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The value of an Iconic Asset
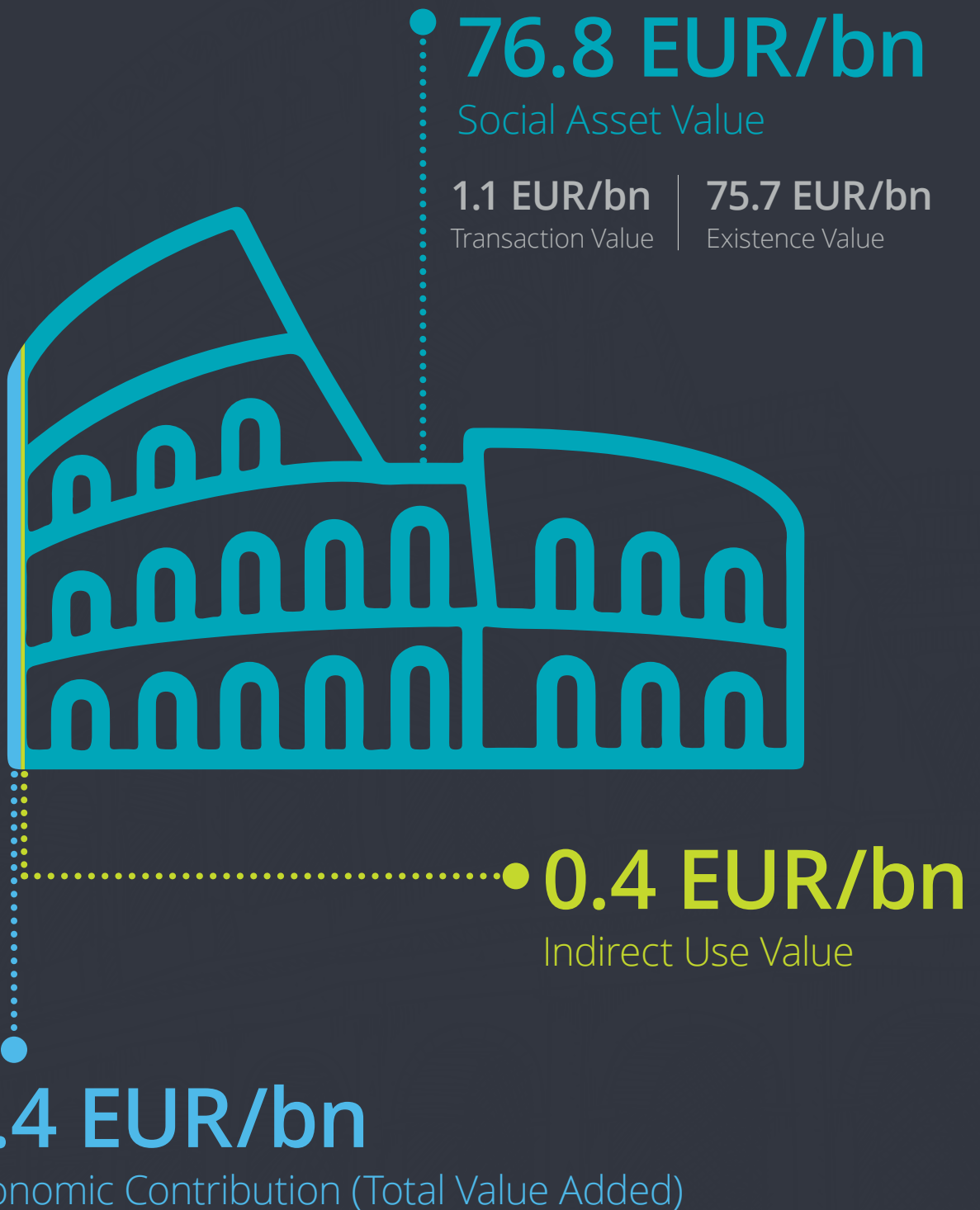
**The economic and social value
of the Colosseum**

Contents

76.8 EUR/bn
Social Asset Value

1.1 EUR/bn
Transaction Value

75.7 EUR/bn
Existence Value

0.4 EUR/bn
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contribution

Executive summary

The Flavian Amphitheater, known as the Colosseum because of a colossal statue that stood nearby, is the most famous symbol of Rome and one of the New Seven Wonders of the World. Moreover, it is the largest amphitheatre in the world and the most visited monument in Italy. In 2019 alone, more than 7 million people from all over the World enjoyed a visit to the Colosseum. Thus, the Colosseum certainly represents a substantial source of value for Italy. In this report, we examine, analyze and quantify the economic and social value of the Colosseum. Our main purpose is to gauge the Colosseum's true worth to Italian residents and visitors.

To this aim, we estimated the economic contribution to the Italian economy in terms of direct, indirect and induced value added by the direct use of the Colosseum; its indirect use value in terms of housing comfort for residents; and its "social asset" value reflecting the transaction and non-use or existence value. The analysis presented in this report is part of the activities carried out by Deloitte Central Mediterranean in the context of the evaluation and enhancement of works of art and, more generally, of cultural heritage.

Economic contribution

The main economic contribution of the Colosseum is related to its actual use. We consider actual use as involving both direct and indirect use. As for its direct use value, we estimated the Colosseum contributes to about 63.3 EUR/mln a year in total direct value added. Value added measures the value of output (i.e. goods and services) generated by the entity's factors of production (i.e. labor and capital).

Then, the Colosseum produces also indirect effects through the reach of its supply chains into other sectors as the result of business-to-business transactions and induced effects as the result of an increase in household-to-business activity. Considering direct, indirect and induced effects, we estimated that, with its operation alone, the Colosseum contributes 100.8 EUR/mln in value added to the Italian economy each year, and supports 1,217 full-time equivalent jobs.

In addition to the direct expenditure for the visit to the Colosseum, the latter contributes to tourism in a broader way by attracting tourists to Rome and Italy that would not otherwise visit, or at least would not stay for the same length of time. After accounting for the overlap between direct expenditure to visit the Colosseum and induced tourism expenditure, we estimated that it contributes about 1,191 EUR/mln in yearly expenditure by visitors to Rome, generating about 1,290 EUR/mln of direct, indirect and induced value added.

Considering both its direct operation and induced tourism, we estimated that the Colosseum generates in total 1,390 EUR/mln a year in value added to the Italian economy. Moreover, the Colosseum is estimated to support the employment of about 42,700 people on a full-time equivalent (FTE) basis.

In addition to the direct use, another element is given by the value derived from indirect use of the Colosseum, i.e. by securing some benefit from it. For example, the Colosseum may provide welfare in the form of housing comfort as people derive welfare from living close to it. We estimated that the indirect use value of the Colosseum, in terms of housing comfort for residents, is 406 EUR/mln. Note that, unlike the direct use value, this is not an annual figure.

Social asset value

In addition to the economic contribution, we estimated the visitor value and the existence value of the Colosseum, which constitute its total "social asset" value. Visitor value is calculated using the market or social value given by the transaction value – the revenue from the sale of goods and services. In addition to the audience value, public institutions such as the Colosseum provide value to people who do not directly use their services.

Beyond its financial strengths, people may value the Colosseum as "iconic" or "symbolic", or may value the contribution of the Colosseum to the national culture. Thus, the welfare produced by the Colosseum is certainly more than the financial benefits that it can produce. Italian residents also place a considerable premium on the non-use value of the Colosseum.

This represents its intangible social value, that we can also refer to as its existence value. This value is perceived by most Italians, and not just those who visit it. Specifically, this value arises when an individual is willing to pay for the Colosseum though she makes no direct use of it, may not benefit even indirectly from it, and may not plan any future use for themselves or others.

On the basis of an ad-hoc survey, we found that about 90% of Italian residents believe the Colosseum is an iconic Italian landmark representing the most important cultural attraction in Italy, and that it must be preserved under any circumstances. We also found that Italian respondents are willing to pay a significant amount of money to preserve the Colosseum. Overall, we estimate the Colosseum has a total social asset value of 76.8 EUR/bn.

Table 1 provides a detailed summary of estimated annual and asset values of the economic and social asset value of the Colosseum.

The future of an icon

Finally, there are also a number of possible opportunities to enhance the economic and social value of the Colosseum. These may include, for example, its support of Italian culture, its educational outreach, and investments in digital technology.

Table 1. Estimated economic and social asset value of the Colosseum

Components		Annual values (EUR/mln)	Asset values (EUR/mln)
Economic Contribution	Direct Economic Contribution	63.3	
	Indirect Economic Contribution	37.5	
	Tourism	1,289.6	
	Total	**1,390**	
Employment (FTE supported)	Direct Economic Contribution	155	
	Indirect Economic Contribution	1,062	
	Tourism	41,483	
	Total	**42,700**	
Indirect Use Value			**406**
Social Asset Value	Transaction Value	75	1,101
	Non Use Value (Existence Value)	2,936	75,672
	Total	**3,011**	**76,773**

Source: Deloitte Economic Advisory

1 | Introduction

In this report, we examine, analyze and quantify the economic and social value of the Colosseum, with a specific focus on its impact on the Italian economy and society. The economic value of a cultural heritage site like the Colosseum can be defined as the amount of welfare that such a heritage generates for society. A broad definition of welfare is used here, encompassing both material and immaterial welfare. In fact, the welfare produced by the Colosseum is certainly more than the financial benefits that it can produce. Benefits that are external to the market economy must be considered too. Thus, in order to determine the economic value of the Colosseum, we first need to find out in what ways it generates welfare.

The first element we have to consider is certainly the role of the Colosseum as a major tourist attraction. Considering this aspect, the Colosseum generates both a direct cash flow from the tourists visiting the Colosseum and contributes to tourism expenditure in a more broad way by attracting tourists to Rome and Italy that would not otherwise visit, or would not stay for the same length of time. Revenues from tourism spending related to both the direct exploitation of the Colosseum and to induced tourism directly generate a value added and contributes to employment.

In addition to these direct effects, tourism expenditure that can be attributed to the Colosseum creates additional activity in the local economy, leading to indirect and induced effects. Indirect effects are the results of business-to-business activities, and concern intermediate consumption for the production of goods and services in the tourism sector related. These are goods and services that tourism companies purchase from their suppliers, forming the tourism supply chain. Induced effects are a measure of an increase in household-to-business activity due to increased personal income caused by the direct and indirect effects. These effects mainly concern the consumption of the companies, and their employees, that have benefited directly or indirectly from initial expenditure in the tourism sector.

The total value added for the economy generated by the visitors' expenditure that can be attributed to the Colosseum represents its direct use value. In fact, the direct use of the Colosseum mainly consists of allowing people to visit it. In addition to this value, another element is given by the value derived from indirect use of the Colosseum, i.e. by securing some benefit from it. For example, the Colosseum may provide welfare to people just passing nearby and enjoying the scenery without spending money, or

in the form of housing comfort as people derive welfare from living close to it. In the former example, the indirect use of the Colosseum is not captured by an economic or financial transaction. Market transactions related to the housing comfort can be instead observed, although indirectly, in the housing market. The sum of direct and indirect use value lead to what we can refer to as the actual use value of the Colosseum.

In addition to the actual use value, another element of the value of the Colosseum is given by the visitor value and the existence value of the Colosseum, which constitute its total "social asset" value. Visitor value is calculated using the market or social value given by the transaction value – the revenue from the sale of goods and services. In addition to the audience value, public institutions such as the Colosseum provide value to people who do not directly use their services.
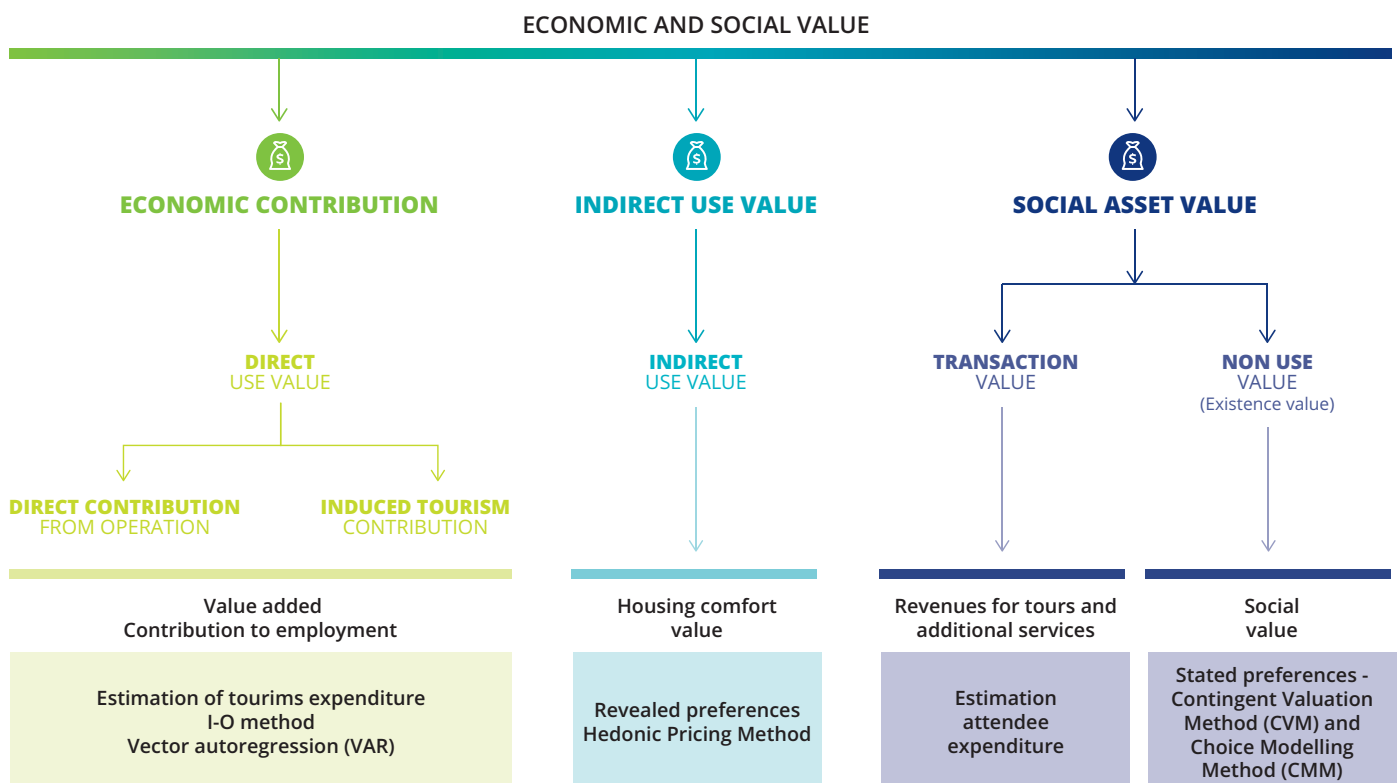
The existence value is given by the so called non-use value. This arises when an individual is willing to pay for the Colosseum though he or she makes no direct use of it, may not benefit even indirectly from it, and may not plan any future use for themselves or others. This is also referred to as the existence value. Thus, we conduct a specific economic analysis in order to examine and quantify this additional component of the value.

Figure 1 gives a representation of the economic and social value. In summation, as outlined above the total value of cultural heritage assets like the Colosseum is given by the use value and the non-use value (see for example Pearce 1994, Bateman et al. 2002, and Throsby 2006). Use value may be further divided into direct use values, indirect use values. Figure 1 also presents the main methodologies applied in this report to estimate each component of the total economic value.

The remainder of this report is organized as follows. After a brief description of the Colosseum provided at the end of this section, Section 2 analyzes and computes the main economic contribution of the Colosseum related to its direct use value. Section 3 analyzes the indirect use value. Then, we go beyond the actual use value and the economic contribution of the Colosseum, and Section 4 explores and provides an estimate of the broader social value related to transaction value and non-market aspects of the Colosseum, capturing its broader social value.

Section 5 summarizes our estimates of the economic and social value of the Colosseum. Finally, Section 6 provides a discussion about possible future opportunities to enhance the economic and social value of the Colosseum. Note that this report is not an evaluation of any particular service or function of the Colosseum, and it is neither a funding needs assessment nor a business case for any project.

Figure 1. The value of the Colosseum

ECONOMIC AND SOCIAL VALUE

- **ECONOMIC CONTRIBUTION**
  - **DIRECT** USE VALUE
    - **DIRECT CONTRIBUTION** FROM OPERATION
    - **INDUCED TOURISM** CONTRIBUTION
    - Value added Contribution to employment
    - Estimation of tourims expenditure I-O method Vector autoregression (VAR)
- **INDIRECT USE VALUE**
  - **INDIRECT** USE VALUE
    - Housing comfort value
    - Revealed preferences Hedonic Pricing Method
- **SOCIAL ASSET VALUE**
  - **TRANSACTION** VALUE
    - Revenues for tours and additional services
    - Estimation attendee expenditure
  - **NON USE** VALUE (Existence value)
    - Social value
    - Stated preferences - Contingent Valuation Method (CVM) and Choice Modelling Method (CMM)

The Colosseum

The Colosseum, known as Flavian amphitheater, is the "single most famous symbol of Rome" (Stirling 2006). The construction of the Colosseum was begun in 72 AD under the reign of Vespasian on the site that was once the lake and gardens of Emperor Nero's Domus Aurea (Cartwright 2018). Vespasian died before Colosseum was opened by his son Titus in 80 AD. When finished, it covered 5 acres, had 76 entrances and seating capacity was up to 50,000-80,000 spectators arranged according to their social status (Stirling 2006). It was finally completed under the reign of the other Vespasian's son, Domitian.

The name Colosseum was attributed to the Flavian amphitheatre in the Middle Ages: it derives from the size of the building itself or, more likely, from the proximity of the colossal statue of Nero.

The main structural features deal with the different architectural orders of the arches: the first floor carried Doric columns, the second Ionic and the third l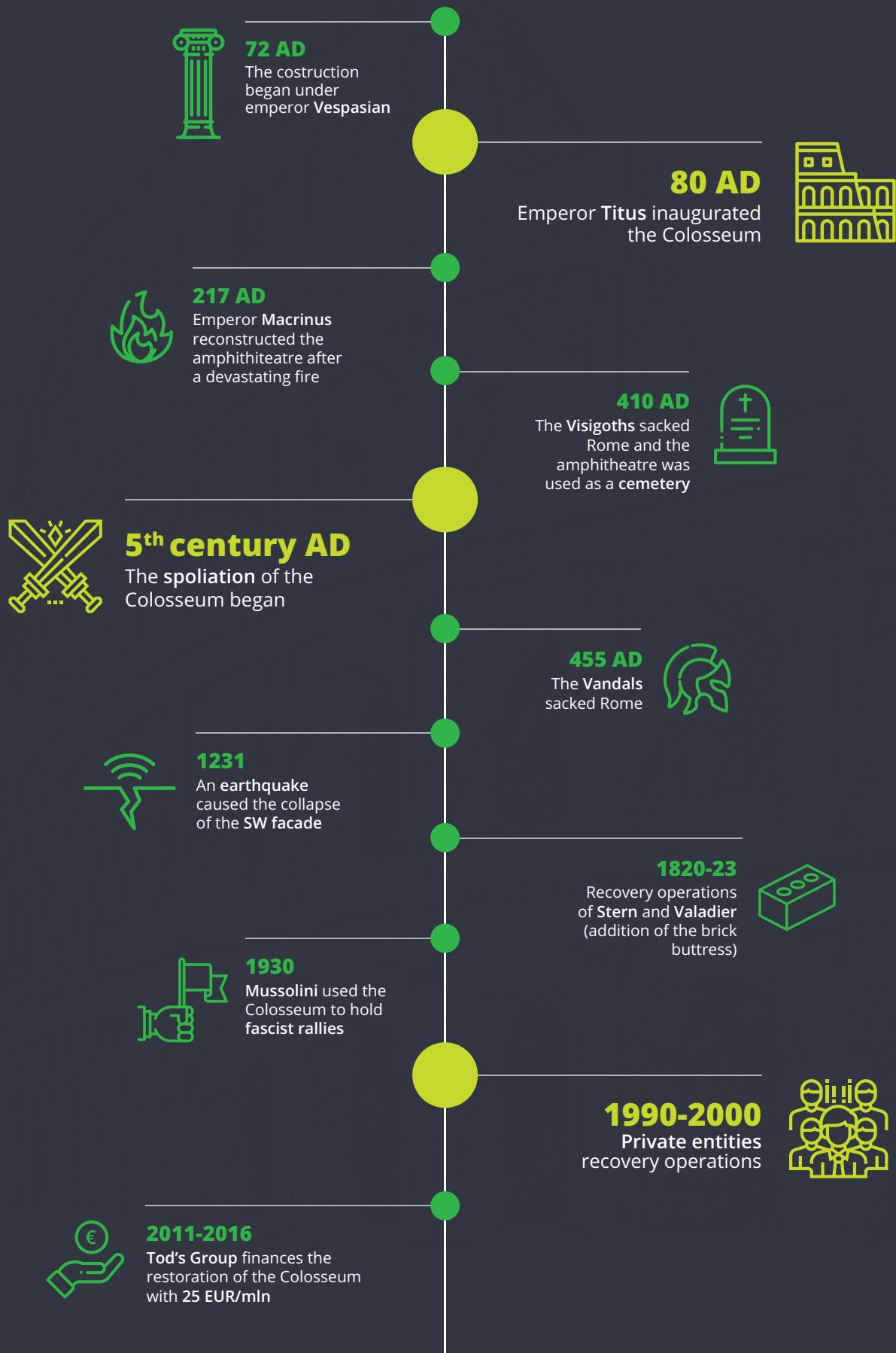evel Corinthian. The top floor had Corinthian pilasters and small rectangular windows. There were no less than eighty entrances; two entrances were used for the gladiators, one of which was known as "Porta Libitina" and it was the door through which the dead were removed from the arena. The other door was the "Porta Sanivivaria" through which winners and those allowed to survive the contests left the arena.

At the beginning of the 3th century, emperor Macrinus reconstructed the Colosseum after a devastating fire. In 404 AD, the games of the Colosseum were finally abolished by Emperor Honorius, although condemned criminals still kept fighting wild animals for a further century. Damaged by earthquake in 422 AD it was repaired by the emperors Theodosius II and Valentinian III. Repairs were also made in 467, 472 and 508 AD. The building began to show signs of neglect and grass was left to grow in the arena. The great earthquake of 1231 AD caused the collapse of the southwest facade and the Colosseum became a vast source of building material - stones and columns were removed, iron clamps holding blocks together were stolen and statues were melted for lime. Indeed, Pope Alexander VI actually leased the Colosseum as a quarry.

From the Renaissance period both artists and architects like Michelangelo and later tourists on their Grand Tour took a renewed interest in Roman architecture and ruins. As a consequence, in 1744 AD Pope Benedict XIV prohibited any further removal of masonry from the Colosseum and consecrated it in memory of the Christian martyrs who had lost their lives there. In the 19th century AD, the Papal authorities sought to restore parts of the building, notably the east and western ends, with the latter being supported by a massive buttress. Finally, in 1871 AD the Italian archaeologist Pietro Rosa removed all of the post-Roman additions (Cartwright 2018). In 2016 a restoration project financed by the Tod's Group for approximately 25 EUR/mln was completed. Figure 2 provides a graphic representation of the chronology outlined above.

Figure 2. The Colosseum: chronology of main events

72 AD
The costruction began under emperor **Vespasian**

80 AD
Emperor **Titus** inaugurated the Colosseum

217 AD
Emperor **Macrinus** reconstructed the amphithiteatre after a devastating fire

410 AD
The **Visigoths** sacked Rome and the amphitheatre was used as a **cemetery**

5th century AD
The **spoliation** of the Colosseum began

455 AD
The **Vandals** sacked Rome

1231
An **earthquake** caused the collapse of the **SW facade**

1820-23
Recovery operations of **Stern** and **Valadier** (addition of the brick buttress)

1930
Mussolini used the Colosseum to hold **fascist rallies**

1990-2000
Private entities recovery operations

2011-2016
Tod's Group finances the restoration of the Colosseum with **25 EUR/mln**

1.4 EUR/bn
Economic Contribution

The economic contribution of the Colosseum includes its value added, as well as the tourism it generates. The total Direct Use Value is mainly given by Induced Tourism Contribution (93%).

1.4 EUR/bn
Economic Contribution (Total Value Added)

0.1 EUR/bn
Economic contribution from operation

1.3 EUR/bn
Induced tourism contribution

2 | Economic Contribution: the actual use value

In this section, we derive the main economic contribution of the Colosseum related to its actual use. We consider actual use as involving both direct and indirect use. We first analyze the economic contribution related to the direct use of the Colosseum. Then, we provide an estimate of the indirect use value.

First of all, let us consider that even heritage like the Colosseum may be considered as a factor of production. In this perspective, a heritage site or a cultural monument like the Colosseum can be considered as being a fixed capital which contributes to a production process. Therefore, the Colosseum, for the purpose of our analysis, would be assimilated to a durable production instrument which contributes to a production process.

At the end of each year, we can safely consider that the main output of the heritage used in the process is represented by the returns from tourism, and specifically classified as creative, arts and entertainment activities. In fact, the Colosseum surely generates revenues within the touristic process, together with hotels, restaurants, etc. In this perspective, the first element of its value is therefore equal to the direct value added generated from its operation, management and maintenance[1].

As a historical and cultural heritage and national icon, the Colosseum supports economic activity through its role in attracting tourists to Rome. As a tourist attraction, the direct use of the Colosseum mainly consists of allowing people to visit it. Thus, the first element of the economic contribution of the Colosseum is actually given by the direct cash flows produced from its specific exploitation. These revenues are mainly given by the entrance fees tourists pay to enter the Colosseum. In addition to the entrance fees, there are some cash flows from additional services related to the visit such as guided tours, purchase of audio guides, ticket pre-sale rights, and royalties on gadgets sold at the bookshops.

These direct effects from the use and operation of the Colosseum creates additional activity in the local economy, generating indirect and induced effects. Indirect effects concern intermediate consumption for the production of goods and services in the tourism sector. These are goods and services that tourism companies purchase from their suppliers, forming the tourism supply chain. Indirect effects can be particularly important for the production of local products. For example, if an accommodation provider buys local products wherever possible, the tourist will be the originator of the purchase and of the domestic production of goods and services.

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[1] Thus, in this perspective, not just for its historical and cultural importance, but also to maximize its value as well as its return to the economy, the lifetime of a cultural site must be as long as possible and a special effort should be devoted to its protection and preservation since, as opposed to other types of "commodities", a cultural site is unique and, in principle, it cannot be replaced.

Moreover, in addition to direct and indirect effects, induced effects must also be considered. Induced effects concern expenditure by employees from wages paid by companies in direct contact with tourists. Induced effects also include the consumption of companies that have benefited directly or indirectly from initial expenditure in the tourism sector. An example of such induced effects would be purchases of consumer goods such as food, clothing and electronic goods by people employed in the hotel sector. For companies, this would be purchases of capital goods or expenditure related to the reinvestment of profits.

In addition to the direct tourism spending generated from its operation, i.e. to visit the Colosseum, the latter contributes to tourism in a broader way by attracting tourists to Rome and Italy that would not otherwise visit, or at least would not stay for the same length of time. Thus, this contribution, and specifically the value added from the total tourism expenditure directly attributable to the Colosseum, is another important component of the total economic contribution.

Again, the total expenditure within the tourism sector that can be attributed to the Colosseum represents a measure of its direct effects. Also these direct effects from the initial spending creates in turn additional activity in the local economy, leading to indirect and induced effects.

Direct, indirect and induced economic contribution

The economic contribution from the direct operation of the Colosseum is measured in terms of its value added, as well as its contribution to employment in the Italian economy. Value added measures the value of goods and services produced by an entity's factors of production (i.e. labor and capital) as reflected in the income to those factors of production (wages and gross operating surplus). The sum of value added across all entities in the economy equals gross domestic product (GDP).

The value added, and the effects on employment, within the tourism sector generated by the visits to the Colosseum represents a measure of its direct effects. These direct effects from the initial spending creates additional activity in the local economy, generating indirect and induced effects. As outlined above, indirect effects are the results of business-to-business transactions indirectly caused by the direct effects. Businesses initially benefiting from the direct effects will subsequently increase spending at other local businesses.

The indirect effect is a measure of this increase in business-to-business activity (not including the initial round of spending, which is included in the direct effects). Furthermore, induced effects are the results of increased personal

income caused by the direct and indirect effects. Businesses experiencing increased revenue from the direct and indirect effects will subsequently increase payroll expenditures (by hiring more employees, increasing payroll hours, raising salaries, etc.). Then, households will increase spending at local businesses.

The induced effect is a measure of this increase in household-to-business activity. The total economic contribution of the Colosseum includes both its direct, indirect and induced contribution to value added.

The main data source for estimating Colosseum's economic contribution from its direct operation is its 2019 financial report maintained by the Italian Ministry of Cultural Heritage and Activities ("Ministero per i beni e le attività culturali" - MiBAC). Our analysis in this report refers to year 2019, because at the time of the study this is the most recent year for which complete data on all the components of the value used in our analysis is consistently available. It should also be noted that focusing our analysis in 2019 has the advantage of avoiding possible distortions due to the pandemic that spread since 2020.

The methodology for evaluating the indirect and induced economic impacts generated from the direct effects is carried out in an input-

output (IO) framework, relying on the key contribution of Tourism Satellite Accounts (TSA), which give the most accurate and reliable measurement of the role of tourism in an economy. A detailed description of the methodology used to measure the direct, indirect and induced economic contribution is provided in Appendix B.

Table 2 shows estimated economic contribution from operation of the Colosseum. The direct cash flows produced from the operation of the Colosseum corresponds to about 75.3 million euros of direct tourism expenditure by its visitors in 2019. These revenues are mainly given by the expenditure for entrance fees paid from the tourists entering the Colosseum and for additional services related to the visit such as guided tours, purchase of audio guides, ticket pre-sale rights, and royalties on gadgets sold at the bookshops. Overall, the operation of the Colosseum generates about 63.3 million euros of value added. In order to quantify the direct contribution to employment related to the Colosseum, we used data from the documents accompanying the 2019 Annual Report.

As previously mentioned, these direct effects create additional activity in the local economy, generating indirect and induced effects estimated using Keynesian multipliers in an input-output framework (see Appendix B). Our estimate of the indirect and induced contribution is 37.5 EUR/mln of value added. The total yearly contribution is then given by the sum of direct, indirect and induced effects. We estimated that the operation of the Colosseum generates 100.8 EUR/mln in total value added to the Italian economy. Moreover, as for the direct, indirect and induced effects on employment, we estimated that the Colosseum contributes to about 1,217 total people on a full-time equivalent basis.

Table 2. Estimated economic contribution of operation of the Colosseum

	Direct	**Indirect and induced**	**Total**
Expenditure (EUR/mln)	75.3		
Value added (EUR/mln)	63.3	37.5	**100.8**
Employment (FTE)	155	1,062	**1,217**

Source: Deloitte Economic Advisory

Induced tourism contribution

In addition to the direct tourism spending related to entering and visiting the Colosseum, the latter contributes to tourism in a broader way by attracting tourists to Rome and Italy that would not otherwise visit, or at least would not stay for the same length of time. Thus, this contribution must be taken into account when computing the total economic value. Nevertheless, while the Colosseum is one of the major tourist attraction in Rome (and in Italy), it is difficult to separate its impact from other attractions. The main approach to estimating the contribution of the Colosseum to broader tourism expenditure in Rome used in this report identifies a proportion of all tourists visiting the Colosseum each year as visitors that would not otherwise visit Rome, or at least would not stay for the same length of time. This way, we are implicitly recognizing that many tourists are attracted to Rome by a bunch of attractions, whilst only some of them, and consequently their tourism expenditure, are directly attributable to the Colosseum.

As a first step in assessing the Colosseum's contribution to tourism, we analyze the profile and the level of expenditure of both domestic and international visitors on different categories of expense. Specifically, we will analyze the amount spent by tourists for:

- Local transportation ("Local transportation")
- Accommodation ("Accommodation")
- Food & Beverage ("Food")
- Purchase of goods in stores ("Shopping")
- Cultural and entertainment services ("Entertainment")

Unfortunately, we do not observe directly data about the Colosseum's visitors expenditure on the different categories. Thus, we estimated such an expenditure for both international and domestic visitors who visited the city of Rome in 2019. Data used to estimate tourism expenditure related to international and domestic visitors comes from two different sources.

The first, used to estimate the expenditure of inbound tourists, is the survey on "International Tourism in Italy" conducted annually by the Bank of Italy. The second, used to estimate the expenditure of domestic tourists, source is the survey on "Trips and holidays" conducted by Italian National Institute of Statistics (ISTAT). Using data from these surveys, we are able to identify a representative sample of foreign and domestic visitors who visited the city of Rome and who reported "cultural vacation" as the main reason of their journey. Thus, we believe our identification of the visitors who are relevant to our analysis is very accurate.

Specifically, our approach to estimate the Colosseum's induced tourism expenditure consists of two main steps. First, we estimated the share of visitors of the Colosseum that would not otherwise visit Rome, or at least would not stay for the same length of time. Then, we estimated the average tourism expenditure for tourists who visit Rome for a cultural vacation. Our estimate of the broader tourism expenditure that can be attributed to the Colosseum is thus given by the product of this average tourism expenditure and the number of visitors of the Colosseum that would not otherwise visit Rome. To estimate the share of visitors of the Colosseum that would not otherwise visit Rome, or at least would not stay for the same length of time, we used responses to an ad-hoc survey.

As part of a survey designed to reveal attitudes towards the Colosseum (discussed in more details in section 4), a number of tourism questions were asked to respondents. Specifically, respondents were also asked whether the Colosseum was the main factor in their decision to visit Rome. The percentage of respondents reporting that the Colosseum was the main factor in their decision to visit Rome is about 52%. Given that Rome is plenty of many other attractions, we suspect that this percentage could possibly overestimate the true share of visitors of the Colosseum that would not otherwise visit Rome.

For this reason, we exploited another question of the survey. Specifically, respondents were also asked to provide a ranking of the most important cultural tourist attractions in Italy, including other attractions in Rome such as the Sistine Chapel. Hence, to keep a conservative approach, we estimated the share of visitors of the Colosseum that would not otherwise visit Rome as the percentage of respondents reporting that the Colosseum was the main factor in their decision to visit Rome and also ranking the Colosseum as the most important cultural tourist attractions in Italy.

This percentage, used as a conservative estimate of the share of visitors of the Colosseum that would not otherwise visit Rome, or at least would not stay for the same length of time, is about 28%. Then, to estimate the average tourism expenditure for tourists who visit Rome for a cultural vacation we used data from the two surveys on inbound and domestic tourism expenditure previously described.

Data from these surveys reveal that average length of stay tends to be relatively long, especially for international visitors. This is probably due to the large number of other attractions available in Rome. For example, the average length of stay of international holiday visitors to Rome was about 11 nights in 2019. While the Colosseum may attract many international visitors, we believe both average length of stay and expenditure would be probably lower in the absence of other attractions in Rome. Considering that domestic visitors stayed on average 3 nights in Rome, we decided to keep a conservative approach in estimating tourism expenditure by assuming that length of stay in Rome of international visitors that can be attributed directly to the Colosseum (the minimum staying coming from abroad to visit Colosseum) in line with the staying of domestic visitors (i.e. 3 nights).

On the other hand, we consider three nights as the minimum stay required by a international visitor to visit a place or to participate to an event in a foreign country. On the basis of the above assumptions, we estimated the touristic expenditure. Moreover, to avoid double counting with respect to the economic contribution from the direct operation of the Colosseum, per person expenditure for entrance fee, for related services (audio-guide, guided tour, etc.) and for souvenirs bought at the book shop are subtracted from estimated average expenditure for, respectively, cultural and entertainment services ("Entertainment") and purchase of goods in stores ("Shopping").

The estimated size of this overlap in tourism expenditure is about 25.5 EUR/mln. A more detailed description of the data and the methodology used to estimate the Colosseum's contribution to tourism, as well as an analysis of visitors' profile, are provided in Appendix C. At the end of this section, we also provide sensitivity analysis related to our main assumptions.

Figure 3. Description of the procedure relative to the estimation of the Induced Tourism Expenditure attributable to the Colosseum

28% of visitors who visited the Colosseum in 2019 * **3** nights * **Average expenditure** for visitors who visited Rome = **Total induced tourism expenditure**

Figure 4 shows estimated total tourism expenditure by category that can be attributed to the Colosseum. Following our approach, by combining the average tourism expenditure and the number of visitors of the Colosseum that would not otherwise visit Rome, we derive an estimate of the level of tourism expenditure directly attributable to the Colosseum. Our estimates, reported in Table 3, indicate that the Colosseum was responsible for about 1,190.9 EUR/mln of tourism expenditure in 2019. Like expenditure related to direct visit to the Colosseum, this expenditure must also be converted into value added (see Appendix B for details).

As shown in Table 3, tourism expenditure attributed to the Colosseum is estimated to contribute to the Italian economy about 696.9 EUR/mln in direct value added and about 592.7 EUR/mln in indirect and induced value added. Thus, our estimate of the total value added is about 1,289.6 EUR/mln. Induced tourism expenditure is estimated to support also the employment of about 41,483.5 people on an FTE basis in all sectors involved by the tourism expenditure, i.e. accommodation, food, local transportation, shopping and entertainment.

Table 4 shows the impact on the economic contribution of tourism induced by the Colosseum of our main assumptions, namely the percentage of visitors of the Colosseum that would not otherwise visit Rome and their average length of stay. The assumptions maintained in this report are in bold. The three numerical rows of the Table show the impact of different average length of stay, from only one night to the actual number of nights observed in the sample. The three numerical columns of the Table shows the impact of the percentage of visitors of the Colosseum that would not otherwise visit Rome, or at least would not stay for the same length of time. This percentage range from 20% to 40%, where 28% is the percentage estimated from the survey. Varying our assumptions would mean that the economic contribution of induced tourism is between 271 EUR/mln and 1,791 EUR/mln.

Figure 4. Total induced tourism expenditure of Colosseum's visitors by category. Total expenditure is equal to 1,190.9 EUR/mln
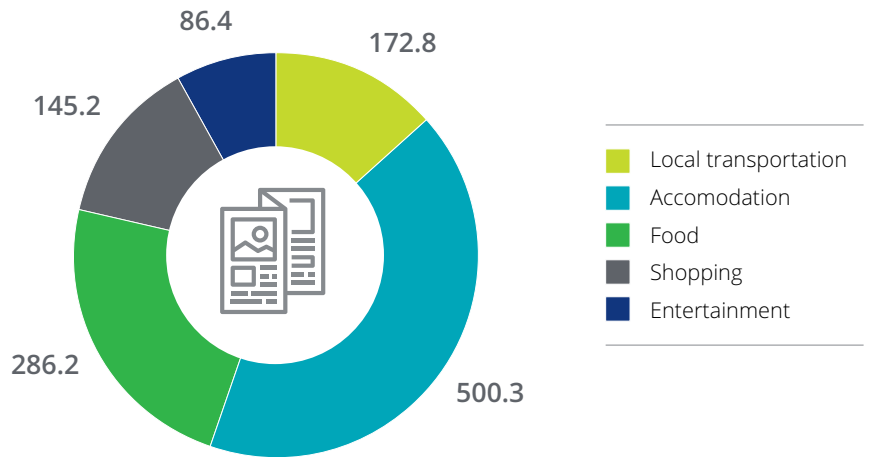
Source: Deloitte Economic Advisory estimates using data from Bank of Italy International Tourism survey an ISTAT Trips and Holidays survey

Table 3. Estimated economic contribution of tourism induced by the Colosseum

	Direct	**Indirect and induced**	**Total**
Expenditure (EUR/mln)	1,190.9		
Value added (EUR/mln)	696.9	592.7	**1,289.6**
Employment (FTE)	24,693	16,791	**41,483**

Source: Deloitte Economic Advisory.

Table 4. Sensitivity of economic contribution of tourism induced by the Colosseum (expenditure EUR/mln) to varying length of stay and percentage of visitors of the Colosseum that would not otherwise visit Rome

Average length of stay	**Percentage of visitors attributed to the Colosseum**		
	20%	**28%**	40%
1	271.4	380.0	542.8
3	850.6	**1,190.9**	1,701.2
Observed	895.4	1,253.6	1,790.9

Source: Deloitte Economic Advisory | Note: Central case in bold

Total economic contribution

The total economic contribution of the Colosseum includes direct, indirect and induced effects of tourism spending related both to direct operation and to induced tourism. The total economic contribution of these elements is shown in Table 5. It is estimated the Colosseum generates in total about 1,266 EUR/mln of tourism expenditure and 1,390 EUR/mln in value added to the Italian economy.

In addition, the Colosseum is estimated to support the employment of about 42,700 people on a full-time equivalent (FTE) basis.

The economic impact of the Colosseum on the local economy: a dynamic approach

To some extent, the analysis provided in the previous section can be considered as a simple historical accounting exercise. No counterfactual inferences, such as "what would happen if the Colosseum disappeared?", should be drawn from it. In fact, this analysis relies on a national input-output model framework, which has some limitations. First of all, the analysis assumes that goods and services provided to the sector are produced by factors of production that are located completely within the state or region defined.

Moreover, the IO framework and the derivation of the multipliers also assume that the relevant economic activity takes place within an unconstrained environment. Finally, whilst the economic effects of the tourism expenditure that can be attributed to the Colosseum are expected to have also a dynamic impact that spreads over time, the IO framework does not account for further flow-on benefits as captured in a more dynamic modelling environment. In order to overcome - at least partially - these limitations, we present in this section a quantitative assessment of the economic impact of tourism expenditure on the local economy of the Rome area in a dynamic framework.

Table 5. Estimated total economic contribution of the Colosseum

	Contribution	Direct	Indirect and induced	Total
Expenditure (EUR/mln)	Operation	75.3		
	Induced tourism	1,190.9		
	Total	**1,266.2**		
Value added (EUR/mln)	Operation	63.3	37.5	**100.8**
	Induced tourism	696.9	592.7	**1,289.6**
	Total	**760.3**	**630.2**	**1,390.5**
Employment (FTE)	Operation	155	1,062	**1,217**
	Induced tourism	24,693	16,791	**41,483**
	Total	**24,848**	**17,853**	**42,700**

Source: Deloitte Economic Advisory.

The analysis is carried out employing the vector autoregression (VAR) econometric model. The VAR model is one of the most successful and flexible models for the analysis of multivariate time series. It is a natural extension of the univariate autoregressive model to dynamic multivariate time series. The VAR model has proven to be especially useful for describing the dynamic behavior of economic and financial time series and for forecasting, as well as for structural inference and economic impact analysis. Given its dynamic nature, this model provides nowadays a very useful framework for assessing the transmission of shocks among economic entities.

The VAR model also has other interesting features. First, the VAR is a reduced form model and consists of a system of equations that relates the current values of a given set of economic variables to the past values of the variables themselves. Moreover, the VAR model exploits the correlations in the system to obtain forecasts about the future trend of the economic variables of interest. Finally, this model is also useful for forecasting the economic impact of an exogenous change in spending levels in a given geographical area.

In order to apply the VAR model, in addition to the microdata from the sample survey on International Tourism conducted by the Bank of Italy, and from the survey on Travels and Holidays conducted by the Italian National Institute for Statistics, we use data from additional sources. Specifically, we use data about several economic series related to the Municipality of Rome and Latium region. These include, at the regional level, time series of some of the main economic indicators such as gross domestic product (GDP), value added (VA), exports, and employment. This data comes from the regional accounting maintained by the Italian National Institute of Statistics (ISTAT). Complete data from the regional accounts about the time series of the main economic indicators included in our analysis are available from 1993 to 2019.

In order to estimate the effects of an exogenous shock in tourism attributable to the presence of the Colosseum, the VAR model includes GDP, exports, employment and VA at the local level as endogenous variables, and tourism expenditure in Rome as the exogenous variable. Both total VA and VA for the accommodation sector only are included[2].

Table 6 shows the expected change in the main economic variables in the local economy with respect to the control scenario represented by the absence of the tourism expenditure of the visitors that can be attributed to the Colosseum. Specifically, these forecasts are obtained by considering an exogenous shock in the local economy of 1,266.2 million euros of total tourism expenditure related to the visitors attributed to the Colosseum in year 2019.

Specifically, we provide one-year, two-year and three-year ahead forecast with respect to the time of the exogenous shock. The forecasts provided by our model confirm that the presence of the Colosseum contributes positively to the growth of the local economy, especially on the value added of the accommodation sector. Moreover, all else equal, the effects on the local economy of the tourism expenditure that can be attributed to the presence of the Colosseum spread over time.

Table 6. Dynamic economic impact of the Colosseum on the local economy

Forecast	Employment (FTE)		VA accommodation		VA	
	Thousand	%	EUR/mln	%	EUR/mln	%
One-year	18.3	0.7	311.0	5.1	983.5	0.6
Two-year	-4.9	-0.2	300.8	4.8	1,724.6	1.0
Three-year	-13.6	-0.5	238.6	3.6	1,846.8	1.0
Total	**-0.2**		**850.5**		**4,554.9**	

Source: Deloitte Economic Advisory estimates using ISTAT and Bank of Italy data.

[2] The model is estimated using yearly data from 1993 to 2018. The analysis is conducted using the econometric software STATA®

0.4 EUR/bn
Indirect Use Value

The indirect use value is estimated in terms of housing comfort as people derive welfare from living close to it.
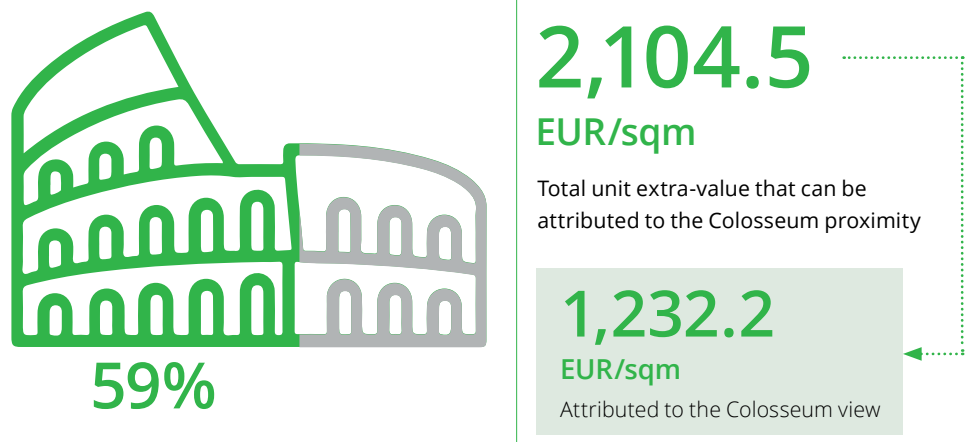
0.4 EUR/bn
Indirect Use Value

3 | Indirect use value

In addition to the direct use value, another element is given by the value derived from indirect use of the Colosseum, i.e. by securing some benefit from it. For example, the Colosseum may provide welfare to people just passing nearby and enjoying the scenery without spending money, or in the form of housing comfort as people derive welfare from living close to it. In the former example, the indirect use of the Colosseum is not captured by an economic or financial transaction. Market transactions related to the housing comfort can be instead observed, although indirectly, in the housing market.

In this section, we provide an estimate of the indirect use value of the Colosseum related to housing comfort. To this aim, we employ an indirect approach, and specifically the hedonic pricing method that seeks to elicit preferences from observed market based information. Hedonic pricing method is a surrogate market technique focused on markets for private goods and services whose price can be influenced by the cultural asset of concern. The hedonic pricing method is aimed at estimating the implicit price of a series of characteristics by looking at real markets in which they are effectively traded.

Figure 5. Description of the unit extra value components

2,104.5
EUR/sqm

Total unit extra-value that can be attributed to the Colosseum proximity

1,232.2
EUR/sqm

Attributed to the Colosseum view

59%

To find the demand function relating to the attribute of interest, it is necessary to first define the market commodity (e.g. housing) and the attributes of the market commodity (e.g. size, number of rooms, closeness to business and amenity areas, etc.). A functional relationship is then specified between the market price and all the relevant attributes of the market commodity. This function is called hedonic price function and it is estimated using regression techniques with data on the value and the relevant attributes of the property. Applying this method it is possible estimate the marginal implicit price of the attribute of interest.

The latter provides the additional amount of money that has to be paid by an individual to buy an identical market good with a higher level of that attribute.

In order to estimate the indirect use value of the Colosseum, we defined a regression model for the price per square meter as a function of elements relevant to potential buyers' decisions with regard to the dwellings located in the area surrounding the Colosseum. Data related to housing market transactions have been collected for different radial distances. The collected data includes announcement

date, type of contract, distance from the Colosseum, year of construction, square meters, number of rooms, car parking, floor, total number of floors in the building, presence or a lift, type of property, view on the Colosseum, price, and heating expenses. Detailed description of the data and the methodology is provided in Appendix D.

From our model, we estimated the implicit price of living in the proximity of the Colosseum as the marginal effect of the view of the Colosseum on the house prices, after controlling for all other relevant characteristics of the houses. The reason why we consider only the extra value of a house specifically enjoying the view of the Colosseum, instead of the higher extra value of simply living in its proximity, is to avoid overestimating the implicit price of living close to the Colosseum due to the presence of some other historical attractions in the same area. The result provides a measure of the additional value per square meters (sqm) due to the view.

The estimated value of the Colosseum view is 1,232 EUR per square meter. Then, we multiply this unit value by the number of total square meters of houses located in the surrounding area (called Archeological area) that can potentially benefit from the view. As shown in Table 7, our estimate of the indirect use of the Colosseum related to housing comfort is 406.1 EUR/mln.

Table 7. Indirect use value of the Colosseum

Unit extra value that can be attributed to the Colosseum (EUR/sqm)	Houses located in the surrounding area (sqm)	Housing comfort value (EUR/mln)
1,232.2	329,584	406.1

Source: Deloitte Economic Advisory

76.8 EUR/bn
Social Asset Value

The Social asset value of the Colosseum includes its Transaction value and Existence value (Non use value). The Social asset value is mainly given by the Non-use value (98%).

76.8 EUR/bn
Social Asset Value

1.1 EUR/bn
Transaction Value

75.7 EUR/bn
Existence Value

4 | Social asset value

In this section, we describe the estimation of the visitor and existence value of the Colosseum. In total, the visitor value and existence value constitute the total social asset value of the Colosseum. Visitor value is calculated using the market or social value given by the transaction value – the revenue from the sale of goods and services. In addition to the audience value, public institutions such as the Colosseum provide value to people who do not directly use their services. For example, the Colosseum contributes more broadly to the Italian culture and identity. To capture this value, we estimated the Colosseum's existence value, a measure of the value that even those who have never been to the venue may benefit from.

Transaction value

Each year, more than 7 million people from all over the World enjoy a visit to the Colosseum (MiBAC, 2019). These people pay an average of 10.2 EUR for their visit. The total transaction value for the Colosseum is about 75.3 EUR/mln as shown in Table 8. This consists of payments for tickets and a few possible additional services related to the visit such as guided tours, purchase of audio guides, ticket pre-sale rights, and royalties on gadgets sold at the bookshops.

Existence value

Another important element of the social asset value of the Colosseum is existence value, also known as cultural or iconic value. People may value the Colosseum as "iconic" or "symbolic", or may value the contribution of the Colosseum to the national culture. Thus, the welfare produced by cultural heritage like the Colosseum is certainly more than the financial benefits that it can produce. Benefits that are external to the market economy must be included too.

Non-use values have to be taken into account in contexts where an individual is willing to pay for a good, even though he or she does not make a direct use of it, does not directly benefit from it and cannot plan any future use for himself or others. Thus, since the economic

Table 8. Estimated total transaction values, 2019

	Transaction Value (EUR/mln)
Tickets	56.3
Additional services	19.0
Total	**75.3**

Source: Deloitte Economic Advisory.

contribution outlined in the previous section may not fully reflect the total contribution of the Colosseum to the welfare of the Italian community, in this section we also estimate the social value of the Colosseum.

Methodology and data

The most common method to quantify the non-use value of heritage is by estimating individual willingness to pay for its preservation through a stated preference technique such as contingent valuation (CV) and choice modelling (CM). These techniques are commonly used in Welfare economics, a sector of economic theory dealing particularly with the provision of public services and the

well being of the community. They are based on a survey conducted among a representative sample of the target population potentially interested in the heritage element.

Each individual in this sample is asked to reveal preferences about his or her maximum willingness to pay (WTP) to secure a public service or avoid its loss or deterioration. Please note that, compared to the analysis carried out in the previous section to quantify the actual (direct and indirect) use value, these methods are fundamentally different approaches to estimating the contribution to the total economic value. In fact, since non-use value is not revealed through a transaction, results for this value are more abstract than the economic contribution results.

Applied to a heritage asset like the Colosseum, stated preference techniques enable to estimate the economic value the society gives to the existence of the heritage, in order to quantify its social value. To this aim, we developed and fielded a survey of Italian residents and international visitors to Rome. This survey was administered online and designed to reveal attitudes towards the Colosseum, as well as to provide a way to estimate the value of the Colosseum that goes beyond its pure economic contribution to Italian GDP.

The questions focused around different main areas, such as general attitudes towards the Colosseum's contribution to Italy's national identity and Italian respondents' willingness to pay for the preservation of the Colosseum, as well as socio-demographic information. The full questionnaire and main descriptive statistics are available in Appendix F. In order to correct for survey design and non-response problems, survey results are weighted to reflect the overall Italian population.

It must be noticed that there are some limitations of using surveys to measure value. In fact, there may be differences between people's stated preference and their true preferences. Moreover, if respondents are only willing to pay what they think a service should cost, it may be difficult to estimate the benefits, leading to an underestimate of the true value. Finally, in practice there may be cognitive and perception limitations to stating preferences. Specifically, in our exercise we recognize it might be difficult to get the respondents to form a concrete view as to how much they will actually pay for the preservation of the Colosseum. Nonetheless, stated preferences techniques may yield valuable data to estimate non-use value, that cannot be otherwise obtained with other approaches.

To estimate the non-use value of the Colosseum we adopt the CV method as the preferred approach. At the end of this section, we show results using the CM as an alternative method to estimate the WTP. Specifically, we asked how much respondents would allocate to fund the preservation of the Colosseum by the mean of payment card elicitation. Payment cards present respondents with a visual aid containing a number of monetary amounts, from which respondents have to choose their maximum willing to pay.

Open-ended elicitation is instead known to have several limitations and drawbacks. In fact, typically it leads to large non-response rates, protest answers, zero answers and unrealistically large bids, and generally to unreliable responses. This is because it may be very difficult for respondents to come up with their true maximum WTP for a change they are unfamiliar with and have never thought about valuing before. For this reason, we used a payment card elicitation that provides a context to the bids, while avoiding starting point bias and reducing the number of outliers. Beside these advantages, this type of elicitation leads to a censoring of the willingness to pay of the respondent.

Consider for example an individual willing to pay a maximum of €27 per year to preserve the Colosseum. Since, with the proposed payment card she can only choose 25 or 30 euros, and €30 is greater than her maximum WTP, she will be likely to mark €25. Then, computing the simple average WTP from responses to this question is expected to underestimate the true willingness to pay due to this interval-censored data issue. For this reason, we used an interval regression model to estimate average WTP. This model is a generalization of the Tobit model because it extends censoring beyond left-censored data or right-censored data to the case of interval-censored data. A detailed description of the methodology used to estimate the non-value use is provided in Appendix E.

Table 9. Willingness to pay for the preservation of the Colosseum (contingent valuation method)

	Average WTP (EUR)	Total WTP (EUR/mln)
Rome	89.6	212.6
Rest of Italy	56.9	2,723.2
Italy	58.4	2,935.9

Source: Deloitte Economic Advisory.

Non-use value

In our estimation of the non-use value of the Colosseum, we allow average per person WTP to differ between residents in Rome and other Italian residents. Table 9 shows estimated Willingness to pay for the preservation of the Colosseum. According to our estimates, on average the respondents suggested a yearly funding of 58.4 EUR per person for the preservation of the Colosseum. Note that the estimated WTP is higher for residents in Rome (89.6 EUR) than for people living elsewhere in Italy (56.9 EUR). Nationwide, considering the 18 years or older Italian residents, this is equivalent to about 2,936 EUR/mln per year.

An alternative WTP estimate using the CM method

As outlined above, an alternative method to estimate the WTP for the non-use value of the Colosseum is the choice modelling. An established result in the literature on methods to elicit preferences, is that the willingness to pay is typically lower (even much lower) when estimated using the CV relative to estimates from the CM. Such a divergence of WTP estimates is actually due to the fact that the CV estimates will tend to be biased downward, and the CM estimates will tend to be biased upward (see, for example, Carson, Groves and Machina, 1999; Boyle et al., 1996; Hoehn and Randall, 1987; Whitehead 2006).

We also estimated the WTP for the preservation of the Colosseum using the CM approach. This method builds upon the specification of an indirect random utility. A detailed description of the CM methodology and the corresponding random utility model is provided in Appendix E. The exact choice experiment question, presenting respondents with a baseline scenario corresponding to the status quo and different alternative options for the preservation of the Colosseum, is reported in Appendix F. Again, we allow average per person WTP to differ between residents in Rome and other Italian residents[3].

According to our estimates, the average WTP for the preservation of the Colosseum is 167 EUR. The CM method confirms that the estimated WTP is higher for residents in Rome (190.1 EUR), than for other Italian residents (165.8 EUR). Nationwide, considering the 18 years or older Italian residents, this corresponds to about 8,388 EUR/mln per year. Thus, as expected, the CM estimate results in a higher value for the WTP compared to CV[4]. To maintain a conservative approach, we decided to adopt the CV method as the preferred approach to the estimation of the non-use value of the Colosseum.

Total social asset value

Overall, we estimated the Colosseum has a total social asset value at a 100-year NPV[5] of 76.8 EUR/bn. Table 10 provides a detailed summary of estimated annual and asset values of the total social asset value of the Colosseum.

Table 10. Estimated total social asset value of the Colosseum

Components		Annual values (EUR/bn)	Asset values (100 year NPV, EUR/bn)
Social Asset Value	Transaction Value	0.1	1.1
	Non Use Value (Existence Value)	2.9	75.7
	Total	**3.0**	**76.8**

Source: Deloitte Economic Advisory.

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[3] Specifically, we allow both the marginal utility of preservation and the marginal utility of money to vary between residents in Rome and all other Italian residents.

[4] Please note that CV and CM estimates are not perfectly comparable, because the CV question is based on a generic preservation of the Colosseum, whilst the CM question presents choices among specific alternative preservation programs. Nevertheless, the difference in estimated WTP between the two methods is in the expected direction.

[5] A sensitivity analysis to the choice of the discount rate is provided in Appendix G.

5 | The economic and social value

Considering both its direct operation and induced tourism, we estimated that the direct use of the Colosseum generates in total 1,390.5 EUR/mln a year in value added to the Italian economy. Moreover, the Colosseum is estimated to support the employment of about 42,700 people on a full-time equivalent (FTE) basis. In addition to the direct use value, we estimated that the indirect use value of the Colosseum, in terms of housing comfort for residents, is 406 EUR/mln.

Note that, unlike the direct use value, this is not an annual figure. Finally, we estimated that the Colosseum total social asset value, including transaction and existence value, is 76.8 EUR/bn. Table 11 provides a detailed summary of estimated annual and asset values of the economic and social value of the Colosseum.

Table 11. Estimated economic and social asset value of the Colosseum

Components		Annual values (EUR/mln)	Asset values (EUR/mln)
Economic Contribution	Direct Economic Contribution	63.3	
	Indirect Economic Contribution	37.5	
	Tourism	1,289.6	
	Total	**1,390**	
Employment (FTE supported)	Direct Economic Contribution	155	
	Indirect Economic Contribution	1,062	
	Tourism	41,483	
	Total	**42,700**	
Indirect Use Value			**406**
Social Asset Value	Transaction Value	75	1,101
	Non Use Value (Existence Value)	2,936	75,672
	Total	**3,011**	**76,773**

Source: Deloitte Economic Advisory.

6 | The future of the asset

The Colosseum provides significant economic and social value to Italians, and to the World community. Thus, it is important to protect this icon, and possibly find new ways to keep growing the value it provides. In this chapter we will provide a brief discussion aimed at stimulating the reflection on the valorization of the Colosseum and how its future valorization might be shaped. To this aim, we start by simply comparing the Colosseum with another iconic, yet modern, asset, namely the Sydney Opera House in Australia. Finally, we provide a brief description of possible risks and opportunities related to the future of the Colosseum, and of its economic and social value.

The Colosseum and an iconic modern building

We start with a simple comparison of the Colosseum with a modern building, namely the Sydney Opera House (SOH) in Australia.

As previously described, operation of the Colosseum is mainly related to tourists visiting the Colosseum and a few additional services related to the visit such as guided tours, purchase of audio guides, ticket pre-sale rights, and royalties on gadgets sold at the bookshops. Since the Sydney Opera House is a recently constructed building, differently from the Colosseum, it has the possibility to host a plurality of events and to host numerous retailers as seen from Table 12.

Table 12. Retailers at the SOH

Resident performing arts companies	Bar, restaurants and retailers
Australian Chamber Orchestra	Opera Bar
Bangarra Dance Theatre	Opera Kitchen
Bell Shakespeare	Bennelong
Opera Australia	Portside
Sydney Symphony Orchestra	Theatre bars
Sydney Theatre Company	Function catering
The Australian Ballet	Green Room
	Sydney Opera House retail

Source: Deloitte Access Economics.

Considering the average economic contribution per international visitor of the two assets (Figure 7), both direct and indirect economic contribution from operation is much higher for SOH as compared to the Colosseum. For the Colosseum, revenues are essentially related to visits, whilst for SOH revenues are mainly related to performances.

Different from the economic contribution from operation, the induced tourism contribution per international visitor is instead slightly higher for the Colosseum than for SOH (293 vs 266 EUR/ international visitor), as shown in Figure 8.

As anticipated, the overall economic contribution is composed by direct and indirect economic contribution from operation and by the induced tourism contribution. The total economic contribution (Figure 9) is higher for the Colosseum than for SOH (1.4 EUR/bn vs 1.1 EUR/bn).

Figure 7. Direct and indirect economic contribution per international visitors: Colosseum vs SOH (EUR/int. visitor)

	SOH	Colosseum
Direct economic contribution from operation	67.7	14.4
Indirect economic contribution from operation	57.5	8.5
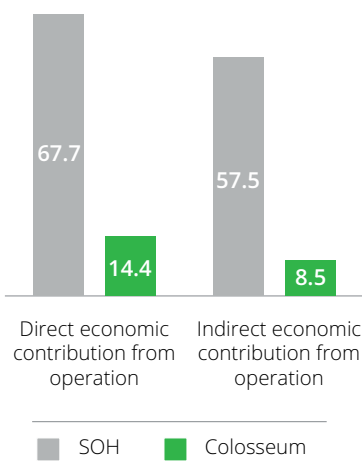
Source: Deloitte Economic Advisory and Deloitte Access Economics

Figure 8. Induced tourism contribution per international visitors: Colosseum vs SOH (EUR/int. visitor)

	SOH	Colosseum
Induced tourism contribution	266.1	293.1
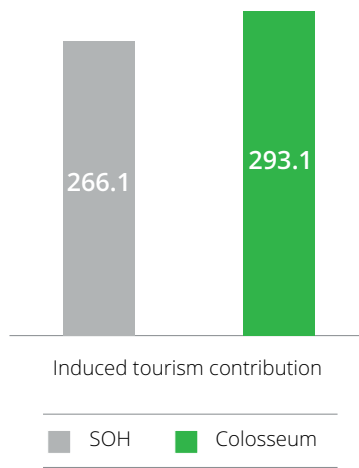
Source: Deloitte Economic Advisory and Deloitte Access Economics

Figure 9. Economic contribution: Colosseum vs SOH (EUR/mln)

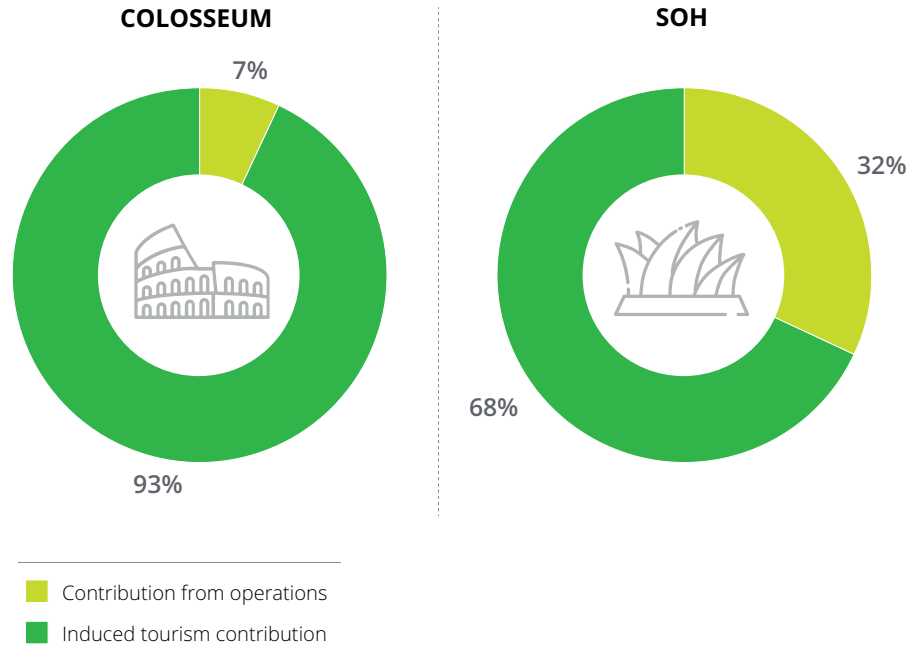|	SOH	Colosseum
Economic contribution	1,135	1,390

Source: Deloitte Economic Advisory and Deloitte Access Economics

Looking at the composition of the total value (Figure 10), the share of total economic contribution represented by induced tourism is much higher for the Colosseum (93%) than for SOH (68%). The high number of international visitors attracted by the Colosseum certainly plays an important role in this aspect.

Whilst the difference in economic contribution in terms of value added to the economy is quite small, the social asset value of the Colosseum is more than 10 times that of the SOH. About 98% of the social asset Value of the Colosseum is represented by the Existence value, also known as cultural or iconic value (75.2 EUR/bn), whilst Existence value only represents about 36% of the of SOH's social asset value.

Although the Colosseum has a much higher social asset value, it should be noted that the calculations have a number of different methodological assumptions, around discount rates, number of years, and precise survey questions, so the results are not directly comparable.

Figure 10. Economic contribution: Colosseum vs SOH

COLOSSEUM

7%

93%

SOH

32%

68%

■ Contribution from operations
■ Induced tourism contribution

Source: Deloitte Economic Advisory and Deloitte Access Economics

Risks and opportunities

Finally, we provide a brief description of possible risks and opportunities related to the future of the Colosseum, and of its economic and social value. The main strengths of the Colosseum are represented by its high attractiveness for, especially foreign, tourists, its high existence value and its uniqueness and representativeness as an Italian cultural heritage asset.

A number of risks could impact the value of the Colosseum. For instance, as the building is ageing, the main risks are represented by conservation risks and economic sustainability risks. In particular, the soil on which the Colosseum was built is partly alluvial formation and part of damages are due to past earthquakes and intentional demolitions protracted over many centuries. Thus, it's clear how critically important it is to invest in maintenance. Moreover, the economic sustainability risk was particularly substantiated by the spread of Covid-19 pandemic in 2020: the long period of closure of the archaeological site caused a sudden setback to the intensive enhancement program.

Regarding these risks, it is then extremely important to invest in order to prevent or mitigate them. In general, as long as economic sustainability is confined to the market, the related risk turns out to be high. Regarding this aspect, the "Parco Archeologico del Colosseo" (Colosseum Archaeological Park), since its establishment in 2017 with the main purpose to ensure the protection and valorization of the central archaeological area of Rome, is increasingly investing in fund raising activities, such as Memberships, Sponsorships and donations.

On the other hand, there is a number of opportunities to enhance the economic and social value of the Colosseum. This includes for example investments in digital technology, metaverse ecosystem and improvements about its educational outreach.

Investments in digital is another way that the Parco Archeologico del Colosseo is increasing the value of the Colosseum. In recent years, the Parco Archeologico del Colosseo has in fact encouraged and boosted the development of digital offers, not meant as mere substitutes to in-person visits, but designed to be extensions thereof, offering new experiences just as engaging and immersive. The increased virtual access to the Colosseum is also particularly important for regional and disadvantaged Italians, and people from all over the World, who are unable to access the Colosseum.

In addition to this, the introduction of the Colosseum to the metaverse ecosystem (as it was started for the Domus Aurea) could have multiple benefits such as experiencing the metaverse ecosystem under a significantly more educational key than the current one (gaming) and making the cultural heritage of the archaeological park accessible to individuals from around the world who are unable to travel.

Finally, education is correlated with a range of positive outcomes and benefits for individuals, including better lifetime wages and better health, stronger civic engagement. In recent years, the Education, Teaching and Training Service of the Parco Archeologico del Colosseo carried out educational and training work and fostered the knowledge of the cultural heritage, with a series of activities mainly aimed at lower and upper secondary school students, as well as at university students. By offering creative experiences and educational opportunities to young people provides engagement with culture and history and foster more creative thinking and innovation.
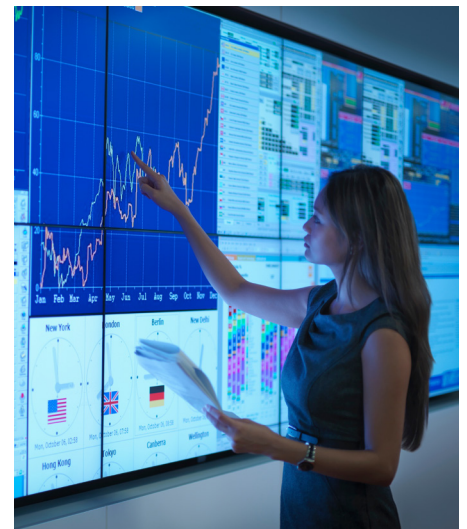
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Appendix A

Review of the literature on economic analysis of historical and cultural assets

In this section, we report a brief review of the literature on economic analysis of cultural or natural heritage assets.

Deloitte Access Economics provided a valuation of two different iconic assets respectively belonging to cultural and naturalistic heritage, namely the Sydney Opera House (SOH) and the Great Barrier Reef (GBR). The report relative to the SOH (2013, updated in 2017) is aimed at estimating the economic, cultural, brand and digital value of this asset. In addition to the economic contribution of the SOH, for those Australians that do not necessarily attend a performance, it is also estimated a cultural and icon value with the support of Stancombe Research & Planning. In comparison with the first report, the updated one has registered an increase in the social asset value equal to 24%.

The economic contribution of the GBR was estimated from the economic activities that occur as part of tourism, commercial fishing and aquaculture production, recreational activities and scientific research, in terms of value added to economy and employment supported. The social, cultural and icon value for non-users was estimated through a survey of over 1,500 Australians and international residents. Non use value represents slightly less than half of total economic, social and icon value of GBR.

For what concerns the estimation of indirect use values, the literature shows that the application of hedonic pricing is well established for the valuation of assets belonging to the real estate market and that the application of this method has recently been borrowed from the market for cultural assets. Belniak and Wieczorek (2017) apply this method to valuate a set of flats in Lublin. Results implies that the values estimated through the application of this model may be substantially different from the observed transaction prices. It has to be noted that the model does not take into account features such as neighborhood conditions.

Lazrak et al. (2014) provide one of the first applications using a spatial autoregressive model to investigate the impact of cultural heritage (in particular listed buildings and historic or cultural sites) on the value of real estate in cities. The effect of cultural heritage is measured by a specific heritage variable given by the number of listed buildings in a 50-m radius. The main findings are that structural characteristics have a positive and significant effect, spatial characteristics are also significant and listed heritage makes a positive and significant contribution to the house value approximately equal to 21% over non listed heritage.

Regarding to the estimation of non use value, Bateman et al. (2002) provide an in-depth analysis relating the application of stated preferences techniques to economic valuation. In particular, they focus on all the steps needed to implement a stated preference study for both contingent valuation and choice modelling, even though they differ in terms of questionnaire design and data analysis.

Beltran and Rojas (1996) apply the CVM to estimate people's WTP for consumption and preservation of three archeological sites in Mexico. Results show that the WTP for visitors who paid an entrance fee is significantly higher than the WTP estimated for non-paying visitors and that there is a significant dispersion in WTP expressed by the respondents, thus a price discrimination strategy is recommended to face the problem of the decline incurred in resources provided by the government to the cultural heritage sector.

Hansen (1997) estimates the aggregated WTP for the Royal Theatre using a sample of 1,843 Danes. Results show two main findings: the estimated aggregated WTP is not lower than the amount received by theatre in terms of public subsidies; even though the majority of Danish population never visit the theatre,

they are willing to pay an option-price for the possibility of being able to visit it in the future, thus it can be affirmed that the theatre has also a non-use value.

Choi et al. (2010) employs choice modelling to study Old Parliament House (OPH) in Canberra. Salazar and Marques (2004) apply CVM to estimate the social benefits that stem from the restoration of an old Arab tower in the Valencia Region of Spain. The main finding is that people were willing to pay much more than the expenditure per capita devoted to the protection of cultural heritage goods in Valencia Region.

Ruijgrok (2006) shows that the economic benefits of conserving the most threatened types of cultural heritage surpass the costs, estimating three different benefits, namely a housing comfort value, a recreational value and a bequest value. The first one is calculated through the application of hedonic pricing method while the second and the third through the application of the CV.

Diafas et al. (2017) carry out a choice experiment (CE) in order to estimate the economic value of changes in ecosystem services that impact on the welfare of rural communities close to a rainforest in Kenya measuring indirect use value of the forest and its bequest value.

Appendix B

Economic contribution from actual use: methodology

Economic contribution is intended to quantify measures such as value added and employment associated with a given industry or firm, in an historical reference year. The economic contribution is a measure of the value of production by a firm or industry. Value added (VA) is the most appropriate measure of an industry or company economic contribution to gross domestic product (GDP) at the national level. Value added measures the value of output (i.e. goods and services) generated by the entity's factors of production, such as labor and capital, as measured in the income to those factors of production. Since the sum of value added across all entities in the economy equals GDP, the value added can be thought of as the increased contribution to welfare. A different measure of activity is employment, which measures the number of workers employed by the entity, rather than the value of the workers' output.

The direct economic contribution is a representation of the flow from factors in the company. These direct effects from the initial spending creates additional activity in the local economy, generating indirect and induced effects. Indirect effects are the results of business-to-business transactions indirectly caused by the direct effects.

Businesses initially benefiting from the direct effects will subsequently increase spending at other local businesses. The indirect effect is a measure of this increase in business-to-business activity (not including the initial round of spending, which is included in the direct effects).

Furthermore, induced effects are the results of increased personal income caused by the direct and indirect effects. Businesses experiencing increased revenue from the direct and indirect effects will subsequently increase payroll expenditures (by hiring more employees, increasing payroll hours, raising salaries, etc.). Then, households will increase spending at local businesses.

The induced effect is a measure of this increase in household-to-business activity. The total economic contribution of the Colosseum includes both its direct, indirect and induced contribution to value added.

The methodology for evaluating the indirect and induced economic impacts generated from the direct effects is carried in an input-output (IO) framework, relying on the key contribution of Tourism Satellite Accounts (TSA), which give the most accurate and reliable measurement of the role of tourism in an economy, yet recognizing the consumer driven nature of the sector.

The TSA methodology developed by the World Tourism Organization (WTO) is essential for obtaining accurate measurements of the impact of tourism. Alongside the TSA-based analysis, it is possible to evaluate the expected impacts of tourism by calculating its multiplier effects. The TSA concept is based on the principles of National Accounts, an integrated statistical framework that measures a country's national output from each sector's contribution to economic activity. The TSA is prepared by extending the system of National Accounts in order to estimate the specific economic importance of tourism by reconstituting the tourism branch. The TSA is based on input/output tables which measure the activity of producers and purchasers of goods and services across the spectrum of economic sectors.

From the TSA, it is thus possible to evaluate tourism consumption and output and to estimate tourism's added value in a country's economy. In our analysis we use data from Italian TSA maintained by the Italian National Institute of Statistics (ISTAT) according to international guidelines and standards. Although indirect and induced effects cannot be calculated immediately from provided data, it provides the basis for measuring the direct and indirect effects of tourism, using intermediate consumption and compensation derived from tourism output. The TSA can also be used to evaluate tourism-related employment. In this case, employment generated by tourism includes only jobs directly attributable to tourism. The TSA thus spans both tourism consumption and tourism output.

Table B1 shows the Keynesian multipliers for the tourism sector used in this report. These were actually used to estimate the value added and the employment from tourism expenditure related to the Colosseum. Total effects on both value added and employment are given by the sum of direct, indirect and induced effects.

The ratio of total to direct contribution compares the total, i.e. direct, indirect and induced, value added or employment created by tourism expenditure with the direct value added, or employment it supports. For example, a ratio of total to direct value added equal to 1.85 means that if the direct value added contribution was 100 EUR, the indirect and induced value added would be 85 EUR.

Table B1. Multipliers for tourism sector

	Direct	Ratio total to direct
Value added	0.59	1.85
Employment (FTE)	20.74	1.68

Source: Deloitte Economic Advisory estimates using CISET, ISTAT and Bank of Italy data

Appendix C

Tourism data and estimation of the Colosseum's contribution to tourism

The first step in assessing the Colosseum's contribution to tourism is the analysis of the profile and the level of expenditure of both domestic and international visitors on different categories of expense. Specifically, we will analyze the amount spent by tourists for:

· Local transportation ("Local transportation")

· Accommodation ("Accomodation")

· Food & Beverage ("Food")

· Purchase of goods in stores ("Shopping")

· Cultural and entertainment services ("Culture & Entertainment")

Unfortunately, we do not observe directly data about the Colosseum's visitors expenditure on the different categories. Nonetheless, our approach is to estimate such an expenditure for both international and domestic visitors who visited the city of Rome in 2019 reporting "cultural vacation" as the main reason of their journey. Data used to estimate tourism expenditure related to international and domestic visitors comes from two different sources. The first is the survey on "International Tourism in Italy" conducted annually by the Bank of Italy. Since this survey only covers international tourism at the country's main border crossings, it can be used to estimate the expenditure related to inbound tourism. The second source is the survey on "Trips and holidays" conducted by Italian National Institute of Statistics (ISTAT). This data is used to estimate the expenditure of domestic tourists. Both surveys are conducted in accordance with international standards.

Since 1996 the Bank of Italy conducts a sample survey on international tourism at the country's main border crossings for balance-of-payments and analysis purposes. Each year a sample of international travelers (both foreigners in Italy and Italians abroad) who have crossed Italy's borders is interviewed; counting operations are carried out in order to determine the size of the reference population.

Since 1996 the Bank of Italy annually conducts a survey entitled "International Tourism in Italy" in order to determine the tourism balance of payments. The main aim of this survey is to monitor travel expenditure and length of stay of inbound and outbound visitors from/to Italy. Travel expenditure includes the total consumption of goods and services made in the country visited divided into five expenditure categories. The inbound-outbound frontier survey is the technique adopted for the collection of the data. A stratified sampling method was applied (using different type of stratified variables per each type of frontier), and face–to–face interviews are made at national borders (including highways, railway, airports, and harbors).

Sampling is carried out independently at each type of frontier. Tourists are interviewed at the end of the trip, when they are returning to their place of habitual residence.

Interviews are conducted in different moment of the day, during both working days and holidays, and month by month with a fixed number of interviews per each period of survey. The questionnaires are anonymous, and written in 14 languages. The questionnaire can be divided into four main sections, namely socio–demographic characteristics of the respondents (gender, age, occupation, and residence), information about the trip (number of nights spent during the trip, type of accommodation, cities visited, etc.), information about the expenditure (total expenditure divided into different categories of expenditure, means of payment), and level of satisfaction with different aspects of the trip and overall satisfaction with the destination.

The survey offers detailed information on the amount of money spent in the five main categories of a typical travel budget, namely accommodation (hotel, apartment for rent, campsite, etc.), food and beverage, internal or local transportation, shopping (including souvenirs, gifts, clothes, etc.), and entertainment (like museums, shows, guided excursions, etc.).

Data used to estimate the expenditure of domestic tourists comes from the survey on "Trips and holidays" conducted by the Italian National Institute of Statistics (ISTAT). The survey is part of the Households Budget Survey and its main purpose is to collect information on the tourist flows of Italian residents, providing data on number of tourists, tourist trips, overnight stays, and amount of expenditure. The survey is conducted monthly and it allows accounting for the seasonality of the tourist phenomena. The sample households are selected using a two-stage stratified sampling method, with first-stage units represented by Italian municipalities and second-stage units represented by households. The interview is conducted with CAPI technique (Computer Assisted Personal Interview). Data on the trips related to every member of the household in the reference period are collected.

Using data from the two surveys described above, we are able to identify foreign and domestic visitors who visited the city of Rome in 2019. Specifically, we restricted our analysis to tourists who visited the city of Rome in 2019 and who reported the label "cultural vacation" as the main reason of their journey. Thus, we are able to identify very precisely a representative sample of visitors for whom we want to estimate tourism related expenditure.

After selecting these specific visitors, we estimated their average per person expenditure.

Specifically, our approach to estimate the Colosseum's induced tourism expenditure consists of two main steps. First, we estimated the share of visitors of the Colosseum that would not otherwise visit Rome, or at least would not stay for the same length of time. Then, we estimated the average tourism expenditure for both international and

domestic tourists who visited the city of Rome in 2019 for a cultural vacation. Our estimate of the broader tourism expenditure that can be attributed to the Colosseum is thus given by the product of this average tourism expenditure and the number of visitors of the Colosseum that would not otherwise visit Rome[6]. In order to implement our approach, we estimated the share of international visitors on total visitors is 60% (source: the Regional Tourism Organization of Latium - EBTL).

[6] This approach relies on the assumption that the average tourism expenditure of Colosseum's visitors does not systematically differ from the average tourism expenditure of tourists visiting Rome for "cultural vacation".

Table C1 shows the results of a model for the relationship between the number of nights and total tourism expenditure of both domestic and international visitors and visitors characteristics.

Table C1. Estimated coefficients of the regression model for average length of stay and average expenditure (EUR) per person per day of domestic and international visitors

	Domestic visitors		International visitors	
	Number of nights	**Total expenditure**	**Number of nights**	**Total expenditure**
January	-3.78 ***	67.24	-0.85 ***	-24.25 **
February	-0.39	61.77	-0.98 ***	-22.87 **
March	-3.07 **	74.89 *	- 0.85 ***	-20.71 **
April	-3.58 **	141.53 ***	-0.61 ***	-1.32
May	-2.85 **	98.66 **	-0.31	11.40
June	-3.02 **	37.19	-0.69 ***	9.56
July	-1.51	27.71	-0.21	2.23
September	-2.18 *	11.70	-0.22	-14.21 *
October	-3.22 *	22.77	0.29	-8.64
November	-1.82	84.53	-1.18 ***	-11.46
December	-3.53 **	144.76 ***	-0.48 *	-14.63
Manager	-0.48	-18.30	0.22	23.16 ***
Industrial worker	-1.23	36.28	-0.96 ***	-83.20 ***
Self-employed	2.97 *	-11.86	-0.18	-17.38 **
Student	-0.86	-22.47	0.22	-52.00 ***
Retired	0.79	90.02 **	-0.56	-101.60 ***
Other	-0.37	14.99	-0.63 ***	-19.55 ***
Age 15-24	0.03	37.10	-1.50 ***	-158.70 ***
Age 25-34	1.28	82.78 ***	-1.34 ***	-134.47 ***
Age 35-44	0.22	-12.06	-0.97 ***	-63.99 ***
Age 65+	-0.68	-58.70	0.54	-5.70
Constant	5.35 ***	25.62	7.20 ***	366.08 ***

*NOTES: Deloitte Economic Advisory estimates using data from Bank of Italy International Tourism survey and ISTAT Trips and Holidays survey. Coefficients: * significant at 10%, ** significant at 5%, *** significant at 1%. The constant refers to the average expenditure of a representative tourist, who is an employee between 45 and 64 years old, visiting Rome in August 2019. All regressors are binary variables (dummy) and their coefficients can be interpreted as the difference in average expenditure between the category they represent and the representative tourist.*

In addition to total per person expenditure, we also estimate expenditures separately for the five main categories of tourism expenditure, namely accommodation, food and beverage, internal or local transportation, shopping, and entertainment. Table C2 shows the results of a model for the relationship between tourism expenditure on different categories and visitors characteristics.
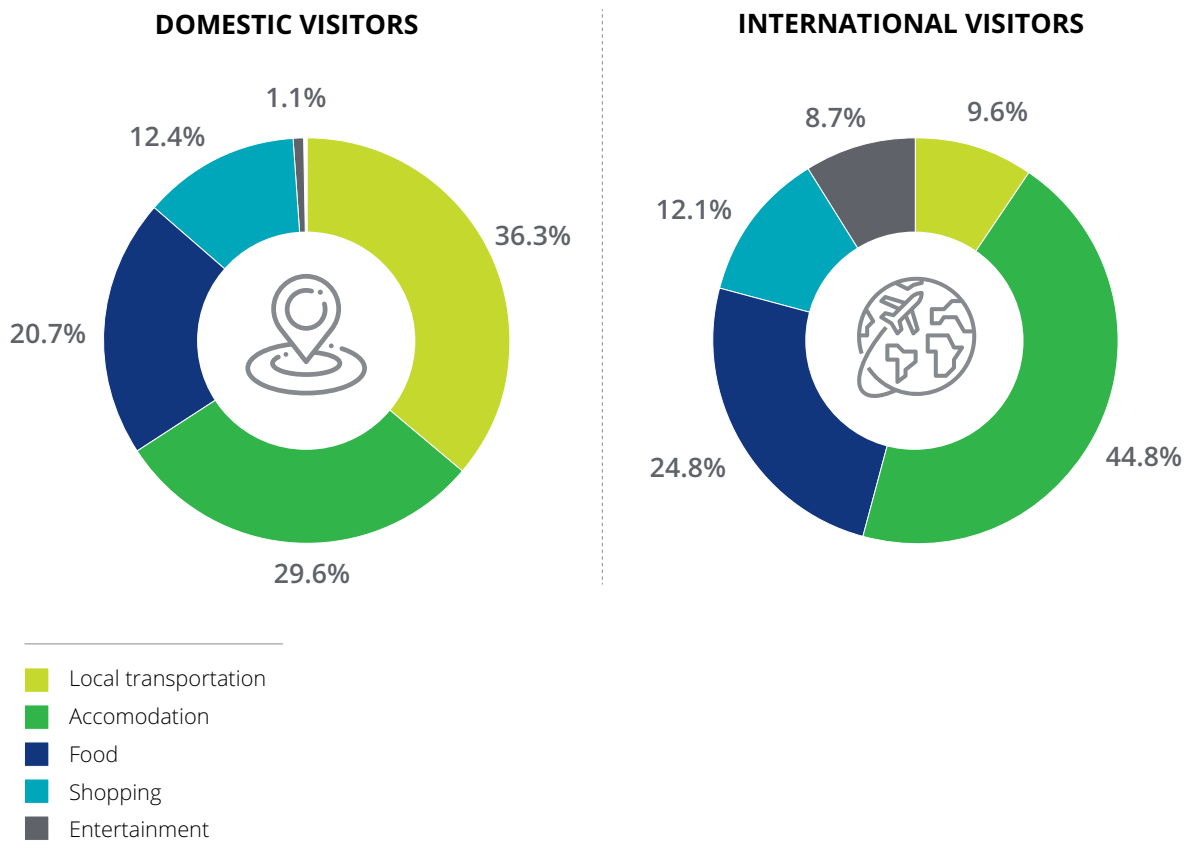
Table C2. Estimated coefficients of the regression model for average expenditure by category (EUR) per person per day of international visitors

	Local transportation		Accommodation		Food		Shopping		Entertainment	
January	-1.29		-21.22	***	-5.87	**	3.02		1.10	
February	-1.19		-23.16	***	-3.49		2.65		2.33	
March	-3.29	***	-23.00	***	-2.17		3.27		4.48	***
April	1.11		-10.28	**	2.00		1.52		4.33	***
May	0.75		-10.88	***	4.39	*	7.82	***	9.32	***
June	1.10		-0.52		4.26	*	3.52		1.21	
July	1.50		2.70		0.20		-1.51		-0.66	
September	1.47		-22.33	***	2.80		3.48		0.38	
October	3.87	***	-26.66	***	9.51	***	2.63		2.01	
November	3.49	***	-26.47	***	3.02		6.16	*	2.34	
December	-1.21		-11.72	**	-1.35		5.77		-6.12	***
Manager	3.47	***	9.67	***	3.94	**	2.65		3.43	***
Industrial worker	-6.93	***	-36.59	***	-17.80	***	-9.18	*	-12.69	***
Self-employed	-1.25		-15.07	***	-2.44		8.59	***	-7.22	***
Student	-1.96		-26.84	***	-11.75	***	-4.38		-7.07	***
Retired	-7.68	***	-44.11	***	-11.49	**	-23.09	***	-15.23	***
Other	-2.11	***	-11.33	***	4.28	***	-4.65	**	-5.74	***
Age 15-24	-14.71	***	-74.52	***	-24.19	***	-22.74	***	-22.55	***
Age 25-34	-11.14	***	-64.92	***	-20.44	***	-17.75	***	-20.22	***
Age 35-44	-5.53	***	-30.00	***	-9.73	***	-8.57	***	-10.16	***
Age 65+	-1.50		6.97		-14.97	***	2.48		1.32	
Constant	32.09	***	175.88	***	76.24	***	41.68	***	40.19	***

*NOTES: Deloitte Economic Advisory estimates using data from Bank of Italy International Tourism survey and ISTAT Trips and Holidays survey. Coefficients: * significant at 10%, ** significant at 5%, *** significant at 1%. The constant refers to the average expenditure of a representative tourist, who is an employee between 45 and 64 years old, visiting Rome in August 2019. All regressors are binary variables (dummy) and their coefficients can be interpreted as the difference in average expenditure between the category they represent and the representative tourist.*

Since for domestic visitors we do not have detailed expenditure data separately by category, we estimated the share of total expenditure for each category using data from TSA. Figure C1 shows the share of total tourism expenditure for domestic and international visitors by category.

Figure C1. Share of total tourism expenditure for domestic and international visitors by category

DOMESTIC VISITORS

1.1%
12.4%
36.3%
20.7%
29.6%

INTERNATIONAL VISITORS

8.7%
9.6%
12.1%
44.8%
24.8%

- Local transportation
- Accomodation
- Food
- Shopping
- Entertainment

Source: Deloitte Economic Advisory estimates using data from Bank of Italy International Tourism survey an ISTAT Trips and Holidays survey.

Appendix D
Revealed preferences: methodology

To estimate the indirect use value of the Colosseum related to housing comfort for residents, we employ an indirect approach, and specifically the hedonic pricing method. Hedonic pricing method is a surrogate market technique focused on markets for private goods and services whose price can be influenced by the cultural asset of concern. The hedonic pricing method is aimed at estimating the implicit price of a series of characteristics by looking at real markets in which they are effectively traded. To find the demand function relating to the attribute of interest, it is necessary to first define the market commodity (e.g. housing) and the attributes of the market commodity (e.g. size, number of rooms, closeness to business and amenity areas, etc.). A functional relationship is then specified between the market price and all the relevant attributes of the market commodity. The functional form of the hedonic regression equation can be linear, semi-logarithmic or log-log. The most common form is the semi-logarithmic one, which has the advantage that the coefficient estimates are proportions of the price that are directly attributable to the respective characteristics. The advantage of the log-log form is that the hedonic regression equation estimates the elasticities relative to each considered characteristic; finally, taking logs of the dependent variable allows to take into account that prices are not negative (Herath and Maier 2010).

In general, this relationship may be described with the use of the following function:

$$P_i = f(X_i, \alpha_i, \varepsilon_i)$$

where:

X_i is the vector of the characteristics of the good i

α_i is the vector of parameters

ε_i is the disturbance term (Belniak 2017)

This method is commonly used in real estate sector, but there are also a body of researches that apply hedonic regression to analyse the pricing of collectible objects, such as art works (Galbraith 2018), and to assess the value of heritage assets in urban areas (Lazrak et al. 2014) and of public parks (Engstrom & Gren 2017).

Data from a wide range of different properties are required and these data have to be accompanied by the information on all features that influence the properties' value (such as, for housing market, structural characteristics, neighborhood characteristics and the property values themselves).

For what concerns the choice of hedonic price function, two questions should be asked about which properties it should possess:

1. Whether the marginal implicit price of the attribute of interest is independent from the levels of the other attributes of the market commodity.

2. Whether the slope of the implicit price function should be linear or not (Pearce 1994).

In addition to the economic contribution the Colosseum also provides welfare in the form of housing comfort. People derive welfare from living in a historical surrounding. This welfare is reflected in real estate prices. It is usually not accounted for in valuation studies on heritage.

The variable of main interest is an indicator for the apartment having a view of the Colosseum. Table D.1 provides the results of the hedonic regression model for the logarithm of price. The statistically significant coefficients are the ones for the following regressors: distance within 800 metres, car parking, floor -1, floor 0, floor 1, excellent condition, last floor and the Colosseum view. We estimated that the house prices with Colosseum view are about 17.5% higher.

Then, we estimated the impact of the Colosseum view as the average partial effect of the dummy view. The result provides a measure of the additional price per square metres due to the presence of the view. Then, this value has been used to estimate the value of the view of the Colosseum taking into account the number of sqm of buildings located in the surrounding area that could benefit from the view.

Table D1. Estimated coefficients of the model for the logarithm of price

Variables	Coefficients	
Colosseum view	0.175	***
Distance>800mt	-0.146	***
Car parking	0.187	**
Basement	-0.755	***
Ground floor	-0.287	***
Floor 1	-0.179	***
Floor 2	-0.101	
Floor 4+	-0.098	
Lift	-0.043	
To be refurbished	-0.111	*
Just refurbished	0.105	**
Top floor	0.155	**
Constant	8.844	***
Obs.	256	
R-sq	0.332	

*NOTES: Deloitte Economic Advisory estimates. Coefficients: * significant at 10%, ** significant at 5%, *** significant at 1%. The constant refers to the average log price per sqm of a representative house, that is a 3rd floor house within 800mt from the Colosseum, without car parking and lift and with no Colosseum view. All regressors are binary variables (dummy) and their coefficients can be interpreted as an approximation of the percentage difference in average price between the category they represent and the representative house.*

Appendix E

Stated preferences: methodology

In order to estimate non-use value, economists apply methods of measuring individual preferences, such as Contingent Valuation Method (CVM) and Choice Modelling (CM): these methods belong to the direct approaches to valuation, which attempt to elicit preferences directly by the use of surveys and experimental techniques (Pearce 1994). In particular, CVM seeks measures of WTP through direct questions (such as "What are you willing to pay?" and "Are you willing to pay X USD?", while CM seeks to secure rankings and ratings of alternatives from which WTP can be inferred. Once elicited values, econometric techniques are applied to survey results to find the mean WTP. CM may avoid some of the response difficulties that can be found in CV: for example, dichotomous choices in CV may be subject to "yea-saying", with respondents giving affirmative but probably false responses; CM avoids this limitation because it provides respondents with a plurality of chances in the interview to express a preference for the asset to be valued over a range of payment amounts (Pearce et al. 2002).

There are three basic parts to most CV survey instruments:

· A hypothetical description of the terms under which the asset is to be offered.

· The respondent is asked questions to quantify both the WTP to obtain an improvement in the provision of the asset compared to the level currently provided, both the willingness to accept (WTA) an economic compensation in case the asset would be no longer usable or it would suffer a loss in terms of usability (Ventura 2005).

· Response validity is tested by relating WTP responses to socio-economic and demographic characteristics.

Choice modelling differs from CV in that it asks for rankings or ratings rather than for values. In analyzing data obtained from the application of CM, the first step towards the formulation of the econometric model is represented by the specification of the indirect utility function that relates attribute levels, costs and individual characteristics to the utility enjoyed. To complete the econometric model, analysts have to add a random element to the indirect utility function (this random element is aimed at capturing the differences the true utility of an option and the estimated utility): the inclusion of the random element explains the use of the title "Random Utility Model" (RUM). When formulating a RUM, the researcher has to decide between:

· The functional form of indirect utility function

· The probability distribution of the random elements

Contingent valuation and the interval regression model

To estimate the non-use value of the Colosseum we asked how much respondents would allocate to fund the preservation of the Colosseum. Open-ended elicitation is known to have several limitations and drawbacks. In fact, typically it leads to large non-response rates, protest answers, zero answers and unrealistically large bids, and generally to unreliable responses. This is because it may be very difficult for respondents to come up with their true maximum WTP for a change they are unfamiliar with and have never thought about valuing before.

For this reason, we used a payment card elicitation that provides a context to the bids, while avoiding starting point bias and reducing the number of outliers. Unfortunately, this type of elicitation leads to a censoring of the willingness to pay of the respondent. Consider for example an individual willing to pay a maximum of 27 EUR per year to preserve the Colosseum. Since, with the proposed payment card she can only choose 25 or 30 EUR, she will be likely to mark 25 EUR, because 30 EUR is greater than her maximum WTP. Then, computing the simple average WTP from responses to this question is expected to underestimate the true willingness to pay. For this reason, we used an interval regression model to estimate average WTP.

This model is a generalization of the Tobit model because it extends censoring beyond left-censored data or right-censored data to the case of interval-censored data (see Cameron and Trivedi 2010 for a discussion of these data types, and Wooldridge 2016 for an introduction to censored and truncated regression models). The values of the outcome variable may be either observed (point data) or unobserved but known to fall within an interval (interval-censored data). Consider the model equation of interest is where y_j is a continuous outcome, say the WTP, for the j-th observation - either observed or unobserved - with regressors x_j and corresponding coefficients β.

$$y_j = x_j \beta + \varepsilon_j$$

The model assumes that the error term is normally distributed, *i.e.* $\varepsilon_j \sim N (0, \sigma^2)$. For observations $j \in C$, we observe y_j, that is, point data. Observations $j \in I$ are intervals, and we only know that the unobserved y_j is in the interval $[y_{1j} , y_{2j}]$. For these observations, the likelihood contribution is $Pr(y_{1j} \leq Y_j \leq y_{2j})$, where Y_j denotes the random variable representing the dependent variable in the model. Observations $j \in L$ are left-censored, and we know only that the unobserved y_j is less than or equal to y_{Lj}, a censoring value that we do know.

Similarly, observations $j \in R$ are right-censored, and we know only that the unobserved y_j is greater than or equal to y_{Rj}. The likelihood for these censored observations contain terms of the form $Pr(Y_j \leq y_{Lj})$ for left-censored data and $Pr(Y_j \geq y_{Rj})$ for right-censored data. Thus, the parameters of the model β can be estimated by maximum likelihood.

Table E1 shows estimated coefficients of the interval regression model for stated preferences over the preservation of the Colosseum. Parameters are allowed to differ between residents in Rome and elsewhere in Italy. Average willingness to pay is higher for residents in Rome than for other Italians, but the difference is not statistically significant.

Table E1. Estimated coefficients of the interval regression model for stated preferences over the preservation of the Colosseum

Rome - rest of Italy	32.667	
Rest of Italy	56.889	**
Insigma	5.134	***
Obs.	850	
Log-lik.	-351.4	

*Source: Deloitte Economic Advisory. Coefficients: * significant at 10%, ** significant at 5%, *** significant at 1%.*
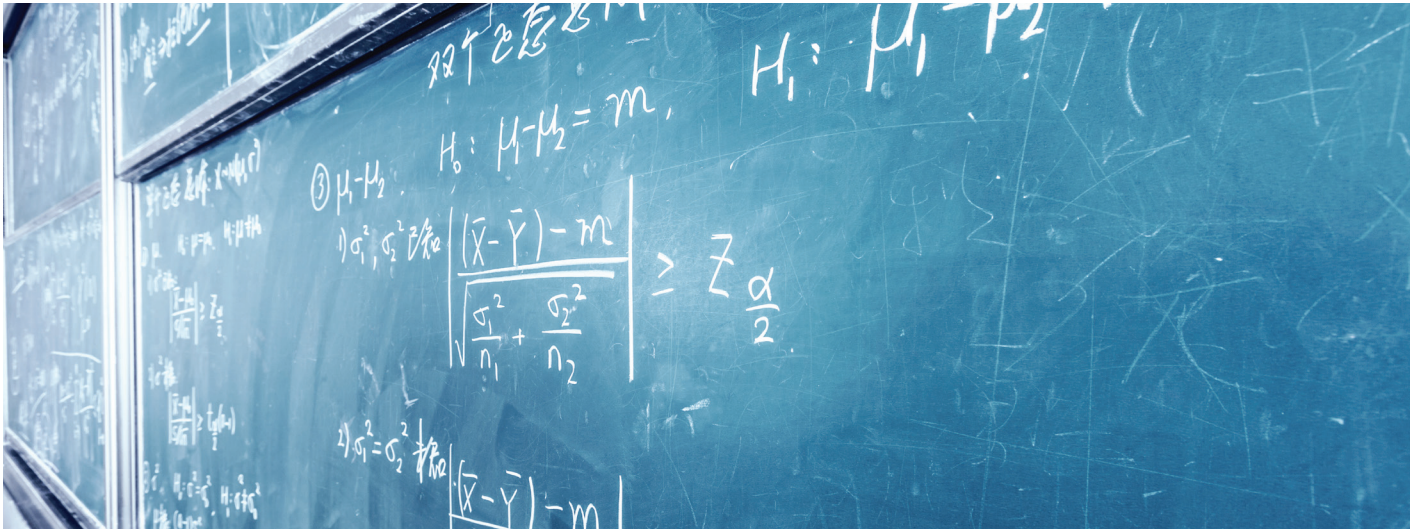
Choice modeling and the Random Utility Model

An alternative method to estimate the non-use value of the Colosseum is the so called choice modeling. Choice modelling approaches (also known as conjoint analysis) are based around the idea that any good can be described in terms of its attributes, or characteristics, and the levels that these take.

This method builds upon the specification of an indirect random utility function. Suppose that Y_i represents a discrete choice among J alternatives. Let U_{ij} represent the value or utility of the j-th choice to the i-th individual. We will treat the U_{ij} as independent random variables with a systematic component η_{ij} and a random component ε_{ij} such that

$$U_{ij} = \eta_{ij} + \varepsilon_{ij}$$

We assume that individuals act in a rational way, maximizing their utility. Thus, subject i will choose alternative j if U_{ij} the largest of $U_{i1},..., U_{ij}$. Note that the choice has a random component, since it depends on random utilities.

The probability that subject i will choose alternative j is

$$\pi_{ij} = Pr\{Y_i = j\} = Pr\{max(U_{i1},...,U_{ij}) = U_{ij}\}$$

It can be shown that if the error terms ε_{ij} have standard Type I extreme value distributions with density

$$f(\varepsilon)=exp\{-\varepsilon-exp\{-\varepsilon\}\}$$

then (see for example Maddala, 1983)

$$\pi_{ij} = \frac{exp\{\eta_{ij}\}}{\sum exp\{\eta_{ij}\}}$$

which is the basic equation defining the multinomial logit model.

In the special case where $J=2$, individual i will choose the first alternative if $U_{i1}-U_{i2}>0$. If the random utilities U_{ij} have independent extreme value distributions, their difference can be shown to have a logistic distribution, and we obtain the standard logistic regression model.

The odds of choosing alternative j over alternative k should be independent of the choice set for all pairs j,k. This property is often referred to as the axiom of independence from irrelevant alternatives. Whether or not this assumption is reasonable (and other alternatives are indeed irrelevant) depends very much on the nature of the choices.

McFadden (1973) proposed modeling the expected utilities η_{ij} in terms of characteristics of the alternatives. If z_{ij} represents a vector of characteristics of the j-th alternative (that may vary by individual), then he postulated the model

$$\eta_{ij} = z'_{ij} \gamma$$

This model is called the conditional logit model, and turns out to be equivalent to a log-linear model where the main effect of the response is represented in terms of the covariates z_{ij}.

Note that with J response categories the response margin may be reproduced exactly using any $J-1$ linearly independent attributes of the choices.

The parameters γ of this model can be estimated by maximum likelihood using numerical procedures such as the Newton-Raphson method[7].

Specifically, we assume the following linear specification for the deterministic utility function $\eta_{ij} = \lambda(I_i - p_j) + \beta q_j$, where I_i represents the income of individual i, p_j and q_j represent respectively the cost of preservation and the level of preservation for alternative j. Thus, $(I_i - p_j)$ corresponds to the amount of money left to spend for individual i on all other goods after choosing alternative j.

Preservation q_j is measured as the delay in time of deterioration. The subjective value of preservation, or willingness to pay (WTP), is the marginal rate of substitution between preservation and money, representing the amount of money that a consumer is willing to pay for preservation.

Therefore, the WTP for the preservation, measured by an increase of delay in time of deterioration, is given by the ratio between the marginal utility of preservation and the marginal utility of money
$WTP = -(\partial \eta_{ij} /\partial q_j) / (\partial \eta_{ij} /\partial p_j) = \beta/\lambda$.

This parameter ratio represents the simplest expression of a WTP. Nonlinear utility functions entail more involved expressions for consumer valuation of attributes. In addition, note that even though estimates of the marginal utilities of a discrete choice model are hard to interpret, the ratio representing consumers' WTP is a meaningful function with a clear economic interpretation.

The choice experiment question presenting respondents with a baseline scenario corresponding to the status quo and several alternative options for the preservation of the Colosseum is reported in Appendix F.

Table E2 shows estimated coefficients of the conditional logit model[8] for stated preferences over the preservation of the Colosseum. Preservation and price parameters are allowed to differ between residents in Rome and elsewhere in Italy. Marginal utility of preservation is higher for residents in Rome than for other Italians, but the difference is not statistically significant.

Table E3 shows estimated Willingness to pay for the preservation of the Colosseum from the CM. According to our estimates, on average the respondents suggested a yearly funding of 167 EUR per person for the preservation of the Colosseum. Note that the estimated WTP is higher for residents in Rome (190.1 EUR) than for people living elsewhere in Italy (165.8 EUR). Nationwide, considering the 18 years or older Italian residents, this is equivalent to about 8,388 EUR/mln per year.

Table E2. Estimated coefficients of the conditional logit model for stated preferences over the preservation of the Colosseum

Choice		
Preservation Rome - rest of Italy	1.162	
Preservation rest of Italy	3.399	***
Price Rome - rest of Italy	0.003	
Price rest of Italy	0.021	***
Obs.	1,700	
Log-lik.	-525.4	
Pseudo R-sq	0.108	

*Source: Deloitte Economic Advisory. Coefficients: * significant at 10%, ** significant at 5%, *** significant at 1%. .*

Table E3. Willingness to pay for the preservation of the Colosseum (choice modeling method)

	Average WTP (EUR)	Total WTP (EUR/mln)
Rome	190.1	451.3
Rest of Italy	165.8	7,937.2
Italy	167.0	8,388.5

Source: Deloitte Economic Advisory.

Appendix **F**

The stated preference survey: questionnaire and main descriptive statistics

This section presents the text of the survey and main descriptive statistics.

Thank you in advance for agreeing to complete this survey. It should take only 5 minutes of your time to complete. This survey will help identify and quantify the **economic and social value** of the most iconic asset ever: the **Colosseum** in Rome. The information you provide will remain **completely confidential**, and the results of this survey will be released in the form of aggregate values, i.e. totals and percentages for large groups of people. We really appreciate your help and your support is helpful to increase Deloitte brand awareness.

1. How important is the existence of the Colosseum to you?

* Very important

* Important

* Indifferent

* Not that important

* Not important at all

Please tell me to what extent you agree with the following statements about the Colosseum.

2. The Colosseum is an iconic Italian landmark representing the most important cultural attraction in Italy.

* Strongly disagree

* Disagree

* Indifferent

* Agree

* Strongly agree

* Don't know

3. The Colosseum must be preserved under any circumstances.

* Strongly disagree

* Disagree

* Indifferent

* Agree

* Strongly agree

* Don't know

4. Please rank from most (1) to least (5) important cultural tourist attractions in Italy:

* The Colosseum

* Pompeii

* The Sistine Chapel

* The Uffizi Gallery

* The St. Mark's Basilica

5. Have you ever visited Rome?

* Yes

* No

> *If yes to 5*

5a. Have you ever visited the Colosseum?

* Yes

* No

> *If no to 5*

5b. If you ever plan to visit Rome for tourism, holiday, or entertainment would you visit the Colosseum?

* Yes

* No

6. If no action is taken, the Colosseum is expected to deteriorate over time. Which of the amounts listed below best describes your <u>maximum willingness to pay every year</u> to fund the preservation of the Colosseum?

* 0	* $30	* $200
* $2	* $35	* $250
* $5	* $40	* $500
* $10	* $50	* $750
* $15	* $75	* $1000
* $20	* $100	* >$1000
* $25	* $150	

6a. If >$1000:

* Please specify how much would you pay _____

7. Now, we will present some specific hypothetical <u>preservation programs</u> for the conservation and maintenance of the Colosseum. Different programs would determine a <u>different increase in the amount of time it would take for the deterioration to occur</u>, and would have a different yearly per capita cost. We ask you to choose among different options in a sequence of choices. It is important that when you choose, you only consider the given set of alternatives, without considering the options presented previously in the sequence. Please make a choice for each set of options.

Which of the following alternatives do you prefer?

	Option A	Option B	Option C	Option D
% delay in time of deterioration	0%	15%	25%	50%
Cost of the preservation	$0	$10	$25	$60

Which of the following alternatives do you prefer?

	Option A	Option B	Option C	Option D
% delay in time of deterioration	0%	10%	70%	100%
Cost of the preservation	$0	$7	$50	$150

Which of the following alternatives do you prefer?

	Option A	Option B	Option C	Option D
% delay in time of deterioration	0%	10%	25%	80%
Cost of the preservation	$0	$5	$30	$60

Which of the following alternatives do you prefer?

	Option A	Option B	Option C	Option D
% delay in time of deterioration	0%	40%	50%	100%
Cost of the preservation	$0	$25	$90	$200

Which of the following alternatives do you prefer?

	Option A	Option B	Option C	Option D
% delay in time of deterioration	0%	20%	50%	65%
Cost of the preservation	$0	$20	$80	$100

8. What is your gender?

* Male

* Female

9. How old are you?

_____

10. In which country do you usually live?

_____

11. What is the ZIP code of your primary home address?

_____

12. What is the highest degree of education you obtained?

* No school leaving certificates

* Primary school education

* Lower secondary school

* Secondary or High school certificates

* Higher education Diploma

* Degree

* Post-graduate qualification

13. What is your main job?

* Manager

* Employee

* Industrial worker

* Self-employed

* Student

* Looking after home or family

* Retired from work

* Unemployed

* Other

14. What is your approximate annual household income after subtracting taxes, including pensions and benefits?

$ _____

15. Who do you think should pay for the preservation of the Colosseum?

* Everyone in the World

* Everyone visiting Colosseum

* All Italian residents

* Local people only

Descriptive statistics

Figure F1. How important is the existence of the Colosseum

3.5%
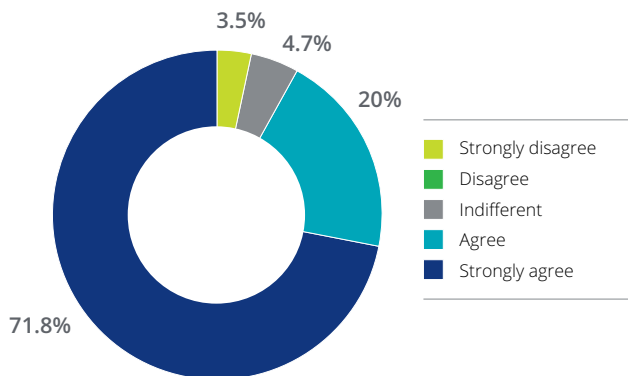
30.6%

Very important
Important
Indifferent

65.9%
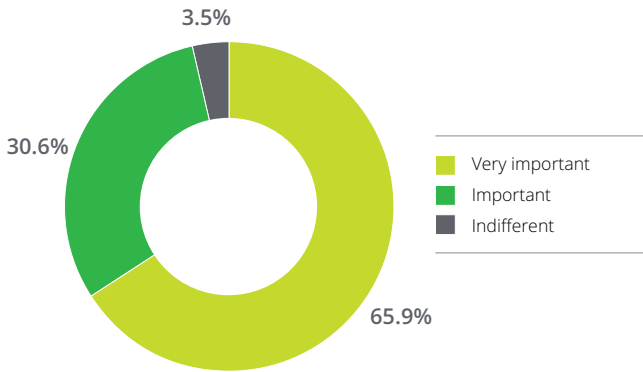
Source: Deloitte Economic Advisory.

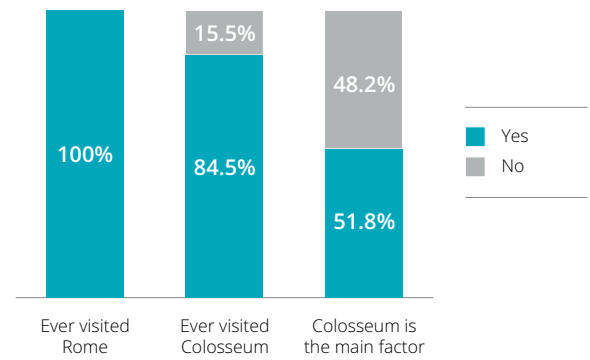**Figure F2**. The Colosseum is an iconic Italian landmark representing the most important cultural attraction in Italy

4.7%   3.5%   4.7%

48.2%

Strongly disagree
Disagree
Indifferent
Agree
Strongly agree

38.8%
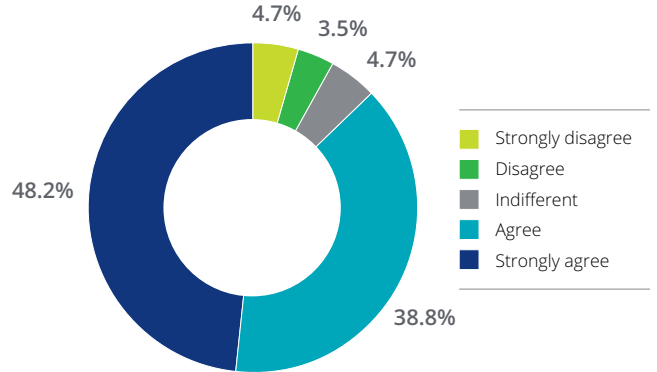
Source: Deloitte Economic Advisory.

Figure F3. The Colosseum must be preserved under any circumstances

3.5%   4.7%

20%

Strongly disagree
Disagree
Indifferent
Agree
Strongly agree

71.8%

Source: Deloitte Economic Advisory.

Figure F4. Visits to Rome and to the Colosseum

	15.5%	48.2%
100%	84.5%	51.8%

Yes
No

Ever visited Rome — Ever visited Colosseum — Colosseum is the main factor

Source: Deloitte Economic Advisory.

Figure F5. Who should pay for the preservation of the Colosseum (by residence of respondents)

ROME

9.4%

34.4%

31.3%

25.0%

REST OF ITALY

1.9%

41.5%

30.2%

26.4%

Everyone in the world
All Italian residents
Everyone visiting Colosseum
Local people only
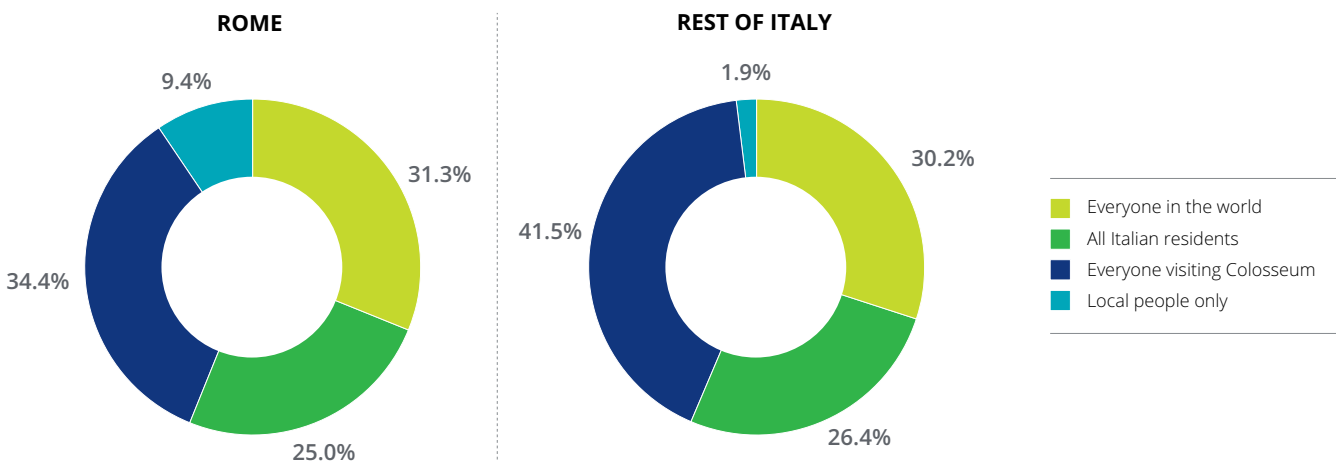
Source: Deloitte Economic Advisory.

Appendix G

Present value and sensitivity to the choice of the discount rate

In order to convert annual figures to an asset figure, we compute present values using an *Unconditional adjusted* approach. Following this approach, the so called Country Risk Premium is reflected in the risk free rate by adding to the yield on 10-year government bonds of a benchmark country with an AAA rating (represented by the United States of America) a Country Risk Premium equal to the difference between the Credit Default Swaps (CDS) spread of the reference country (Italy) and the benchmark country (i.e. the United States of America). The risk free rate (average yield on 10-year government bonds) is adjusted for inflation rate of the benchmark country and for the inflation rate of the reference country.

We applied two different discount rates to convert annual figures to an asset figure: the first one, applied to components related to Transaction value is equal to 8.5% a year, corresponding to the Weighted Average Cost of Capital estimated for a company which operates in the tourism sector in Rome; the second one, applied for Non use value component, is equal to 4.0% a year, corresponding to the Adjusted Risk Free Rate (Table G1 provides the details).

We also estimated a terminal value applying a growth rate which is equal to the CPI long term for Italy at December 2019 for the Transaction value and to 0 for the Non use value.

The difference between these growth rates are due to the following reasons:

- The values that make up the Transaction value presumably follow the trend in the prices of consumer goods.

- The values resulting from the responses to the questionnaire are expressive of personal preferences, therefore it is not possible to set a growth rate that describes their trend.

Table G1. Estimation of risk free adjusted discount rate

Cost of equity (ke)	
Nominal Risk Free USA	2.5%
CPI Long Term USA	1.8%
Real Risk Free Rate	0.7%
CPI Long Term Italy	1.3%
Risk Free Rate	2.0%
Country Risk Premium	1.9%
Adjusted Risk Free Rate	4.0%
Beta unlevered	0.85
D/E	0.10
Beta relevered	0.92
Tax rate Beta relevered	24.0%
Market risk premium	5.5%
Ke	**9.0%**

Cost of debt (Kd)	
Kd before tax	4.7%
Kd Tax rate	24.0%
Kd after tax	**3.6%**

Financial structure	
Equity E/(D+E)	90.9%
Debt D/(D+E)	9.1%
WACC	**8.5%**

Source: Deloitte Economic Advisory.

Table G2 shows sensitivity of the total asset value of the Colosseum to different periods and discount rates, where the non-use value is estimated using the Contingent Valuation method.

Table G2. Sensitivity of the total asset value of the Colosseum to different periods and discount rates (Contingent Valuation Method)

Years	Social Asset Value Discount rate		
	8.0%	8.5%	9.0%
	3.5%	4.0%	4.5%
20	87.555,2	76.741,4	68.347,0
30	87.564,9	76.750,7	68.355,7
40	87.574,3	76.759,0	68.363,0
50	87.581,3	76.764,8	68.367,8
60	87.586,0	76.768,5	68.370,7
70	87.589,0	76.770,7	68.372,4
80	87.590,7	76.772,0	68.373,3
90	87.591,8	76.772,7	68.373,8
100	87.592,4	76.773,1	68.374,1

Source: Deloitte Economic Advisory.

Authors

Marco Vulpiani

Equity Partner
Head of Valuation,
Business Modelling
and Economic
Advisory Services

Deloitte Central Mediterranean

Direct: +39 06 36749315
Mobile: +39 348 8856689

mvulpiani@deloitte.it

Claudio Rossetti

Director
Economic Advisory
Services

Deloitte Central Mediterranean

Mobile: +39 345 6056303

crossetti@deloitte.it

Marco Caiffa

Manager
Economic Advisory
Services

Deloitte Central Mediterranean

Mobile: +39 342 6248094

mcaiffa@deloitte.it

**Sara Cristina
Lisa Petrongolo**

Assistant Manager
Economic Advisory
Services

Deloitte Central Mediterranean

Mobile: +39 345 5890644

spetrongolo@deloitte.it

Deloitte.