The Smart City Agenda, Master Plan Revisions and Intra-regional Inequality in Brazil[1]

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Abstract

This study examines whether the intensive incorporation of the smart city agenda into master plan revisions is associated with changes in municipalities' contribution to intra-regional economic inequality. The analysis shifts the assessment from the isolated city to the municipality's position within its functional region. Treatment is constructed through a dictionary-based textual search applied to 535 master plan revisions between 2013 and 2020, identifying new content relative to the immediately preceding version. The Smart City index combines economy, society, environment, governance, technology and urban branding, coded through thematic subgroups. The outcome is the municipal additive contribution to the intra-regional component of gross domestic product (GDP) per capita inequality, obtained from the decomposition of the Theil T index. The empirical strategy uses Difference-in-Differences (DiD) with multiple periods, following Callaway and Sant'Anna. The results indicate that revisions in the upper quartile of incorporation are associated with a reduction in the municipal additive term, with clearer evidence than under the median threshold. This pattern shows no systematic pre-treatment differences in the main specification and is concentrated among metropolises and regional capitals. Complementary exercises preserve the direction of the effect for the Theil T index, but call for caution regarding the precision and distributive sensitivity of the estimates. The evidence is consistent with a relative recomposition of municipal economic position, rather than with a general or automatic effect of smart policies on regional inequality.

Keywords: Smart cities; Master plans; Intra-regional inequality.

Resumo

Este estudo examina se a incorporação intensiva da agenda de cidades inteligentes em revisões de planos diretores se associa a mudanças na contribuição dos municípios para a desigualdade econômica intrarregional. A análise desloca a avaliação da cidade isolada para a posição do município em sua região funcional. O tratamento é construído por busca textual baseada em dicionário, aplicada a 535 revisões de planos diretores entre 2013 e 2020, identificando conteúdos novos em relação à versão imediatamente anterior. O índice Smart City combina economia, sociedade, ambiente, governança, tecnologia e marcas urbanas, codificadas por subgrupos temáticos. O desfecho é a contribuição aditiva municipal ao componente intrarregional da desigualdade do Produto Interno Bruto (PIB) per capita, obtida pela decomposição do Theil T. A estratégia empírica utiliza Diferenças em Diferenças (DiD) com múltiplos períodos, seguindo Callaway e Sant'Anna. Os resultados indicam que revisões no quartil superior de incorporação estão associadas à redução do termo aditivo municipal, com evidência mais definida do que no limiar mediano. O padrão não apresenta diferenças prévias sistemáticas na especificação principal e concentra-se em metrópoles e capitais regionais. Exercícios complementares preservam a direção do efeito para o Theil T, mas recomendam cautela quanto à precisão e à sensibilidade distributiva das estimativas. A evidência é compatível com recomposição relativa da posição econômica municipal, não com efeito geral ou automático de políticas inteligentes sobre desigualdade regional.

Palavras-chave: Cidades inteligentes; Planos diretores; Desigualdade intrarregional.

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1 Introduction

The smart cities literature has advanced rapidly over the past two decades, but its empirical assessment still tends to treat the city as a relatively autonomous unit. Recent studies examine whether smart policies and attributes are associated with urban innovation, income inequality, population growth or other indicators of local performance (Caragliu; Del Bo, 2019, 2022; Chen et al., 2023). These outcomes are relevant, but they leave in the background a question that is central to regional and urban economics. Urban policies do not operate only within the city. They act upon localities that occupy different positions within systems of economic, institutional and functional relations.

Municipalities and cities are part of interdependent urban systems, in which flows of labour, consumption, specialised services, information, investment and public decision-making distribute functions among centres at different levels of the hierarchy (Pred, 1977; Pumain, 2001; Taylor; Hoyler; Verbruggen, 2010). A policy embedded in municipal planning may alter internal attributes of the locality, such as connectivity, governance, urban services or quality of life. Its economic effects, however, tend to be mediated by the position that this locality occupies in its regional surroundings, by forces of agglomeration and dispersion, and by the functional relations that connect it to other municipalities (Capello, 2015; Fujita; Thisse, 2002).

This shift in analytical scale is particularly relevant in Brazil. The municipality is the federative entity responsible for part of the formal decisions on urban planning and for relevant responsibilities in service provision, although the functional unit of economic and social life often extends beyond its administrative boundaries (Abrucio; Sano, 2013; Arretche, 2004). The Master Plan occupies a central position in this arrangement because it organises guidelines for urban development, land use, regulatory instruments, social participation and priorities for public action (Bodnar; Priess; Bianchi, 2019). The 1988 Federal Constitution defined the Master Plan as the basic instrument of urban development and expansion policy (Brasil, 1988), and the Estatuto da Cidade (City Statute), established by Law No. 10,257 of 2001, required its periodic revision, at least every ten years (Brasil, 2008).

The smart city agenda diffuses through this institutional environment in a decentralised and heterogeneous manner. Rather than a standardised national policy, there are local initiatives, strategic documents, administrative programmes, sectoral projects and regulatory references that appear with varying degrees of intensity (Brasil, 2021). This fragmentation creates an empirical problem. For the full set of Brazilian municipalities, it is not straightforward to identify when a smart city policy begins, how intensive it is, and which dimensions it mobilises. The Master Plan offers a partial but comparable way to observe this incorporation. The document does not provide information on budget execution, project delivery or administrative continuity. It does, however, make it possible to identify whether the agenda entered the formal vocabulary of municipal planning and how intensively this occurred.

This study asks whether the intensive incorporation of the smart city agenda into Master Plan revisions is associated with changes in municipalities' contribution to intra-regional economic inequality. The formulation is deliberately narrow. The aim is not to test whether smart cities reduce inequalities in general, nor whether the approval of an urban law produces automatic economic effects. The analysis examines whether Master Plan revisions, when they introduce new content associated with the Smart City agenda, are related to changes in the additive term through which the municipality participates in the composition of gross domestic product (GDP) per capita inequality within its functional region.

The focus on revisions stems from the institutional nature of the process itself. Unlike initial adoption, a revision takes place against a pre-existing normative trajectory. Even when the previous plan is limited, its existence indicates that the municipality has already undergone some process of drafting, approval and possible regulation of urban guidelines. For this reason, treatment is constructed as net incorporation. For each municipality undertaking a revision, the revised plan is compared with the immediately preceding version, so that the index records new content rather than the textual stock accumulated in earlier documents. The outcome is also defined relationally. The dependent variable is neither municipal GDP per capita nor the region's aggregate inequality. It is each municipality's additive contribution to the intra-regional component of inequality.

The empirical strategy combines document analysis and multi-period Difference-in-Differences (DiD). Treatment is defined by annual thresholds of the Smart City index among eligible municipalities undertaking Master Plan revisions. The main threshold corresponds to the 75th percentile, interpreted as intensive incorporation, while the 50th percentile is used as a sensitivity benchmark. The estimator follows Callaway and Sant'Anna (2021), which is suited to staggered treatment adoption and to the possibility of heterogeneous effects across cohorts. The main comparison uses eligible municipalities that revised their plans but never reached the treatment threshold within the period analysed. The complementary exercises vary the comparison group, the estimator, the inequality measure and the form of stratification by urban hierarchy.

The results suggest a conditional pattern. At the median threshold, the estimates are negative in some specifications, but less stable. At the intensive threshold, the average effects are negative and more clearly defined. In the main specification, controlling for the logarithm of municipal population, the estimate is -0.0028, significant at the 10% level. The event study shows pre-treatment coefficients close to zero in this specification, although this diagnostic does not replace the parallel trends assumption. Heterogeneity by urban hierarchy indicates that the signal is concentrated among metropolises and regional capitals. The robustness checks preserve the direction of the result for the Theil T index, but significance is marginal in some exercises and does not carry over to all generalised entropy measures.

The study's contribution is to show that the Smart City agenda can be analysed as institutional incorporation in planning documents and assessed through an outcome that preserves the municipality's position within its regional system. This choice brings the smart cities literature closer to regional and urban economics. Digital infrastructure, governance, sustainability, innovation and quality of life are not observed only as internal attributes of the city, but as elements that may relate to centrality, dependence, hierarchy and intra-regional inequality. The evidence is suggestive and conditional, but indicates that urban policies embedded in municipal instruments may be better understood when situated within the territorial structures in which their effects take shape.

2 Smart urban planning and regional position

Moving from the isolated city to the system of cities changes how urban policies are interpreted. Pred (1977) defines city systems as interdependent sets in which changes in one locality may produce direct or indirect effects in others. Pumain (2001) reinforces this view by treating cities as components of evolutionary systems, marked by functional differentiation, path dependence and co-evolution. This approach is consistent with regional economics, which interprets location, agglomeration, interaction costs and territorial capabilities as central mechanisms in the spatial distribution of economic activity (Capello, 2015).

Urban policies operate on attributes involved in these mechanisms. Infrastructure, connectivity, environmental quality, governance, human capital and service provision affect location costs, productivity, well-being, accessibility and the expectations of firms and households. The New Economic Geography showed that increasing returns, transport costs and market effects can sustain cumulative processes of spatial concentration (Fujita; Thisse, 2002; Krugman, 1991). The literature on urban size adds that these gains coexist with agglomeration diseconomies, such as congestion, land costs and environmental pressures (Camagni; Capello; Caragliu, 2013). A local policy may reinforce existing centralities, favour diffusion towards intermediate centres, or remain confined to the normative level.

The smart city agenda enters this debate because its content is not limited to technology. Giffinger et al. (2007) organised the notion of the smart city around the dimensions of economy, people, governance, mobility, environment and urban living. Caragliu, Del Bo and Nijkamp (2011) associated smart cities with investments in human and social capital, traditional and digital infrastructure, sustainable growth, quality of life, natural resource management and participatory governance. Nam and Pardo (2011) summarised the concept through technology, people and institutions. Yigitcanlar et al. (2019) linked the discussion to sustainability and quality of life. What these formulations have in common is that information and communication technologies (ICTs) matter, but do not exhaust the meaning of urban smartness.

This multidimensional reading is particularly important for the Brazilian case. Many cities still face deficits in sanitation, housing, mobility, connectivity, safety and administrative capacity. Marchetti, Oliveira and Figueira (2019) argue that solutions designed for cities in the Global North cannot be automatically transferred to Latin American contexts marked by urban inequalities and institutional fragilities. The smart city agenda needs to be interpreted in light of the problems that each territory seeks to address and the capacities available to do so. When this agenda appears in a Master Plan, its presence should be read as normative and programmatic incorporation, not as direct evidence of implementation.

To avoid conflating documentary incorporation with actual implementation, the analysis must distinguish the plan as a normative instrument, the planning process, and the conditions that enable its execution. Mastop and Faludi (1997) criticise evaluations of plans that consider only the mechanical conformity between provisions and outcomes. Plans guide subsequent decisions, structure justifications and establish references for public action. Healey (1998) defines institutional capacity as a combination of knowledge resources, networks of relations, arenas of mobilisation and shared discourses. Berke et al. (2006) add that implementation depends on the quality of the document, the availability of instruments, administrative routines and monitoring mechanisms. Thus, the textual embedding of the Smart City agenda may matter, but its capacity to produce effects depends on intermediate institutional conditions.

The revision of the Master Plan offers a particularly informative institutional setting. Initial adoption creates the first formal framework for urban planning, but it may occur in municipalities without consolidated technical routines, regulated instruments or effective linkage to the budget. A revision, by contrast, operates on a pre-existing document. It may mobilise earlier diagnoses, participatory experiences, already known conflicts, partially implemented instruments and administrative learning. A revision does not guarantee implementation, but it offers a more plausible institutional context for new content to be connected to planning practices.

Based on this discussion, the article is guided by a central hypothesis: Master Plan revisions with intensive incorporation of the smart city agenda are associated with a reduction in the municipal additive term in the intra-regional component of economic inequality. The hypothesis does not claim that the smart city agenda is egalitarian by definition. It proposes that, when incorporated intensively in a revision process, this agenda may alter the municipality's institutional and locational attributes, with repercussions for its relative economic position. The secondary hypothesis is that this pattern varies according to urban hierarchy, because municipalities with denser regional functions have broader channels through which changes in planning can be transmitted.

A regional reading also qualifies the meaning of the expected result. A negative coefficient on the municipal additive contribution does not, in itself, indicate lower growth, economic loss or a reduction in wealth. The dependent variable is relational and may take positive or negative values. It expresses how the municipality's position, weighted by its economic share and regional embeddedness, enters the composition of the intra-regional component of inequality. Its interpretation depends on a joint reading of the sign of the estimates, temporal dynamics, position in the urban hierarchy and auxiliary outcomes. For this reason, the main results are read together with the diagnostic exercises, which help delimit whether the estimated pattern reflects a relative recomposition of the municipality's position within the functional region.

3 Data, treatment and outcome variable

This section describes the analytical sample, the construction of the treatment, and the outcome variable used in the estimations.

3.1 Master Plans and analytical sample

The unit of analysis is the Brazilian municipality, observed annually between 2013 and 2020. The period begins in 2013 because the construction of the outcome variable uses a stable municipal grid after the incorporation of new municipalities into the databases of the Instituto Brasileiro de Geografia e Estatística (Brazilian Institute of Geography and Statistics, IBGE). The upper limit of 2020 reflects the availability of Master Plans identified from the 2021 Pesquisa de Informações Básicas Municipais (Municipal Basic Information Survey, MUNIC) of IBGE (2022), complemented by direct searches in the institutional repositories of municipal governments, municipal councils and local legal databases.

The analysis focuses on municipalities that revised their Master Plans between 2013 and 2020. The documentary database starts from 535 revisions for which it was possible to locate the revised plan and, in most cases, the immediately preceding version. Comparing the two versions is necessary because the treatment variable measures net incorporation. Two municipalities were excluded at this stage because the previous document was unavailable in the repositories consulted and no response was received to formal access requests. The effective estimation sample ranges from 508 to 511 municipalities, depending on the treatment threshold and the availability of the required observations in the panel.

The selection of municipalities follows filters defined before estimation. First, municipalities directly affected by recent municipal emancipations and those whose territory had been split were excluded. The creation of a municipality changes administrative boundaries, budgets, elected offices, service provision and local flows. These territorial shocks are deeper than the revision of a Master Plan and could contaminate the interpretation of the treatment. Second, municipalities located in the same Immediate Geographic Region (ImGR) as an emancipated municipality were excluded when the revision occurred in 2013 or 2014. This rule reduces the interference of territorially proximate shocks. Third, municipalities in ImGRs with fewer than four municipalities were excluded, since the decomposition of intra-regional inequality becomes less informative when the immediate region contains a very small number of units.

The next step sought to reduce problems of document standardisation and proximate institutional interference. Master Plans of municipalities located in the same ImGR and revised in the same year or in the immediately preceding year were compared using cosine similarity, calculated from the disaggregated vectors of subgroups in the textual dictionary. Cases with similarity equal to or greater than 0.90 were manually reviewed. Exclusion occurred only when direct inspection indicated that the documents were practically identical. The aim is not to penalise intermunicipal cooperation or the legitimate use of shared consultancy services, but to prevent a standardised text from being interpreted as a specific local incorporation of the Smart City agenda.

Operationally, each municipality undertaking a revision is represented by a binary vector of zeros and ones, in which each position corresponds to a subgroup of the dictionary. Cosine similarity compares the orientation of these vectors, not only the total number of terms identified. Two plans may have similar aggregate scores and still address different agendas. The similarity criterion seeks to identify the more problematic case, in which documents share practically the same thematic composition. Manual review was retained because legal documents may contain common formulae without being substantively identical. The exclusion rule combines statistical screening and documentary assessment.

The regional interference filter follows a similar logic. The study does not exclude municipalities merely because they belong to the same ImGR as a larger centre. Such a decision would be incompatible with the relational argument itself. Exclusion occurs only when the revision of the higher-ranking municipality is temporally proximate, presents positive net incorporation and has a higher total index. This combination indicates an institutional change with greater potential to reorganise regional flows and contaminate the interpretation of the municipality under analysis. The design preserves regional interdependence as an object of analysis, but removes cases in which the direction of exposure becomes too ambiguous for the DiD comparison.

Finally, potential competing events in higher-ranking municipalities within the same ImGR were considered. A municipality undertaking a revision ceases to be eligible when, in the same year or in the previous year, a higher-ranking municipality revised its Master Plan, incorporated positive net content from the Smart City agenda, recorded a higher total index in the revised plan, and occupied a higher position in the Regiões de Influência das Cidades (Regions of Influence of Cities, REGIC). REGIC classifies urban centres according to management functions, the supply of goods and services, and population movements (IBGE, 2019). This filter is conservative. It recognises that changes in the planning of a regional pole may affect expectations, flows and decisions in lower-order municipalities, making it more difficult to attribute the observed pattern to the revision undertaken by the municipality under analysis.

After these filters, Table 1 reports the analytical sample and the treatment support by cut-off. The effective panel ranges from 4,064 to 4,088 municipality-year observations and from 508 to 511 municipalities, depending on the treatment threshold. As expected, the number of treated municipalities decreases as the cut-off becomes more demanding, from 361 under $p25$ to 125 under $p75$.

Table 1 - Analytical sample and support by treatment threshold in Master Plan revisions

Cut-off	Obs.	Munic.	Treated	Never treated	First year	Last year	Treatment cohorts
p25	4,064	508	361	147	2013	2020	2014=21; 2015=30; 2016=57; 2017=39; 2018=61; 2019=84; 2020=69
p50	4,064	508	249	259	2013	2020	2014=18; 2015=24; 2016=38; 2017=28; 2018=40; 2019=56; 2020=45
p75	4,088	511	125	386	2013	2020	2014=9; 2015=12; 2016=19; 2017=14; 2018=20; 2019=28; 2020=23

Source: Authors' own elaboration.

Note: Obs. refers to municipality-year observations and Mun. to municipalities. Municipalities treated in 2013 are excluded from the estimations because they do not have a pre-treatment observation in the 2013-2020 outcome panel. Treatment cohorts report the first treatment year and the number of treated municipalities in each cohort. Totals vary by cut-off because the annual definition of treatment changes the composition of eligible cohorts and controls.

3.2 Textual dictionary and Smart City index

Treatment is constructed from a textual dictionary applied to the Master Plans. The choice of a dictionary, rather than a simple count of isolated words, reflects the nature of the documents. Master Plans vary widely in length, legal style, level of detail and wording. Isolated words such as development, mobility, technology or sustainability may carry very different meanings. For this reason, the basic unit of the dictionary is the compound expression, organised into thematic subgroups. For each subgroup, the coding takes the value of one when at least one associated expression appears in the document, and zero otherwise. This rule reduces the influence of repetition and privileges the thematic diversity incorporated into the plan.

The dictionary combines six dimensions. Economy captures economic development, productivity, entrepreneurship and productive diversification. Society brings together well-being, quality of life, inclusion, safety, health, education and housing. Environment covers environmental sustainability, sanitation, waste, green areas, urban mobility and accessibility. Governance includes participation, transparency, democratic management and planning. Technology records connectivity, digitalisation, intelligent systems, innovation and digital inclusion. Urban branding identifies positioning labels, such as smart city, sustainable city and creative city. Table 2 summarises the structure used in the paper. The full list of terms is extensive and should accompany the replication material, since reproducing it in full in the body of the study would consume space without adding proportionately to the assessment of the empirical design.

Table 2 - Hierarchical structure of the textual dictionary used to identify the Smart City agenda

Dimension	Groups and subgroups	Examples of compound expressions	Explicit signalling in the index
Economy	Sustainable economy, productivity and entrepreneurship, with 14 subgroups.	sustainable development; local productive arrangement; technology park; creative economy; job creation; entrepreneurship; public-private partnership.	SE4, economic smartness.
Society	Well-being and habitability, with 20 subgroups.	quality of life; social inclusion; healthy city; vocational education; right to housing; social housing; public lighting; public facilities.	L7, smart facilities; L10, smart building, green building and green roof.
Environment	Environmental sustainability, urban mobility and accessibility, with 28 subgroups.	environmental preservation; selective waste collection; water reuse; green area; renewable energy; public transport; cycle lane; universal accessibility; basic sanitation.	UM10, smart control, smart bus stop and smart traffic light.
Governance	Governance and planning, with 9 subgroups.	public hearing; municipal council; popular participation; democratic management; transparency; integrated planning; sectoral plan.	There is no specific subgroup in the explicit component, but the dimension is included in the multidimensional component.
Technology	Technology, research and development, connectivity and innovation, with 9 subgroups.	information technology; digitalisation; software; artificial intelligence; database; big data; connectivity; internet; innovation.	T5, intelligent system.
Urban Branding	Urban positioning labels and brands, with 11 subgroups.	sustainable city; sustainable municipality; smart city (*cidade inteligente*); resilient city; connected city; creative city; digital city.	UB2, smart city, smart urban area and smart city.

Source: Authors' own elaboration.

Note: Each subgroup takes the value of one when at least one associated expression appears in the Master Plan. The explicit component of the index is added to the multidimensional component to differentiate plans with generic references from those that incorporate terminology directly associated with the Smart City agenda. Examples are author translations of the Portuguese expressions used in the dictionary. Original English expressions are preserved when they appear in the municipal Master Plans.

For each Master Plan d, $S_{d,s} = 1$ is defined when subgroup s appears in the document. The subgroups are aggregated into thematic groups and then into dimensions. The multidimensional component of the index corresponds to the average of the six dimensions. The index used in the main definition of treatment adds an explicit signalling component, composed of subgroups SE4, L7, L10, UM10, T5 and UB2. This choice prevents a document with many general references to sustainability, mobility or participation from being treated as equivalent to a document that also incorporates terms directly associated with smart city systems, facilities or branding labels.

$$SC_d^* = B_d + I_d \tag{1}$$

In this expression, B_d represents the average multidimensional component and I_d represents the average of the six explicit signalling subgroups. For municipalities undertaking a revision, the index is calculated in net terms. If a subgroup was already present in the previous plan and remains in the revised plan, it is not counted as new incorporation. If it appears in the revised plan and was not present in the immediately preceding version, it takes the value of one. The rule can be written as follows:

$$S_{mts}^{net} = \max\{0, S_{mts}^{new} - S_{ms}^{prev}\} \tag{2}$$

Net incorporation is the core element of the documentary identification strategy. It avoids conflating revisions that merely preserve earlier vocabulary with revisions that introduce new content. The main treatment is defined by the upper quartile of the annual distribution of the net index among eligible municipalities undertaking revisions. The 50th percentile ($p50$) is used as a reference threshold, and $p25$ only as a diagnostic of sample sensitivity. Formally, for each year t and threshold p, a municipality is treated when it has a positive net index and a value equal to or greater than the corresponding percentile calculated among eligible municipalities undertaking revisions in that same year.

$$D_{mtp} = 1\{SC_{mt}^{net} > 0,\ SC_{mt}^{net} \geq Q_{pt}\} \tag{3}$$

The use of annual percentiles avoids comparing absolute index values across years in which the vocabulary of urban planning had different levels of maturity. A reference to digital city or technological transformation in 2013 does not have the same contextual meaning as a similar reference in 2020. The annual rule keeps the comparison within cohorts exposed to the same temporal environment of agenda diffusion. The requirement of a positive index prevents municipalities with no identifiable incorporation from being classified as treated when the annual distribution contains many values equal to zero.

The choice of $p75$ as the main treatment responds to the substantive issue addressed by the paper. The aim is not to capture any reference to sustainability, participation or quality of life, since these themes may appear in Master Plans as part of the general vocabulary of urban policy. The upper quartile selects revisions in which the agenda is incorporated with greater thematic diversity and a stronger presence of signals explicitly associated with smart cities. The $p50$ threshold remains relevant because it shows what happens when the treatment definition is less demanding. The difference between the two thresholds helps distinguish generic incorporation from more intensive incorporation.

3.3 Outcome variable

The outcome variable captures the municipality's economic position within a nested regional structure. Each municipality belongs to an Immediate Geographic Region (ImGR), and each ImGR belongs to an Intermediate Geographic Region (IntGR). IBGE created these regions to capture proximity relations, urban centres, daily flows, access to services and higher-complexity functions (IBGE, 2017). The ImGR is used as the immediate functional reference for comparing the municipality with its surroundings. The IntGR provides the broader regional total within which the contribution of each ImGR is weighted.

The Theil T index, proposed by Theil (1967), corresponds to the GE(1) case of the Generalized Entropy (GE) family. This family is well suited to the problem because it allows additive decomposition by subgroups, a property discussed by Bourguignon (1979), Cowell (1980) and Shorrocks (1980). In territorial applications, the decomposition can be organised in nested form, separating between-region and within-region components. Akita (2003) uses this logic in multi-level regional decompositions. The paper adopts this principle to construct a municipal term that sums exactly to the intra-regional component of inequality within the IntGR.

If i denotes the municipality, r the ImGR, h the IntGR and t the year, let Y_{it} be municipal GDP, y_{it} municipal GDP per capita and μ_{rt} the average GDP per capita of the ImGR. The municipal additive contribution to the intra-regional component of inequality calculated with the Theil T index is defined as:

$$AC_{irht}^{T} = \left(\frac{Y_{it}}{Y_{ht}}\right) \ln\left(\frac{y_{it}}{\mu_{rt}}\right) \tag{4}$$

The expression combines the municipality's economic share in the IntGR, given by Y_{it}/Y_{ht}, and its proportional distance from the average GDP per capita of the ImGR, given by $\ln(y_{it}/\mu_{rt})$. The measure is signed. Municipalities above the ImGR average tend to make a positive contribution, while municipalities below the average tend to make a negative contribution. The sign should not be interpreted in isolation as an advantage or problem of the municipality. It indicates the algebraic direction of the contribution to the intra-regional component of inequality.

This choice is useful because the treatment is municipal, but the question is regional. The Master Plan is approved by the municipality, yet its possible effects may appear in the relationship between the municipality and the other members of its functional region. The additive contribution is not a counterfactual based on removing the municipality from the region. It measures how its relative economic position enters the composition of observed inequality. To assess the distributional sensitivity of the results, the paper also estimates specifications with GE(0), which is more sensitive to the lower part of the distribution, and GE(2), which is more sensitive to the upper part.

For GE(0), the municipal term is weighted by the municipality's population share in the IntGR and by the logarithmic distance between the ImGR mean and municipal GDP per capita. For GE(2), the term assigns greater weight to large deviations from the regional mean. These measures do not replace the Theil T index as the main outcome. They serve as sensitivity checks, since they make it possible to assess whether the empirical pattern depends on the part of the distribution to which the inequality measure assigns greater weight. When the results differ across GE(0), GE(1) and GE(2), this divergence informs the economic interpretation of the estimated effect.

4 Empirical strategy

Entry into treatment occurs in different years. Municipalities revise their plans in 2014, 2015, 2016, 2017, 2018, 2019 and 2020, and some never reach the Smart City incorporation threshold within the period analysed. In staggered treatment settings, traditional two-way fixed effects estimators may combine groups treated at different times in ways that are difficult to interpret when effects are heterogeneous over time or across cohorts. Goodman-Bacon (2021), de Chaisemartin and D'Haultfoeuille (2020), and Sun and Abraham (2021) show the problems associated with this type of aggregation.

For this reason, the study uses the Callaway and Sant'Anna (2021) estimator. The basic parameter is the Average Treatment Effect on the Treated (ATT), specific to the group that enters treatment in year g and to period t. The notation is:

$$ATT(g,t) = E[Y_t(g) - Y_t(0) \mid G = g] \tag{5}$$

The parameter compares the observed evolution of treated municipalities in cohort g with the counterfactual evolution they would have followed had they not reached the incorporation threshold. The counterfactual is approximated by the trajectory of eligible municipalities undertaking revisions that never reach the threshold in the main window. The robustness specification replaces this group with not-yet-treated municipalities. In all cases, interpretation depends on the conditional parallel trends assumption between treated and comparison units. This assumption cannot be proved, but it can be examined through pre-treatment diagnostics.

The comparison with never-treated municipalities has a substantive advantage. All municipalities in the comparison group revised their Master Plans and passed through the same eligibility filters, but did not reach the Smart City incorporation threshold. The comparison therefore does not contrast municipalities undertaking revisions with municipalities without revisions, nor does it conflate documentary change with the intensity of the agenda incorporated. The central contrast is between revisions with intensive incorporation and revisions without intensive incorporation. This choice brings the comparison group closer to the institutional event observed among the treated municipalities.

The comparison with not-yet-treated municipalities serves a different purpose. It allows municipalities that reach the threshold only in later years to be used as controls in certain periods. This alternative increases the proximity between treated and control units in terms of future propensity for incorporation, but requires caution because units that will later be treated may already be on a trajectory of institutional preparation. Convergence between the two comparison groups is therefore more informative than any isolated estimate.

The main specification estimates the aggregate effect for $p75$ revisions, controlling for the logarithm of municipal population. Population is included because municipal scale affects administrative capacity, local market size, urban complexity and the municipality's economic weight. Two additional specifications are presented. The first includes no controls. The second controls for REGIC urban hierarchy through indicators for metropolis, regional capital, sub-regional centre, and zone or local centres. These specifications are not intended to exhaust the determinants of the outcome, but to assess whether the main signal depends on observable differences in scale and urban position.

Standard errors are obtained by bootstrap with clustering at the municipality level. The event studies aggregate effects by time relative to treatment, with five periods before and six periods after treatment. The presence of pre-treatment coefficients statistically close to zero is read as a favourable diagnostic, not as a definitive test of the strategy. The joint pre-test reported in the tables examines whether the group-time effects before treatment are jointly equal to zero. When the p-value is low, interpretation is more cautious, even if the estimated average effect is statistically different from zero.

Estimation is carried out separately by threshold. This separation is important because treatment is absorbing within each definition. A municipality may be untreated under $p75$ and treated under $p50$, or enter different cohorts depending on the annual distribution of the index. Aggregating thresholds in a single specification would conflate documentary intensity with treatment timing. The presentation by $p50$ and $p75$ makes clear that the main inference depends on a demanding definition of incorporation, while the median threshold serves as a benchmark for comparison.

The empirical strategy makes it possible to estimate a conditional temporal association between documentary incorporation and the regional outcome. It does not measure actual project implementation, nor does it directly observe budgets, contracting, administrative continuity or service delivery. The scope of the exercise is more limited. It estimates whether, after a Master Plan revision with intensive net incorporation of the Smart City agenda, the municipality begins to follow a different trajectory in its additive contribution to intra-regional inequality, relative to eligible municipalities undertaking revisions that do not reach the threshold. This delimitation strengthens the interpretation of the results because it avoids attributing to the textual index a meaning that the data do not support.

5 Results

The results are presented in four stages: average effects, temporal dynamics, heterogeneity by urban hierarchy, and complementary exercises.

5.1 Average effects

Table 3 presents the aggregate average effects. Under $p50$, which identifies municipalities above the annual median of incorporation among eligible revisers, the estimates are negative in two specifications, but the evidence is less stable. Controlling for the logarithm of population reduces the magnitude to -0.0010 and the p-value rises to 0.3694. In addition, the pre-tests are unfavourable in the three $p50$ specifications, which limits the substantive interpretation of the median threshold.

Table 3 - Average effects of Smart City incorporation in Master Plan revisions

Cut-off	Specification	Estimate	SE	p-value	95% CI	Pre-test p-value	Munic.	Treated	Controls
p50	No controls	-0.0018*	0.001	0.0693	[-0.0038; 0.0001]	0.0118	508	249	259
p50	Log(population)	-0.0010	0.0011	0.3694	[-0.0031; 0.0012]	0.03022	508	249	259
p50	REGIC hierarchy	-0.0018*	0.0011	0.0831	[-0.0039; 0.0002]	0.01823	508	249	259
p75	No controls	-0.0035**	0.0014	0.0141	[-0.0063; -0.0007]	0.04407	511	125	386
p75	Log(population)	-0.0028*	0.0016	0.0766	[-0.0058; 0.0003]	0.13357	511	125	386
p75	REGIC hierarchy	-0.0036**	0.0016	0.0225	[-0.0067; -0.0005]	0.08333	511	125	386

Source: Authors' own elaboration.

Note: The outcome is the municipal additive contribution to the intra-regional component of GDP per capita inequality, calculated with GE(1), Theil T. Mun. refers to municipalities. The main comparison group consists of never-treated eligible municipalities undertaking revisions. SE indicates standard error and CI indicates confidence interval. *, ** and *** indicate significance at the 10%, 5% and 1% levels.

Under $p75$, the evidence is more clearly defined. Without controls, the estimated effect is -0.0035 and statistically significant at the 5% level. When controlling for the logarithm of population, the estimate is -0.0028, significant at the 10% level, with a 95% confidence interval between -0.0058 and 0.0003. The specification with REGIC hierarchy produces an estimate of -0.0036, significant at the 5% level. The common direction of the estimates suggests that the result does not arise from a single isolated specification. Even so, precision varies, and the main interpretation should rest on the full set of diagnostics.

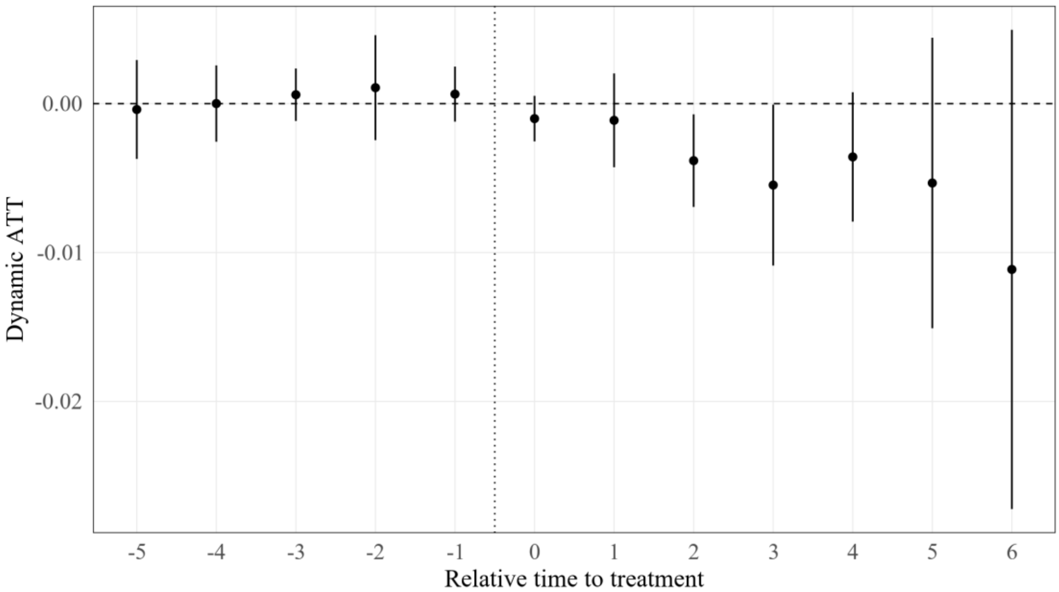
The substantive interpretation is that revisions with intensive incorporation of the Smart City agenda are associated with a reduction in the municipal additive term in the intra-regional component of GDP per capita inequality. The result should not be read as proof that smart policies were implemented, nor as evidence of municipal economic growth. It indicates an average change in the way the treated municipality participates in the composition of inequality within its regional structure. The strength of the pattern appears precisely in the difference between $p50$ and $p75$. Median references may reflect a generic planning vocabulary. The upper quartile tends to capture revisions that incorporate the agenda in a more diversified and explicit way.

The pre-tests also help identify the specification to be used for interpretation. The $p75$ specification controlling for the logarithm of population has a pre-test p-value of 0.13357, higher than the values observed under $p50$. This diagnostic does not turn the estimate into definitive causal proof, but it makes the specification more defensible than those with prior evidence of systematic differences. For this reason, the exercises on dynamics, heterogeneity and robustness take $p75$ with the logarithm of population as the article's main specification.

5.2 Temporal dynamics

Figure 1 presents the event study for the main specification, with $p75$ treatment and control for the logarithm of municipal population. The pre-treatment coefficients remain close to zero. At $t-5$, $t-4$, $t-3$, $t-2$ and $t-1$, the confidence intervals include zero and do not indicate a clear differential trajectory before the revision. This pattern is consistent with the conditional parallel trends assumption, although it does not prove it. The advantage of the figure is that it makes visible the dynamics summarised by the aggregate estimate.

Figure 1 - Dynamic effects of intensive incorporation of the Smart City agenda in Master Plan revisions



Source: Authors' own elaboration.
Note: The figure presents dynamic ATTs for $p75$, controlling for the logarithm of municipal population. The bars represent 95% confidence intervals. The vertical line indicates the year prior to treatment.

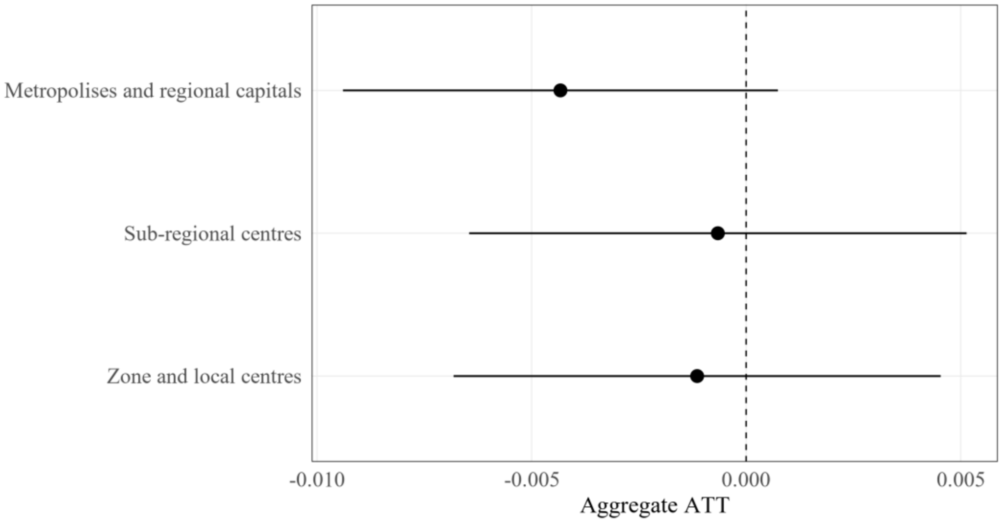
After treatment, the coefficients become negative. The effect at $t = 0$ is still small and imprecise. The magnitude increases from $t = 2$, with a coefficient of -0.0038 and significance at the 5% level. At $t = 3$ and $t = 4$, the coefficients remain negative and marginally significant. At longer horizons, the intervals widen, as expected because fewer cohorts contribute to the estimates. The most appropriate reading is not one of immediate impact, but of a pattern that becomes more visible a few years after the revision. This timing is consistent with the institutional argument. A revised plan needs to be incorporated into decisions, instruments and administrative practices before relative economic changes can appear in the panel.

The event study also helps avoid an excessively strong interpretation. The graph does not show an abrupt decline in the year of the revision. The trajectory suggests a gradual adjustment, consistent with the role of the Master Plan as an institutional reference. Since the index measures documentary incorporation, the interval between the revision and the subsequent effects is substantively plausible. The estimated result should not be treated as a mechanical effect of the approval of the law, but as evidence that intensive revisions are associated with distinct subsequent trajectories relative to comparable municipalities.

5.3 Heterogeneity by urban hierarchy

The study's territorial hypothesis suggests that the effects of Smart City incorporation depend on the municipality's position in the urban network. Figure 2 estimates the $p75$ effect separately for metropolises and regional capitals, sub-regional centres, and zone or local centres. All specifications control for the logarithm of municipal population and use never-treated eligible municipalities undertaking revisions as the comparison group.

Figure 2 - Heterogeneity by urban hierarchy in $p75$ revisions



Source: Authors' own elaboration.
Note: The figure presents aggregate ATTs for $p75$, estimated separately by REGIC urban hierarchy groups. All specifications control for the logarithm of municipal population.

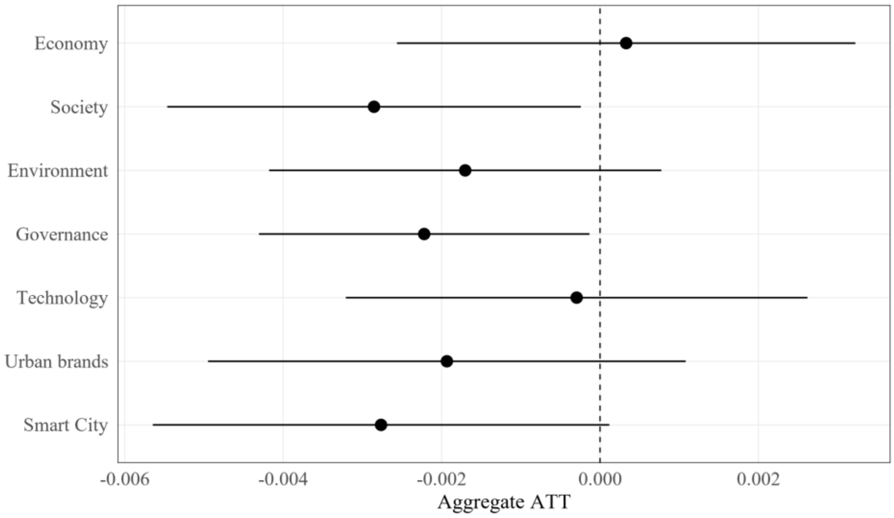
The clearest signal appears among metropolises and regional capitals. The estimate is -0.0043, with a p-value of 0.0872. The confidence interval still includes zero at the upper bound, but the magnitude is larger than in the other groups. For sub-regional centres, the estimate is -0.0007 and statistically indistinguishable from zero. For zone and local centres, the estimate is -0.0011, also statistically imprecise. The pattern is consistent with the idea that higher-ranking municipalities have denser channels through which changes in planning can be translated into economically observable changes. They concentrate management functions, services, jobs, infrastructure and regional flows, which may broaden the reach of an institutional revision.

This evidence does not imply that local centres are unable to benefit from smart strategies. The result indicates only that, in the design and period analysed, the detectable regional signal is concentrated in municipalities with greater centrality. In smaller or lower-ranking municipalities, the plan revision may produce relevant effects for local management, inclusion, services or quality of life without measurably altering the contribution to the intra-regional component of GDP per capita inequality. This distinction is important because it prevents the economic outcome used in the article from being conflated with a comprehensive evaluation of urban policy.

5.4 Textual dimensions, robustness and auxiliary outcomes

The analysis by textual dimension is exploratory, but helps qualify the mechanism. Figure 3 shows that the clearest negative signals appear in the Society and Governance dimensions. Society has an estimate of -0.0029, significant at the 5% level, and Governance has an estimate of -0.0022, also significant at the 5% level. Environment, Technology and Urban branding have negative but imprecise signs. Economy has a positive sign, very close to zero. The aggregate Smart City index remains negative. This composition suggests that the main results are not driven by a strictly technological dimension. The pattern appears closer to content associated with well-being, inclusion, participation, management and public coordination.

Figure 3 - Exploratory estimates by textual dimension in Master Plan revisions



Source: Authors' own elaboration.
Note: The estimates control for the logarithm of municipal population. For Urban branding, $p80$ is used because of the dimension's relatively low frequency. For the other dimensions, $p75$ is used.

This reading is substantively relevant. A Master Plan revision that mentions only digital devices may have little effect if it is not connected to governance, services, instruments and local capacities. By contrast, the incorporation of social and institutional content may reorganise planning priorities, broaden coordination instruments and strengthen the link between the urban agenda and local needs. The result does not prove this mechanism, but it guides the interpretation of the aggregate index. The Smart City agenda that appears in Brazilian Master Plans should not be reduced to sensors, platforms and connectivity. It also involves the language of urban rights, participation, sustainability and territorial management.

Table 4 brings together robustness checks for the $p75$ specification controlling for the logarithm of population. The main result for GE(1), Theil T, is -0.0028. When the comparison group is changed to not-yet-treated municipalities, the estimate remains -0.0028 and the p-value falls to 0.0576. When Inverse Probability Weighting (IPW) is used, the estimate also remains at -0.0028, with a p-value of 0.0787. These exercises preserve the direction and order of magnitude of the result, which strengthens the qualitative reading of the pattern.

Table 4 - Robustness checks for $p75$ revisions

Check	Outcome or comparison	Estimate	SE	p-value	95% CI	Pre-test p-value
Main	Theil T and never treated	-0.0028*	0.0015	0.0697	[-0.0058; 0.0002]	0.13357
Alternative group	Theil T and not-yet treated	-0.0028*	0.0015	0.0576	[-0.0056; 0.0001]	0.12409
Alternative estimator	Theil T and IPW	-0.0028*	0.0016	0.0787	[-0.0058; 0.0003]	0.1373
Alternative measure	GE(0)	0.0005	0.0013	0.6755	[-0.0019; 0.0030]	0.67437
Alternative measure	GE(2)	-0.0047*	0.0025	0.0567	[-0.0096; 0.0001]	0.22419

Source: Authors' own elaboration.

Note: All specifications control for the logarithm of municipal population. Treatment corresponds to $p75$ of net Smart City incorporation in Master Plan revisions. GE indicates generalised entropy.

The sensitivity to inequality measures recommends caution. With GE(0), the estimate is positive and statistically indistinguishable from zero. With GE(2), the estimate is -0.0047 and marginally significant. Since GE(0) is more sensitive to the lower part of the distribution and GE(2) to the upper part, the difference suggests that the main pattern is more closely aligned with changes captured by relative economic share and the upper part of the distribution than with adjustments at the lower end. The result for the Theil T index is informative, but should not be presented as invariant to any distributional metric.

The auxiliary outcomes in Table 5 further delimit the interpretation. The effect on the logarithm of municipal GDP per capita is -0.0106 and is not statistically well defined. The relative gap in log GDP per capita with respect to the leave-one-out ImGR mean also shows no clear effect. The absolute gap, in turn, has an estimate of -0.0333 and is significant at the 5% level. This pattern is consistent with a reduction in the absolute economic distance between the treated municipality and its immediate region, without evidence of an average growth shock in GDP per capita. The main finding should be understood as relative recomposition, not as autonomous economic expansion.

Table 5 - Auxiliary outcomes for $p75$ revisions

Outcome	Estimate	SE	p-value	95% CI	Pre-test p-value
Log of municipal GDP per capita	-0.0106	0.0138	0.4416	[-0.0376; 0.0164]	0.09521
Relative gap in log GDP per capita with respect to the leave-one-out ImGR mean	-0.0091	0.0162	0.5718	[-0.0408; 0.0226]	0.13933
Absolute gap in log GDP per capita with respect to the leave-one-out ImGR mean	-0.0333**	0.0164	0.043	[-0.0655; -0.0010]	0.0504

Source: Authors' own elaboration.

Note: All specifications control for the logarithm of municipal population and use never-treated eligible municipalities undertaking revisions as the comparison group. The leave-one-out mean excludes the municipality itself from the calculation of the immediate regional mean.

6 Discussion

The results point to an institutional and regional interpretation of the smart city agenda. The evidence does not support a general relationship between any form of documentary incorporation and a reduction in intra-regional inequality. The most consistent signal appears when the Master Plan revision incorporates the agenda intensively. This suggests that the generic planning vocabulary present in many documents is not sufficient to produce observable differences. Intensity matters because it brings the treatment closer to a broader normative update, capable of combining social, environmental, institutional, technological and discursive dimensions.

The emphasis on revisions is also relevant. The result does not stem from the mere existence of the Master Plan. It appears when the municipality modifies an existing instrument and adds new content associated with the Smart City agenda. This difference is consistent with the planning literature that distinguishes between the document, the process and implementation. Revision may represent a moment of institutional learning, recomposition of priorities and rearticulation of instruments. Even so, the evidence does not show that every intensive revision is effective. The average effect summarises heterogeneous trajectories and depends on local conditions that the econometric design does not observe directly.

Heterogeneity by urban hierarchy indicates that position in the network matters. Metropolises and regional capitals concentrate management functions, specialised facilities, denser labour markets and service flows. When these municipalities revise their plans and intensively incorporate the Smart City agenda, there is a greater possibility that normative change connects to economic and administrative decisions with regional reach. In sub-regional, zone and local centres, the channels may be narrower, or the effects may be expressed in dimensions not captured by GDP per capita. This pattern reinforces that the smart city agenda does not neutralise urban hierarchies. It operates through them.

The dimensional exercises help move the interpretation away from a technocentric reading. Society and Governance show the clearest signals, while Technology does not present an estimated effect statistically distinguishable from zero. This composition is consistent with the recent trajectory of the smart cities literature, which has shifted emphasis from digital infrastructure towards governance, human capital, inclusion and sustainability. In the Brazilian context, this shift is even more important because deficits in basic infrastructure, social inequalities and institutional asymmetries condition the appropriation of technological solutions. A city may become more digital without becoming more inclusive, more coordinated or more capable of altering its regional position.

The robustness of the result is partial, and this should be read transparently. The direction and magnitude are preserved when the comparison group and the estimator are changed. This reduces the likelihood that the finding is an artefact of a single operational choice. Sensitivity across entropy measures shows, however, that the result is not distributionally neutral. It appears for the Theil T index and GE(2), but not for GE(0). This difference suggests that the observed recomposition is more closely associated with changes weighted by economic share and by the upper part of the regional distribution. The article therefore does not claim that smart revisions reduce inequalities in every possible sense.

The auxiliary evidence on the absolute gap offers the most plausible economic interpretation. Since there is no clear effect on the logarithm of municipal GDP per capita, intensive incorporation does not appear to operate as a local growth shock. Since there is a reduction in the absolute gap relative to the leave-one-out ImGR mean, the data are consistent with relative movement towards the immediate regional benchmark. The main result, measured by the additive contribution to the intra-regional component, should be understood through this recomposition. The policy embedded in the plan does not, by itself, transform municipal economic performance, but it may be associated with adjustments in the municipality's relative position within its region.

There are limitations that delimit the scope of the paper. The textual index measures normative incorporation, not execution. The documentary database depends on the availability of plans and the quality of the files. The panel ends in 2020 and does not follow later effects, including those that might appear after regulation or investment. The outcome variable uses municipal GDP per capita, not household income, intra-municipal inequality, access to services or well-being. The eligibility filters reduce documentary and territorial interference, but do not eliminate all spillovers between municipalities. These limitations do not invalidate the exercise. They indicate that the evidence should be interpreted as consistent with the proposed mechanism, rather than as a definitive estimate of a structural effect.

The article contributes by proposing a way to observe urban policies through regional outcomes. The Smart City agenda is often assessed through rankings, internal indicators, technological projects or isolated urban performance. Here, the question is different. What changes in the municipality's relative economic position when the main instrument of urban planning intensively incorporates new content associated with this agenda? The empirical answer is cautious, but informative. Intensive revision is associated with a lower additive contribution to intra-regional inequality, especially in higher-ranking municipalities, and this pattern appears closer to social and institutional dimensions than to a strictly technological agenda.

7 Concluding remarks

This study analysed whether the incorporation of the smart city agenda into municipal Master Plan revisions is associated with changes in the way municipalities participate in the economic inequality of their regions. The question was formulated from a conceptual choice. The Master Plan was treated as an institutional space in which urban priorities are inscribed, rather than as direct evidence of implementation. The region was treated as a functional structure of interdependencies, not merely as a unit of aggregation. In doing so, the paper shifted the usual question about smart cities. Instead of assessing whether certain municipalities become more modern, technological or efficient, it investigated whether the updating of the main instrument of urban planning is related to the municipality's relative economic position in its regional surroundings.

The empirical strategy combined three operations. The first was the construction of a documentary measure of net incorporation of the Smart City agenda in Master Plan revision processes, comparing the revised plan with its immediately preceding version. The second was the definition of a relational outcome, the municipal additive contribution to the intra-regional component of GDP per capita inequality, derived from the decomposition of the Theil T index. The third was estimation through multi-period Difference-in-Differences, suited to the staggered entry of municipalities into treatment and to the expected heterogeneity across cohorts. These choices made it possible to bring urban planning, textual analysis and regional economics into the same empirical design.

The results suggest that revisions with intensive incorporation of the Smart City agenda are associated with a reduction in the municipal additive term in the intra-regional component of inequality. The pattern is more clearly defined when treatment is delimited by the upper quartile of the annual distribution of the index, becomes more visible a few years after the revision, and is concentrated in municipalities at higher levels of the urban hierarchy. The evidence does not support a general relationship between smart cities and a reduction in regional inequality. Nor does it allow one to claim that the presence of the agenda in the legal text was necessarily converted into implemented projects. What the data allow us to sustain is more specific. In certain contexts, the revision of the Master Plan appears to operate as an institutional update associated with a recomposition of the municipality's relative economic position within its immediate region.

This interpretation is reinforced by the complementary exercises. The direction of the main effect is preserved in part of the robustness checks, although significance and sensitivity to alternative entropy measures recommend caution. The auxiliary outcomes do not indicate a clear shock to municipal growth. The pattern is more consistent with relative movement towards the economic level of the ImGR than with an autonomous expansion of GDP per capita. The most appropriate reading, therefore, is not that intensive incorporation of the Smart City agenda makes the municipality richer in the short term. The evidence points to a change in the municipality's contribution to the regional composition of inequality, measured by its relative position in the functional space in which it is embedded.

This distinction is important for the literature. A substantial part of the research on smart cities remains focused on indicators internal to cities, such as innovation, connectivity, sustainability, quality of life, administrative efficiency or local economic performance. These outcomes are relevant, but they leave in the background a central dimension of regional and urban economics. Municipalities do not operate as isolated units. They concentrate or depend on functions, organise flows, access labour markets, share services and respond to territorial hierarchies. A policy embedded in a municipal instrument may have a different meaning depending on the position occupied by the municipality within this structure. By showing that the estimated signals are concentrated in higher-ranking centres, the work suggests that the capacity to transform a normative agenda into regional recomposition depends on the channels through which the municipality connects to its surroundings.

The contribution of the study lies less in claiming a conclusive effect of smart cities and more in proposing a way to observe them territorially. The Smart City agenda is often presented as a set of urban solutions, frequently associated with digitalisation, efficient management and the use of technologies. The exercise developed here indicates that its analytical relevance increases when it is situated within the institutional process of planning and within the regional network of municipal relations. Urban smartness, from this perspective, is not only an attribute of a place. It may be understood as a capacity to reorganise priorities, coordinate instruments and alter, even if conditionally, the relative position of a locality within a broader territorial system.

The implications for public policy follow from this reading. Smart city strategies should not be treated as replicable catalogues of technological solutions. In a federal system marked by strong asymmetries of capacity, the same guideline has different meanings in a metropolis, a regional capital, an intermediate centre or a local municipality dependent on external services. The revision of the Master Plan may be a moment of reorganisation of municipal capacities, provided that it connects diagnosis, urban policy instruments, budgetary priorities, data governance, social participation, monitoring and territorial cooperation. When this connection does not exist, the agenda tends to remain a language of modernisation, without producing observable changes in the regional structure.

This point also qualifies the relationship between urban planning and regional development. Updating a Master Plan is not merely a legal obligation or a technical exercise in normative revision. It may be an opportunity to redefine how the municipality deals with environmental pressures, social demands, digital transformation, infrastructure, mobility, land use and articulation with neighbouring municipalities. In unequal territories, this capacity for institutional adaptation matters because urban challenges do not respect administrative boundaries. Labour markets, daily commuting, access to specialised services, sanitation, connectivity and environmental management are organised at scales that often extend beyond the municipality. Planning only within the legal boundaries of the city reduces the reach of policies. Planning with regard to the municipality's regional position increases its capacity to respond to change and reduce persistent asymmetries.

The results also suggest that national and state smart city policies should incorporate the heterogeneity of the Brazilian urban network. Smaller municipalities may require support to build basic capacities in planning, data, connectivity, fiscal management and administrative integration. Regional centres, in turn, may require more complex coordination instruments, since they provide services, attract movements and organise flows that reach populations in other municipalities. Intermunicipal cooperation, public consortia, shared information systems and financing mechanisms oriented by regional functions may be as important as localised technological projects. The smart agenda gains density when it ceases to be a competitive attribute of a few centres and becomes part of a territorial strategy of public coordination.

Future research can advance along three paths. The first consists of connecting documentary incorporation to implementation data, such as the regulation of instruments, budget execution, contracts, investments, service delivery and monitoring indicators. This step would make it possible to distinguish plans that merely incorporate contemporary vocabulary from those that guide effective decisions. The second path involves explicitly modelling spillovers between municipalities, considering labour flows, mobility, services, distance, centrality and urban hierarchy. This agenda is necessary to understand whether changes in more structured centres produce diffusion, drainage or functional reorganisation in their surroundings. The third path is to broaden the outcomes analysed, incorporating household income inequality, access to services, environmental quality, digital inclusion, mobility and well-being. These outcomes would make it possible to observe dimensions that GDP per capita does not capture, but that are central to the contemporary urban agenda.

The study, therefore, does not close the discussion on smart cities and regional inequality. It proposes a way to formulate it. By combining planning documents, staggered treatment and a relational measure of inequality, the study shows that the Smart City agenda can be analysed beyond the isolated city. The municipality is the entity that approves the Master Plan, but its potential effects are formed within a network of economic, institutional and functional relations. This is the main message of the paper. Urban smartness should not be assessed only by what a city declares, installs or measures internally, but also by how its institutional choices reorganise capacities, linkages and positions across the territory.

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