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Network analysis of cultural funding in Brazil: uncovering regional differences and signatures

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Abstract

This study investigates how cultural funding patterns reflect regional inequalities through network analysis techniques. Public funding of cultural projects should preserve diversity but can intensify socioeconomic inequalities; hence, countries can benefit from macro analyses of funding data. We present a network-based study of Brazil's main cultural funding mechanism (2010–2014), based on 106,804 transactions across 12,326 projects. Our research objectives are to: (1) identify distinct regional cultural funding patterns, (2) quantify sponsorship disparities across states, and (3) construct a network representation of cultural segment relationships that reveals funding dynamics. Our findings reveal distinct cultural signatures and regional disparities, with some states 40% less likely to secure sponsorship. Although strongly correlated with economic indicators, a significant share of funding variance remains unexplained and could be a reflection of the diverse Brazilian cultural scene. Our primary contribution is the creation of a "cultural space" network that (unlike previous descriptive analyses of cultural funding) exposes systematic relationships between cultural segments and demonstrates how these connections correlate with economic development. This approach can support evidence-based policy reforms by revealing both the magnitude and structural nature of funding imbalances across Brazil's diverse regions.

Keywords Cultural funding, Network analysis, Regional differences, Brazil, Creative economy, Cultural signatures

Introduction

The concept of *culture* represents a complex, multidimensional phenomenon that has evolved significantly in its conceptualisation since its Latin origin, *cultura*. While historically referring to the cultivation of land or mind, contemporary approaches frame culture as an emergent system of shared information, behavioural patterns, and transmission mechanisms that evolve through social learning and interaction networks (Boyd and Richerson 2005; Keesing 1981). This information-centred perspective, developed from the synthesis of Germanic *Kultur* (representing spiritual aspects) and French *Civilisation* (denoting material achievements), now encompasses the comprehensive fabric of

human society, including beliefs, arts, laws, customs, and acquired skills that distinguish communities in our increasingly globalised world.

In recognition of culture's fundamental role in societal well-being and development, various stakeholders (from governments to individual citizens) actively support cultural initiatives, particularly focusing on visible cultural expressions. Schein (1984) provides a hierarchical framework for understanding these cultural dimensions through three interacting levels (see Fig. 1). This model illustrates how surface-level cultural expressions (such as art and technology) are intrinsically connected to deeper structures of societal values and basic assumptions about human nature and reality, emphasising that culture is not merely an abstract concept but a vital force that shapes both individual identity and collective prosperity in modern societies.

The economic significance of cultural development has become increasingly evident in modern economies. Research continues to demonstrate that investments in cultural and creative sectors yield multifaceted returns, including reduced violence rates (Krug et al. 2002), enhanced educational outcomes (Scherger and Savage 2010), and improved public health indicators (Konlaan et al. 2000). Recent data demonstrates that Brazil's creative economy contributes 3.11% to the national GDP, employing approximately 7.5 million people across more than 130,000 formalised enterprises (Minc 2024). This sector's significance was institutionalised through Brazil's *Secretaria da Economia Criativa* (SEC) in 2012, and has shown consistent growth, catalysing both economic development and social transformation.

Quantitative analysis of cultural funding allocation has emerged as an important methodological approach for understanding patterns of inequality in public support for the arts. Research examining private funding of culture has demonstrated that geographical disparities can be systematically analysed through decomposable inequality measures, revealing how funding differences across regions compare to disparities within regions (Méndez-Carbajo and Stanziola 2008). Such approaches enable researchers to separate funding variations attributable to regional location from those stemming from heterogeneity among cultural organisations within each area. Similar quantitative frameworks have been applied to broader questions of geographical inequalities in public funding allocation, where researchers have employed time series analysis and econometric methods to identify how demographic changes, economic conditions, and political factors correlate with funding patterns over extended periods (Feder and Katz-Gerro 2012).

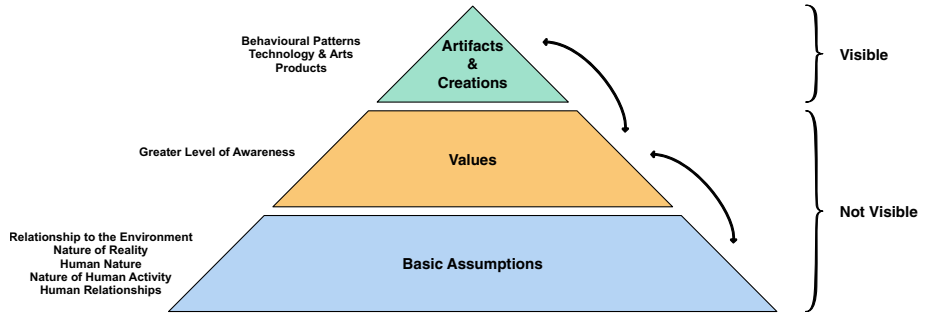

Fig. 1 The pyramid illustrates culture's visible artefacts and creations (mint green, top) where funding for cultural events typically occurs, supported by underlying values (amber, middle) and invisible basic assumptions (light blue, bottom). The arrows indicate the interconnection and influence between these hierarchical levels (Schein 1984)

While previous studies have documented regional concentration of cultural resources through descriptive statistics, these analyses typically have not explored the underlying structural relationships between different cultural segments or the systemic biases embedded in funding allocation mechanisms. Network-based approaches offer particular promise for revealing how different cultural domains are interconnected through funding relationships and for identifying both visible inequalities and their hidden structural drivers (Schuster 2003). By moving beyond simple geographical concentration to examine patterns of co-sponsorship and the implicit preferences that shape resource distribution, network analysis can expose systematic relationships that inform our understanding of who benefits from public cultural funding. Network analysis has proven particularly valuable in revealing hidden patterns in resource allocation systems across diverse domains. Applications to research funding have demonstrated how collaboration networks shape grant success (Kardes et al. 2014; Hicks et al. 2019), while studies of philanthropic giving have used network methods to identify donor clustering and preference structures (McClure et al. 2017). In cultural contexts specifically, network approaches have illuminated the structure of creative collaboration (Uzzi and Spiro 2005), the geography of cultural flows (Schich et al. 2014), and the relationships between cultural organisations and their stakeholders (Oehler and Sheppard 2010).

Recent research has begun to address whether cultural policy frameworks serve to democratise access or inadvertently reinforce existing inequalities. Critical perspectives have questioned whether creativity-oriented policies prioritise economic development over broad cultural participation, potentially creating new barriers rather than opportunities (Kruczkowska 2014). Studies analysing funding allocation across different contexts have identified economic indicators, demographic composition, and institutional capacity as key correlates, with particular attention to how ethnic heterogeneity and socioeconomic stratification influence public expenditure patterns (Feder and Katz-Gerro 2012; Hoole et al. 2025). Comparative studies across European contexts have demonstrated that cultural funding allocation reflects not only economic capacity but also institutional frameworks, with decentralised systems exhibiting different inequality patterns than centralised models (Duelund 2001). Research on the creative economy has increasingly recognised the role of network structures in shaping cultural production and distribution, with studies examining how collaboration networks influence innovation in creative industries (Lazzeretti 2012) and how geographical clustering affects access to cultural resources (Markusen 2006). In the specific context of tax-incentive mechanisms similar to Brazil's Rouanet Law, international comparisons have shown that while such systems can mobilise private resources for culture, they risk concentrating benefits in economically advantaged regions unless accompanied by targeted equity measures (Caust 2003). By applying network analysis to cultural funding data alongside examination of socio-economic and demographic correlates, we can develop more nuanced understandings of funding dynamics that distinguish between approaches emphasising art provision for the wider public versus those that may facilitate processes of hegemony and distinction.

Assessing public funding, especially for cultural initiatives, is crucial given the involvement of taxpayer resources (Belfiore 2004). The evaluation of government policies and programs is a vital issue for maintaining public trust (Nye et al. 1997). As Bok (1997) argues, such assessments are challenging due to the generally uninformed nature of the

public, underscoring the importance of education. Furthermore, as societies transition towards e-government (Layne and Lee 2001), assessment will become even more essential as citizens expect immediate transparency and accountability.

Though inherently qualitative, culture has been quantitatively examined through the analysis of digitised books and other cultural data (Michel 2011). Such studies have yielded important insights into cultural trends, historical patterns, and even epidemiological phenomena. Researchers have also leveraged network science and data science techniques to assess cultural funding and mobility by examining the structure of intellectual collaboration and migration (Schich et al. 2014; Melo et al. 2014). These innovative approaches demonstrate the potential for data-driven analysis of cultural policies and funding mechanisms.

While previous research has documented regional disparities in cultural funding (Da Costa 2023; Menezes 2016), these studies typically focus on descriptive statistics without exploring the structural relationships between different cultural segments. The underlying connections we aim to investigate are the patterns of co-sponsorship between cultural segments, in other words, which cultural segments tend to receive funding together more frequently than would be expected by chance. These connections represent the implicit preferences of sponsors and potentially reveal systemic biases in funding allocation that go beyond simple geographical concentration. By applying network analysis to cultural funding data, we contribute a novel methodological approach to cultural policy evaluation that can identify both visible inequalities and their hidden structural drivers.

Building upon these foundations, this study applies network analysis to systematically investigate cultural funding patterns in Brazil's Rouanet Law mechanism. Our research pursues three specific objectives: (i) to assess the spatial distribution of cultural funding across Brazilian states, quantifying regional disparities in project approval and sponsorship success; (ii) to identify distinct cultural signatures that characterise each state's funding patterns, revealing how regional contexts shape cultural investment priorities; and (iii) to construct and analyse a network representation of the overall cultural landscape that captures structural relationships between cultural segments through co-sponsorship patterns. Unlike previous descriptive analyses, our network-based approach exposes systematic connections between cultural domains and demonstrates how funding patterns correlate with economic development indicators. Crucially, while we apply this methodology to Brazil's Rouanet Law, the network-based framework is generalisable to any context where multiple sponsors fund multiple projects: whether in cultural policy, research funding, philanthropic allocation, or other domains where co-sponsorship patterns exist. The approach requires only a dataset of sponsors, projects, and the relationships between them. What is specific to Brazil is the pattern of regional differences and corporate concentration we uncover; what is generalisable is the analytical framework that makes such patterns visible and interpretable.

Rouanet law and access to public funding

The Brazilian Ministry of Culture (MinC) operationalises culture through three interconnected dimensions (Calabre 2009): *(i)* culture as a symbolic construct that shapes national identity and distinguishes Brazilian society in the global context; *(ii)* culture as an economic driver and productive sector, intrinsically linked to socioeconomic development and innovation (Reis 2007); and *(iii)* culture as a fundamental constitutional

right, emphasizing universal access and participation (Brazilian Constitution 1988). This tripartite framework aligns with Schein's model while extending beyond it, facilitating the development of democratic cultural policies and highlighting culture's transversal role across various governmental sectors and knowledge domains (Rubim 2007).

The Brazilian Constitution of 1988, in Article 215, establishes that it is the State's responsibility to "guarantee to all the full exercise of cultural rights and access to the sources of national culture, and to support and encourage the appreciation and diffusion of cultural manifestations" (Brazilian Constitution 1988). The Article further mandates that the Brazilian State must "protect the manifestations of popular cultures, indigenous and Afro-Brazilian, and those of other groups participating in the national development process." This constitutional framework extends beyond mere legal obligation, aligning with contemporary understanding of culture's role in societal development and economic growth (Bianchini 1993; Herrero et al. 2006).

The Brazilian model is uniquely exemplified through initiatives such as the Market of Brazilian Creative Industries (MICBR), which has evolved from covering nine creative sectors in 2018 to encompassing fifteen sectors in 2023. This expansion reflects the government's recognition of further sectors with economic potential, while maintaining focus on Brazil's cultural diversity and social inclusion. The recognition of creative industries as economic drivers has been documented internationally, with research demonstrating how cultural and creative sectors contribute to regional development (Andersson 1985), generate employment multiplier effects (Veselá and Klimová 2014), and foster urban regeneration (Evans 2009; Suciu 2009). In Latin American contexts specifically, studies have examined how creative economy initiatives interact with persistent socioeconomic inequalities, revealing both opportunities and challenges in using cultural policy as a development tool(Quartesan et al. 2007). One notable mechanism for fostering creative sector development in Brazil is the tax incentive system, which exemplifies the government's role in cultural policy implementation. Through this system, the state fulfils its constitutional mandate while enabling market-driven support for cultural initiatives, creating a balanced approach to cultural development that addresses both economic and social objectives.

Within Brazil's diverse ecosystem of cultural funding mechanisms, the Federal Culture Incentive Law (Law No. 8313/1991), commonly known as *Lei Rouanet*, represents one of the most significant instruments for cultural financing (Calabre 2009; Menezes 2016). Established during the post-democratisation period to replace the earlier law (known as *Lei Sarney*), this mechanism operates through fiscal incentives allowing companies and individuals to redirect up to 6% and 4% of their income tax, respectively, towards cultural projects. The law's implementation marked a crucial shift in Brazilian cultural policy, introducing a hybrid model where public resources are allocated through private sector decision-making (Calabre 2009).

At the time of the dataset we collected, the Rouanet Law's operational framework consisted of three distinct mechanisms: the National Cultural Fund (FNC), the Cultural and Artistic Investment Fund (FICART), and the most widely used Incentive to Cultural Projects (PRONAC). Despite its significant contribution to cultural development (having facilitated investments of over R$49 billion in more than 50,000 cultural projects between 1991 and 2020), the law has faced criticism regarding regional concentration of resources and accessibility (Da Costa 2023). However, as argued by Menezes (2016),

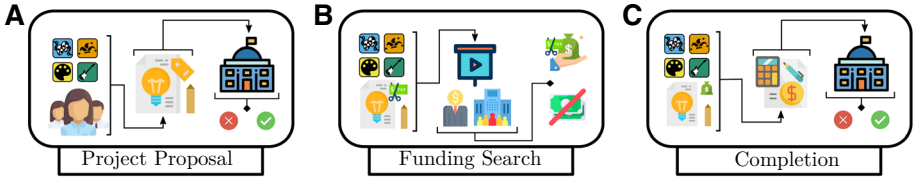

Fig. 2 Funding Lifecycle for Cultural Projects under *Rouanet Law*. **A** Individuals or organisations submit project proposals to the government for evaluation and approval. **B** Approved projects then seek private sponsorship, as the law allows companies and individuals to receive tax deductions for their cultural investments. However, not all approved projects are able to secure adequate funding. **C** Funded projects must submit detailed accountability reports to the government, which can either approve the completion of the project or request additional evidence to ensure the original goals were met

Table 1 Summary of the Rouanet law cultural projects dataset

Description	Count
Transactions (contributions)	106,804
Sponsors (total)	39,809
Individuals	32,810
Companies	6999
Approved projects	12,326
Proponents	5609
Years covered	2010–2014

these challenges reflect broader structural inequalities in Brazilian society rather than inherent flaws in the law's design. Recent modifications to the law have attempted to address these issues by introducing mechanisms to encourage broader geographical distribution of resources and greater participation from smaller cultural producers, while maintaining its fundamental role in Brazil's creative economy ecosystem. Figure 2 depicts the main stages which make the funding process.

The remainder of this paper is organised as follows. Section Data describes our dataset of 106,804 transactions across 12,326 projects from 2010 to 2014, while Section Methods details the methods, especially the network construction methodology and the ϕ-correlation approach for identifying significant co-sponsorship patterns. Section Results presents our findings in three parts: first, the distinct cultural signatures that characterise each Brazilian state's funding patterns. Second, the cultural space network that reveals structural relationships between cultural segments. And third, the regional variations in their coverage. We conclude with Sections Discussion and Conclusion by discussing the policy implications of our findings, particularly how this network-based framework can guide strategic interventions to address funding imbalances while fostering cultural diversity across Brazil's diverse regions.

Data

We used a dataset of cultural projects submitted to a tax-deduction system known as Rouanet law (Menezes 2016). Each project is associated with a *cultural area* (e.g., music, performing arts) and *cultural segment* (e.g., popular music, dance, photography). In our analysis, we considered 106,804 transactions (contributions) involving a total of 39,810 sponsors (companies and individuals) to 12,326 approved projects that were submitted by 5609 fundraisers between the years 2010 and 2014 (see Table 1). The raw data consists of descriptive records of several entities involved in the funding of cultural projects.

These records, which include information such as sponsors, project descriptions, project proponents, and donation details, are available at http://versalic.cultura.gov.br/.

This five-year aggregation period was chosen because our aim is to reveal the underlying co-sponsorship patterns that define how cultural segments interconnect through shared sponsors: a structural approach. Aggregating across multiple years provides sufficient data volume (over 100,000 transactions) to robustly estimate ϕ-correlation values while reducing noise from year-to-year fluctuations in individual sponsor behaviour. The period 2010–2014 represents a relatively stable policy environment under the same governmental administration, minimising confounds from major policy changes that could obscure the structural patterns we seek to identify.

It is important to note that our study considers all "promises" of funding within the approval system. Under the Rouanet law, proponents must seek sponsors after receiving project approval, and projects are only executed if they secure their total approved funding amount. However, for this research, we deliberately disregard whether projects were ultimately executed or not, as our focus is on evaluating the potential linkages between cultural segments. The mere existence of a funding promise is sufficient to demonstrate the intention to support a particular cultural segment of an approved project, which is the primary consideration for our network analysis. This methodological choice prioritises understanding sponsors' intentions and the implicit preferences that shape funding patterns, rather than focusing solely on realised transactions which are more susceptible to variables such as economic variations. Distinguishing between funded and unfunded projects could provide complementary insights into the efficiency of different cultural segments in converting approval into actual funding, and might reveal whether certain segments face systematic barriers in the funding search stage. However, such an analysis would shift the focus from co-sponsorship patterns (our primary interest) to fundraising success rates. Figure 3 shows the main 3 stages of this process.

The geographical distribution of cultural funding through Brazil's Rouanet Law reveals significant regional disparities across three critical dimensions, shown in Fig. 3. Figure 3A demonstrates approval variations, with southeastern states generally enjoying higher project approval rates while states like Mato Grosso (MT) and Maranhão (MA) fall significantly below the national average. Figure 3B illustrates efficiency imbalance in securing funding, revealing that approval does not guarantee sponsorship success;

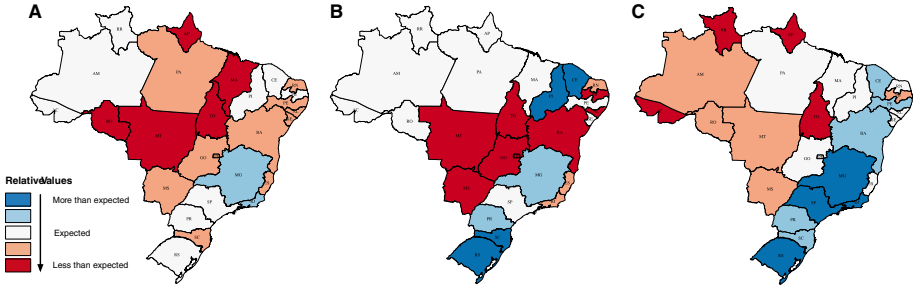

Fig. 3 Regional disparities in cultural funding across Brazil's states. **A** Approval Bias: The level of submitted projects that receive approval varies significantly by state, with southeastern states generally showing higher approval rates. **B** Efficiency Imbalance: The success rate in securing private sponsorship for already-approved projects demonstrates distinct geographical patterns independent of initial approval rates. **C** Funding Inequality: When normalised by state GDP, funding distribution reveals which states receive disproportionately high or low cultural investment relative to their economic output. Each map represents a different stage in the funding lifecycle shown in Fig. 2, highlighting how regional disparities manifest throughout the process

northeastern states like Piauí (PI) and Ceará (CE) excel at attracting private funding despite only average approval rates, suggesting local business environments and fundraising capacities play crucial roles independent of initial approval processes. Figure 3C completes this multifaceted picture by showing funding variations relative to GDP, where some economically modest states achieve disproportionately high cultural completion rates (project fully funded and executed). Yet, the overall maps suggest that wealthier states like Rio de Janeiro (RJ) and São Paulo (SP) tend to perform even better than expected from their GDP.

These three perspectives show how regional disparities manifest throughout the funding lifecycle, information already recognised by the Ministry of Culture. Our deeper analysis in the following sections moves beyond these known patterns to explore the underlying connections between cultural segments that might explain these differences, providing policymakers with a more nuanced understanding of how funding disparities emerge and where targeted interventions might yield the greatest improvements in cultural development across Brazil's diverse regions.

Methods

Cultural sponsorship signatures

The Rouanet Law is unique in that it is a government incentive yet largely decentralised. Individuals and companies not only propose projects but also act as sponsors, deciding which initiatives receive funding. More notably, tax benefits extend to both corporations and individuals.

From a tax deduction perspective, sponsors could, in theory, maximise their "donations" without regard for project type. However, companies may strategically fund projects that offer indirect benefits, such as marketing opportunities. For individuals, the incentive allows them to support cultural initiatives aligned with their personal values and beliefs. These dynamics are not independent, as companies may also align their sponsorship choices with the cultural landscape of the regions in which they operate.

Brazil is a vast and diverse country, often organised into five geographical regions distinguished by climate, biodiversity, and economic activity. Administratively, it is divided into 27 federative units (states), which play a crucial role in shaping cultural expression, traditions, and even linguistic variations. The differences between states can be illustrated by their size and population: for instance, Amazonas, the largest state by area, is comparable to Mongolia, while São Paulo, the most populous state, has a population similar to that of Argentina. Given this diversity and the multifaceted nature of culture itself, cultural characterisation at the state level is both necessary and informative.

Network construction

We construct a network in which nodes represent cultural segments defined by the Brazilian Ministry of Culture's classification system, and edges encode statistically significant co-sponsorship relationships between segments. The construction follows the probabilistic framework introduced by Hidalgo et al. (2009) for phenotypic disease networks, adapted here to cultural funding data.

The underlying data form a bipartite structure connecting sponsors to cultural projects. Two cultural segments are connected if they share at least one sponsor (Fig. 4), with edge weights determined by the ϕ-correlation coefficient, which quantifies whether

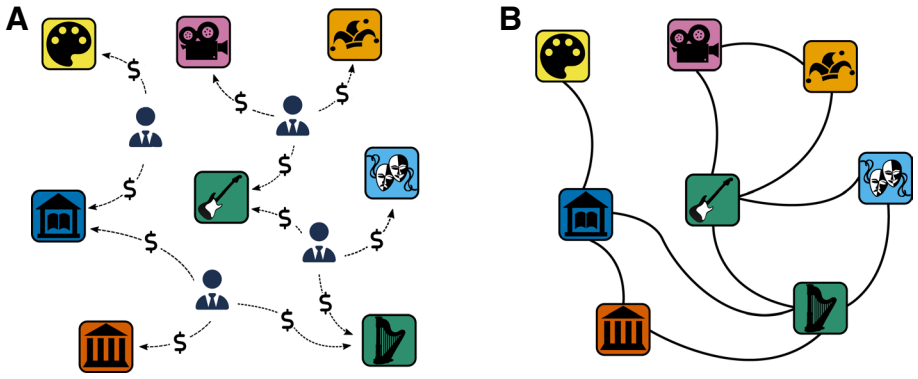

Fig. 4 Construction of the cultural sponsorship network. **A** Bipartite data linking sponsors to cultural segments (e.g., popular music, dance). **B** The resulting projected network, where nodes are cultural segments and edges indicate statistically filtered co-sponsorship relationships weighted by the ϕ-correlation coefficient

the observed level of shared sponsorship exceeds random expectation given segment prevalence. The ϕ-correlation between segments *i* and *j* is defined as:

$$\phi_{ij} = \frac{C_{ij}N - P_iP_j}{\sqrt{P_iP_j(N-P_i)(N-P_j)}}, \tag{1}$$

where N is the total number of sponsors in the dataset, P_i and P_j denote the number of sponsors supporting segments *i* and *j*, respectively, and C_{ij} represents the number of sponsors supporting both segments. This formulation normalises observed co-occurrence against its expected value under random mixing, given the marginal prevalence of each segment. We adopt the ϕ-correlation rather than raw co-occurrence counts or similarity indices (e.g., Jaccard) because it explicitly accounts for heterogeneity in segment prevalence, which is particularly important in funding data where some segments receive substantially more support than others. The ϕ-based approach has been shown to perform well in comparable settings, including disease comorbidity networks (Hidalgo et al. 2009; Rzhetsky et al. 2007) and economic complexity analysis (Hidalgo et al. 2007).

Following (Hidalgo et al. 2009), the statistical significance of the ϕ-correlation is evaluated using the associated *t*-statistic under the null hypothesis that sponsorship of two cultural segments occurs independently across sponsors. An edge between segments *i* and *j* is retained only if ϕ_{ij} is significantly different from zero ($p < 0.05$), using

$$t_{ij} = \frac{\phi_{ij}\sqrt{n_{ij}-2}}{\sqrt{1-\phi_{ij}^2}}, \tag{2}$$

where n_{ij} is the number of observations used to estimate ϕ_{ij}, defined as $n_{ij} = \max(P_i, P_j) \ll N$. For large samples ($n > 1000$), values of $t \geq 1.96$ correspond to significance at the 5% level. This filtering step restricts the network to statistically meaningful co-sponsorship relationships. The resulting network provides the basis for constructing the *cultural space* analysed in "Cultural space" section.

Because the construction of the cultural space involves testing all pairs of cultural segments, we also evaluate robustness to multiple hypothesis testing using the Benjamini–Hochberg false discovery rate (FDR) correction, which yields a more conservative backbone network containing only the strongest statistically supported connections. We note that projecting the bipartite sponsor–segment network into a segment–segment

network entails a loss of sponsor-level information and may introduce spurious associations; the use of ϕ-correlation, statistical filtering, and FDR correction together mitigates this risk.

State coverage of the cultural space

To evaluate how different states participate in the national *cultural space*, we define a coverage metric based on the segments that form the cultural backbone of each state.

For each state *s*, we first construct a state-specific bipartite network between sponsors located in that state and the cultural segments of the projects they support. From this bipartite structure, we derive a segment–segment network using the same ϕ-correlation procedure described above. We then identify the largest connected component of this state-level segment network, which we denote by C_s, representing the collection of cultural segments that form the core cultural structure of state *s*.

To measure how strongly this state-level cultural structure connects to the national cultural space, we compute the sum of ϕ-correlation weights linking the segments in C_s to all other segments in the national network. The coverage of the cultural space for state *s* is defined as

$$S_\phi(s) = \sum_{i \in C_s} \sum_{j} \phi_{ij}. \tag{3}$$

States whose core segments correspond to highly connected segments in the national cultural space will have larger values of S_ϕ, indicating broader coverage of the cultural landscape.

Results

Cultural sponsorship signature

Our analysis spans five years and covers more than 12,000 projects, nearly 40,000 sponsors, and more than one billion dollars.[1] Although they represent only 18% of the sponsors, companies contribute 98% of the total investment.

We examine the *Cultural Signature* of each Brazilian state by determining the percentage of sponsorship allocated to each cultural segment (the comprehensive list of segments is available in Appendix A). Generally, sponsorship distribution is highly uneven, with segments such as *Theatre (Performing Arts)* and *Instrumental and Popular (Music)* receiving the majority of funding. The sponsorship characterisation differs between corporate and individual contributors, as shown in Fig. 5A and B, respectively. Corporations tend to sponsor a broader array of segments across all states compared to individuals, indicating a more diverse sponsorship footprint. For example, corporations in São Paulo (SP) allocated resources to 89 distinct segments, compared to approximately 57 for individuals. Similarly, in Amapá (AP), corporate sponsorship encompassed 16 segments, whereas individual sponsorships extended to only 2.

Hierarchical clustering (Virtanen 2020) based on the cosine similarity of state cultural profiles is applied to both panels, with the resulting dendrograms depicted on the left side of each heatmap in Fig. 5. The clusters derived from corporate data differ from those identified at the individual level, substantiating the visual observations: state cultural

[1] Original values not adjusted for inflation. At the time of writing, 1 USD = 6.20 BRL.

Fig. 5 Cultural sponsorship contributions by state, categorised by **A** companies and **B** individuals. In both panels, each column represents one of the 103 *cultural segments*, grouped by *Area* according to the overall amount of sponsorship received nationally. Within each *Area*, segments are further ordered by their sponsorship level. Each row corresponds to a state, with values normalised to sum to 100%

profiles exhibit notable distinctions when examined through corporate versus individual sponsorship. Furthermore, neither clustering methodology aligns with geographic regions or proximity.

Cultural space

Figure 6A shows the national cultural space obtained from the ϕ-correlation network of cultural segments, where nodes represent cultural segments and edges indicate significant co-funding relationships. Edge weights (ϕ) capture the strength of these associations, with stronger connections (thicker edges) indicating segments that are more frequently co-funded than would be expected by chance. For example, strong links appear between the performing arts and audiovisual sectors, suggesting that these domains often attract support from the same sponsors.

As a robustness check, we reconstructed the cultural space using a Benjamini–Hochberg false discovery rate (FDR) correction applied to the 5253 pairwise segment tests. This correction reduces the number of statistically significant edges from 442 to 171 and decreases the size of the giant component from 74 to 47 segments. However, the FDR giant component is entirely contained within the original giant component, indicating that the correction primarily removes peripheral nodes while preserving the core structure. Consistent with this result, eight of the ten most connected segments remain among the top ten after FDR filtering.

State coverage of the cultural space

We next examine how different states participate in the national cultural space. For each state, we construct a state-level segment network and identify the segments belonging to

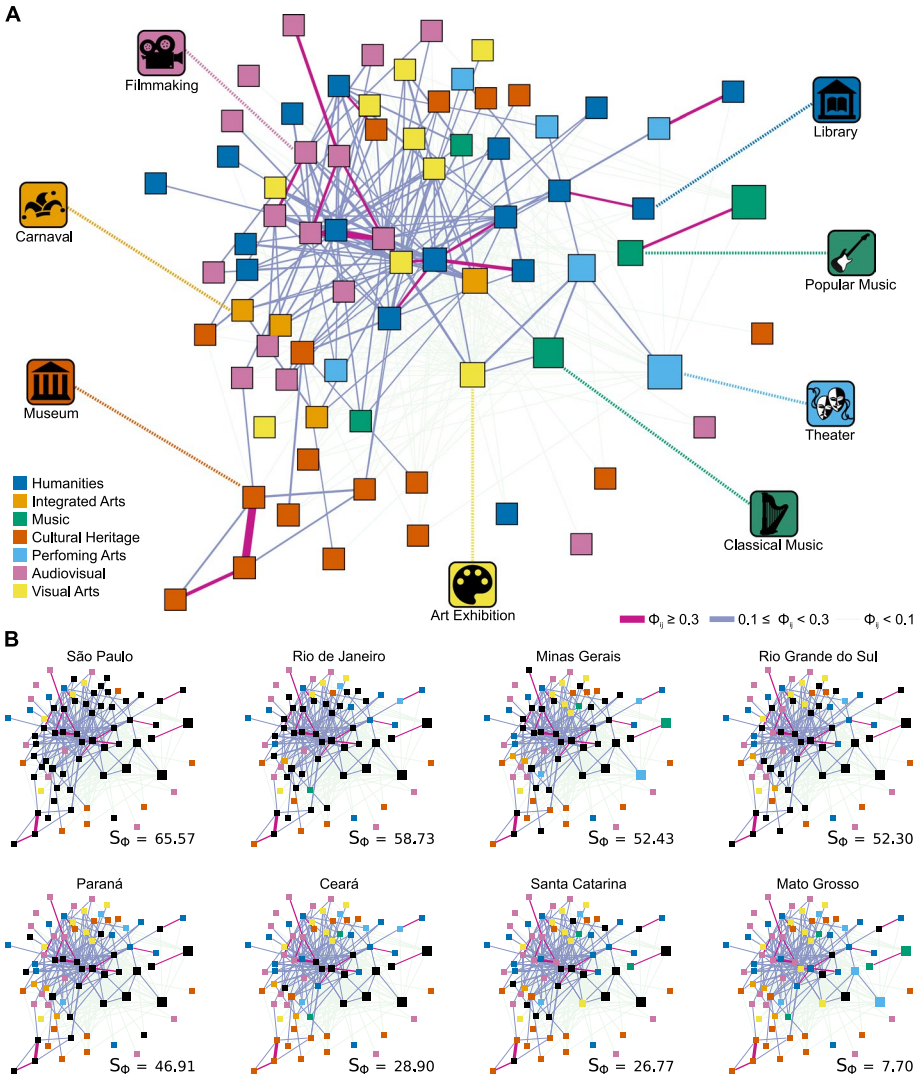

Fig. 6 **A** The national cultural space, built from the co-funding of cultural segments as described in Fig. 4. **B** State-level coverage of the cultural space, where nodes shown in black indicate segments that receive relatively greater support from sponsors located in that state compared to the national average. For instance, sponsors from São Paulo support a wider variety of cultural segments than sponsors in Mato Grosso

its giant component, which are then used to compute the coverage metric S_ϕ defined in the Methods section.

The state-level analysis (Fig. 6B) reveals substantial geographical variation in how different regions occupy the national cultural space. Southeastern states (e.g., São Paulo, Rio de Janeiro, and Minas Gerais) demonstrate notably broad coverage, consistent with their economic prominence: these states together account for roughly 70% of Brazil's GDP. São Paulo, in particular, shows the most extensive coverage ($S_\phi = 65.57$), with a strong presence across almost all cultural segments.

When the analysis is restricted to the FDR-filtered cultural space, the resulting backbone network becomes smaller, with only six states retaining non-zero connectivity (SP, RS, MG, RJ, PR, and DF). Despite this reduction, the ranking of the most connected states remains largely stable, with the only change being a swap in position between RS and RJ.

This pattern may reflect an indirect geographical bias in the funding system. Because many corporate sponsors are headquartered in the Southeast, cultural organisations in these states benefit from greater access to sponsorship networks, creating a reinforcing cycle in which economically stronger regions support a broader diversity of cultural sectors, which in turn attract additional funding.

Drawing parallels with analyses of economic development (Hidalgo et al. 2007), just as the product space helps identify potential paths for economic diversification, the cultural space can guide strategic investment in underdeveloped cultural segments. States with limited presence in certain areas could identify adjacent segments where expansion may be feasible, given their existing strengths. The Ministry of Culture could use this framework not only to monitor funding levels but also to strategically incentivise development in specific cultural segments, particularly in regions currently exhibiting limited diversity in cultural funding.

Discussion

Our network-based analysis of Brazil's cultural funding mechanism reveals complex patterns of resource distribution and highlights structural features that both support and potentially hinder the law's effectiveness in promoting cultural diversity.

The key contributions of this study are: (1) the application of network analysis to cultural policy evaluation, revealing structural relationships between cultural segments through co-sponsorship patterns; (2) the creation of a 'cultural space' framework that maps funding interconnections and enables identification of underserved sectors; (3) quantitative evidence that sponsorship disparities are substantial, with some states up to 40% less likely to secure funding, and that these disparities correlate strongly with broader socioeconomic indicators; and (4) a generalisable analytical framework applicable to any setting where sponsors fund projects, independent of the specific institutional context.

The cultural space framework offers policymakers several concrete tools for intervention:

- **Strategic targeting** States with limited coverage can identify adjacent cultural sectors for expansion by leveraging existing co-sponsorship relationships, rather than attempting to develop all segments simultaneously.
- **Redistributing sponsorship incentives** Because corporate sponsors concentrate in southeastern regions, the framework can help identify where targeted incentives would have the greatest effect in breaking the self-reinforcing cycle of regional concentration.
- **Monitoring cultural diversity** The network representation enables the Ministry of Culture to track not only funding levels but also the structural diversity of cultural segment development across regions over time.

Beyond these immediate applications, the methodology could be extended in several directions. Future analyses could examine how the cultural space changes when large and small funders are treated separately, which could reveal whether the funding landscape is overly dependent on major corporate sponsors in ways that create structural vulnerability. Additionally, constructing cultural spaces based on supplier relationships or project proponents rather than sponsors could provide complementary views of the

cultural sector's structure and dynamics, particularly as Brazil increasingly adopts the broader concept of the creative economy.

Like any study with a defined methodological focus, the choices made here prioritise structural co-sponsorship patterns over other equally valid perspectives. Two such choices are worth making explicit:

- **Temporal aggregation** The analysis aggregates data from 2010–2014 to identify structural co-sponsorship patterns, prioritising robust estimation of underlying relationships over temporal dynamics. As a result, year-to-year changes and the specific effects of policy modifications to the Rouanet Law during this period are not captured.
- **Statistical assumptions** The statistical filtering relies on an independence assumption between cultural segments and does not explicitly control for heterogeneous sponsor and segment degrees. More restrictive null models based on bipartite configuration models could, in principle, account for such heterogeneity. However, the robustness analysis shows that the main structural patterns of the cultural space remain stable under stricter filtering.

Conclusion

This study has shown how network analysis can reveal structural patterns in cultural funding that go beyond traditional descriptive statistics. By constructing a cultural space from co-sponsorship relationships, we have demonstrated how cultural segments interconnect and how these connections vary systematically across Brazil's diverse regions. The stark differences in how states occupy this cultural space suggest that funding disparities reflect deeper structural inequalities in how cultural sectors develop and attract investment, rather than simply uneven resource allocation.

The policy implications are concrete. Rather than redistributing resources uniformly, policymakers can use the cultural space framework to identify strategically important segments whose development might catalyse broader cultural activity in underserved regions, targeting interventions where they are most likely to have a lasting structural effect.

A particularly valuable direction for future research would be to distinguish between funding promises and successfully funded projects in the network construction. Such a comparison could reveal whether certain segment combinations face systematic barriers in converting approval into actual funding, complementing the intention-based network presented here and enabling more targeted interventions at the funding search stage. More broadly, the co-sponsorship framework introduced here is applicable to any context where sponsors fund projects, and we are confident it will find use beyond the Brazilian cultural sector.

Appendix A Cultural areas and segments

Figure 5 delineates seven distinct Areas along with 103 Segments. The Areas are systematically ordered based on the cumulative sponsorship amount obtained, while within each Area, the Segments are correspondingly organised. Furthermore, each Area's initial Segment is annotated with a numeral in parentheses that corresponds to the x-axis index, arranged from right to left, also as depicted in Fig. 5. The areas and segments are in Table 2.

Table 2 Cultural areas and segments classification

Area	Segments
Performing arts	Theatre (1), Dance, Circus, Staff Training and Capacity Building, Integrated Arts, Opera, Mime
Music	Instrumental Music (8), Classical Music, Popular Music, Integrated Arts, Integrated Areas, Orchestra
Audiovisual	Audiovisual Collection Dissemination (14), Dissemination, Medium-Length Film Production, Cinematic Production, Video Games, Cinematic Exhibition, Educational Radio and TV, Audiovisual Training, Television Production, Short Film Cinematic Production, Formation/Research/Information, Cinematic Memory Preservation/Restoration, Short-Length Video Production, Transmedia Audiovisual Projects, Formation/Research and Information, Multimedia, Medium-Length Video Production, Educational Radio/TV, Radio Production, Cinematic Distribution, Series Production, Audiovisual Technical Infrastructure, Cinema Room Maintenance (<100k inhabitants), Audiovisual Collection Restoration, Audiovisual Preservation, Videofonographic
Humanities	Book Editing (40), Artistically Valuable Books, Literary Events, Bibliographic Collection, Humanistic Value Books, Literary Value Books, Library, Integrated Arts, Reference Works, Periodicals, Training and Capacity Building Actions, Bibliographic Collection Maintenance Equipment Acquisition, Periodicals and Other Publications, Archive, Philosophy, Reading Promotion Events and Actions, Personnel Training for Bibliographic Collection Maintenance, History
Cultural heritage	Architecture (58), Museum Heritage Preservation, History, Museum Collection Preservation, Museum, Material Heritage Restoration, Crafts/Folklore, Museum Collections, Cultural Equipment Maintenance, Museum Heritage Restoration, Material Heritage Preservation, Archaeological, Collection, Construction of Theater Rooms in Municipalities (< 100k inhabitants), Intangible Heritage Preservation, Collection Preservation, Afro-Brazilian Culture, Community Center Construction with Theater (< 100k inhabitants), Integrated Arts, Equipment Acquisition for Collection Maintenance, Capacity Building Actions, Indigenous Culture, Theater Room Maintenance (< 100k inhabitants), Collection Restoration, Instrumental Music, Cultural Equipment Construction, Museum Collection Restoration
Integrated arts	Integrated Arts (85), Carnival, Multifunctional Cultural Equipment, Restoration/Grants, Multimedia, Popular Culture
Visual arts	Art Exhibitions (91), Fine Arts, Photography, Integrated Arts, Travelling Exhibitions, Graphics, Educational Visual Arts Projects, Engraving, Philately, Fine Arts, Visual Arts Productive Chain Promotion Project, Fashion, Design

Numbers in parentheses correspond to the x-axis index in Fig. 5, arranged from right to left

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Author contributions
All authors contributed to the study conception and design. Data collection and initial analysis were performed by DP (Diogo Pacheco), DPi (Diego Pinheiro), JF, MO, and RM; GM conducted additional analysis following the initial investigations. The network visualisations and cultural space representations were designed by DP, DPi, JF, and MO. HM provided essential expertise on cultural funding mechanisms and creative economy policy frameworks. The first draft of the manuscript was written by DP, DPi, JF, MO, and RM, and the final version was prepared by DP and RM. All authors reviewed and approved the final manuscript.

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Data availability
The raw data analysed in this study is publicly available under Brazil's Information Access Law (Lei de Acesso à Informação) at http://versalic.cultura.gov.br. The structured dataset is also available at https://dados.gov.br/dados/conjuntos-dados/projetos-do-programa-nacional-de-apoio-a-cultura-lei-rouanet. Yet, we are fully committed to transparency, so the aggregated data used in the experiments are available at Zenodo (Pacheco et al. 2026).

Declarations

Competing interests
The authors declare that they have no conflict of interest.

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