

Executive summary on the master thesis paper
‘Analysing relationships between museums and local economic activities by
mobile phone data in Moscow’

Introduction

Today the global pandemic dictates cities to make decisions cautiously by keeping a balance between people safety and economic stability. This means that using urban data is necessary for authorities in order to run cities effectively and for businesses in order to survive. One of the crucially important questions is to predict how people will behave in the streets, especially to define where they will gather. For the government, it is important to set proper measures, whereas for business, knowing new patterns of people’s life means a better prediction of potential footfall, which is key for predicting revenue.

In this situation, cultural places stayed out of governmental concerns as organisations that don’t directly impact city economy and, therefore, not essential for city survival. However, since the middle of the last century, in Europe and some Asian cities, cultural places have been considered one of major drivers of city regeneration – at first, because of their ability to generate tourists’ crowds and later, because of their impact on high-income and well-educated residents. (DCMS,2006; UNESCO, 2009; European Commission (2019) While the first strength is not relevant today because of a lack of tourists in cities, the second is worth attention because it has a potential to explain citizens behaviour and find economically-stable areas in large cities.

However, prior attempts to analyse economic potential of cultural places suffered from methodological weaknesses: training data contained city-wide rather than fine-grained figures(Ulldemolins 2014); used statistical methods (HM Treasury 2013) did not lead to statistically significant results that would explain relationships between cultural places and economic development; economic success was not properly defined. These issues are even more crucial in large and diverse cities because the variety of demographic and economic conditions, as well as high density of available facilities do not allow to establish an impact of a single institution. Therefore, an alternative approach was needed.

The research, therefore, used new sources of location data and spatial-economic models in order to analyse local relationships between museums and economically active citizens. Moscow has been chosen as a study area because of its size, economic diversity of its districts and spatial

heterogeneity. Drawing on consulting reports (Deloitte, 2019; Feedvisor, 2019) about Russian market, we defined economically active citizens as summary of *active youth* and *rich* people.

Data and methodology

The ambition to detect local relationships between museums and pedestrians required to find a new source of data that contains behaviour patterns and a portrait of pedestrians. Data provided by the company Locomizer met this requirement. Locomizer has pioneered and patented a unique way of using mobile location data received via GPS-signals and algorithms to build extremely detailed profiles of individuals and audiences based on their behaviour in the physical world.

For this research, they attributed people walking around Moscow to one of two categories: *active youth* and *rich people* - that describe people's affinity to such places as luxury goods and young brands stores, expensive restaurants, high-end gyms and 5-stars hotels. They calculated it based on the frequency of observations near a particular category of POI's generated by users' smartphones (Locomizer n.d.). Data was provided for Moscow residents for the period from January 2019 till July 2020 and aggregated by spatial hexagons of H3 system. The radius of each hexagon was around 174 m.

To digitize museums, the paper used coordinates of their location. They were extracted from Open Street Map and Moscow open data portal, and then mapped against hexagon centroids. Two variables, the number of museums within 350m and the number within 1-km distance from every hexagon centroid, were calculated. Secondly, it was indispensable to account for other features of built-up environment that might have attracted target groups of residents. To this list we added walkability score, street connectivity and transport accessibility levels. To match them with other variables, they were also calculated for polygons of one km radius built for each hexagon. Lastly, the feature referred to time of the year was transformed into two categorical variables: the number of season of year and one describing different movement restrictions set by the government due to COVID-19. The latter took values as following: normal, lockdown and recovery time.

Having all features ready, we made spatial-econometric analysis using OLS regressions, global Mora's I index and geographically-weighted regressions (GWRs). First, we built two OLS regressions, one per each affinity score, then we calculated spatial autocorrelation index, and, finally, we built six GWRs on cross-section of the residents' target groups and three time periods related to movement restrictions. The results were mapped and coloured by the direction of relationships in order to make analytical conclusions.

Key Findings

Overall, due to our fine-grained approach and proper statistical methods we have detected no significant impact of museums on economically active residents. Mobile phone data together with spatial economic models confirmed that prior conclusions about general museums' economic impact were not substantiated but individual case study is demanded to detect triggers of economic growth of the area. Thus, museums are not a guarantee of economic success of businesses located around them. Although OLS regressions showed that within 1-km numbers of economically active residents usually increase, we could not fully trust the results because of the high level of heterogeneity of residuals. To be more specific, they showed a high level of spatial autocorrelation in numbers of active youth and rich people (global Moran's $I > 0.5$). Meanwhile, GWR models identified that in 95% of cases the presence of young and rich residents around museums was explained not by close proximity to it but by other factors such as diversity of entertaining and shopping facilities or underground accessibility. This tendency has stayed over three periods of restrictions: neither at normal time, nor when long-distance travels were limited, economically active residents did not show particular interest to museums. However, there were several findings which worth closer examination.

- **People attract people**

At first, discovered spatial autocorrelation of OLS regression residuals, by using global Moran Index, showed that local-scale figures of residents could not be fully explained by surrounding infrastructure, there is a strong dependence of pedestrians numbers at one place from pedestrians numbers at neighboring locations, in other words, crowdedness attracts people at the same extent as infrastructure does. This complies with urbanists words about people's habit to walk inside the crowd and observe what other people do around them (Jan 2006).

- **Moscow central districts with museums look attractive for wealthy people, while active youth prefer to be near other facilities in the city centre**

Other findings relate to the change of people behavior occurred with different regulations for citizens movements. Although the percentage of significant relationships between museums and attractive consumers was not high, it is noteworthy that in normal times in the Moscow city centre museums neighbourhoods (within 1 km from a building) were more likely to attract affluent pedestrians, while outside of it they rather discouraged them. An opposite trend has been observed for active youth audience – in 10% of observations museums located in residential areas served magnets for young citizens, though we do not know if they visited museums. Meanwhile, their visits to city centre were triggered by reasons different from visiting cultural spots. In 83% of

cases, the level of walkability, refer to diversity of POIs, positively correlated with numbers of active youth people, while museums, in opposite, had mostly negative associations.

- **Within conditions of travel restrictions museums may become local centres of gravity for the economically active audience, but individual features are important for the success**

Comparing three periods: normal (April – July 2019), lockdown (May-June 2020) and recovery periods (July 2020) found out differences in spatial variation of affinity scores between them. As such, during lockdown more people deliberately avoided areas around museums. To be specific, near quarter of places around museums at the city centre indicated decrease in youth numbers and near 10% of spots in residential area indicated decrease in affluent men numbers. At the centre, this might have happened because of usually higher rental costs in museums neighbourhoods which assumes lack of essential shops and less numbers of residents at these areas (Bereitschaft 2019). Given that people were allowed to go out only for necessity and only within 5-km distance museums neighbourhoods stayed out of their way. However, to justify the assumption of rent prices impact on relationships between museums and numbers of active youth, a housing prices dataset is needed.

At the recovery period, when citizens could move around the city with caution and museums were open again, several museums started to serve as incentive for *active youth* and *rich men* to go out and meet people— an overall increase by 4% in positive relationships between distance to museums and target residents' categories variables was detected for July 2020. The positive impact on youth people has increased by 5% regardless a type of land use, while for *rich men* it rose by 2% and 4% in central area and residential, respectively. To understand which museums became attractive, the study collected insights about successful museums features.

- **In residential areas museums with a high level of online activity and a variety of events were successful in youth residents during post-lockdown period.**

By matching GWR models local coefficients with museums location (Fig.1) we have detected four museums which associated with a positive increase in active youth audience figures in neighbourhoods during the time when museums were open and did not impact this audience when they were closed. These museums are Museum of Darwin, Belyaev gallery, Museum *Our origins* and Museum of *the Rise of the Machines*. The information on museums' official websites helped to identify commonalities such as focus on youth education programs, modern, creatively-designed space, and high level of online activity – all museums regularly post to Intstagram, and three of them have over 15000 of followers. Therefore, we could consider these features important

for popularity of museum among active young audience. However, to detect if these factors are exclusive for museum success, further research is required.

- **Technologically advanced museums and museums located near natural sides served gravity centres for affluent citizens during post-lockdown period**

Applying for rich men the same procedure as we applied for active youth residents, we have found out (Fig.2) three big areas around museums - two in north-west and one in south-east from the city centre - and several spots where there was a higher level of affluent citizens than Moscow average.

In the first cluster Jewish museum with Tolerance centre, Tapan centre are located. According to the website, Jewish museum is a private museum which hosts a rich collection of artefacts related to Jewish history in Russia. Similar to this one, Tapan centre also links to a particular nationality - Armenian. Its plays an important role in modern life of Armenian people in Russia and translates its culture through the architecture of its building and the exhibitions. Apart from being connected with the nationalities historically considered wealthy, both places stand out by their interactive, high-tech exhibitions and outstanding buildings – Tapan is located in traditional Armenian Temple standing out among Moscow buildings of Soviet epoch, while Jewish museum is located in former Bakhmetevsky Bus Garage, the outstanding monument of Constructivism designed by famous architects Konstantin Melnikov and Vladimir Shukhov. What also stands out is that these museums are more important for *rich* men than the diversity of POIs around – despite the high level of walkability, Walkscore did not have an impact on rich residents figures there.

In the second cluster in north-west, results indirectly pointed to the role of creative clusters Flakon and Hklebzavod. According to the literature (Markusen, 2006; Pratt, 2008;) creative clusters bring the atmosphere of chic and creativity - thing wealthy residents usually seek. However, the impact of creative clusters on wealthy people is also a question of another study.

The third place in the south-east, as well as a couple of spots in the east and west outskirts of Moscow, are areas inside or near park zones. The biggest green area refers to Kolomenskoe Museum-park, others are museum *Datcha (countryside house)* near Izmailovo park and museum of Russian drinks near Mescherskiy park. Arguably, during the summer time when long-distance travels were banned, affluent people preferred green spaces and their cultural facilities to overcrowded central streets.

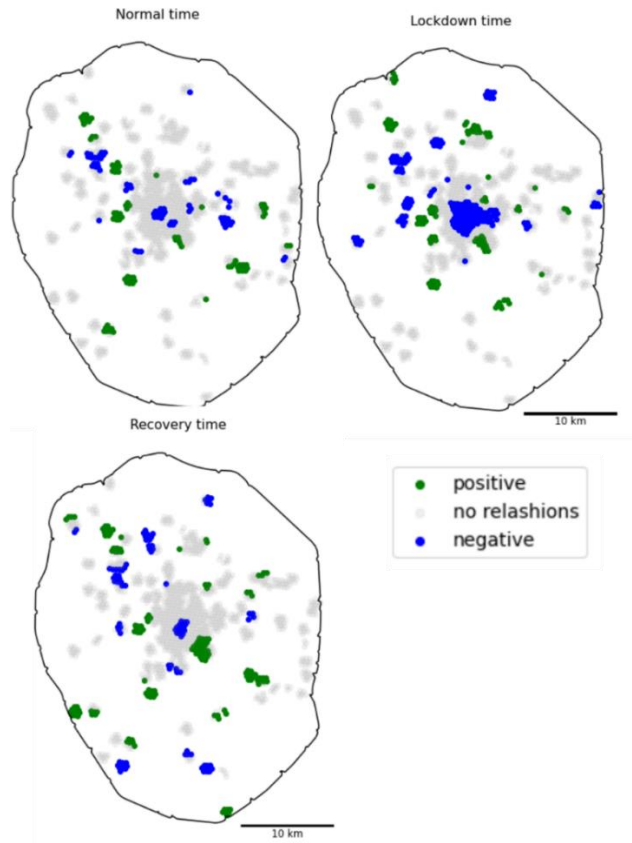


Fig. 1 Distribution of sign of relationships between museums and 'Active youth' audience

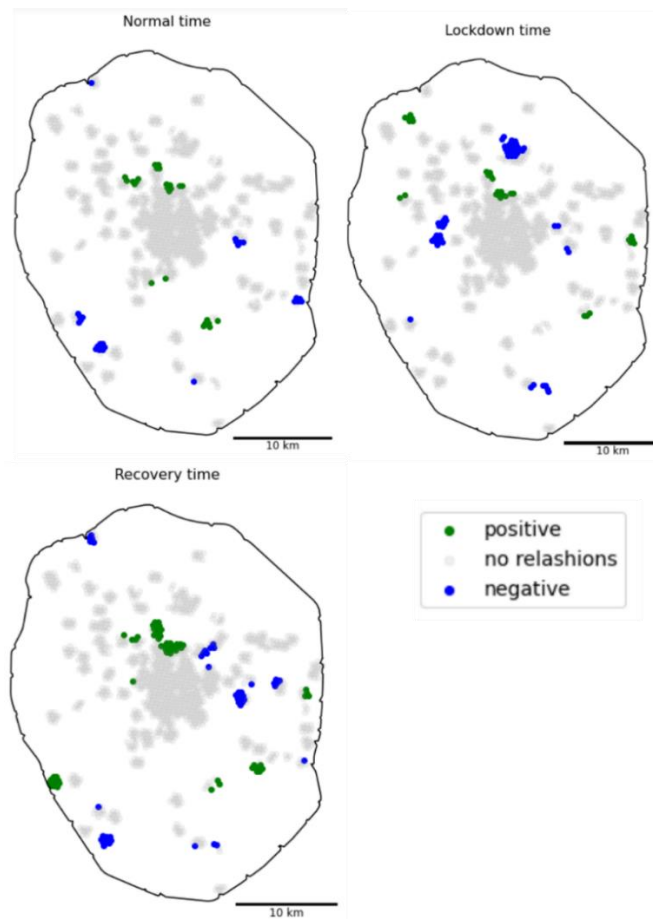


Fig 2. Distribution of sign of relationships between museums and 'Rich' audience

Recommendations

Although the assumption of a general positive impact of museums on economically active residents has been rejected, the results can still be useful as for businesses selecting a new office location as well as for policymakers planning to boost city regeneration through cultural facilities. Four insights, one for the first group and one for the second have been formulated.

First of all, the results proved that the current approach to measuring economic results achieved due to museums in city-wide scale was untenable. By comparing OLS results and GWR results, we have detected a strong advantage of using multiple local-scale models over creating a single model when we need to explain relationships between infrastructure and residents' numbers in a city. In future cases it is recommended to apply fine-grained analysis to assessing cultural impact on residents, especially in large cities.

Secondly, results confirmed that relying on museums without efforts to develop surrounding infrastructure is not a reliable strategy for policymakers. Museums building, themselves, are not usually attractive for people who like to spend money - only when they stand out of surrounding landscape. This may occur when a museum is housed in remarkable building inside residential area or when they have a good walkable area nearby like a park or riverbank. Overall, in Moscow standard urban environment features such as walkability score and type of land use identified a wider impact on pedestrians' behaviours than museums. All this together assumes that nowadays, when tourists are not numerous, city authorities should pay attention to the quality of infrastructure around museums, especially those located outside the city centres. This will help amplify creative image around museums and engage economically active citizens to visit such places.

On the other hand, the perception of cultural places as a waste of state budget is also not correct. Several successful examples of Moscow museums which were not meant to bring economic development to a neighbourhood, such as Jewish museum and Tolerance centre, urge Russian authorities to pay more attention to cultural facilities and develop a strategy which will help museums to reveal their economic potential for business sector.

Given all saying above, museums worth attention of business when it is looking for a next place to open a store. At such places it is possible to draw younger and wealthier consumers than in other places. But it does not work for every museum – their location, architectural features of buildings as well as characteristics of surrounding environment such as POI's diversity and street connectivity are essential criteria of business success. The higher chances exist in residential areas around museums with astonishing architecture or near walking area. The level of technological

maturity of museums is also important, especially for young visitors. The total number of pedestrians will be rather lower than at the centre, but the level of potential consumers in them will be higher.

Lastly, we cannot skip saying about the benefits of using local-scale. In contrast to city-wide scale data, this one provides much deeper insights about people preferences and behaviour which became very important information in post-Covid-19 time. Moreover, such data is received with only one-month lag which allows always have an up-to-date information about changing citizens behaviour. In other words, it solves the issue when short-term results of some initiative do not represent a long-term effect which may be different, especially in case of cultural initiatives. Location data scientists can't anymore rely on historical footfall data to estimate where people will be, so such data as one that Locomizer provides is needed.

Conclusion

The historical overview of the role of culture in a city over the last 100 years has stressed out its importance for urban planners and policymakers. Since the growth of urban regeneration activities in Europe, cultural initiatives have been commonly embodied into city regeneration processes because of a general belief in their ability to generate income for a city.

But the real situation is not so simple – the concerns about weak methodological approaches applied to the assessment of museum contribution have been raised over the last 20 years. In particular, papers highlighted that most conclusions were made on administrative figures changes. Meanwhile, to ensure no confusion of a museum's contribution with other interventions, the fine-grained data, usually unavailable for policymakers, was needed.

Nowadays, when the global pandemic urged governments to balance in their decisions between people safety and country economic stability, an understanding of real economic value of museums has become very important. Given the limited numbers of tourists in cities, it can only be measured in terms of residents' money attraction.

Following this, the paper proposed a new approach to measuring museums' economic value to the city based on GPS-data of economically active people who live or pass by there.

By accounting for previous papers weaknesses, strength, significance and direction of relationships between museums and pedestrians were assessed by building OLS and geographically-weighted regressions. The models allowed us to draw conclusions as following :

Firstly, an attempt to apply OLS regressions failed because of heterogeneity of residuals and the high level of spatial autocorrelation, thus assuming that there is a significant variety in how built-up environment, including museums, impact people in dependence of location. This has demonstrated the need for a fine-grained approach.

Secondly, building GWR which significantly better explained relationships between museums and pedestrians' propensity for consumption than OLS has resulted in no impact of museums on the local economic activity in 90% of the Moscow area. Other features such as POIs diversity and street connectivity were able to explain the numbers of residents much better.

Thirdly, splitting sample on three time periods in terms of movement restrictions helped (1) firstly to distinguish areas with pedestrians with high consuming power due to museums features from those where it is due to neighbourhood opportunities; secondly, to found out the increased importance of local museums in residential areas for affluent people in *the recovery* time – the latter started to treat them as alternative to creative places unreachable after the quarantine.

Last, considering individual features of museums with discovered economic potential we identified that such features as outstanding architectures of the building, good walkable infrastructure and technological maturity of museum may increase attractiveness of places among economically active citizens. To detect the degree and generality of their impact, further study is demanded.

To conclude, on the one hand, the study demonstrated the weak link between museums and active consumers in large cities like Moscow, on the other hand it revealed uncovered opportunities of particular cases in which cultural place may facilitate economic growth via attracting wealthy and active residents. But these ones require a deeper investigation.

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