Czech University of Life Sciences Prague

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Bachelor Thesis

Evaluation of Environment Impact upon Prices of Real Estate in Prague

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BACHELOR THESIS ASSIGNMENT

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Thesis title

Evaluation of environment impact upon prices of real estate in Prague

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Objectives of thesis

Evaluate impact of environment, specifically quality of air, biodiversity, etc. upon prices of real estate in Prague.

Methodology

Extraction, deduction, induction and synthesis for the literature review are used. Hedonic pricing method is used for the analysis together with graphical quantitative and qualitative analytical methods.

Schedule for processing

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The proposed extent of the thesis

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Real Estate, Property analysis, Environment, Hedonic Pricing Method

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Fischel, William. 1985. The Economics of Zoning Laws: A Property Rights Approach to American Land Use Controls. Baltimore: Johns Hopkins University Press.
Foster, David D. and Anita Summers. 2005. "Current State Legislative and Judicial Profiles on Land-Use Regulations in the U.S." Wharton Real Estate Center Working Paper No. 512. Philadelphia: The Wharton School, University of Pennsylvania.
Glaeser, Edward and Joseph Gyourko. 2003. "The Impact of Building Restrictions on Housing Affordability", FRBNY Economic Policy Review. Federal Reserve Bank of New York (June).
Glaeser, Edward, Joseph Gyourko and Raven Saks. 2005a. "Why Is Manhattan So Expensive? Regulation and Rise in Housing Prices", Journal of Law and Economics, 48(2): 331-370.

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Dean

Affidavit

I hereby declare that this bachelor thesis “Evaluation of the Impact of the Envrionment on Real Estate Prices in Prague” has been written only by the undersigned and without any assistance from third parties. Furthermore, I confirm that no sources have been used in the preparation of this thesis other than those indicated in the thesis itself.

In Prague 17.03.2014 _____

Josephine Shonga

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Evaluation of Environment Impact upon Prices of Real Estate in Prague

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Summary

This study deals with the analysis of the environmental amenities and the impact they have on prices of real estate demand in Prague. The reason for this analysis is to show how the price of real estate is affected, with regard to the external amenities or the housing features available. This thesis also documents some environmental pollution levels, stemming from industrial and construction works, with effects such as air particulate concentration and noise pollution.
The methodology used to calculate housing prices in relation to various external factors, in this research, is the Hedonic pricing method (HPM).

Using qualitative and quantitative statistical measures, to answer the research question; whether real estate prices in Prague are affected by environmental amenities, the results are plotted in tabular and graph format.
This research is useful to everyone who is interested in knowing how much of the environment affects the price they paid for an apartment. This is also informative for real estate agents so that they may start to provide pollution level statistics to their clients.
This thesis proved that there are significant and insignificant factors that contribute to the price of the housing unit and that the pollution levels are not a major factor as many individuals are not informed of the risks.

Keywords: Land, Real estate, Air Pollution, Hedonic Pricing, Globalisation, Sustainable development, Property analysis, Environment, Tunnel Blanka**,**

Zhodnocení vlivu ŽP na cenu nemovitostí v Praze

Souhrn

Tato studie se zabývá analýzou životního prostředí, jeho externími faktory a dopadem, který mají na cenovou poptávku nemovitostí v Praze. Cílem této analýzy je ukázat, jak je cena nemovitostí ovlivněna, s ohledem na občanskou vybavenost nebo vybavenost nemovitosti, které jsou k dispozici. Tato práce také popisuje některé úrovně znečištění životního prostředí, vyplývající z průmyslových a stavebních prací, s efekty jako je koncentrace pevných prachových částic vzduchu a hlukové zátěže. Metodikou použitou v tomto výzkumu, pro výpočet ceny nemovitosti, v souvislosti s různými vnějšími faktory, je metodika hedonické ceny. Použití kvalitativních a kvantitativních statistických měření odpoví na výzkumnou otázku, zda jsou ceny nemovitostí v Praze ovlivněny občanskou vybavenosti, výsledky jsou vyneseny v tabulkovém a grafickém formátu.

Tento výzkum je užitečný pro každého, kdo má zájem vědět, jaký vliv má prostředí na cenu, kterou zaplatil za nemovitost. Je to také informace pro realitní kanceláře, aby mohly začít poskytovat statistické údaje o úrovni znečištění pro své klienty.

Tato práce prokázala, že existují významné a nevýznamné faktory, které přispívají k ceně bytové jednotky a že úrovně znečištění nejsou hlavním faktorem, protože většina lidí není informována o rizicích spojených se zenečištěním.

Klíčová slova: Pozemek, nemovitostí, znečištění ovzduší, hedonická oceňování, globalizace, udržitelný vývoj, majetkové analyza, životní prostředí, Tunel Blanka

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1. INTRODUCTION

The United Nations' Department of Economic and Social Affairs (DESA) projected in 1998 that by 2010 half of the worlds' population will live in urban areas (Council, 1998). This projection has exceeded not only on urbanisation statistics but also world population as a whole. The Earth has currently 7 billion inhabitants covering all corners from Australia to Alaska, from Russia to Argentina and from Sweden to South Africa with everything in between. This we share with thousands of other creatures and different species. We compete with each other and with other animals for food, clean water, clean air, energy and natural resources, and most importantly for space.

In humans, almost every young and able bodied individual would prefer to live in the urban areas. Places where they can attend University and find jobs and places that are full of many different opportunities.

With regards to this information, the Czech Republic is not exempt from having to deal with urbanisation. It has to, therefore, cope with having a huge migration of young people moving into the major cities, coupled with foreign nationals also living and working here. The government has to find a way to house these individuals with their families and as well maintain an economy that is up to standard with European Union regulations.

This bachelor thesis deals with the analysis of real estate growth in Czech Republic and the impact of various external factors on the prices of housing developments. Over the years, the Czech Republic has seen a growing number of buildings, housing, roads and bridges popping up in various areas at a very fast rate.

Construction and modifications are the norm of everyday Czech society, since the beginning of the 21st century. Construction and real estate is a very lucrative business on an economic viewpoint. If a government sees a potential to maximize tax collection and revenues, it will not stop issuing out licenses to build or modify nor will it thoroughly control the nature in which these buildings are constructed or modified.

When you first arrive in Czech Republic, the first thing you notice as you enter the city from Vaclav Havel International Airport into the Dejvicka area of Prague 6 is the amount of traffic on the roads. This is because there is usually a traffic jam at the end of the road leading into the city center, on the roundabout, as there is some construction taking place nearby. This can either be that the road is being dug up to fix the tram station platforms or the entire tram lines or tram rails are being uplifted and changed.

You will not notice buildings or homes being re-constructed as most of the buildings in this area are quite old but of good quality if you must add. Most were built in the 1950s or earlier. They have some good solid foundations and they are made of material that has lasted years and years, and most without external repair. The one thing you will notice though is the colour of these buildings. Most of them are darkened with soot or smog residue from vehicles. This area has a mixture of residential and office buildings. There is the Czech Technical University of Prague situated in this area as well.

Most building constructions for homes and apartments happen in the heart of Prague. Reconstructions top the charts in the city center. This may be due to the fact that most people would like to see Prague look similar to other major European cities, but still retain a unique feel of old mixed with new. The younger generations would like to see a modern trend followed through, a mini-New York city so to speak, while the older generations would like to forget what some of these buildings represent in a historical point of view.

Some people prefer to live just outside Prague in the area where it's mostly low on traffic noise but close enough to go shopping and or touring around the capital city.

Even though the focus may be on Prague as it is the capital city of the Czech Republic, other cities in Czech Republic have similar attributes when it comes to construction and renovations. Cities like Brno, Ostrava, Cesky Krumlov, Ceska Budejovice and Karlovy Vary, are very well known to outsiders as potential business areas. Therefore, it is not surprising to see people commuting every week to do business

or to set up shop in these areas. Others prefer to live in these cities as housing is cheaper and affordable than Prague. They choose to have their homes there and commute to Prague by train. It is the kind of commitment that keeps the transport system effectively in business and the construction companies as well.
Even though Czech Republic has a fast growing real estate business, its population has been steadily hovering at 10 million inhabitants since the 1980s. So the need to build does not stem mainly from population explosion as we have seen happen in other countries around the world such as China and the United States of America.

2. Goals of Research and Methodology

2.1 Goals

The goal of this research is to determine if environmental external amenities have any influence on how much the price of real estate in Prague, will be. To see if people are willing to pay a little bit more for more space, quieter area, cleaner air in their surroundings or if the buildings have elevators or not. If such special features offer any change in how they decide to buy or sell property.

2.2 Research Question

Are real estate prices in Prague affected by environmental amenities?

With regard to the history and the current situation in Czech Republic with real estate; housing and road infrastructure has topped the charts over the recent years. The more people decide to move to urban areas the more the cities and towns are flooded with housing projects, both newly built housing and re-constructed. Many young and vibrant people move to the city for various reasons. Their ideal urban environment has access to jobs, recreational facilities or green space, arts and culture, entertainment in close proximity, good transport network and areas that free or have a very low crime rate. Above all this, young people are looking for affordable housing.
Market demand for affordable apartments is very high. The question only arises when looking at the area surrounding the accommodation.

2.3 Methodology.

The hedonic pricing method will be used to help show the significance of environmental features for the prices of the goods on the market in this case housing units. It is applicable in cases where the prices of a good are directly influenced by environmental factors. (Andrea Baranzini, José Ramirez, 2008)
The most widely used example is the housing market, where the value of two comparable properties or apartments will be different depending on the environmental amenities close to each site. These environmental amenities can include children's schools, parks, playgrounds, recreational and sports facilities, public transportation system, waste dump sites, open pit mines etc.
Multiple regression will be used as method of data analysis, using Microsoft excel, to also help determine the extent of hedonic pricing methods. The regression analysis may is useful whenever a quantitative variable (the dependent variable) is to be examined in relation to any other factors (independent or predictor variables). These relationships may be non-linear and the independent variables may be quantitative or qualitative.

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Hedonic pricing usually estimates the relationship between the price (P) of an apartment (the dependent variable) and all of its various characteristics (independent variables). For example, the price of an apartment can be summarized using a hedonic price function like below;
The question at hand is to find out if the price of housing units as a function of Size (**Sz**), Number of Rooms (**NoR**), Level (**Lev**), Newly built (**NB**) and Distance to transport system (**DTs**) is affected by any changes that may occur in the independent variables.

Housing Price (P) = f (Sz, NoR, Lev, NB, DTs) = a_0+ B_1 * Sz + B_2 * NoR + B_3 * Lev + ...+ error

Price is the dependent variable (P) and all other factors are independent or predictor variables (x_i). The Hedonic price can be also interpreted as the willingness to pay. For example the size of square meters that a flat may have will be a deciding factor for an individual wanting to buy or sell property. An increase in the size may be the only reason one might choose to buy at a certain price. If negotiated, if a flat has low square meters, the price can be brought down.

Using regression analysis and correlation, the relation between the prices of housing units, size of apartment, distance to transport systems, will be analysed, by using Microsoft Office.
Here you see the regression model: $Y' = A + B_1x_1 + B_2x_2 + B_3x_3$ .....$B_kx_k + U_t$
Where we have the unknown parameters, denoted as x and the variable of interest Y' which is the dependent. The constant variable is 'A' and the coefficients of independent variables are from B_1 to B_k. Ut is the error term, the non explained part of the price.
To apply the equation, each x_i score for an individual case is multiplied by the corresponding B_i value, the products are added together, and the constant A is added to the sum. The result is Y', the predicted Y value for the case, and the correlation between Y' and the actual Y value is also called the multiple correlation coefficient - R. Therefore, R provides a measure of how well Y can be predicted from the set of x scores.
The value of R is such that -1 < r < +1. And using the R-squared as below, to interpret the co-relation and level of dependency of variable (y) on variables (x):

|r| is in range between <0; 0,33> weak dependence
|r| is in range between <0,34; 0,66> medium strong dependence
|r| is in range between <0,67; 1> strong to very strong dependence

Data was collected for comparison of Prague-6 with Prague-10 area. The area in Prague 6 is chosen because of its close proximity to the metro stations and center of the city. The area was also chosen because of construction of the tunnel Blanka. Focus and attention is given to this area as a future hub of transport systems.
Prague-10 area is the other area chosen as it is further away from the city center. The research will try to show if there is a significant difference in prices depending on location in comparison to Prague 6. Prague 10-area is a good distance away from the city center therefore there maybe some differences in price for the same size housing unit as one found in Prague 6.

2. Literature review

The decision to own property has many factors that need to be considered. Location and price are the top considerations that people look at when buying or renting property.

One can have many questions as to why there have been a huge number of real estate constructions and reconstructions around the Central and Eastern Europe in general. This can be attributed in part to Globalisation and as well to the fact that post socialist states are in a hurry to catch up with the Western block in terms of infrastructure and representation. This can be seen in the number of modern architectural buildings and sites that are taking over the baroque and gothic style buildings, or being fused together to create an atmosphere of modern and old in one. Most old baroque buildings in Prague have interiors only kings would dream of. They are beautifully furnished and the art and decor represents both an era gone by and an era at present. Modern and old mixed in one.

2.1 Globalisation

Globalisation is a term that is used to understand what integration means in many different aspects of culture, world views and more importantly ideas. In many professional workplaces, this is a term that can be used to bring together colleagues, situated in different locations, to mean that they are one, working together as a team.

To simply put it "Globalisation can be defined as a process which is deepening and accelerating the functional integration, competition and co-operation, dependency or interdependency of cities and their regions, across international and national borders." (Knox P, Taylor P, 1995)

This statement alone speaks volumes about what the world thinks should be done or should be doing in order to reach a common goal, when it comes to development. The rapid integration of economies worldwide through globalisation has been most notable since the 1980s because of convergence of trends reflecting structural adjustment and internationalisation of production, technological innovation and knowledge-based activities. (Lo and Yeung, 1998)

Most major cities around the world such as London, New York, Toronto, Milan, Johannesburg, and Paris, have no trouble painting a picture in a person's mind of how they look like. People watch these cities in movies and fashion shows and they conclude, in their minds that these are the cities one must live in for success and beauty. Most post-communist cities such as Prague have to fight for their identity as a city that's bustling with business and multiculturalism. People around the world have put a label on such cities are dark and grey and over run by a "Nazi type" of lifestyle. Many people are shocked, when they visit Prague for the first time, to see so much beauty that attracts thousands of visitors each year.

Prague has become a notable city for international conventions, which hold their meetings every year. It has become one of the number one destinations in central Europe for business transactions and business co operations. Czech Republic is considered one of the best locations for local production for the European market for the following reasons, the country's tradition of manufacturing; many qualified and skilled workers; qualified production managers; advantageous geographical location for the EU market; and relatively well established infrastructure when it comes to roads and railways (Ikemoto, 2007)

The concept of globalisation is not new. Many economists and writer referenced globalisation in a different way. They did not know how to explain it quite like the way we see it now. Patrick Geddes talked about world cities and the coming together of nations, working as one unit (Geddes, 1915). He may not have understood that technology would play an important part in all this, but he understood where the political systems where heading to. He lived long enough to see some of the changes he predicted in his vast experience as a city planner.

Globalisation in my understanding is; having to move from one place to another, without having to see any differences. The culture, the dress-code, the language to some extent, may be different, but the services and infrastructure remain the same. In terms of language, this is also another sign in some way as languages such as English, German and Russian, start to be used as modes of business communication in many places.

Prague as a city emerging from years of socialist rule has massively changed over the past 20 years. You can now see international brands and supermarkets everywhere you go in the city. Top designer shops such as Dolce and Gabbana, Louis Vuitton are available in the city center.

2.2 Urbanisation

Another term that is closely linked to the growth of real estate is urbanisation. This is simply the number of people living in urban areas. This number continues to grow everyday as more and more people migrate from small towns and villages to bigger and major cities. In Czech Republic, the capital city; Prague has the largest number of inhabitants with about 1, 2 million people of the 10, 4 million inhabitants of the country. This number, coupled with many foreign immigrants, documented and undocumented, has led to people wanting more space, better roads to drive on, as more and more cars are on the road.

Many cities undergo these transitions because of economic pressure. In order for them to be competitive and accepted or included in the urban international networks, they have to have to go through a certain transformation of both physical and social nature. This puts pressure on many governments to conform to the current norms of society. The inhabitants want cities and dwelling places that look and feel modern or are at par with the rest of the developed world.

Reconfiguring countries such as Czech Republic, in my opinion has not been easy. After the downfall of communism and the Soviet Union, trade with the outside world was not immediate. The change was not overnight. The city of Prague itself though has remained strongly linked to the past with its old town filled with tourists every year and as well with its old buildings. Inhabitants of Prague are mostly people from around the country. Many students decide to settle here after university and eventually begin to work. Most individuals when asked where they are from, they mention places such as Plzen, Brno, Most, Usti nad Labem, Ostrava to mention but a few. Prague to them is center of all that happens and should happen.

Urbanisation, in my point view, is a win-lose situation. Let me elaborate.

A win situation:

Is a situation where we all gain from an action of another, without having to contribute much of anything. We build ourselves roads and beautiful homes. We ensure that our lives are fulfilled with every gadget possibly imaginable for us to use, heaters, cookers, televisions and fridges. All this we gain because we move from point A to point B. We develop our surroundings and influence and encourage one another to move to the city, to live in the city, to work and raise families there. We consider this success. We look upon individuals living in the forest as primitive and backward, never to reach a status or level we have at that moment. (Denslow J, Padoch C, 1998) We do forget that world systems we have now did not start off in a civilised manner. There was chaos and misguided conceptions before all this was put in order.

Lee and Daly continue with this notion as they explain the political and economical system of the Ituri rain forest pygmies. They introduce us to a political system observed where an individual is elected as a spokesperson for the different groups (bands) of the community. These spokespersons present individual difficulties faced by his band to a chief who is a presiding judge and jury (Lee R, Daly H R, 1999). There is nothing primitive in this scenario at all.

A lose situation:

We focus so much on our wealth that we lose sight of our health. We have decided it upon ourselves to not care about other animals that we share the planet with. Growth of our surroundings has become a number one priority for almost every developed and developing nation. Pushing further and further into animal territory and the animals have no choice but to adapt to the changes taking place in their habitat. This change as always is not over night. For the animals to reach a certain level of adaptation that will ensure their survival and that of their offspring, it takes quite a number of years. And in these years that they are striving to adapt, many are lost on the way, as they die out without having to reach that level of survival. In some instances, entire species are lost while some are modified. It is important to note that our time frame in years could be a thousand lifetimes for a butterfly or a fish. We modify their environment without regard of what are the consequences. These are bi-directional. Our health is put on the line as well as entire ecosystems.

In many major cities, challenges occur when there is need to build for instance roads, airports and shopping centers. These require quite a large amount of space and usually the focus turns on the land that is seen as “unused”. This can be some part of a forest, a clearing in a field or some old buildings in the city center.

Airports are a fast growing business and to build one, there are a number of factors that need to be considered both during construction and after construction. Noise pollution and air pollution are the major concerns of airport construction. The amount of time it takes from start to finish may vary but the effects are usually similar.

In 2012, the Federal Department of Foreign Affairs (FDFA) and the Federal Department of Economic Affairs, Education and Research (EAER) of Switzerland, proposed to work with the Czech government, in building trolley bus lines in Ostrava. This was proposed to help reduce air pollution levels in the city. Ostrava is a city with heavy industrial activity and it is ranked among the worst cities with air pollution in the European Union (EU) block. Other than industries contributing to air pollution, city traffic levels contribute a significant amount of pollution as well. A trolleybus system spanning 3 kilometres would help about 7,500 (seven thousand five hundred) commuting passengers throughout the city. Some 300,000 residents of Ostrava will benefit from better air quality and less noise as fewer diesel buses will be in operation and more passengers leave their vehicles at home in favour of public transport. The project is expected to complete in 2014.

In Prague, one of the major projects undertaken by the city has been the creation of the Tunnel Blanka, which begun as far back as 2008. This is a road tunnel system that is 17 kilometers long, making it the longest traffic tunnel in Czech Republic and the longest city tunnel in Europe. The tunnel consisting of a number of connections and exits will as well connect to the recently built Trojsky Bridge. The bridge is almost in completion as of 2014, while parts of the tunnel Blanka have already become operational. This means that the metro system as well will be affected and an extension of it is planned.

Figure 1 - Construction of tunnel Blanka in the Hradcanska area in 2008
Source: (spol, 2006)

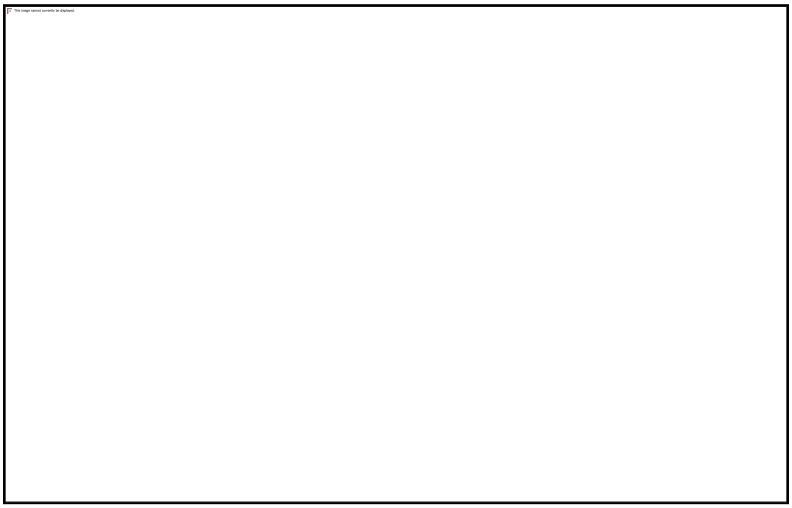


Figure 2 - Construction of tunnel Blanka in the Hradcanska area in 2008
Source: (spol, 2006)

Figure 3 - Construction of tunnel Blanka in the Hradcanska area in 2009 – With some parts completed
Source: (spol, 2006)

Figure 4 - Construction of tunnel Blanka in the Hradcanska area in 2012
Source: (spol, 2006)

Figure 5 - Construction of tunnel Blanka in the Hradcanska area in 2013
Source: (spol, 2006)

This kind of project reflects a lot on what will be the state of real estate prices in Prague in the next 3 years and beyond. Though this project as well creates job security for a number of people, during this whole period of construction, the major pollution problems are air and noise pollution.
Usually, traffic is almost at a standstill as some parts of the city are closed due to construction, there are a lot more vehicles on the road every day. The air is constantly filled with dust particles from drilling and digging and the loading and dumping of soil moved from one part of the city to another.
As many would argue that this is the best project undertaken to improve the image of the city, again we forget the effects of such a long term project on our environment.

2.3 World City Formation

World city formation is the process by which the global economy has an effect upon cities and transforms their social, economic and physical dimensions. (Friedmann J, Wolff G, 1986) World city formation focuses on the role of commanding and controlling the activities in large urban areas with particular attention to where and what should be in the city. For example, the location of headquarters for transnational corporations, big international institutions, some business-services and educational facilities, are all planned.

In agreement to this statement, Brenner continues to say that as part of the re-territorialisation, implies, in order to be effective in global and regional networks or to be part of the global networks, cities have undergone physical restructuring of their urban patterns. A lot of urban policies are based upon a response to global economic pressure, with the objective to attract capital investments and increase competitiveness in relation to other cities. (Brenner, 1998)

It all comes down to the fact that, if a city such as Prague would like to be one of the top contenders in the race to modernisation, investment, recognition as a world leader, top manufacturer of goods etc. it has to follow some dimensional world guideline, as to what it should have in the city. Otherwise it is nothing more than just a place where a lot of people live. It has to have systems that work and connect it to the rest of the world.

From the end of the 1980s Central and Eastern European countries have undergone major or important political and economic changes, from various forms of socialist systems towards democratic systems. This has played in part to the huge number of growth in real estate construction and modifications.

The region of central and Eastern Europe has gone through tremendous change following the fall of communism in many parts of the region. Czech Republic saw this change slowly start to take effect from the beginning of 1990s. After the velvet revolution of 1989, many people realised just how much potential the Czech Republic had, at a shot of being recognised as a major investment area in Central Europe. The country has emerged as a hub for business and tourism and has thus seen a major influx of people from all over the world settling here in order to do business.

Prague has to compete with other cities in the region such as Warsaw, Budapest, Berlin and Vienna. These cities all strive to be the top contender when it comes to tourism, business and infrastructure.

After the economic crisis of 2007-2008 that slumped major international markets into a whirlwind of chaos and economic depression that was last experienced 30 years ago, Czech Republic quickly picked itself up economically speaking and somehow managed to establish itself as a major trading partner for most industries, and putting Prague in the center of it all. The car manufacturing department being one of the major industries that has helped see the Czech economy stay just a little bit stronger than most central European nations.

The car manufacturing industry has been in the Czech Republic since the late 1800s in the Mlada Boleslav area when Skoda car (Skoda Auto) company was started. And as such, there is a great sense of pride among the Czech citizens when it comes to driving a Skoda vehicle on the road.

Unfortunately the number of vehicles on the road has not decreased over the years but has grown from strength to strength. This has resulted in a need to construct better roads for these vehicles to move on, and the number of particulate matter, mostly from vehicle combustion by-products, that contribute to the negative quality of air and as well noise pollution has somewhat increased.

2.4 Sustainable Development

Prague is developing at a very rapid state. The major concern is of course sustainable development.

Air quality and noise pollution are some of the major issues that cities such as Prague have to deal with, for the price of looking beautiful. Large amounts of traffic on the roads don't help much when it comes to pollution and noise. Prague has an area of 496 square kilometres. It is one of the largest cities in Europe. It has however, like most cities here, very narrow roads. This brings up two problems, firstly, there are too many cars on the road, and second, there is not enough room for the cars. Bearing in mind that there are tram lines as well and tram trains. This however is a problem faced mainly by inner city Prague, where everything happens and where almost every human being wants to be. So the congestion on the roads in some parts of the city is unbearable. The amount of time people spend in traffic jams increases the amount of fuel they burn in their vehicles thereby adding to pollution levels.

As such, many people when deciding where to live in the city, have to take into consideration a number of factors; the noise of the city, the constant disruption due to reconstruction, the amount of money spent on fuel for their vehicles if they decide to live just in the outskirts of Prague and most importantly the price of real estate. Musil observed that residential Prague is slowly declining. Most buildings set aside for apartments are being bought off and sold to make way for commercial use of these buildings. People are forced to buy, sell or rent in the newly built expensive buildings elsewhere in the city as they have no choice but to leave these buildings for commercial purposes. (Jiří Musil in F. E. Ian Hamilton, 2005).Whether Prague is constructing buildings with sustainability in mind remains a question to be answered in the future. The future generations will have to testify to say that the situation they will be facing at that moment will be as a result of the great work done by the current generation, to help build a city that is environmentally friendly.

3. Defining Real Estate

What is real estate? In layman's language, when one thinks of real estate, all that comes to mind is beautiful houses and big mansions of Hollywood.
Real estate is "Land and things attached to it" (Barlowe, 1978). It is clear from this sentence alone that real estate encompasses everything that will be found on a piece of property be it a tree stump or a pond of water, a house and its gardens and anything that can be classified as property.
This definition may be argued by some as being too broad and should not include things that cannot be modified or reconstructed by an owner, as real estate mainly deals with construction.
If we look at infrastructure, we discover that there is a lot more to construction than meets the eye. This part will divide the different categorisations of real estate property that are available.

3.1 Categories of Real Estate

Real estate can further be broken down into different categories when dealing with infrastructure. Classification can be residential or non-residential meaning some buildings are built for human occupation, that is as a home dwelling or reserved for office space, while others are for example factories, bridges, and towers. As real estate is as well the natural resources found on a particular piece of land or property (Floyd C, Allen M, 1987), then we definitely have to include all this in the research to find out to what extent these natural resources are impacted, as a result of construction and or modifications. Also this paper evaluates the environmental impact on the prices of these real estate properties with concerns to pollution.

There are different categories of real estate. These are residential, commercial, special purposes, agriculture and industrial.

3.1.1 Residential property

This is very easy to describe. Residential property is property built with the intention that people will live there and use it as a dwelling place. They are homes for families, large or small. These can be found or located in urban or sub-urban areas. To some extent, may be found in rural areas as well.

These are further classified into other categories such as apartments (in some countries also known as - Block of flats), semi-detached houses, single family housings, mobile home, and cooperatives.

Figure 6 - A mobile home in the United States of America
Source: (Mobile homes for sale, 2012)

Figure 7 - An example of a house in Roztocky U Prahy
Source: (NORDSTAV, 2006)

Figure 8 - A block of flats/apartments in Lenteske Namesti Prague
Source: My own

The majority of young people and young families prefer to live in apartments as this is one the first steps to being independent. They feel liberated to live in a place that is not similar to their childhood home. It gives a sense of ownership to most young persons. Real estate agents try to lure these potential clients with the promise of affordable rentals, environmentally friendly neighbourhoods and good transport systems.

Residential housing is the most constructed type of real estate. The number of people currently residing in urban areas is growing rapidly each year and as mentioned earlier in the chapter, the estimates keep changing, and the need for space grows even higher.

3.1.2 Commercial property

These types of property are used mainly for business purposes. These include spaces set aside for shopping centers or malls, office buildings, may include industrial buildings as they are meant for commercial production activities, and farming land. Though at times some landowners will define the category they want to place their property, especially when it comes to tax payments and tax categorisations for property. So in some cases one might find a farm land classified as residential while in another case it may be classified as a commercial property.

Commercial properties are on demand and many major and international companies are targets of the real estate market dealers as these companies try to expand into foreign markets.

3.1.3 Special Purpose

This may fall under any one of the categories mentioned above but it has a distinct description. This is property that includes religious buildings such as Churches, Mosques, Synagogues etc; it includes as well recreational facilities like swimming pools and athletic fields. Parks and other recreational facilities are considered special purpose estates.

Some classifications go as far as fuel service stations and child care facilities. Though this can be argued that they are commercial property as the owner is running a business, there is a thin line.

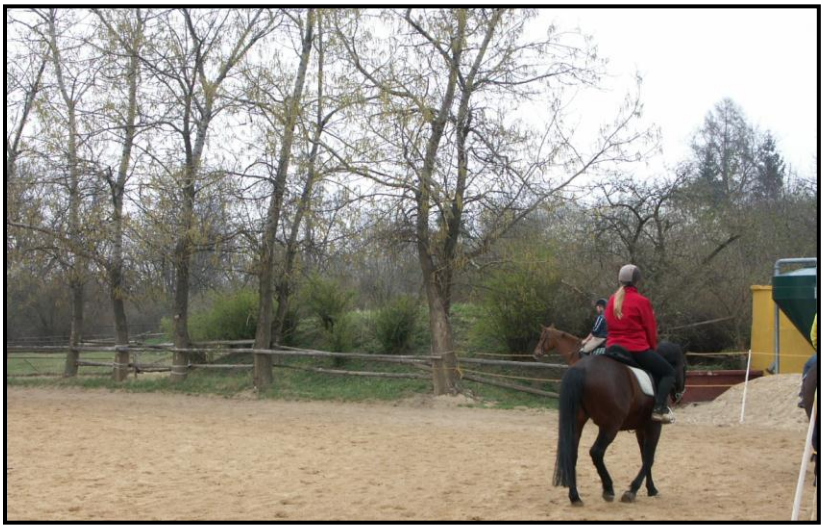
Some government owned estates such as land, are classified as special purpose.

3.1.4 Agricultural Estates

These are specifically reserved for agricultural purposes. This can be storage of crops or growing of crops. They can also be set aside for rearing animals such as cattle, pigs, horses and poultry. Specialised farming areas set aside for a specific crop such as tobacco or coffee and greenhouses for certain of plants, are classified as agricultural estates. Orchards are under agricultural purposes.

Figure 9 - A horse riding school in Suchdol Prague

Source: My own



3.2 A Different point of View

Post socialist cities such as Prague are very keen on losing the identity associated with the past. Most cities in central and Eastern Europe are plagued by the view from the rest of the World that they are still communistic in style and feel. As you walk around the city of Prague, it is noticeable how much the mix of old and new has taken place and how much the new style is slowly taking over, pushing inch by inch and winning the hearts of the people.
Since the fall of communism, Czech Republic has risen from that image with great strength, with Prague slowly shaping up into a modern city mixed with baroque and new age.
The Velvet Revolution of November 1989 marked the beginning of a journey for this small but powerful nation in the Center of Europe. The significance of this historical moment of 1989, marked a change that would come for the economy, political system and also it would revolutionize how systems work in central Europe.

Before 1993, Czechoslovakia was still building itself from the woes of the communist regime. Together as a nation Czech Republic and Slovakia worked and fought for a democratic system. However, many attributes played a part in the peaceful separation of two nations, Czech Republic as we know it now, and Slovakia. Economical differences and infrastructure made it very difficult to continue as one nation. Cultural differences would be a major factor and it played a huge role in this decision. To this day, many Slovaks do not appreciate having to be mistaken as Czech and vice versa. The languages are very similar and the two parties are able to understand each other without translation. However, this remains very clear as to where each of them would like to stand, for instance, labels on food and other products are explained in both languages.

3.2.1 The Communist Era

During the communist era, citizens were living in fear of persecution for very simple acts of freedom like trying to emigrate or buying certain goods or services. Buying and selling property was monitored of course and for some individuals it was not even possible to do so.
People had to be for the government and not against. Anyone who broke the rules was subject to interrogation, house search and sometimes put on a government watch list as a potential threat.
Many individuals, who were highly educated, emigrated leaving big gaps in most needed knowledge, in most needed areas such as hospitals and schools, architecture and art.

Real estate property was owned by the state. Farmers owning large pieces of land were forced to give up this land or join cooperatives. If they disobeyed, their punishment was lack of supplies for their farms or no market for their produce. Most were viewed as enemies. (Maier K in Temlova et al, 2010)

3.2.2 Housing in the Communist Era

From as far back as the 1950s, the construction of housing for inhabitants was done on a uniform scale. As many people might find it hard to believe, the soviet governing system did not come up with the idea of panel block residency. The government, at that time, constructed large numbers of apartment buildings known as Panel blocks.
These were constructed to reduce the shortage of housing after the war and as well to provide some affordable housing to the citizens.

In Prague the first of such buildings was built in an area called Petriny. (Stankova, 1991). These Panel block, known locally as Panelak, have, to this day, a very important role to play in Prague housing system. Many people live in them and the majority have been reconstructed and painted. In most part of the city where the Panel blocks are located, one can see from very far off how beautifully coloured they are. The rainbow design of these buildings was funded by the government to have them look modern and with a happier outlook than a grey colour.

3.2.3 Rent Matters 1990 to 2013

In the 1990s, the government tried to look good in the eyes of the people. They were still trying to win back the faith in their citizens. They did this with real estate's by setting rent control limits for most of the apartments. Most landlords were not able to make renovations on their property as they were receiving very little income from these flats. This also meant that people were living in affordable housing but with dilapidated conditions (Zarecor, 2008) Most Czech home or apartment owners living abroad could only stand with their hands tied behind their backs as they watched how their property went to ruin. Some families lived in such flats where they paid as little as five thousand Czech korunas (5,000kc) per month, while renting out their own nicely done, new apartment or house to someone else for as much as twenty thousand Czech korunas (20,000kc) per month. This went on like this for two decades. These sitting tenants would not spend any of their income to renovate an apartment they lived in, because they did not own it. This is one of the many reasons why after the rent control was lifted in January 2013, an increase in reconstruction and construction permits went sky high. Sitting tenants were forced to either pay the owner a fitting market price rent after renovations or move out.

3.2.4 The number of permits issued

Continuing the debate about historical matters that may have led to decisions and choices made today both by government officials and individuals wanting to sell or buy property in Czech Republic, especially in Prague, we look also at another contributor to the growth of real estate prices.
Getting a permit for anything is always a daunting task. The idea of standing in a queue waiting to be served and then to be turned back once you reach the window that you do not have sufficient or necessary paperwork. Many people would rather pay someone to do this part for them so as to have an ease of mind. Even though this is allowed, this may lead to a number of corrupt cases where individuals with high influence and deep pockets, may receive faster service than the individual who has very little significance, political or business-wise, to receive a simple thing as a permit to modify his bathroom.

The Czech National Statistical Office (CZSO) calculates the number of permits issued for reconstruction or modifications to already existing buildings and new construction of property, almost doubles each year. Each year the office records over 20,000 applications for new infrastructure, and over 13,000 applications for modifications to already existing buildings. In 2013, for the period starting January 2013 to August 2013, on average 409 permits per month where issued for Prague city alone. These are permits for both residential and non-residential properties.

If we say theoretically that 50% of this number is new buildings and the other 50% is reconstruction, then we are looking at a potential 205 new buildings given a go-ahead every month. Multiply this by 12 and you have at least 2,460 thousand new buildings each year, which can be built. The real estate market continues to grow. Some of these buildings of course will be built in Prague city center close to the major metro stops and shopping areas, but of course some will be built in the outskirts of Prague. The difference in location as a significant factor of price will be shown in the data collection and calculation of hedonic pricing later in the chapters.

The **Table 1** below shows the number of permits issued calculated by the Czech National Statistical Office (CZSO)

Period: January - August 2013

Table 1 - Number of building permits: residential and non-residential buildings by region

Source: (úřad, 2014)

území Territory	Počet povolení Number of permits						
	Celkem Total	bytové / Residential			nebytové / Non-residential		
		celkem Total	nová výstavba New construction	změna dokončených staveb Modifications to completed buildings	celkem Total	nová výstavba New construction	změna dokončených staveb Modifications to completed buildings
Česká republika/Czech Republic	33,205	**20,168**	8,150	12,018	**13,037**	4,887	8,150
z toho kraj/region:	-	-	-	-	-	-	-
Hl. m. Praha	**2,864**	**2,009**	**172**	**1,837**	**855**	**96**	**759**
Středočeský	5,550	3,622	1,954	1,668	1,928	808	1,120
Jihočeský	2,580	1,486	624	862	1,094	506	588
Plzeňský	2,102	1,224	544	680	878	395	483
Karlovarský	834	448	168	280	386	117	269
Ústecký	2,166	1,085	374	711	1,081	368	713
Liberecký	1,077	675	361	314	402	181	221
Královéhradecký	1,541	929	388	541	612	233	379
Pardubický	1,557	956	417	539	601	231	370
Vysočina	1,871	1,036	462	574	835	376	459
Jihomoravský	4,121	2,652	1,045	1,607	1,469	667	802
Olomoucký	1,808	1,057	414	643	751	298	453
Zlínský	1,585	943	435	508	642	250	392
Moravskoslezský	3,429	2,046	792	1,254	1,383	341	1,042

3.2.4.1 Explaining the values

The totals are calculated by adding the figures for residential buildings plus the figures for non-residential values. In the case for Prague – the total number of permits issued for residential building construction and modifications was 2,009 thousand, and the total of permits issued for non-residential construction and modification was 855. The total of permits given for Prague city was then 2,864 thousand. The highest value was for the Středočeský region with a total of 5,550 thousand permits.
This is an area just surrounding Prague, consisting of districts such as Kolin, Nymburk, Kladno, Beroun, Kutna Hora, Příbram etc Not too far from Prague, very idea area for people who would prefer to live away from the city center of Prague but close enough to travel by car to work or school.
This large number of permits issued for this area can be interpreted as, Prague has no space anymore, and can we please start to build around it? – more or less.

Figure 10 - Středočeský region surrounding Prague
Source: (kraj, 2008)

3.2.5 The Population Debate

Population numbers for the Czech Republic have been holding steadily at around 10 million inhabitants, since the beginning of the 1980s. There has been however an influx of foreigners as mentioned that have come here to settle and work. Another issue one can debate about is that there is a large amount of labour available for construction, coming from Ukraine, Russia and Romania.

Continuing with the issue of population, Prague is especially a popular hub for foreigners because of businesses, university and work. Each year the number of immigrants increases as there is an influx of people from the Eastern part of Europe mainly Ukraine, Russia, Slovakia and Poland. Almost all have the intention to live and work in Czech Republic and in particular, Prague the capital city.

As of December 2011, the CZSO calculated the number of foreigners living in Czech Republic including asylum seekers, around 434,153. Prague had the highest number of immigrants recorded at 160,783 in thousands. See table 2 below showing the data from the Czech Statistical Office (CZSO)

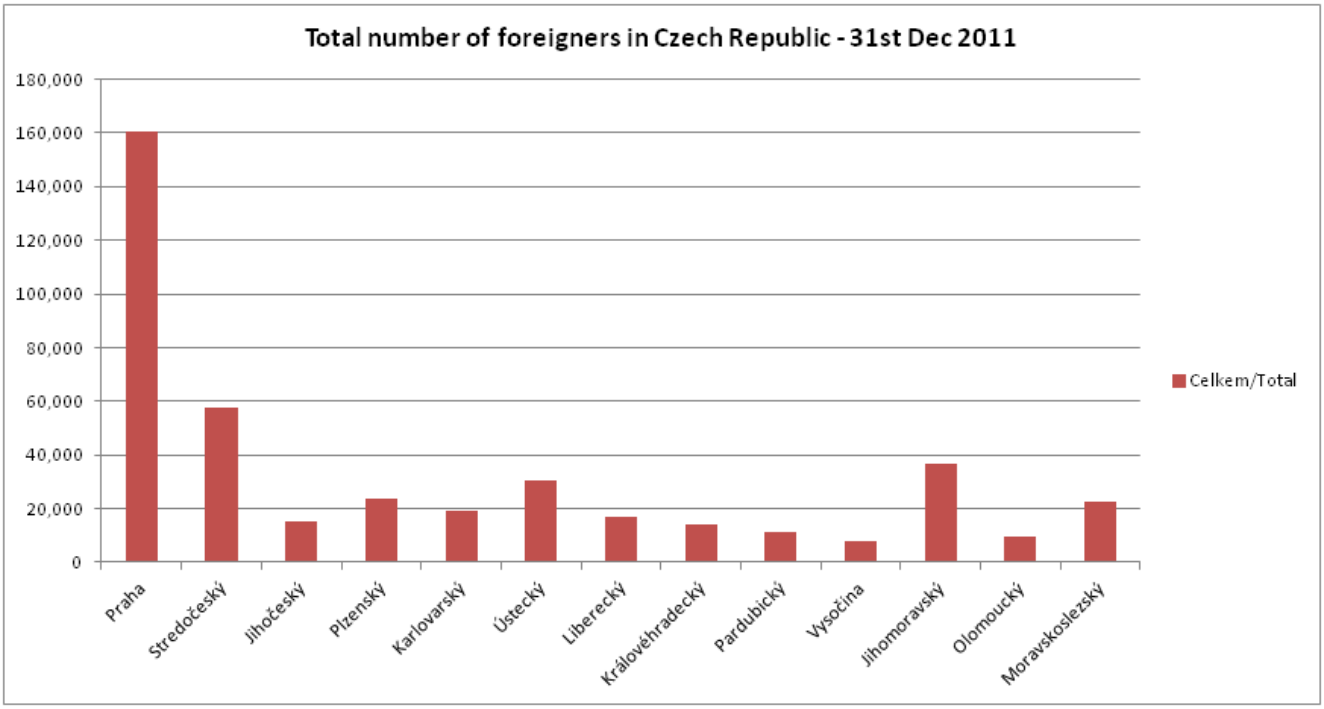
Table 2 - Cizinci v ČR podle kraje, k 31.12.2011
Source: (CR, 2011)

Foreigners: by region 31 December 2011

Pramen: Český statistický úřad

Ředitelství služby cizinecké a pohraniční policie Ministerstva vnitra ČR

Kraj/Region	**Celkem/Totals**
Praha	**160,783**
Stredočeský	**57,522**
Jihočeský	**14,894**
Plzenský	**23,884**
Karlovarský	**19,411**
Ústecký	**30,607**
Liberecký	**16,660**
Královéhradecký	**14,078**
Pardubický	**11,495**
Vysočina	**7,873**
Jihomoravský	**36,386**
Olomoucký	**9,765**
Moravskoslezský	**22,786**
Celkem	**434,153**



Graph 1 - Total number of foreigners in Czech Republic in December 2011
Source: (CR, 2011)

This type of rapid growth determines how people in an area such as Prague, use their environmental assets - land, water and air. It is important to know to what extent and to what levels. These levels can be efficient or can be wasteful. Efficient will mean building with sustainability in mind and wasteful means there will be a large amount of waste and pollution as a result of this growth.
It is important to study the significance of these changes, with regards to the impact it has on the accommodation prices especially in Prague, where the numbers of inhabitants are high and keep going higher.

Prague, as the capital city of Czech Republic, is a city that has progressed a lot further than expected, in its post-socialist period

A lot has changed and continues to change. With the influx of foreigners comes with it foreign trade and many international businesses continue to move their headquarters to Prague for labour.

4. Environmental Pollution

4.1 Air pollution

"Smog alert in Moravia and Silesia

The authorities have called a smog alert in Moravia and Silesia following a severe worsening of air pollution in the regions. The amount of dust particles in the air now exceeds permitted norms several-fold at all monitoring stations in the region, and in the worst affected areas they are five times higher than normal. Children, chronically ill people and senior citizens have been advised to stay indoors. If the situation should worsen further the authorities could ask local companies to scale down production."

(Lazarová, 2014)

This was an announcement on Radio Praha (Český Rozhlas) on the 28th of January 2014
The objective of this part of the research is to explain what air pollution is and what the main sources of air pollution are. Also this part shows the effects on human health and environment
In this first part of the research, focus is given to environmental pollution and some effects of it. This part of the research helps to determine if people are looking at these environmental figures when choosing real estate property.
Most real estate agents will not inform their customers about the quality of air or water in the area. This is left to the individual to discover later on when usually it is too late to reverse the effects.

Air an important part of life; without it we are non-existent it's simple as that. We breathe therefore we are, the alternative is death. Even though we need air, we do not realise how much damage we are causing to our own source of life. We look away because breathing is something we do unconsciously. We do not have to remember to breath. This makes us comfortable and we only realise we are in trouble when our lungs are failing to breathe in clean air. When we sit with a tube up our nostrils in a hospital bed, then we realise how bad things can get.

Air pollution is harmful to human health and the environment with its eco-systems. There have been many studies throughout the years, to show how air pollution affects human health and how it eventually destroys our environment. There are many associated effects of air pollution for example; breathing difficulties in children and the elderly, leading to respiratory diseases such as asthma, smog in the cities, and smoke from old vehicles on the roads, the list can go on. All these things come from many different sources.

Emissions of many harmful air pollutants has decreased over the years but air pollutant concentrations are very high, and therefore problems with air quality are still a major problem. Air pollutants are emitted from a wide range of sources both manmade and natural. Some examples include but are not limited to, agriculture, transportation, waste management and burning of fossil fuels in electricity generation. (CENIA, 2013)

In some areas nature contributes by sending dust particles in the atmosphere blown by the wind and some plants emit certain particulates that are harmful to human health as some people are allergic.

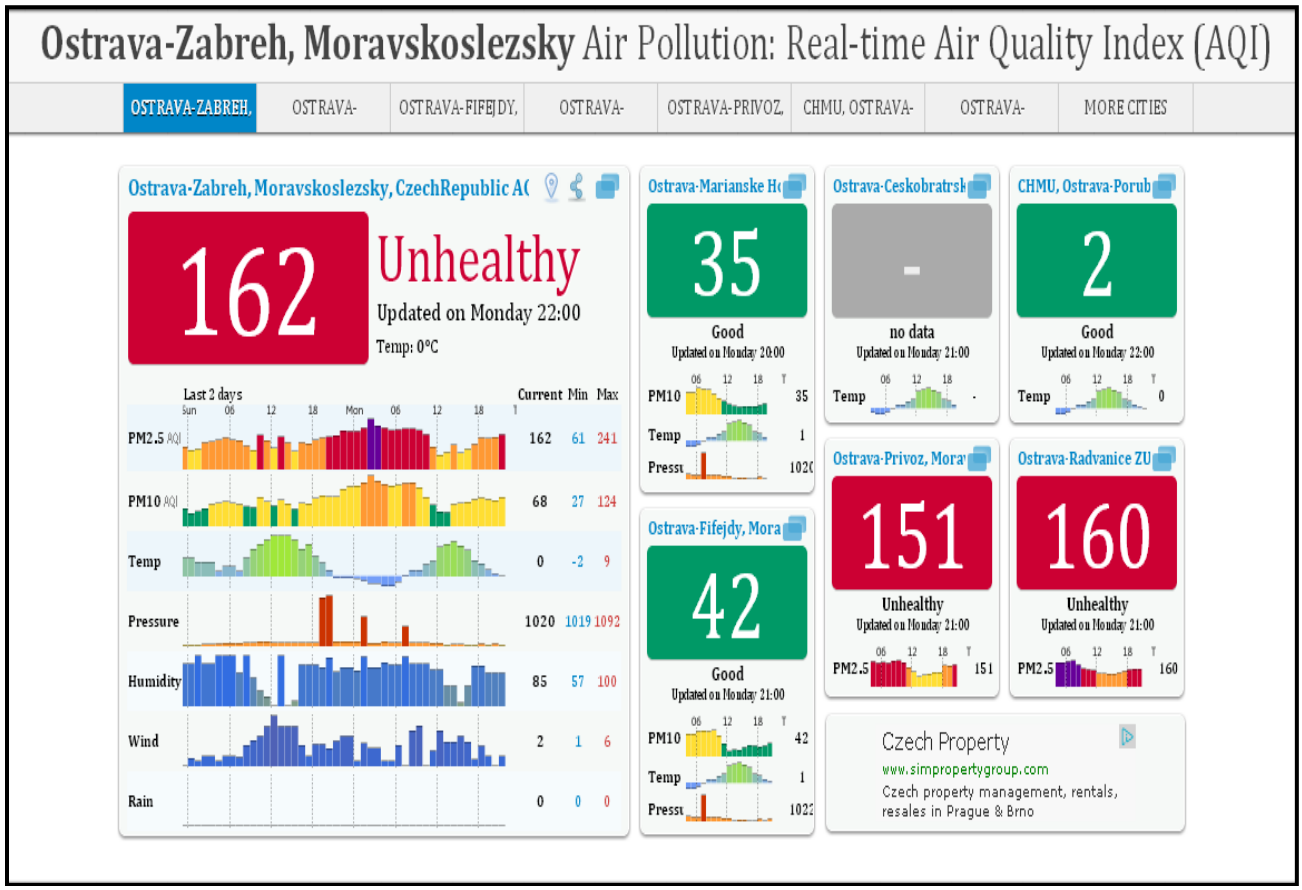
Some of the major air pollutants are Sulphur dioxide (SO2), nitrogen oxides (NOX), particulate matter (PM) and carbon monoxide (CO) to mention but a few. These air pollutants affect the environment each in a different way. Table 1 below shows these 4 air pollutants with their sources and effects on environment and human health. (CENIA, 2013)

Table 3 - Air pollutants and their effects on environment and health
Source: European Environment Agency (EEA) – Air Quality Fact sheet 2013 (CENIA, 2013)

Pollutant	Description and Sources	Health and Environmental Effects
Sulphur dioxide (SO2)	SO2 is formed by oxidation of sulphur (S), mainly through combustion of fuels containing S. The electricity generation sector is the most important source of SO2. SO2 also can contribute to the formation of secondary sulphate particles in the atmosphere	SO2 aggravates asthma and can reduce lung function and inflame the respiratory tract. It can cause headache, general discomfort and anxiety. SO2 contributes to acid deposition, the impacts of which can be significant, causing damage to forests and ecosystems in rivers and lakes.
Nitrogen oxides (NOX)	NOx is emitted during fuel combustion e.g. from industrial facilities and the road transport sector. NOx is a group of gases comprising nitrogen monoxide (NO) and nitrogen dioxide (NO2). NO makes up the majority of NOx emissions. NOx contributes to the formation of ozone and particulate matter.	NO2 is associated with adverse effects on health: it can affect the liver, lung, spleen and blood. It can also aggravate lung diseases leading to respiratory symptoms and increased susceptibility to respiratory infection. As with SO2, NOx contributes to acid deposition but also to eutrophication of soil and water.
Particulate matter (PM)	PM is a mixture of aerosol particles (solid and liquid) covering a wide range of sizes and chemical compositions. PM10 (PM2.5) refers to particles with a diameter of 10 (2.5) micrometres or less. PM is either directly emitted as primary particles or it forms in the atmosphere from emissions of SO2, NOx, NH3 and NMVOCs. PM is emitted from many anthropogenic sources, including both combustion and non-combustion sources. Important natural sources of PM are sea salt and natural re-suspended dust.	PM can cause or aggravate cardiovascular and lung diseases, heart attacks and arrhythmias. It can also affect the central nervous system and the reproductive system, and can cause cancer. One outcome of exposure to PM can be premature death. PM also acts as a greenhouse gas, mainly cooling the earth's climate, although in some cases it can lead to warming. PM in the atmosphere can also alter rainfall patterns, and affect the surface albedo properties of snow (the extent to which the snow reflects light).
Carbon monoxide (CO)	CO is emitted due to incomplete combustion. Important sources of CO include road transport, businesses, households, and industry. CO reacts with other pollutants producing ground-level ozone	CO can lead to heart disease and damage to the nervous system. It can also cause headache, dizziness and fatigue

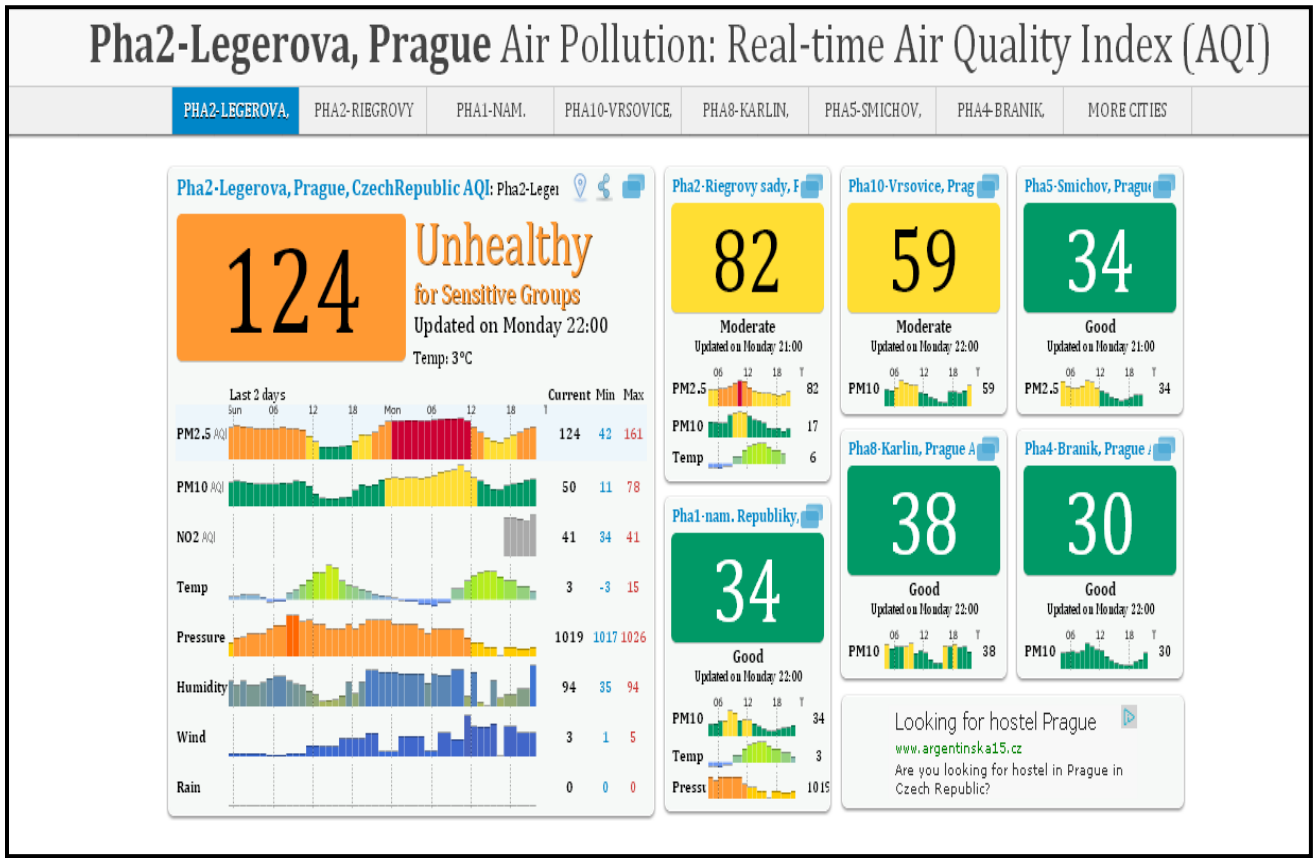
As can be seen from Table 4 - these pollutants are not only harmful to the environment but to human health as well with some causing very dangerous diseases that affect people on a long term basis.
Areas in Prague seem to be of a mixed nature. Some parts are in the extremely unhealthy levels while others are in very good to very healthy levels. The tables below are of actual air quality figures.
These air quality figures shown below are from the ČHMÚ – Český Hydrometeorologický Ústav (Czech Hydrometerological Station)
Air quality figures shown are from Prague and some areas in Ostrava city respectively.

Figure 11 - Air quality in Ostrava-Zabreh as of Monday 24th February 2014
Source: http://aqicn.org/city/czechrepublic/moravskoslezsky/ostrava-zabreh/



Compared to Prague below, the figures shown for Prague 2 Legerova area are very high. Showing the result unhealthy for sensitive groups

Figure 12 - Air quality in Prague 2 - Legerova as of Monday 24th February 2014
Source: http://aqicn.org/city/czechrepublic/prague/pha2-legerova/



These values are at an alarming level. Some parts of the city are in good to low levels while some are very high.

4.2 Noise Pollution

There are many factors to consider when dealing with noise pollution. As well there are different cases of what is considered noise and what levels are measured as beyond permissible limits. There are more and more vehicles on the road each day and the transportation system is a major part of our daily lives. It is impossible to stop all traffic movement as people would not get anywhere in time. It can however be controlled to some extent. With the construction of the major highways and links in Prague, comes with it the debate about noise pollution.

Across Europe and Czech Republic included, the major source of noise pollution comes from transport. This includes air traffic and railways. Many people are exposed to noise levels beyond the acceptable limits. This can have many side effects especially in young children, sensitive people and the elderly. The World Health Organisation (WHO) defines health as a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity (WHO, 2009).This statement in relation to noise pollution can be loosely interpreted as if a person lacks such a simple thing as peaceful sleep, their mental and physical capabilities might become challenged.

In 2010, there were plans by the health ministry to raise the legal noise-level limits for Prague. This was done to allow for more construction of shopping malls and connecting roads.
The legal noise levels in the Czech Republic permit 60 decibels (dB) during the day and 50 dB at night. The proposed change by the health ministry was to increase these levels by 5 dB. (Inspectorate, 2012)
The world health organisation estimates that a safe night time noise level in a residential area is at 40 dB. (WHO, 2009)
A lot of people living and working in Prague are exposed to noise levels above the permitted limit. These can be even higher than 55 decibels. Most have become accustomed to it that they do not realise how noisy an area is until they go further in the outskirts of Prague city.
According to the National Reference Laboratory for Noise Measurement and Assessment in Municipal Environment, in Prague city alone, 14 hospitals and 36 elementary schools are exposed to excessive noise levels of over 60 decibels during the day and over 40 decibels during the night. This is mostly contributed by traffic.

5. Data Analysis and Observations

For the purposes of this qualitative research, data was collected for the housing prices for Prague 6 area for the period December 2013 to February 2014. There are 40 observations in total with half of the observations (20) for Prague 6 and the other half (20) of observations for Prague 10. And again for the purpose of this research, Prague 6 was chosen as area of study because of its close proximity to the construction on the tunnel Blanka, and see if housing prices in this area are affected in part by the fact that this will be a center and highlight of transportation movement in the coming years. Also the air pollution levels even though not always shown to customers by real estate agents, are checked to see if this can as well be a factor to consider when buying property. Prague 10 was the second area chosen for the research because it's an area much further away from the city center and pollution figures for this area are as well very different in comparison to Prague 6 area, and therefore as mentioned, this too is not discussed with many a client, when it comes to buying or selling property.

Some actual air quality table figures for Prague 6 – Valeslavin and Suchdol areas and also some data figures for Prague 10 – Vrešévice and Prumyslova from ČHMÚ – Český Hydrometeorologický Ústav (Czech Hydrometerological Station) are in Appendix below. The large data tables for housing units and their features are in Appendix. The tables with the housing information, were created using Microsoft (MS) excel 2007, and the function graphs are as well created using MS excel 2007

5.1 Analysis

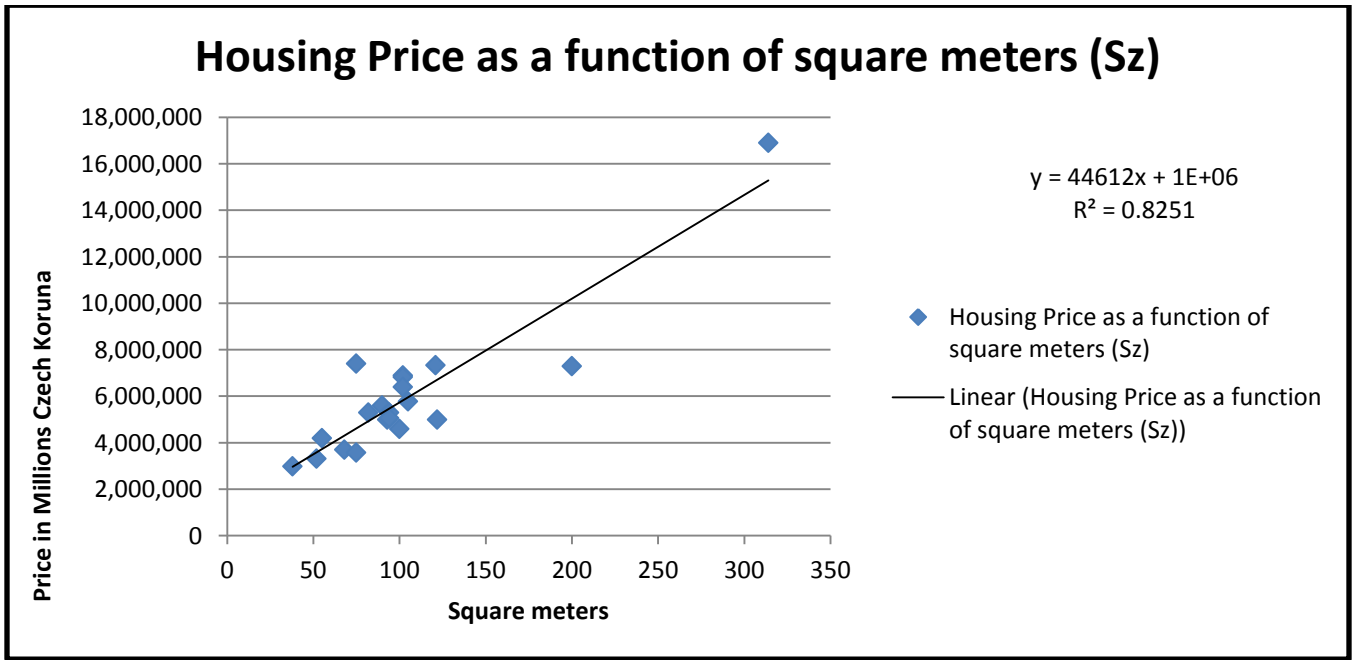
The results of the regression analysis correlation, (see table 15 in Appendix), show that there is a significant relation of price with the increase in size of housing units. The R-squared shows an 86% positive relation of our variables but this does not mean that all of these variables are significant to the dependent variable Price (P). The model is significant as the F value is high and positive.

The P-value for our size in square meters is very significant at less than 0.025 meaning it has a 95% significance that with every increase in size, there will be an increase in price. In the data, we see a value of thirty nine thousand, four hundred and ninety four (39,494) Czech korunas for every 1 square meter increase. This is a significant trend for the housing prices. The other variables are all insignificant in that they do not influence the changes in price of the housing units. These are individually analysed below to show their independent r-squares, which determines if there is a week dependency or a strong dependency on them for changes in price (P). Firstly the significant variable is tested and shown.

The first table is showing a compilation of housing prices and square meters (Size = Sz) and the graph below is showing a simple linear regression of price as a function of size (Sz) in square meters. The question to ask here is 'do people pay more for a larger sized apartment?'

Table 4 - Price as a function of Size (Sz) - Prague 6

Price	Square meters
3,699,999	68
7,289,520	200
7,339,500	121
16,900,000	314
4,590,000	100
6,890,000	102
5,600,000	90
5,299,000	82
6,830,000	102
4,990,000	93
3,570,000	75
5,780,000	105
4,200,000	55
5,300,000	94
2,980,000	38
4,990,000	122
3,320,000	52
5,068,000	94
6,398,000	102
7,404,500	75



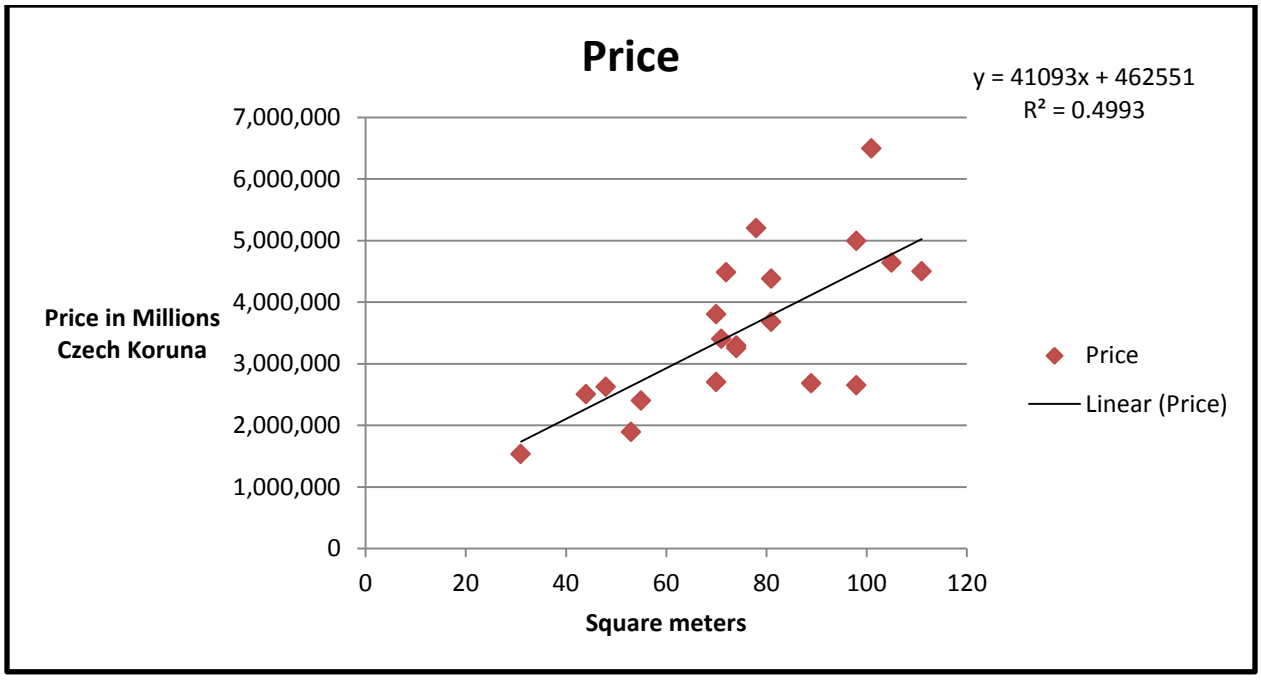
Graph 2 - Relation of square meters (size = Sz) to price in millions – Prague 6

Graph 2 above shows an R-squared (R^2) of 82.5 percent. This indicates a very strong positive dependency relation between the size of the apartment in Prague 6 and the high price for the apartment. As it shows, the apartment with the highest price of just over 16 million Czech korunas has a size of more than 300 square meters. There is 82% significance in change in size of the apartment, with change in price. With every increase in size, there will be a likelihood of a price increase in 82% of the cases.

We shall now compare the prices and size (Sz) for Prague 10, using Price as our dependent variable and square meters as an independent variable as before.

Table 5 - Price as a function of Size (Sz) - Prague 10

Price	Square meters
2,620,589	48
5,200,000	78
2,680,000	89
2,500,000	44
4,495,000	111
1,530,000	31
2,700,000	70
3,800,000	70
2,400,000	55
4,990,000	98
4,480,000	72
3,290,000	74
1,890,000	53
3,675,000	81
3,399,000	71
4,380,000	81
4,635,000	105
2,650,000	98
3,250,000	74
6,490,000	101



Graph 3 - Relation of square meters (Sz) to price in millions – Prague 10

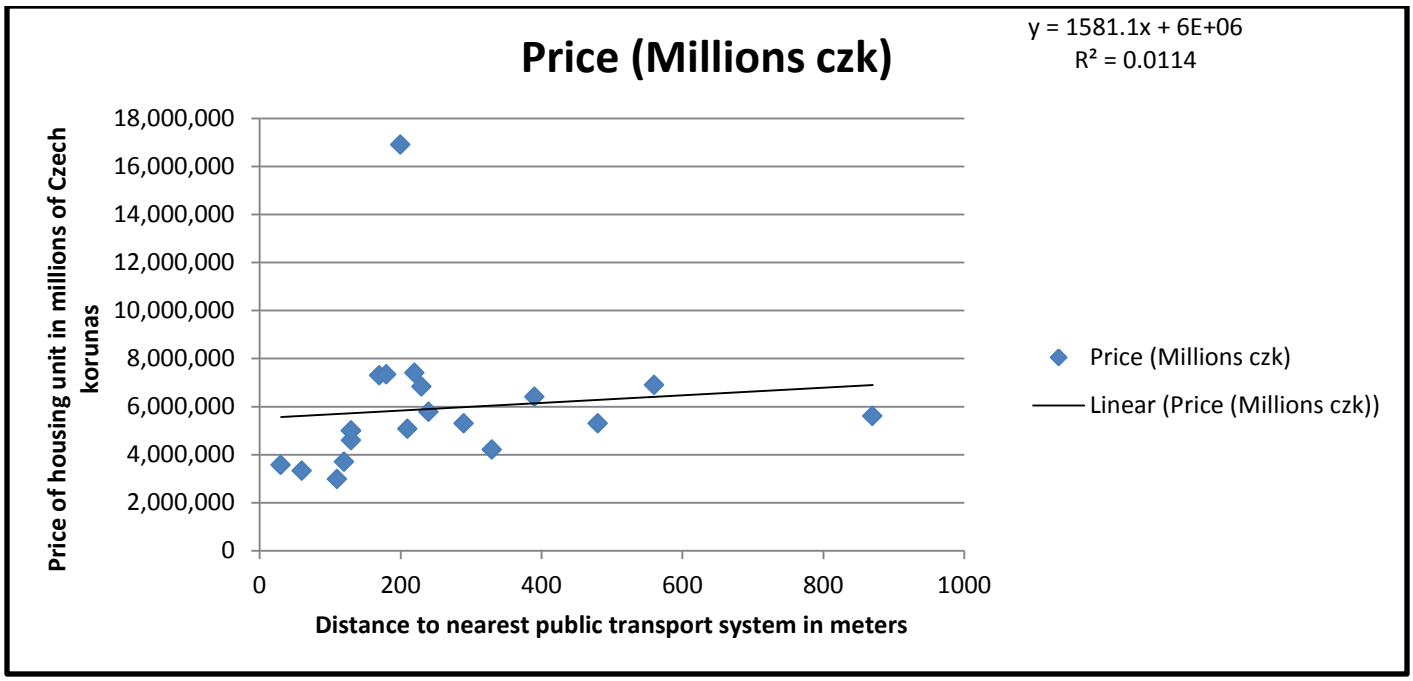
In Prague 10 however, we see quite a different story. The R-squared in graph 4 above is at 49.9%. This indicates a medium to strong dependency on size as factor of price change. The graph clearly shows some apartments lying in the range of prices between 4 million Czech korunas and 5 million Czech korunas, having a larger size in square meters compared to the apartment costing 7 million Czech korunas. We can also determine that the size of the apartment is a reliable variable to predict housing price trends.

The size alone cannot be the only factor taken into consideration, to determine the potential hedonic price changes. The research also takes a look at distance to the nearest public transportation system, to see if this is another significant variable that determines if people are willing to buy an apartment in an area in question.

Using the values from the data collected for Prague areas 6 and 10 respectively, the graphs will be plotted similarly to the graphs plotted above. As before, first Prague 6 is plotted and graphed then Prague 10 table and graph.

Table 6 - Price as a function of distance to nearest public transport system (DTs) – Prague 6

Price (Millions czk)	Distance to transport system (meters)
3,699,999	120
7,289,520	170
7,339,500	180
16,900,000	200
4,590,000	130
6,890,000	560
5,600,000	870
5,299,000	480
6,830,000	230
4,990,000	130
3,570,000	30
5,780,000	240
4,200,000	330
5,300,000	290
2,980,000	110
4,990,000	130
3,320,000	60
5,068,000	210
6,398,000	390
7,404,500	220

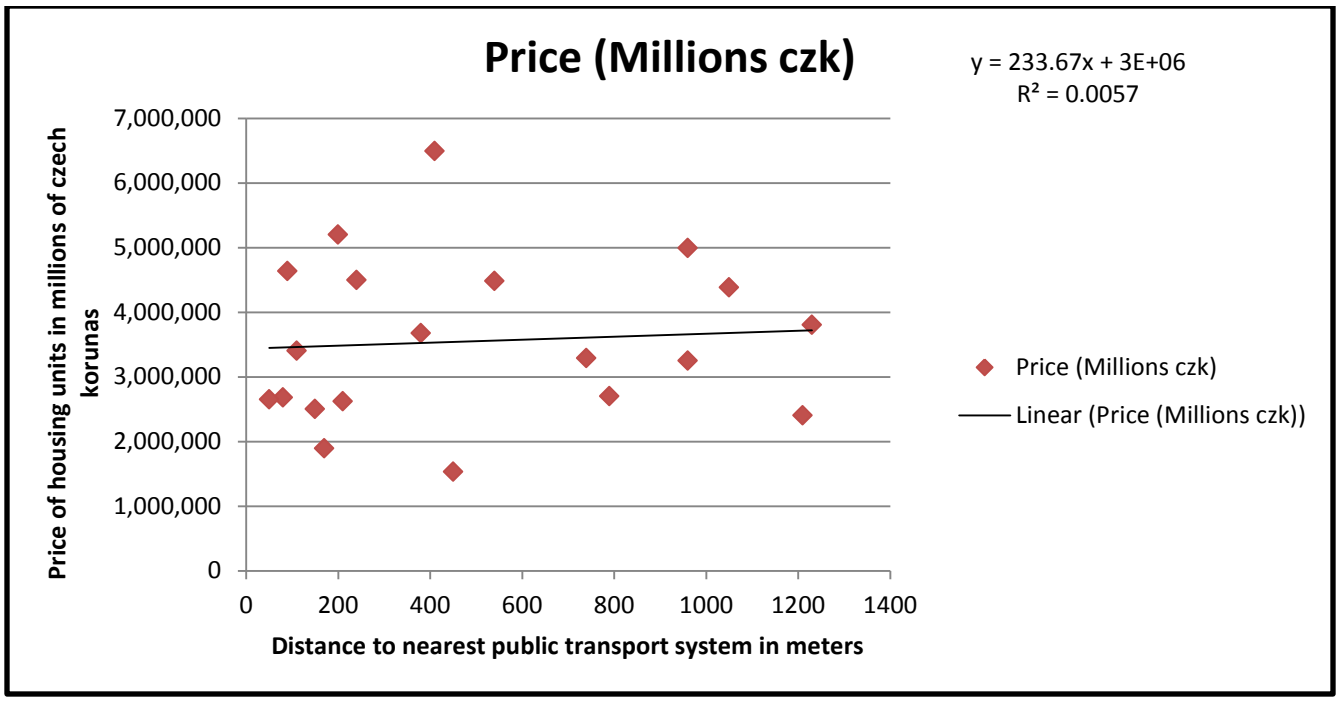


Graph 4 - Relation of distance to nearest public transport system (DTs) to price in millions – Prague 6

Interpreting the graph above, it is clear from the R^2 that the distance to a transport network is not at all a significant variable, in relation to the price of the apartment. R-Squared of 0.011% is an indicator that individuals would pay for an apartment that is nearly 1000 meters away from the nearest public transport system, of up to 6 million Czech korunas. There is a low dependency on transport distance in relation to housing prices. We can also determine that using distance to nearest transport system is not a reliable variable in predicting housing prices forecast.

Table 7- Price as a function of distance to nearest public transport system (DTs) – Prague 10

Price (Millions czk)	Distance to transport system (meters)
2,620,589	210
5,200,000	200
2,680,000	80
2,500,000	150
4,495,000	240
1,530,000	450
2,700,000	790
3,800,000	1230
2,400,000	1210
4,990,000	960
4,480,000	540
3,290,000	740
1,890,000	170
3,675,000	380
3,399,000	110
4,380,000	1050
4,635,000	90
2,650,000	50
3,250,000	960
6,490,000	410



Graph 5 - Relation of distance to nearest public transport system (DTs) to price in millions – Prague 10

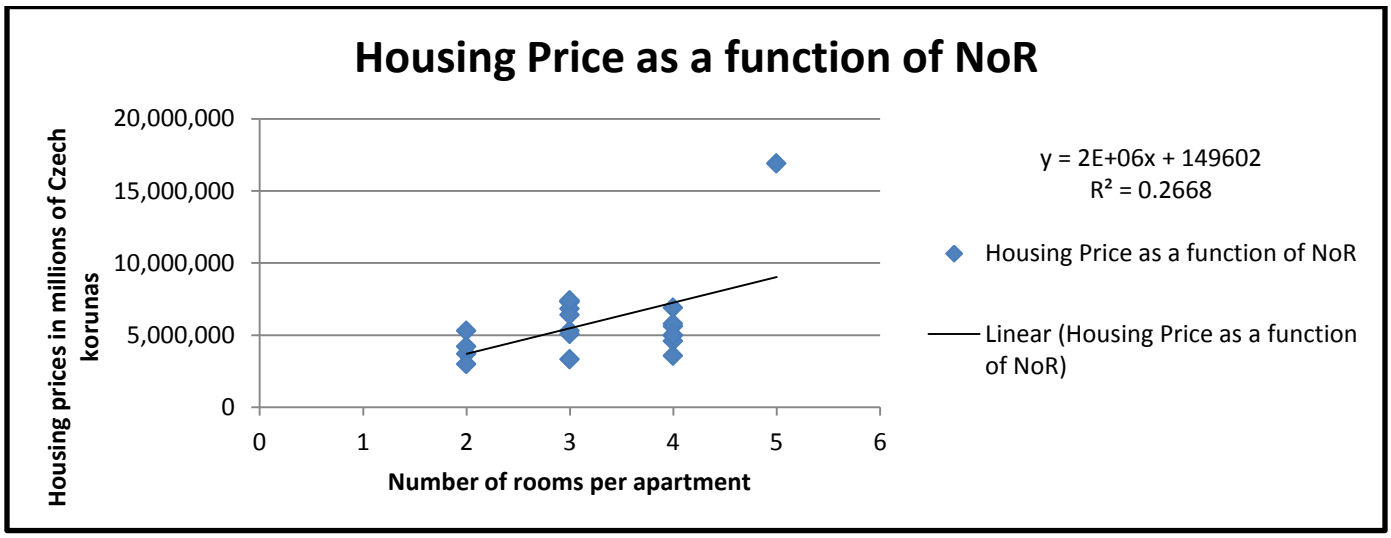
Clearly the distance is not a significant variable in willingness to pay for an apartment. The R-squared is very, very low and not closer to hundred (or 1 - regarding the scale given earlier) as one would expect, but it is 0.0057%. Therefore, people would not mind to live in an area that is further away from a public transportation system, no matter the price of the housing unit. There is a low dependency on transport distance in relation to price.

Other variables calculated but not shown in graph or tabula form both for Prague 6 and Prague 10 areas respectively where;

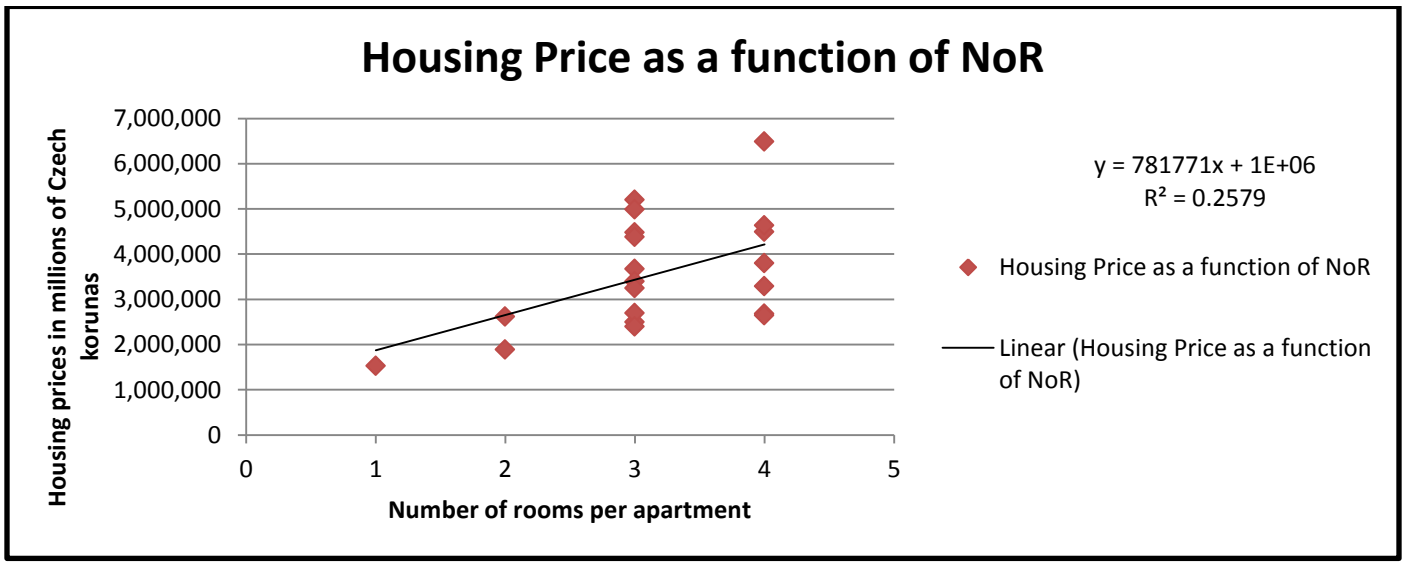
Number of rooms (NoR), features (NBE), and level/ floor (Lev) where apartment is situated. Under features, the data collected was whether the flat was newly built (N), had a balcony (B) and if it had elevator access (E)

5.2 Observations

From the data, it was discovered that in Prague 6 area, with an R-squared of 0.2668, there is 26.6% low significance in dependency in relation to room numbers. People are willing to pay for an apartment regardless of how many rooms it may have. Similar results were calculated for Prague 10 area with an R-squared of 0.2579. There was a 25.7% weak dependency on room number.



Graph 6 - housing prices as a function of number of rooms (NoR) – Prague 6



Graph 7 - housing prices as a function of number of rooms (NoR) – Prague 10

A similar case is recorded in the level/floor where the apartment is situated. This is also one feature that most people are less concerned with, when picking an apartment. In the data collected, Prague 6 had an R-squared of 0.0873 or 8% weak dependency on this feature. Though it was discovered that even though the apartments where picked randomly, most of them where located either on the 3rd floor or 1st floor. Prague 10 had a 0.0791 R-squared recorded or a 7% weak dependency on this feature. Though it had a scatter of apartments situated on almost all levels collected that is between 0 and 8 floors. The other feature that was compared was whether the apartment was newly built or not. Prague 6 area had an R-squared of 0.22 or 22% weak dependency. This was even lower in Prague 10 results at 0.0942 or 9% weak dependency. Floor/ level and newly built or not features, can be ruled out as reliable sources of information when looking at the hedonic pricing method as these two features do not affect the price of the housing units.

It seems that people would pay for an apartment considering only size and location. They are not interested in how long it takes them to get to work or if their apartment has a balcony or elevator or indeed on what levels they are situated on. From the data collected, size of the apartment has a lot more influence on how much a housing unit will cost. If people took into account the levels of noise and air pollution in these areas, they would maybe reconsider the cost of their health.

6. Conclusion

This research dealt with analysis of external amenities and how they affect the prices of housing units in Prague. Prague as a capital city located in a country with a very strong and growing economic market has the burden of having to cater for different groups of people. Low and high income individuals, foreign and native, young and old etcetera all expect something different when it comes to prices of almost anything.

There could be many factors that would influence peoples' choices when it comes to buying property such as income or status quo. Some people would prefer to live in certain areas because of familiarity or social needs. All these factors can and might affect these choices.

The methodological part of the research shows the external attributes that contribute to the prices of real estate in Prague. They are some of the most commonly used environmental externalities by almost every real estate agent to classify and rate a housing unit.

Using hedonic pricing method to determine if these attributes are significant or otherwise not significant, has shown that very few external amenities contribute to the changes in prices. However, the lack of real estate agents in providing pollution levels of the areas, limits the amenities to only those that can be physically seen, such as building quality and available resources. Marketing firms and real estate agents are not ready to provide crucial information regarding noise and air pollution in the areas that they operate in. Therefore, results could be different if these two environmental amenities are taken into consideration.

The theoretical part of this research was essential to describe some historical points and some documented influences of changes that may occur when dealing with large cities in a developed environment. There could be many resolutions to some extent that can help improve the environment and as well encourage sustainable development. In future, housing prices should not only be based on size. This should be based more on how well one would be able to sleep in their apartment from an environmental perspective, a utopia.

I consider my research successful as it accomplished all the goals.

Bibliography

Books and Reports Resources

Knox P, Taylor P. (1995). *World Cities in a World-System.* Cambridge: Cambridge University Press.

Andrea Baranzini, José Ramirez. (2008). *Hedonic Methods in Housing Markets: Pricing Environmental Amenities and Segregation.* New York: Springer science + Business media.

Barlowe, R. (1978). *Land resource economics: the economics of real estate - 3rd Edition.* Carlifornia: University of California Press.

Brenner, N. (1998). *Globalisation as Reterritorialisation: The Re-scaling of Urban Governance in the European Union.* Chicago: University of Chicago Department of Political Science.

CENIA. (2013). *Air Quality Fact Sheet - Czech Republic.* Copenhagen: European Environemental Agency.

Council, E. a. (1998). *Report of the Committee for Development Policy.* New York: United Nations.

CR, M. o. (2011). *Foreigners: by region 31 December 2011.* Prague: Czech Statistical Office.

Denslow J, Padoch C. (1998). *People of the Tropical Rain Forest.* California: University of California Press.

Floyd C, Allen M. (1987). *Real Estate Principles.* Chicago: Dearborn Real Estate Education.

Friedmann J, Wolff G. (1986). *World city formation:an agenda for research and action.* Berkeley and Los Angeles: University of California Press.

Geddes, P. (1915). *Cities in Evolution.* London: Williams and Norgate.

Ikemoto, S. (2007). *Globalization and Japanese Investment in the Czech Republic.* Tokyo: Nihon University.

Jiří Musil in F. E. Ian Hamilton, K. D. (2005). *Transformation of Cities in Central and Eastern Europe: Towards Globalization.* New York: United Nations University Press.

Lee R, Daly H R. (1999). *The Cambridge Encyclopedia of Hunters and Gatherers.* Cambridge: Cambridge University Press.

Lo and Yeung. (1998). *Globalization and the World of Large Cities.* Tokyo: United Nations University Press.

Maier K in Temlova et al. (2010). *Housing Estates in the Czech Republic after Socialism: Various Trajectories and Inner Differentiation.* Prague: Urban Studies Journal Limited.

Stankova, J. (1991). *Prague: Eleven Centuries of Architecture.* Prague: Tiskarske Zavody.

úřad, Č. s. (2014). *Number of building permits - residential and non-residential buildings by region.* Prague: Český statistický úřad.

WHO. (2009). *Night Noise Guidlines for Europe.* Copenhagen: WHO Regional Office for Europe.

Zarecor, K. E. (2008). *The Rainbow Edges:The Legacy of Communist Mass Housing and the Colorful Future of Czech Cities.* Iowa: Department of Architecture, Iowa State University.

Web Resources

Středočeský kraj. (2008). Online. Retrieved February 5, 2014, from http://www.kr-stredocesky.cz/portal/stredocesky-kraj

Air Pollution: Real-time Air Quality Index. (2014, March). Retrieved March 2, 2014, from http://aqicn.org/city/czechrepublic/moravskoslezsky/ostrava-zabreh/

Air Pollution: Real-time Air Quality Index. (2014, March). Retrieved February 24, 2014, from http://aqicn.org/city/czechrepublic/prague/pha2-legerova/

Inspectorate, C. E. (2012, July). Online. The Czech Environmental Inspectorate (CEI) Retrieved December 2013, from the Czech Environmental Inspectorate (CEI) http://www.cizp.cz/lang/l=1

Lazarová, D. (2014). Radio Praha. Online. Retrieved January 28, 2014, http://www.radio.cz/en/news

Mobile homes for sale. (2012). Online. Retrieved Febuary 5, 2014, from http://www.mhbo.com/mobile-home/149008-955-co-rd-437-cullman-al-35055-double-wide

NORDSTAV. (2006). Stavební firma NORDSTAV. Retrieved February 5, 2014, from http://www.nordstav.cz/rodinne-domy-na-klic/ukazkove-domy/roztoky-u-prahy/

spol, S. (2006). Tunelovy Komplex Blanka. Retrieved February 7, 2014, from http://www.tunelblanka.cz

Sreality Prodej byty. (1996 - 2014, July). Retrieved March 4, 2014, from Sreality: http://www.sreality.cz/detail/prodej/byt

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Appendix

Figure 13 - Air quality in Prague 6 - Veleslavin as of Sunday 2nd March 2014
(Air Pollution: Real-time Air Quality Index, 2014)

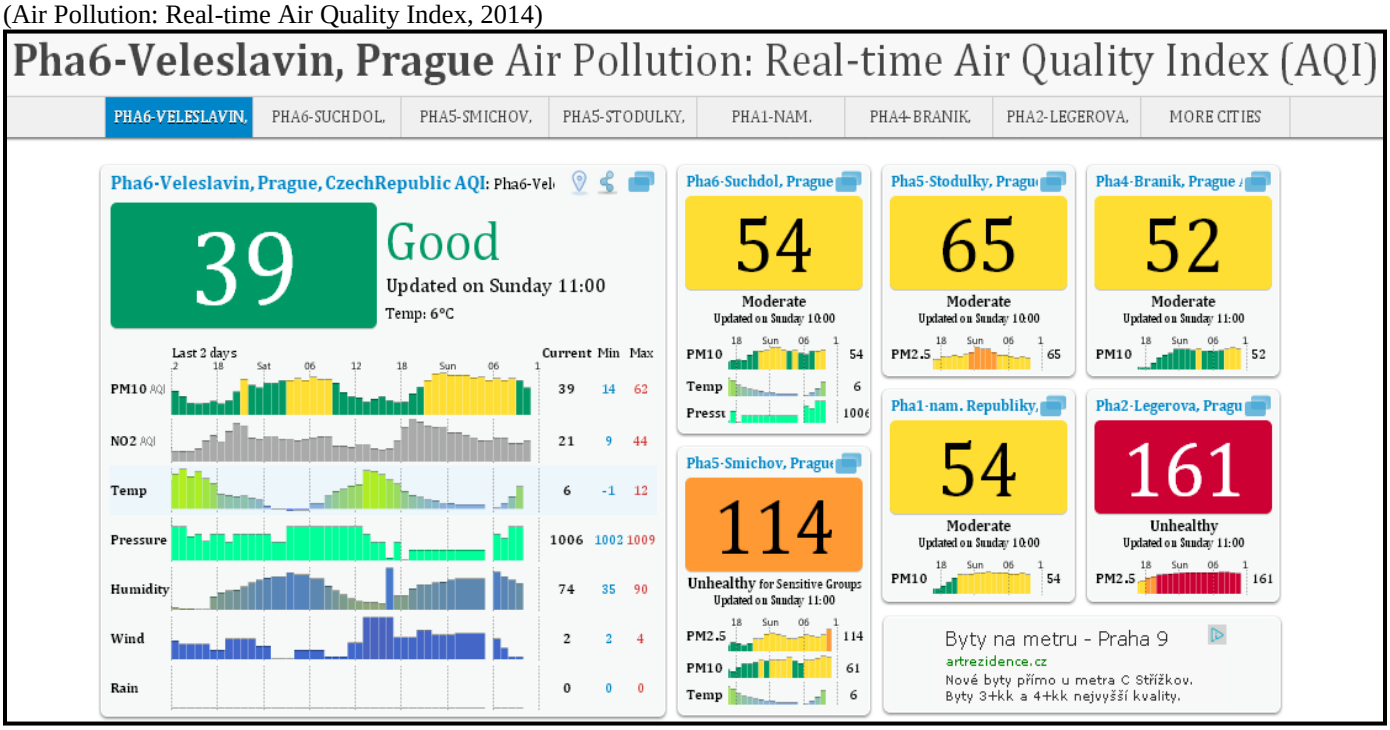


Figure 14 - Air quality in Prague 6 - Suchdol as of Sunday 2nd March 2014
(Air Pollution: Real-time Air Quality Index, 2014)

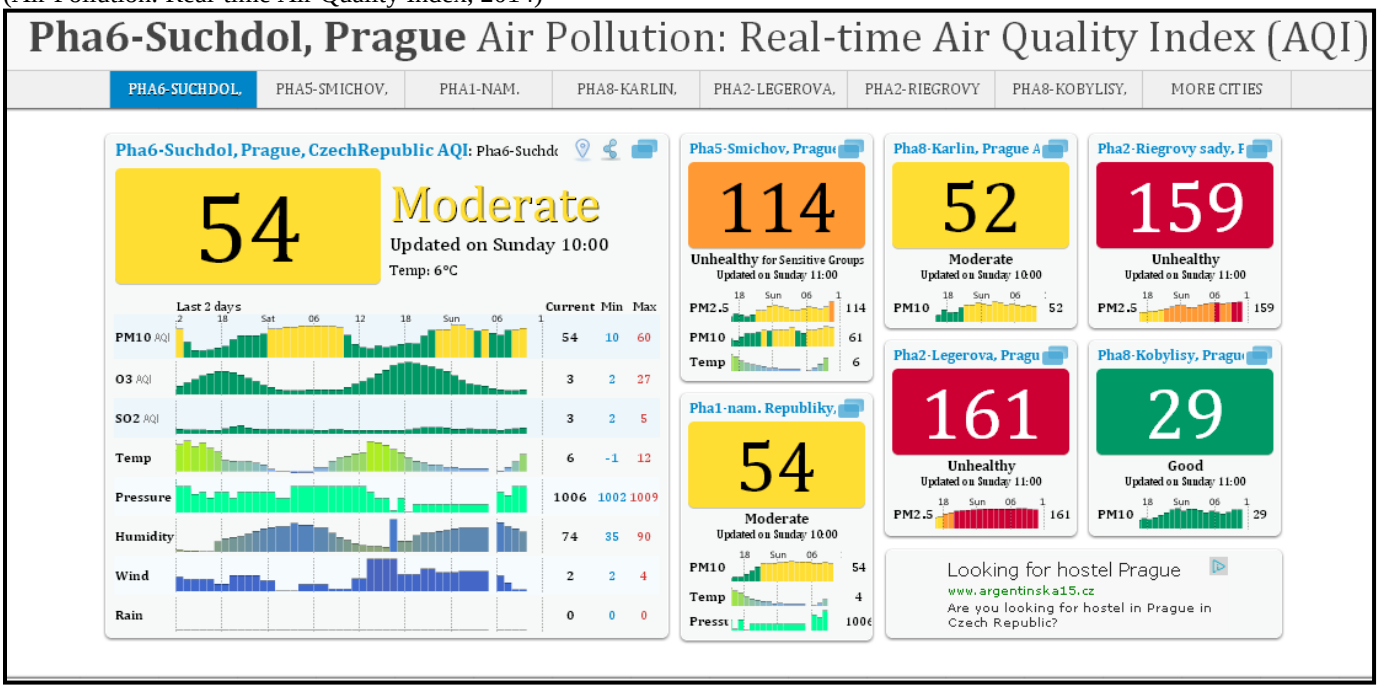


Figure 15 - Air quality in Prague 10 - Vrsovice as of Sunday 2nd March 2014
(Air Pollution: Real-time Air Quality Index, 2014)

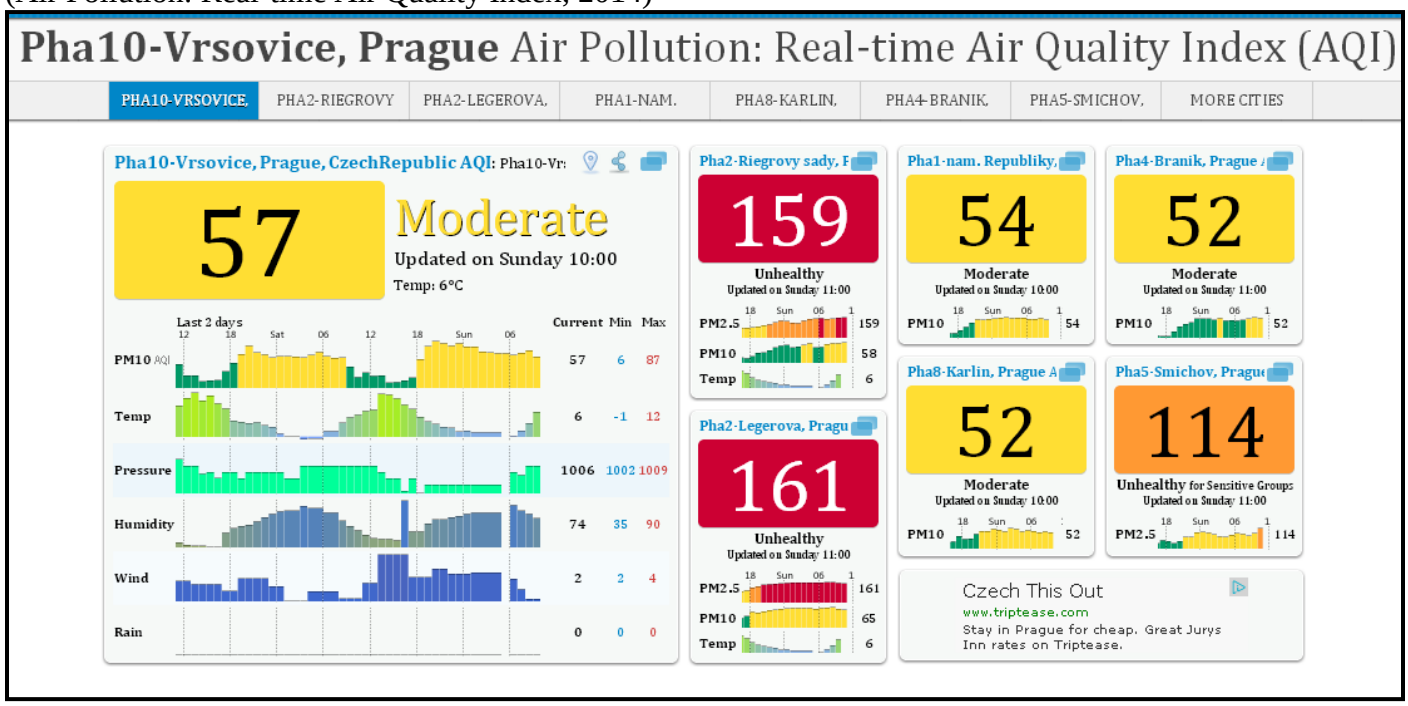
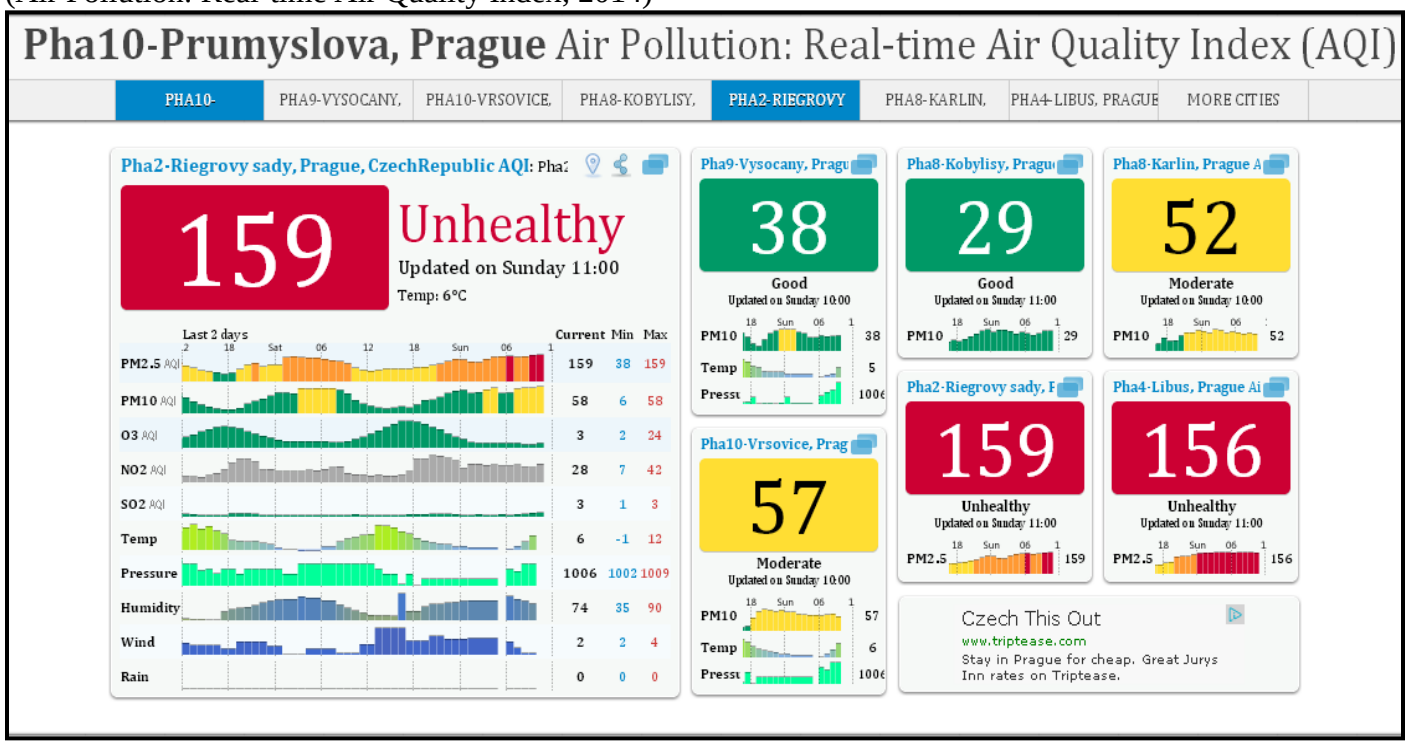


Figure 16 - Air quality in Prague 10 - Prumyslova as of Sunday 2nd March 2014
(Air Pollution: Real-time Air Quality Index, 2014)



Presented here is data collected for the housing units.

Table 8 - Prague 6 housing features
Source: (Sreality Prodej byty, 1996 - 2014)

Price	Square meters	Number of rooms	Level /Floor	Newly built	Distance to transport system (meters)	Distance to recreational facilities (meters)	Balcony	Location
3,699,999	68	2	1	1	120	1140	1	Prague 6, Suchdol
7,289,520	200	3	2	1	170	350	1	Prague 6, Dejvice
7,339,500	121	3	3	1	180	230	1	Prague 6, Dejvice
16,900,000	314	5	6	1	200	150	1	Prague 6, Břevnov
4,590,000	100	4	3	0	130	520	0	Prague 6, Podbaba
6,890,000	102	4	4	0	560	1130	1	Prague 6, Bubeneč
5,600,000	90	4	3	0	870	330	0	Prague 6, Střešovice
5,299,000	82	2	1	0	480	160	0	Prague 6, Podbaba
6,830,000	102	3	2	1	230	290	1	Prague 6, Hradčanská
4,990,000	93	4	1	0	130	160	1	Prague 6, Podbaba
3,570,000	75	4	1	0	30	1080	0	Prague 6, Bubeneč
5,780,000	105	4	1	1	240	290	1	Prague 6, Břevnov
4,200,000	55	2	5	0	330	820	0	Prague 6, Vítězne Namestí
5,300,000	94	3	1	0	290	660	1	Prague 6, Bubenec
2,980,000	38	2	3	0	110	620	1	Prague 6 Suchdol
4,990,000	122	4	2	1	130	160	1	Praha 6 Suchdol
3,320,000	52	3	7	0	60	950	0	Prague 6 Sidliste Petrin
5,068,000	94	3	2	0	210	210	0	Prague 6 Stresovice
6,398,000	102	3	1	1	390	540	1	Prague 6 Bubenec
7,404,500	75	3	1	1	220	580	1	Prague 6 Brevnov

Key:

Price - in millions of Czech Koruna (czk) /**Newly Built** 1 = Yes, 0 = No

Balcony 1 = Yes, 0 = No

The data was collected for the housing prices for Prague 10 area for the period December 2013 to February 2014.

Table 9 - Prague 10 housing features

Source: sreality.cz

Price	Square meters	Number of rooms	Level /Floor	Newly built	Distance to transport system (meters)	Distance to recreational facilities (meters)	Balcony	Location
2,620,589	48	2	6	1	210	800	1	Prague 10 Horní Měcholupy
5,200,000	78	3	1	1	200	400	1	Prague 10 Michle
2,680,000	89	4	7	0	80	250	0	P rague 10 Horní Měcholupy
2,500,000	44	3	4	0	150	350	1	Prague 10 Strasnice
4,495,000	111	4	2	1	240	940	0	Prague 10 Dolní Měcholupy
1,530,000	31	1	7	0	450	250	0	Prague 10 Záběhlice
2,700,000	70	3	7	0	790	290	0	Prague 10 Zabehlice
3,800,000	70	4	7	0	1230	250	1	Prague 10, Vrsovice
2,400,000	55	3	4	0	1210	250	0	Prague 10, Malesice
4,990,000	98	3	4	0	960	800	1	Prague 10 Hostivar
4,480,000	72	3	2	1	540	910	1	Prague 10 Zabehlice
3,290,000	74	4	1	0	740	750	0	Prague 10 Vrsovice
1,890,000	53	2	3	1	170	350	1	Prague 10 Kolovraty
3,675,000	81	3	1	0	380	90	1	Prague 10 Strasnice
3,399,000	71	3	3	1	110	550	1	Prgaue 10, Urineves
4,380,000	81	3	5	0	1050	760	0	Prague 10 Vrsovice
4,635,000	105	4	2	1	90	420	1	Prague 10, Kolovraty
2,650,000	98	4	1	0	50	310	0	Prague 10, Horní Měcholupy
3,250,000	74	3	7	0	960	370	1	Prague 10, Vrsovice
6,490,000	101	4	5	1	410	530	1	Prague 10, Zabehlice

Key:

Price - in millions of Czech Koruna (czk) /**Newly Built** 1 = Yes, 0 = No

Balcony 1 = Yes, 0 = No

Table 10 - Summary output of Regression /correlation of variables

SUMMARY OUTPUT						
Regression Statistics						
Multiple R	0.93					
R Square	0.86					
Adjusted R Square	0.81					
Standard Error	1262355.58					
Observations	20					
ANOVA						
	df	*SS*	*MS*	*F*	*Significance F*	
Regression	5	1.40272E+14	2.80544E+13	17.60507306	1.3465E-05	
Residual	14	2.23096E+13	1.59354E+12			
Total	19	1.62582E+14				
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	139758.44	1310741.61	0.11	0.917	-2671502.71	2951019.59
Square meters	39494.32	7422.95	5.32	0.000	23573.67	55414.97
Number of rooms	48079.35	429909.20	0.11	0.913	-873984.18	970142.87
Level /Floor	203690.55	180490.09	1.13	0.278	-183422.20	590803.30
Newly built	864447.63	733407.73	1.18	0.258	-708555.50	2437450.76
Distance to transport	2410.92	1509.15	1.60	0.132	-825.88	5647.72