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Towards a Cost-Benefit Analysis of the High Line in New York City

Verso un'analisi costi-benefici della High Line di New York City

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Abstract:

This study considers the High line in New York City as the case study of a renewal project. This urban infrastructure that one day was an unused railway now became a model for other elevated parks all around the world. The paper will move towards the economic assessment of the High line. We will use Cost Benefit Analysis for our evaluation. The important CBA impacts will be considered and, the total costs and benefits of the project will be assessed. Calculation of the tourist revenue, as the main part of this work, is of interest. By doing linear regression analysis and some corrections, the amount of tourist revenue will be obtained. Finally, the Net Present Value $NPV_{(2019)}$ will be calculated and, the limitations in obtaining some benefits will be discussed.

Astratto:

Questa ricerca considera High Line di New York City come il caso di studio di un progetto di rinnovamento. Questa infrastruttura urbana che un giorno era una ferrovia inutilizzata ora è diventata un modello per altri parchi sopraelevati in tutto il mondo. L'articolo si sposterà verso la valutazione economica di High line. Useremo Analisi Costi e Benefici per la nostra analisi. Verranno presi in considerazione gli importanti impatti CBA e verranno valutati i costi ei benefici totali del progetto. Ci interessa il calcolo delle entrate turistiche, come parte principale di questo lavoro. Facendo un'analisi di regressione lineare e alcune correzioni, si otterrà l'importo delle entrate turistiche. Infine, verrà calcolato il Valore Attuale Netto $VAN_{(2019)}$ e verranno discusse le limitazioni nell'ottenimento di alcuni benefici.

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1 Introduction

The High line in New York City is one of the most well-known renewal urban transformation projects. This elevated park which one day was only a discarded old railway and now becomes the most famous elevated park around the world, may bring high sources of revenue for NYC every year. In this study, the analysis of the costs and benefits contributing to this project is of interest. The economic assessment of the High line will illustrate a clearer picture of such projects for considerations in case of other similar projects. This study moves towards the cost-benefit analysis of High line. The project aims at analyzing the impacts used for the cost-benefit analysis and computing the net benefit value of this urban transformation. As an important factor, the tourist revenue will be obtained accurately and will be considered for the CBA.

Transformation projects may encourage economic growth, create jobs and bring amenities closer to residents. Some of these projects may refer to the renewal of part of a city like Metro Tech Center in Brooklyn, L.A. Live downtown Los Angeles, or the downtown project of Nevada (Fontenot, n.d.). But in some cases, there are more challenges to handle. In these cases, the nature of the old project change completely, and they undergo a change of use. We can mention some successful urban renewal projects that involve hospitality. The Flon area of Lausanne used to be a maze of abandoned workshops, factories, and stores a few years ago. Nowadays, the Flon is full of people of all ages and cultures who go there to enjoy the many restaurants and cafes (Quartier du Flon, n.d.). Marina Bay in Singapore, which once was just a body of water of Collyer Quay where ships docked for their passengers by transferring to small boats that then ferried them to Johnston's Pier, is a successful example of excellent long term urban planning projects. The area was repurposed during the 1970s and 1980s to grow the city center. It is a mixed-use district developed to embrace sustainable development strategies. There are many hotels and restaurants, plus transportation options to attract tourists to the area (Auger, 2015).

Urban renewal projects can bring new energy to the neglected areas by demographic and economic change. From the High line Park in New York City to reclaimed docklands in Stockholm, there are designers and community members who have seen potential in old and places of the urban landscape. One of these projects is False Creek South in Vancouver, which was the industrial heart of Vancouver through to the 1950s and was home to many sawmills and small port operations. Shifting industry to other areas results in the deterioration of the vicinity around False Creek. In 1960, the BC Forest Products plant and lumber storage facility on the south side of False Creek caught fire and, the facility was totally destroyed. Now it is turned into a walkable waterfront community in Vancouver. Which is a mix of affordable and for-profit housing, gardens, courtyards, and green space, schools, community centers, and senior services within walking distance to residential areas (Stanton, 2018). As another example, Hammarby Sjöstad in Stockholm was an industrial area surrounding a lake in central Stockholm until the 1980s (Lindholm, 2019), when city planners and private companies began to turn it into a sustainable region for 25,000 people. In the early 1990s, Hammarby Sjöstad had a reputation for being a polluted and unsafe industrial and residential area. Now, Hammarby Sjöstad is one of Stockholm's most pleasant residential regions and a successful urban renewal region. Melbourne's CBD is another example of urban transformation (Morgan, 2016). The City of Melbourne's policy implemented in 1992, helped to transform empty office towers and vacant buildings into apartments. It encouraged more people to live in the city, which results in emerging bars, restaurants, and other businesses.

The High line, which opened in 2009, is known as a lesson in urban renewal projects. It has become one of New York City's most popular tourist destinations, attracting millions of visitors each year. This Park is one the most foremost contemporary urban revitalization ones. The High line has become an inspiration and justification for a wide range of regeneration efforts in cities around the world. For example, the Lines of Life park in Singapore is similar to the High line located on an abandoned railway. The park will be 25 km long, and the layout of this park is at the planning stage at the moment. The 606 Bloomingdale Trail park looks like the High line because it is located on an elevated railway. The park was opened in the summer of 2015. The Woodhouse Urban Park was opened in 2017 and is a kid-friendly park in the London neighborhood, Brent. The 101 Freeway which goes through Los Angeles is planning to transform this freeway into a park that is another example of inspired projects of High line. Philadelphia is planning to build a 5 km long similar to the High line, which provides a view of the city (Esch, 2018). The Coulée Verte in Paris and the Railpath park in Toronto are other examples that were inspired by the High line.

These examples were only a few numbers of the complete or incomplete projects which followed the High line. In the near future, more cities may desire to implement such projects. Based on what we discussed in the previous paragraphs, many projects will take the High line as their model. Therefore, the economic assessment of such projects becomes a crucial topic. This assessment for example for the High line will show if it was a successful project in terms of the effects on the net social surplus, and whether it reached its goals or not. In this study, we are planning to take a step towards the economic evaluation of the High line. Up to now, there is no useful study regarding this topic, and the lack of information about this matter is felt. In general, there are a few studies which concern the economic effects of High line. For example, Song studied the economic impact of the High line on nearby property value changes, the number of jobs created by the project, and subsequent demands on other industries (Song, 2013). Gore *et al.* considered the High line as a green infrastructure that brings economic growth (Gore, 2013). However, there is no straightforward economic assessment of the High line in the literature. Though the tourist attraction is one of the main reasons for renewal projects, especially in the case of public spaces, this important factor is ignored in the case of the High line. The number of visitors has been reported in related sources but, the monetized value of this impact is not available in the literature.

In the first step, we will investigate the impacts which influence the economic assessment of the High line. Tourism revenue, as an important impact, is one of the main parts of this study. In the next step, we will seek to moving forward to performing the economic assessment.

There may exist many limitations for obtaining the costs and benefits of High line which mostly concern the side of the benefits, and public agencies should overcome this issue, in order to provide a complete and reliable assessment. Notice that these limitations do not just concern data, but also methodologies that should be applied to measure the different costs and benefits. We will have a brief discussion about the applicable methods to do an economic assessment of impacts.

There are some methods to undertake economic assessment. The most common methods that assess the overall merits of a proposal or compare a set of choices are the hedonic pricing method, contingent valuation, econometrics, choice modeling, cost-benefit analysis, cost-effectiveness analysis, break-even analysis, and multi-criteria analysis. In the following, we define each method briefly.

The hedonic pricing method is used for the determination of the economic value for an ecosystem service or external factor that can influence the total price of a good or asset. This method is usually applied for the value determination of properties like houses and explains economic costs or benefits, which can affect the overall value of the asset. Hedonic price valuation is a quantitative method and is based on statistical analysis (Baltas, 2001).

The contingent valuation method is an economic technique for the valuation of non-market resources like environmental impact. These kinds of resources give people utility, but some of their aspects do not have a market price because they are not directly sold. For instance, a beautiful view of a mountain is beneficial, but it is hard to assert a value by using price-based models. The contingent valuation technique is used to measure such aspects. Typically, a contingent valuation survey asks the monetize willing to pay for an environmental feature (Diamond, 1994).

Choice modeling is a scientific method that is used by economists and policy-makers to measure consumer preferences. This method helps to determine the nature of the demand for new and existing products or services. Choice modeling allows organizations to estimate demand accurately and help them to know exactly how customers make decisions. It is applicable to estimate the demand for existing products or to forecast demand for new ones. Also, it can observe the effects of changes to marketing materials (Marley, 1968).

The econometric methods use statistical tools and economic theories to estimate the economic variables and anticipate the intended variables. The econometric methods are most widely applicable in forecasting the demand for a product. The forecast made by these methods is more reliable than the other forecasting methods (Wooldridge, 2015).

Break-even analysis (BEA) is an analysis to determine the point at which the benefits of the choice equal its costs (Boldrin, 2008). The costs are divided by the monetized value of a unit of benefit in order to identify the minimum amount of benefits required for a choice to break even. By the estimation of the minimum benefits required, break-even analysis allows having a judgment about the likelihood of those benefits whether they are being achieved or not. Break-even analysis can be used where it is possible to assign the units of benefits a monetary value but, the effectiveness of a choice or the magnitude of the likely benefits is uncertain. Break-even analysis is useful for analyzing options but less useful for comparing the relative effectiveness of several choices. For example, if two proposals have an equivalent break-even point, we cannot determine which one is probably going to give us a greater net benefit.

Cost-effectiveness analysis (CEA) is a partial cost-benefit analysis that compares the costs of other ways of producing equivalent or similar outcomes. CEA provides an estimation of the average cost per unit of a given outcome (Asaria, 2016). Cost-effectiveness analysis is beneficial when the main benefits cannot be easily expressed in terms of money or when it is hard to undertake the valuation. In such cases, benefits are expressed in terms of physical units while costs are expressed in terms of money. Cost-effectiveness offers a priority ranking of choices based on "cost per unit of outcome". Cost-effectiveness analysis is most usually applicable in areas such as education, health, and the environment where quantification of advantages is harder. Cost-effectiveness analysis cannot determine whether the preferred choice is of net benefit to society or not. It can be only the most cost-effective option. Moreover, this method cannot find or compare alternative projects that would achieve greater net social benefits by targeting different outcomes. Therefore, the cost-effectiveness analysis is applicable where the choice to focus on a particular outcome has already been agreed upon by decision-makers. Cost-benefit analysis (CBA) is the primary economic assessment method used for regulatory decisions. The cost-benefit analysis quantifies in terms of money as many of the costs and benefits of a particular proposal as feasible. The cost-benefit method contains a systematic evaluation of impacts. It endeavors to account for effects on the entire community and economy and not just for the immediate, direct, or financial effect on one group. This involves the consistent valuation of the market and non-market costs and benefits in a monetary value during the time. The cost-benefit analysis determines whether a proposal has a net benefit or not. In addition, it can determine which of the alternative proposals has the greatest net benefit. By translating impacts into a monetary value, the cost-benefit analysis provides a framework for weighing up different choices and determining the priorities in different parts such as transport, health, and education. Multi-criteria analysis (MCA) is applicable when it is not feasible to quantify the impacts of the choice. MCA can include a wide range of criteria (for example, social and environmental considerations), all measured in the most relevant unit rather than in terms of money. Due to the lack of theoretical foundation in welfare economics for MCA, this method is recommended as the last solution or to be used to complement a CBA. Economic modeling tools that focus on assessing the economic impact of an intervention or proposal are input-output analysis, computable general equilibrium (CGE) modeling, and market-specific models. These methods are often used alone or in combination with CBA.

Based on the explanation of the proposed methods, the hedonic pricing method and the contingent method usually concern non-marketing impacts like environmental impact. In the case of the High line, though there is the environmental impact, considering its environmental effect is not the aim of this study. More attempts like the willingness to pay analysis are needed to capture this effect. But it seems that the environmental benefits were less notable than other impacts. However, more studies and surveys should be performed to compute the exact influence of this impact. Although the hedonic pricing method is an applicable method for determining the benefits of some impacts like properties' value increase, this calculation is not the aim of this study. Some other methods such as CEA, break-even analysis, econometrics, and choice modeling do not account for the present study because this study aims to obtain the net benefit value of the High line. Some of the proposed methods are usually applicable to forecast the effect of undetermined impacts, but we know the impacts and the costs and benefits in terms of money for the case of the High line. The CBA is a fundamental method to analyze economic assessment and evaluate the monetized value directly. In other words, we will able to compute the revenue of the High line by using CBA.

By determining the impacts and find the total costs and benefits during years, we can do the CBA of High line. Therefore, the most important part of the CBA is the computation of costs and benefits. As the first step, we need to investigate the impacts. In the next step, we will analyze these impacts and obtain their effects in the final analysis. The thesis continues as follow:

in Chapter 2, we review the history of High line, other options for reuse of it and, the advantage and disadvantages of reusing High line as an elevated park. After introducing the case study in Chapter 2, Chapter 3 addresses the introduction of the CBA method and the fundamental theorems of welfare economics and then, a brief introduction of time series analysis will review. In Chapter 4, we will investigate the most important impacts of CBA and compute the cost and benefits of each one. The main focus of this study will be on the benefits of tourist revenue as one of the most important impacts. In Chapter 5, the final results will be reported and, we will have a brief discussion about the analysis we performed and the limitations we encountered. Finally, chapter 6 is the conclusion.

2 Overview of the Case Study

2.1 History of the High line

History of the High line of the days that it was operating shipping trains is interesting. The New York Central System in combination with the New York City built the route to decrease the number of accidents along Manhattan's West Side. This project, although costly, was successful and considerably ameliorated the NYC's operations in downtown area of the city. Island's rail service dated to the 19th century, and until about 100 years later; when the "High line" project was done, the line was disturbed with more than 100-grade crossing. By the improvement of the highways and taking away short-haul freight from railroads by trucks, the short corridor became useless more and more (High Line History New York, n.d.).

Manhattan Iceland's rail service can be transferred to the Hudson River Railroad (HRRR), an early predecessor of the New York City Central. In 1847 the New York City allowed to build street-level rails on Manhattan's west side. In 1863 this system was confirmed to build a line from 32nd street in Manhattan to Albany, which inaugurated in 1851. By 1863, the great railroad capitalist Cornelius "Commodore" Vanderbilt had taken control of the Hudson River Railroad and would unite it with his New York Central Railroad to create the New York Central & Hudson River Railroad in 1869. Within 1868, when a line was arrived to St. John's Park, once owned by the St. John's Episcopal Church, extension continued in south of 32nd Street along 10th avenue. In here, the main St. John's Park Freight Terminal was built on Hudson Street as a giant facility to settle and arrange incoming and out coming freight movements.

Unfortunately, from 1851 to 1929, the whole route was filled with 105-grade crossings. After several accidents at 10th avenue, it was renamed "Death Avenue". To help alleviate these incidents, the railroad and city began to use what became known as "West Side Cowboys". As the train crossed the street, especially where it was passing guards, some men rode horses right ahead of the trains, while they had a red flag in their hands. On July 2, 1929, the NYC and city made a deal that would subtract the street problems as a whole: "The West Side Improvement Project". This creative idea with a great team work enhanced the southern lanes of 30th Street Yard using a 14-foot-high steel and concrete viaduct. During the planning, the engineers made certain that the paths could straightly be efficient for the building and warehouses, therefore line's services improved. After destruction of the original St. John's Park Freight Terminal's structure, on June 28, 1934, the city and railroad dedicated a new one. Covering three city blocks, managing 14 freight elevators and servicing 150 trucks was only a part of its capabilities. The whole route, all double-tracked paths from 30th Street to St. John's Park, was 13 miles long and cost more than $150 million. Also the corridor, which was a part of railroad's much larger West Side Line (or West Side Freight Line, the only railroad for serving Manhattan Island instantly), was electrified by The New York Central with the construction of a third-rail running. Later with the advent of diesel-electric locomotives, the era of these electrifications came to an end.

As regards to the fact that The West Side Improvement Project was completed during the Great Depression, it almost failed to meet the expectations and highways and trucks were already swallowing up by the fright traffic of the railroad industry. This was especially true of short-haul and less-than-carload (LCL) movements that made up the majority of West Side Line traffic. Apart from this, from a long time ago, the NYC handled significant freight across the line, such as the transportation of dairy products, meat, fowl and eggs, produce, mail and so many other manufactured stuff. As expected, over the years, trucks have taken up more fright lines, especially in the 1950s.

In 1963, the New York Central leaved and devastated nearly half of the south bank Street. The northern part, which was remained, continued serving to the customers who were still there during the dark days of Penn Central (an integration of NYC, Pennsylvania and New Heaven). At the time that Conrail started in the spring of 1976. On that time, there wasn't too much cargo to be carried; in the early 1980s, Conrail was stopped providing services altogether at the then-owner's discretion, so the last train carrying three shipments of frozen turkeys departed The High line on that time.

In 1983, Chelsea resident Peter Obletz tried to preserve the estates for light-rail or travel service, although he failed. Over the next 20 years, arguments began over keeping or ruining the elevated road. For maintaining the structure as a recreational route, in 1999, the "Friends of the High line" was founded by two residents of the High line Neighborhood, Joshua David and Robert

Hammond. This effort lasted for several years but finally received sufficient public support, even from the city.

At the early 20^{th} century, the latter development into the huge New York Central System, extending from New York City across the Midwest to Chicago, Detroit, St. Louis and many more. From 2001 to 2002, The Design Trust for Public Space provided a grant to architect Casey Jones to conduct researches and information about "The High line reconstruction", a jointly planned study by The Design Trust and Friends of High line to manage the process of preserving and reusing the High line.

In March 2002, Friends of High line received their first municipal support, which was a city council resolution to support the reuse of High line. In October 2002, a study by Friends of High line showed that the High line project is economically viable, and the new tax revenue generated by the public space would exceed construction costs. In December of that year, The City in conjunction with the federal Surface Transportation Board conducted the necessary research to establish rail banking, which, in addition to maintaining urban policies, also made it possible to reuse the High line. Also in the same year, a competition was organized to select the best design for the High line, which was supported by Friends of the High line.

From 2003 to September 2004, a design competition for the High line was organized and a group was selected by Friends of the High line and the City of New York, which will be discussed in more detail later.

In April 2005, an exhibition of initial designs by Lames Corner Field Operations, Diller Scofidio and Renfro opened at the Museum of Modern Art. In June of that year, The Surface Transportation Board issued a temporary permit for the High line to end the City and railroad discussions about rail banking. In November 2005, CSX transportation's property was given to the city by the then-owner (the structure was donated).

In April 2006, groundbreaking was celebrated in the High line to coincide with the start of the first phase of the High line construction's section 1.

Construction of the landscape in section 1 started in 2008 with installing paths, access points, and seats, lighting and planting. In June 2008, final plans to turn the High line into a public park were announced.

The High line's project section 1 which opened to the public on June 2009 runs from Gansevoort Street to 20th Street, and section 2 from 20th West St to 30th St in June 8, 2011. In 2012, the whole elevated route south of 30^{th} Street was used as a recreational road. The third part, from West 30th to West 34th St was opened in 2014. In 2015 a small section of 30th Street with access to lifts in this sector was opened. Finally, the last part of the High line was opened to the public in 2019.

2.1.1 High line: Annihilation and rebuilding or reuse?

Many of groups had suggested reuse methods to use the High line as a branch of an elevated residential complex, a robot-controlled parking lot, a garbage line and a theme-oriented train for travelers and visitors. Many studies were conducted to focus on practical scenarios and cases that maximize long-term profits for more people by planners, architects, landscape architects and community members to find the best acceptable design for reusing the High line. This study focused on four broad perspectives: the destruction of the High line and redevelopment of infrastructure land, using the building again for transportation, reusing for commercial purposes and as a public open area. The study covered many aspects, including architectural inspection, outdoor design and support, urban management, hauling, real estate development, and collective participation.

The Design Trust introduced and developed some determination factors for public area and Friends of the High line that became key elements in the recommendations:

- The advantages of retinue and reuse are more than the advantages of destruction.
- Reusable design should be more pedestrian focused than rail, light rail, or bicyclists.
- Although it was possible to find commercial capability in spaces beside the High line, and limited mercantile activity brought positional benefits to the High line it did not become a main commercial organization.
- Reusing it as a public area had too numerous advantages for the biggest constituency.

According to the studies was decided to keep and reuse it, because it was more profitable for the community and City than its destruction and redevelopment.

The destruction brought benefits to private property owners who had bought a lot of land, hence this burden fell on the High line's easement and those who wanted to lift existing restrictions to maximize profits from new construction to handle this situation.

But 6.7 acres of open area in central Manhattan must be lost to gain this benefit. Those 6.7 hectares is paid by public money, and there was a plan to open them for everyone's use. The long-term environmental and social profits of building this 6.7 hectares public space, which made it possible for New Yorkers to move 22 blocks without having to cross city streets, outweighed the short-term cash benefits paid by a small bunch of landlords. Plus, existence a walkway above the High line pushed up the price of neighboring private properties, because it was close to the public open area.

The destruction by removing a part of the building and replacing it with a different structure, ended in favor of people who in their view, industrial architecture and/or transportation infrastructure were aesthetically unpleasant. But, to put it to the end, the building that was an essential part of the economic, architectural and civic history of the entire West Side had to be demolished.

It was just started to be discovered that the profits of High line industrial complex as a key factor to its neighbors were far more than a series of short-sighted aesthetic theories for the comfort of neighbors which were not even capable to understand the importance of industrial and transportation structures.

The destruction of a building that casts a shadow on some pavements ended in favor of the pedestrians. But this shadow was slender, it passed fast and this problem was possible to be improved by lighting and other beautification technologies. The square-footage of open area created by the High line’s upper height, which reached the sky, is much bigger than the square-footage of pavement shaded by the building.

The demolition of a building which partly blocked some of the corridors leading to the Hudson River might also be pleasant for passers-by. But these corridors were semi-closed, while many corridors were completely blocked by the Chelsea Piers (17th Street-22nd Street) and by a U.S.

Postal Service truck depot (24th Street). The visual beauty of the High line- from the Hudson River, the central city sky line and the infrequently visible interior of the city blocks- is more beneficial to pedestrians than the partly view-corridor obstructions. Destruction of the High line due to construction tax revenues could bring potential economic profits to the city. But history proved that public outdoor properties were more valuable and therefore made more tax revenue. With a 22-block public area, property values will raise and new investments will be gained, which is more profitable than redevelopment without the High line.

Some supporters of the demolition posed that the destruction of the High line would lead to a halt in the construction of tall or heavy structures by making changes to taxes and construction laws.

It is not an acceptable logic that by eliminating public profit factors, people's desire for specific areas can be controlled. Someone would not want to shut down the subway system to reduce station upgrade costs to zero, or destroy Grand Central Station for stopping the shifts of its remaining construction rights. In fact, the Department of City Planning, the Board of Standards and Appeals, and/or public entities that reviewed requests for special permits or procedures decided on the dimensions and height of new building in the neighborhood, regardless of the removal or presence of the High line. Influenced by the profits and the enthusiasm that overcame the community, in the basic reviews, a decision was made against the public benefit and with the aim of continuing the activity for High line.

2.1.2 Alternative solutions for reusing High line

- Temporary reuse

  The High line was created for transporting freight trains down the West Side of Manhattan; therefore, obviously many people would like to reuse it as a transportation corridor. Peter Obletz, one of the main custodians of the High line, wanted to re-establish rail transport services.

  Due to these studies, transportation systems including freight- or passenger trains, subway trains, light-rail, or motorized, rubber-wheeled vehicles were not the most useful reuse scenario for the High line. The society opposed the reopening of the fright service or initiating passenger rail service on the line, and both services were somewhat inefficient. The Farley-Penn Station, a block beyond the High line, satisfied the passenger-rail needs of its neighbors. Because the trucks were originally transported from the High line to the converted sheds, the transportation service had operational challenges to deal with. Reusing the subway could be effective, but the technical requirements and the resulting environmental impacts, made it virtually to an impossible idea. For example, it was ideal aim to connect the proposed extension of the number 7 subway line to 34th Street with the L line, at 14th Street—to probably built a subway line moving from Flushing, Queens, to Canarsie, Brooklyn, by way of the city's central commerce zone. Unluckily, the two trains moved in different directions, and moving the L train at 14th Street up to the High line needed destruction and permanent relocation of many existing buildings and streets. Even if only one of the simple goal of re-opening the subway was to be pursued—bringing the 7 train south on the High line, ending at 14th Street—a massive demolition was needed to make room for the platforms and stations. The High line width was 30 feet, but the two train lines were 20 feet wide, and the platforms needed an extra 24 feet, which was about the size of two city blocks. As a result, the community was strongly against to any reuse of the subway.

Light rail could probably be more efficient for the community, but a transportation system using vehicles with rubber-tires and electric motors could have the same potential as the light rail at a lower cost; but the lines on that time were not efficient enough for this system. In designing how to reuse the High line, according to the potential to augment the corridors, it should have borne in mind that light-rail or rubber-wheeled transit may one day become popular; thus, no unchangeable obstacle should be created for these systems.

Having a bike track seemed interesting at first, but the track was too short to give cyclists the feeling of a real bike. The most likely option for changing the use of the High line was to turn it into a pedestrian crossing. This route was used as a north-south communication route between three neighborhoods that did not have a specific pedestrian crossing route. A quiet passage through the city blocks with no cars passing through had significant positive points over 10th avenue with its heavy traffic and noise pollution. An invitation was given to the Convention Center area visitors to explore the environment for themselves; ultimately this plan had far fewer opponents than the reuse-based plans for transportation.

- Mercantile reuse
- The High line was basically like a commercial engine for the city to generate revenue for factories and warehouses in the area; it was connected to many commercial buildings and even had the capacity to connect with more, in fact the structure was designed as an economical passageway.
- The idea of reusing it as a business unit could turn the building into a retail unit, which was not only unworkable but not very desirable. The height and length of the structure made the process of investment and trade in this project to face with some challenges; in addition, if rail-trail mechanisms were used to acquire the line, many commercial activities at the crossing would be prohibited by the law. Also people were showed that they are against this retail operation and prefer to establish small, independent stores in the area.
- The idea of turning the High line into an extensive shopping mall with many retail outlets, in addition adding an acceptable public transportation gateway at the middle of it, had many economic benefits and could also be a positive step in supporting the establishment of public areas, but it jeopardized many of High line's most interesting features: its exemplary quality, its ability to show transportation developments throughout history, and its ability to give people the feeling of being in a place far away from the city. But these were not attractive to the community who were thirsty for open spaces and did not pay much attention to shopping districts.
- The presence of small commercial activity in the region, in addition to making income in order to keep public spaces, also played a role in ensuring of the security of the region. Also thanks to the right business choices, more people came to the High line, which made this place more secure. As a result, the plan to reuse the area as a partial and limited business unit was proposed; in this plan, other uses were also included so that the main focus of the collection was not on economic purposes.
- Public spaces reuse

  Using the High line building once again as an open area for everyone, brought many profits to many people. In the High line area, there was a need for an open space. Of 59

Community Boards in New York City, Board 4, which most of the High line was basically there, was forth from the bottom, in terms of outdoor space. This means less than one-fifth of a hectare of open space per thousand people, while there was an average of 2.5 hectares per thousand people in the city. Finishing the Hudson River Park project could have added more open space to the grounds, but even creating a temporary sidewalk for pedestrians or cyclists could make it one of the busiest public spaces in the city.

The need for more outdoor space was also confirmed by the administrators of the Hudson River Park. This change of use for the surrounding real estate also had economic benefits, as New York's Central Park has affected the economy of the surrounding neighborhoods. The wealth obtained in this way could be used to create more jobs and attract new residents to the region.

Open areas have always been a contentious issue between society and proponents of economic growth. Demands for additional open space increased as the Department of City Planning presented possible deformation scenarios to Community Board 4’s Preservation and Planning Committee. The use of open space was based on rail-banking, which was known to be the most cost-efficient way to achieve the easement. It was also possible that the reuse of open areas would lead to the expansion of the West Side. In addition, it could give to the West Side and permanent transportation system a chance to flourish and grow. Artistic activities were also supported; and all of this could make the area a cultural hub (Joshua David K. H., 2002).

The open areas of the High line helped to preserve the beauty of the city and the community. The situations of the High line were such that a park-like space was naturally created in it.

2.1.3 Reuse of the High line as an open area for everyone: things to consider

The news was reporting the first steps to convert the High line into a public place and pedestrian route. The redesign process was as laborious as the design of the original structure and proceeded gradually. The first attempts to extend the New York's Central Railroads to city streets took place half a century before the construction of the High line, and the design of the structure underwent many changes over the decades, based on public decisions, to eventually the current plan was agreed. Also, in order to reform the structure, changes were made in the plans to meet the new needs of the community, economy, city and state.

Turning an idea step by step into a more coherent or better one, especially in the case of the High line, was important because it took up a lot of space and a lot of time was spent to research about how to create it. The High line construction, like New York City's most famous buildings was not easy, as it was built by people a generation ago to reflect their vast view of the city that was built to grow.

Those who wanted to destroy the High line called people who were trying to turn it into a great promenade, romantics; this proves how undesirable it was to pay attention to the beauty, creativity or improvement of public areas at that time, although the opposite was true.

2.1.3.1 Design principles

- The High line's design is a cooperation between James Corner Field Operations (Project Lead), Diller Scofidio, Renfro, and Piet Oudolf. This section provides the information on the design and construction steps needed to convert the High line to a public park.
- Friends of the High line organized an ideation contest to add more enthusiasm to the High line remodeling process and asked participants to come up with innovative ideas; there was no need for the designs to be practical or realistic, but participants were encouraged to bring ambitious and beyond-imagination designs to build a special and different place like the High line.
- From January to July 2003, they had participants from 36 different countries who competed individually and as a team (720 teams).
- In 2004, Friends of the High line and the City of New York worked together to choose the selected team of the design competition. 52 teams were certified for this purpose that each of them had specialists in the field of architecture, landscape architecture, engineering, art, urban planning, and horticulture. The four finalist teams managed to present their plans for implementation.
- In October 2004, a Steering Committee of representatives from the City of New York and Friends of the High line chose the team of James Corner Field Operations (Project Lead), Diller Scofidio, Renfro, and Piet Oudolf to start designing the High line. Turning each part of the High line from a desolate railroad into a public space, not only required

years of planning, public support, and design, but also it took more than two years to build every section (Design, n.d.).

- Deleting and preparation the site

Construction started with the removal of all previous parts of the structure, such as rail tracks, gravel ballast, soil and plantings, debris, and a thin layer of concrete. By removing each part of the truck, it was labeled, inspected and stored; although a significant number of rails and other artifacts were returned to their previous place and used in the design of the site.

After finishing the removal, the High line steel parts were sandblasted to remove the previous lead paint; during this time a containment tent was used to cover a 25-foot part of the High line. After sandblasting, the steels were repainted to match the overall color of the High line. At the end, the concrete was fixed and the installation of waterproofing was done. The High line is basically perfect- because it was built to carry two full freight trains- but it needed these small changes to be ready for reusing.

- Landscape construction

In the last stage of construction, the High line passages, access points, planting flowers and trees, furnishing the environment and installing lighting facilities were done. The paths were made of prefabricated concrete paving- or wood planks- that rested on the set of piers, and irrigation and electrical infrastructure equipment was placed in this hollow area. In the areas where the stairs were installed, metal beams were removed-creating a passageway through the High line using stairs allowed visitors to watch the huge steel beams that are holding the whole structure. Also, energy-saving LED lamps were used in the park space, in a way that does not interfere with the natural light of the environment but at the same time keep the paths bright.

2.1.3.2 Respond to the needs of different groups

The High line reconstruction is an exemplary case of the conversion of an elevated railroad to an open space that demonstrates the strategies needed for such an operation. This study conducted in collaboration with Friends of the High line, assesses the potential of the old buildings to reconnect them with the community, generate economic benefits, inspire bold designs, and improve the city by creating a 1.45-mile-long, 6.7 acre, elevated open area.

Many of the strategies, design principles and recommendations presented during the study, were implemented through the park construction operation:

- The best way to use the High line is to reconstruct it as a pedestrian crossing.
- The environment should be diverse and enjoyable for visitors.
- Creating green space should be in such a way that the main lawns are preserved.
- The design of the building must be artistic.
- The environment should be fun and imaginative.
- The environment must also be economically beneficial.
- The space should not become just a shopping center.
- The potential of the region should be used to attract privet investors to invest in these public facilities.

The High line reconstructions required a series of comprehensive and practical plans and designs that could illustrate the original nature of the High line as one of the main elements of the New York City. Therefore, a unified program was presented that addresses the needs of different members of society, businesses, landlords, city and the state. Based on this study, suggestions were made for each of the High line neighbors.

2.1.3.3 Construction processes

The High line is placed in western Manhattan. It runs from Gansevoort Street in the Meatpacking District to 34th Street, between Avenues 10 and 11.

Access to the High line is possible in the following places:

Gansevoort Street, 14th Street – with elevator, 16th Street – with elevator, 18th Street, 20th Street, 23th Street – with elevator, West 26th St, West 28th St, West 30th St – with few meters each access by stairs and a lift, West 34th St.

In the High line Park, by overlooking the Hudson River and Manhattan's commercial district, it is possible to see some of the Big Apple's most famous landmarks, from the Statue of Liberty to the Empire State Building.

In this project, preservation of the metal structure and protective rails, as well as the design of a green space with sidewalks, resorts, restaurants, exhibitions and small shops, were on the agenda.

This plan was not possible expect by rebuilding the old links and rail lines in order to turning them into large flower gardens.

This project was done in several stages:

- Stage 1 – The part runs from Gansevoort Street to 20th Street started in 2006 and was opened in June 2009.
- Stage 2 – The High line of Ganservoort Street to 30th was opened in 2011.
- Stage 3 – The third and final stage was officially opened to the public on September 21, 2014 and reaches the 34th St. In 2016, the other part of this phase was also unveiled that connected 10^{th} Street to 30^{th} Street.

The biggest gravitation along this approximately 2.5 km route is the enjoyment of well-regenerated landscape and scenery, while you can see the Hudson River on one side and the skyscrapers on the other, as well as the greenery in front of you, which is created by a collection of flowers and plants that have grown on unused train tracks. A number of benches were set up along the ground to relax, watch the view or sunbathe. There were also spaces for cultural events in the park that even are expected to increase over time.

To build a new concrete structure, it was necessary to completely remove and destroy all the components of the previous building, including steel rails, sandblasting, earthmoving, and the first layer of the previous concrete; which means everything that was required to create the High line steel structure and make the essential changes.

Some of these renovations were waterproofing steel beams in concrete and installing drainage systems on the previous building.

- Stairs – In some parts, beams are deleted in order to replace them with stairs, so the visitors are able to watch the metal beams of the structure as they are crossing the stairs at the middle of the High line.
- Pigeons protector – Because of the damage to the pigeons during the reconstruction of the metal rods under the structure, it was decided to install a guard for the pigeons.
- LED – The LED lights used on the High line, are showing the park paths at night, so, the spectators are able to have a safe and enjoyable walk. These lamps are placed in

the substructure and between the beams to fully illuminate the sidewalk. All lighting fixtures are made of aluminum and stainless steel.

- Plants
- Some parts of the land are intended for growing different plants; the plants are selected in the greenhouse and brought to the High line to be planted in the yard by the High line gardening team, based on the design of landscape architects James Corner and Piet Oudolf. The vegetation of the garden is diverse and everything from grasses to shrubs and bulbs and even perennial trees or tropical plants such as banana tree can be found there.
- Sidewalks were rebuilt with prefab concrete and Ipe wood and old steel left over from the side walls of the stairs.
- Railroad

During the transfer, each part of the railway was tagged and their location marked on the map so that they could later decide to save it or return it to its original place and use it as a decoration in planting area.

Next, the steel parts of the High line structure were sandblasted to remove its original color from the lead. The top layer of the enclosure is actually the closest color to the main color of the structure.

- Railing

The old Art Deco rails of the structure were repaired and the steel parts rebuilt, as well as the missing parts, so that the gate could be restored to its original shape. The High line doors were opened to the public part by part from 2009, also in 2011, 2014, and finally in 2019 (High Line Park in New York, n.d.).

2.1.3.4 Lifetime management and Maintenance of the High line

In order to manage, protect and operate the park for the profits of the city, Friends of the High line entered into a License Agreement with the City’s Department of Parks. The cost of maintaining and management the Park is about $2.5-3 million per a year, plus another $2-3 million to pay the staff and employees. These costs make the management of the High line Park, a lot more expensive than maintaining other regular parks in the city. In fact, it costs $500,000 per acre for the High line Park, while it costs $10,000 per acre for the other parks in New York City to be built (Ling, High Line Architecture, 2013).

The High line is a prominent transportation park that runs from the bottom of west Manhattan to 30th Street. This park is 20-30 feet above street level, so, not many traditional preservation methods are suitable to that location; even many normal daily functions such as collecting garbage or transferring materials to the modified park, can become a challenging operation. In addition, the essence of the building and the way that is designed is such that makes it unsuitable for vehicles. Because of the constraints and in order to find a possible solution for the site management and implementation of phase 1 and 2 of the High line, ETM Associates worked with James Corner Field Operations, an NYC landscape architecture firm, the NYC Department of Parks, the NYC Economic Development Corporation, and Friends of the High line, a non-profit organization.

A clear instance of the role of ETM was the redesign of benches; in the original design, the benches were made of concrete and were uninterrupted for 12 feet and even longer. After an extensive investigation, the ETM found that whenever a part of the bench needed to be repaired or replaced, the entire street has to be closed and a five-ton crane rented to transport the materials to the location. Therefore, the ETM presented a plan to solve this problem without disturbing the unification of the structural design by using traditional slat benches instead of concrete benches, in that case the movement and transfer of materials would be easier.

In addition, ETM provided some ideas for designing park equipment and requirements; some advises like using special elevators to lift materials and supplies and moving them to the upper floors, installing garbage chutes to transport trashes straightly to the lower floors, and setting up small mobile units such as golf carts and bicycles for moving around in the site.

Some of these challenges were addressed with starting phase 3 of the High line, at the time of ETM's operation the future of phase 3 was unclear.

The ETM program for protection and utilization of the park won an NJASLA Landscape Planning and Analysis Award and an NYASLA Analysis, Planning, Research & Communications Award (Joshua David R. H., 2011), (Duran, 2010).

2.1.3.5 The profits of reusing the High line as a public open area

The High line was supposed to be a huge success from the start. Prior to the opening of its first phase in 2009, and before the railway was converted into an elevated park with an area of 2.4 km, it was estimated that 400,000 tourists would visit it annually, which it was bringing tax revenues to $286-million (U.S.) over 20 years. It was an exciting but ambitious prediction.

after completion of the project, it became the most successful open-air converted place in the United States, with 5 million annual visitors which made it to be called the city's second cultural attraction. It also has a significant influence on the economy by generating $980-million in tax profits in two decades, as it was estimated.

Nowadays, Chicago, Philadelphia, San Francisco, Rotterdam, Seoul, Toronto and Mexico City all wanted to have the same successful “parks in the sky” project; Projects that change our description of a park and build more open spaces with more attractive and meaningful landscapes and designs (Mcginn, 2014).

Understanding the concept of the park and its impact on people's lives first discovered in the mid-19th century; the park should be a quiet place to relax and be away from the hustle and bustle of the city. And no one adhered to this definition as much as Frederick Law Olmsted, the landscape architect who designed Central Park. He believed that parks can spread the sense of calm, but for this purpose it is necessary to build them as far away from the cities as possible; this idea explains why in most of his designs parks are surrounded with trees and shrubs.

Parks were to be built in the city but separated from the city space. “Green space and parks do more than promote physical activity,” says Laura Jackson, a researcher for the U.S. Environmental Protection Agency whose work centralizes solely on examining the connection between built environment and human health. “The outdoors brings people together, so it facilitates social engagement, which is so important, particularly in urban areas where people can become isolated.” Olmsted also believed that every large urban park needed a large promenade too. So-called linear parks like the High line have modernized the rules of both designs. “Linear parks are dynamic rather than static; they are not peaceful retreats but ways,” writes Diana Balmori in her 2010 book, A Landscape Manifesto.

In fact, these parks are a combination of old rules and new principles, which can show a different face of the city, and can be a good model for other cities.

“We point to the High line all the time as a precedent for what we’re trying to accomplish,” says Leah Murphy, president of Friends of the Rail Park, a non-profit organization defending for a 4.8-km linear park in Philadelphia.

Not every High line-inspired project follows exactly the same plan, although it is obviously attractive to build parks above the street level. Mexico City’s Public Space Authority was so pleased with the High line project that it assigned a $4.3-million budget to build a new elevated route to connect a metro station to the city’s greatest park.

2.1.3.6 Negative effects of rebuilding an environment as a public space

In 2016, seven years after inauguration of the High line, almost 8 million people came to the High line—more than any other New York tourist attraction. With this number of visitors, the wealth of the park owners will never be estimated: The High line is located between the sleek condos, restaurants, and museums that are built in the middle of metal beams in order to generate about $1 billion in tax revenue for the city during the next 20 years.

On this account, the High line is a brilliant success; but from another point of view it is not. The locals are not much beneficial for the park and also do not make much money from the park.

As the American population grows and urban centers become denser, green spaces have become more of an advantage. There are very few open spaces left in the central cities that can be turned into parks; and even this small amount of vacant lands has housed many industrial items from the past. That is why many of these so-called “adaptive reuse” projects— that highlight the potential beauties of the environment instead of hiding them, like old highway/flood channel/railway—are being created (Bliss, 2017).

However, city governments scarcely have the enough budget, or even time to imagination for the reconstruction of these lands. From the investors' point of view, the remarkable success of the High line leaves no room for doubt about such projects: green space will pave the way for new jobs and homes, so the capital spent on these projects will be reimbursed.

But usually around these desolate lands with worn-out tissue live people who are mostly poor with low income. This is confirmed in many of all 17 projects that are included in the High line Network.

Alexander Reichl, a professor of urban studies at Queens College, has studied social mixing patterns of the High line. The High line's elevated structure is naturally located above street level; along block 21, there are 10 stair entrances that make it easier for the visitors to enter; but Reichl thinks that this number is not sufficient, and also some of these inputs are not very recognizable.

3 Theoretical prerequisites

3.1 Part A: Principles of Welfare Economics underlying CBA

3.1.1 History of Welfare Economics

Welfare economics is that the branch of economics which its aim is evaluating of economic policies in terms of their effects on the well-being of the community. This branch became established as a well-defined branch of economic theory during the 20th century (Britannica, 2016).

Earlier scholars considered welfare as directly the sum of the satisfactions accruing to all individuals within an economic system. Later scientists became doubtful of the possibility of measuring even one person’s satisfaction and argued that it was impossible to compare with precision the states of the well-being of two or more individuals. In simple terms, the old assumption that poor people would receive more additional satisfaction than rich people from any given increase in income couldn't be maintained as before.

"Welfare economics is the part of economics that deals with the evaluation of states of the world and formulating recommendations for policies that would improve the well-being of society as a whole" (Nishizawa, 2020). This is not only for policy advice but, it is a frame of principles on which such assessments and recommendations should be relying. Economists purport that how wealthy society is, is referred to as social welfare, depends only on the well-being of the individuals making up that society. To be more specific, if a change does not make any individual better off, then social welfare cannot have increased. When economists have coped with practical issues they have pursued a much wider range of ethical judgments beyond welfarism. For instance, they have seen better equality in the distribution as favorable in itself; they have reasoned that the rights of individuals must be respected to do certain things, and they have related importance to the way economic consequences are achieved.

The "welfarism" is used when social welfare depends only on the well-being, or welfare of individuals. The "welfarism" seems to have first been used by (Hicks, 1959) when he defined it as meaning a concern with "economic welfare," a term used by (Pigou, 1920) to denote "that a part of welfare which will be brought directly or indirectly into relation with the measuring-rod of cash ." The latter one divested some considerations like justice, freedom, and rights to which money values could not be defined. However, this word was not widely used until it was independently invented by Amartya Sen in the late 1970s. He defined it as "The general approach of creating no use of any information about the social states aside from that of private welfares generated in them could also be called 'welfarism'". In debating about this assertion, Sen described welfarism as taking social welfare to depend on nothing other than individual usefulness information. Welfarism in this concept requires making a recognition between the information needed to form the welfare of individuals (which depend on the welfare of others if people are altruistic), on which social welfare is assumed to depend, from other information, which should be ignored on the ground that it does not affect anyone, or at least does not affect them in any pertinent way.

Economists, in the duration of the history of welfare economics, have usually focused on the transform from the "old" to the "new" welfare economics which took place in the 1930s and 1940s. An important part of this transition was the refusal of interpersonal utility comparisons, in favor of Paretian welfare economics that required as inputs no more than general utilities. Some questions have been asked about this transition, for instance: whether standard accounts leave out economists who were important at the time (Backhouse, 2010). However, none of this historical literature has challenged the idea that economists adopted a welfarist approach to welfare economics, a minimum of until Sen and other modern welfare economists had developed other conceptions of welfare. The essays argue that this was not the case and that, even though their statements about welfare theory rarely acknowledged this, economists repeatedly invoked non-welfarist criteria in their work. The conclusion is that, despite the focus on welfarism found in most histories of welfare economics, arguments that cannot be accommodated within welfarism have been widespread.

The two fundamental theorems of welfare economics are (Fundamental theorems of welfare economics, n.d.):

•First fundamental theorem of welfare economics (also referred to as the "Invisible Hand Theorem"):

Any competitive equilibrium results in a Pareto efficient (Pareto optimality, n.d.) allocation of resources. The definition of Pareto optimality can be made in two steps:

- a change from situation A to B may be a Pareto improvement if a minimum of one individual is best off without making other individuals worse off;

- B is Pareto optimal if there's no possible Pareto improvement.

The main idea is that markets lead to the social optimum. Thus, no intervention of the govt is required, and it should adopt only "laissez-faire"[1] policies. Laissez-faire, laissez-passer may be a French expression that translates as "to let do, let pass", that's letting things work on their own. In a sense it sums up the economic doctrine of physiocracy, expressing that there's a universe of things, with its laws, and it's best to let them run by themselves without laying restrictions. However, those that support government intervention say that the assumptions needed so as for this theorem to figure, are rarely seen in the real world.

It must be noted that a situation where someone holds every good and therefore the remainder of the population holds none, could be a Pareto efficient distribution. However, this situation can hardly be considered perfect under any welfare definition. The second theorem allows a more reliable definition of welfare.

•Second fundamental theorem of welfare economics:

Any efficient allocation is often attained by a competitive equilibrium, given the market mechanisms resulting in redistribution.

This theorem is vital because it allows for a separation of efficiency and distribution matters. Those supporting government intervention will invite wealth redistribution policies.

3.1.2 Definition and Scope of Cost Benefit Analysis

[1] https://policonomics.com/laissez-faire/

The CBA is one of the most tools for measuring the efficiency of investments; it quantifies the anticipated costs and benefits of a program or project with the aim of comparing them and determining whether the advantages outweigh the prices. The CBA consists of a series of calculations that end in incremental net financial or economic flows, and these are wont to estimate indicators of the economic or financial feasibility of investment.

CBA is typically administered at different stages within the project cycle. These are (Module 5: Fiscal Financial and Economic Analysis (FFEA), n.d.):

a) Ex-ante (or previous) evaluation

This is carried out before the start of the program or project implementation. During implementation, the aim of the CBA is to guide the formulation of investment programs or projects to assess various options for achieving the targets set, also as decision making about whether to fund the proposed investment. The CBA at this stage is predicated on projections of the prices and benefits to be generated by the project implementation.

b) Medium term (or intermediate) evaluation

As its name suggests, it's administered approximately halfway through the implementation period of the program or project. During implementation, the CBA aims to supply information to managers of programs or projects on how the implementation is being administered in reference to what was planned in terms of physical goals and their corresponding benefits, and therefore the costs of implementation. At this stage of the project, the CBA results are usually useful for identifying areas that need attention especially and for reconsidering options for the management of the project consistent with its aims and objectives during its last half. In other words, it is a management tool for evaluating what has been achieved within the medium term of the project and for deciding consistent with adjustments that might be necessary during the last half of the implementation.

c) Ex post (or subsequent) evaluation

This is administered at the highest of the implementation of the program or project to be evaluated. During the implementation, the CBA seeks to gauge whether the investment as implemented was economically or financially beneficial, as determined during the ex-post evaluation. The results of the ex-post CBA are compared with the results of the ex-ante CBA and if there's an enormous difference between the indications of both, an attempt is made to identify the reasons for this difference. to undertake to the present, however, the same assumptions must be used during the ex-post CBA as during the ex-ante CBA (for example duration of the analysis period, discount rate, etc.). The analysis of the causes of any differences could even be useful for identifying factors of success or failure, validating assumptions established during the project preparation, and thus generating information that may be useful for a replacement stage of the program or project in another region or country.

The main indicators for measuring the economic and financial feasibility of projects are the Internal Rate of Return (IRR) and the Net Present Value (NPV), which the following formula is used to calculate NPV:

$$NPV = \sum_{n=1}^{N} \frac{C_N}{(1+r)^n}$$

Where:

N is the total number of periods, n is a non- negative integer, C_N is cash flow, and r is IRR.

The main indicators used to measure the economic or financial feasibility of investment programs or projects are generally defined in many sources.

The NPV is that this value (updated employing a reduction rate that represents the prospect cost of capital) of the incremental net flow of benefits of an investment. If the NPV is greater than zero, this means that taking into account the effect of some time on the price of money, the benefits of an investment are greater than its costs and thus the inversion is therefore feasible from the economic or financial point of view, as applicable.

The F-CBA and E-CBA discount rates are often different as both analyses represent different perspectives. generally, it is often said that the financial discount rate should represent the prospect cost of capital on the financial market, while the economic discount rate should represent the prospect cost for the state of funding the project with regard to other public investment projects.

The analysis could also be a scientific process that companies use to research which decisions to make and which to forgo. the worth benefit analyst sums the potential rewards expected from a situation or action then subtracts the whole costs associated with taking that action. Some consultants or analysts also build models to assign a dollar value on intangible items, just like the advantages and costs associated with living in a particular town.

• A analysis (CBA) is that the method used to measure the benefits of a choice or taking action minus the costs associated with taking that action.

• A CBA involves measurable financial metrics like revenue earned or costs saved as a result of the selection to pursue a project.

• A CBA can also include intangible benefits and costs or effects from a choice like employee morale and customer satisfaction.

Before building a replacement plant or taking up a replacement project, prudent managers conduct an analysis to gauge all the potential costs and revenues that an organization might generate from the project. the results of the analysis will determine whether the project is financially feasible or if the company should pursue another project.

In many models, an analysis also will factor the prospect cost into the decision-making process. Opportunity costs are alternative benefits that might are realized when choosing one alternative over another. In other words, the prospect cost is that the forgone or missed opportunity as a result of a choice or decision. Factoring in opportunity costs allows project managers to weigh the benefits from alternative courses of action and not merely this path or choice being considered within the analysis.

By consideration of all options and the potential abstained opportunities, the analysis is more precise and allows for better decision-making.

3.1.2.1 Steps of CBA

A cost-benefit analysis (CBA) should begin with selecting a complete list of all the costs and benefits associated with the project or decision (Hayes, 2021). The costs involved during a CBA might include the following:

• Direct costs would be direct workers involved in manufacturing, inventory, raw materials, manufacturing costs.

• Indirect costs might like electricity, overhead costs from management, rent, utilities.

• Intangible costs of a decision, such as an influence on customers, employees, or delivery times.

• Opportunity expenses like alternative investments, or buying a plant versus building one.

• Cost of potential risks such as regulative risks, competition, and environmental impacts.

Benefits might include the following:

• Revenue and sales increase from increased production or new product.

• Intangible benefits, such as increased employee safety and assurance, as well as customer satisfaction due to enhanced product offerings or faster delivery.

• Competing advantage or market share gained as a result of the choice.

An analyst or project manager should apply financial analysis to all of the items on the cost-benefit list, taking special care not to underestimate costs or overestimate benefits. A conventional approach with a known effort to avoid any subjective biases when calculating estimates is best suited when assigning a value to both costs and benefits for a cost-benefit analysis.

Finally, the results of the mixture costs and benefits should be compared quantitatively to work out if the advantages outweigh the prices. If so, then the rational decision is to travel forward with the project. If not, the business should review the project to ascertain if it can make adjustments to either increase benefits or decrease costs to form the project viable. Otherwise, the company should likely avoid the project.

With analysis, there are a variety of forecasts built into the method, and if any of the forecasts are inaccurate, the results could also be called into question.

3.1.2.2 Benefits of Cost-Benefit Analysis

Based on researches done by (Ref: Attitudes towards the Role of Cost-Benefit Analysis in the decision-making process for spatial-infrastructure projects A Dutch case study) the benefits of CBA are:

• CBA improves contemplation concerning the usefulness, demand, and design of a project.

• CBA ends in a better decision-making process and better decision-making regarding the usefulness, demand, and design of a project. This hinders the development of projects that have a negative influence on the welfare of a country.

• CBA gives insight into the order of magnitude of different welfare impacts and the ratio of costs versus benefits of a project.

• CBA presents unbiased and independent information.

• CBA improves discussions concerning the usefulness, demand, and design of a project.

3.1.2.3 Limitations of Cost-Benefit Analysis

For projects that involve small- to mid-level capital expenditures and are short to intermediate in terms of your time to completion, the in-depth analysis could also be sufficient enough to form a well-informed, rational decision. For very large projects with a long-term time horizon, an analysis might fail to account for important financial concerns like inflation, interest rates, varying cash flows, and the present value of money.

Alternative capital budgeting analysis methods, including net present value (NPV), might be more appropriate for these situations. The concept of present value states that an amount of cash or take advantage of this day is worth quite receiving the quantity within the future since today's money could be invested and earn income.

One of the advantages of using the internet present value for choosing a project is that it uses an alternate rate of return that would be earned if the project had never been done. That return is discounted from the results. In other words, the project must earn a minimum of quite the speed of return that would be earned elsewhere or the discount rate.

However, with any sort of model utilized in performing analysis, there are a big amount of forecasts built into the models. The forecasts utilized in any CBA might include future revenue or sales, alternative rates of return, expected costs, and expected future cash flows. If one or two of the forecasts are off, the CBA results would likely be thrown into question, thus highlighting the restrictions in performing an analysis.

3.1.3 Microeconomic Foundation of CBA

The microeconomic theory provides the foundations for CBA. This section begins with a review of the main concepts of microeconomic theory that are relevant to the measurement of social costs and benefits. Specifically, we assume that there are numerous buyers and sellers within the market that no one can individually affect prices.

- **Demand Curves**

An individual demand curve indicates the quantities of an honest that the individual wishes to get at various prices. The market demand curve is the horizontal sum of individual demand curves. It indicates the mixture quantities of each individual within the market wishes to get at various prices.

In contrast, a market inverse demand curve, as represented by line D in Figure 1, has a price as a function of quantity. The vertical axis can be interpreted because the highest price a person is willing to buy a further unit of the good. a typical assumption in economics is a downward slope in demand curves. The reason for this assumption is predicated on the principle of diminishing marginal utility; each additional unit of the great is valued slightly less by each consumer than the preceding unit. Therefore, each consumer has a willingness to pay less for an additional unit than for the preceding one. In fact, at some points, each consumer might be unwilling to pay anything for an additional unit; his demand would be sated.

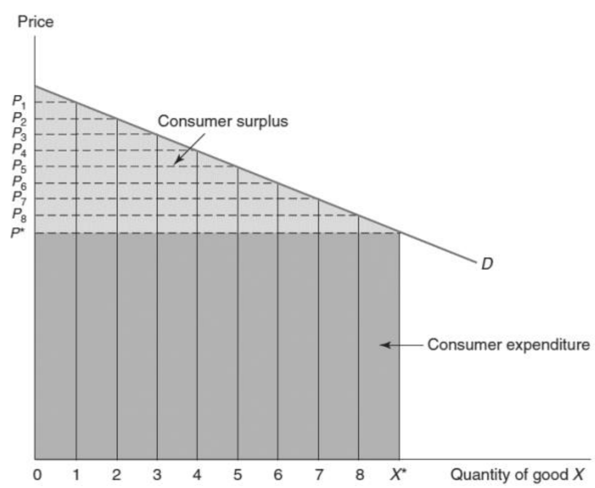

Figure 1: Consumers' total benefits and consumer surplus (Boardman, 2018)

- **Consumer Surplus and Changes in Consumers' Surplus**

In a competitive market, consumers pay the market value, which is denoted as P*. Thus, consumers spend P*X*(darker region), to consume X* units. The net benefit for consumers equals the benefits (B) minus consumers' expenditures (P*X*). This light shaded zone, which equals the area below the demand curve but above the worth line, is called consumer surplus (CS):

$$CS = B - P^*X^* \quad (1)$$

Consumer surplus may be a basic concept used in CBA. Under most circumstances, changes in consumer surplus are often used as an inexpensive measure of the benefits to consumers of a policy change.

To see how the concept of consumer surplus is often utilized in CBA, suppose that the price and quantity that consumed are given by P* and Q*, respectively, and then consider a policy that leads to a change in price. For instance, as shown in Figure 2, a policy that reduces the price of good X from P* to P_1 would result in a benefit to consumers adequate to the world of the shaded area P*ABP_1. This consumer benefit occurs because existing consumers pay a lower cost for the X* units they previously purchased, and some consumers gain from the consumption of X_1− X* additional units. Similarly, as shown in Figure 3, a policy that increases the price of good X from P* to P_2 would impose a "cost" on consumers equal to the area of the shaded area P_2ABP^*.

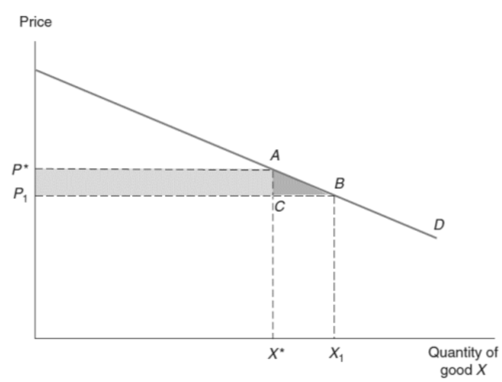

Figure 2: Change in consumer surplus due to a price decrease (Boardman, 2018)

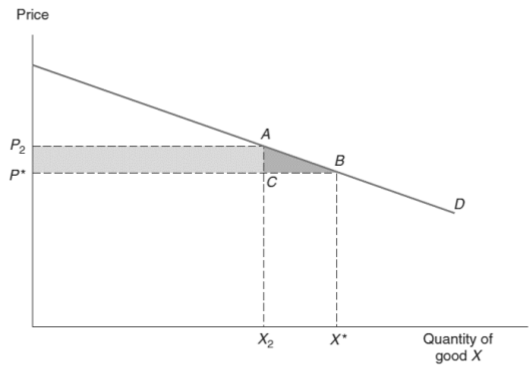

Figure 3: Change in consumer surplus due to a price increase (Boardman, 2018)

- **Supply Curves**

In CBA, costs are opportunity costs. Figure 4 presents a standard U-shaped marginal cost (MC) curve for an individual firm, where costs are opportunity costs. This curve depends on the costs in the short run when at least one factor of production is fixed. Then, we consider the long run where all factors of production can change. The MC curve passes within the firm's average variable cost (AVC) curve at its lowest point, as shown in Figure 4. The increasing part of the MC curve shows diminishing marginal returns. Diminishing returns happen as output increases and rising amounts of the variable factors of production are used with the fixed factor, or it reflects rising opportunity costs of a variable factor of production as more units of that factor are used.

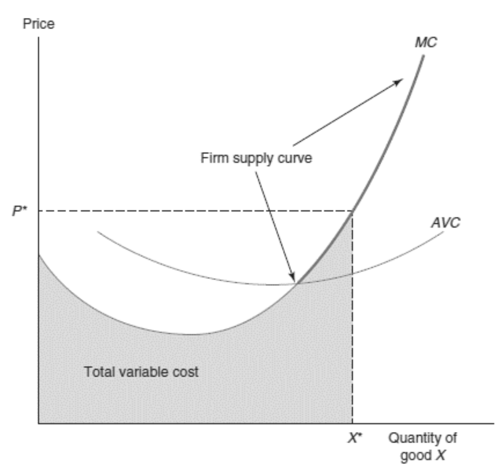

Figure 4: Individual firm's supply curve (Boardman, 2018)

When the demand curve shows the marginal benefit of each additional unit of a good which is consumed, the supply curve shows the marginal cost of each additional unit of the good provided. Therefore, the area under the firm's marginal cost curve represents the firm's total variable cost (VC) of producing a given amount of good X, say X*.

The upward-sloping part of the firm's marginal cost curve above the firm's AVC (the darker line), corresponds to the firm's supply curve in a competitive market. If the worth were less than the firm's average variable cost, then the firm couldn't cover its average variable cost and would prefer to pack up, instead of produce any output. At a price above average variable cost, however, the upward-sloping part of the marginal cost curve determines how much output the firm will produce at any given price.

- **Market Supply Curve**

The market supply curve shown in Figure 5 springs by summing horizontally the supply curves of all the individual firms during a market. It indicates the entire supply available to the market at each price. for instance, at price P_1 firms within the aggregate are willing to supply X_1 units. Because individual firm supply curves are supported their incremental cost, the market supply curve also reflects the incremental cost. for instance, the incremental cost of the X_1th unit is P_1 therefore the firms are willing to provide X_1 units at price P_1.

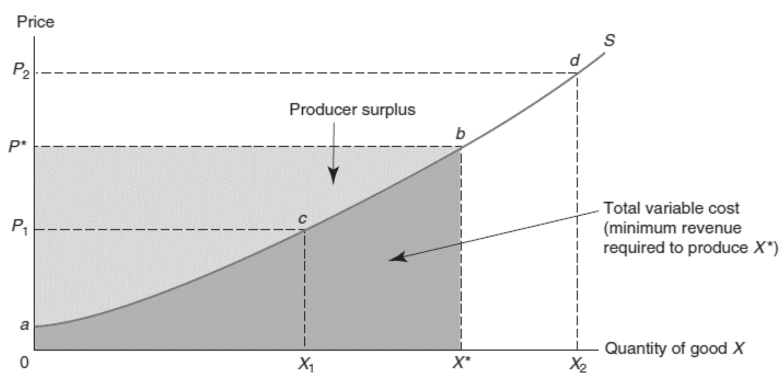

Figure 5: Market supply curve (Boardman, 2018)

As with incremental cost curves for individual firms, the region under the market supply curve represents the entire variable cost of manufacturing a given amount of output, say X*. The region 0abX* is that the total variable cost of supplying X* units. Put differently, it's the minimum total revenue that firms must receive before they might be willing to supply output X*.

- **Producer Surplus and Changes in Producer Surplus**

Suppose that the market value of an honest is P* and, consequently, firms supply X* units. Their income would be P*X*, which is the rectangle 0P*bX* in Figure 5. Their total variable cost (TVC) would be 0abX*, the dark shaded area in Figure 5. The difference between these two areas (aP*b), is called the producer surplus (PS):

$$PS = P^*X^* - TVC \qquad (2)$$

Producer surplus is that the benefit growing to firms (or their factors of production). It equals the difference between actual revenues and therefore the minimum total revenue that firms within the market represented in Figure 5 must receive before they might be willing to supply X* units at a price of P*.

Producer surplus is that the supply-side equivalent of consumer surplus. Even as changes in prices resulting from government policies have impacts on consumers which will be valued in terms of changes in consumer surplus, price changes also end in impacts on producers which will be valued in terms of changes in producer surplus. For instance, in Figure 5, a decrease within the market value from P* to P_1 decreases producer surplus by P*bcP_1 to P_1ca, and a rise in price from P* to P_2 increases producer surplus by P_2dbP* to P_2da.

3.2 Part B: Introduction to Time Series Analysis

Time series analysis is a statistical method that deals with time-series data or trend of them. Time series data is in a series of particular periods or intervals. Time series analysis considers the data points over time that may have an internal structure (autocorrelation, trend, or seasonal variation).

3.2.1 Definitions, Applications, and Techniques

The application of time series models is obtaining the understanding of the structure of the observed data. Then, it will help to fit a model for forecasting, monitoring, or even controlling (NIST/SEMATECH e-Handbook of Statistical Methods, 2013).

Time Series analysis is applicable for:

- Economic forecasting
- Sales forecasting
- Budgetary analysis
- Stock market analysis

And many other applications. There are many methods of model fitting. The preference of the user will determine which technique is appropriate.

A common assumption in most time-series analyses is that the data should be stationary. A stationary means that the mean, variance, and autocorrelation structure do not change over time. Stationarity has a precise mathematical definition. However, in our analysis, we consider constant variance over time, a constant autocorrelation structure over time, and no periodic fluctuations (seasonality). For practical purposes, stationarity is determined from a run sequence plot. If the time series is not stationary, we can often transform it to stationarity with one of the following methods.

One method is differencing the data. Consider the series Z_t, the new series is created as

$$Y_i = Z_i - Z_{i-1} \tag{3}$$

The differenced data has one less point than the original data. Although we can differentiate the data more than once, usually one difference is sufficient.

If the data contain a trend, fitting some curves to the data can be helpful. Then, the residuals from that fit can be modeled. The purpose of the fit is to remove the long-term trends. Consequently, a simple fitting like a straight line is usually used.

For non-constant variance, we can take the logarithm or square root of the series that may stabilize the variance. Adding a constant to make all the data positive before applying the transformation is the solution for the negative data.

The above techniques intend to generate series with constant location and scale. The seasonality violates stationarity but, this issue is considered explicitly in the time series model.

3.2.2 Univariate Time Series Models

The term univariate time series is a time series that consists of observations recorded over equal time increments. The univariate time series data set is typically given as a single column of numbers, but the time is an implicit variable. If the time increments are equal, there is no need to have an explicit time variable. The time variable is sometimes explicitly used for plotting the series but, it does not have any role in the time series modeling.

There are several approaches to modeling time series. The most common of them are introducing below.

One approach is decomposing the time series into trend, seasonal, and residual parts. For example, the seasonal loess that is based on weighted least squares is discussed by (Cleveland, 1993).

Another approach that is applicable in scientific and engineering applications is analyzing the series in the frequency domain. Detailed explanations of frequency-based methods are discussed in (Chatfield, 1996).

One of the most common approaches for modeling univariate time series is the autoregressive (AR) model:

$$X_t = \delta + \phi_1 X_{t-1} + \phi_2 X_{t-2} + \cdots + \phi_p X_{t-p} + A_t \tag{4}$$

Where

$$\delta = (1 - \sum_{i=1}^{p} \phi_i)\mu \tag{5}$$

X_t is the time series, A_t is white noise, and μ is the process mean.

An autoregressive model is simply a linear regression of the current value of the series versus one or more prior values of the series and, P is the order of the AR model.

AR models may be analyzed with one of the various methods, like standard linear least-squares techniques. They also have a clear interpretation.

Another well-known approach for modeling univariate time series models is the moving average (MA) model:

$$X_t = \mu + A_t - \theta_1 A_{t-1} + \theta_2 A_{t-2} - \cdots - \theta_q A_{t-q} \quad (6)$$

where X_t is the time series, μ is the mean of the series, A_t is the white noise, and $\theta_1 . \theta_2 . \dots . \theta_q$ are the parameters of the model. The value of q is known as the order of the MA model.

A moving average model is a linear regression of the current value of the series versus the white noise of one or more prior values of the series. The random shocks at each point as assumed to originate from the same distribution, typically a normal distribution. The difference in this model is that the random shocks are propagating to future values of the time series. Fitting the MA estimates is more complicated than with AR models because of unobservable error terms. In other words, iterative non-linear fitting procedures are needed instead of linear least squares. MA models also have a less obvious interpretation than AR models.

Note that the error terms of the fitted model should be independent and follow the standard assumptions for a univariate process.

4 Evaluation of impacts

The emphasis of a cost-benefit analysis lies on the considerations on whether the society will benefit from the investment of the construction of the High line park or not, thus in the appraisal should be considered social costs and benefits derived from the operation. The generated effects of the project have different nature, but due to the limit of the model, we will consider only that ones, which can be expressed in monetary terms, such as construction cost, maintenance, and operational cost, increase in revenue from taxes, increase in employment, increase in property value and additional revenue generated by tourists. Probably, other impacts could be appraised through models for the evaluation of non-market goods. For example, the High line's ecosystem also provides food and shelter for wildlife species, including native pollinators. This will have environmental benefits, or the High line is a good place for people which make them relax and may have many psychological benefits too. Calculation of these non-market values needs to perform other methods that deal with non-market impacts but in this study, we skip all non-market factors.

Another noteworthy point that should be noticed is that we consider 2019 as the base year. All calculations are done for 2019 to omit the uncertainties due to the pandemic.

4.1 Increase in nearby Properties' value

The High line enthralls thousands of people every day who walkthrough. Nevertheless, this park has also helped transform real-estate values for apartment owners in the surrounding blocks since its first section opened in 2009. Resale values of properties already nearby rose a cumulative 10 percentage points faster than areas only a few blocks farther away. It is the "High line's halo effect". While resale prices in many other Manhattan neighborhoods have been tapering off, but they have continued to rise near the High line (Barbanel, 2016).

Between 2003 and 2011, the market value of nearby properties grew 108%. In order to compare the measured property value changes in the site with the other areas in NYC, the average change in land value per square foot in the city was calculated from the spreadsheet developed based upon the Property Assessment Roll Archives. The total average change in value laid in NYC is estimated to be $226 per square foot from 2007 to 2011 but, this amount was greater for High line surroundings (Song, 2013). To compute the increase of properties due to the high line, we considered the region showed in Figure 6, from Gansevoort Street to 34 West street. This region accesses the High line in less than five minutes of walking. The surface area of this region is about 1 square kilometer that equals 1e7 square feet.

Figure 6: The region that is considered for increase of properties value, the map is derived from (Song, 2013).

Therefore, the total value change from 2007 to 2011 is 2260 M$. But this increase is not due to the High line solely. Regarding (Song, 2013), we assume that 10% of the region shown in Fig.7, increased 226-758 per square feet. Assuming 500$ increase on average for 1e6 square feet, the further total value change due to the High line is obtained equal to (500-226) ×1e6=274 M$. By considering an equal increase every year, the increase of properties in each year is equal to 68.5 M$.

According to (Song, 2013), the increase in properties' value is depicted in Table 1.

Table 1: The Property Value Changes between 2007 and 2011, derived from (Song, 2013)

Year	2007-2008	2008-2009	2009-2010	2010-2011	2007-2011
Market value changes	32%	14%	20%	13%	108%

We used the moving average forecasting to determine the properties' value increase for 2011-2019. Figure 8 shows the time forecast of properties' value increase. The increase in properties' value from 2011-2012 and 2012-2013 is 6.8% and 0.6%, respectively. Therefore, the increase in properties' value due to the High line reached zero after 2013. To have a estimation of properties' value increase in 2011-2013, we consider $\frac{108}{4} = 27\%$ increase in properties' value from 2007-2011. By considering further increase of 8% from 2011-2014, we consider 4% increase in properties' value increase each year, which is equal to $\frac{4}{27} \times 68.5 \text{ M\$} = 10.15 \text{ M\$}$ per year from 2011-2013.

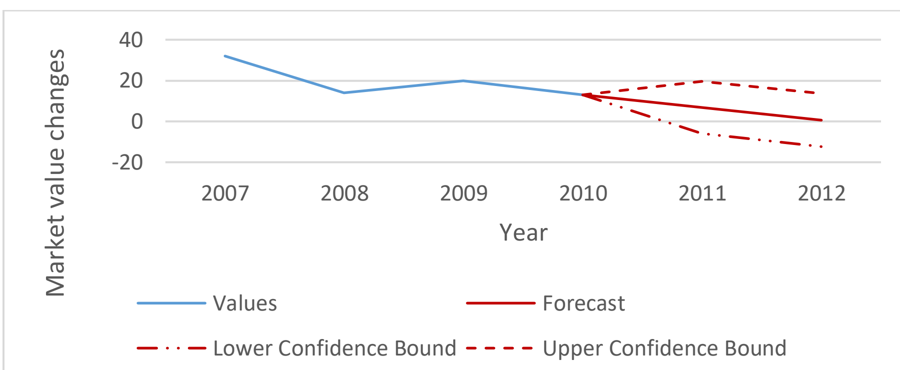

Figure 7: the forecast of value changes of properties from 2011-2013

We will then calculate the present value of this impact in the year 2019, which is the starting point of our analysis. The rate of interest is assumed to equal 3 percent per year[2].

The total revenue from increased properties' value (PV (2019)): 409,404,337$.

[2] https://www.in2013dollars.com/New-York/price-inflation/2003-to-2019?amount=1

4.2 Taxes revenue

'The High line will have generated over $1.4 billion in tax revenue for New York City between 2007 and 2027, roughly $65 million annually' (Landscape Performance Benefits, n.d.). We will then calculate the present value of this annuity from 2007 to 2019, at the base year 2019. The rate of interest is considered 0.03. Therefore, the total revenue from generated taxes (PV (2019)): $1,015,156,379.

Also, we will consider the taxes to be fixed for the following years. As for a long time, we assume a fixed revenue of taxes, we will use the following formula to obtain perpetuity:

$$Perpetuity = \frac{C}{1+r} + \frac{C}{(1+r)^2} + \frac{C}{(1+r)^3} + \cdots = \frac{C}{r} \qquad 7$$

Where in our case C is the fixed taxes revenue and r is the interest rate which is equal to 0.03. Therefore, the perpetuity of tax revenues is equal to $2,166,666,666.

However, tax revenues will not be considered as the benefits independently. Unfortunately, we did not have any access to the tax sources. For example, one of the important parts of the taxes is the real state taxes. This tax is due to the increase in properties values. We consider this revenue in properties increase. Another part of the tax revenue may relate to the revenues from newly created jobs. The revenue of the taxes paid by them will consider as the revenue. We will consider these revenues separately in the following parts.

Thus, we exclude tax revenues from our final CBA analysis to avoid double counting.

4.3 Tourism

Many investigations have been done to find out the impact of some factors on Cost-benefit analysis of High line. None of them considered tourism as an important factor. To obtain a rough estimation for the effect of the High line on tourism, in this section, we will employ some assumptions. Indeed, we should find out how many visitors come to New York because of the Highline. Because the pandemic started in early 2020 and of the sudden falling of NY tourists, we decide to choose 2019 as the base year. By choosing 2019 as a base year, we will avoid eccentric changes in our analysis in 2020.

In this part, we desire to obtain the effects of High line on the touristic flow. To investigate this, we could use a questionnaire or an analytical approach. As we were not able to perform a questionnaire, we do an analysis by using the available data of touristic flow of High line. In this section, first, we start with the change of the slope of touristic flow, then, by using some modification factors, we obtain the High line's effect on tourism idiosyncratically. The detail of our analysis will explain in the following part.

In the next step, we consider some other touristic spots in New York City. We compare our results with tourist spots in which revenue information are available. This will give us insight into the accuracy of our method.

4.3.1 Analysis process:

As a starting point, we consider the trend of visitors who came to New York from 2000-2019. The data of NY tourists is available for 2000-2018. As there was no data for 2019, we used interpolation to obtain the number of NY tourists in 2019.

4.3.1.1 Vertical difference

We consider the number of NY tourists in two intervals, 2000-2009 and 2010-2019. The first interval is the time before opening the High line and, the second one is after the opening of the first section in 2009. Figure 8 and Figure 9 show the number of visitors from 2000-2009 and 2010-2019, respectively.

The trends of domestic, international, and all visitors are plotted separately. Also, the trends of NY visitors are shown in Figure 8 and Figure 9. As shown in these figures, the trend of international visitors did not change. Thus, the existence of the High line does not have any effect on the number of international visitors. This trend was predictable, because people from other countries may not be interested enough in this project to spend a lot of money to come to NY just for visiting the High line. Based on trends shown in these figures, we can say that the trend of domestic visitors has increased from 2010. Therefore, we confine our estimation only to domestic visitors.

To deal with the number of domestic visitors, we use the slope change of domestic touristic flow. This analysis will help us obtaining a starting point in finding the number of visitors whose main purpose of coming to New York is visiting the High line.

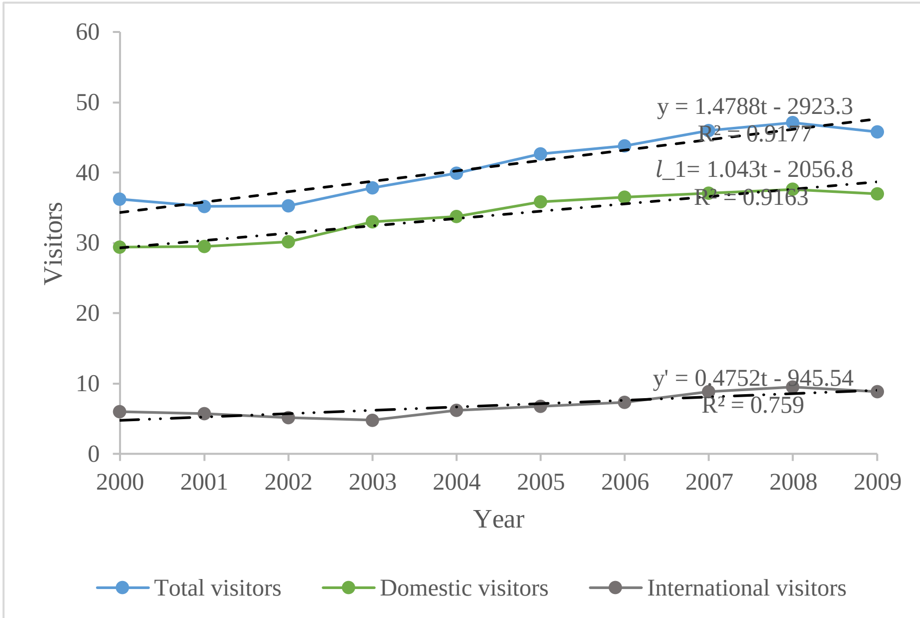

Figure 8: NYC visitors between 2000-2009

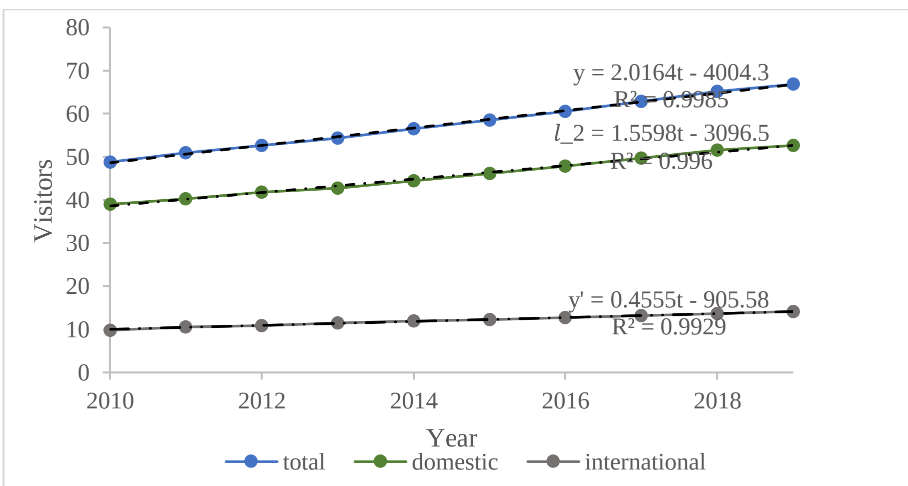

Figure 9:NYC visitors between 2009-2019

We consider the following linear regression for touristic flow:

$$touristic\ flow = \begin{cases} l_1:\ \alpha + \beta\, t = 1.043t - 2056.8 & t \leq 2009 \\ l_2:\ \alpha' + \beta' t = 1.5598t - 3096.5 & t > 2009 \end{cases} \quad (8)$$

2009 is the year in which the first phase of High line was opened. Figure 10 shows the trend of domestic NY visitors from 2000-2019. The dashed line is the continuation of l_1 for $t \geq 2009$.

Therefore, the vertical difference, which is indicated by v, will be equal to $domestic\ HL\ visitors - l_1$ for $t \geq 2009$. The amounts of v are the necessary data for completing our analysis.

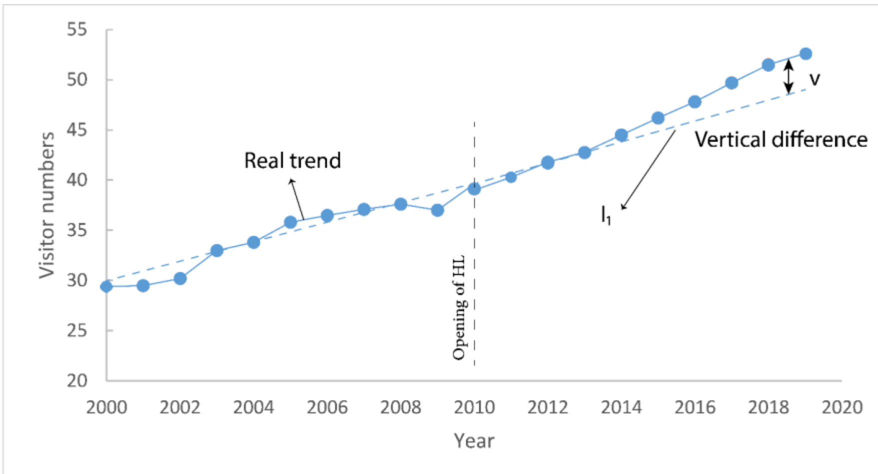

Figure 10: The trend of High line domestic visitors from 2000-2019. Solid line: the real trend, and the dashed one is the line is the old trend, l_1.

Although the amounts of v may not seem to be a big difference, as the years go by, v becomes larger and larger. For example, the number of visitors in 2018 must have been around 48 million if we assume the trend was l_1 but, the number of visitors in reality is approximately 51 million in 2018. Therefore, we can conclude that about 3 million increase in the number of visitors.

4.3.1.2 Time series verification

In the previous section, we conclude that there is a slope change in the number of domestic visitors and no change observed in the slope of international visitors after opening the High line. But the question is that how can we make sure that the slope of the visitors of the High line changed after opening the High line?

To answer this question, we did a time series analysis on NYC visitors from 2000-2019. The time series analysis will help us to examine the change in the slope of NYC visitors after opening the High line. Table 2 shows the total number of NYC visitors, domestic visitors, and international visitors from 2000-2019.

Table 2: number of NYC visitors, domestic visitors, and international visitors (in million) from 2000-2019.

Year	Total NYC visitors	Dom. NYC Visitors	International NYC visitors
2000	36.2	29.4	6
2001	35.2	29.5	5.7
2002	35.3	30.2	5.1
2003	37.8	33	4.8
2004	39.9	33.8	6.2
2005	42.7	35.8	6.8
2006	43.8	36.5	7.3
2007	46	37.1	8.8
2008	47.1	37.6	9.5
2009	45.8	37	8.8
2010	48.8	39	9.8
2011	50.9	40.3	10.6
2012	52.7	41.8	10.9
2013	54.3	42.8	11.5
2014	56.5	44.5	12
2015	58.5	46.2	12.3
2016	60.5	47.8	12.7
2017	62.8	49.7	13.1
2018	65.1	51.5	13.6
2019	66.8223	52.64	14.1623

The trend of domestic visitors and international visitors from 2000-2019 are depicted in figure 12.

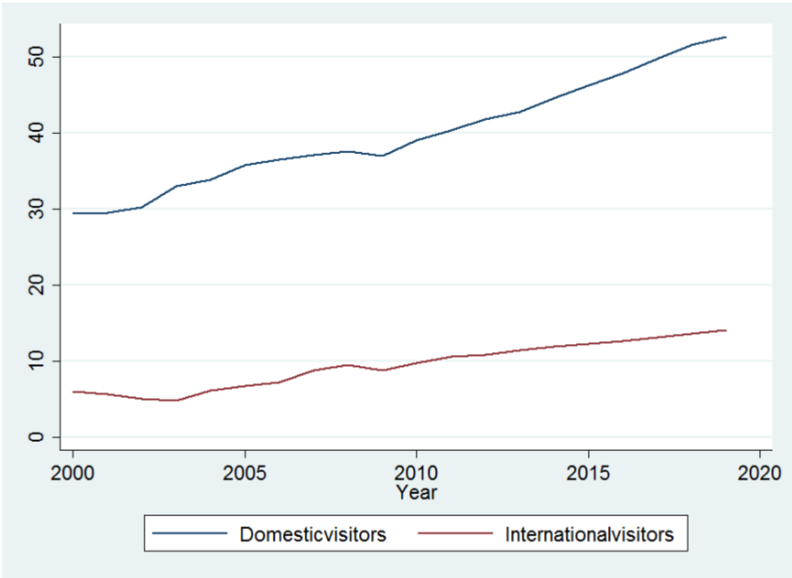

Figure 11: NYC domestic visitors and international visitors from 2000-2019

We wish to write the following relation between NYC visitors and the existence of High line. We consider the following time series for tourist flow:

$$tourist\ flow = A + Bt + Ct \times X \qquad 9$$

Where A is the intercept, t is the time (in years), B and C are respecting coefficients, and X is a dummy variable which in our analysis is referred to the High Line effect. We define X such that

$$X = \begin{cases} 0 & for\ t \leq 2009 \\ 1 & for\ t > 2009 \end{cases}$$

2009 is the year in which the first phase of the High line was opened. As it can be seen in Figure 12, the data is not stationary. In time series analysis we usually need stationary data. This means that the mean, variance, and autocorrelation structure do not change over time. To avoid these changes, we use the differenced data. The differenced data of domestic and international NYC visitors are shown in Figure 13.

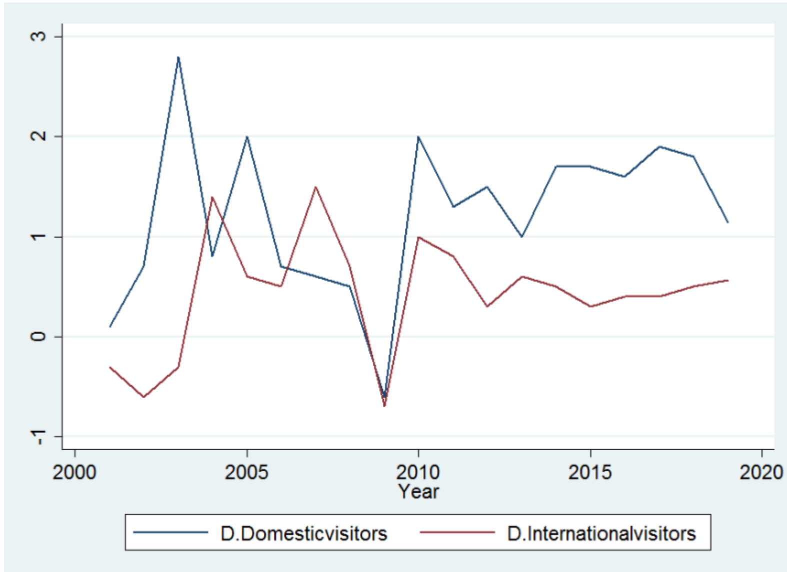

Figure 12: The differenced data of domestic and international NYC visitors

As shown in figure 13, the differenced data seem stationary. Then we can do the time series analysis for this data. “D” is used for the difference operator in STATA. For analyzing the time series, we used STATA 14.

We did a regression for "D.Domesticvisitors" versus "HLex". Where "HLex" is a dummy variable that is equal to 0 before the High line opening and, it is equal to 1 after the High line opening. The following relation is obtained:

$$Difference(Domestic\ visitors) = 0.8444 + 0.7195\ HLex \qquad 10$$

This equation means that there is a change in the slope of NYC domestic visitors after opening the High line. Before 2009, the slope of Domestic visitors versus year was 0.8444 but after opening the High line, the slope increased to $0.8444 + 0.7195 = 1.56$, which is very close to the result of Equation 8 (1.56). Results of regression for domestic NYC visitors are depicted in table 3.

Table 3: The regression parameters of domestic visitors versus HLex

. regress D.Domesticvisitors HLex

Source	SS	df	MS			
				Number of obs	=	19
				F(1, 17)	=	4.64
Model	2.4525476	1	2.4525476	Prob > F	=	0.0459
Residual	8.99085653	17	.528873913	R-squared	=	0.2143
				Adj R-squared	=	0.1681
Total	11.4434041	18	.635744674	Root MSE	=	.72724

D. Domesticvi~s	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
HLex	.7195555	.3341424	2.15	0.046	.0145766	1.424534
_cons	.8444445	.2424124	3.48	0.003	.332999	1.35589

We did a regression for "D.Internationalvisitors" versus "HLex". The parameters of this regression are shown in table 4. As shown in this table, the adjacent R-squared is a negative number, which means that the explanation towards response is very low or negligible. In other words, we cannot find a relation between international visitors and the High line as we mentioned before.

Table 4: The regression parameters of international visitors versus HLex

Source	SS	df	MS			
				Number of obs	=	19
				F(1, 17)	=	0.69
Model	.240056057	1	.240056057	Prob > F	=	0.4175
Residual	5.90964297	17	.347626057	R-squared	=	0.0390
				Adj R-squared	=	-0.0175
Total	6.14969903	18	.341649946	Root MSE	=	.5896

D. Internatio~s	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
HLex	.2251189	.2709017	0.83	0.417	-.3464337	.7966715
_cons	.3111111	.1965327	1.58	0.132	-.1035367	.725759

However, as we mentioned before, the increase of domestic HL visitors is not solely due to the High line. We should consider that there may exist many other factors to be the reason for this increase, for example, the economic situation, business travels, etc. It may be a rough estimation to suppose that the benefit of domestic visitors is obtained by the number of domestic visitors cross the money they spend, but this is not a good estimation. For instance, suppose that a person who visited the High line came to New York for a week. During his travel, he may visit other tourist spots like the Empire state building. If we do not consider this, we may compute the hotel revenue twice.

To avoid such interactions, we must consider that most people who visit the High line do not come to NY only and solely for this park and, they usually have other purposes. In this work, we will apply some assumptions to estimate the number of people whose main purpose of travel to NY is visiting the High line.

4.3.2 Corrections

In this part, we will do some corrections on v to complete our analysis. About 31 percent of High line visitors come from NY, 9% from cities less than 45 miles distance, 30% were domestic visitors from cities of more than 45 miles distance, and 30% were international in 2015 (Ganser, 2017). We assume these proportions constant for other years and divide our analysis into two parts:

1) the benefits from domestic visitors who come from less than 45 miles, and 2) the benefits of domestic visitors from cities with a distance of more than 45 miles.

4.3.2.1 Less than 45miles:

We start with the estimation of part 1. In the first case, we assume that most people who visit the High line from cities less than 45 miles choose the High line as their main destination. Although this is an optimistic case, this estimation seems rational. By considering about 2-3 hours spending on High line, we can say that our assumption seems good. Those who come to New York from the cities with less than 45 miles won't stay for the night because they can return to their homes. Thus, we only consider the travel cost. We estimate that each person pays about 80$ for travel, considering only transportation costs for these people.

About 9 percent of High line visitors come from cities less than 45 miles. Table 5 shows the number of High line visitors from 2010- 2019. The following equations obtain the number of High line visitors whose main purpose of travel to New York is visiting the High line.

$$N_1 = 0.09 \times total\ Highline\ visitors \times e \qquad 11$$

$$V_1 = N_1 \times 80\$ \qquad 12$$

Where 0.09 is the percentage of domestic visitors of the High line from less than 45 miles, e is the coefficient of domestic visitors from less than 45 miles whose purpose is visiting the High line (which in the first case, we consider to be equal to 1), and V_1 is the revenue obtained from visitors coming from less than 45 miles. In our estimation we first consider the amount of e is equal to 1. In the next following parts, we will discuss on other cases with $e < 1$. Table 5 shows the amount of N_1 and V_1. As shown in this table, the revenue of domestic visitors from less than 45 miles increased to $60 M in 2019.

Table 5: Number of High line visitors, the domestic visitors who come from less than 45 miles, and their revenue from 2010-2019.

Year	High line visitors	N_1	V_1
2010	1.3**	0.117	9.36
2011	2	0.18	14.4
2012	2.6	0.234	18.72
2013	4.3	0.387	30.96
2014	5	0.45	36
2015	6	0.54	43.2
2016	7.3	0.657	52.56
2017	7.5	0.684	54.72
2018	8	0.72	57.6
2019	8.3	0.756	60.48

** the green cells data is based on (Geiger, 2014), other cell number are obtained by interpolation.

4.3.2.2 More than 45miles:

For the second part, we apply another method to obtain the number of visitors whose main purpose of visiting New York is the High line. For this aim, we try to remove other impacts by applying some corrections on v. By applying these corrections, the tourist revenue of visitors with a distance of more than 45 miles will be obtained. We will do two analyses and then we will find out which one resembles more rational.

4.3.2.2.1 First analysis:

The number of domestic NY visitors has been presented in Table 6. About 39 percent of Highline visitors are domestic (we exclude visitors who come from NY). Dividing domestic Highline visitors to NY domestic visitors gives the percentage of domestic visitors who have a willingness to visit Highline. This assumption helps us having a realistic estimation of the number of people whose purpose of travel to New York is visiting the High line. Next, by considering that 30 percent of Highline visitors come from more than 45 miles and 9 percent of them come from cities less than 45 miles, the percentage of domestic visitors of the High line who come from more than 45 miles can be computed by $\frac{30}{30+9} \times 100 = 77\%$. If we consider 240$ per person for a day and use these statistics, we can calculate the benefit of domestic people who come from more than 45 miles.

By considering these statistics, now we can estimate the number of visitors whose purpose is visiting the Highline.

$$N_2 = v \times c \times d \qquad (13)$$

Where

N_2: the number of visitors who come to NY because of visiting of High line.

v: the vertical difference between the time series data and real data of domestic tourists

$c = \frac{\text{domestic High line visitors more than 45 miles}}{\text{All domestic Highline visitor(excluding visitors from NY)}} = \frac{30}{30+9} = 77\%$.

$d = \frac{\text{domestic High line visitors}}{\text{domestic NY visitors}}$: the percentage of domestic NY visitors who may visit the Highline.

The correction factor c shows how many of v may relate to domestic visitors from more than 45 miles. As we do not know how many NY visitors come from more than 45 miles, we used the ratio from High line visitors.

The correction factor d is used to determine how many of v come to New York for the main purpose of visiting High line. As we did not have enough data, we use the correction factor d to obtain realistic results.

Now we can obtain the number of visitors whose main purpose of traveling to New York was visiting the High line. We consider 240$ for a day staying in New York (budget your trip, n.d.). Therefore, the benefit of domestic visitors of more than 45 miles, V_2 can be calculated as:

$$V_2 = N_2 \times 240\$. \qquad (14)$$

4.3.2.2.2 Second analysis:

In the second analysis, we obtain the revenue of visitors from more than 45 miles by doing another set of corrections.

Statistics show that about 21 percent of people visit New York for business purposes. Based on (NYC & Company, 2017), the trend of business travels did not change a lot between 2010-2019; therefore, we consider about 21 percent of travels to New York are for business. Thus, about 79 percent of people who visit New York come there for non-business purposes. Also, about 33 percent of these 79 percent travel for visiting their relatives and friends (NYC & Company, 2017); therefore, $\frac{2}{3} \times 79\% = 52.67\%$ of total visitors who come to New York are tourists. Figure 13 shows the NY visitors based on purpose.

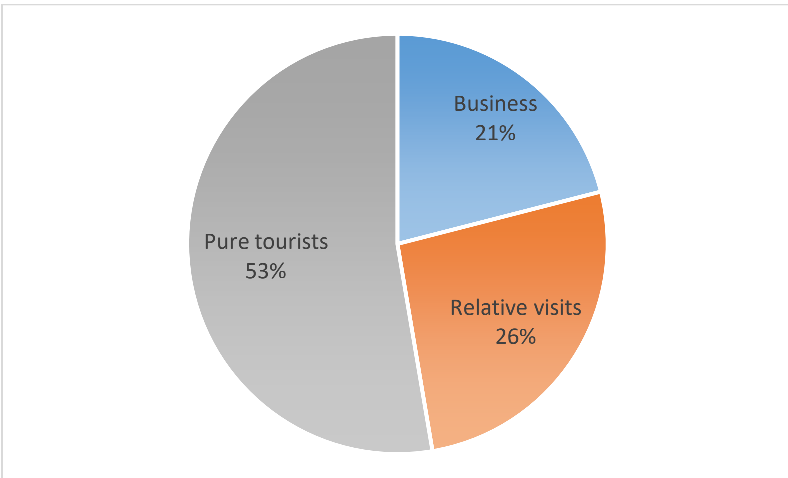

Figure 13: NY visitors based on travel purpose.

In other words, 52.67% f total NY visitors may have a willingness to visit the High line as their main purpose. The number of High line visitors in 2010, 2014, 2016, 2018 are available in references (Geiger, 2014). Other numbers are obtained by interpolation as mentioned before.

Now, we assume that each High line visitor from more than 45 miles stays four days in New York. During these days the visitors may visit ten tourist spots of New York which are named in in the next sections. Therefore, in this case, we divide the total revenue by 10.

$V_2^* = v \times c \times b \times 4 \times 240\$/10,$

Where V_2^* is the revenue of second analysis for visitors from more than 45 miles, v and c where introduced before and

$b = \frac{2}{3} \times (100 - 21) = 52.67\%$ is the percentage of people whose purpose is not business or visiting their family. We consider 240$ per day for staying in New York like the previous part.

Table 6 shows the benefits of tourists for the two abovementioned cases.

Table 6: The number of Highline visitors, N_2, in millions, and V_2, V_2^*, in M$.

Year	v	visitors of the High line (millions)	domestic HL visitors(exclude from NY)	Domestic NY visitors	d	N_2	V_2	V_2^*
2010	0	1.3	0.507	39	0.013	0	0	0
2011	0	2	0.78	40.3	0.0193	0	0	0
2012	0	2.6	1.014	41.8	0.0242	0	0	0
2013	0	4.3	1.677	42.8	0.0391	0	0	0
2014	0.602	5	1.95	44.5	0.0438	0.0202	4.8701	23.413
2015	1.259	6	2.34	46.2	0.0506	0.049	11.772	48.965
2016	1.816	7.3	2.847	47.8	0.0595	0.0832	19.968	70.628
2017	2.673	7.6	2.964	49.7	0.0596	0.1226	29.429	103.95
2018	3.43	8	3.12	51.5	0.0605	0.1598	38.362	133.40
2019	3.623	8.4	3.276	52.64	0.0622	0.1734	41.625	140.90

Figure 14 shows the total benefit of Tourists for more than 45 miles (by considering the first analysis, V_2) and less than 45 miles (by considering the most optimistic case, V_1). The total revenue, in this case, is reached 102 M$ in 2019.

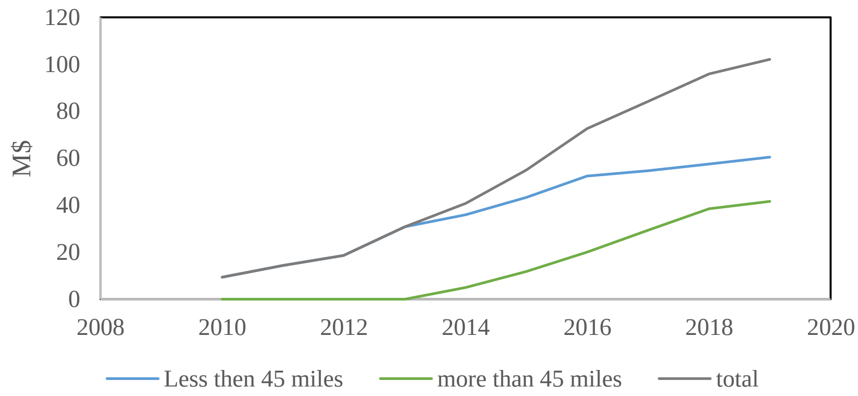

Figure 14: Benefit of tourists ($V_1 + V_2$) in M$.

4.3.3 Other cases:

Now, we will examine what happens if we consider different percentages for the contribution of the visitors from more than 45 miles and less than 45 miles.

The results are shown in Table 7. Case 1 is the defined case. In case 2, for having more realistic results, we consider only 15 percent of High line visitors from less than 45 miles come to New York for High line (e=0.15). We should mention that 15 percent is only an estimation due to a lack of information. Also, in case 2, the revenue of visitors from more than 45 miles is considered V_2^*.

In case 3, we consider that e=0.5 means that half of the people from less than 45 miles choose the High line as their main purpose. For the visitors from more than 45 miles, we use the amounts of V_2. This case may give us more realistic result than case 1 and case 2.

Table 7: the total revenue of High line visitors, in M$ for different cases.

Year	Case 1	Case 2	Case 3
2010	9.36	1.404	4.68
2011	14.4	2.16	7.2
2012	18.72	2.808	9.36

2013	30.96	4.644	15.48
2014	40.870	28.813	22.870
2015	54.972	55.44	33.3724
2016	72.528	78.512	46.248
2017	84.1498	112.16	56.7898
2018	95.9627	142.04	67.1627
2019	102.1059	149.97	71.8659

Until now, we estimated the revenue of tourists visited the High line and considered some assumptions and cases. Now, we want to do a comparison with other NY tourist spots revenue to examine how much our estimation was accurate. Also, we can find out which of the considered cases has a better interpretation of the High line effect on touristic revenue.

4.3.4 Confirmation of results:

To validate the estimation we proposed in section 4.3.2, we consider other tourist spots in New York City. Based on the number of visitors, the first twenty tourist spots were considered. Same as the High line, some of them do not have any tickets. Therefore, we do not have any exact data about their revenue. If we had enough information about other spots in NY, we could obtain the Tourist revenue of High line. However, we check our estimation based on the studies done before for other tourist spots such as the NY wheel or the Empire state building.

We start by identifying other tourist spots in NYC. Statue of Liberty, Central Park, Rockefeller Center & Top of the Rock Observation Deck, Metropolitan Museum of Art, Broadway and the Theater District, Empire State Building, 9/11 Memorial and Museum and, New York Wheel are the most attracted tourist spots in New York. In the Table 8, the revenues of the most attracted destinations for tourists in NYC are represented. For example, the NY wheel brought about $127M in 2017 and was estimated to bring about $166 million in 2021, if we consider a linear trend, its revenue in 2019 was about $145M. About $96 million was considered to be obtained from tickets. Therefore, if we discard the revenue of tickets, revenue of the NY wheel was about $75 million in 2019. Having a comparison with the results we obtained for the High line in 2019, the tourist revenue of High line in 2019 was about $102 million in case 1 and $72 million in case 3. These two estimations seem rational.

Table 8: The revenues of some tourist spots of NYC

Name of Tourist spot	Revenue*
Central Park	$420 M
NY wheel	$145 M
Empire state	$130 M
Metropolitan Museum of Art	$55 M
9/11 Memorial and Museum	$200 M
Broadway and the Theater District	$2000 M
Rockefeller Center & Top of the Rock Observation Deck	$270 M
All Museums in NYC	$1000 M

*References: (CBS NEWS, 2019), (Noto, 2015), (Grant, 2018), (Central Park Conservancy, 2015), (Statista Research Department, 2021).

We use the statistics of Central Park to have another comparison with the results we obtained for High line. The non-domestic number of visitors to Central Park and their revenue for NYC in 2014 was 13.8 million (Central Park Conservancy, 2015). In this year, the total revenue of tourists who visited the Central park was $204 M. The total number of High line visitors in 2014 (except those who live in New York) was about $0.61 \times 5 = 3.05$ million. Therefore, we estimate that the revenue of High line visitors in 2014 was $\frac{3.05}{13.8} \times 204 = 45.08$ million. Considering the revenue of about $41 million in 2014 for case 1, we conclude that our estimation process was accurate enough and, we accept the first case as our final result.

4.3.5 Present value analysis

After some corrections and comparisons, we suggested that the first case analysis describes the revenue of High line visitors better. Like previous parts, we consider that the interest rate equals 0.03. Thus, the total revenue of tourists until 2019 is obtained as PV (2019) = 569.2M$. Also, if we assume a fixed revenue of 100M$ per year, the perpetuity of tourists will obtain equal to 3333.33M$.

It should be noted that in this study, we did not anticipate the tourist flow after 2020. This was because of uncertainties due to the pandemic. The pandemic affected the number of NYC visitors in 2020-2021 and, we consider this data as outlier data. Although the pandemic may affect the NYC visitors in the next year, we do not have any model to anticipate the tourist revenue after the pandemic and, we should wait to see how everything changes in the next future.

4.4 The construction workers' salary

One of the other factors which may be considered as a benefit is the salary paid to construction workers. As reported by Friends of the High line, the construction of sections 1 and 2 of the High line has created 344 new construction jobs every year. Since we do not have the data for section 3, we assume that the number of jobs is proportional to the construction costs; equal to $152,3 million for sections 1 and 2, and to $90 million for section 3. But, section 3 was divided into two parts, part one was finished in 2015, and the latter part was opened in April 2019. The total costs for construction of the first part were about 75 million dollars, therefore, we consider about 15 million dollars for the second part of section 3. Therefore, we calculate the number of construction jobs created for section 3 as follows: $Round\left(\frac{75\,million}{152.3\,million}\times\ 344\,employees\right)=$ 169 employees for the first part and 34 workers for the second part. In addition, we will take on the annual wages of these construction workers as $37,000 per year (What Is the Average Construction Worker Salary by State, n.d.). In 2019, we just consider 3 months. By considering the interest rate equal to 0.03, the total revenue for construction workers (PV (2019)): $132,459,725.

4.5 The benefits for workers of other industries

The total number of employees from 2006 to 2011 is equal to 1390. Thanks to the construction of the 2 sections, from 2006 to 2011, most of them are related to the industry of "maintenance and repair of parks, highways, roads, bridges, and tunnels" (1,211 people) and "other services" (179 people); furthermore, from 2011, the number of employees was increased in "maintenance and repair of non-residential structures", “retail trade”, and “health and social services” (706 people) with a total of 2096 jobs (Song, 2013). Since these employees work as part-time workers, their wages have been considered to be $20,000 per year. As of 2019, the total revenue of these workers is assumed to remain constant as no new jobs due to the High line will be added. For the financial analysis, the value of these revenues was calculated, referring to 2019 year.

The total revenue for workers in other industries (PV (2019)): $ 618,446,390.

Perpetuity: $1,397,333,333.33.

4.6 Construction Costs

In order to finance the project, with a total cost of $242,3 million, more than 90 % of the park's annual operating budget was raised from private donations. Table 9 shows the sources of the budget that was needed to complete the High line.

Table 9: Sources of budget

Section 1 & 2 (in million dollars)		Section 3 (in million dollars)	
NYC	$87.6	NYC	$10
Federal Government	$20.3	Related companies	$27.8
The state	$0.4	Friends of High line	$20
Fundraise	$44	Fundraise	$32

The data found shows that the total construction costs of the first two sections of the High line accounts for $152,3 million. We have distributed this cost equally between the years of construction of these sections (from 2006 to 2011) that gives us the yearly cost of construction, equal to $25,4 million. From 2012-2014 we distributed equally 75 million dollars which yields $25,000,000 dollars per year and similarly 3,000,000 per year from 2015-2019. By considering 3 percent for interest rate, we obtain the total construction cost (PV (2019)): $ 313,634,711.

4.7 Maintenance and overhead costs

According to the available data, annual operations and maintenance cost is nearly $3 million; in addition to these costs, approximately $3 million is required for overhead support and staff costs (Ling, HIGH LINE ARCHITECTURE, 2013).

The total maintenance and overhead cost (PV (2019)): $102,517,945.

The perpetuity can be obtained by $6,000,000/0.03=$200,000,000.

5 Results and discussion

Regarding the impact analysis done in Chapter 4, we will obtain some CBA results in this chapter and, we will have a brief discussion about our analysis.

5.1 Results

5.1.1 Net present value

The benefits and costs of the High line project are depicted in Table 10 each year. The NPV of the High line project is shown in Table 11. $NPV_{(2019)}$ is obtained about 1.313 billion dollars by considering the interest rate equal to 0.03 per year. It should be noted that the perpetuities are not considered in the total $NPV_{(2019)}$).

5.1.2 Benefit-Cost Ratio (BCR)

To obtain BCR, we divide the total benefits in 2019 by the total costs. The amount of BCR equals 4.15 by considering 2019 as the base year. This number seems a reasonable result however, will discuss about how can we increase the accuracy of the results.

Figure 15 shows the contribution of each impact in the $NPV_{(2019)}$. As shown in this figure, about 36% of benefits are due to the revenue of workers in other industries. 33% is because of tourist revenues, 24% is because of increase in properties value, and 7% is for construction workers' salary. The costs are shown with a minus sign in this figure. As represented in Figure 15, 75% of total costs are due to the construction costs and the remaining 25% of it is for maintenance and overhead costs. The total benefits are about 4 times of total costs.

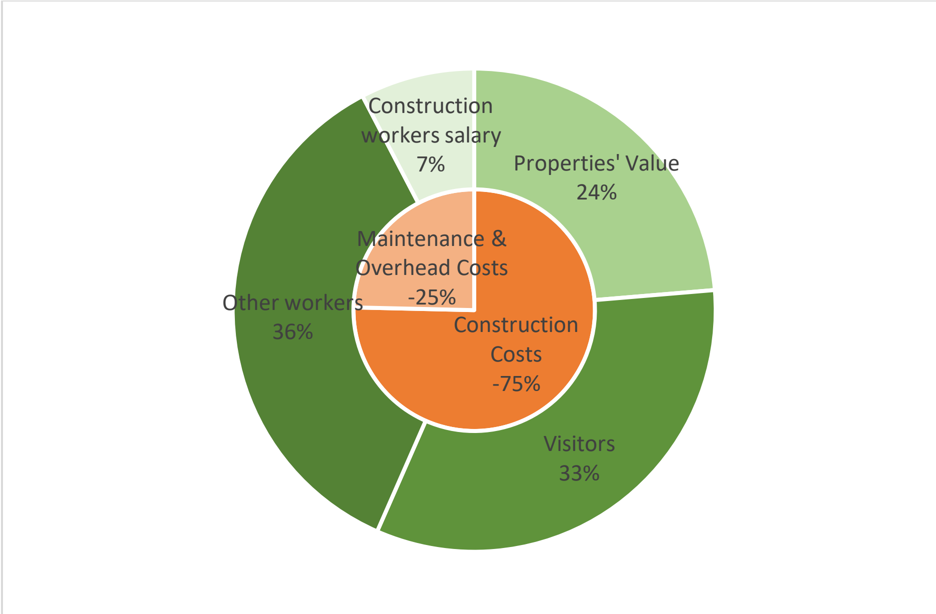

Figure 15: Benefits and Costs (2019) and the percentage of each element. The minus sign represents that the element is considered as the cost.

5.1.3 Effects on social surplus- demand and supply curves

For an explanation of the supply and demand curves, in the short run, only supply shifts rightwards as a result of the additional capacity of the green area added to the city that results in a higher consumer surplus immediately after the implementation of the project (Figure 16). In the long run as shown in Figure 17, because of the fast increase in the number of visitors of the High Line, the demand grows quickly, but it reaches a maximum value that is because the capacity of supply is much higher than the values of demand. Therefore, the increased demand will not offset the increased supply's benefits.

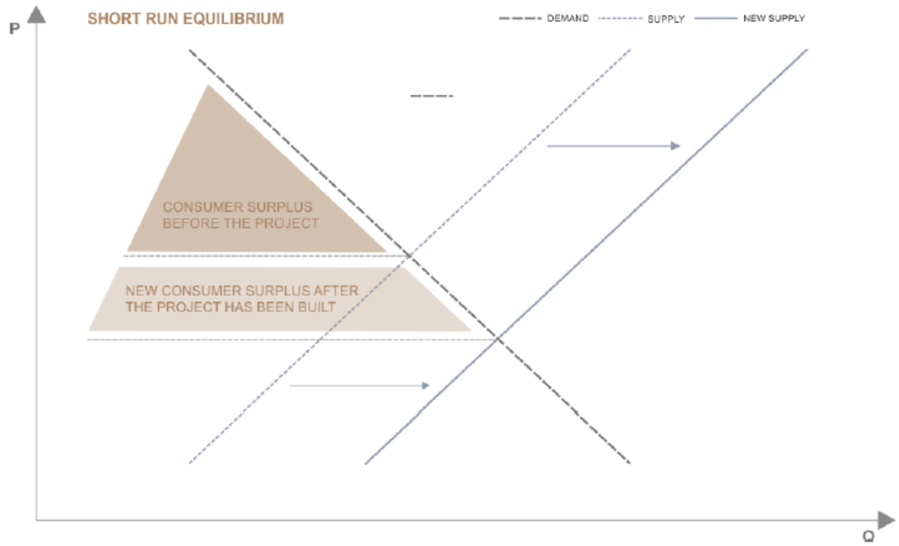

Figure 16: Short run Demand - Supply equilibrium after opening the High line

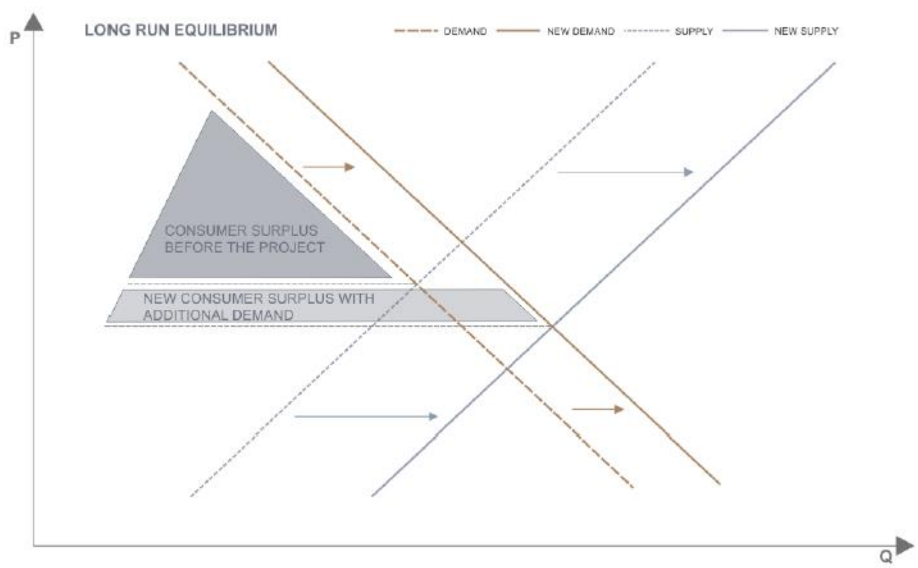

Figure 17: Long run Demand - Supply equilibrium after opening the High line

Table 10: The benefits and costs of the High line project from 2006-2019 in each field, their total amount.

	Benefits (undiscounted)$				Costs (undiscounted)$			
Year	Properties' value	Tourist	Construction workers	Workers (other industries)	Construction costs	Maintenance & Overhead costs	Total benefits	Total costs
2006			12728000	27800000	25400000	6000000	40528000	31400000
2007	68500000		12728000	27800000	25400000	6000000	109028000	31400000
2008	68500000		12728000	27800000	25400000	6000000	109028000	31400000
2009	68500000		12728000	27800000	25400000	6000000	109028000	31400000
2010	68500000	9360000	12728000	27800000	25400000	6000000	118388000	31400000
2011	10148148	14400000	12728000	41920000	25400000	6000000	79196148.15	31400000
2012	10148148	18720000	6253000	41920000	25000000	6000000	77041148.15	31000000
2013		30960000	6253000	41920000	25000000	6000000	79133000	31000000
2014		40870112.4	6253000	41920000	25000000	6000000	89043112.36	31000000
2015		54972467.5	1258000	41920000	3000000	6000000	98150467.53	9000000
2016		72528401.7	1258000	41920000	3000000	6000000	115706401.7	9000000
2017		84149891.3	1258000	41920000	3000000	6000000	127327891.3	9000000
2018		95962718.4	1258000	41920000	3000000	6000000	139140718.4	9000000
2019		102105957	340000	41920000	3000000	6000000	144365957.4	9000000

Table 11: The revenues and costs by considering 0.03 interest rate in 2019, the Net present value in 2019 and the cost benefit ratio.

Revenues (Benefits)- Prior to 2019; 2019 NPV	
Properties' Value	$409,404,337
Visitors	$569,172,842
Workers Salary	
Construction workers	$132,459,725
Workers in other industries	$618,446,390
Costs- Prior to 2019; 2019 NPV	
Construction Costs	$313,634,711
Maintenance & Overhead Costs	$102,517,945
$NPV_{(2019)}$	$1,313,330,637
BCR	4.155886709

5.2 Limitations of analysis

We have obtained the costs and benefits in chapter 5. However, there were many encountering limitations. In the parts of benefits evaluation, there were exist no enough data. To obtain an accurate increase in properties value, we did not have access to the relevant organizations. The exact increase in properties value near the High line in comparison with other regions of Manhattan in different years was not specified in the literature. There may exist other ways to obtain the exact data such as tax offices but, in this research we have tried to obtain the results with only accessible data.

Another way was running a kind of Hedonic pricing model to obtain the effects of High line in properties value increase quantitatively. The hedonic pricing model could be used to estimate the extent to which the high line affects the market price of the property. As we did not have access to the data of the region, we did not do the Hedonic pricing analysis to capture the increase in properties value exactly. However, this was not the aim of our study.

Another issue was the unsupported statements about the tax revenues. As we mentioned in Chapter 4, there was no accurate information about the tax revenue of the High line. 'The High line will have generated over $1.4 billion in tax revenue for New York City between 2007 and 2027, roughly $65 million annually (Landscape Performance Benefits, n.d.). These numbers are only estimations that there is no evidence available about their accuracy. We do not know what are the sources of these taxes. Are they due to the real estate taxes? It seems that a part of this amount is because of an increase in properties value but, this 1.4 billion dollars revenue from taxes seems unreasonable for such a project. However, the lack of clear data about tax revenues and ambiguous sources of tax revenue resulted in omitting its effect on benefits.

We analyzed to obtain the effect of High line on tourism. We aimed to capture the High line benefits as accurately as we can. However, calculating the tourist revenue needs more attempts. One good way was collecting all economic and social changes to find out the other impacts which may affect the change in the slope of NYC visitors. Then, by employing a regression analysis, we could obtain the exact effect of the High line on tourist revenue. But this method was impractical for the case of the High line.

Another way was preparing a questionnaire to evaluate the willingness to pay and, also the attraction of High line for visitors. This way seems more practical but, doing such a study needs to access the High line visitors by running an online poll. This topic can be a proposal to study in the future.

There are also uncertainties in the computation of benefits of workers in other industries. We did use the data of available sources but, they may have been ignored some effects or on the other side, they may have been overestimated the effects of High line on workers in other industries. We did not have any access to exact data and also it was hard to estimate the exact number of new jobs due to the High line.

We did not do a complete CBA analysis. As shown in Table 10, the Net cash flow is obtained a positive number every year, even in the first year. Therefore, the payback period and internal rate of return are meaningless. This is because of the revenues for construction workers and workers in other industries. By the way, this may because of limitations and inaccurate benefits for workers in other industries.

6 Conclusion

In this study, we analyzed the costs and benefits of the High line project. We considered the CBA impacts specifically, focused on the tourist revenue. To calculate the tourist impact, we did a regression analysis and applied some corrections to obtain the tourist revenue precisely. Then, we calculate the $NPV_{(2019)}$ equal to 1.3 billion dollars. Also, the obtained BCR equals 4.15. This analysis shows the outstanding economic benefit of High line and will increase the impetus for organizations to invest in such projects.

However, to calculate the benefits of each impact, we encountered many limitations. The limitations are not only due to the lack of data but also the methods needed to calculate some of the impacts. In future works, other impacts such as the increase in properties value and the benefits for workers in other industries can be calculated by using other economic assessment methods. Also, the benefits of some impacts like tourist revenue in the next years could be anticipated.

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