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Skyscrapers and City Well-Being in the United States: A Statistical Investigation

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Abstract

An important element of tall building sustainability is the effects the buildings have on the social and economic well-being of residents. The results of a statistical analysis into the broader relationship between measures of city well-being and the construction of tall buildings are explored through a data set representing 186 metropolitan areas across the United States. This data study analyzes the number of tall buildings in a city against other measures of city performance, including income, population; and an index of social well-being, which measures the average life satisfaction, or happiness, of residents. Strong support emerged suggesting that the number of both high-rises and skyscrapers are positively related to a city’s economic activity, suggesting that tall buildings are an important element of economic growth. Additional results found that high-rises had a negative effect on well-being measures, while skyscrapers were positively correlated to happiness due to fostering a sense of community and increased physical activity.

Keywords: Cities, Economics, Happiness Studies, Tall Buildings, United States, Urban Well-being

Introduction

Skyscrapers have been controversial ever since the first ones appeared in American cities at the end of the 19th century. From an economic perspective, tall buildings are constructed based on the demand for office and residential space in central locations. As a result, they enhance urban growth by providing needed building space. The collection of tall structures—the skyline—can be an additional source of economic growth, through tourism and urban advertising. The skyline may also enhance feelings of local identity and pride (Al-Kodmany et al. 2013).

But to their detractors, tall buildings are seen as being responsible for a suite of negative externalities, including creating traffic and pedestrian congestion, casting shade on the streets and neighboring buildings, emitting high rates of greenhouse gases, and burdening local infrastructure. Additionally, a common perception is that they are frequently built as monuments rather than revenue tools (Helsley and Strange 2008). Developers can use skyscrapers as physical manifestations of their egos or they can use them to seek the thrill of competition to claim the title of “tallest building.” To the degree that this is true, it can exacerbate negative externalities, and also drive down real estate prices by over-supplying the market (Barr 2014).

Additionally, those interested in city design claim that too many tall buildings destroy the “feel” of the city and do not encourage dense pedestrian activity at the street level (Florida 2016). The “optimal” city from a Jane Jacobsian perspective has few tall buildings and a mix of different types of low-rise and medium-rise structures.

Recently, tall building construction has become associated with gentrification, which leads to negative perceptions about displacement and central cities becoming consumer cities for billionaires (see Figure 1). Furthermore, research on the psychological effects of residing in tall buildings has produced mixed findings (Gifford 2007). Studies that investigate psychological well-being and a sense of security tend to find that occupants in high-rise buildings report psychological problems such as fear of crime and loneliness, especially in public housing projects (see Figure 2).
In short, in the nearly thirteen decades of tall building construction, the debate remains about whether they are good or bad for cities. The aim of this research is, first, to test the economic theory which says that tall buildings are built to satisfy the economic needs of residents and businesses and, second, to provide evidence if tall building construction impacts the happiness level of residents within cities across the United States. Despite the controversy surrounding tall buildings, no work has explored the degree to which they can impact residents’ sense of well-being on average.

To explore this relationship, a new data set was created consisting of a cross-section of 186 US Metropolitan Statistical Areas (MSAs) as of 2017. For each MSA a well-being index score was created by Gallup-Sharecare (Well Being Index 2017). The aim to use this data to test for the degree to which tall building construction may be affecting the well-being of the residents in these urban areas. A positive relationship would suggest that, on net, they allow people to achieve a happier life; while a negative relationship would suggest a role for policies that diminish or eliminate some of these effects, without reducing their benefits.

As a preview of the findings, the results suggest that, first, tall buildings are a direct response to satisfying the economic needs of residents. Cities with higher populations, greater incomes, and higher Global City Index values have more tall buildings, on average. Second, the results of tests for the effect of tall building construction on happiness levels are mixed. On average, the impact of the number of high-rises on well-being appears to be negative; while the number of skyscrapers is positively related to happiness. The results emerge from different types of statistical (regression) models, which also include a host of additional other factors that might drive well-being. We note that while the regression analysis does not necessarily prove a causal connection, that the fact that such relationship exists, after controlling for other drivers of well-being, is highly suggestive of an impact of tall buildings on well-being.1

1: Again, though causality can never be proven using regression analysis on a data set such the one used here, the aim of this paper is to test hypotheses about the relationships between tall buildings and city well-being on average. To the extent that certain statistical relationships are found after controlling for other factors suggests a causal connection. For this reason, and as is typical in the economic literature, the paper uses words that imply causality or impacts when such relationships are found in the statistical analysis.
Finally, additional models that look at the effect of tall buildings on the components of the happiness index suggest that skyscrapers improve a city's sense of community and foster more physical activity or better health. High-rises, however, do not seem to positively affect any of the subcategories. Given that this a first study of its kind, more work is needed on exploring the tall building-happiness nexus.

Data Summary

This section summarizes the data used in the analysis, but more details about specific sources and preparation are provided in Barr and Johnson (2019).

The Well-Being Index

The well-being index is from the Gallup-Sharecare State of American Well-Being series. The index comes from a nationwide survey of individuals which measures five elements of well-being (Gallup-Sharecare 2017). In particular, and to quote from Gallup-Sharecare, the poll asks people about the following aspects of their lives:

- Purpose: liking what you do each day and being motivated to achieve your goals
- Social: having supportive relationships and love in your life
- Financial: managing your economic life to reduce stress and increase security
- Community: liking where you live, feeling safe, and having pride in your community
- Physical: having good health and enough energy to get things done daily

From these survey responses, an index value is created for 186 Metropolitan Statistical Areas (MSAs) in the United States (see Figure 3). In 2017, the MSA with the highest value was Naples, Florida (67.6). The lowest MSA (with 58.2) was Fort Smith in Arkansas. The median MSAs of 61.5 are Chicago, Illinois and Rochester, New York.

The index is a composite measure of psychological, social, physical, and financial well-being, and, as a result, is likely to be a strong indicator of general life-satisfaction. For this reason, the index is also referred to here as a happiness index (as is also done, for example, in Florida et al. 2013).

High-Rise Skyscraper Data

The building data was collected from Emporis.com as of 1 March 2018. For the central city in each MSA, data was collected on the number of completed low rises (less than 35 meters), the number of high-rises (35–99.9 meters), and the number of skyscrapers (100 meters or greater) as well as the tallest building in each city. The impacts from the number of high-rises and skyscrapers are studied separately, as they are likely to have differing effects.

Generally speaking, skyscrapers are used for office buildings and high-end residences. High-rises are used for both middle income housing and public housing, as well as for offices and luxury buildings. Thus, high-rise construction in cities throughout the United States is likely to be more heterogeneous in their uses. In order to control for the construction of high-rises due to public housing projects, a variable measuring the number of public housing high-rise buildings in each MSA was also included. Because of the urban problems associated with concentrated poverty and segregation in public housing in the United States (Cutler and Glaeser 1997), it is likely that cities that have a higher number of public housing projects will have lower happiness. The goal is to also see how public housing implicitly affects well-being by looking at the relationship between the number of high-rises and public housing construction.

Note that for some MSAs with multiple cities, only the number of skyscrapers in the main central city was included;
while this may impact the measure to some degree, central cities are generally the location of the overwhelming majority of tall buildings.

In order to more precisely estimate the impact of tall buildings on happiness, additional control variables were included in the analysis. From Weiss (1992), the number of high-rise buildings (10 to 20 stories) and skyscrapers (greater than 20 stories) from 59 cities as of 1920 were collected. Building counts from the 1920s are to help control for the “taste” for skyscrapers that may have emerged early in a city’s history. Building counts for cities not listed were assigned a value of zero.

As another possible determinant of skyscraper construction, a variable from a “Global Cities” report was created (GaWC 2018). The report lists cities based on the degree to which they are tapped into the global economy or not. New York City and London are rated as “Alpha ++” cities, being the most global in their orientation. Next are cities like Hong Kong, Dubai, and Paris. The GaWC classification lists 12 categories from the highest, most global-oriented, to those not dependent on other international cities. Each category was then given a number from 1 to 12 (from lowest to highest) and each city assigned a number based on its category.

**MSA Data**

Several control variables were collected at the MSA level from either the Bureau of Labor Statistics, the American Community Survey, or the Decennial Census (see Barr and Johnson 2019 for more details). These include MSA population, MSA Gross Domestic Product, median household income, and other demographic, economic, and environmental characteristics.

**The Determinants of Tall Building Construction**

The study intended to investigate economic drivers of skyscraper and high-rise construction, and secondly to explore the degree to which this construction may affect city happiness levels. Economic theory suggests that tall buildings are a response to demand for people and businesses to occupy central city locations. As the demand for these locations increases, land values rise, and developers are thus incentivized to build tall as a way to increase the return on their investment. Thus, the price of land is a means by which economic demand promotes a corresponding match in building supply (Barr 2016).

If this theory is correct, then it should be the case that variables such as a city’s population, its per capita gross domestic product (GDP), its Global City status, and its history of embracing tall buildings should positively impact the number of tall buildings. The data set created here is designed to test this economic theory. If support for the theory is found, it suggests that tall buildings are an efficient allocation of valuable urban land and are thus providing an economic benefit to their respective cities. This is further illustrated by the positive relationship between tall building construction and an MSA’s level of per capital GDP (see Figures 4 and 5) and the positive relationship between skyscraper construction and global city status (see Figure 6).

The results provide strong support for the land use model. The included economic variables—population, GDP per capita, and number of high-rises in 1920—explain over 70 percent of the variation in the number of high-rises and...
skyscrapers, respectively. Each of the variables is found to be positively related to skyscraper construction and are statistically significant. In other words, the larger a city, the more tall buildings it has, on average; the greater its per capita GDP is the more tall buildings it has; and the more tapped into the global economy it is, the more skyscrapers it has.

Though a detailed exploration of the impact of global city status on skyscrapers is beyond the scope of this paper, it’s important to highlight that the positive coefficient could be due either to economic forces or from the desire of building occupants to use their buildings to advertise or signal their productivities (Garza and Lizieri 2016).

Figure 5. Number of skyscrapers in an MSA versus per capita GDP (in natural logs) demonstrates a positive correlation between the two factors. © Jason Barr

Figure 6. The number of skyscrapers in an MSA (in log form) versus global city status were positively correlated. © Jason Barr
Tall Buildings and Happiness

Given that the results strongly suggest that tall building construction is a response to the economic needs of the residents, this section investigates the degree to which tall buildings may influence residents’ sense of life-satisfaction.

Scatter plots were developed for the relationship between happiness and high-rise construction (see Figure 7) and happiness and skyscraper construction (see Figure 8). The data results show, on average, weak relationships (without controlling for other possible confounding variables).

Figure 7. Well-being index for 186 MSAs versus number of high-rises (in natural logs) shows a weak relationship between the two. © Jason Barr

Figure 8. Well-being index for 186 MSAs versus number of skyscrapers (in natural logs) shows a low-strength correlation. © Jason Barr
Clues Driving the Findings

While a deeper investigation on the mechanism of the impact of tall buildings on urban happiness levels remains for future work, some possible clues were explored. As discussed above, the well-being index is comprised of responses to five categories of well-being: life-purpose, social well-being, financial well-being, a sense of community, and physical health. While Gallup-Sharecare does not provide index values for each of these categories, they do rank the cities from highest to lowest.

To this end, it was investigated how the tall building measures impacted the relative rankings of cities in the five different categories (that is percentile rankings, where a large percentile number means a high ranking). Findings from regression models can suggest the path by which tall buildings may or may not influence well-being overall. As an illustrative example, the correlations between the sub-index percentiles and skyscraper and high-rise construction were explored respectively (see Table 1). Note that since they are raw correlations, they don’t necessarily show the direction of (possible) causality. Those numbers with a star suggest that the correlations are statistically different than zero. The results show a negative correlation with high-rise housing and sense of life purpose, and social well-being. For skyscrapers, physical well-being is positively correlated with skyscrapers.

To investigate these relationships further, and to test for a possible causal link, regressions were run that looked at the effect of high-rise and skyscraper construction on the sub-indexes, after controlling for a host of other economic and happiness is more complex and thus is not discussed here (see Barr & Johnson (n.d.) for more discussion).

Tall Buildings and Happiness

Given the baseline model, the tall building measures were then added to the equation to see how they impact well-being, controlling for the other key factors that drive happiness. In short, the various regressions suggest that the number of skyscrapers is positively related to the happiness measure, while the number of high-rises is negatively related to the happiness measure.

For the models that looked at high-rise construction on happiness, the number of high-rise public housing projects was also included as a control variable (this variable was not included in the skyscraper models, as it was found to be statistically insignificant). As expected, the number of public housing projects negatively impacted city happiness levels. But, just as importantly, even after controlling for public housing, the number of high-rises in a city was still a negative determinant of a city’s happiness value.

The Baseline Happiness Model

The baseline model is a relatively basic one that includes the standard factors that are likely to drive average happiness across cities, based on prior research (Frey and Stutzer 2010, Leyden et al. 2011). For each of the 186 MSAs in the sample, included was a measure of the population size, the residents’ median age, the median household income, the unemployment rate, the percent of residents with a bachelor’s degree or higher; and racial/ethnic characteristics. Also included was the average January temperature, since warmer winters are likely to be associated with happiness. Two measures of commuting were also included (the percent of residents who commute via driving and public transportation, respectively).

Also included was a measure of housing consumption, given by the MSA population divided by number of housing units. It is hypothesized that a negative relationship exists with happiness, since the fewer people per housing unit would mean more housing consumption per capita. This would likely increase people’s sense of well-being.

The results show that the baseline model can account for 61 percent of the variation in the happiness index across cities; nearly all of the variables have the expected impacts. Cities with higher incomes are happier; lower unemployment rates create happier cities; cities with warmer winters are happier; higher educated cities are happier; those with longer commutes appear to be less happy. The more housing space per capita people have the happier they are. Finally, there is a u-shaped relationship between age and happiness—younger and older cities are happier than those with more middle-aged residents (Florida et al. 2013). The role of population density

<table>
<thead>
<tr>
<th>Variable</th>
<th>ln(1+#High-rises)</th>
<th>ln(1+#Skyscrapers)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ln(1+#Skyscrapers)</td>
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<td></td>
</tr>
<tr>
<td>Well-being Index</td>
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<td>0.02</td>
</tr>
<tr>
<td>Financial Well-being Percentile</td>
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<td>0</td>
</tr>
<tr>
<td>Life Purpose Well-being Index Percentile</td>
<td>-0.13*</td>
<td>-0.04</td>
</tr>
<tr>
<td>Social Well-being Index Percentile</td>
<td>-0.17*</td>
<td>-0.08</td>
</tr>
<tr>
<td>Community Well-being Index Percentile</td>
<td>-0.11</td>
<td>-0.05</td>
</tr>
<tr>
<td>Physical Well-being Index Percentile</td>
<td>0.09</td>
<td>0.17*</td>
</tr>
</tbody>
</table>

*indicates statistically different than zero at the 90 percent or greater confidence level. Subcategories are given in percentile values. Thus, positive correlation values suggest skyscrapers or high-rises a positively associated with the well-being in a subcategory, respectively; negative relationship suggests the opposite.

Table 1. Correlation coefficients between well-being index and subcategories and number of high-rises and skyscrapers, respectively, in 186 MSAs in the United States. Tall building measures given in natural log form. © Jason Barr

To this end, a regression model was the first run that looked at the social and economic determents of well-being to provide a baseline model. Given this baseline, the tall building measures were then added into the analysis to see how they impacted well-being, controlling for the key social and economic factors that drive well-being.
and demographic variables for each MSA. The results of this regression analysis show that, for the skyscraper variable, a positive effect was found from all of the categories except the financial one, though statistical significance varied. A significant effect was found from the community and physical activity variables. This suggests that those cities that embrace skyscraper construction foster greater urban activity in general.

However, negative, though insignificant, effects for high-rises for each of the categories except the financial one was found. The results suggest that while high-rises may not have a strong impact on well-being across cities, the negative coefficients indicate that there may be issues with building design and high-rise locations that can negatively impact residents. Further research is needed in this area.

**Conclusion**

Since the first skyscrapers emerged in cities like New York City and Chicago toward the end of the 19th century, they have been the causes of much debate. Proponents argue they are an efficient allocation of geography, and they enhance urban economic growth. Furthermore, skyscrapers may foster a collective sense of urban identity and increase tourism because of their role in creating iconic skylines. Detractors, on the other hand, focus on the shadows, traffic congestion, potential impacts on gentrification, carbon dioxide emissions, and how they impact the “feel” of city streets. To the authors’ knowledge, no work in the social sciences has explored the degree to which skyscraper construction can affect the happiness of residents within cities. To investigate this question, a data set was assembled in order to investigate the determinants of both the average happiness level across 186 metropolitan areas in the United States and the construction of tall buildings.

The results provide strong support that both high-rises (35- to 99.9-meter buildings) and skyscrapers (100 meters or taller) respond to the economic fundamentals of each city. Tall buildings are positively related to population, per capita GDP, and other economic measures of density and business activity. This suggests that tall building construction is consistent with the findings of the urban economics land-use theory.

On the other hand, mixed results for the impact of high-rises and skyscrapers on happiness were found, even after controlling for several of the key variables that happiness literature has shown to be important. Though statistical significance varies across specifications, the statistical models show that, on average, the coefficient estimates for the impact of high-rises on well-being is negative; while the impact of skyscrapers is positive. Regressions that look at the effect of tall buildings on the components of the happiness index suggest that skyscrapers improve a city’s sense of community and foster more physical activity or better health. High-rises however do not seem to positively affect any of the subcategories.

Given this is a first attempt to estimate the role of building types in the well-being of city dwellers, more research is needed to tease out the mechanism by which building form and locations affects people’s individual and collective behavior in a way that impacts their life satisfaction. Once this mechanism is understood, policies can be crafted to enhance both the efficiency of land use and the happiness of cities.

**References:**