ($RECAGRO_{g,t}$) and industrial revenue variables ($RECIND_{g,t}$) were selected as placebos, which due to the operational rules of the Programs, should not be affected. The results are highlighted in Table 8 below:

Table 8 – Placebo with Agricultural and Industrial Revenues

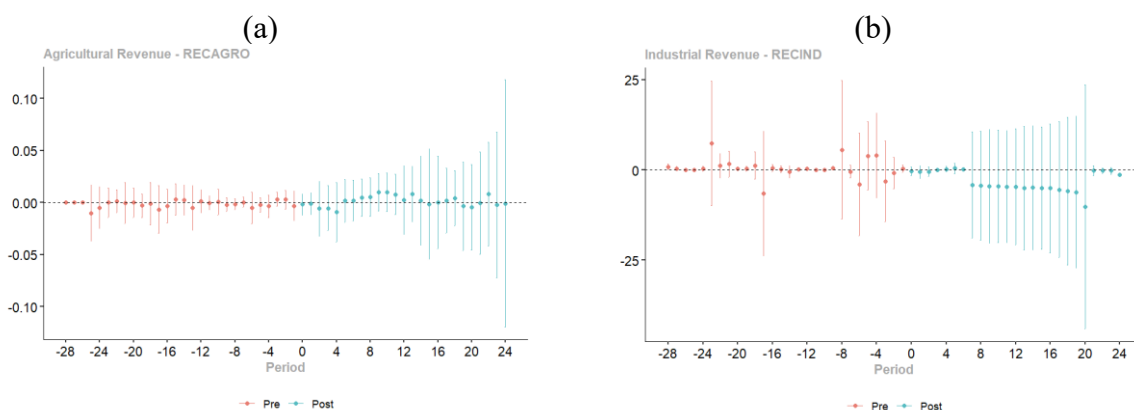
	$RECAGRO_{g,t}$	$RECIND_{g,t}$
<i>Treatment Effect</i>	0.00 (0.00)	-3.08 (4.30)
[95% Conf. Int.]	-0.0171 - 0.0197	-11.52 - 5.3545
<i>Treated Units</i>	74	74
<i>Groups</i>	19	19
<i>Observações</i>	49725	49725

Legend: * = 10%; ** = 5%; *** = 1%; () Standard Deviation.

Source: Authors' own elaboration.

Graph 4 complements Table 9 by presenting the dynamic effects of the aggregation of agricultural (a) and industrial (b) revenues in the municipalities of northeastern Brazil, considering their exposure to the PMAT and PNAFM programs.

Graph 4 – Dynamic Effects on Municipal *per Capita* Revenues



Source: Authors' own elaboration.

The results were as expected. The placebo variables showed no significance regarding the treatment effects, neither on their pre-treatment trends nor on the impacts of the intervention.

Overall, the estimated results suggest that participation in the PMAT and PNAFM Programs generated positive and statistically significant effects on the own-source tax revenue of municipalities in the Brazilian Northeast. However, there is notable heterogeneity among the states in the region: impacts were particularly strong in states like Bahia, Pernambuco, Maranhão, and Rio Grande do Norte, while in some other states the effects were more modest or not significant. These findings underscore the importance of institutional context and local administrative capacity as key determinants of program effectiveness, as well as highlighting the potential of these instruments to promote greater fiscal autonomy and reduce regional inequalities in the country.

6. FINAL REMARKS

This research aimed to provide statistical evidence demonstrating that adherence to the PMAT, managed by BNDES, and the PNAFM, coordinated by the Ministry of Finance with resources from the IDB, generated positive and statistically significant effects on the own-source revenue collection of municipalities in the Northeast region of Brazil.

To this end, the empirical strategy consisted of applying the Difference-in-Differences (DiD) method over multiple time periods. This method is based on the fact that, when an exogenous event occurs, it is possible to assess its impact by comparing two groups — treatment and control — through estimating double differences: the first between groups, and the second between time periods (Callaway and Sant’Anna, 2021).

The main response variable of this evaluation was the total own-source tax revenue ($RECTRIB_{g,t}$), followed by the impacts on specific accounts: $IPTU_{g,t}$, $ISSQN_{g,t}$ e $ITBI_{g,t}$, all measured on a *per capita* basis. The estimations performed here concluded that the effect of participation in the Programs was positive, as the 95% confidence intervals of the aggregated estimations with dynamic effects do not include zero, indicating statistical significance at the 1% level.

In other words, it can be inferred that municipalities that received resources from PMAT and/or PNAFM experienced significant increases in tax revenue compared to municipalities that did not participate in the Programs. Put differently, if these municipalities had not joined the Programs, their revenue growth would have been statistically lower than what was observed after receiving the resources. The various empirical exercises conducted support this conclusion.

Among the main mechanisms implemented within the scope of the Programs are: aerial photogrammetry; updating generic value maps; property re-registration; implementation of automated active debt collection systems; development of multi-purpose cadasters; deployment of georeferenced information systems; acquisition of furniture and equipment for taxpayer service; as well as training sessions for administrative staff, as prescribed by the Programs’ guidelines (BNDES, 2023a; Brasil, 2008, 2014, 2018).

For model validation, the agricultural revenues ($RECAGRO_{g,t}$) and industrial revenues ($RECIND_{g,t}$) used as placebo tests showed no significant effects related to the treatment, neither on their pre-treatment trends nor on the impacts of the intervention.

Besides technical issues — such as the need for specialized municipal staff to prepare funding projects, submit consultation letters to the appropriate banks, and draft the reports required for credit operation authorization by the National Treasury Secretariat after verifying legal limits and conditions — it is crucial to consider the political costs associated with implementing the Programs. This includes everything from negotiating the approval of new

tax legislation with the Municipal Councils to possible communication failures between the public administration and the population. These failures are particularly relevant when the changes cause abrupt increases in tax collection, which may be one of the factors contributing to the low adherence of municipalities to the Programs, especially when comparing municipalities in the treatment and control groups.

It is important to emphasize that this study did not analyze all the objectives listed among the fundable items under PMAT and PNAFM, such as the pursuit of greater transparency, improved citizen services, increased efficiency in municipal expenditures, among others. This limitation prevents a definitive conclusion about the effectiveness of the programs across all their levels and scopes.

Among the limitations of this study, the absence of analysis on spending efficiency and transparency effects stands out, as well as the lack of evaluation of long-term impacts. Future research could explore these aspects and assess whether the revenue gains translate into improvements in local public services.

Finally, it is believed that the results obtained in this empirical research can contribute to improving the management of these types of programs by BNDES, the IDB, and the Ministry of Finance, allowing for a more efficient allocation of resources as well as the dissemination of the policy to other municipalities. This is crucial, as an increase in municipal tax revenue has the potential to enhance public services and, consequently, improve the population's quality of life.

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