The economic contribution of the cultural sector in Brazil: An input–output approach with different income groups[1]

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Abstract
Brazil is characterized by strong income inequality, which is naturally reflected in the consumption of goods and services. Such disparities in access are also reproduced in the sector of artistic and cultural activities. Thus, understanding the cultural sector as a fundamental part of the development of a society, this article evaluates the intersectoral impact of the sector of artistic and cultural activities on other sectors of the Brazilian economy. First, this analysis identifies the effects of COVID-19, which allows us to determine how the sector is affected by such a shock in terms of production, employment and income. Then, the relevance of the cultural sector is evaluated through the identification of different family income brackets through the 2015 input-output matrix of the Brazilian Institute of Geography and Statistics (IBGE) and information from the Family Budget Survey (POF). The main results indicate that the COVID-19 pandemic, specifically its effect on the cultural sector, reduced the production of cultural activities by 31.8%, which is equivalent to a loss of 237,701 jobs. This result indicates the relevance of the cultural sector to the Brazilian economy.
Keywords: Cultural sectors; cultural expenditure; Brazil; input–output analysis.

Resumo
O Brasil é caracterizado por uma forte desigualdade de renda, que se reflete naturalmente no consumo dos bens e serviços. Tais disparidades de acesso são também reproduzidas no setor de atividades artísticas e culturais. Assim, compreendendo o setor cultural como uma peça-chave do desenvolvimento da uma sociedade, o presente artigo tem como objetivo avaliar o impacto intersetorial do setor de atividades artísticas e culturais nos demais setores da economia brasileira. Primeiro, tal análise é conduzida ponderando os efeitos da Covid-19, o que permite identificar como o setor foi afetado, em termos de produto, emprego e renda. Na sequência, é avaliada a relevância do setor cultural considerando os diferentes grupos de renda familiar. Para tanto, é utilizado a abordagem de insumo-produto, com a matriz de dados brasileiros mais recente de 2015 e informações da Pesquisa de Orçamentos Familiares. Os principais resultados apontam que uma crise, como a da Covid-19, considerando apenas o efeito no setor cultural, tem um impacto de reduzir em 31,8% o produto das atividades culturais, o equivalente a uma perda de 237.701 postos de trabalho. Esse resultado indica a relevância do setor cultural para a economia brasileira.
Palavras-chave: Setor cultural; Consumo cultural; Brasil; Análise Insumo-Produto.

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1 Introduction

The cultural sector, even in developed countries, naturally exhibits large inequalities in consumption, especially in terms of highbrow culture (Almeida et al., 2019; Benhamou, 2007). In Brazil, a country marked by strong income and opportunity inequalities, the consumption of cultural products and events is influenced by this scenario of high social segregation. Even so, Brazilian families have a representative cultural expenditure. According to the 2017-2018 Family Budget Survey (POF), the average monthly expenditure of families on the cultural sector was R\$ 291.18. Considering that the average consumption expenditure of goods in general among Brazilian families corresponds to R\$ 4,116.76, the expenditure on culture corresponds to 7.1% of this total. While this survey of household spending on culture demonstrates the relevance of the sector for the structure of family consumption in Brazil, it does not capture inequality in consumption.

In terms of aggregate consumption in the cultural sector, some studies examine how changes in household income and consumption affect the cultural sector in Brazil (Machado et al., 2020; Silva & Brito, 2019; Souza et al., 2019). For example, Silva and Brito (2019) and Machado et al. (2020) show that changes in household consumption have direct impacts on the cultural sector and indirect impacts on other sectors, affecting the generation of employment and national income. Thus, there is a gap in the literature regarding the understanding of the structure of consumption of cultural goods and services by family income groups. The present article therefore evaluates the impact of the cultural sector on the Brazilian economy through an empirical investigation of the multiplier effects of the cultural sector on other sectors of the economy, based on the structure of consumption among family income groups.

The methodology of this article consists of an intersectoral analysis involving the input–output matrix provided by the Brazilian Institute of Geography and Statistics (IBGE), for year 2015. While revealing the data regarding the consumption and income of families in this input–output matrix, we divide family units into ten distinct income groups, and we then evaluate the sectoral impacts of changes in the cultural consumption patterns of these family groups. The disaggregation of consumption and income data by income class is performed using information from the Family Budget Survey (POF) for the period 2017-2018. Additionally, we hypothetically extract the cultural sector to identify the sectors that are strategically important for analysis of the cultural sector, i.e., those sectors that have more intense connections with the demand and supply of inputs of the cultural sector.

Specifically, in this study, we seek to answer three questions: What are the economic impacts, in relation to output, employment and income, of cultural activities on other sectors of the Brazilian economy? How would sectoral production in the Brazilian economy be affected if the cultural sector were removed from this economy? What is the importance of the consumption structure of the different social income groups for the output of the cultural sector? The answers to these questions are important because they will allow a better understanding of the size, in terms of activity level, of the cultural sector in the Brazilian economy, by considering the inequalities in consumption resulting from income disparities.

Notably, this examination of the cultural sector has become even more relevant, given the restrictions imposed by COVID-19. Because it is a sector based on entertainment and socialization, according to Machado et al. (2020), culture has been one of the sectors most affected by social isolation in relation to the cultural goods and services that are consumed outside the home (concerts, cinemas, museums and artistic performances). During the pandemic, the domestic

consumption of cultural goods became possible due to digital technologies and platforms, which were used as the main vehicle for communication and social interaction in the household (e.g., social networks, digital platforms and digital games) to maintain social isolation and preserve public health. However, such efforts were insufficient to move the labor market associated with the cultural sector that existed before the pandemic. Thus, given the significance of the cultural sector and the impact of the pandemic, it is critical to understand its potential to generate jobs, income and economic growth by evaluating the role of Brazil's different income groups.

The present study is divided into five sections. Following the introduction, section two presents an brief literature review on the economic impact of the cultural sector. In the three section, our methodology is discussed: we describe our database, and we detail our empirical application of the input–output strategy. The forth section provides our results. At the end of the article, our final considerations are listed.

2 Brief Literature Review on the Economic Impact of the Cultural Sector

Analyses that seek to deepen the understanding of the economic impact, in terms of employment and production levels, of the cultural sector on local and regional economies have increased in the literature due to the seminal contribution of Cwi and Lyndall (1977). In this context, the input–output methodology developed by Wassily Leontief has been widely used in empirical studies because it enables the generation of information on intersectoral and interregional multipliers of income and employment for different economic sectors (Miller & Blair, 2009; Rose & Miernyk, 1989).

Input–output modeling has been applied, among others, by the Alliance for the Arts (1997) for several arts institutions in New York, by Brand et al. (2000) for the sector of museums and art galleries in the United Kingdom, by Dunlop et al. (2004) for the entire cultural sector in Scotland, by Herrero et al. (2006) for European cultural capitals, by Plaza (2006) for the Guggenheim Museum in Bilbao, and by Vu and Ngo (2019) for the cultural industry in Vietnam.

Greffe (2004), for example, has conducted an investigation in France using input–output methodology and demonstrated how the appreciation of cultural heritage (conservation, maintenance and renovation) can generate direct and indirect jobs and increase tourism-related jobs. cultural. With the same methodological perspective, Tohmo (2005) examines the economic impact of the Kaustien Folk Music Festival held in Finland. The author seeks to understand the festival's impacts on production, demand, wages, jobs and national and regional taxes. Thus, such methodology provides important information that can guide national and regional public policies to support the cultural sector.

Furthermore, Llop and Arauzo-Carod (2012) investigate a particular facility within the cultural industry, specifically, the Gaudí Center[5], a museum in Reus, Spain. The objective of the study is to quantify the economic impact of the creation of a cultural facility and the existing interindustrial effects of such activity on production revenues and jobs. Using an input–output model, the authors differentiate the service sectors that are directly linked to this cultural facility from those that are not. Llop and Arauzo-Carod (2012) therefore identify the considerable economic impacts of the museum on its regional economy and the generation of income and employment, which extend to sectors that have no direct connection with cultural facilities but benefit from such activity via positive externalities.

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[5] The museum officially opened in May 2007.

In the Brazilian literature, several authors have investigated the interindustrial impacts of the cultural sector (Machado et al., 2020; Silva & Brito, 2019; Souza et al., 2019). Silva and Brito (2019), for instance, analyze the effects of a hypothetical reduction in the consumption of goods and services of the cultural sector on production, income and employment in the sector itself and in those sectors connected to it. The study shows that a 10% reduction in consumption in the cultural sector generates a drop of R$ 2.7 billion in this sector, a direct effect, and a reduction in R$ 1.5 billion for the entire economy, an indirect effect. Hence, the multiplier effect of this economic activity and its spillovers to other sectors are clearly visible.

Souza et al. (2019), using data from the 2008-2009 POF and the PNAD from the same years, apply the Brazilian Recursive Dynamic General Equilibrium (BRIDGE) model to investigate the effect of the Culture-Voucher policy, implemented through the Worker's Culture Program (PCT), on the nine main metropolitan regions of Brazil. The authors note that the Culture-Voucher policy increased access to culture among the lower-income population. In this case, the policy generated positive externalities, both for consumers and producers, through the creation of employment, income and an overflow of creativity and culture into society.

Finally, Machado et al. (2020) simulate a 100% reduction in the activities of the cultural sector for a period of three months to capture the effect of the COVID-19 pandemic on this sector. The authors, using the input–output model, show a 21.2% decrease in the gross value of the annual production of the sector itself and a 0.17% reduction in the economy. This shows the representative effect that the cultural sector has on employment generation and income in Brazil.

As these studies have shown, input–output methodology allows us to measure the intersectoral effects and the effects of the spillovers of production, employment and income, which occur over a given time and in an economic sector. Moreover, to advance the extant research, it is necessary to identify the impacts of changes in the consumption of goods and services in the cultural sector and the interconnected sectors by identifying different family income groups. Such research will contribute to a better understanding of the participation of different income classes in cultural consumption, making it possible to determine the multiplier effects of employment and income that are associated with the consumption of each of these groups.

3 Data and Methodology

3.1 Data

Brazil is the fifth largest country on the planet, occupying almost half of the South American continent. Its territory is divided into 5,570 municipalities, with an estimated population of more than 213 million inhabitants in 2022. With 84.72 percent of the population residing in urban areas and an average monthly per capita household income of R$1,511.00, the country is marked by strong regional inequalities. In this context, 73 percent of industrial activity is concentrated in the South and Southeast regions, while the North, Northeast and Midwest regions of the country account for only 27 percent of industrial activity, as of 2015 (IPEA, 2020). In terms of poverty, 7.4 percent of the Brazilian population lived on less than R$140.00 per month in 2017 (IBGE, 2018a).

The System of National Accounts (SCN) is based on the manual of National Accounts published by the United Nations (UN) in 1947, called "A system of national accounts and supporting tables" (SNA). This manual is widely used by different nations. SNA-53 was the first widely adopted manual for the development of an SCN. SNA-2008 is the most current manual and

is used as the basis for the Brazilian SCN. The Brazilian SCN comprises the framework of the Integrated Economic Accounts (CEI) and the Tables of Resources and Uses (TRU). Information from the input-output matrix, which is drawn from the TRU, is used in the present study. These tables present the results of the macroeconomic aggregates by sectors of economic activity, representing the flow of goods and services between the sectors and the final demand. The data detail the Brazilian productive structure, allowing us to understand the degree of sectoral interconnection in the economy and the impact of the variation in demand on the production of goods and services (IBGE, 2018b).

The IBGE provides a matrix with 67 activities in which includes the sector of "artistic, creative and entertainment activities"[6]. Via sector analysis, it is possible to show the flows of goods and services that are produced by each sector, what goods and services are used as productive inputs by these sectors, and which of these comprise the final demand. The SNC follows the international recommendations of the *System of National Accounts-2008,* making the information available according to the National Classification of Economic Activities 2.0 (CNAE 2.0) of the IBGE.

Chart 1 shows the detailed structure of the sector of artistic, creative and entertainment activities with the CNAE 2.0 codes. Version 2.0 of the CNAE is composed of 21 sections, 87 divisions, 285 groups, 673 classes and 1,301 subclasses (Instituto Brasileiro de Geografia e Estatística, 2021a). The CNAE groups the production units based on the similarity of their production process; this grouping can also occur due to the nature or use of their products.

Chart 1. Detailed structure of the artistic, creative and entertainment activities sector, according to CNAE 2.0

Group	Class	Subclass	Denomination
			ARTISTIC, CREATIVE AND ENTERTAINMENT ACTIVITIES
90.0			Artistic, creative and entertainment activities
	90.01-9		Performing arts, shows and complementary activities
		9001-9/01	Theatrical production
		9001-9/02	Music production
		9001-9/03	Production of dance shows
		9001-9/04	Production of circus shows, e.g., a puppet show
		9001-9/05	Production of rodeo shows, e.g., *vaquejadas*
		9001-9/06	Sound and lighting activities
		9001-9/99	Performing arts, performances and complementary activities not previously specified
	90.02-7		Artistic creation
		9002-7/01	Activities of artists, independent journalists and writers
		9001-7/02	Restoration of works of art
	90.03-5	9003-5/00	Management of spaces for performing arts, shows and other artistic activities
			ACTIVITIES LINKED TO CULTURAL AND ENVIRONMENTAL HERITAGE
91.0			Activities linked to cultural and environmental heritage
	91.01-5	9101-5/00	Activities of libraries and archives
	91.02-3		Activities of museums and exploration, artistic restoration and conservation of historical places and buildings and similar attractions
		9102-3/01	Activities of museums and exploration of places and historic buildings and similar attractions
		9102-3/02	Restoration and conservation of historic sites and buildings

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[6] This sector is treated in this work as only a cultural sector.

	91.03-1	9103-1/00	Activities of botanical gardens, zoos, national parks, ecological reserves and environmental protection areas
			EXPLORATION ACTIVITIES OF GAMBLING AND BETTING
92.0			Gambling and betting activities
	92.00-3		Activities of gambling and betting
		9200-1/01	Bingo halls
		9200-0/02	Exploration of horse racing bets
		9200-3/99	Exploitation of gambling and betting not otherwise specified
			SPORTS AND RECREATION AND LEISURE ACTIVITIES
93.1			Sports activities
	93.11-5	9311-5/00	Management of sports facilities
	93.12-3	9312-3/00	Social, sports and similar clubs
	93.13-1	9313-1/00	Physical activities
	9319-1		Sports activities not otherwise specified
		9319-1/01	Production and promotion of sporting events
		9319-1/99	Other sports activities not otherwise specified
93.2			Activity of recreation and leisure
	93.21-2	9321-2/00	Amusement parks and theme parks
	93.29-8		Recreation and leisure activities not otherwise specified
		9329-8/01	Discotheques, nightclubs, dance halls and the like
		9329-8/02	Bowling exploitation
		9329-8/03	Operating pool games, billiards and similar
		9329-8/04	Exploration of recreational electronic games
		9329-8/99	Other recreation and leisure activities not otherwise specified

Source: Silva and Brito (2019), based on CNAE 2.0.

To analyze how changes in final demand affect the cultural sector and the other sectors of the economy by identifying the different Brazilian income classes, an opening of the vector of consumption and family income is performed to divide them into ten groups according to family incomes. The input–output matrix data are compatible with the consumption and income data of the 2017-2018 POF provided by the IBGE. The POF evaluates the structure of consumption, spending and income and part of households' equity variation, characterizing the living conditions of families via an analysis of their household budgets.

As mentioned above, the disaggregation by income groups allows us to analyze, in detail, aspects regarding the concentration and distribution of income and the diversification of consumption among the ten groups of representative families. We distinguish income groups according to monthly income range, based on the minimum wage in force in January 2018, which was R$ 954.00 (Table 1).

The classification of the ten family income groups follows the same pattern as that developed by Ferreira Filho and Horridge (2006) and Cardoso (2016). Table 1 shows the detailed structure of the ten family income groups in Brazil. The family income intervals are closed at their final value. Each household in the sample is associated with a sample weight to function as a representative household. Therefore, in this study, the analyses using the POF (2017-2018) involve the expansion factor.

Table 1. Detailed structure of the ten family income groups

Families	Minimum wages	Family income interval R$	No. of individuals	No. of families	Average income	Standard deviation
HH_1	0 to 2	R$ 0 to R$ 1,908	45,532,541	16,672,427	R$ 1,250.97	R$ 437.56
HH_2	2 to 3	R$ 1,908 to R$ 2,862	37,031,074	13,055,997	R$ 2,394.04	R$ 270.06
HH_3	3 to 5	R$ 2,862 to R$ 4770	50,672,412	16,166,140	R$ 3,718.67	R$ 541.22
HH_4	5 to 6	R$ 4,770 to R$ 5,724	16,059,756	4,886,869	R$ 5,224.12	R$ 276.59
HH_5	6 to 8	R$ 5,724 to R$ 7,632	20,360,763	6,159,906	R$ 6,546.05	R$ 541.84
HH_6	8 to 10	R$ 7,632 to R$ 9,540	10,742,287	3,334,587	R$ 8,506.38	R$ 541.21
HH_7	10 to 15	R$ 9,540 to R$ 14,310	13,423,175	4,251,663	R$ 11,464.83	R$ 1,324.76
HH_8	15 to 20	R$ 14,310 to R$ 19,080	5,469,243	1,781,584	R$ 16,438.03	R$ 1,328.13
HH_9	20 to 30	R$ 19,080 to R$ 28,620	4,267,810	1,399,354	R$ 23,242.80	R$ 2,649.33
HH_{10}	Above 30	Greater than R$ 28,620	3,544,728	1,153,769	R$ 49,225.87	R$ 33,936.22

Source: Prepared by the authors, based on POF data (2017-2018), following income groups defined by Ferreira Filho and Horridge (2006) and Cardoso (2016).
Note: The mean income and standard deviation values refer to the number of individuals in the sample.

3.2 Input–Output Approach

By revealing the consumption and income vectors for ten different family income groups, it becomes possible to identify how much each type of family is consuming from a sector in the input–output matrix, specifically, the cultural sector. Such analysis can identify the impacts of a demand shock on the production, employment and income of the cultural sector and the economy as a whole. Furthermore, it is possible to analyze how the consumption of different family income groups impacts the production of the cultural sector and the economy as a whole[7].

The mathematical structure of an input–output model can be represented in a matrix form, as it consists of a set of *n* linear equations with *n* unknowns. The model is constructed from data referring to an economic area, e.g., state, region or country. These economic areas can be divided into sectors, and the relevant information is the product flow that occurs from each of the purchasing sectors to each of the selling sectors. These interindustrial or intersectoral flows are measured for a certain period of time and in monetary terms (Miller & Blair, 2009).

The monetary values of transactions that occur between pairs of sectors (of each sector i for each sector j) are represented by z_{ij}. The demand of sector j by inputs from other sectors in a given period is directly related to the amount of goods produced by sector j in the same period. In addition to these intersectoral sales where goods and services are used as production inputs, there are sales to final consumers, such as households, governments and foreign entities. These final consumers are usually defined as final demand.

When an economy is represented by n sectors, x_i characterizes the total production of sector i, and f_i the total final demand for the sector's product i. Sector i performs the sale of its production to the sector itself, to other sectors and to the final demand; thus:

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[7] This subsection is based on Miller and Blair (2009).

$$x_i = z_{i1} + \cdots + z_{ij} + \cdots + z_{in} + f_i = \sum_{j=1}^{n} z_{ij} + f_i \qquad (2.1)$$

Therefore, a system of equations indicates the production distribution of each sector i for each sector j:

$$x_1 = z_{11} + \cdots + z_{1j} + \cdots + z_{1n} + f_1$$
$$\vdots$$
$$x_i = z_{i1} + \cdots + z_{ij} + \cdots + z_{in} + f_i \qquad (2.2)$$
$$\vdots$$
$$x_n = z_{n1} + \cdots + z_{nj} + \cdots + z_{nn} + f_n$$

In the matrix form, the distribution of the sector's production i for the other sectors can be represented by:

$$\mathbf{x} = \mathbf{Z} + \mathbf{f} \qquad (2.3)$$

In the input–output analysis, the intersectoral flows of i for j depend on how much is being produced in a given period in sector j. In other words, sector j demands inputs from sector i according to the size of the sector's production j in a given year. If sector j increases its production, it also increases the demand for intermediate goods of the producing sector i. This buy–sell relationship between sectors is kept constant. That is, there are fixed relationships between the production of a sector and its inputs. The model thus works with constant returns to scale, without considering the existence of economies of scale (Miller & Blair, 2009). If sector j increases its production, it will demand a quantity of inputs from sector i that is proportional to the increase in production. This relationship is called the technical coefficient and is given by:

$$a_{ij} = \frac{z_{ij}}{x_j} \qquad (2.4)$$

Using the expression of the technical coefficient obtained in (2.4), reorganized as a function of z_{ij} and being replaced in (2.2), $j = i$ for sales made to the sector itself; hence:

$$x_1 = a_{11}x_1 + \cdots + a_{1i}x_i + \cdots + a_{1n}x_n + f_1$$
$$\vdots$$
$$x_i = a_{i1}x_1 + \cdots + a_{ii}x_i + \cdots + a_{in}x_n + f_i \qquad (2.5)$$
$$\vdots$$
$$x_n = a_{n1}x_1 + \cdots + a_{ni}x_i + \cdots + a_{nn}x_n + f_n$$

These equations explicitly show the dependence of intersectoral flows on the total production of each sector, i.e., how much should be produced in each sector i if there is a change in final demand. Therefore, isolating the final demand and grouping x_1, x_2 up to x_n, we have:

$$(1 - a_{11})x_1 - \cdots - a_{1i}x_i - \cdots - a_{1n}x_n = f_1$$
$$\vdots$$
$$- a_{i1}x_1 - \cdots + (1 - a_{ii})x_i - \cdots - a_{in}x_n = f_i \qquad (2.6)$$
$$\vdots$$
$$- a_{n1}x_1 - \cdots - a_{ni}x_i - \cdots + (1 - a_{nn})x_n = f_n$$

Thus, system (2.6) will be represented by:

$$(\mathbf{I} - \mathbf{A})\mathbf{x} = \mathbf{f} \qquad (2.7)$$

Therefore,

$$\mathbf{x} = (\mathbf{I} - \mathbf{A})^{-1}\mathbf{f} \qquad (2.8)$$

Considering $\mathbf{B} = (\mathbf{I} - \mathbf{A})^{-1}$, we obtain:

$$\mathbf{x} = \mathbf{B}\mathbf{f} \qquad (2.9)$$

In equation (2.9), **B** is a Leontief inverse matrix. This equation expresses how the total production represented by **x** depends on final demand **f** for each of the sectors.

3.2.1 Production Multiplier

Via the Leontief model presented in equation (2.9), it is possible to investigate the sectoral impact of changes in the final demand of a specific sector on the production of each sector and on the total product. This variation in final demand can be represented as follows:

$$\Delta \mathbf{x} = (\mathbf{I} - \mathbf{A})^{-1} \Delta \mathbf{f} \tag{2.10}$$

where $\Delta \mathbf{x}$ is a vector $(n \times 1)$ that captures the change by sector and the effect on the economy as a whole, and $\Delta \mathbf{f}$ is a vector $(n \times 1)$ that represents the impacts on the production volume. As Leontief's inverse is given by $(\mathbf{I} - \mathbf{A})^{-1} = \mathbf{B}$, it is possible to obtain the production multiplier as follows:

$$MP_j = \sum_{i=1}^{n} b_{ij} \tag{2.11}$$

where MP_j represents the production multiplier of the $j - ésimo$ sector, and b_{ij} represents the $ij - ésimo$ element of the Leontief inverse matrix. The production multiplier captures the direct effect on the production sector that suffers the shock of demand variation (family consumption)—in this case, the cultural sector—and the indirect effect on the other sectors that offer productive inputs to the sector that suffered the direct impact.

3.2.2 Employment Multiplier

The input–output model enables, in addition to the abovementioned investigation of the change in final demand on production, analysis of how this same change in demand generates effects on the level of employment (occupation). The expression that captures the variation in the level of employment is given by:

$$\Delta \mathbf{E} = \widehat{ce} \Delta \mathbf{x} \tag{2.12}$$

where $\Delta \mathbf{E}$ is a vector $(n \times 1)$ that represents the impact of a change in final demand on employment variation; $\widehat{ce}$ is a diagonal matrix $(n \times n)$ where the elements of its main diagonal are formed by the employment coefficients; and $\Delta \mathbf{x}$ captures the effects on the production of the sectors, given a change in the final demand. The values of the employment coefficients ce_{ij}, when $i = j$, are obtained by the ratio, for each sector, of the total number of jobs (e) used in j by the total production for each sector:

$$ce_j = \frac{e_j}{x_j} \tag{2.13}$$

Thus, if the objective is to obtain the impact of the variation in family consumption on employment from all the elements of $\Delta \mathbf{E}$, the employment generator resulting from variations in final demand on employment for each sector of the economy can be represented as follows:

$$GE_j = \sum_{i=1}^{n} ce_j \, b_{ij} \tag{2.14}$$

where GE_j represents the number of jobs generated for each sector due to the variation of one unit in monetary value in the final demand; b_{ij} represents the $ij - th$ element of the Leontief inverse matrix; and ce_j represents the direct coefficient of the employment variable.

The employment multiplier, in turn, is obtained by the ratio between the employment generator for each sector and its respective employment coefficient:

$$ME_j = \frac{GE_j}{ce_j} \tag{2.15}$$

The employment multiplier indicates the number of jobs created, directly and indirectly, throughout the economy for each new job created in sector j in the analysis, that is, the cultural sector.

3.2.3 Income Multiplier

Similar to the employment multiplier discussed in the previous section, it is possible to obtain the income multiplier. For the construction of these multipliers, it is necessary to obtain the income coefficients, cr_j, through the ratio of total household income (r) in sector j and the total value of production in sector j, that is:

$$cr_j = \frac{r_j}{x_j} \tag{2.16}$$

Thus, the income generator, GR_j, can be obtained as follows:

$$GR_j = \sum_{i=1}^{n} cr_j b_{ij} \tag{2.17}$$

Through this generator, it is possible to identify the additional income generated for each sector through the remuneration of its workers due to the variation of one unit in monetary value in the final demand. To obtain the income multiplier, MR_j, the quotient between the income generator and the income coefficient is computed:

$$MR_j = \frac{GR_j}{cr_j} \tag{2.18}$$

The income multiplier represents the variation in income that occurs in the economy as a whole for each unit of income directly generated in sector j, i.e., the cultural sector, given that there was a variation in the final demand component.

3.2.4 Hypothetical Extraction Method

The hypothetical extraction procedure investigates how much the total production of a given sector, n, is affected when a specific sector, e.g., j, is removed from this economy (Miller & Blair, 2009). In the present study, the hypothetical extraction method is performed to analyze the economic consequences of exclusion from the cultural sector. Thus, it is possible to measure forward and backward chaining effects on the economy as a whole. The identification of such effects is important to verify the dependencies that occur during purchase and sale in other sectors in the economy with the hypothetical extraction of the cultural sector.

To calculate the dependence of the sectors from the perspective of purchasing, that is, the effects of the backward link of the cultural sector with the other sectors, the effects of reduction in total production are initially evaluated when column j, the cultural sector, is extracted from the input–output matrix. Using $\overline{\mathbf{A}}_{(cj)}$ to represent the new matrix of technical coefficients where only the column referring to sector j—the cultural sector—is equal to zero, the production of the reduced economy will be given by:

$$\bar{\mathbf{x}}_{(cj)} = (\mathbf{I} - \bar{\mathbf{A}}_{(cj)})^{-1}\mathbf{f} \tag{2.19}$$

The difference between the complete model, equation (2.9), and the reduced model, equation (2.19), reveals the decrease in the gross production value (GPV). Formally, the decrease in the GPV when the cultural sector is excluded from the analysis is:

$$T_j = \mathbf{i}'\mathbf{x} - \mathbf{i}'\bar{\mathbf{x}}_{(cj)} \tag{2.20}$$

The $\mathbf{i}$ represents a column vector of 1s of dimension n. Equation (2.20) shows the importance or total linkage of sector j for the economy as a whole.

In the forward link, the hypothetical extraction occurs in j, that is, the analysis is now performed from the perspective of eliminating intermediate sales from the cultural sector in the technical coefficient matrix; hence, the matrix is denominated as $\bar{\mathbf{B}}_{rj}$. The new equation that summarizes the production of the economy, after extracting the sales of the cultural sector, is given by:

$$\bar{\mathbf{x}}'_{(rj)} = \mathbf{v}'(\mathbf{I} - \bar{\mathbf{B}}_{(rj)})^{-1} \tag{2.21}$$

The $\mathbf{v}$ is the column vector of value-added spending in each sector. In this case, the impact of extraction on the gross value of production is:

$$T_j = \mathbf{x}'\mathbf{i} - [\bar{\mathbf{x}}'_{(rj)}]\mathbf{i} \tag{2.22}$$

Thus, the above expression shows a reduction in the output of the economy, given the hypothetical exclusion of the sales of intermediate inputs from the cultural sector.

4 Results

Analysis of the cultural sector via the input–output model allows quantifying the effects of changes in production on the sector itself and on other sectors of the economy. In this context, the multiplier effects of a 30.8% reduction in the final demand of the cultural sector on the Brazilian economy's production, employment and income are initially observed. According to the Covid-19 Economic Impacts on the Creative Economy report of the Getulio Vargas Foundation, the drop in output in the cultural sector during 2020 due to the effects of the pandemic was 31.8% (Barbosa, 2020). Using input–output ratios, it is possible to estimate that this drop in production of 31.8% is equivalent to a reduction of 30.8% in the demand of the cultural sector. Based on this information, the multiplier effects of this demand shock are evaluated in the cultural sector and the other sectors. Notably, the results we have presented do not refer to the effects of the pandemic but rather are a projection of the possible effects on the economy of an isolated shock in the cultural sector.

Table 2 lists the main sectors that suffered from the demand shock in the cultural sector, showing the existing intersectoral relationships. According to the results we have obtained, a shock of 30.8% in the final demand of the cultural sector generates a reduction of more than R$ 8.3 billion in the production of the sector itself and of more than R$ 12.9 billion in the economy as a whole, capturing the indirect effects of the shock.

The reduction in demand for the cultural sector causes effects on all sectors, and the more interconnected the sectors are, the greater the loss. A drop in the final demand of the cultural sector has an effect, for example, on recordings, space rentals, and financial intermediations, among other activities. Approximately 6% of the reduction in the economy resulting from the shock occurs in the real estate sector. This can be explained by the fact that this sector is closely related to the cultural activities sector. For example, cultural companies rent physical spaces to establish themselves in their market, while studios are often rented for rehearsals and recordings and other spaces are rented for parties (large events, weddings, birthdays, Christmas celebrations, etc.). This

close relationship between culture and facilities therefore explains why the real estate sector is the second-most affected by the shock effect on the cultural sector.

Table 2. Impact on sector production of a 30.8% reduction in demand from the cultural sector, 2015

Sector	Reduction in production (R$ million)	Percentage reduction
Artistic, creative and entertainment activities	-8.348	64.37%
Real estate activities	-736	5.67%
Other professional, scientific and technical activities	-400	3.08%
Financial intermediation, insurance and private pension	-355	2.74%
Electricity, natural gas and other utilities	-326	2.51%
Legal, accounting, consulting and corporate headquarters activities	-310	2.39%
Other administrative activities and complementary services	-295	2.28%
Wholesaling and retail trade	-292	2.25%
Activities of television, radio, cinema and sound/image recording/editing	-178	1.37%
Land transport	-151	1.16%
Oil refining and coking plants	-131	1.01%
Maintenance, repair and installation of machinery and equipment	-123	0.95%
Telecommunications	-93	0.71%

Source: Prepared by the authors based on the input–output matrix of Brazil (2015).
Note: The cited sectors represent the 13 most affected with a 30.8% reduction in demand from the cultural sector. Reduction in production is in billions.

Curiously, only approximately 1.4% of the reduction in the economy resulting from the shock in the cultural sector occurs in the sector of television, radio, cinema and sound/image recording/editing. This can be explained by the fact that this sector consumes more intermediate goods from the cultural sector than it provides to it. Thus, a demand shock in the cultural sector has a smaller effect on this sector than other sectors, such as real estate activities, which provide more productive inputs to the cultural sector. These results are in line with the findings of Llop and Arouzo-Carod (2011), who suggest that the multiplier effects of the cultural sector are asymmetrical compared to the other sectors, with substantial differences in the effects felt in each sector.

Table 3 provides information on the main sectors affected by the reduction in employment of the hypothetical shock of 30.8% in the final demand of the cultural sector. There is a reduction of 237,701 jobs in the cultural sector and a decrease of 31,635 jobs in the other sectors of the economy, totaling 269,336 jobs lost. Table 3 shows that after the cultural sector, the sectors that lose the most jobs are the other administrative activities and complementary services sector and the wholesale and retail trade sector. The former encompasses activities related to building condominiums, services related to tour packages, and administrative issues of events in general, etc. In the case of a shock, this sector experiences one of the largest losses in terms of employment because it is one of the largest service providers for the cultural sector. This result is confirmed by the findings of Silva and Brito (2019).

Such loss in terms of employed labor for the cultural sector and, consequently, for the other interconnected sectors represents a clear reduction in the level of well-being of Brazilian society. The employment multiplier for the cultural sector is 1.16 in Brazil and represents how many job openings are created, directly and indirectly, in the Brazilian economy for each new job in the cultural sector. That is, for each new job in the cultural sector, 1.16 jobs are created in the economy.

Alternatively, for every 100 jobs created directly in the cultural sector, another 16 job openings are created indirectly in other sectors of the economy.

Table 3. Impact on sector employment of a 30.8% reduction in demand from the cultural sector, 2015

Sector	Reduction in employment	Percentage reduction
Artistic, creative and entertainment activities	-237,701	88.25%
Other administrative activities and complementary services	-5,855	2.17%
Wholesaling and retail trade	-5,014	1.86%
Legal, accounting, consulting and corporate headquarters activities	-2,820	1.05%
Other professional, scientific and technical activities	-2,129	0.79%
Land transport	-1,710	0.64%
Surveillance, security and investigation activities	-1,154	0.43%
Manufacture of clothing artifacts and accessories	-1,056	0.39%
Maintenance, repair and installation of machinery and equipment	-1,002	0.37%
Printing and reproduction of recordings	-835	0.31%
Construction	-770	0.29%
Financial intermediation, insurance and private pension	-741	0.28%
Activities of television, radio, cinema and sound/image recording/editing	-716	0.27%

Source: Prepared by the authors based on the input–output matrix of Brazil (2015).
Note: The cited sectors represent the 13 most affected with a 30.8% reduction in demand from the cultural sector.

The shock in the final demand also has an effect on the income received by workers in both the cultural sector (direct effect) and other sectors (indirect effect). The results presented in Table 4 show that a shock of 30.8% in the demand of the cultural sector causes a reduction of more than R$ 2.6 billion in the sector's income and a decrease of more than R$ 3.5 billion in the income of the economy as a whole. Thus, multiplier effects have importance in the economy. These results also align with the findings, for other locations, of Cwi and Lyndall (1977) and Herrero et al. (2002) on the perceptible effects on employment, income, and turnover arising from cultural activity in the economy.

Table 4. Impact on sector income of a 30.8% reduction in demand from the cultural sector, 2015

Sector	Reduced yield (R$ million)	Percentage reduction
Artistic, creative and entertainment activities	-2.646	74.02%
Other administrative activities and complementary services	-141	3.96%
Wholesaling and retail trade	-92	2.46%
Financial intermediation, insurance and private pension	-88	2.48%
Legal, accounting, consulting and corporate headquarters activities	-86	2.42%
Other professional, scientific and technical activities	-47	1.33%
Public administration, defense and social security	-39	1.08%
Surveillance, security and investigation activities	-38	1.06%
Ground Transportation	-35	0.99%
Development of systems and other information services	-30	0.83%
Printing and reproduction of recordings	-24	0.67%
Maintenance, repair and installation of machinery and equipment	-23	0.65%
Electricity, natural gas and other utilities	-20	0.56%

Source: Prepared by the authors based on the input–output matrix of Brazil (2015).
Note: The cited sectors represent the 13 most affected with a 30.8% reduction in demand from the cultural sector.

The income multiplier for the cultural sector is 1.38; that is, for each reduction of a single real in the income of the cultural sector, there is a reduction of R$ 1.38 in the income of the Brazilian economy. Thus, a decrease in household income causes a reduction in the consumption of both the cultural sector and the other sectors due to the multiplier effect. This finding highlights the importance of this sector for the Brazilian economy, corroborating existing results in the literature (Machado et al., 2020; Silva & Brito, 2019; Souza et al., 2019). Moreover, these findings justify the importance of public policies aimed at providing greater support for cultural activities in Brazil.

4.1 Results of the Hypothetical Extraction of the Cultural Sector

The productive structure of an economy involves complex sectoral links that encompass the entire economy. In this context, a hypothetical sectoral extraction allows quantifying how much of the total production of a given economy tends to decrease if a specific sector is extracted. Here, our results are presented in terms of percentage losses of GDP (Tables 5 and 6).

Table 5. Effect of the hypothetical extraction of the cultural sector on the economy, backward links, 2015 (in percentages)

Sector	Percentage reduction
Artistic, creative and entertainment activities	2.45%
Other professional, scientific and technical activities	1.76%
Printing and reproduction of recordings	1.74%
Activities of television, radio, cinema and sound/image recording/editing	1.70%
Maintenance, repair and installation of machinery and equipment	0.82%
Nonreal estate leases and management of intellectual property assets	0.80%
Legal, accounting, consulting and corporate headquarters activities	0.68%
Other administrative activities and complementary services	0.59%
Real estate activities	0.56%
Surveillance, security and investigation activities	0.55%
Electricity, natural gas and other utilities	0.52%
Accommodations	0.40%
Manufacture of cleaning products, cosmetics/perfumes and personal hygiene	0.39%

Source: Prepared by the authors based on data from the input–output matrix of Brazil (2015).
Note: The sectors cited represent the 13 that have the largest backward links with the cultural sector.

The back links show how the cultural sector consumes the goods and services of other sectors to produce cultural goods and services. Table 5 shows the results of the backward link, demonstrating how the sectors show a more pronounced drop in their production if the cultural sector is excluded from the economy as an intermediate consumer.

According to the results obtained through hypothetical extraction described in Table 5, the sectors most affected by the hypothetical exclusion of purchases by the cultural sector are, in addition to the sector itself, other professional, scientific and technical activities; printing and reproduction of recordings; and television, radio, cinema and sound/image recording/editing activities. Such sectors stand out due to their backward links, representing almost 2% of the decrease in total production when the cultural sector is extracted as an intermediate consumer. This occurs because these sectors offer productive inputs to the cultural sector and thus have the greatest percentage loss in their production.

Regarding the effects on the economy as a whole, a hypothetical extraction of the cultural sector generates a reduction of 18.44% in the total production of the economy. This result underscores the relevance of the cultural sector for the Brazilian economy. These effects extend beyond the economic issues shown in this research; there are intangible benefits of cultural activity for a society. For example, Baumol (1986), Loon et al. (2014), Backman e Nilson (2018) e Falck et al. (2018) suggests that the agglomerations of individuals with higher levels of human and cultural capital generate knowledge overflow effects. In turn, these spillovers generate economic development.

The forward links show the effects on the economy of the extraction of the intermediate sales of inputs produced in the cultural sector. Table 6 shows the results of these forward links. The first sector highlighted, in terms of forward linkage, is television, radio, cinema and sound/image recording/editing activities, with a drop in production of approximately 8%. Other sectors that also stand out are the cultural sector itself and the other professional, scientific and technical activities sector. Clearly such sectors display high intermediary dependence on the cultural sector to produce their goods and services. In other words, these sectors depend on the inputs provided by the cultural sector to produce entertainment, music, films, and advertising, among other related services. Indeed, the advertising activities in all sectors make intense use of the goods and services produced by the cultural sector.

Table 6. Effect of the hypothetical extraction of the cultural sector on the economy, forward links, 2015 (in percentages)

Sector	Percentage reduction
Activities of television, radio, cinema and sound/image recording/editing	7.70%
Artistic, creative and entertainment activities	2.46%
Other professional, scientific and technical activities	2.37%
Membership organizations and other personal services	0.85%
Telecommunications	0.41%
Manufacture of beverages	0.30%
Editing and editing integrated with printing	0.28%
Private education	0.23%
Accommodations	0.20%
Manufacture of pharmaceutical and pharmaceutical products	0.19%
Manufacture of cleaning products, cosmetics/perfumery and personal hygiene	0.15%
Public health	0.15%
Manufacture of footwear and leather goods	0.13%

Source: Prepared by the authors based on data from the input–output matrix of Brazil (2015).
Note: The sectors cited represent the 13 that have the largest forward links with the cultural sector.

The other sectors experience a drop in total production below 1% if the cultural sector is extracted from the economy, showing that much of what is produced in the cultural sector is destined for final demand, specifically, for household consumption and export. Notably, the exports from the cultural sector involve the sales of goods and services – e.g., works of art, artisanal productions, ceramic pieces, sculptures, organization services, artistic activities support, etc. – to foreign markets. According to the Secretaria de Economia da Cultura (2017), the export of goods and services with cultural content generates benefits for the national economy through both the cultural sector's increased customer diversification, productivity and innovation capacity and the generation of business opportunities with other sectors.

4.2 Results by Income Group

To obtain the results of the consumption multiplier effect per family income group, it is necessary to disaggregate the families into ten distinct groups (Table 7). The second and third columns of Table 7 detail the disaggregated household consumption and income structure of the cultural sector. Here, consumption refers to the amount spent by families in each type of income group in the cultural sector. Conversely, income expresses how this sector remunerates the different income groups. Based on this information, one can conclude that the groups with the highest income in the cultural activities sector also have the highest consumption of cultural goods and services, an event that is possibly associated with the spillover effects of human and cultural capital. Such effects are also verified by Ateca-Amestoy (2009) and Almeida et al. (2019).

Table 7. Direct and indirect effects of the multiplier of the drop in family consumption, by income group, in terms of production, in the Brazilian economy, 2015

Family groups	Consumption in the cultural sector (R$ million)	Income in the cultural sector (R$ million)	Reduction in production of the cultural sector (R$ million)	Reduction in production (R$ million)	Percentage of consumption per family group in the cultural sector	Percentage participation of families
HH1	1.520	631	-1.558	-2.421	6.15%	28.86%
HH2	1.729	771	-1.772	-2.753	6.99%	20.63%
HH3	3.681	2.233	-3.774	-5.863	14.9%	23.65%
HH4	1.638	744	-1.679	-2.609	6.63%	6.42%
HH5	2.974	1.279	-3.049	-4.736	12.03%	7.91%
HH6	2.093	1.029	-2.145	-3.333	8.47%	4.13%
HH7	3.528	1.266	-3.617	-5.620	14.28%	4.98%
HH8	2.105	1.364	-2.158	-3.353	8.52%	1.92%
HH9	2.276	616	-2.333	-3.625	9.21%	1.50%
HH10	3.171	1.041	-3.250	-5.050	12.83%	1.11%

Source: Prepared by the authors based on IBGE (2015) and POF (2017-2018) data.

The fourth column of Table 7 shows the effects on the production of the cultural sector and on total production when the consumption of cultural goods and services of each family income group is reduced to zero. This analysis is performed to determine the participation of each family income group in the consumption of the cultural sector. It therefore demonstrates that such a reduction causes a drop in the production of both the cultural sector and the economy as a whole.

Regarding the families in the first income group, HH1, there is a reduction of more than R$ 1.5 million in the production of the cultural sector as a direct effect and of more than R$ 2.4 billion in the national economy. Despite being the largest group of families, it has the lowest participation in the consumption of cultural goods and services[8]: 28.86% of families are in the HH1 income group, but HH1 has only a 6.15% share of consumption in the cultural sector of only.

According to the literature, income is one of the main restrictions on access to cultural consumption in Brazil (Almeida et al., 2019; Diniz & Machado, 2011; Machado et al., 2017; Paglioto & Machado, 2012). Accordingly, and given the economic importance of the cultural sector for the Brazilian economy as well as the overflowing effects of human capital caused by the consumption of such goods and services, the participation of families in cultural access and consumption generates effects of increased welfare for society as a whole. This observed

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[8] See Table 1 to verify the detailed structure of the ten family income groups.

inequality in access thus highlights the need for public policies that promote the inclusion of lower-income groups in the consumption of cultural goods and services.

Moreover, the results of Table 7 regarding the composition of cultural consumption show that the largest consumption percentages are among groups HH3, HH5, HH7 and HH10. These proportions are likely influenced by both the incomes and number of families in each group. The HH3 income group represents 23.65% of total households, with a consumption in the cultural sector of 14.9%. This income group stands out for having the highest participation in cultural consumption. This is certainly due to the two factors mentioned above; first, because HH3 has the second largest number of families, and second, because it has higher income levels than HH1 (the group with the greatest number of families).

The HH10 income group has a lower participation of families, with only 1.11% of family units in this category, but its spending on cultural consumption corresponds to 12.83% of total spending on the sector. These families have very high income levels by Brazilian standards that are higher than those of other income groups, which allows greater access to consumption in general. Moreover, a vast body of literature documents the strong correlation between income and education and the consumption of cultural goods and services (Ateca-Amestoy, 2009; Mantecón, 2009; Notten et al., 2015; Ringstad & Løyland, 2006). Hence, families with higher levels of income and formal education are more likely to spend on the cultural sector.

These results regarding family income groups allow a reflection on the distribution of income in the Brazilian economy and consumption in the cultural sector. That is, the HH1, HH2 and HH3 family groups comprise more than 70% of Brazilian families but consume only 28% of cultural goods and services, while families in HH9 and HH10, which represent less than 3% of households, consume 22% of the sector. Clearly, one of the major current challenges for the cultural sector is to break this barrier to make access more inclusive. In this regard, government policies are essential to stimulate and subsidize the consumption of low-income families. The current concentration of consumption inhibits the demand of the cultural sector, limiting its economic growth spillover effects on the national economy.

It is worth noting that the democratization of access to culture has implications beyond the purely economical, also affecting aspects of individuals' social life. Cultural capital influences personal, professional, and educational training as an instrument of social development.

5 Conclusion

The present study evaluates, by opening the vector of consumption and family income in the input–output matrix, the sectoral impacts of changes in Brazil's cultural consumption patterns by considering the roles of its different family income groups. One of the main results, referring to the effects of COVID-19 on the cultural sector, reveals that a 30.8% reduction in the sector's demand generates a reduction in the product of over R$ 8.3 billion in the sector itself and of more than R$ 12.9 billion in the economy as a whole. In terms of employment, there is a reduction of 237,701 job openings in the cultural sector and an additional drop of 31,635 jobs in the other sectors of the economy.

Regarding the results of the hypothetical extraction of the cultural sector, the data for the Brazilian economy show that the sectors that show the greatest drop in production — in addition to the artistic, creative, and entertainment sector — are other professional, scientific activities, and techniques; recording and reproduction of recordings; and television, radio, film, sound, and image recording/editing activities. Such sectors are the main demanders and suppliers of productive

inputs to the cultural sector, and, given the extraction of the cultural sector, they bear the greatest decreases in sectoral production. Knowing the sectors most linked to the cultural sector allows specific public policies to be developed to minimize the adverse effects of a shock in the cultural sector.

Another important result is our finding that family groups with higher income levels are also those with greater participation in the consumption of cultural goods and services. Notably, nationwide, approximately 70% of Brazilian families are responsible for only 28% of all demand of the cultural sector, while higher-income families, i.e., less than 3% of households, are responsible for the consumption of 22% of the sector. This result underscores how the unequal distribution of income is reflected in terms of access to the cultural sector.

In summary, the consumption of cultural goods and services is unequal among Brazil's income groups. Currently, the consumption of family groups that represent the highest income classes in Brazilian society has the greatest impact on the production of the cultural sector. This result highlights the importance of developing public policies to stimulate consumption among low-income groups, given that in addition to the economic benefits discussed above, there are intangible benefits of cultural activity for a society.

Finally, regarding public policies, actions that prioritize transfers to families, such as some type of cultural voucher that provides greater access to cultural facilities among workers, have the potential to affect the structure of cultural consumption. Another way to affect the consumption of low-income families in the cultural sector is through a wider range of projects that are funded by the Rouanet Law, allowing more diverse income groups to enjoy cultural goods and services.

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