ANGLO AMERICAN UNIVERSITY

WHAT ARE THE PRICE DETERMINANTS OF PRAGUE'S REAL ESTATE MARKET?

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I hereby declare that no portion of the work referred to in this thesis has been submitted in support of an application for another degree, or qualification thereof, or for any other university or institute of learning.

I declare that this thesis is my independent work. All sources and literature are cited and included.

I also hereby acknowledge that my thesis will be made publicly available pursuant to Section 47b of Act No. 552/2005 Coll. and AAU's internal regulations.

Susann Weissová

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ABSTRACT

The purpose of this thesis was to analyze the presumed determinants of real estate prices in Prague between the years 2010 and 2020. By reviewing previous literature, I found patterns in real estate price determinants in Prague. In doing so, I chose to reassess those determinants as independent variables in relation to my dependent variable: price indices of second-hand flats in Prague. The analysis consisted of several single linear regressions, comparing the price indices of second-hand flats in Prague with each independent variable. This paper shows similar patterns from literature considering previous decades, where the X variables of mortgage volume, salaries, construction output, and prices of new flats in Prague, have a strong correlation to the Y variable, prices of second-hand flats in Prague.

Introduction

Significant attention has been devoted to studying the housing prices of the Czech real estate market in the 21st century. Since 1989, every aspect of the Czech economy has undergone an evolution from centralization to a more market based economy, and real estate is no exception. This has impacted the incentives of society when purchasing property, and highlighted the importance of being an economic textbook example of a 'land-owner'. Ownership of land has sought considerable changes in laws and environment, evolving to the market we live in today. Every aspect of different markets were on the route towards more capitalist market economies, and now, with increases in tax, higher regulations and an increase of public debt, some argue the Czech Republic is moving towards socialism once again. Still, the Czech Republic is going through restitution and privatization processes, however simultaneously emerging as Central Europe's role model of urbanization and development.

Such transformation has led to Czech property owners recognizing the importance of having to manage such assets. Real estate management is the business of managing land and buildings, and undertaking activities such as keeping homes in good condition and organizing the renting of property. Technology has reshaped the world of business by growing networks of platform businesses, which has opened many doors in the real estate industry as well (e.g. AirBnb). Platform businesses have aided real estate

managers to effectively record property information, in both short and long term time scopes. The increasing role of platform businesses has made it a lot easier for property owners to trust outsourcing the management of their assets to companies devoted to building frameworks aimed at accommodating collaborative strategies.

With growing demand in the services provided by real estate management firms, Prague, the most attractive city for tourists to visit throughout the country, has had a reactive rental market. Property owners in tourist-heavy districts of the city have fueled the economy by converting flats for the use of sub-leases using networks of platform businesses and sometimes outsourcing them to real estate management companies. Prague is particular when investigating the real estate market, even though all of Czech Republic has undergone economic transformation, that being, the shift towards a more market-based economy. To answer the question "What are the price determinants of Prague's real estate market?", this research has explored the historical trends in Czech real estate market, and compared it to the years between 2010 and 2020. Determinants that proved historically significant were the effects of mortgages, wages, and construction.

Many factors characterize Prague to be different from the rest of the Czech Republic, such as the fact it accounts for about 25% of the country's GDP. Given Prague is the fulcrum of opportunities, higher wages, and consequently, higher rent, I will analyze the following variables and hypothesize that:

H_1 There is a strong, negative correlation between the prices of real estate in Prague and annual mortgage rates.
H_2 There is a strong, positive correlation between the prices of real estate in Prague and annual mortgage volumes.
H_3 There is a strong, positive correlation between the prices of real estate and average annual wages in Prague.
H_4 There is a strong, positive correlation between the prices of second-hand flats and new flats in Prague.
H_5 There is a strong, negative correlation between the prices of real estate and the volume of construction in Prague.

H_6 There is a strong, negative correlation between the prices of real estate and the ease of obtaining a building permit in Prague.
H_7 There is a strong, positive correlation between the prices of real estate and the ease of registering property in Prague.

Theoretical Part

Not only did the global real estate market experience different trends between the years of 2010 and 2020, such as using real estate as a service, but the global economy has also undergone the longest period of economic growth. This matters, because as the economy is expanding, people have more jobs, higher wages, and more money to spend on goods and services, such as housing. Different monetary and fiscal policies play different roles in the development of the economy. Some policies may wish to effect the economy in a specific way, yet the market reacts otherwise.

Such market reactions were observed in the 2008 recession, which was caused by vulnerabilities in the financial system, leading to events resulting in the burst of the United States housing bubble. As housing prices dropped, homeowners were unable to pay for their mortgages, leading to banks collapsing, or having to be bailed out. This was the subprime mortgage crisis.

While many countries were impacted, Czech Republic did not experience such a hit, such as other Eastern European countries (e.g. Hungary and Romania, where the IMF had to aid in order to stabilize the situation). Given that historically, the Czech Republic had low interest rates and a healthy financial sector, there was no incentive for individuals to seek foreign currency loans in hope of better rates.

Although the Czech Republic was not hit as dramatically as neighboring countries, the economy was yet to undergo its' longest recession in history. Because of the 2012 European debt crisis, demand for Czech exports started decreasing, which is one of the GDP's largest sources. Low household and government consumption followed, and remained low for some time due to the uncertainties about the future. The Czech authorities did their best to avoid financial volatility. The Czech National Bank (CNB) reduced policy rates to almost zero. Long-term money market rates also lowered due to weak growth and inflation expectations. The CNB pledged to keep a record-low

interest rate (0.05%) to maintain price stability and contribute to the country's economic growth. The exchange rate was also used as a monetary policy instrument to maintain price stability in the Czech economy, weaken the CZK, and hit the inflation target of 2%, due to the fear of deflation. This way, households and firms would not postpone their purchases in expectation of falling prices, which would have eliminated investment incentives, and in turn, real estate. The use of foreign exchange interventions, recommended by the IMF mission in 2013, supported Czech Republic's general economic policies. By 2014, the economy grew by 2% due to recovering external demand, and higher government investment. Although the immediate effects of weakening the CZK were unfavorable to some in the short-run, the long-term results were well worth it. As prices of imports rose, demand for domestic goods rose as well. People realized prices were not going down, and started spending rather than saving more. Eventually, Czech firms began to enjoy higher sales, hence hired more people and offered better wages. The economy and overall confidence starting witnessing some hope for restoration in the near future. [1]

[1] "What was the exchange rate commitment?" *Czech National Bank*, CNB, 2019, https://www.cnb.cz/en/faq/What-was-the-exchange-rate-commitment/. Accessed 7 April 2021.

Between November 2013 and October 2014, the key economic indicators developed as follows (year-on-year change in %):

2.1 Key Economic Indicators (2013-2014)

	2013	2014
Gross domestic product	-1.3	2.5
Consumer price index	1.0	0.7
Monetary policy-relevant inflation	0.2	0.6
General unemployment rate	7.1	5.9
Average nominal wage in business sector (CZK)	25,199	25,542
Average nominal wage, total	1.2	2.3
Number of job vacancies	39,040	56,600
Overall confidence indicator (index)	88.9	94.1

Source: CNB

The Czech economy was finally resorted in 2014, and had it not been for monetary policy, the growth would have been far slower. The CNB decided to discontinue the exchange rate commitment from 2017, as it was used for the primary as a temporary instrument after observing that the possibility of cutting down interest rates had been exhausted. The CNB's main objective is price stability, at 2% inflation. The advantage the Czech economy has is the independent monetary policy, as seen after undergoing the period of a global crisis. The inflation target has been possible due to the managed exchange rate float, and acts as a shock absorber for the Czech economy.[2]

While exhausting the cutting of interest rates, in 2015 the Czech economy was risking excessive growth in lending. A recovery for demand of loans and easing of credit standards put the financial stability in potential danger. After the longest recession in Czech Republic's history, the financial sector built a high resilience to potential adverse

[2] "What was the exchange rate commitment?" *Czech National Bank*, CNB, 2019, https://www.cnb.cz/en/faq/What-was-the-exchange-rate-commitment/. Accessed 7 April 2021.

shocks. Banks increased capital adequacy and liquidity and were comfortably in accordance with the new European regulatory rules. Residential property prices rose, and accelerated in Prague. By the end of 2014, the CNB regarded apartment prices to be slightly overvalued due to the macroeconomic environment. Favorable conditions in the housing market had become a systematic risk due to the low interest rates, making it more affordable for borrowers with less stable income, who may have experienced problems with repayments if the interest rates were to rise, or the economic growth of the country to worsen. Simultaneously, the attractiveness of buying for sub-letting on platform businesses such as AirBnb, started increasing. The growth of property prices and increasing yield of buying to sublet was creating a price spiral between prices of property and mortgage loans. For this reason, the CNB introduced a new set of recommendations with regards to the provision of mortgage loans, as well as a new methodology for checking credit standards.[3]

By 2016, the prices of residential properties had accelerated. Apartment prices started outpacing the growth in wages by 2017, decreasing the affordability index. The price-to-income ratio was 13.2%, compared to 2013. It seemed the price spiral between prices of property and mortgage loans were developing further. Czech Republic's house price growth reached over 11%, making it one of the highest figures in the EU. While apartment prices were growing, prices of building plots were too. Supply-side factors played a key role behind the growth in residential property prices, due to the limited availability of such real estate. The barriers for new constructions made it more difficult to increase residential housing, pushing upward pressure on prices. Some analysts believed this may have a positive effect in the long-run, as increased construction could lead to investment or speculative demand (i.e. money for the purpose of investing into assets), which arguably increases future expectations of inflation, interest rates, and market returns. Although possible long-run effects was good for investors, the prior mentioned analysts disregarded the effect on actual individuals buying homes for themselves, such as in the case of Ireland and Spain. Demand pushed construction

[3] "Financial Stability Report 2014/2015." *Czech National Bank*, CNB, 2015, www.cnb.cz/export/sites/cnb/en/financial-stability/.galleries/fs_reports/fsr_2014-2015/fsr_2014-2015.pdf. Accessed 7 April 2021.

levels above demographic ones, hence an increase in mortgages and household indebtedness. When the recession hit, the excess housing supply slumped residential property prices, leading to losses on loans for the purchases of houses.[4]

Subletting apartments played a large role in the deterioration of the affordability index, as the sharing economy explosively grew, influencing the housing market in tourist dense parts of Prague. According to the European Commission, the current housing market affordability crisis and tourism are highly correlated to each other. While short-term leases may have had some positive effects in some cities, such as renovating older buildings, and boosting tourism, it has also fueled the ongoing crisis.[5] The average occupancy rate in Prague's available AirBnb apartments were above the values of 14 largest European cities. Prague 1 had around 4,000 Airbnb host's of the total 11,000 hosts registered in the entirety of the Czech Republic. Less than 500 of those hosts were paying taxes as defined in law. 80% of real estate that was represented on Airbnb did not reflect the usual sharing economy, however, as many were subject to tax. This was one of the attempts of the government to strengthen Airbnb regulations and regulate companies in the shared economy. In some cities, such as those located in Los Angeles County, restrictions and requirements resulted to a decline in property values that were associated with AirBnb listings. This effect is yet to be determined in Prague, while municipal councilors continuously update documents outlining several measures that should be applied to those subletting apartments, such as providing information of their guests to public authorities.[6]

Not only has the Czech Republic, at a national level, attempt to regulate the short-term leasing market. The European Commission was addressed to improve the

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[4] "Financial Stability Report 2016/2017." *Czech National Bank,* CNB, 2017, www.cnb.cz/export/sites/cnb/en/financial-stability/.galleries/fs_reports/fsr_2016-2017/fsr_2016-2017.pdf Accessed 7 April 2021.

[5] Alberti, V., Alonso Raposo, M., Attardo, et al. "Urban property: prices, ownership and occupany", *Publications Office of the European Union,* , 2019, doi:10.2760/364135. Accessed 15 May 2021.

[6] Ključnikov, A., Krajčík, V., Vincúrová, Z. (2018). "International Sharing Economy: The Case of AirBnB in the Czech Republic." *Economics and Sociology*. May. 2018, https://www.researchgate.net/publication/326106312. Accessed 7 April 2021.

enforcement of short-term leasing related legislation early 2018, to legally initiate and secure the process of accessing data.[7]

There had been debates whether Airbnb had a negative impact on Prague's urban development and tourism industry. Anita Roth, the head of Airbnb's policy research, claimed 10% of the hosts were people over the age of 60, who had already retired and had free accommodation to offer. Without renting their space, they would not have been able to live in the city center and pay for other expenses. AirBnb can provide between 1.2 to 2.2 times more gross income than long-term rental in tourist dense cities, such as Prague. Some may argue that such individuals could have rented their homes on the long-term market, however, short-term rentals provided a higher yield than long-term ones, given the profound tourism industry within the city. She also stated that many of the hosts live in the flats they are renting out, and are only renting the flats out temporarily, making short-term rentals an attractive method of some passive income. Airbnb, thus, made housing more affordable, and gave the local residents extra cash.

Whether the impact on local residents is exaggerated or not, one must recognize that either way, such demand in this specific accommodative service led to growing demand in the real estate market. That is primarily for apartments in Prague. [8]

Alongside the risk introduced by the sharing economy, the previously mentioned spiral between prices of property and mortgage loans was identified as a systemic risk for the domestic economy as well. The CNB believed such risks needed macro-prudential and micro-prudential supervision. Rules were outlined in the *Recommendation on the management of risks associated with the provision of retail loans secured by residential property* (CNB) which suggested quantitative limits on a few mortgage loan indicators and quality criteria to provide such loans. In October 2018, the recommendations also included limits on debt-to-income (DTI) and debt-to-service (DSTI) ratios. The debt to income ratio is the percentage of the borrower's total

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[7] Alberti, V., Alonso Raposo, M., Attardo, et al. "Urban property: prices, ownership and occupany", *Publications Office of the European Union,* , 2019, doi:10.2760/364135. Accessed 15 May 2021.

[8] Ključnikov, A., Krajčík, V., Vincúrová, Z. (2018). "International Sharing Economy: The Case of AirBnB in the Czech Republic." *Economics and Sociology*. May. 2018, https://www.researchgate.net/publication/326106312. Accessed 7 April 2021.

available credit that is being used. Lenders use the DTI to determine if a borrower is reaching their credit peaks. It calculates the monthly debt payments compared to a borrower's income, measuring debt balanced compared to the amount of existing credit approved by credit card companies. The debt-to-service ratio is used to determine the fraction of gross income that is already spent on other non-housing-related payments. Lenders determine if a borrower can manage monthly payments by considering the percentage of the borrower's income that would be spent on a mortgage payment, real estate taxes, property insurances, and others, while taking into account more than a stable income, timely payments and strong credit score. Unlike the DTI, it also considers other non-housing related obligations. The CNB's cap on such ratios would prevent certain groups of the population to become over indebted and assess the income situation of loan applicants more thoroughly.[9]

Recommending such caps was a result of banks giving out a record amount of housing loans in 2018. The total amount of loans in 2018 was valued at CZK 232 billion, of which CZK 187 billion were mortgage loans.

By the first few months of 2019, weakening credit growth was observed. This was due to the exhaustion of the credit market capacity. Tightening the conditions in 2018 (introducing the limits of the DTI and DSTI caps), increasing interest rates, and a worsening house affordability index also played major roles in the weakening credit growth. In the first quarter of 2019, new mortgage loans were CZK 9 billion lower than the average since 2015. Since monthly volumes of new mortgage loans in March and April of 2019 were CZK 1 billion lower than those of 2018, the decline was not expected to be significant. This led to favorable conditions for the spiral between property prices and mortgage loans. The spiral and optimistic expectations in Czech Republic's property values intensified once again after the first two quarters of 2019. This was due to purchasing property continuously being preferred due to the financial conditions. This boosted attractiveness in investing and housing, and such conditions were likely to escalate the spiral in the medium-term.

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[9] "Recommendation - Limits Applicable to Mortgage Loans." Czech National Bank, CNB, 2018, www.cnb.cz/en/financial-stability/macroprudential-policy/recommendation-limits-applicable-to-mortgage-loans/. Accessed 8 April 2021.

Even with the CNB's efforts to slow down the spiral, the financial conditions led to a continuous growth of loan applicants. While property prices continued to rise, the average size of loans would too. The growth of loans exceeded the growth in net incomes. The applied limits on the DTI and DSTI ratios only partly responded to the growth. Loan applicants were primarily households with both high and low incomes, and around half of those prospective borrowers had a net income below CZK 35,000. Due to the sensitivity of a large proportion of these borrowers towards economic conditions, it was critical for the CNB to maintain financial stability, and continuously assess the characteristics and monitoring of loans, as well as their their recommended ratio limits. The CNB is also seeking statutory power to set up limits for such ratios for mortgage loans. The CNB and the Czech Ministry of Finance have discussed a legislative process, suggesting an Act that would empower the CNB to set up such limits in a legally binding manner. The legally binding limits would ensure a framework on the market, and prevent unfair competition between lenders in the future. This could possibly lead to new lenders (i.e. non-bank or foreign lenders) having an easier time in the lending market than domestic banks would, as unfair competition would be eliminated.[10]

Just as the central bank was investing their efforts into slowing down the spiral in the Czech Republic, and a record-high usage of real estate management outsourcing services was reported, the world was hit by COVID-19. The economic consequences ran a financial plague across the globe, making the COVID-19 recession a major economic crisis, surpassing the impacts of modern recessions. This too, impacted the supply and demand in Prague's rental market. Several countries imposed measures on the restrictions of people, which had a direct effect on the tourism industry. Because of this, the management between short term and long term rentals faced different obstacles. Many properties intended for the short term rentals converted their use to long term rentals, as discovered through a short interview I conducted with various real estate management companies. The respondent's faced COVID-19's impact on the real estate

[10] "Financial Stability Report 2018/2019." *Czech National Bank,* CNB, 2019, https://www.cnb.cz/export/sites/cnb/en/financial-stability/.galleries/fs_reports/fsr_2018-2019/fsr_2018-2019_chapter_5.pdf Accessed 8 April 2021.

market in similar manners, if having shared similar organizational characteristics (i.e. size, location, portfolio). Those operating a short term rental portfolio either had to give up the management of those properties, or were requested to convert them into medium or long term rentals. The management of long-term rentals, however, were less impacted in a structural manner, but instead faced growing supply coming from the former mentioned properties. Although a fraction of real estate management companies quickly responded to the laws of supply and demand, those who were slow suffered an adjustment process that took far longer than their competitors, leading to great losses. The successful companies who were quick to react did so by offering their rental properties at drastically lower prices.

As the rental market was battling with the laws of supply and demand, the buying market had consequential impacts to be faced as well. According to the consulting firm Deloitte, apartment prices in Prague and regional cities increased by about 13% between 2019 and 2020, to 65,400 CZK per sqm. In Prague, flats cost at an average of 88,100 CZK per square meter, but vary according to area. For example, flats in Prague 1 cost 163,894 CZK per square meter, and flats in Prague 2 cost 121,900 CZK per square meter[11]

The global impact of the coronavirus led to a deep recession in mid-March of 2020. Since then, central banks eased measures to support liquidity and financial stability, which partly mitigated the adverse effects of the pandemic. Governments also adopted various fiscal measures to help mitigate the impacts as well, assisting households on both the income side, and expenditure side. In the EU, such mitigation measures were being adopted at a national and central level. The Czech government introduced support measures such as an employment support program, support for the self-employed, and attendance allowances. Despite such measures, the labor market was expected to worsen, with the CNB's predictions reaching at 5% in 2021. Other support measures the Czech Republic introduced that could have had an impact on the real estate market include the reduction of monetary interest rates, loan moratorium, postponement of

[11] "Deloitte Real Index." *Deloitte Czech Republic*, Jan. 2021, www2.deloitte.com/cz/en/pages/real-estate/articles/cze-real-index.html. Accessed 8 April 2021.

rent payments, COVID rent program, COVID I credit program, relaxation of credit ratio limits, such as the previously mentioned DTI and DSTI limits, for mortgages, postponement of rent for businesses, and others.

Loan moratorium allowed borrowers to apply for loan instalments to be deferred between 3 and 6 months, and applied to loans for consumption, as well as loans secured by property. Postponement of rent payments allows tenants to halt the rent payments between 12 March and 31 July, and was to be paid by 31 December. The COVID rent program related to firms and self-employed. It allowed tenants to waive 30% of the full rent payment, while the state would contribute 50% to the tenant. This meant tenants only had to pay 20% of the rent. The relaxation of credit ratios would limit the assessment of applicants for new mortgages, except for investment mortgages. The recommended limit of the DTI and DSTI ratios introduced in previous years was completely abolished.

Despite such measures, the country witnessed an increased number of job applicants, reflecting the rise in the unemployment rate. With businesses closing down, losses in income and changes in the structure of household consumption, a decline in aggregate consumption and weakened demand was around the corner. The way the CNB believes to recover the economy was to stimulate the aggregate demand by supporting the employment rate.[12]

While monetary and fiscal policies affect the whole country, the impacts are seen in Prague primarily. Many researches have considered determinants of real estate prices in the Czech Republic, as well as in Prague, but there have not been studies reflecting the period between the years 2010 and 2020. Given Prague is the 13th largest city by population in the European Union, home to 1.3 million people, and 2.7 million people when taking into account its metropolitan area, conducting a study which only factors Prague's real estate market within the recent decade is yet to be done.

[12] "Financial Stability Report 2019/2020." *Czech National Bank,* CNB, 2020, https://www.cnb.cz/export/sites/cnb/en/financial-stability/.galleries/fs_reports/fsr_2019-2020/fsr_2019-2020.pdf Accessed 8 April 2021.

Prague is considered to be an "alpha" global city, according to the Globalization and World Cities Research (GaWC) conducted by Loughborough University. The GaWC considers cities' accountancy, advertising, baking/finance, and law. City economics are more heavily factored in than the politics of culture factors, which refers to the way that culture shapes and gives rise to social, economic, and legal realities.[13]

Other rankings, such as on Tripadvisor, Mercer, The Economist, and PICSA show Prague as one of the most livable cities, as well as one of the best travel destinations. In fact, Prague was the 5th most visited European city in 2017, followed by London, Paris, Rome, and Istanbul. Most visitors came from Germany, Russia, the USA, the UK, and Italy. This may be why subletting was an attractive business opportunity, and why demand for apartments within the tourist dense areas of Prague had sprung. In fact, almost 50% of Czech Republic's national income from tourism is spent in Prague.

The city employs 20% of the Czech workforce, and pays around 20% more than the national average salary. In the 4th quarter of 2020, in the midst of the global pandemic, average salaries increased 4% in Prague, however, high inflation rates also play a major key in such a figure. Most of Prague's economic structure is service-oriented, employing 80% of the city's workforce. Such services include financial, commercial, trade, restaurants, hospitality, and public administration services.

Prague is also home to the 22nd most expensive streets to live in the world. An average price per square meter per year on Na Příkopě street is CZK 67,480. It is also the most expensive street in all V4 countries, and is followed by Pařížská street.

Not only does Prague have surprising and distinctive figures in real estate, but it also ranked 5th among Europe's 271 regions with regards to GDP/person. This puts Prague 172% above the EU average, ranking above Paris.[14]

Being a regular seat of central authorities, a host of significant and historical cultural institutions, and the predominant economic supplier, Prague is a unique case

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[13] "The World According to GaWC 2020." *Globalization and World Cities Research Network*, Loughborough University, 2020, www.lboro.ac.uk/gawc/world2020t.html. Accessed 8 April 2021.

[14] Contiguglia, Cat. "Prague Is Best CEE City for Business - Survey." *The Prague Post*, 13 Oct. 2013, web.archive.org/web/20101125092300/www.praguepost.com/business/6003-prague-is-best-cee-city-for-business-survey.html. Accessed 9 April 2021.

study, and should be analyzed as such. For this reason, my research strives to observe the defined variables within the city's context.

Literature Review

The literature and theoretical background on factors affecting property prices is incredibly large and the goal of this study is not to provide a comprehensive review. The following chapter, rather, shows applied studies or information showing historical factors that have played a role in Czech Republic's housing market, and factors uniquely tied to the city of Prague.

Skala[15] (2010) conducted research regarding the evolution of the Prague real estate market after 1989. His research is divided in such to describe the economics of real estate, institutional changes and legislative environment, the market situation from 1995 to 2008, and finally undergoes a data analysis using a classical linear regression. Real estate properties are described as "products" that are not as liquid as other goods or services, yet the rental market is rather fast and adaptive to reflect certain preferences. If one considers the value of real estate based on profit, the value of a property or building can therefore be determined by the rental market value. Other methods of price determination consider the various factors, making real estate a heterogeneous good or service that it is. Here, Skala distinguished between real estate as a durable good vs. real estate as a consumption good. Real estate as a durable good is for value keepers, whereas real estate as a consumption good is for those on the rental-market side. He notes that the latter real estate is more vivid and adjustable, meaning higher mobility, easy exchange of information and low transaction costs, making this market more reflective towards a perfect competition mode. An individual wishing to rent an apartment does a quick online search or links with an agency for a small fee (usually a month deposit) and is introduced to almost all the information he/she needs in order to finalize a contract that barely any other transactions or delays in the process.

[15] Skala, Maximillian. "Institute of Economic Studies Faculty of Social Sciences, Charles University." *Institute of Economic Studies*, Charles University, 2010, www.ies.fsv.cuni.cz/work/index/show/id/1363/lang/en. Accessed 6 April 2021.

Skala mentions this is why the rental market is almost always very close to the equilibrium.

Skala goes on to discuss factors influencing the supply and demand of real estate in the Czech Republic. Factors that influence demand are the population, income, general economic growth, price, and financing cost. The population growth rate is a key factor in determining where most people would work or live, hence driving demand higher. With higher incomes, individuals are more likely to satisfy their housing needs, or demand higher priced properties or rentals. Economic growth has historically been highly correlated with the demand for housing units, as a rise in an economy's consumption will in turn increase commerce which will require it to expand. The price is one of the most influential factors with regards to demand, with real estate and prices have a strong, negative correlation. The conditions of which financing is available or costs also affects the buyer power, hence impacting demand. Factors influencing supply are construction and moving. Construction involves input prices, such as costs of land, labor, materials, and money, which in turn determines a developer's willingness to build, or price of which he/she will sell. An interesting point Skala points out is that following the supply of new construction on the market is rather vague, as developers sometimes start selling units before the first brick is laid on the ground. Moving (i.e. people emigrating), although is a factor influencing supply, itself consists of different motives more linked to demand, e.g. growing interest rates, rising rents or changes in the job market.

Skala then analyzes the evolution laws and acts since before World War II, expressing how a new legislative environment has created a new real estate market. Although the historical development of such legislations is interesting, the focus of this research should consider Skala's analysis in the 21st century. In 2001 and 2002, the Czech Republic implemented a new law supporting persons younger than 36 years old to apply for a reduced mortgage rate (1% at a time when mortgages were 4%). This law was limited to 10 years, yet triggered the demand on the housing market drastically. Realized prices of real estate surpassed that of expected prices by 2006, which led to many speculations of investors looking for high return in the short-run. In 2007, developers also increased their output of residential real estate. Construction businesses and banks were blooming, as accumulated housing credits to residents valued at almost

700 million CZK in 2009, growing from less than 50 million CZK in 2000. This was especially visible in Prague, attracting workers from other cities and countries, nourishing the demand and growing property prices. In the summer of 2008, supply was at a peak due to the motivation of developers trying to satisfy the growing demand and the confidence banks had for financing such constructions. While supply was increasing, demand started decreasing. This was due to the US market, making financial institutions in the Czech Republic suspect similar patterns, thus raising interests. Simultaneously, confidence in the general economy was dropping.

Based on the empirical patterns in history, Skala chooses to base his model on migrational data, quarterly numbers of construction, mortgage default, construction bankruptcies, mortgage information, and price. His chosen indices were the Prague housing index, the GDP, the interest rate, and the wage index. He conducted a classical linear regression by using the price index of housing as his dependent variable, and the other variables as independent. Skala's findings prove his hypotheses, where GDP, the interest rate and the wage index are all highly correlated with the price of real estate. An interesting finding was that the lower interest rates on mortgages made housing more affordable to many households, thus increasing demand and rising prices. Globally, as interest rates fall, people turn to certain investment opportunities, such as real estate. For this reason, Skala believes it would have been interesting to consider the deposit interest rate.

Skala's research has proved that the basic historical predictions were present throughout the years 2005 and 2009, implying the market is reactive and is continuously working towards a more open economy. Some limitations of Skala's research was the lack of specificity in location. Although his dependent variable was the housing price index in Prague, he concluded them in the scope of the entirety of the Czech Republic. Another limitation was the time frame. Skala conducted the analysis between the years 2005 and 2009, given the rather new Czech real estate market and lack of data provided by the Czech Statistical Office. For this reason, it would be interesting to have a larger time frame of observations in order to assess the real estate market cycle in reaction to supply and demand of the economy. This research has built a good foundation for understanding the evolution of Czech Republic's real estate market, and has sparked many ideas when approaching such research in a more modern time

frame. My analysis has a similar aim to Skala's, however; I will be assessing Prague's real estate market in a different time frame, that is, between the years 2010 and 2020 primarily.

Slavata[16] (2018) conducted a research comparing the historical housing affordability in the Czech Republic, using data from 2018 to determine if history has yet repeated itself. The aim of the research is to analyze the long-term growth of real estate prices and the influence such prices have on the availability of housing. This is done by analyzing the housing affordability in selected European countries, comparing historical housing data, indicating whether housing is overvalued or undervalued, by comparing it all within the sphere of the Czech market. Skala compares values of the:

- Price to income ratio (PI): representing the basic affordability of housing. Calculated as the ratio of average house prices to average value of personal income.
- Price to rent ratio (PR): representing the inverted value of capitalization. Calculated as the ratio of average house prices to average year rent. A value lower than 15 suggests it is much better to buy a flat, 15-20 suggests it is typically better to rent rather than buy, and above 20 suggests it is much better to rent a flat.

Such averages are used to calculate the following mathematical formula:

$$OUa = \frac{\frac{PIa + PRa}{1} - \frac{\Sigma(PIn + PRn)}{n}}{\frac{\Sigma(PIn + PRn)}{n}} x\ 100$$

Where OU: over/under valuation

a: given European country

n: number of selected countries

[16] Slavata, David. "The Historical Comparison of Housing Affordability in Czech Republic." Trzniceny, The International Scientific Conference INPROFORUM 2018, Nov. 2018, www.trzniceny.cz/att/Historical_comparison_2018.pdf. Accessed 6 April 2021.

The results show the level of over/undervaluation (%) in city center areas, outskirts, average value, and ranking. Czech Republic ranked the to have the second highest overvalued real estate prices in 2018, by 31,75% in the city center, and 32,55% in the outskirts. Slavata's results imply there is almost no difference between the overvaluation of Prague vs. its surroundings, concluding demand covers all the areas equally. Historically, Slavata found a strong, positive correlation between average level of wages, average asking price per one flat family house, and average asking price per year rent for average flat, between the years 1861 and 1943. The average level of asking price per one flat family house has sought an interesting pattern. Between the years 1924 and 1925, the asking price dropped, likely due to the emigration of Czechs to the USA. Due to strict immigration rules, there was a set deadline in 1925, where many homeowners in the Czech Republic tried to sell their homes. This resulted in lowering asking prices, as time was of the essence. He also found the 2018 overvaluation is only comparable to the First World War period.

Slavata assumes this overvaluation results from the actions of the Czech Central Bank's monetary policy in recent years, which focused on holding the exchange rate at an advantageous position for foreign investors. Another assumption is due to the increase of wages, thus increasing demand of those interested in buying real estate. Lastly, the staggering overvaluation in 2018 is also associated with the use of shared housing, primarily for incoming tourists staying at short-term rentals.

Some limitations in Slavata's research include the broad assumption of applying findings from the 20th century to today's market. Although price determinants are likely similar, the environment of the housing market has been transformative. After the period of 1943, Czech Republic was yet to experience the Cold War and the effects of a communist regime on the Czech real estate market. Since then, the market is evolving towards a capital market, alongside developments in technology, changes in demography, and interdependencies across the global economy.

Similarly to Skala's findings, Slavata has found historical predictions present in the present real estate market. Slavata, however, has considered a different time frame, putting more focus onto the year 2018 and comparing it to the early and mid 1950's. This has further emphasized the recurring patterns in the real estate market. Slavata also conducted his analysis in different means, without using regression. Instead, he

ranked countries based on the average valuation of properties in the city center and the outskirts. This was enough to support the concluding remarks on the similarity of overvaluation of Prague and its surroundings, and the placement of the Czech Republic in Europe's real estate valuations.

While limitations exist, Slavata's findings also show the overvaluation's possible determinants such as monetary policies implemented by the central bank, migration, and wages. This research has inspired me to consider such determinants, yet in a closer scope, and compare them with the recent trends in Prague's overvalued real estate market.

Belke and Jonas[17] (2017) published a paper examining fundamental determinants of real estate prices using German regions as their study. The aim of the study is to find the determinants of real estate prices covering almost 100 German cities. Out of careful consideration, the chosen dependent variables were house prices and apartment prices. Their independent variables included rents, transactions[18], construction[19], stock[20], age structure[21], household[22], unemployment[23], economic structure[24], income[25], purchasing power index[26], hospital proximity[27], and interest rates[28]. Rents are based on rental prices of apartments, and denoted in EUR/m^2. Belke and Jonas deflate this index by

[17] Belke, Ansgar, and Jonas Keil. "Fundamental Determinants of Real Estate Prices: A Panel Study of German Regions." *Ruhr Economic Papers*, 2017, doi:10.4419/86788851. Accessed 8 April 2021.
[18] The recorded number of real estate market transactions in every 1000 inhabitants per city, measuring the general real estate market in a specific area.
[19] The number of newly built apartments in every 1000 inhabitants per city, measuring construction activity
[20] The number of apartments already available in every 1000 inhabitants per city
[21] Shows the dependencies amongst different age groups, showing the differences across cities which have lower or higher working-age populations.
[22] The number of people living within a unit
[23] The rate of dependent employees in each city
[24] The sum of people working in services divided by those working in manufacturing and agriculture
[25] The average annual disposable income per capita
[26] An alternative for considering income, to also take into account net incomes, transfer payments, pensions, unemployment benefits, etc.
[27] The number of hospitals in every 1000 inhabitants per city
[28] The 10-year yield rate the German government imposes

using the Consumer Price Index, but do not include it as a dependent variable, due to the lack of available data.

By using a two-way fixed effects panel model, Belke and Jonas conducted an analysis considering two dependent factors in correlation to various independent variables. The results showed that construction was a note-worthy supply-side determinant of real estate prices in Germany, showing a positive correlation between the two variables. Stock and the price of real estate resulted in a negative correlation. On the demand-side, the age structure shows a negative correlation, whereas the number of households, employment, and income show a positive correlation. Higher unemployed regions are associated with lower real estate prices, whereas areas with low unemployment are associated with higher real estate prices. The number of hospitals and the interest rates also show a positive relationship in the regression equation.

Such results show an interesting approach to determining factors influencing real estate prices amongst regions, and dividing the variables in such to consider the supply vs. demand determinants. Using a two-way fixed effects model included both region and year specific fixed effects, and was chosen based on the idea of real estate being a heterogeneous good. Real estate prices depend on several characteristics, such as region-specific factors.

Some limitations the study included were the lack of real estate's institutional factors, such as building or financial regulations, having assumed these are not significant with regards to the variations across German regions. Further considerations can examine more specific determinants, such as mortgage interest rates, rather than the general interest of the 10-year yield rate. Belke and Jonas have also combined the value of property and rent into their dependent variables, whereas it may be interesting to consider the relationship between the two, instead. This could analyze the price-to-rent ratios and the extent of overvaluation of properties across German regions.

The research conducted by Belke and Jonas was heavily influenced and based on the literature of Hlaváček and Komárek[29] (2009), which underwent an empirical analysis discussing the various factors that affect property prices, and identified periods where property values were high. Such factors were examined using a regional analysis of housing prices bubbles across regions in the Czech Republic. By using three approaches, they were able to identify property prices that were overvalued in 2002, 2003, 2007 and 2008. In order to find this out, they used ratios related to house prices, simple analysis of time trends in different regions, and a panel regression. Before identifying these periods, Hlaváček and Komárek provided a thorough explanation of different macroeconomic fundamentals that are believed to play a significant factor in property prices. The profitability of construction businesses, saturation of housing needs, and cost factors are the main supply side factors. The housing market is explained to be divided in two segments. The first one is that of existing housing (with inelastic supply), and where the price is being determined. The second segment is of new housing, where the price determines the amount of the new construction taking place. The first segment can be represented using the second supply factor affecting property prices: the saturation of housing needs. The higher the saturation, the lower is the pressure on flat prices. Cost factors, such as construction costs and investment costs, determine the value of new flats.

The demand side factors play a larger role in the valuation of property prices. Hlaváček and Komárek noted the main component is of disposable income, that is, wages and salaries. Other labor market forces such as the unemployment rate, the economic activity rate, and the number of vacancies may also play a role. Various demographic factors were also mentioned, such as migration, birth rate, age, divorce rate and the marriage rate. The divorce rate was a surprising factor, but Hlaváček and Komárek explained the significance of it, as divorces may turn one household into two,

[29] Hlavaček, Michal, and Luboš Komarek. "Regional Analysis of Housing Price Bubbles and Their Determinants in the Czech Republic." *Charles University*, Czech Journal of Economics and Finance, 2009, www.journal.fsv.cuni.cz/storage/1205_1205_hlavacek_upr.graf_10__resume.pdf. Accessed 6 April 2021.

hence increasing demand for a new dwelling. The marriage rate also may lead to a higher demand of new dwellings, as newly married couples make a new household.

Other demand factors found in Hlaváček and Komárek's analysis include growth in housing loans and interest rates. The more available money is to a society, or the cheaper the cost of borrowing money is, the more individuals are willing to invest into new housing. Lastly, Hlaváček and Komárek suggest market rents as a critical demand-side factor determining property prices. The higher the rents are, the more individuals are motivated to buy a flat of their own. The level of rents also affect investments, since growth in rents increases the rates of return on such investments, thus rising property demand.

Hlaváček and Komárek conducted an empirical analysis using panel regression across Czech regions, between the years 1998 and 2008. The dependent variable was apartment price growth. The results showed supply side factors did not play as big of a role on the dependent variable, except for the influence of the saturation of housing needs. Many of the demand side factors proved significant, such as the divorce rate, population growth, net migration, variables related to the labor market, and the growth in market rent. The marriage rate, housing loans, and interest rates did not prove significant. This may be a surprise, however, Hlaváček and Komárek explained the possibility of the "'exponential nature' of housing loans in 2002-2008, when they recorded approximately 30% yearly growth irrespective of developments on the housing market". This growth may, however, be explained by the fact that mortgages are not bound to be spent on housing, as long as an individual has a house to put down. The interest rate too, had an explanation of its insignificance, where it could be due to the use of interest rate on the interbank market used in the study. Instead, Hlaváček and Komárek advised using interest rates on new housing, which is more economically meaningful. Their main findings were that housing prices in the Czech Republic were mainly determined by demand factors

This paper inspired me to approach my analysis of price determinants using two perspectives: supply and demand. By assigning each dependent variable to either side of a supply-demand relationship, I will be able to determine whether there is a balance in the real estate market. While Hlaváček and Komárek found demand-side determinants influence housing prices in the Czech Republic more, Skala has shown that historically,

supply played a large role as well. Although Skala, Hlaváček and Komárek all approached their research in characterizing price determinants as with supply or demand side factors, an empirical analysis specific to Prague's real estate market in the present day is yet to prove their findings. In answering the question "What are the price determinants of Prague's real estate market", I hope to find the transformative and open economy of the Czech Republic shift towards reaching a market equilibrium.

The motivation of discovering such a transformation has been inspired from the study conducted by Ouředníček, Špačková and Pospíšilová[30] (2018). By exploring the long-term development and current spatial differentiation of housing estate in Prague, the Czech Republic, the authors have confirmed that new housing construction and ethnic differentiation are some of the key processes to change the social environment within Prague's real estate market. The aim of the research was to explain Prague's housing estates during the second half of the 20th century, and beginning of the 21st century.

Housing estates are defined as a group of buildings built as a single development, developed most intensively from the 1960's to 1980's in the Czech Republic. Such estates symbolized the era of communism by emphasizing on the idea of a socialist normalization and equality. Housing estates make ⅓ of the housing stock in the Czech Republic, out of which 40% of them are based in Prague.

After the fall of communism, new housing construction slowed down, as there were uncertainties about the restitution process, and a slow development of the real estate market due to a non-existent support of financial tools. As a result of the decentralized government, Prague's previous division of 10 administrative districts were further divided into 57 self-governed parts. Each city part had its own strategic decisions, which fueled the privatization process. The degree of privatization was dependent on the ruling part of each city determining whether housing will be a municipal ownership or not. At the end of this process, 90% of the former municipal housing was privatized.

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[30] Ouředníček M., Špačková P., Pospíšilová L. "Long-term Development and Current Socio-Spatial Differentiation of Housing Estates in Prague, Czechia." *Housing Estates in Europe. The Urban Book Series*, 2018, https://doi.org/10.1007/978-3-319-92813-5_15. Accessed 8 April 2021.

Today, most of the older housing estates have been reconstructed, resulting from cooperative ownership. By an increase in owner-occupied housing, the proportion of rented dwellings has seen a decline. Former tenants that remained in their dwellings started to invest into modernizing them, which helped the socio-economic status of the general population.

The new residential constructions following the large transformation of legislative procedures after the socialist era has played a significant role in the socio-spatial differentiation in Prague. Developers started growing an interest in areas where housing estates had historically been developed due to the provided building plots, good transportation to the city center, and the coming technical and social infrastructure. About 43% of new housing developments were located within specified housing estate zones in 2014. This poses the question of whether such a development will support a social mix or lead to more social polarization and micro-segregation of new and old residents.

Many new estates are a preferred investment and are of high demand, as seen in the recent housing policies (e.g. long-term rent regulations, large-scale privatization, and high share of privately owned flats). Such demand is due to the reluctant behavior amongst the Czech population with regards to changing the place of residence. Local playgrounds and schools in such areas built the living environment citizens of Prague are used to, and moving out would mean losing an important place for memory and sentiment. This mentality in Czech society may be a large indicator as to where developers put their efforts. Is reconstructing housing estates more profitable than creating new developments? This may be why Prague is experiencing a real estate supply shortage.

There are two assumed approaches of slowing down the prices of property. Some believe increasing the supply of housing, that is, affordable housing, will lead to some relief. Such an approach deals with the previously mentioned obstacle of getting a building permit, where Prague ranks 156th in the world for the ease of acquiring one, according to the World Bank. The unstable political climate is blamed for prolonging a proposed legislation aiming to boost housing supply and adopting a new building act. This legislative lag seeks is assumed to centralize the process under the Czech government,

who some argue, purposely make the process of obtaining a construction permit difficult. Such arguments have been suggested as many political authorities in the government are real estate investors, hence keeping supply low and prices high are in their favor. Demand for new flats in Prague is to rise by 3.4%, however, the number of available properties will only increase by 1.4%. The Czech Republic has pledged to drive demand by speeding up and simplifying the building permit process, however it continuously deals with the complaints coming from the public's interests. Majority of Czech-based developers believe 60 m^2 apartments and properties intended for investment purposes will be high in demand, whereas flats larger than 100 m2 in the center of Prague will be the least attractive. Tomáš Kadeřábek, the director of the Association of Developers, says that alongside a smoother administrative process, the government must focus on sufficient workforce, which will decrease the cost of construction.[31]

The other assumed approach of slowing down property prices in Prague is demand driven, pointing out that prices are an issue of the affordability crisis, rather than the lack of supply. Growing demand is being powered by investors, taking advantage of price rises, cheap mortgages, limited regulations, and lower taxes on property ownership. Investors have acquired 50% of apartment purchases in Prague, and see no decline in such a growth. Martin Lux, the head of the Department of Socio-Economics of Housing at the Czech Academy of Sciences, states that even if there will be five times more housing in Prague, investors will bulk buy, and individuals seeking to own a home will miss out.

According to the OECD, there is an additional reason as to why property prices are slowing down, causing Czech Republic's housing crisis, and in turn, threaten economic development. Younger people are jumping up the ladder, and lower income families are moving to cheaper locations outside the capital, pressuring issues around transportation, infrastructure and the environment. Prague, being the engine of the

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[31] Willoughby, Ian. "Study: Demand for New Flats in Prague Set to Keep Outstripping Supply." *Radio Prague International*, Czech Radio, 20 Sept. 2020, www.english.radio.cz/study-demand-new-flats-prague-set-keep-outstripping-supply-8111302#:~:text=Demand%20for%20new%20apartments%20in,by%20the%20Czech%20News%20Agency. Accessed 12 April 2021.

economy, and hosts many of the higher added value sectors. Young managers, however, may be pushed to search for housing elsewhere, unable to afford to live in the city comfortably. Martin Lux believes this situation will continue to rise, as many middle-income people living in Europe's urban cities will only have the possibility to become a tenant. [32]

Data Collection

To determine the appropriate approach for data collection, one should consider the research question under study, the design, and the information gathered about the variables. To answer the research question *What are the Price Determinants of Prague's Real Estate Market?*, I am to design a research that allows me to consider the variables studied in previous literature. I will collect data on the following variables: prices of property in Prague, mortgages, construction, wages, and registering property.

Prices of Property in Prague

Considerations regarding prices of real estate are heavily influenced by the data sources selected. The real estate market is specific in this sense, given it is a heterogeneous good, meaning the attributes it consists of are different from each other, making it difficult to substitute one for another. This is because of the many factors that the price of an individual real estate depends on. Size, type, age, quality, and location are some of the characteristics that make real estate data collection specific. The most specifying factor, however, is the impossibility of moving a property to a different location. For this reason, data collection in the real estate market is best determined regionally. This is one of the reasons why Prague is the only region being considered in this research.

Czech Republic offers many sources of data series on real estate, however, those specific to Prague are limited. While international organizations such as Eurostat or

[32] Lux, Martin, and Petr Sunega. "Using Path Dependence Theory to Explain Housing Regime Change: The Traps of Super-Homeownership." *ResearchGate*, The Czech Academy of Sciences, June 2020, www.researchgate.net/publication/342061173_Using_Path_Dependence_Theory_to_Explain_Housing_Regime_Change_The_Traps_of_Super-Homeownership. Accessed 15 May 2021.

Consensus Economics offer indices evaluating the trends and data collected in the Czech Republic, such indices do not measure city-specific statistics, and use a unified methodology across all EU countries. The Czech Statistical Office (CZSO) offers one of these measurements being the House Price Index, used in the European Union. The HPI shows the changes in price of purchased residential properties. CZSO also offers various measurements that allow one to choose specific regions, such as Prague, to help filter the generalizations of real estate pricing within the Czech Republic.

One of these measurements is a subcategory of the Consumer Price Index, which measures the average of prices in a basket of goods, and has data of different regions in the Czech Republic. In this case, the basket contains housing, water, electricity, gas, and other fuels. Although this may be a good indication of pricing trends, a dependent variable, such as price of real estate in Prague, requires more specificity this measurement does not offer.

For this reason, one should consider the CZSO data of either new or second-hand realized price indices in Prague. The methodology of calculation of Index of Realized Prices in new flats only considers Prague. This is because there is a low number of reported prices of flats from other regions within the Czech Republic. Municipalities within Prague, however, have individual data, based on three different criterions: location, price, and comparability of flats. The objects of the data are prices of new flats intended for housing and are the first sale of a property. The methodology of calculation of Index of Realized Prices in second-hand flats considers the whole of Czech Republic, given the availability of reported prices. The method of calculating Prague is different from other cities on the basis of a quality adjustment. Quality adjustments for Prague flats consider the flat state (e.g. original, partly reconstructed, reconstructed. etc.). Weights of Prague also differ, as it is the only city in the dataset that is subdivided into 9 different territories, whilst other regions are subdivided into 3. Relative shares of the volumes of transactions are taken into account, as a weighted index of the 9 territories. Some may argue focusing the research on flat prices may be a limitation, as prices of other kinds of properties are not being considered, however, after assessing the ratio of flat to overall dwellings constructed in Prague, one can agree the price of flats is an agreeable indicator. Given the limited data on new construction, choosing the specific

indicator of realized prices of Second-hand flats in Prague represents a good indication of real estate prices.

2.2 Classification of Dwellings in Prague (2006-2020)

	Dwellings, total	including		In family houses new construction	In multi-dwelling buildings new construction	In non-residential buildings
		New construction	Modifications to completed buildings			
2006	5 186	.	.	571	3 542	53
2007	9 422	.	.	845	7 908	38
2008	6 328	.	.	1 006	4 520	30
2009	7 397	.	.	548	5 926	225
2010	6 151	.	.	666	4 675	54
2011	3 480	.	.	557	2 324	30
2012	4 024	.	.	471	2 942	27
2013	3 844	.	.	523	2 871	16
2014	4 848	.	.	485	3 892	56
2015	5 211	.	.	528	3 996	116
2016	6 092	.	.	546	5 033	87
2017	5 846	.	.	622	4 623	10
2018	5 290	4 769	521	756	4 008	37
2019	6 002	5 381	621	711	4 669	27
2020	5 445	5 134	311	689	4 436	12

Source: CZSO

Multi-dwelling buildings are those composing of two or more dwelling units, including apartments, condominiums, co-ops, townhouses, attached residences and multiple family houses. The Index of Realized Prices of either new or second-hand flats include such properties as described in the methodology of calculation. Flats are any dwelling intended for housing in the household sector, other than a family home.[33]

Considering the availabilities, one should choose a measurement most adequate to the dependent variable of this research. The price of property should be most specific to the time frame and region in consideration. Given Prague's recent real estate market is the main element of this research; the realized prices of second-hand flats provided by the CZSO would be most adjacent.

[33] "Dwellings Started and Completed - Selected Territory." *Czech Statistical Office*, European Union, www.czso.cz/vdbvo2/faces/en/index.jsf?page=vystup-objekt&z=T&f=TABULKA&skupId=1353&katalog=30836&pvo=BYT11-B&str=v62&u=v62__VUZEMI__100__3018. Accessed 16 April 2021.

Mortgages

The mortgage rate is the interest charged on a mortgage intended to purchase a piece of property. Lenders determine this rate, which can be fixed or variable. A fixed mortgage rate is one that stays the same for the term agreed upon, whereas a varying mortgage rate fluctuates based on the interest rate. There are four factors that may determine a borrower's mortgage rate:

- Principal: the amount that pays down the outstanding loan. Loans can be designed in a way where the amount of principal that is to be returned starts out low and increases with each mortgage payment. The first few payments are applied to interest, while the last ones are applied to the principal.
- Interest: cost of borrowing the money. Loan balance determines the amount of interest paid. The mortgage payment is directly impacted by the interest rate of a mortgage. The higher the interest on a mortgage, the higher the payments. Higher interests also typically decrease the amount of money one can borrow.
- Taxes: property assessments by the government. These taxes are calculated on a yearly basis. Banks collect taxes in every mortgage payment and hold on to them until they are due to the government.
- Insurance: insurance payments are held in the account and paid to the insurance company from the borrower’s behalf once due.

Individual banks, such as UniCredit, Hypotečni Banka, Česká Spořitelna, and so on, have various repayment plans, based on one's needs. For example, Česká Spořitelna has a variable payment feature, allowing one to increase or decrease repayments by 30%, or in some critical cases, suspend payments for 3 months. Other banks offer plans that require some arrangement or maintenance fees, while others do not. Most banks have an online calculator allowing an individual to compare mortgages based on property value, mortgage amount, interest rate, mortgage term, and the length of fixation. Due to such differences in repayment plans, and numerous lending facilities, choosing the right source is critical. The Czech National Bank (CNB) offers the public a database “ARAD” with the aim of creating a unified system in the presentation of aggregated data for statistical and financial market areas in a time series. The methodology on mortgage rates is based on a breakdown assessing:

- Volumes of mortgages by purpose and the method of acquisition
- Number of loan agreements concluded
- Volumes and average interest rates of mortgages by interest rate fixation
- Volumes of mortgages by categorization of receivables

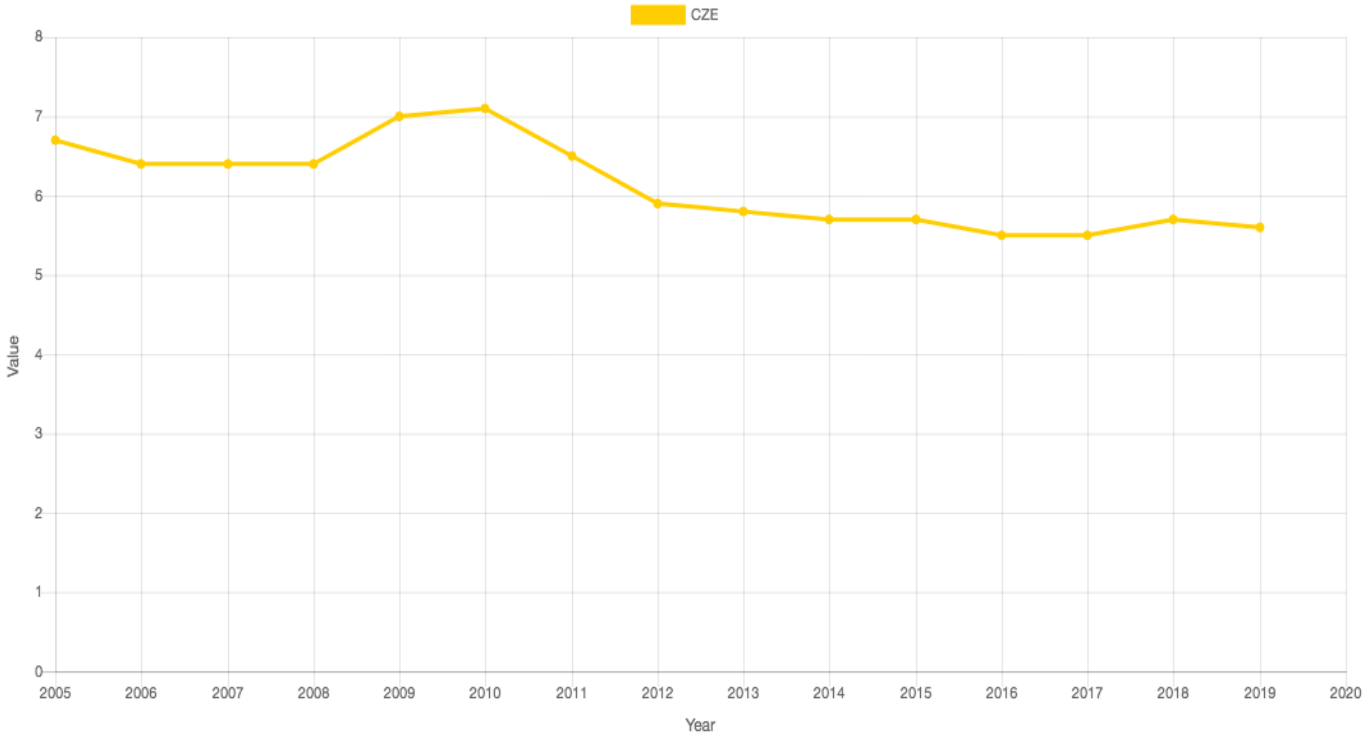
The data collected are average rates applied by Czech banks in CZK as early as 2004. The economic sector of the client is a resident, and non-financial in accordance with specific classifications set up by the bank. The CNB also provides data on the volume of mortgages, but does not take into account any loans below CZK 7.5 million, or above CZK 30 million. This would fall into a separate economic sector, than that of a resident.[34]

Construction Output

The construction industry is a good indicator of determining how well an economy is performing, and is one of the components of measuring a country's gross domestic product. There are several types, such as residential buildings, non-residential buildings, civil engineering works, and water management works. To determine the value of the construction industry, the total costs should be considered, such as costs of preparation, construction and operation. Typically, a nation measures construction output by quarters, and takes into account construction done for public housing, private housing, infrastructure, non-housing public goods (e.g. schools and hospitals), private industrial properties, private commercial properties, new buildings, and information on repair and maintenance of properties. Figure 2.3 shows the percentage share of construction in Czech Republic's GDP.

[34] "Mortgage Loans for Housing Purchase According to Interest Rate Fixation (% P.a. and Volumes in Millions CZK)." *ARAD - Time Series System*, Czech National Bank, www.cnb.cz/cnb/STAT.ARADY_PKG.VYSTUP?p_period=12&p_sort=2&p_des=50&p_sestuid=60261&p_uka=1%2C15&p_strid=AAABAD&p_od=200401&p_do=202101&p_lang=EN&p_format=0&p_decsep=. Accessed 19 April 2021.

2.3 Percentage Share of Construction in Czech Republic's GDP



Source: UNECE

Construction is an industry, which is composed of groupings of companies that have related primary business functions and makes around 30% of Czech Republic's GDP.[35]

While the share of the construction industry is decreasing, ⅙ of industrial companies are involved in construction output, making it a vital component to the Czech Republic's economy.

CZSO provides such data, specific to different cities in the Czech Republic. Data of construction output in the Czech Republic dates back to 1998, and is provided monthly, quarterly, or annually. Considering construction output is critical, not only because of the role it has in the overall economic activity, but also when investigating what the determinants of Prague's real estate are.

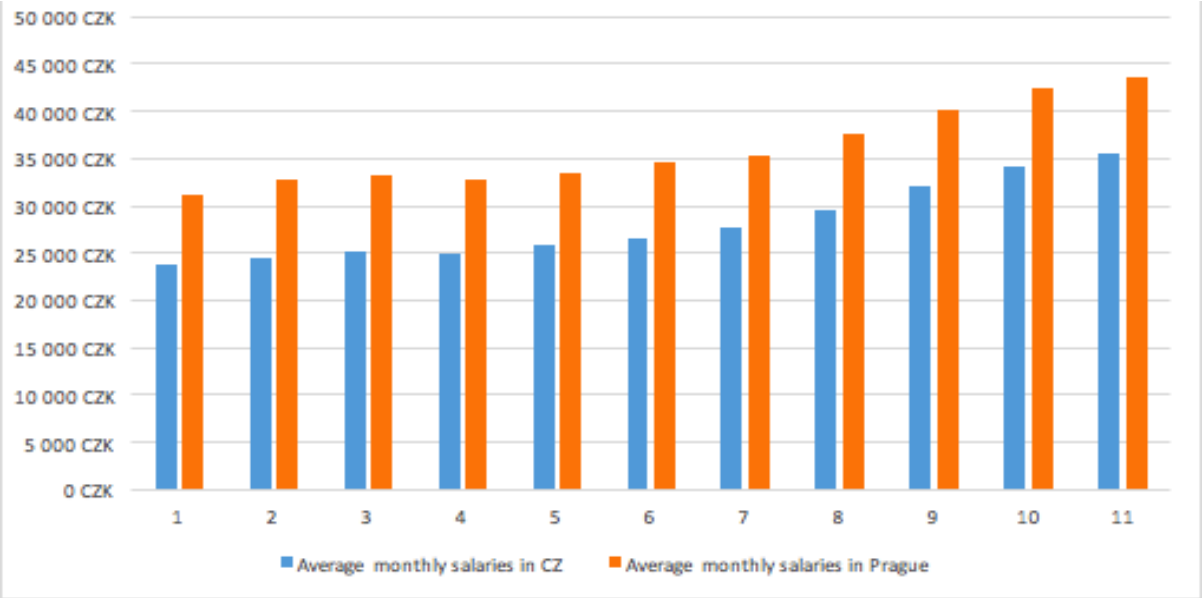
[35] O'Neill, Aaron. "Czech Republic - Share of Economic Sectors in the Gross Domestic Product 2019." *Statista*, 31 Mar. 2021, www.statista.com/statistics/369830/share-of-economic-sectors-in-the-gdp-czech-republic/. Accessed 23 April 2021.

Wages

Wages and salaries are remuneration paid to an employee by cash or a cash equivalent typically at intervals of weeks or months. They do not include non-cash earnings or benefits (e.g. flights). Employers typically have to deduct income taxes and social contributions that are then paid to the respectful authorities. Payroll taxes, contributions to pensions, social insurance, and other compensation insurances are not included as wages and salaries on the national account.

As preliminary research has proved, wages are one of the key determinants of property prices, and have historically been an underlying variable when considering the demand for real estate in Prague. There are several sources providing data on the wages in the Czech Republic, such as Eurostat, Deloitte, the CNB and the CZSO. Eurostat, Deloitte and the CNB offer data spanning the entirety of the Czech Republic, whereas CZSO publishes more detailed information with regards to type of employment, region, age, and gender. For the purposes of this research, any data that offers the specificity of Prague's economic activity will be the preferred indicator. This is because wages in Prague are comparatively higher than the rest of the Czech Republic, shown in the figure below, spanning between 2010 and 2020.

2.4 Salaries in CZ vs. Prague



Source: CZSO

The methodology the CZSO uses in determining the average gross wage is composed of the share of wages, excluding any personnel costs, per employee of the registered number of employees in a month (a separately calculated index). Wages include wages, salaries, payments additional to wages or salaries, bonuses, compensations, and other components that are to be paid by the employer to an employee in a given time period. The index does not include compensation of wages to individuals who temporarily are incapable of work due to injury or health. It is important to note that gross wages do not consider the premiums paid to public health insurance authorities, social security, income tax advances, or other deductibles.[36]

The CZSO also published data from the structure of earnings (SES) survey, produced in cooperation with the Ministry of Labor and Social Affairs (MoLSA). The purposes of the survey is to provide detailed information on wages, breaking down data to occupation, wage distribution, and the means of how these wages are distributed. Statistics of the SES include gross wages, but also all compensations of wage for the hours not worked, and bonuses throughout the whole year. The average wage of an employee in a year is hence calculated by the hours paid, wage compensation during times of disease, and unpaid time of absence. This way, the data produced also considers the hours worked. A disadvantage of using the results from this survey, however, is the SES does not include employees with weekly hours that are shorter than 30 days. This is a sample error.

After comparing the different sources available with regards to wages and salaries in Prague, the CZSO's average wage measurement will be the chosen indicator. This is also for the reasons of specificity, period, and accessibility.

Ease of Doing Business Indices

The following indicators are part of the World Bank's Ease of Doing Business Index. The index consists of 10 sub-indices including: starting a business, dealing with construction

[36] "Labour and Earnings." *The Number of Employees and Average Gross Monthly Wages and Salaries*, Czech Statistical Office, www.vdb.czso.cz/vdbvo2/faces/en/index.jsf?page=vystup-objekt-parametry&z=T&f=TABULKA&sp=A&skupId=855&katalog=30852&pvo=MZD01-D&evo=v750_%21_MZD-R-INDX-. Accessed 23 April 2021.

permits, getting electricity, registering property, getting credit, paying taxes, trading across borders, enforcing contracts, and resolving insolvency. Together, nations are given a score and ranking determining how easy or difficult it is to do business in a certain country. The indices collect data from a nation's largest business city, which for the case of the Czech Republic, would be Prague. For the purposes of this research, the sub-indices of construction permits and registering properties will be considered.
The following indices consider the construction and/or acquiring of commercial properties, however, according to the CZSO, the construction production index shows a similar growth/decline in number of building permits issued to both residential and non-residential buildings.[37] For this reason, the World Bank's sub-index of construction permits is a close measure to obtaining a residential permit as well. According to the Administration of Land Surveying and Cadaster of the Czech Republic, the registration of commercial and residential properties also follow a similar process, allowing the World Bank's sub-index of property registration as an agreeable indicator.[38]

Construction Permits

According to the World Bank, Prague is one of the hardest cities to get a construction permit in, ranking 157 out of 187 countries in the Ease of Doing Business Index 2019 (DBI). The Ease of Doing Business Index are rankings of an economy based on regulations which directly affect businesses. The higher the score, the better the country is performing, i.e. the easier it is to get a construction permit. The Index consists of several measures, such as regulations for starting a business, dealing with construction permits, registering property, getting credit, etc. Dealing with construction permits tracks the procedures, time and costs associated with building a warehouse. Prague is the city under analysis, offering a good foundation for measuring the obtainment of a construction permit for this research. Separate scores of component indicators are

[37] "Short-Term Statistics - Construction – Methodology." *Czech Statistical Office*, European Union, www.czso.cz/csu/czso/sta_m. Accessed 20 April 2021.
[38] "Registration into the Cadastre of Real Estate." *ČÚZK*, State Administration of Land Surveying and Cadastre, www.cuzk.cz/English/Cadastre-of-Real-Estate/Registration-into-the-Cadastre-of-Real-Estate/Registration-into-the-Cadastre-of-Real-Estate.aspx. Accessed 25 April 2021.

averages from an accumulation of procedures, interviews, and assumptions. The general component indicators are:

- Assumptions about the construction company: e.g. is a limited liability company (or legal equivalent), operates in the country's largest business city, is 100% domestically and privately owned, etc.
- Assumptions about the warehouse: e.g. will be used for general storage activities, have at least two stories about the ground, is not located in a special economic zone, etc.
- Assumptions about utility connections: is 150m from a water source, will not require water or fire protection, has a constant level of water demand and wastewater flow, etc.
- Procedures: any interactions of the development company's employees, managers, or parties acting on behalf of the company (including government agencies).
- Time: the median duration that experts indicate.
- Cost: all costs associated with finishing the procedure to legally build the warehouse
- Building quality control, which is composed of six sub-indices: Quality of building regulations index, control before construction index, control during construction index, control after construction index, liability and insurance regimes index, and professional certifications index. Each index has several components, whose sum of scores is concluded as the final building quality control index. The index ranges from 0 to 15, where the higher the value, the better the control and safety mechanism.
- Reforms: considers yearly (if any) changes related to efficiency and quality of permitting systems. This allows the index to acknowledge any significant reforms that either makes it easier or harder to do business within the specified city.[39]

By evaluating the quality of building regulations, control, safety, regimes, and certification requirements, the DBI index of obtaining construction permits in Prague

[39] "Dealing with Construction Permits." *Doing Business*, World Bank Group, www.doingbusiness.org/en/data/exploretopics/dealing-with-construction-permits/what-measured. Accessed 25 April 2021.

provides one with a general idea of possible obstacles in the construction of real estate within the city, being a major determinant of the price of property.

Registering Property

The Doing Business Index also provides a measurement involved with registering property. The index assumes there is a standard entrepreneur who is interested in purchasing land or a building that is already registered in the cadaster, i.e. a limited liability company who is to purchase a property from another business. Assumptions have been made about each party involved in the transaction of property to make data comparable across different economies. Alongside the assumptions, the general component indicators are:

- Assumptions about the parties (buyer and seller) are: limited liability companies (or a legal equivalent), located in the city or its outskirts defined within the official limits, and are 100% domestically and privately owned.
- Assumptions about the property involved in the transaction include: valuing 50 times income per capita (which is considered the sale price), fully owned by the seller, has no mortgages attached, has been under ownership from the seller for over 10 years, is registered in the cadaster, is located within the city or its outskirts, consists of land or building, is not subject to renovations or reconstructions, has no natural reserves or historical monuments, will not be used for special purposes (e.g. industrial plants, waste storage), and has no occupants.
- Procedures: any interaction between the buyer, seller, and their agents (including government agencies)
- Time: the median duration that property lawyers and experts indicate. The index excludes considering time involved in the acquisition of construction permits, or the construction itself. Data is solely focused on an observed property ready to take part in a transaction.
- Cost: official costs associated with the transaction, such as fees, transfer taxes, payment to authorities, etc.
- Quality of land administration, which is composed of five sub-indices: reliability of infrastructure, transparency of information, geographic coverage, land dispute

resolution, and equal access to property rights. The index ranges from 0 to 30, where the higher the value, the better the quality of land administration.

- Reforms: classified changes that impact the data are taken into measure to acknowledge the implementation of property reforms. The reforms are defined as either those making business easier to do, or those making it more difficult. All of which are able to affect the prices of property. [40]

By evaluating the quality and ease of registering property, the DBI index of registering properties in Prague provides one with a general idea of possible obstacles in the property registration system within the city, being a major determinant of Prague's property demand.

Methodology

When performing a regression analysis, there are a few critical regression statistics one should understand. After using Excel to perform a regression analysis, the summary output regression statistics will provide information of the multiple T, R-squared, adjusted R square, and standard error.

The multiple R, also known as the absolute value of the correlation coefficient, shows the relationship between the dependent and independent variables. This figure indicates how closely the variables move together. In multiple regression, similarly to linear regression, the multiple R assumes the relationship is linear hence measuring the linear relationship amongst the variables. The value of a correlation coefficient must be between -1 and 1. A correlation coefficient of 0 indicates there is no relationship between the variables. A value of -1 indicates the variables have a perfect, negative correlation, whereas 1 indicates there is a perfect, positive correlation. Given the multiple R is expressed in absolute terms, one will not know whether a correlation is positive or negative by just assessing this single output.

The value of R-squared indicates how well of a fit the regression line has with the data. In other words, determines how many data points fall within the results of the

[40] "Registering Property." *Doing Business*, World Bank Group, www.doingbusiness.org/en/data/exploretopics/dealing-with-construction-permits/what-measured. Accessed 26 April 2021.

regression line. Since variables are impacted by several factors, the R-squared shows how much variation occurs in the dependent variable as a result of the independent variables. The R-squared value ranges from 0 and 1. The higher the coefficient, the better the goodness of fit. R-squared is useful for making assumptions of the future within the predicted outcomes.

Adjusted R-squared determines how many data points fall within the results of the regression line as well, however, it also determines the variation explained by only the independent variables that would affect the dependent variable. This means, the adjusted R-squared will only consider variables that are of significance, which is determined by f-tests or p-tests explained in the following paragraphs. Some may argue that in doing so, the adjusted R-squared is penalizing an analysis which consists of several variables. Others, however, believe adjusted R-squared corrects some limitations of the R-squared. One would be that the R-squared increases (and never decreases), which may mislead an observer to believe there is a better fit as more terms are being added to the model. Another limitation of R-squared may be introduced if there are too many high-order polynomials which can over-fit data, hence leading to a misleading high R-square and misleading projections. Adjusted R-squared corrects these limitations by solely considering variables of significance.

The standard error (s-value) for regression shows how spread the observed values varies from the regression line. In other words, it gives on an idea of how wrong or right the regression model is. The smaller the s value, the closer the values are to the regression line. Unlike R-squared, s is used to assess the preciseness of projections.

There are two outputs Excel produces when conducting a regression analysis. One output is from the Regression's output, and another is the ANOVA table. Both have standard error terms. The regression output's standard error is in the units of the dependent variable, i.e. in the unit of Price Indices of Second Hand Flats in Prague. The ANOVA standard error is the square root of the Residual Mean Square, estimating the common within-group standard deviation. For the purposes of this research, the figure of the ANOVA table will be used to determine if the verification criteria is met.

Another important statistical output is the p-value. The p-value allows the researcher to support or reject a null hypothesis. P-value is the evidence against the null hypothesis, meaning the smaller it is (i.e. $p < 0.05$), the stronger the evidence that it is

possible to reject the null hypothesis. Alternatively, a large p-value ($p > 0.05$) means the alternative hypothesis is weak, and one cannot reject the null hypothesis.

Given this analysis will compromise a set of linear regression models, correlation coefficients, r-squared, s value and p value are the most determining statistical outputs to determine the effects on Prague's real estate market.

A linear regression is used in predictive analysis, which consists of data mining, predictive modelling, and sometimes, machine learning, to analyze historical data in order to make predictions of future output. There are some questions to be considered when using linear regression: 1) Does an independent variable do a good job in predicting an outcome of the dependent variables? 2) Which variable is most significant with respect to the prediction of the dependent variable, and to what extent does it make an impact? 3) What can be done for increased validity of a regression? Analysts use linear regression to determine the strength between two or more variables, forecast the effects they have on each other, and forecast trends.

There are four general assumptions of a linear regression model:

1. Linearity: the independent and dependent variable have a linear relationship.
2. Homoscedasticity: the error term, or the variance of the residual of the model, is constant. I.e. the error term should not vary much as the independent variables change.
3. Independence: observations are independent of each other, i.e. there is no autocorrelation within the data.
4. Normality: for any fixed value of the independent variable, the dependent variable is normally distributed.

The equation of a linear regression is as follows: $Y = a + bX$

Where Y is the dependent variable, and X is the independent variable. The slope of the regression is b, and the intercept is a (i.e. the value of the dependent variable when the independent variable is zero).

For the purposes of this research, the dependent variable prices of real estate in Prague, using the indices of realized prices of second-hand flats in Prague, provided by the CZSO. The independent variables are mortgage rate and mortgage volume, provided by the CNB. Wages in Prague, realized prices of new flats in Prague and construction output in Prague are other independent variables being considered and provided by the CZSO. Finally, the last independent variables are the index of obtaining a construction permit in Prague and the index of registering property in Prague provided by the Ease of Doing Business Index published by the World Bank.

Practical Part

Verification Criteria

Absolute value of Correlation Coefficient (Multiple R) must be <0.8, 1>
R-squared must be greater than 0.6.
S value must be less than 0.3.
P value must be less than 0.1.

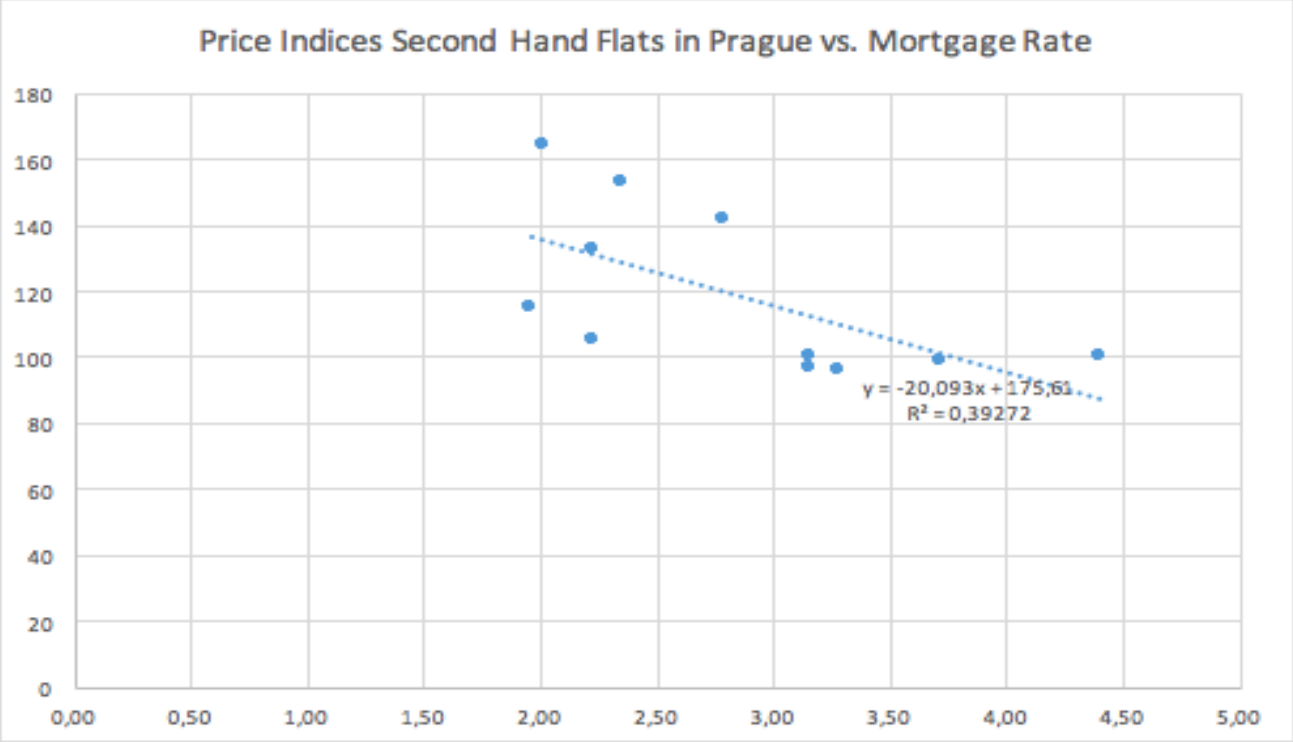
A high correlation coefficient would show a strong relationship between my dependent and independent variables, that is, the realized price of second-hand flats in Prague vs. the mortgage loans interest rate, mortgage loans volume, average monthly salaries in Prague, construction output volume, price indices of new flats in Prague, obtaining a construction permit index, or the registering property index. With an R-squared value over 0.6, I hope to find most of my data fall on the regression line. Given the short time frame being considered, falling between 10 and 12 years, and the several factors that impact the variables, the R-squared of 0.6 expects some variation to occur to the realized price of second-hand flats in Prague as a result of the comparing attributes. A small s-value implies how spread the observed values vary from the regression line. Similarly to the reasons of the r-squared, the s-value is given some space to consider the limited amount of observed values, hence the possibility of variation from other observed years. Finally, the p-value should be less than 0.1 in order to reject the null

hypothesis. Given this research has multiple hypothesis; the null hypothesis would indicate there is a weak correlation between the dependent and independent variables. This would also indicate the regression is statistically significant.

The hypothesis is: there is a strong, positive correlation between the price of second hand flats in Prague with mortgage volumes, average wages in Prague, prices of new flats in Prague, and the difficulty of registering property in Prague, whereas a strong, negative correlation with annual mortgage rates, volume of construction in Prague, and the ease of obtaining a building permit.

Results

3.1 Price Indices of Second Hand Flats in Prague vs. Mortgage Loans Interest Rate



Source: Authors Calculations

Multiple R= 0,626670143

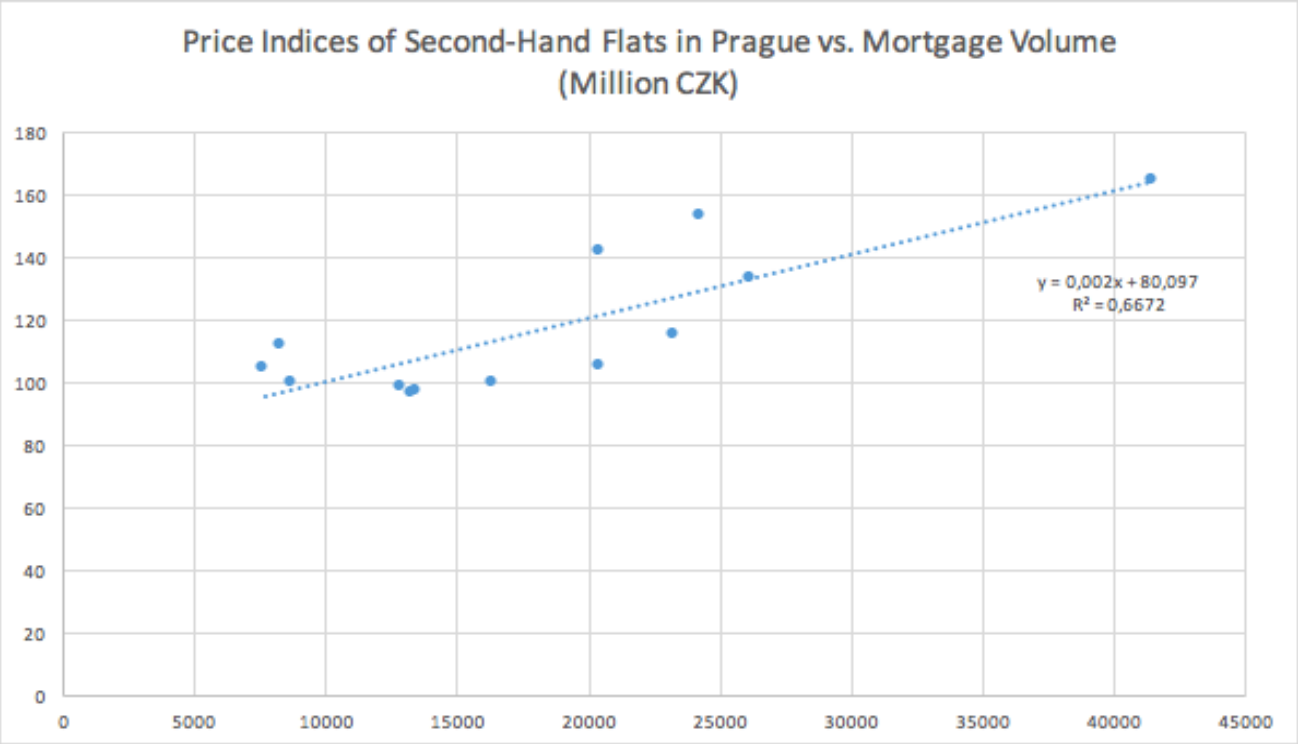
R^2 = 0,392715468

S- Value = 8,328720083

P - Value = 0,039089578

The regression between the price indices of second hand flats in Prague and mortgage loans interest rate meets hypothesis 1 somewhat, by showing a negatively correlated regression line, however, does not meet the verification criteria, and hence we cannot prove the hypothesis. Although the fit of the line does move downwards, the correlation coefficient of 0.63 indicates it is weak. The r-square did not meet the verification criteria, with a figure of 0.39, indicating the regression line has a weak goodness of fit. The s-value has also not met the verification criteria, with a value of 8.33 indicating the regression's precision of projection in the model is low. The p-value, however, has met the verification criteria, implying the comparison is of statistical significance.

3.2 Price Indices of Second Hand Flats in Prague vs. Mortgage Volume (Millions CZK)



Source: Authors Calculations

Multiple R= 0,81682414

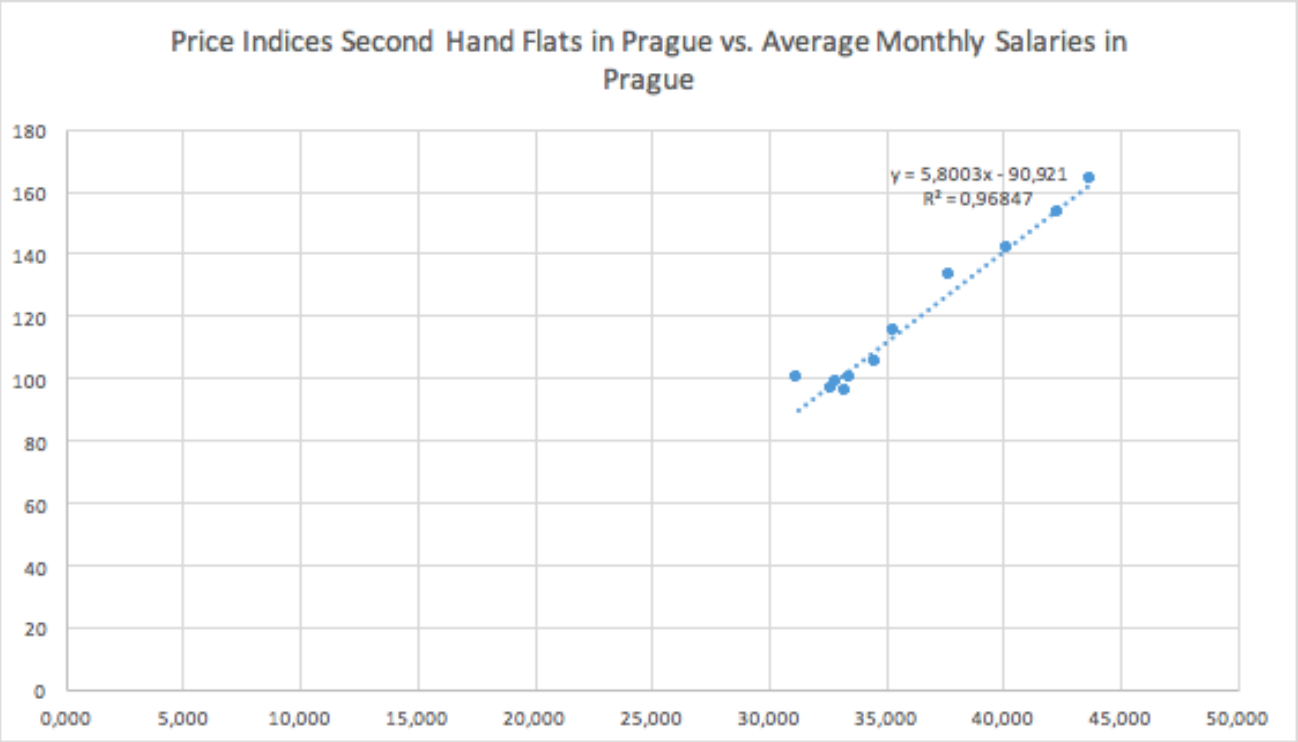
R^2 = 0,667201676

S- Value = 0,000430178

P - Value =0,000654295

The regression between the price indices of second hand flats in Prague and mortgage volume meets hypothesis 2, stating there is a strong and positive correlation between the two variables. All of the verification criteria are met, with the correlation coefficient of 0.82 indicating the variables move closely together. The higher the volume of mortgage loans, the higher the price of second-hand flats in Prague. The R-squared also just meets the verification criteria, with a figure of 0.66 indicating a decent goodness of fit. With an s-value of 0.0004, the regression's precision of projection in the model is high. The p-value also met the criteria, being far smaller than 0.1, indicating the statistical significance of this regression.

3.3 Price Indices of Second Hand Flats in Prague vs. Average Monthly Salaries in Prague



Source: Authors Calculations

Multiple R= 0,984110168

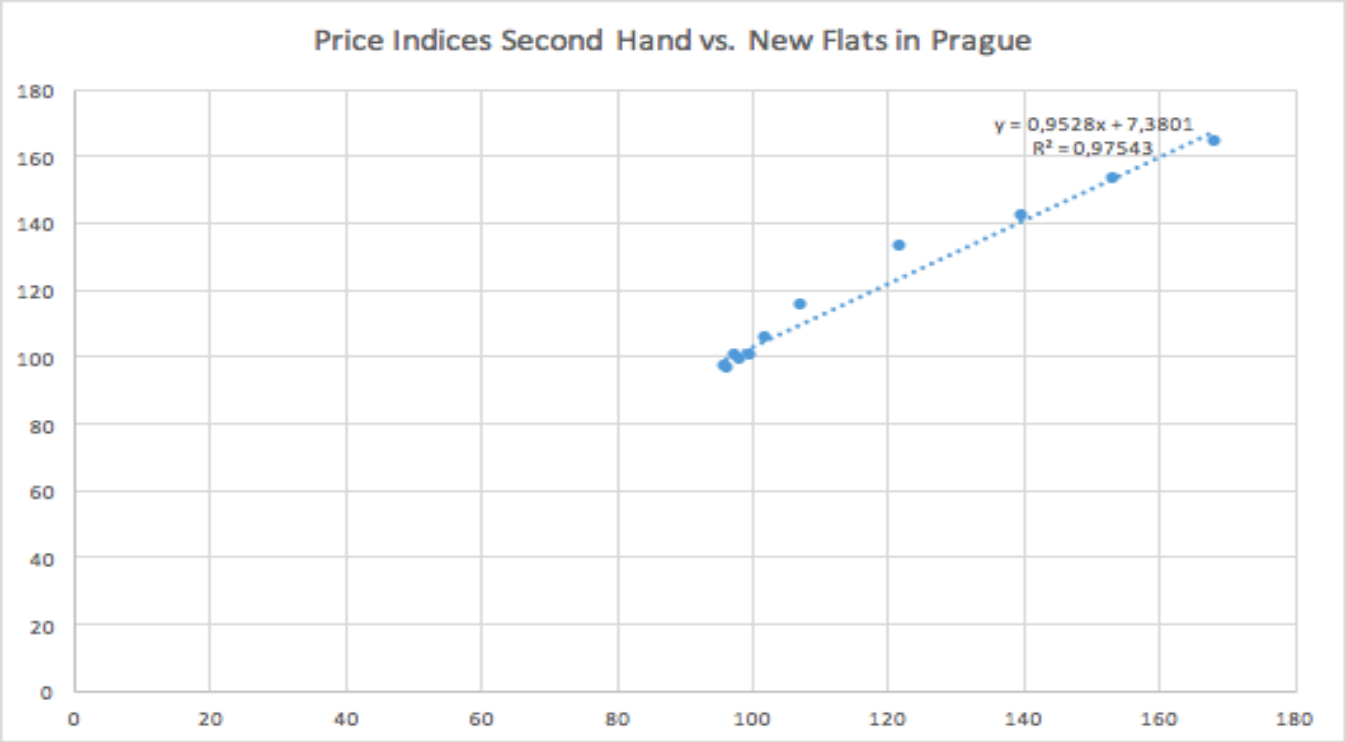
R^2 = 0,968472823

S- Value = 0,01004189

P - Value = 4,59771E-08

The regression between the price indices of second hand flats in Prague and the average monthly salaries in Prague meet hypothesis 3, stating there is a strong and positive correlation between the two variables. All of the verification criteria are met, with the correlation coefficient of 0.98 indicating the variables move closely together. The higher the average wages in Prague, the higher the price of second-hand flats in Prague. The R-squared also meets the verification criteria, with a figure of 0.97 indicating a strong goodness of fit. With an s-value of 0.01, the regression's precision of projection in the model is high. The p-value has also met the criteria, being far smaller than 0.1, indicating the statistical significance of this regression.

3.4 Price Indices of Second Hand Flats in Prague vs. Price Indices of New Flats in Prague



Source: Authors Calculations

Multiple R= 0,987636699

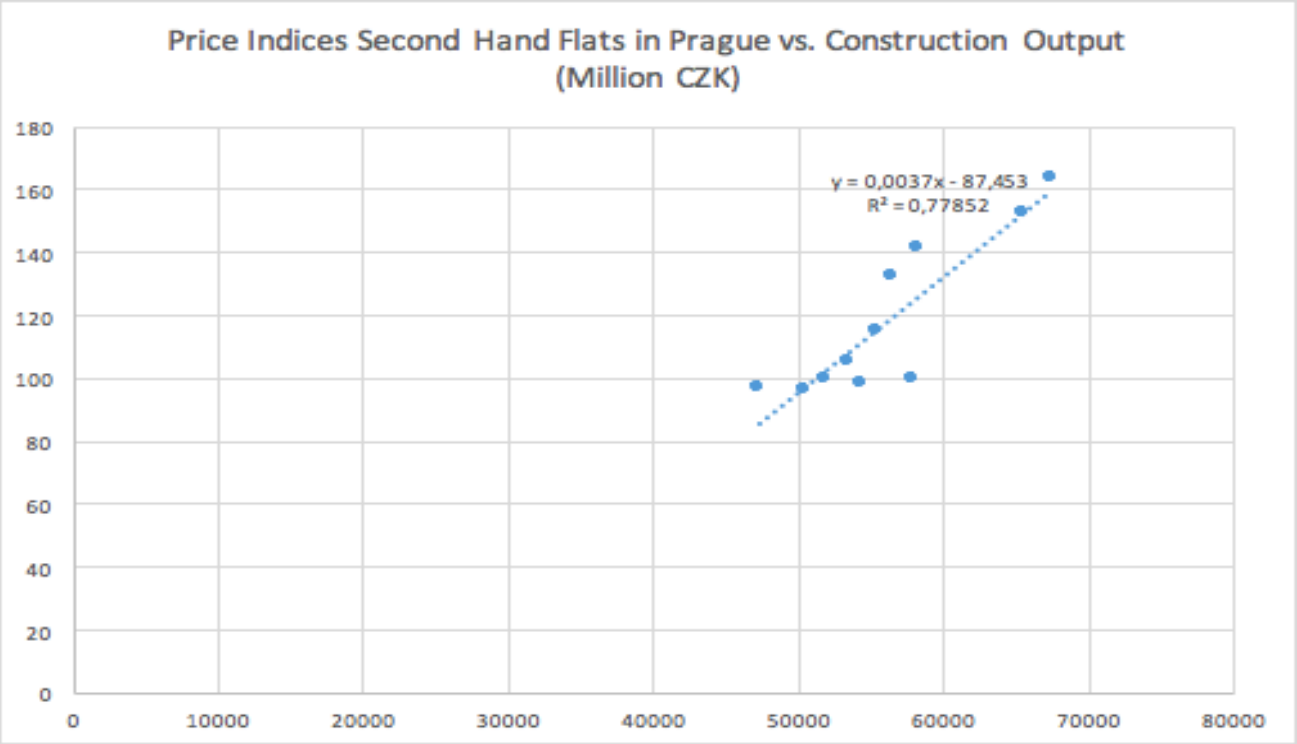
R^2 = 0,97542625

S- Value = 0,050409681

P - Value = 1,49387E-08

The regression between the price of second hand flats and new flats in Prague meets hypothesis 4, stating there is a strong, positive correlation between the two variables. All of the statistical output meets the verification criteria. With a correlation coefficient being 0.99, indicating the variables move closely together. The price of second hand properties in Prague reflect the price of new flats in Prague. The r-square meets the verification criteria with a figure of 0.98, indicating a strong goodness of fit. S-value of 0.05 indicates the precision of projections in the model is high. The p-value has also met the verification criteria, being far smaller than 0.1, indicating the statistical significance of this regression.

3.5 Price Indices of Second Hand Flats in Prague vs. Construction Output Volume (Millions CZK)



Source: Authors Calculations

Multiple R= 0,882334977

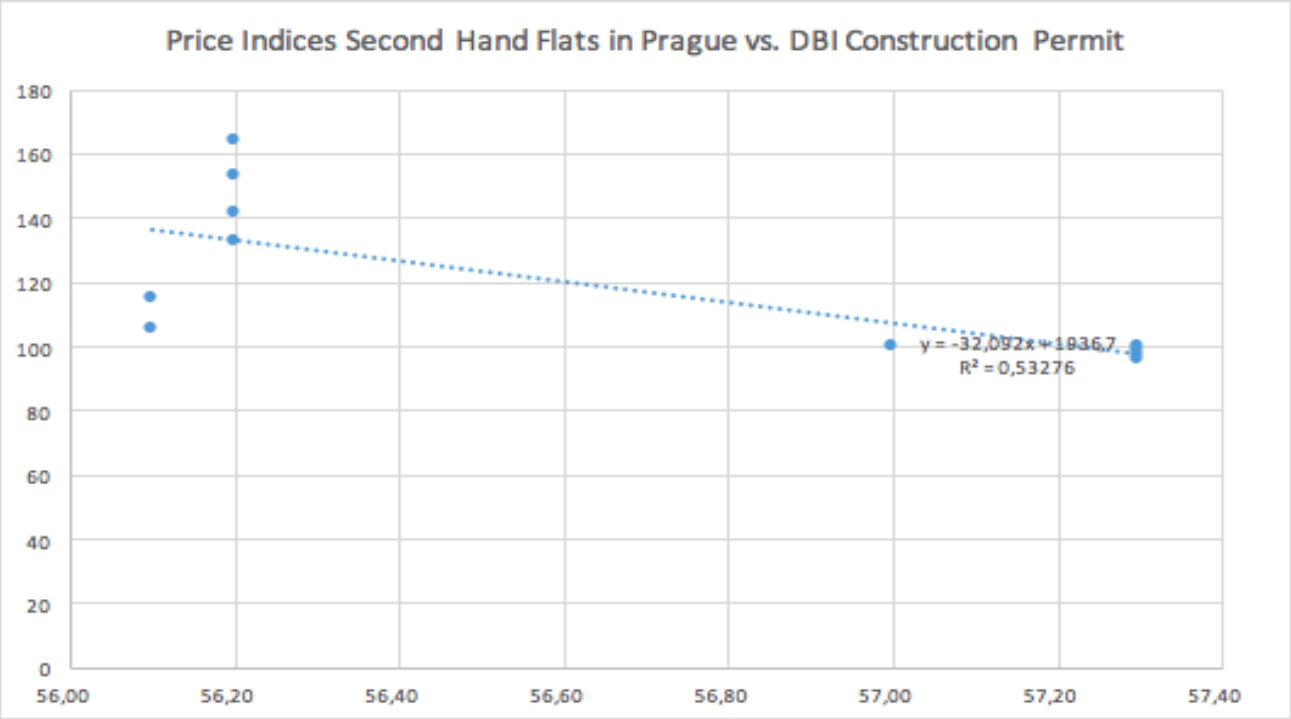
R^2 = 0,778515012

S- Value = 0,000651932

P - Value = 0,000323972

The regression between the price indices of second hand flats in Prague and the construction output does not meet hypothesis 5, however all verification criteria are met. I hypothesized there will be a strong, negative correlation between the two variables. With the correlation coefficient of 0.88 the regression indicates the variables move closely together. The higher the construction output, the higher the price of second-hand flats in Prague. The R-squared also meets the verification criteria, with a figure of 0.78 indicating a strong goodness of fit. With an s-value of 0.0007, the regression's precision of projection in the model is high. The p-value also met the criteria, being far smaller than 0.1, indicating the statistical significance of this regression.

3.6 Price Indices of Second Hand Flats in Prague vs. Doing Business Index - Obtaining a Construction Permit



Source: Authors Calculations

Multiple R= 0,729907142

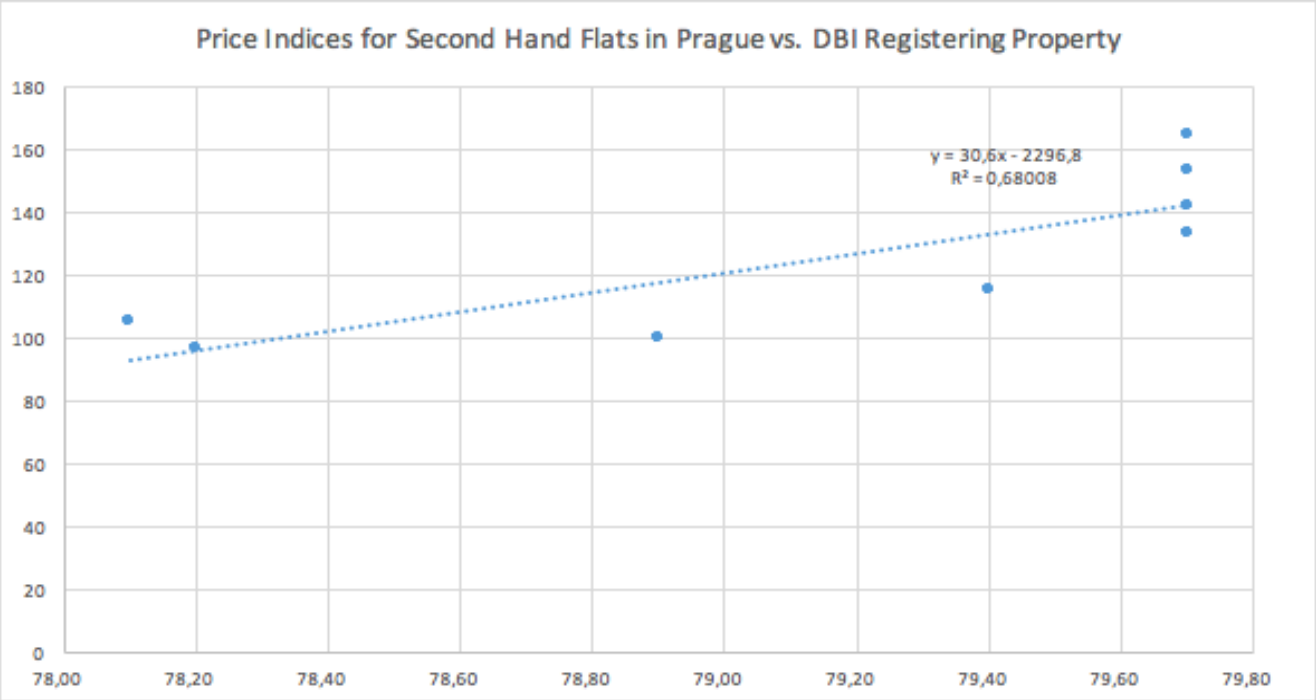
R^2 = 0,532764435

S- Value = 10,01780611

P - Value = 0,010771129

The regression between the price indices of second hand flats in Prague and the ease of obtaining a construction permit in Prague do not meet hypothesis 6. Although there is a negative correlation between the two variables, it is not strong. With a correlation coefficient of 0.73, the regression indicates the variables do not move very closely together. The R-squared of 0.53 indicates a weak goodness of fit. With an s-value of 10.018, the regression's precision of projection in the model is weak, however this is due to the nature of the data. The p-value is the only statistical output that has almost met the verifying criteria with a figure of 0.011, indicating there is some statistical significance of this regression.

3.7 Price Indices of Second Hand Flats in Prague vs. Doing Business Index - Registering Property



Source: Authors Calculations

Multiple R= 0,824668159

R^2 = 0,680077573

S- Value = 8,568260094

P - Value = 0,011765015

The regression between the price indices of second hand flats in Prague and the ease of registering property meets hypothesis 7 for the most part, stating there is a strong and positive correlation between the two variables. All of the verification are met, except for the s-value. With the correlation coefficient of 0.82, the variables move closely together. The easier it is to register property, the higher the prices of second-hand flats in Prague. The R-squared also meets the verification criteria with a figure of 0.68, indicating a goodness of fit. With an s-value of 8.57, the regression's precision of projection in the model is very low, but similarly to the regression in figure 3.6, this is due to the nature of the data. The p-value has almost met the verifying criteria with a figure of 0.012, indicating there is some statistical significance of this regression.

Discussion

The analyses that meet the verification criteria of proving my hypothesis correct are price indices of second hand flats in Prague vs. mortgage volume, average monthly salary, and prices indices of new flats. The analyses that have not met the verification criteria thus rejecting my hypothesis are price indices of second hand flats in Prague vs. mortgage loan interest rates, ease of obtaining a building permit and ease of registering property. The verification criteria of price indices of second hand flats in Prague vs. construction output have been met, however, do not prove the hypothesis, as the correlation between the two variables are negative, whereas I hypothesized a positive correlation.

Given previous literature, such as Skala's analysis on the evolution of Prague's real estate market, found that mortgage loan rates triggered demand in the housing market drastically. Prices of real estate boomed by 2006, especially that of Prague. Hlaváček and Komárek found different results after conducting a panel regression across Czech regions, and concluded mortgage rates were not economically meaningful to second-hand homes as it would be with new homes. I hypothesized the higher the mortgage rates; the less people are willing to borrow, lowering demand, thus lowering the price. This negative relationship was seen in the results of my analysis, but similarly to Hlaváček and Komárek, the correlation and significance is weak.

Weak relationship between the two variables show that changes in the CNB's policies do not directly impact the prices of property in Prague. Instead, such changes impact the availability of money, thus resulting in the volume of money being borrowed i.e. policy changes are not directly noticeable, and time some time for adjustment. Given the high s-value figure, the applicability of this regression to future projections are low, as impacts of changes in mortgage rates are better seen on mortgage volume instead. For this reason, the following correlation proves statistically more significant.

The relationship between prices of second hand flats in Prague and mortgage volume, however, questioned the findings of Hlaváček and Komárek. They concluded mortgage volumes, or rather, housing loans, did not prove significant. This was explained by the

fact that mortgages are not bound to be spent on housing, as long as an individual has a house to put down. My analysis between the variables show there is a strong correlation between the two variables, of which is significant. While most of the regressions had 11 observations, this one had 13, to show the effect of the CNB's policies that were implemented in 2008 and 2013. Such policies effects are only noticeable in the actual output value of mortgage loans, which requires a longer time frame. 11 observations would make the regression insignificant and further prone to error.

The difference in findings with Hlaváček and Komárek may be due to the time frame being considered in each research. Hlaváček and Komárek focused their analysis between the years of 2000 and 2010, whereas the research question under current consideration focuses on the years between 2010 and 2020. A decade may have changed the incentives of individuals borrowing money, such as the growing popularity of AirBnb and subleasing apartments. As discovered in the theoretical part of this paper, subleasing apartments played a large role in the affordability index, meaning prices rose far quicker than the rate of average salaries.

Another reason the findings have differed may be due to the location specificity. Hlaváček and Komárek compared the entirety of the Czech Republic, while I have focused on Prague. Using a price index specific to Prague showed that mortgage volumes have a strong impact on the city's real estate, rather than the nation as a whole.

Similarly to the findings of Skala, Slavata, Belke & Jonas, and Hlaváček & Komárek, wages are a critical determinant of price of real estate. While previous literature considered wages across the Czech Republic, Prague-specific statistics may have amplified the correlation between the two variables, as both omit the possible variation resulting from price and wage disparities across the nation. Prague's special economic and social characteristics are especially highlighted. Still, it does not ignore the affordability of real estate. While both variables are moving upwards, Czechs are still paying 11 times more their annual salary in 2019 to buy an average sized apartment of 70 sqm.

The s-value of 0.01 indicates the regression is able to project the relationship of the two variables in the future to a high extent, further supported by its statistical significance. Here, we find that history has repeated itself, and will likely continue to.

The relationship between price indices of second hand vs. new flats in Prague was the most unique pair to analyze, as previous literature has not done so before. While there is a growing supply of new flats, second hand flats are continuously being reconstructed, such as the housing estates mentioned in Ouředníček, Špačková and Pospíšilová's research. This has led to socio-spatial differences within the city, however, the value of both types of property continue to move closely together in a positive direction. This may be due to the fact that Prague, in general, has an excess demand in real estate. Incentives to invest are either to use real estate as a durable good, or as a consumption good. Demand is coming from both, aspiring home-owners, and profit-seeking investors. This introduces a broad interest in a variety of characteristics that are typically micro-determinants of real estate prices, e.g. street, number of hospitals, proximity to schools, etc.

In the future, the relationship between the two may differ if there is a supply relief of new developments. While the current Czech legislation says it takes 246 days to get a building permit, developers claim it takes 5 years or more, hence why the country ranks at 156th in the world for the ease of acquiring a building permit. Having an s-value of 0.05 in this regression analysis shows the pattern between the two variables are likely to be similar in the future. It would be interesting, however, to see whether a supply relief would change the correlation.

Another explanation as to why the prices indices of second hand vs. new flats in Prague is simply the way the economy progresses. Inflation, wages, money supply, and consumer confidence are determinants in a broad range of economic activities, and real estate, be it second hand or new, is no exception.

Price indices of second hand flats and construction output have a strong correlation as well, however, did not prove my hypothesis. While meeting the verification criteria, the relationship between the two variables is positive. I predicted the relationship would be negative. Using the laws of supply and demand, one could assume the more housing is available on the market, the less the price. This regression shows Prague's real estate market is not a textbook example of supply and demand, given there is an excess demand in housing. The relationship between price indices of second-hand and new

flats in Prague proves this as well, showing a demand for both older apartments, as well as new developments.

One must note, however, the methodology used to find the construction output also considers reconstructions. Due to the difficulty of obtaining a building permit, shown by the World Bank's Doing Business Index, Czech's are likely to reconstruct the homes they already live in, as seen in Ouředníček, Špačková and Pospíšilová's research. Reconstructing homes increases the value, hence why the price indices of second-hand flats show a positive correlation with the construction output volume.

The World Bank's Doing Business Indices used in this research resulted in high s-values, meaning the projection between the variables for future reference is low. Price indices of second-hand flats in Prague in relation to obtaining a construction permit have not met most of the verification criteria. The correlation between the two variables, although above 0.6, is still not strong enough to prove my hypothesis stating there is a strong, negative relationship between the two. The regression line does, however, move downwards, indicating a negative relationship. The only criterion that has been verified is the p-value, indicating there is some statistical significance.

The relationship between second-hand flats in Prague and ease of registering property did meet most of the criteria, except for the p-value. This may be due to the exclusion of outliers, making the sample size far smaller than the rest of the analyzed regressions. By conducting the IQR method, I identified outliers to set a "fence" against outliers falling out of the range between the value of the first quartile less the median, and the third quartile plus the median. In doing so, years 2011 and 2013 were omitted from the regression analysis. This may be why the correlation between the two variables is high, whereas the s-value is low. Given a limited amount of observations, it would be hard to determine whether the relationship can project future patterns between prices of second-hand flats in Prague, and the ease of registering property.

In both indices, ease of obtaining a construction permit and registering property, the Czech Republic ranked the same throughout consecutive years. Due to the nature of the data, that being a sample consisting of whole numbers that denotes a ranking which is simply revised every year, and a limited sample size, the s-value is prone to detecting a high standard error. Additionally, the Ease of Doing Business Index has recently dealt

with controversies. In 2020, irregularities in data were found by the Financial Times, The Economist, and The Wall Street Journal, reporting some statistics were suspected to be inappropriately altered. Because of this, the World Bank delayed the publication of the Doing Business Index to review data changes. In December, reports were released, specifying the revision of such data irregularities are to:

- Review specific irregularities identified
- Independently confirm the specified irregularities
- Independently review Doing Business's processes for data production and management.

Secondly, the data extracted to analyze the relationships between the Ease of Doing Business Indices and prices of second-hand flats in Prague used the ranking of Czech Republic, rather than the score. By using the ranking, the data failed to consider that other countries performance may impact the placement of the Czech Republic. If having used the score, one could depict whether there is a difference in the indices from previous years. Unfortunately, individual scores of sub-indices are not available, and is only provided in the context of an economy's entire Doing Business Index.

Finally, the way Doing Business is implemented may have also impacted the results of my analysis. For instance, Doing Business does not evaluate whether a reform has been implemented within an economy, instead, it takes the governments' word for it. Another flaw in implementation is the sample selection bias. Different cities are focused on different sectors within the economy (e.g. agriculture or manufacturing). Obtaining a construction permit for a service-oriented business is rather easier, as less space is required (e.g. customer service), however, obtaining a construction permit for a manufacturing plant may be more difficult, as more space is required. Prague, according to the 2020 Global Manufacturing Risk Index by Cushman & Wakefield, ranks as the 4th top manufacturing locations in the world.[41] The Doing Business Index fails to reflect this, and does not weigh in such factors when analyzing the playing field of a business environment. On top of the limited sample used in this analysis and the elimination of

[41] Graham, Lisa, and Jason Tolliver. "2020 Global Manufacturing Risk Index: Insights." *Cushman & Wakefield*, 25 June 2020, www.cushmanwakefield.com/en/insights/2020-global-manufacturing-risk-index. Accessed 25 April 2021.

outliers, the Ease of Doing Business Indices are exposed to external elements that affect the results of my analysis, thus rejecting my hypotheses.

Limitations

This research consisted of some limitations one must consider for future reference. Limitations typically include those seen in variables, methods of analysis, and the general availability of data. In the following paragraphs, I will discuss possible deterring factors amongst the variables used to determine the price of real estate in Prague.

Price Indices of real estate are generally used to determine residential property prices, as macro-economic indicators of economic growth, from authorities to implement certain monetary policies, input on the estimation of housing as a component of wealth, etc. The Price Indices of Second Hand Flats in Prague can be used in all of the ways mentioned, but still has limitations. One being, the index constitutes of data collected from real estate agencies in the Czech Republic. While this does give an idea of the average offerings in Prague, the real valuation may be skewed due to costs involved with individual agencies. Secondly, price indices match prices of identical items over time. This may be enough in some contexts, however, housing and properties have unique attributes, such as location and structural characteristics. Lastly, attempting to construct a real estate price index that matches exact properties over time is not possible due to quality changes, undergoing renovations or being subject do depreciation.

The result of the Price Indices of New flats in Prague is the weighted average of the results from each region of Prague. This is beneficial, as dynamic changes in construction of each region is being taken into consideration. For example, each region in Prague has different motivations for development. Some regions, such as Prague 9, are prone to developments that would result to increased parking, as the area faces a parking deficit. This does however, distribute the weighted average across all regions in Prague, even those where there are lesser new developments. Each region may have their own demand determinants, making it difficult to assume the corresponding variables in relation to real estate prices in Prague. Another limitation of this index is the pre-development sales. Some developers often sell their properties, or rather, the property contracts, before the first brick has been laid. This skews the valuation of new

flats in Prague, as some individuals or investors may have purchased properties at a far lower price than those who purchase it after the development is completed.

Using the mortgage loan interest rate is a good indicator to determine the decisions made by financial authorities, which in turn, affect the trends in real estate prices. The problem with using the mortgage loan interest rate as an independent variable, however, was the slow effect it has on the actual economy. Even though authorities choose to decrease or increase the mortgage loan interest rate, the motives of society will be seen after some time. For this reason, the value of mortgage volumes would be sufficient enough, as they show the reaction individuals and investors have on the decisions being made by financial authorities. In doing so, the indicator proves to be a larger determinant of real estate prices.

Data for the average monthly salaries was extracted from the CZSO, which highlighted the difference between Prague vs. the rest of the Czech Republic, making this indicator a good determinants of Prague's real estate market. Even though the significance between the price indices of second-hand flats in Prague and average monthly salaries in Prague was high, the index excludes some factors and people, such as workers who are not registered employees (e.g. sole traders). Many individuals are working for large companies, earning a similar salary, but do not work in the framework of an employee contract. Reasons for doing so are primarily for tax, and is widely used as a form of payment. Other types of workers are not included in the calculation of the average monthly salary index as well. For example, since 2009 the data does not include employees who work less than 30 hours a week.

Construction output is also calculated by the CZSO. Construction output considers all regions of the Czech Republic, but does not have city-specific data. Most of construction conducted in the nation is focused around Prague or its surroundings, however, the lack of specificity may have exaggerated the results. Another limitation is construction work that is being considered is only those working under contracts. The volume of this work is carried out using invoiced values. Such means of measurement is unable to attain data from work outside the framework of contracts. Lastly, a limitation is introduced given

the types of constructions taken into account. This researches primary objective is to focus on determinants of real estate in Prague, that being, residential real estate. The index, however, takes into account residential buildings, non-residential buildings, civil engineering works, and water management works. The largest sums of investment and development are devoted to civil engineering work, with the help of the government. Large sums such as these extend the output volume of construction, generalizing the assumption that construction is highly correlated to prices of residential real estate in Prague.

The authors of the Doing Business Indices have claimed the responsibility of persuading countries to impose reforms given the World Bank's recommendations, which has lead to leading economies climb up the ladder of the Doing Business rankings. The competitiveness of leading economies poses a threat to smaller ones, such as the Czech Republic, when using rankings rather than scores to conduct analysis. Several criticisms directed towards the World Bank fall into four general ideas: 1) a common law basis, 2) a preference for deregulation and free market solutions, 3) a lack of correlation between the rankings and realities each nation faces, and 4) methodological flaws.

Common law countries tend to regulate less than civil law countries, hence measuring economic outcomes associated with inefficiency are not as heavily regulated as in civil law countries. Czech Republic follows civil law, and is a victim of this bias. The generalized method of obtaining data does not account for individual country characteristics, such as culture dimensions affecting their way of conducting business. The World Bank recommended the Doing Business reports shall be more transparent, and modifications in methodology should be considered. The World Bank's own review panel argues that the index reports were misinterpreted, relied on a narrow range of sources, was not designed to help countries take appropriate action, and faced problems with the use of aggregate rankings.[42]

[42] McCormack, Gerard. "Why 'Doing Business' with the World Bank May Be Bad for You." *European Business Organization Law Review*, Springer International Publishing, 30 Aug. 2018, www.link.springer.com/article/10.1007/s40804-018-0116-4. Accessed 25 April 2021.

While the single linear regression is straight-forward, has a simple implementation, fits linearly separable datasets almost perfectly, and regularizes over-fitting, it has some disadvantages as well. Single linear regression is prone to under-fitting, meaning the model can fail to capture the data properly. Linear regression models are also sensitive to outliers. Any abnormality in a dataset that deviates from other points on the plot can significantly change the performance of a model. In this research, however, I used the IQR method to determine whether there were outliers in a given dataset. Having omitted them out of the regression, only 9 observations were made to output the model. If having more observations, the result may have differed and changed its statistical significance.

Just as in every research, limitations are found in many perspectives, however, this means future work on the determinants on the price of real estate in Prague can use the results to build a basic framework for new methodologies.

Future Research

For future research, one should consider topics that may be equally as interesting as the analysis and results of this research. Although limitations introduce new methods and approaches to this topic, it does not call for new research questions. For this reason, I believe the following mentioned ideas are worth considering in the academic scope of real estate investigation.

Commercial real estate has the same barriers as residential, such as the difficulty of obtaining a construction permit or registering property, however, it would be interesting to assess whether the chosen independent variables in my research would mirror the affects on prices of commercial real estate. While Prague suffers from a residential real estate deficit, does it in the commercial real estate sector? Buyers of residential real estate are primarily individuals, but given the evolution of the Czech economy, international investors and corporations are drawn by the economic opportunities.

Future research can also investigate the portfolio of buyers of commercial real estate, and may find that commercial real estate is considered a nondurable good (i.e.

consumption good), rather than a durable good. That means, determining whether commercial real estate is being rented out, or bought.

After thorough analysis of previous literature, and the interpretation of results, the mortgage loan interest rate proves to be a significant determinant of real estate prices in Prague. Future research could assess whether the mortgage loan interest rate determines more the price of old vs. new flats in Prague. As previous literature has pointed out, there is an excess of demand, but for what type of property is demand more directed to? This could also reveal why the reconstruction of housing estates have high demand. Variables to be considered may be consumer preference, obstacles of obtaining a construction permit or level of risk a buyer is willing to take. Perhaps it is easier for a buyer to borrow against the equity of their home, which allows a borrower to borrow against their home, minus the outstanding mortgage on that property.

Amid the spread of the novel Coronavirus disease (COVID-19), the residential real estate market sought a drastic structural change. The apartments once used for short-term leases in the center of Prague were being converted to medium or long-term leases, which in turn, led to a sudden supply of available apartments for rent. With a sharp rise in supply, rental prices within the city dropped, and continue to operate in a highly competitive market. Simultaneously, the prices of buying real estate (real estate as a durable good), sought a sharp increase. To help the economy absorb the shock, the CNB decreased interest rates. Some believe the sharp increase in the prices of real estate were a reaction to the CNB's actions. Future research can examine whether the independent variables of this study have a similar correlation to the prices of second-hand flats in the market after the impact of the virus.

Real estate in Prague may also be evaluated by comparing the relationship of rental prices and selling prices. By using the rent-to-buy ratio (sale price divided by rent price), research may determine at what point of the economy's cycle, Czechs have had the biggest opportunities. This may be further investigated whether it was individuals or investors who grasped at such opportunities, given the high housing affordability index of the Czech Republic.

Finally, future research should use variables which sources have of quarterly data. The more observations each variable has, the more it is possible to reevaluate the hypothesis of this research, strengthen the statistical significance of each independent variable and conclude whether there is a pattern in determinants of real estate in Prague.

Conclusion

In this research, I focused on analyzing the determinants of real estate prices in Prague using a single linear regression analysis, using 7 different independent variables presumed to affect housing prices. These variables were chosen given the previous literature that has been published upon this topic, yet also included variables presumably unique to the business characteristics of Prague, such as the Doing Business Indices. Prague is known for having one of the lowest scores in the ease of obtaining a construction permit, and in including a corresponding variable, I was able to conduct a well-rounded analysis. My analysis considered whether supply or demand-side determinants play a larger role in the prices of second hand real estate in Prague. To the best of my knowledge, this research is one of the first analyses of Prague's unique pattern in property prices of second hand flats, between the years 2010 and 2020. While the country managed to handle the Euro crisis well, Czech Republic was hit with one of the longest economic regressions it has experienced in the early 2010's. The effects of some monetary and fiscal policies appeared after years of application. Because of this, the results of the analysis should be interpreted in discretion.

A number of conclusions can be drawn after interpreting the results of the various single linear regression models. I found real estate prices in Prague are driven based on both supply and demand-side factors. Demand-side factors were represented by the average monthly salaries, mortgage loan interest rates, and the Doing Business Indices. Supply-side factors were represented by mortgage volumes, construction output, and prices of new flats in Prague.

Low interest rates and limited supply of residential real are what marks the housing crisis, as it has over-valued property prices in the Czech Republic in the past, primarily in Prague. Assumed approaches described in previous literature suggest that

in order to fix this, there must be an increase of affordable housing supply, and an improvement in regulations by adopting a new building act. A new building act would allow society to have easier access to obtaining a building permit. Growing demand is driven by investors who try to take advantage of price increases and cheap mortgages (low mortgage loan interest rates), but individuals hoping to purchase property for the purposes of living in it have limited availability due to the high prices driven by those investors. This is seen in the regression analysis between the price indices of second hand flats in Prague and construction output. Textbook economics tells us the greater the supply of a good or service, the lower the price, hence why I hypothesized a negative correlation. However, the real estate market in Prague proves otherwise. The more construction, the higher the prices, due to the excess demand. One can conclude a critical determinant of real estate prices in Prague is construction.

An interesting finding resulted from the analysis of the Doing Business Indices. Both regressions have high statistical errors, but are statistically significant, yet previous literature shows obtaining a building permit and the bureaucratic difficulties involved in registering properties are primary reasons as to why there is a deficit in real estate supply. For this reason, the interpreted results of the Doing Business Index remain a mystery, as to the extent of determining the price of second-hand flats in Prague. Perhaps the limitations involved with these indices highlight why they have not fully aligned or distinct to previous literature.

Overall, the variables proven most determinant to the real estate of second-hand flats in Prague are mortgage volumes, average monthly salaries in Prague, prices of new flats in Prague, and overall construction output.

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