Choices on Museums Attendance: An Agent-based Approach

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- Recent pieces of evidence suggest that enlarging the possibility of free attendance at museum leads to an increase of not only free visits, but also paid visits. This is the case of Taiwan, where the introduction of universal free-entrance for public museums in Taipei has also benefited charged attendance at private museums (Chen et al., 2016); this is also the case of State museums in Italy, where the introduction of universal free-entrance on the first Sunday of each month, since July 2014, seems to have enhanced subsequent charged attendance (Cellini and Cuccia, 2018).

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- A different rationale is held by less recent contributions. Steiner (1997), focusing on a few large American museums, found that increasing the number of free-entrance days does not entail an increase of museum revenues. A similar conclusion is suggested by Luksetich and Partridge (1998). More in general, regressive effects of free attendance, along with pros and cons of different pricing rules, are well known by available literature (Peacock and Godfrey, 1976).

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Agent-based models employ simulations to study individual choices and the resulting aggregate outcomes. This approach is becoming increasingly popular in economics, specially to study economies as complex evolving systems (Tesfatsion, 2006a, 2006b) for they allow to characterize micro motives within macro dynamics, due to their bottom-up design (Delli Gatti et al., 2008, 2011, and Fagiolo and Roventini, 2008).

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Despite usual applications of agent-based modelling concern macroeconomic, monetary and financial problems, as recently surveyed in Dawid and Delli Gatti (2018), a wide variety of applications to different economic fields are available as well, among which, industrial organization (as, for example, in Chang, 2011, 2015), labour economics (as surveyed in Neugart and Richiardi, 2012), transport economics (Djvadian and Chow, 2017), tourism economics (Alvarez and Brida, 2019).

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To the best of our knowledge, the present paper is a first attempt to employ agent-based modelling in the field of cultural economics.

Calibration

The features concerning the dimension of the variables at hand are set according to their numerical consistency, shown by true data referred to Italy in 2015. The reason why the characteristics of the individuals and the consistency of different activities are approximately modelled in accordance to the Italian situation in 2015 rests on the fact that a new rule has been introduced in Italy in July 2014, allowing for free entrance to all State museums and similar institutions on the first Sunday of each month.

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We specifically investigate here how the introduction of a larger free-entrance policy affects the charged attendance at museums. Our present computational results provide some support to the point that enlarging free-entrance possibilities may entail an increase in paid visits too. In other words, our simulations suggest that the positive effects of free visit upon paid ones can prevail over crowding-out effects, under condition.

The Model

Consider a community of $N = R + T$ agents, composed by R residents and T tourists, living in a dimensionless country where they can choose how to spend their leisure time, pursuing different activities of K types, such as shopping in available shops (${}_jS$), enjoy environmental/naturalistic goods in parks (${}_jP$), go for a movie/events in cinemas (${}_jC$), or enjoy visits to monuments and exhibitions in museums(${}_jM$).

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Each Resident i has three individual-specific attributes: age, income, education. All attributes have been distributed according to data referred to the Italian population in 2015, as emerging from the data provided by the Italian National Institute of Statistics (ISTAT, 2016, 2019):

SYMBOL	VARIABLE	VALUE	SYMBOL	VARIABLE	VALUE
R_y :15-29	%Y-RES	18%	R_a :30-64	%A-RES	57%
R_m :65+	%M-RES	25%	$\bar{Y}_R$	av.Y RES	1280
$edu_1^y\%$	%Y-EDU=1	$26,6\%$	$edu_2^y\%$	%Y-EDU=2	$48,3\%$
$edu_3^y\%$	%Y-EDU=3	$24,8\%$	$edu_4^y\%$	%Y-EDU=4	$0,3\%$
$edu_1^a\%$	%A-EDU=1	50%	$edu_2^a\%$	%A-EDU=2	$37,4\%$
$edu_3^a\%$	%A-EDU=3	$12,2\%$	$edu_4^a\%$	%A-EDU=4	$0,3\%$
$edu_1^m\%$	%M-EDU=1	$81,1\%$	$edu_2^m\%$	%M-EDU=2	$13,8\%$
$edu_3^m\%$	%M-EDU=3	5%	$edu_4^m\%$	%M-EDU=4	$0,1\%$

The number of residents (500) and of tourists (950) have been set in such a way to mimic the proportion between residents and total tourist arrivals in Italy in 2015 (60.8 million and 113.4 million, respectively).

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Tourists are are created with completely random features, instead. Their arrivals are distributed during the year, according to a very simple rule of seasonal differentiation, i.e., by ensuring that summer arrivals are twice the spring and autumn ones, which are, in turn, twice the winter arrivals. The length of the holiday is an heterogeneous parameter for tourists, individually chosen as $\mathcal{N}(3,5\ ,\ 0.875)$.

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Each activity j, belonging to one of the four possible types $K = S, P, C, M$, is created with two randomly assigned features, which remain constant in time: 1) a basic level of intrinsic value, ${}_jv^K$, and (2) the price ${}_jp^K$:

SYMBOL	VARIABLE	VALUE	SYMBOL	VARIABLE	VALUE
N^S	#SHOPS	300	N^P	#PARKS	3
N^M	#MUSEUMS	10	N^C	#CINEMAS	7
v^S	VALUE of S	1000	v^P	VALUE of P	35
v^M	VALUE of M	15	v^C	VALUE of C	10
${}_jp^S$	PRICE of S	$[1, 400]$	${}_jp^P$	PRICE of P	$[1, 18]$
${}_jp^M$	PRICE of M	$[2, 26]$	${}_jp^C$	PRICE of C	$\mathcal{N}(6,3\,,\ 1,5)$

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Museums have also a renovation time, measuring the number of days after which the supply is renewed. In the model it has been fixed to 90 days. As already mentioned, museum supply renovation has to be interpreted here in an extensive way: it includes not only the exhibition renewal, but also the organization of special (temporary) events, and the improvement of complementary services. Also cinemas have been modelled with a renovation time, which has been fixed to 15 days. All renovation activities occur independently.

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In order to make such a choice, each agent i computes the net utility deriving from choosing each of the alternatives ${}^{i}_{j}u^{K}_{t}$. Then she chooses the activity with the highest utility value. A linear, additive, heterogenoeus utility is calculated, by each agent at each time step, as:

$$ {}^{i}_{j}u^{K}_{t} = ({}_{j}v^{K} \pm {}^{i}_{j}\phi^{K}_{t})(1 - {}^{i}b^{K}_{t}) - {}_{j}p^{K} \tag{1} $$

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where the parameter ${}^{i}_{j}\phi^{K}_{t} \in (-{}_{j}v^{K}, {}_{j}v^{K})$ ensures the heterogeneity of preferences among individuals and the parameter ${}^{i}b^{K}_{t}$ stands for the boredom arising from repeating the same choice in time, thus assigning to repeated consumption of the same good a decreasing, though positive, impact on utility. In order to compute such a component, each agent is endowed with a parameter ${}^{i}\mu \in (0, 7]$ representing her memory attitude, defined as the number of consecutive instants preceding t that the agents remembers. Thus, the boredom is the number of occurrences of a choice divided by the memory length.

Boredom, Addiction, Education

The boredom does not necessarily hold for cultural consumption: in cultural economics literature, the assumption that the past consumption of cultural goods feeds current cultural consumption –and even creates "addiction"– is a cornerstone. The assumption of positive externality from past cultural consumption to current demand for culture (in brief, addiction) is supported by the fact that the opportunity cost of cultural consumption is decreasing in the stock of consumed cultural goods.

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In other words, the marginal utility of cultural consumption is not decreasing in the stock of previous consumption. The idea traces back to Marshall (1890, Book 3, Ch. 3)), and has been formalized by Stigler and Becker (1977) and Becker and Murphy (1988). Brito and Barros (2005) and Brida et al. 2016) are two recent contributions, among many others, that consider specific addiction among the determinants of musuem visits.

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- The second mechanism, named *strong* addiction, is instead based also on the educational level of the agent, which can increase the strength of addiction, and it is actually computed by multiplying the value of museums, free of boredom, by the education level of the agent, i.e., $(1 + {}^{i}b_t^M + {}^{i}e)$, where ${}^{i}e = {}^{i}\gamma/4$ is the relative level of education of agent i, with ${}^{i}\gamma = 1, 2, 3, 4$.

Plan of Simulations

The following tables report the average number of museum visits chosen by agents (i.e., the times in which museum visit is the choice with the highest utility), under different assumptions. One model run reproduces exactly one calendar year. In order to provide average values reported in the following Tables, a complete cycle of simulations for each setting has been performed, by iterating the model 100 times for each scenario.

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The first column of each Table reports the setting of the world (i.e., with or without museal renovation, and in the absence or presence of soft or strong addiction to museum attendance), while the other columns, respectively, report: the number of charged visits at museums, the number of free ones, the total number of museum visits, the Sunday visits, and the charged visits in non-Sunday days.

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A final comparison will be provided to show the potential effects of an policy devoted to improve the education level of the population. Its implementation has been done by a 10% reduction of the share of population with lower levels of education and by a simultaneous 10% increase of the share with higher ones.

Results - I

SETTING: NULL	CHARGED	FREE	TOTAL	SUN	non-SUN-$
NOR-NOA-NOE	1593, 08	0	1593, 08	224, 96	1368, 84
NOR-A-NOE	2806, 88	0	2806, 88	399, 96	2406, 92
NOR-A-E	4021, 32	0	4021, 32	671, 12	3350, 3
R-NOA-NOE	4139, 52	0	4139, 52	594, 84	3544, 68
R-A-NOE	40322, 56	0	40322, 56	5794, 64	34527, 92
R-A-E	48877, 92	0	48877, 92	7228, 28	41649, 64

Table 2: The null model (no free visits), in the absence or presence of museum renovation.

Results - I

SETTING: 1SUN	CHARGED	FREE	TOTAL	SUN	non-SUN-$
NOR-NOA-NOE	1567, 34	96, 76	1664, 1	274, 6	1389, 5
NOR-A-NOE	2703, 28	162, 84	2866, 12	462, 04	2404, 08
NOR-A-E	4107, 46	201, 84	4309, 3	668, 52	3604, 78
R-NOA-NOE	3998, 76	140, 2	4138, 96	599, 56	3539, 4
R-A-NOE	39962, 72	1251, 16	41213, 88	5568, 8	35645, 08
R-A-E	49759, 92	1620, 68	51380, 6	7119, 08	44261, 52

Table 3: Free entrance on the first Sunday of each month (without and with periodic museum renovation).

Results - I

SETTING: ALLSUN	CHARGED	FREE	TOTAL	SUN	non-SUN-$
NOR-NOA-NOE	1370, 72	359, 12	1729, 84	359, 12	1370, 72
NOR-A-NOE	2778, 68	691, 72	3470, 4	691, 72	2778, 68
NOR-A-E	4059, 02	851, 72	4910, 74	851, 72	4059, 02
R-NOA-NOE	3608, 72	602, 08	4210, 8	602, 08	3608, 72
R-A-NOE	35829, 2	5332, 4	41161, 6	5332, 4	35829, 2
R-A-E	50007, 16	6587, 08	56594, 24	6587, 08	50007, 16

Table 4: Free entrance on all Sundays (without and with periodic museum renovation).

Results - I

SETTING: NULL	CHARGED	FREE	TOTAL	SUN	non-SUN-$
NOR-NOA-NOE	1593, 08	0	1593, 08	224, 96	1368, 84
NOR-A-NOE	2806, 88	0	2806, 88	399, 96	2406, 92
NOR-A-E	4021, 32	0	4021, 32	671, 12	3350, 3
R-NOA-NOE	4139, 52	0	4139, 52	594, 84	3544, 68
R-A-NOE	40322, 56	0	40322, 56	5794, 64	34527, 92
R-A-E	48877, 92	0	48877, 92	7228, 28	41649, 64

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SETTING: 1SUN	CHARGED	FREE	TOTAL	SUN	non-SUN-$
NOR-NOA-NOE	1567, 34	96, 76	1664, 1	274, 6	1389, 5
NOR-A-NOE	2703, 28	162, 84	2866, 12	462, 04	2404, 08
NOR-A-E	4107, 46	201, 84	4309, 3	668, 52	3604, 78
R-NOA-NOE	3998, 76	140, 2	4138, 96	599, 56	3539, 4
R-A-NOE	39962, 72	1251, 16	41213, 88	5568, 8	35645, 08
R-A-E	49759, 92	1620, 68	51380, 6	7119, 08	44261, 52

Table 3: Free entrance on the first Sunday of each month (without and with periodic museum renovation).

SETTING: ALLSUN	CHARGED	FREE	TOTAL	SUN	non-SUN-$
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Table 4: Free entrance on all Sundays (without and with periodic museum renovation).

Results - II

SETTING	CHARGED	FREE	TOTAL	CHARGED*	FREE*	TOTAL*	Δ%
NULL:							
NOR-A-E	4021, 32	0	4021, 32	4229, 1	0	4229, 1	5, 17%
R-A-E	48877, 92	0	48877, 92	51321, 8	0	51321, 8	5%
1SUN:							
NOR-A-E	4107, 46	201, 84	4309, 3	4385, 57	225, 33	4610, 9	7%
R-A-E	49759, 92	1620, 68	51380, 6	52645, 3	1817, 1	54462, 4	6%
ALLSUN:							
NOR-A-E	4059, 02	851, 72	4910, 74	4228, 5	870, 9	5099, 4	3, 8%
R-A-E	50007, 16	6587, 08	56594, 24	50641.5	6569, 8	57211, 3	1%

Table 5: Averages variations induced by modifying the education level of population, all scenarios.

Tab.5 shows a final comparison after an hypothetical policy improving the education level of the population. The effect of a 10% reduction of the share of residents with lower levels of education and of a simultaneous 10% increase of the share with higher ones leads to an increment of the number of visits, in all possible scenarios where education counts.

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NOR-A-E	4107, 46	201, 84	4309, 3	4385, 57	225, 33	4610, 9	7%
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Although the impact is always positive, data in Tab.5 – averaged over 25 simulations for each scenario – suggest a new round of tuning for exogenous parameters of the model. In cases where values approach their upper bounds, the increments cannot be greater than that. In principle, there are solid reasons to presume that increments can be greater than the shown ones, specially in the case of free entrance on all Sundays.

Conclusive remarks

Simulations confirm that free admissions can increase the occurrence of charged visits, provided that the population exhibits a “sufficient” level of addiction.

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In our simulations we defined soft and strong addiction in order to entail a differential impact of education with respect to the “simply” enthusiastic involvement that can derive from past visits solely.

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An important by-product is that simulations confirm the possibility that the policy-maker can obtain improvements in cultural consumption by means of educational policies. Indeed, in presence of suitable pricing strategies, such policies may induce higher revenues from museum attendance while contributing to the cultural development of the Country.

Thank you for your attention.

Choices on Museums Attendance: An Agent-based Approach

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