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EFFICIENCY OF MANAGEMENT BY RESULTS: A STUDY ON INCENTIVE SYSTEMS IN THE PUBLIC SECTOR

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ABSTRACT

This study examines the efficiency of the Institutional Performance Bonus (GDI) implemented at the Municipal Department of Finance of Goiânia, within the framework of results-based management established by Results Contract No. 001/2015. To measure the relative performance of decision-making units (DMUs) on a monthly basis, Data Envelopment Analysis (DEA) was applied using an output-oriented CCR model, based on secondary data related to payroll, tax revenues, and current expenditures, collected for the periods 2014–2016 and 2021–2023. The selection of these variables was grounded in their fiscal and operational nature, as well as in the requirement for temporal comparability through objective metrics. The results reveal significant variation across the months analyzed, highlighting the effect of fiscal seasonality, which strongly influences revenue collection during periods such as January, February, and December. This cyclical pattern constrains the ability to attribute efficiency gains exclusively to the incentive system, suggesting that, although the GDI is relevant as a performance-inducing mechanism, it did not operate as the primary determinant of the observed performance. The analysis also identifies weaknesses in the structuring of targets and performance indicators, indicating the need for improvements in the municipality's variable compensation model. The study contributes by empirically demonstrating the limitations of monetary incentives as a standalone explanatory mechanism for efficiency in municipal contexts under fiscal seasonality.

Keywords: Incentive Systems, Results-Based Evaluation, Efficiency, Public Management.

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1 INTRODUCTION

The adoption of results-oriented management models has become a primary strategy for administrative modernization in the public sector, reflecting the transition from bureaucratic approaches to performance-based management arrangements (Boland & Fowler, 2000; Gaetani, 2003). This movement has been supported by the increasing use of instruments such as strategic planning, agreed-upon goals, indicators, and monitoring systems, considered essential for improving administrative efficiency and strengthening state accountability (Corrêa, 2007; Bol & Smith, 2011). The literature highlights that, when well-structured, these mechanisms align individual behaviors and institutional objectives, reducing informational asymmetries and encouraging the delivery of results (Baker et al., 1994; Gibbs et al., 2004).

In this context, incentive systems, especially those linked to performance, have become central tools for increasing efficiency and inducing desirable behaviors in the public sector (Krauter, 2009). Empirical evidence, however, demonstrates that their effectiveness depends on institutional, cultural, and organizational factors, as public environments are marked by normative constraints, multiple stakeholders, and challenges in performance measurement (Peres, 2007; Ditterich et al., 2012). Studies on financial incentives reveal that their adoption can generate improvements, but also opportunistic behaviors when goals are not well calibrated or when the evaluation system presents weaknesses (Silva, 2000; Oliveira et al., 2016). Thus, understanding how incentives operate within specific public structures becomes fundamental to evaluating the alignment among design, implementation, and achieved results (Xavier & Emmendoerfer, 2009; Defaveri et al., 2020).

At the municipal level, the City Hall of Goiânia incorporated the logic of results-based management after the approval of Complementary Law No. 276/2015, which consolidated a governance model based on the monitoring of goals and the linking of institutional performance with financial rewards, such as the Institutional Performance Bonus (GDI, Portuguese acronym for "Gratificação de Desempenho Institucional") (Brazil, 2015). This policy was inspired by management reforms adopted in other federative spheres, such as the "Management Shock" in Minas Gerais, which expanded the use of results-based contracts and modernized the organizational structure (Anastasia, 2006; Corrêa, 2007). In Goiânia, the main instrument of this policy was Contract No. 001/2015, signed with the Municipal Finance Secretariat, which defined indicators, goals, and bonus criteria linked to revenue collection efficiency and expenditure control (Scapens & Roberts, 1993; City Hall of Goiânia, 2015). However, despite the initiative's relevance, few studies empirically analyze the effectiveness of these incentives at the municipal level, mainly using robust quantitative methods (Peña, 2008; Ferreira & Gomes, 2009).

The literature also shows that measuring efficiency in the public sector is complex, given the multiple dimensions of inputs and outputs, which demand methods capable of capturing non-linear relationships and multiple outputs simultaneously (Peña, 2008; Gomes & Guimarães, 2013). Data Envelopment Analysis (DEA), in this sense, has established itself as a suitable tool to investigate the relative performance of organizational units in different public contexts, allowing the construction of efficiency frontiers and the identification of comparative productivity levels (Charnes, Cooper and Rhodes, 1978; Silveira et al., 2012). Its increasing use in public management studies reinforces its capacity to contribute to evidence-based diagnoses and policies (Pinto & Rodrigues, 2016; Alves & Melo, 2015).

Given this scenario, this study aims to analyze the efficiency of results-based management implemented in the Municipal Finance Secretariat of Goiânia, using the DEA technique, considering two distinct periods: the initial phase of GDI implementation (2014–2016) and the post-pandemic period (2021–2023). These intervals were selected based on criteria of institutional coherence, avoiding distortions resulting from political-administrative transitions and the impacts of the pandemic, which directly affected municipal fiscal indicators, aspects widely discussed in the literature on government performance in volatile contexts (Fernandes, 2016; Jacomossi & Silva, 2016).

By offering empirical evidence on the behavior of decision-making units throughout these cycles, the study contributes to the debate on the effectiveness of financial incentive systems, highlighting structural conditions, limitations, and potential for improving municipal management. Furthermore, it advances the literature by applying an assertive method to evaluate variable compensation policies at the municipal level, a field still little explored in Brazil (De Assis & Neto, 2011; Barbosa et al., 2016). In this way, the work broadens theoretical and empirical understanding of the relationship among incentives, institutional capacity, and the efficient use of public resources, offering support for managers, researchers, and policymakers.

2 THEORETICAL AND NORMATIVE FRAMEWORK

2.1 Overview of incentive systems

Literature on incentive systems highlights that such mechanisms play a decisive role in individuals' behavior within organizations, directly affecting their motivation, effort, and alignment with institutional goals (Baker et al., 1994; Krauter, 2009). In the public sector, however, the effectiveness of incentives is conditioned by structural and institutional factors, such as bureaucratic rules, informational asymmetries, and legal restrictions, which shape the use of Management Control Systems (MCS) and limit their operationalization (Assis & Neto, 2011; Bol & Smith, 2011). Even in the face of these challenges, incentives play a strategic role, helping mitigate opportunistic behavior, improving decisional predictability, and inducing performance patterns compatible with government priorities (Gibbs et al., 2004; Peres, 2007).

The adoption of incentive systems requires adherence to the organizational context, since public structures frequently combine multiple values, such as morality, distributive justice, and normative standards that strain reward models based exclusively on performance (Baker et al., 1994; Corrêa, 2007). In these environments, characteristics such as the waiting time to receive the incentive, the level of managerial control, and the intensity of informational asymmetry influence employees' responses to the agreed-upon goals (Dikolli & Vaysman, 2006; Xavier & Emmendoerfer, 2009). Therefore, the design of incentives must consider both economic aspects and behavioral and cultural elements present in public administration (Ditterich et al., 2012; Oliveira et al., 2016).

Well-structured incentive systems incorporate collaborative work, clear goals, and appropriate evaluation metrics, with variable compensation being the component most sensitive to organizational impacts (Krauter, 2009; Bol & Smith, 2011). As Hansen et al. (2003) observe, the exclusive use of budgetary metrics to evaluate performance tends to generate distortions, since not all relevant results can be fully captured by financial indicators. Therefore, best practices recommend combining objective and subjective metrics to enable more comprehensive diagnoses of employee performance (Bol, 2008; Baker et al., 1994). This balance is particularly relevant at the municipal level, where seasonal variations, data limitations, and political instability affect indicator behavior.

Despite theoretical advances, the public sector still faces significant limitations stemming from factors such as organizational culture, regulatory rigidity, and resistance to structural change (Beuren et al., 2014; Barbosa et al., 2016). In Goiânia, these challenges have been addressed through the adoption of management mechanisms to improve financial and operational results, aligned with the guidelines of results-based management and the incentive model established by Complementary Law No. 276/2015 (Goiânia City Hall, 2015). Thus, the literature reinforces that effective incentive systems depend on a combination of appropriate institutional design, robust metrics, and managerial capacity to integrate them into the decision-making process.

2.2 Efficiency in the public sector

Efficiency is one of the pillars of contemporary public management, especially in administrations that adopt results-oriented models and performance evaluation mechanisms (Peña, 2008; Gomes & Guimarães, 2013). With the enactment of Complementary Law No. 276/2015, Goiânia formally incorporated planning, monitoring, and evaluation practices, integrating the use of indicators, targets, and technical teams dedicated to monitoring results (Goiânia City Hall, 2015; Scapens & Roberts, 1993). This process sought to modernize the municipal administrative structure by linking institutional performance to the distribution of the Institutional Performance Bonus (GDI), aligning individual efforts with the administration's strategic priorities.

Performance-Based Agreements, recently adopted in the public sector, reinforce this movement by establishing formal commitments between managers and administrative units, thereby allowing greater predictability, accountability, and clarity in the delivery of public services (Alcoforado, 2005; Anastasia, 2006). In this scenario, organizational factors, such as incentive systems, budget execution, and accounting processes, serve as critical components influencing the performance of public policies (Fernandes, 2016; Peres, 2007). Efficiency, therefore, comes to be understood as the ability to transform inputs into results in an optimized way, considering both the rational use of resources and the definition of realistic goals consistent with institutional capacity (Peña, 2008; Gomes & Guimarães, 2013).

Literature distinguishes two main types of efficiency: technical efficiency, related to the optimal use of available resources to produce goods, and economic efficiency, which involves minimizing costs to achieve a given level of production (Peña, 2008; Oliveira et al., 2016). In the public sector, measuring efficiency faces obstacles, including a multiplicity of objectives, informational limitations, and seasonal variations in budget execution. To overcome these limitations, Data Envelopment Analysis (DEA) has been widely used in studies that evaluate the relative performance of organizational units, especially in public administration and non-profit entities (Peña, 2008; Ferreira & Gomes, 2009). The technique allows the identification of patterns of efficiency and inefficiency, building boundaries that guide benchmarking and institutional learning (Pinto & Rodrigues, 2016; Silveira et al., 2012).

In the context of this study, DEA proves particularly suitable for evaluating the performance of the Municipal Finance Secretariat, since the indicators of Contract No. 001/2015 involve multiple simultaneous variables—such as revenues, expenses, and payroll costs—which demand techniques capable of capturing complex interactions between inputs and outputs (Goiânia City Hall, 2015; Alves & Melo, 2015). Therefore, the use of DEA enables robust, consistent analyses aligned with evidence-based public management practices.

2.3 Related studies

Brazilian literature on incentives in the public sector has advanced in examining the effects of variable compensation, especially regarding its capacity to promote motivation, efficiency, and retention of qualified employees (Silva, 2000; Xavier & Emmendoerfer, 2009). Studies demonstrate that financial incentives can generate positive behaviors, but also reveal risks of opportunism when goals are not well defined or when evaluation processes are weak (Peres, 2007; De Assis & Neto, 2011). This ambiguity reinforces the importance of understanding how different institutional arrangements shape the results of these policies.

From a managerial perspective, research such as Anastasia's (2006) highlights that results-based reforms, such as the Minas Gerais "Management Shock," have increased administrative efficiency by introducing goals, indicators, and greater accountability for managers. This movement has inspired similar practices in several municipalities, including Goiânia, whose experience seeks to integrate these guidelines into the financial incentive system established by GDI. Studies on variable compensation, however, point out that structural flaws, such as the absence of precise parameters, inadequate indicators, and subjective evaluation, limit its effectiveness and require continuous adjustments (Silva et al., 2000; Ditterich et al., 2012).

Furthermore, the link between incentives and organizational commitment has been extensively discussed by Oliveira et al. (2016) and Rodrigues et al. (2014), who point to the influence of managerial feedback, institutional mission, and rewards on employee motivation. In the field of management control systems, Beuren et al. (2014) observed differences in the use of management information between administrative managers and clinical professionals in hospitals, while Barbosa et al. (2016) demonstrated that job satisfaction strongly depends on relational factors rather than salary. The influence of the institutional environment, in turn, was evidenced by Jacomossi & Silva (2016), who demonstrated how uncertainty affects the use of control practices and decision-making.

Finally, Defaveri et al. (2020) reinforce the idea that positive perceptions of the benefits of management control systems shape their design and practical use, encouraging both diagnostic practices and continuous improvement processes. These studies converge in indicating that the effectiveness of incentive systems depends on the combination of institutional design, goal clarity, indicator robustness, and alignment among agents, reinforcing the relevance of empirical analyses, such as the one carried out in this study.

3 METHODOLOGICAL DESIGN

The methodological design of this study was structured to ensure analytical rigor, internal coherence, and adherence to the objective of investigating the efficiency of the variable compensation implemented by the Municipality of Goiânia, especially in the context of Results-Based Management and the Institutional Performance Bonus (GDI). Considering the nature of the policy studied, structured around goals, indicators, and financial rewards, and the focus on measuring the relative performance of the Municipal Finance Secretariat (SEFIN), a methodological approach was adopted that drew on quantitative methods, consolidated theoretical foundations, and recognized efficiency evaluation techniques.

3.1 Sample, population, and time frame

The target population of the research comprises the administrative units subject to the incentive system created by Performance Contract No. 001/2015. However, to ensure comparability between the decision-making units (DMUs) and reduce structural heterogeneity, an essential condition for the application of efficiency models, the sample was restricted to SEFIN itself. This choice is widely supported in the methodological literature, which recommends selecting homogeneous units with respect to functions, processes, and objectives, especially in analyses using the Data Envelopment Analysis (DEA) technique (Peña, 2008; Ferreira & Gomes, 2009).

The period analyzed was delimited according to the institutional maturation cycle of the results-based management policy. The years 2014 to 2016 were included, corresponding to the pre-implementation, transition, and consolidation phases of results-based management, and the period from 2021 to 2023, marked by administrative stabilization after the pandemic. The exclusion of the years 2017 to 2020 is justified by three main reasons: (i) the political-administrative change resulting from the 2016 elections, which altered internal processes and management priorities; (ii) the strong fiscal instability generated by the pandemic period, which distorted revenues and expenses; and (iii) the absence of a consolidated results-based management cycle in these years, which would compromise consistent temporal comparisons. This temporal delimitation, therefore, reinforces the institutional validity of the research and avoids external interferences that could compromise the integrity of the analysis (Jacomossi & Silva, 2016).

3.2 Construction of variables and indicators

The original indicators established under Contract No. 001/2015 were revised by the 1st Addendum in light of Complementary Law No. 276/2015, which reorganized the metrics linked to SEFIN's performance. Among the five agreed-upon indicators—tax revenue, current expenses, taxpayer satisfaction, compliance with deadlines, and urban property tax (IPTU, Portuguese acronym for "Imposto Predial e Territorial Urbano") collection—priority was given to those of a strictly quantitative nature, in accordance with methodological recommendations for the application of DEA (Silveira et al., 2012). Thus, it was decided to exclude qualitative indicators, whose measurement asymmetry would compromise the model's robustness.

Therefore, the selected input was the total cost of the SEFIN payroll, as it represents the main resource used in the production of institutional outputs. Tax revenue and current expenses were used as outputs. Considering that, in the context of public management, lower expenses indicate greater efficiency, an inverse transformation was applied to current expenses (1/Current Expenses), a technique used to treat undesirable variables in DEA models (Pinto & Rodrigues, 2016). This construction ensures alignment between economic theory, incentive literature, and consolidated methodological standards.

Based on the Amendment to Contract No. 001/2015, specifically Clause II, two strategic indicators were selected: Indicator 1, which measures tax revenue growth; and Indicator 2, which refers to the percentage of operating expenses. These variables reflect the objectives of results-based management, revenue collection efficiency, and cost control, and were operationalized as outputs in the model. The variable considered as input was the total cost of the Secretariat's

payroll. Limiting the sample to SEFIN itself aims to ensure analytical homogeneity, guarantee comparability across units, and improve the precision of the results obtained from applying DEA.

Table 1. Variables used to calculate efficiency

Variable	Variable description	Type
CustFl	Total Cost Payroll Finances	Input
RecTrib	Tax Revenue	Output1
DespCor	Current Expenses	Output2

3.3 Data collection, processing, and structuring

The data used in the research were extracted from the Transparency Portal of the Goiânia City Hall, ensuring authenticity, reproducibility, and adherence to good research practices in public administration (Fernandes, 2016). The values for payroll, revenue, and expenses were collected monthly and organized into an input-output matrix. During data processing, consistency checks were performed, any discrepancies arising from accounting reclassifications were identified, and operational adjustments were applied to standardize historical series.

Each month was treated as a DMU (Decision-Making Unit), totaling 72 decision-making units. This temporal granularity allows the capture of intra-monthly and inter-annual variations, as well as the identification of seasonal patterns and structural behaviors, which are essential for correctly interpreting relative efficiency in tax and budgetary contexts.

3.4 Specification of the technique and software used

To ensure transparency and replicability, it is explicitly stated that the efficiency analysis was conducted using MaxDEA 8.2, an internationally recognized and widely used software package in empirical studies of technical efficiency. As a secondary alternative, DEAFrontier 4.1, coupled with Microsoft Excel, was used to verify results and cross-check efficiency scores.

Both tools were parameterized using the CCR (Constant Returns to Scale) model, initially proposed by Charnes, Cooper, and Rhodes (1978). This model assumes a constant proportionality between inputs and outputs and is particularly suitable for mature, relatively stable administrative structures, such as municipal finance departments (Alves & Melo, 2015).

The approach adopted was output-oriented, consistent with the study's analytical objective of maximizing institutional results in the face of relatively rigid resources, especially payroll, whose behavior is strongly conditioned by statutory rules.

3.5 Analytical structure, DMUs, and seasonality control

Each DMU corresponded to one administrative month, totaling 36 units between 2014 and 2016 and 36 units between 2021 and 2023. The choice of this temporal structure responds to three methodological reasons: (i) the tax administration operates under strongly marked seasonal cycles, requiring fine granularity; (ii) the DEA is particularly sensitive to temporal aggregations that distort the efficient frontier; and (iii) the monthly assessment allows the identification of transient and permanent effects of incentives.

It is recognized that months such as January, February, and December exhibit structurally distinct behavior in the public sector due to revenue seasonality. Therefore, three complementary methodological measures were adopted: (i) explicit identification of seasonal months as critical units, whose efficiency should be interpreted with caution; (ii) homologous comparison between equivalent months (e.g., January 2014 vs. January 2021); (iii) in-depth discussion of the impossibility of isolating the effect of GDI without additional techniques, such as seasonal regressions or difference-in-differences models. These choices reinforce analytical prudence and confer greater methodological maturity to the study.

3.6 Validity, reliability, and consistency of the analytical design

The present methodological design meets the formal requirements of internal validity, ensured by the homogeneity of the DMUs and the adherence between variables and objectives; external validity, guaranteed by public data and a technique widely recognized in the literature; reliability, supported by the use of robust and replicable software; consistency, anchored in solid theoretical foundations and explicit justifications. The adopted methodological structure provides adequate support for answering the research question, while respecting the limitations inherent to the method and ensuring scientific integrity of the study.

4 RESULTS

The results obtained from applying Data Envelopment Analysis (DEA-CCR) reveal relevant patterns regarding the efficiency behavior of the Municipal Finance Secretariat during the analyzed periods. However, these patterns should be interpreted with caution due to the effect of fiscal seasonality, widely documented in the literature as an exogenous variable independent of incentive systems (Peña, 2008; Gomes & Guimarães, 2013).

The analysis was based on 72 DMUs (administrative months), covering the periods from 2014 to 2016 and from 2021 to 2023. It was evaluated using MaxDEA 8.2, an internationally recognized software package employed in empirical studies of technical efficiency. As a secondary alternative, DEAFrontier 4.1, coupled with Microsoft Excel, was used.

The analysis of Results-Based Management efficiency in the Municipal Finance Department was conducted using the data presented in Table 2, which consolidates the efficiency scores for the 30 Municipal Development Units (DMUs) observed between 2014 and 2016.

For each unit, scores were calculated based on the standard, inverted, and composite frontiers, allowing DMUs to be grouped by performance: efficient, average, and inefficient. This approach highlights patterns of evolution and persistence of inefficiencies over the period, contributing to the identification of priority areas for adjustment and the practical impacts of the incentive instruments adopted.

Table 2. Efficiency scores (2014 to 2016)

Month/Year	DMU	Standard	Inverted	Composed	Composed *
Jan/14	DMU1	0,854504	0,573893	0,640305	0,855694
Feb/14	DMU2	0,828469	0,440207	0,694131	0,927626
Mar/14	DMU3	0,40503	1.000.000	0,202515	0,270638
Apr/14	DMU4	0,424295	0,876471	0,273912	0,366052
May/14	DMU5	0,349994	0,842556	0,253719	0,339066
Jun/14	DMU6	0,34567	1.000.000	0,172835	0,230974
Jul/14	DMU7	0,45324	0,609145	0,422048	0,564018
Aug/14	DMU8	0,55455	0,50647	0,52404	0,700319
Sep/14	DMU9	0,439668	0,686395	0,376636	0,503331
Oct/14	DMU10	0,42946	0,689884	0,369788	0,494179
Nov/14	DMU11	0,395253	0,858543	0,268355	0,358626
Dec/14	DMU12	0,523552	0,718339	0,402607	0,538037
Jan/15	DMU13	1.000.000	0,503453	0,748274	0,999981
Feb/15	DMU14	1.000.000	1.000.000	0,5	0,668192
Mar/15	DMU15	0,485938	0,591518	0,44721	0,597645
Apr/15	DMU16	0,399579	0,717767	0,340906	0,455581
May/15	DMU17	0,384558	0,725721	0,329418	0,44023
Jun/15	DMU18	0,357328	0,800656	0,278336	0,371964
Jul/15	DMU19	0,339813	0,819043	0,260385	0,347975
Aug/15	DMU20	0,358102	0,845033	0,256535	0,342829
Sep/15	DMU21	0,333827	0,896369	0,218729	0,292306
Oct/15	DMU22	0,274542	1.000.000	0,137271	0,183447
Nov/15	DMU23	0,278235	1.000.000	0,139117	0,185914
Dec/15	DMU24	0,701282	1.000.000	0,350641	0,468591
Jan/16	DMU25	0,689476	0,708239	0,490619	0,655655
Feb/16	DMU26	0,87054	0,373964	0,748288	1.000.000
Mar/16	DMU27	0,420006	0,856766	0,28162	0,376353
Apr/16	DMU28	0,301649	0,910423	0,195613	0,261414
May/16	DMU29	0,303221	1.000.000	0,151611	0,20261
Jun/16	DMU30	0,337861	0,820055	0,258903	0,345994
Efficient		2			1
Inefficient		28	7		29

The analysis of efficiency scores shows that few DMUs reached the efficiency frontier throughout the period, with occasional advances in 2015 and setbacks in 2016, reflecting limitations in converting inputs into results. A predominance of inefficiencies was observed, indicating operational weaknesses and necessitating adjustments to incentives and targets. Table 3 details the ranking of the units and facilitates relative performance comparisons.

Table 3. Ranking of composite efficiency *

Position	**DMU26**	**Composed**
Feb/16	DMU26	1,000000
Jan/15	DMU13	0,999981
Feb/14	DMU2	0,927626
Jan/14	DMU1	0,855694
Aug/14	DMU8	0,700319
Feb/15	DMU14	0,668192
Jan/16	DMU25	0,655655
Mar/15	DMU15	0,597645
Jul/14	DMU7	0,564018
Dec/14	DMU12	0,538037
Sep/14	DMU9	0,503331
Oct/14	DMU10	0,494179
Dec/15	DMU24	0,468591
Apr/15	DMU16	0,455581
May/15	DMU17	0,44023
Mar/16	DMU27	0,376353
Jun/15	DMU18	0,371964
Apr/14	DMU4	0,366052
Nov/14	DMU11	0,358626
Jul/15	DMU19	0,347975
Jun/16	DMU30	0,345994
Aug/15	DMU20	0,342829
May/14	DMU5	0,339066
Sep/15	DMU21	0,292306
Mar/14	DMU3	0,270638
Apr/16	DMU28	0,261414
Jun/14	DMU6	0,230974
May/16	DMU29	0,20261
Nov/15	DMU23	0,185914
Oct/15	DMU22	0,183447

The data indicate that only DMU26 (February 2016) achieved full efficiency, becoming a benchmark in the evaluated set. The composite efficiency, calculated as the weighted average of the standard scores and the complement of the inverted inefficiency, is then normalized to facilitate comparison between units, enabling more precise identification of benchmarks and performance nuances.

Table 4. Composite efficiency and normalized composite efficiency *

Composite Efficiency	(Standard Efficiency + (1 – Inverted Efficiency)) / 2
Composite Efficiency *	Composite Efficiency / Max (Compound Efficiency)

Composite and normalized efficiency metrics are useful for refining comparative analysis between DMUs, ranking relative performance, and precisely identifying benchmarks. Table 4 illustrates this application, aligning with the DEA's function as a benchmarking tool to guide continuous improvements and more efficient resource allocation practices (Peña, 2008).

4.1 General efficiency standards

The results demonstrate significant variations in efficiency scores throughout the year, particularly in January, February, and December, where scores were equal to or close to 1. Literature on public finance and fiscal management indicates that these months typically record peaks in revenue collection—January due to the payment of annual taxes and December due to the closing of the fiscal year —accompanied by intensified active collection efforts (Fernandes, 2016; Jacomossi & Silva, 2016). Therefore, these months constitute "naturally efficient" periods, regardless of the presence of financial incentives, which requires rigorous analytical interpretation.

It was observed that the 2015 DMUs exhibited heterogeneous behavior, with high efficiency in the first months of the year, followed by a progressive decline until November. Despite the temporal coincidence with the implementation of the GDI, this pattern does not allow for a direct causal link, as seasonality may have played a preponderant role in the performance of the outputs, mainly tax revenue.

The analyses reveal variations in efficiency scores, with DMU1 maintaining stable performance, while units such as DMU3, DMU6, and DMU8 showed persistent inefficiencies, indicating the need for strategic adjustments (Peña, 2008; Gomes & Guimarães, 2013).

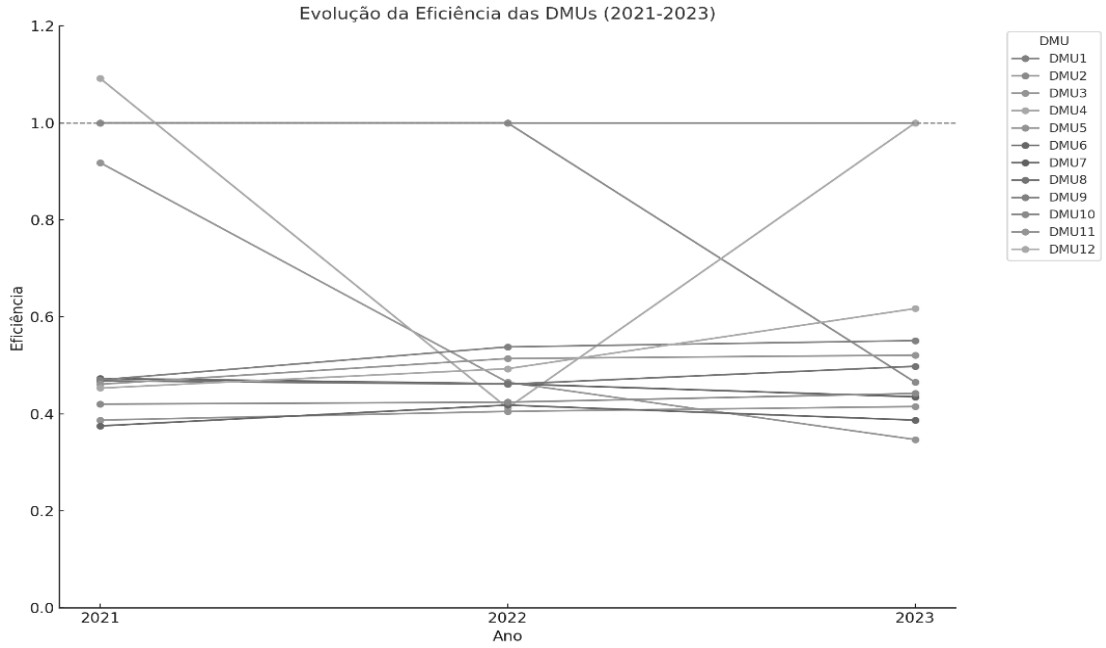
This heterogeneity reinforces the importance of benchmarking and management strategies aligned with the reality of each unit to promote continuous improvement (Silveira et al., 2012; De Assis & Neto, 2011), as evidenced in Table 5.

Table 5. Efficiency analysis (2021-2023)

DMU	2021	2022	2023	Observations
DMU1	1,000 *	1,000 *	1,000 *	Consistency in full efficiency
DMU2	1,000 *	1,000 *	0,465	Decline in 2023
DMU3	0,918	0,465	0,347	Continuous reduction in efficiency
DMU4	1,092 *	0,412	1,000 *	Recovery in 2023
DMU5	0,387	0,405	0,415	Slight improvement over the years
DMU6	0,375	0,418	0,387	Persistent inefficiency
DMU7	0,473	0,462	0,435	Marginal variation
DMU8	0,468	0,461	0,498	Slight improvement in 2023
DMU9	0,470	0,538	0,551	Improving trend
DMU10	0,420	0,424	0,442	Slight increase in efficiency
DMU11	0,461	0,514	0,521	Gradual improvement
DMU12	0,453	0,493	0,617	Greatest progress among DMUs

DMU1 maintained full efficiency over the three years analyzed, while DMU3 and DMU6 remained low-efficiency, and DMU4 fluctuated, recovering in 2023. These patterns indicate trends of improvement in some units and the need for adjustments in others to optimize resources and increase productivity, as illustrated in figure 1.

Figure 1. Evolution of DMU efficiency – 2021-2023



Longitudinal analysis reinforces the consistency of DMU1 in maintaining efficiency, while DMU3 and DMU6 presented recurring inefficiencies. The observed slack in inputs and outputs highlights opportunities for better resource allocation, indicating that some units have improved, but others still require more effective management strategies.

4.2 Comparison between institutional phases

Comparing the periods, 2016, the year of GDI consolidation, showed greater stability in efficiency, although it did not reach scores close to the frontier in all months. The slight increase in average efficiency may indicate that GDI contributed to disciplining collection processes, reducing rework, and encouraging more systematic monitoring of indicators, as suggested by studies of incentives in the public sector (De Assis & Neto, 2011; Ditterich et al., 2012).

The results from 2021–2023 reveal distinct behavior: more dispersed scores, greater variability, and a drop in efficiency in the middle months of the year, especially between April and August. These patterns suggest that the return to normalcy post-pandemic altered the fiscal cycle and administrative processes, making direct comparisons with previous periods difficult. Furthermore, political stabilization after 2021 did not, in itself, result in greater efficiency, reinforcing the idea that isolated incentives are insufficient to generate structural changes, as pointed out by Baker et al. (1994) and Bol & Smith (2011).

4.3 Effect of seasonality vs. effect of GDI

Detailed analysis showed that it is not possible to attribute, based solely on DEA, efficient months to a direct consequence of GDI. For example, January and February 2015, both efficient months, coincide with a period of greater seasonality in revenue collection, not with months with greater additional financial incentive or differentiated organizational events.

Thus, seasonality serves as an interfering variable, potentially masking or amplifying the actual effect of incentives. DEA, although powerful, does not automatically separate seasonal effects from institutional effects, a limitation recognized in the literature (Ferreira & Gomes, 2009; Peña, 2008). Therefore, the causal relationship between incentives and efficiency cannot be confirmed; it can only be suggested, reinforcing the need for future techniques such as adjusted time-series, regression with seasonal dummies, or difference-in-differences models.

5 FINAL CONSIDERATIONS

The discussion of the findings should articulate the observed performance with the theoretical framework that underpins incentive systems, results-based management, and the measurement of public efficiency. By comparing the empirical results with the literature, interpretations emerge that illuminate the complex role of incentives in institutionally rigid environments, such as the municipal public sector.

The results obtained align with the classic analyses of Baker et al. (1994), which hold that financial incentives are powerful but subject to several factors that can enhance or neutralize their effects, such as managerial capacity, goal clarity, and organizational culture. The behavior of the DMUs indicates that the GDI may have influenced internal processes, the standardization of routines, a greater focus on results, and a commitment to revenue collection. However, this influence does not outweigh the systemic effect of fiscal seasonality.

Furthermore, studies such as Bol & Smith (2011) reinforce that incentives act heterogeneously among civil servants, being filtered by subjective factors, personal values, sense of justice, and expectations of recognition. The variable performance between months reflects this multiplicity of elements. The behavior of efficiency in the SEFIN (Finance Department) of the Municipality of Goiânia confirms the arguments of Corrêa (2007) and Ditterich et al. (2012) that managerial reforms, when implemented within inflexible structures, tend to produce diffuse results, particularly when indicators are strongly associated with the fiscal cycle. The GDI (General Development Incentive) provided structural advances, but it could not, on its own, compensate for historical limitations in technology, information, administrative culture, and operational routines.

The findings reveal significant opportunities for adjusting incentive systems. Based on the results and the theory consulted, the following is recommended: (i) adoption of seasonally adjusted targets, establishing expected ranges for peak and low months; (ii) revision of performance metrics, incorporating variables such as individual and collective productivity, timeliness of processes, and active collection actions; (iii) integration of operational data with digital systems, facilitating continuous monitoring of targets; (iv) adoption of qualitative management reports that complement exclusively fiscal indicators; (v) creation of continuous feedback mechanisms, as suggested by Oliveira et al. (2016) and Rodrigues et al. (2014).

The study demonstrates that incentives should be understood as part of a broader set of governance practices, not as a single solution. This research presents limitations that need to be recognized for proper interpretation of the results and advancement of the scientific agenda. DEA is sensitive to outliers and does not separate exogenous effects (such as seasonality). The technique assumes homogeneity among DMUs, which may not capture unobservable internal asymmetries. It does not incorporate random errors, being entirely deterministic (Peña, 2008).

The lack of specific modeling for seasonality limited the ability to identify effects unique to GDI (Governance Incentive Development). The distinction between incentive-induced performance and performance driven by the fiscal cycle remains partially unresolved. The data from the Transparency Portal are reliable but aggregated, so they do not allow analysis of individual productivity, internal effort, or qualitative metrics. Future research should employ regressions with instrumental variables, multivariate models, adjusted time series, cluster analysis, or difference-in-differences methods to isolate effects.

The study showed that GDI (Management by Results) contributed to disciplining routines and strengthening the focus on results in the Municipal Finance Department. However, its direct impact on efficiency cannot be completely isolated from fiscal seasonality. DEA (Digital Economic Analysis) revealed relevant performance patterns, but also demonstrated the need for more sophisticated methodological approaches for causal analyses. From a practical point of view, the results encourage the formulation of more robust incentive policies that consider seasonal contexts, non-financial metrics, and subjective elements of motivation, reaffirming the importance of results-based management as an instrument of fiscal governance. Finally, the study reinforces the debate on incentives, efficiency, and accountability, contributing to the contemporary agenda of modernizing Brazilian public management and offering technical foundations for the continuous improvement of variable remuneration models applied in municipalities.

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