REAL ESTATE AND ECONOMIC GROWTH. HOW ARE BOTH AFFECTED BY ECONOMIC CRISES: THE CASE OF CYPRUS

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Abstract

This essay examines the future house price changes based on previous changes for the past 12 years from 2010 to 2022. It provides information on Cyprus's past crises, economic growth, real estate market literature recent data, and possible upcoming changes in house prices. In 2022, transaction activity levels exceeded expectations, reaching a record high of €5,2 billion in real estate transaction value. Economic growth and the real estate market are linked, whether the real estate market is expanding growth rate is also positive. Moreover, it discussed Cyprus's recessions affecting the real estate and GDP growth rate of the country. Next, it refers to real estate investment and the real estate cycle. Cyprus is in the expansion phase based on the results and the literature of real estate cycles. An investor or developer will invest money in the phase of recession and recovery but in the expansion, they need to sell the properties overpriced. Moreover, in the literature forecasting real estate prices have three kinds of ways to predict. The research used serial dependence in real estate returns and weak-form market efficiency. Data was provided from surveys in the Central Bank of Cyprus, Cystat, Eurostat, and the Department of Lands etc. The aim is to estimate future house prices to answer the question of whether it is more profitable for a junior investor to buy now or to wait. According to the results, during expansion, the prices for houses are higher than the market value. For an investor, this is a great time to sell at a higher level its property and have profits.

Keywords

Real estate investment trusts "REITs", European Central Bank "ECB", Central Bank of Cyprus "CBC", Gross national product "GNP" Gross domestic product "GDP", "CIP" Cyprus Investments Program, "ESTIA" government stimulus program, "OECD" The Organization for Economic Cooperation and Development, "MFI" Monetary Financial Institutions, "IV" Independent Variable, "DV" Dependent Variable

Thanks

Thankful to my parents Paulina and Kyriakos who supported me mentally, physically, and economically my whole life to be here presenting this thesis to the academic people of the University of Cyprus. Thankful to my brother Christodoulos who assisted me every time I needed him for papers that I needed to present, even if he was in New York and there are a lot of hours difference. Thankful for my two sisters Andria and Olga who were there to empathize with me and reminded me how much I need to believe in myself and my achievements and how far I've come and grown up and encouraged me during the most difficult times in this master's and full-time work period. Finally, a big thanks to my fiancé Andreas who was always there for me and keep me motivated to study and to achieve my goals even if there is hard work behind this. I have learned that I should never give up on my dreams!

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1 Introduction

Several major crises have affected our world over the years and cost a benefit to economic growth and real estate infrastructure in Cyprus. During a weakening EU economy, the Cyprus economy has maintained solid growth throughout 2022, despite the effects of rising inflation and a decline in purchasing power. As evidenced by the optimistic growth projections for 2023, the Cypriot economy's small size, flexibility, and extroversion regarding investments give it the agility to effectively adapt to and overcome challenges. Also, Cyprus due to the so-called scenario of "sun and sea" (and I would add sand as well "sea, sun, sand"), the tourism and the geographical location makes it easy to adapt to various changes over time. The Cypriot real estate market has proven to be particularly resilient in this ever-changing environment. In 2022, transaction activity levels exceeded expectations, reaching a record high of €5,2 billion in real estate transaction value (See Figure 2). The demand has all the earmarks of being fueled by the continuous segment shifts, regarding a constantly developing craving of unfamiliar organizations to move to Cyprus, a pattern that has been additionally sped up following the conflict in Ukraine. [7] The first place by far continues to be held by buyers of real estate from Russia in the Cypriot market, according to the data of the Land Registry for purchases and sales documents in the months of January and February 2023. Russian buyers are followed by the British, then the Israelis, the Greeks, the Lebanese and the Germans. [17]

The importance of housing for the average Cypriot citizen is significant and this can be seen from the fact that the largest percentage of savings is meant for the purchase of housing. According to the results of the Family Budget Survey published by the Cyprus Statistical Service for the period 2015/16, the percentage spent on housing amounted to 25.5%, while

food and alcoholic beverages followed with 15.3%. Moreover, in recent years, the demand for apartments and houses has increased dramatically, resulting in a notable upward shift in prices.

This thesis studies the Real Estate market in Cyprus and specifically the housing prices change during 2010 to 2022. Additionally, the research examines, how the economic growth affects real estate market, and both how are affected by various economic crises. Based on theoretical perspectives and knowledge some other components affecting the house price changes have also been researched in this thesis. The rationale behind this thesis is simply the need of people to know when the right time is, to buy a house or an apartment or else, to rent because it has a significant impact on their personal finances and long-term wealth accumulation. Of course, the aim of this research is to understand what are the main factors that influence housing market price changes during economic recessions like the one happening now, to forecast the next three years house price changes and have a clear picture of what the prices and economic condition will look like.

The first chapter is the foreword of my interests and the definitions of some keywords. Following, chapter two, I introduce my focus on economic growth and how it is affected by interest rate, inflation, and debt to GDP ratio. I introduce the recession in the literature and compare the economic growth and the real estate market. Then I analyze the market for houses and their investment cycle. I then compare these two topics. In chapter three, I state the methodology I used in my research, the data I analyzed, how and why I applied my data as well as its accuracy and validity. In chapter four, I list my research, the series I plugged into my model, and which economic variables I used to present the tests and results in the next chapter that I analyze my results. Chapter six contains my conclusions and chapter seven contains my sources and references.

1.1 Economic growth definition

A rise in the output of economic goods and services from one period to the next is referred to as "economic growth." It can be calculated in nominal or real (inflation-adjusted) terms. Although other metrics are occasionally used, gross national product (GNP) or gross domestic product (GDP) are the most common ways to measure overall economic growth.

1.2 Real estate definition

The term "real estate" refers to the land as well as any permanent structures, such as a house, or improvements affixed to the land, whether created naturally or artificially. Real estate is anything permanently affixed to or constructed on land, whether it be created naturally or artificially. Real estate can be divided into five main categories: residential, commercial, industrial, raw land, and special use. Buying a house, a rental property, or land is a real estate investment. REITs and pooled real estate investments are two options for indirect real estate investment.

1.3 Inflation and deflation definitions

The term "inflation" refers to an upsurge in the supply of money (in the broadest sense, encompassing trustworthy media as well), and this isn't accompanied by a matching rise in the need for money (again, in the biggest sense), resulting in a drop in the desired exchange-value of money.

The expression "deflation" (which can be translated as "restriction," "contraction," or "reduction") describes a decrease in the overall quantity of money that does not coincide with an associated decline in the overall need for money, causing a boost in the money's "objective exchange value." [8]

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1.4 Interest rate and negative interest rate definitions

The rate of interest is the amount of cash that the lender receives as payment for lending money for a particular amount of a period typically a year. Commercial banks based their rates of interest on the annualized rate of interest (APR), which is established by the country's central bank. [12]

In times of economic recession, central banks use negative interest rates to increase borrowing. Aiming to boost economic activity through increased investment and consumption spending, the central bank lowers the overall cost of borrowing for the entire economy by providing a negative interest rate. [13]

1.5 Debt/GDP ratio definition

The percentage of a nation's public debt to its gross domestic product is known as the debt-to-GDP ratio. By comparing what a country owes and what it generates, the debt-to-GDP ratio effectively anticipates the degree to which a community will be capable to pay back its debts in the future. This proportion, which usually appears in the form of a percentage, can alternatively be interpreted as simply the amount of years necessary to pay off debt if GDP had been utilized solely for that purpose. The equation that follows is used to determine the debt-to-GDP ratio: $Debt\ to\ GDP = \frac{Total\ Debt\ to\ Country}{Total\ GDP\ of\ Country}$

[14]

1.6 Bailout definition

A bailout is the inflow of money into a company or that would otherwise be in danger of failing soon. Loans, bonds, stocks, or cash can all be used as bailout funds. Some loans need to be repaid, with or without interest charges. Instead of just one specific sector or industry, bailouts

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are typically given to businesses or sectors that have a direct impact on the health of the entire economy. [15]

2 Theoretical perspectives

In this section I examine the Cyprus economy and real estate levels from the past to the present in 4 paragraphs. Furthermore, I introduce the recession definition and the impact on the GDP growth and the relation to the immovables. I go deep with economic growth and the relationship it had with inflation, debt and interest rates and find some conclusions. Real estate cycles come next, the factors that influence them and the duration of each cycle. Later on, investing in properties is the subject and when is the right time for an investor is the focus. Finally, the literature ends with the three types of forecasting in real estate prices, and there are models and evidence of some tests and statistics.

2.1 Cyprus growth during the years

From older years Cyprus was always occupied by other region (French, English, Turkish and other) and the economy wasn't developing during such times. In 1960 when Cyprus gained its independence from the United Kingdom, contribute with Greece, Turkey, and UK to Zurich London agreement. Between 1960 -1977 the president of Cyprus was Makarios who was also the chief of the church. During that period when Makarios was the president of Cyprus the executive, legislative, and judicial power was all in the Orthodox Christian church and politicians. Later when the Turkish invasion occurred, nobody could support Cyprus politically and financially other than the Cypriot human capital. In most families in Cyprus in contrast with more northern countries, parents consider the future of their children, and they work hard to set their kids an easier future than the one they lived in. All these years people have been working in agriculture and animal husbandry. After the 1974 invasion, more people started to

be educated and have better living conditions and higher wages. Apparently at that step of the economy then, the growth could be explained by the proper utilization of the country's available resources such as agriculture resources and comparative advantages like the so-called "sun and sea" scenario, the tourism growth, and the geographic location.

The economy of Cyprus has evolved the most, during the past few years because of its membership in the EU the 2004. After 2005 with the new technological improvements, Cyprus like other developing and developed countries emerged with jobs with better benefits. Thus, Cyprus grew in the private sector such as companies dealing with finance, management, law, technology, medicine, and more. During the entry of Cyprus into the European Union and the euro, Cyprus' laws and regulations were modernized with respect to the environmental, health, economic, and social sectors. In just five decades, per capita income in Cyprus climbed from €290 in 1960 to €21.700 in 2010.

2.2 Cyprus and real estate market the recent years

Due to Cyprus's local banks' complete lack of exposure to subprime securities, the American financial crisis of 2007 had no immediate impact on the country. Despite various criticism, the CBC's systematic and stringent monitoring in earlier years was advantageous to the financial sector and, consequently, to general macroeconomic stability. Banks have operated according to established business models, concentrating on essential services like lending and deposit-taking. Also, because client deposits have historically been their primary source of funding, the interbank market crisis, and the financial instability of 2008–2009 had little impact on their liquidity.

Yet, the economic downturn that particularly affected the UK had indirect impacts. Particularly, the recession-related decrease in the value of the pound sterling contributed to a

dramatic decline in British demand for real estate in Cyprus. Property values thus decreased in local real estate markets when demand was mostly from the UK (e.g. Pafos). As a result, Cyprus's construction sector began to register reduced and eventually negative growth rates, which had a severe effect on the country's economy. Decreased tax collection from the real estate market, which was not supported by a decrease in public spending, made the fiscal imbalances considerably worse and led to Cyprus' credit rating being downgraded again for the first time since 2003.

Notwithstanding certain drawbacks, such as a rise in non-performing loans in Greece, stringent oversight of capital adequacy was necessary given the scale of the banking industry in the Cyprus economy (Clerides and Stephanou, 2009). The start of the banking crisis in Cyprus in March 2013 was caused by the debt of the major banks and their financial bailout. In addition to the national and banking debts, the bailout was accompanied by a memorandum that imposed austerity measures that have had a significant impact on all facets of the local society (political, economic, social, cultural, etc.). As to be expected, the crisis has changed how people live their lives and how they portray it, which has changed how most Cypriots view the world.

Cyprus was regarded as a tax haven and attracted significant amounts of foreign direct investment, primarily from Russian capitals but not exclusively (Charalambous 2013). The banking and financial industry grew rapidly during this time frame. By 2010, its capital volume had nearly eight times the nation's GDP (Stefanou 2011). However, it was precisely this rapid growth that prompted the Eurogroup to make an unprecedented decision in March 2013 regarding the Cypriot economic crisis (as well as the wider Eurozone). This decision was made for a number of reasons, including this rapid growth. The final plan adopted a haircut on

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deposits over 100,000 euros, despite the initial proposal's intention to also penalize small savers (Charalambous 2014). [16]

2.3 Development of the real estate industry in Cyprus

Residential immovables priced between 100,000 and 300,000 euros is still in high demand. In 2022, there were 7.600 dwellings sold overall in this price bracket, up 19% from the year before and 41% from the period before the pandemic. In 2022, the value of purchases in this class totaled around €1.3 billion, or 25% of the total transactions that year. There have been 5% reduced fresh construction licenses filed. Over the course of two consecutive years (2021 and 2022), the cost of materials increased considerably, with prices climbing by around 30% (2020 increase: -0,4%; 2022 increase: 17,2%) (see Figure 1). Despite rising demand, fewer building permits were given. That was mainly because of higher construction costs, which also had an influence on the private/single-living segment of the housing market. In 10mln 2022, there were 5% lower fresh construction authorizations granted than there had been in 10mln 2021.

Figure 1: Change in construction price material index

Change in construction price material index
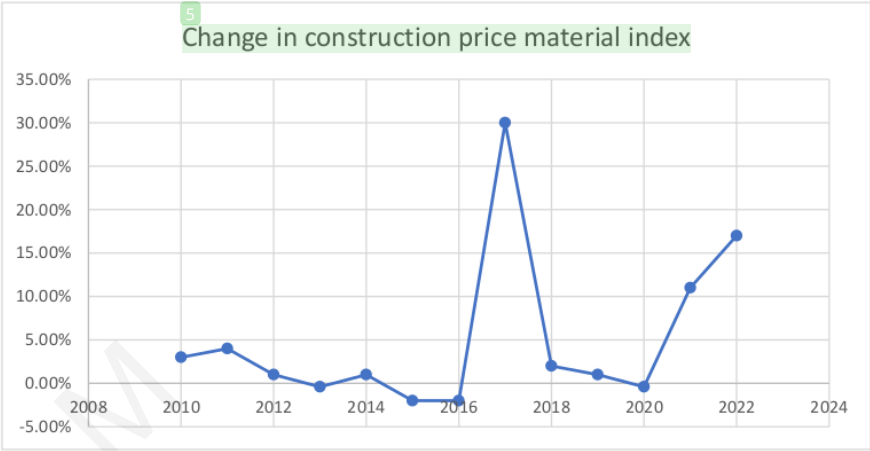
The property market in Cyprus is shown exceptional durability in 2022. Transaction activity levels exceeded forecasts and reached a record-high of €5,2 billion in value (Figure 2), registering a 27% yearly rise in value. In terms of transaction volume, the total number of properties transferred in 2022 was 22,500, up from 20,100 in 2021, a 12% rise. This figure is even above the pre-pandemic peak 2019 levels (17,200) by 31%. The most recent report from the European Commission (Autumn 2022) states that the significant increase in transactions throughout 2022 reflects the rising desire from enterprises with foreign interests to transfer their activities and employees to the island, together with a robust domestic segment. Since the beginning of the year, over 1.000 international businesses have chosen to move their operations to Cyprus, together with a reported 9.000 staff. This translates to around 25.000 persons (employees and their families) moving to Cyprus.

Figure 2: Volume and value of properties transacted 2013 -2022

Volume and value of properties transacted 2013 -2022

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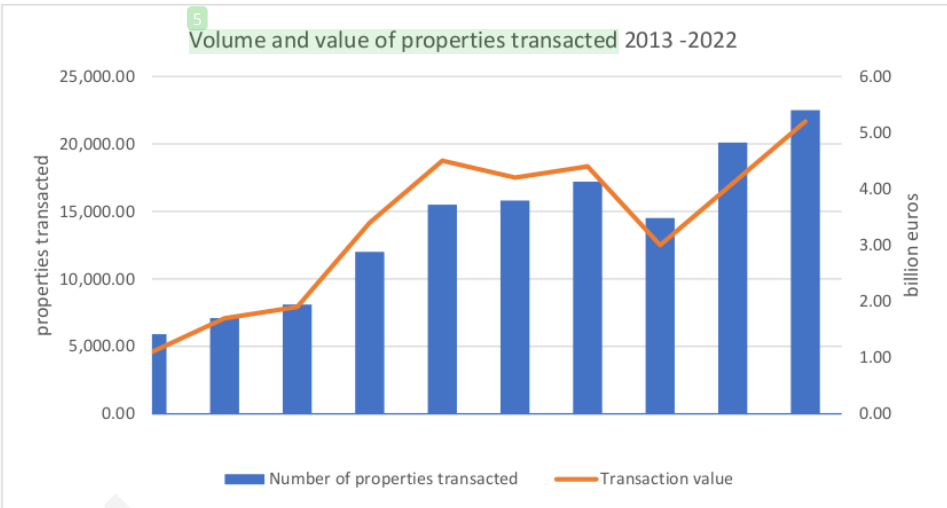
Other factors that influence the market prices are the GDP growth rate (Figure3), the inflation (Figure 5), the unemployment rate (Figure 4), the average income (Figure 7), the interest rate on loans (Figure 6).

Figure 3: Cyprus GDP growth rate in 2013 has the lower rate and after this is th -4,40 in 2020
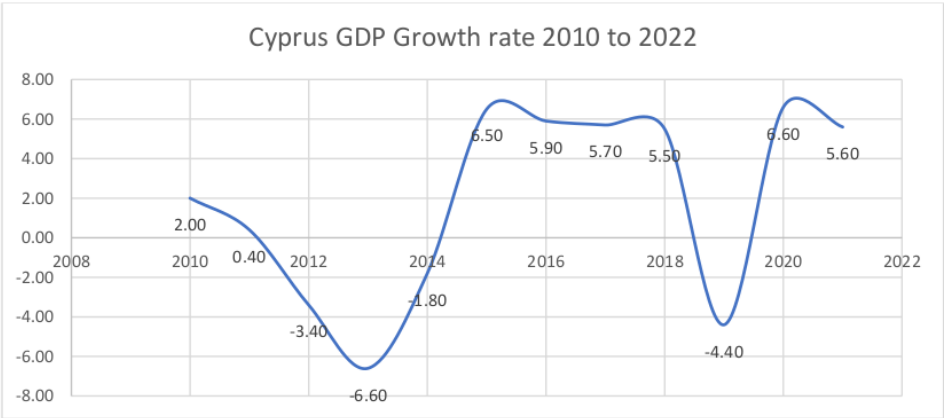
Figure 4: Unemployment high rates starts in 2012 till 2017 when bailout crisis occured in Cyprus
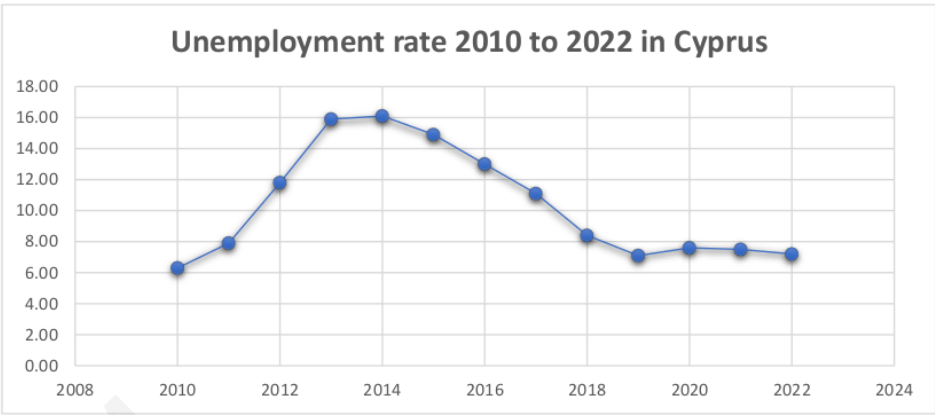
Figure 5: Deflation observed during the years 2013 to 2016 and in 2020 and high inflation in 2022.
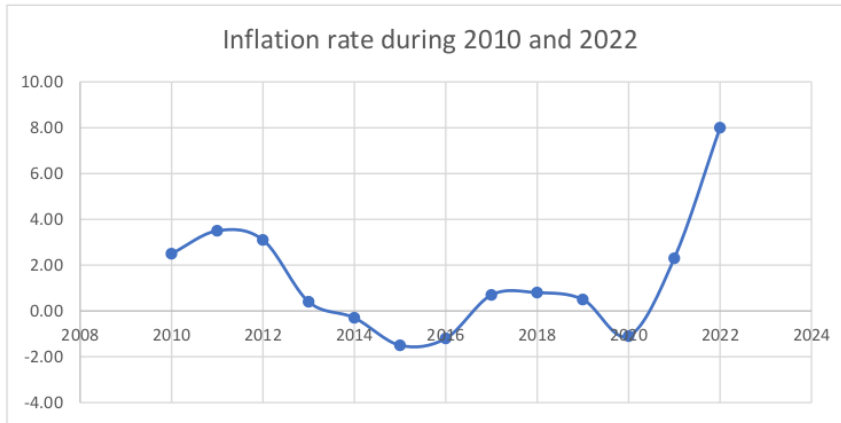
Figure 6: Cyprus interest rates in mortgages expected in 2023 to increase to an average of 4,28%
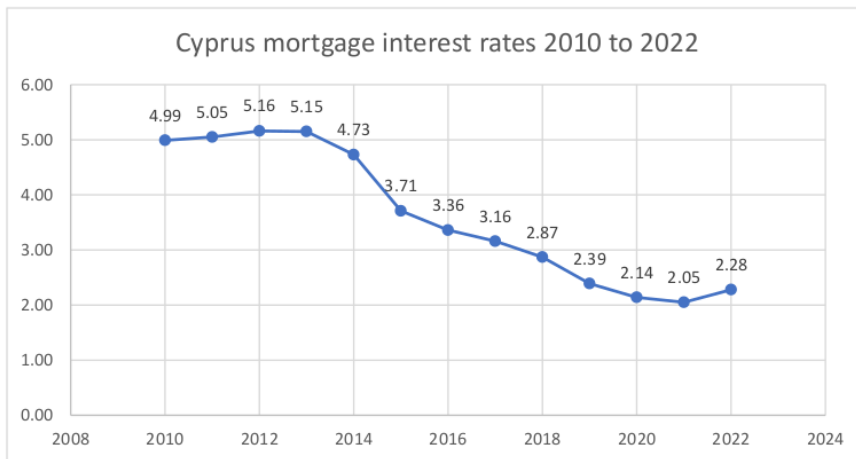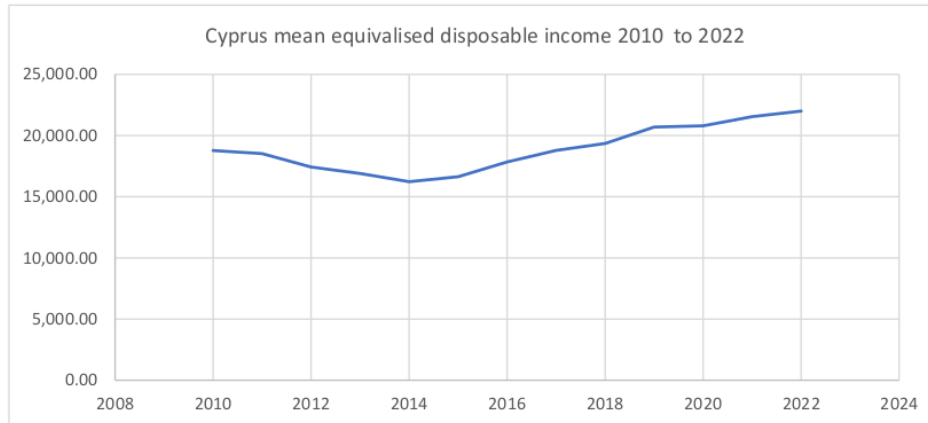
2.4 Affordability problem of residents in Cyprus

Over the years, the affordability of housing has been a changing problem, and if it is not addressed effectively, it is anticipated to get worse. The PwC Survey (Emerging Trends in Real Estate Europe 2021) highlighted the need for increased investment in social infrastructure, such as affordable housing, throughout Europe, with the COVID-19 pandemic exacerbating this problem. Although, the property industry in Cyprus is still expanding, mostly due to strong domestic demand and continuous international investors.

Around 70% of the housing stock in Cyprus is owner-occupied, and a sizable chunk of it is subject to a mortgage or loan, according to statistics published by Cyprus. Those households have debts totaling roughly €3.5 billion. Even though the ESTIA program (which is a fund given from government for houses to some specific addresses in Cyprus,) might help to reduce some of the issues, households still make mortgage loan defaults at a steady rate. There is also a plan for the provision of financial assistance for the housing of displaced persons and refugees but there are a lot of income criteria, that needs to be covered.

It is deemed crucial to implement an efficient housing policy. This framework's policy measures should encourage housing and development initiatives for the society's lower-income strata. According to the demographics of the various areas on the island, these policies could be scaled. Examples of alternative housing policies that exist around the globe include setting rents in housing schemes that are lower than average rents in the neighborhood (i.e. capping rents as a percentage of the market rent, regulated by the local authorities), downsizing real estate (i.e. creating housing units that are smaller than the minimum threshold size, specified by the town planning regulations), rent-to-buy programs, and repurposing. [6]

2.5 Real estate market and economic growth

The landholding market is closely linked with the broader economy and can significantly impact economic growth. ECB's estimated elasticities computed from the Panel Probit model, suggest that past economic growth, short term interest rates, local and global money, credit developments and the incidence of mortgage market deregulation significantly affect the probability of experiencing booms and busts. [22]

In LHT Chui and KW Chau research, discovered that immovables values, in particular office and residential prices, drive GDP growth. Consequently, changes in real estate values may be utilized to predict GDP growth. Second, since landholding values tend to follow GDP, policies that control residential prices are probably also going to control economic expansion. Third, any policy that restricts or discourages the real estate industry, particularly the residential sector, is likely to have a detrimental impact on the economy. Similarly, any measure that boosts home values would likewise boost the economy. [24]

Following are five ways in which the property market and economic growth are connected. First, the real estate market contributes to job creation through the construction of new

buildings, maintenance of existing properties, and provision of related services such as REITs, property management and real estate brokerage. This can help stimulate economic upswing by increasing employment opportunities.

Second, immovables are a significant form of underlineinvestment for individuals and businesses. When the landholdings are performing well, investors may see increased returns on their investments. This can lead to higher levels of investment, which can in turn contribute to economic growth.

Consumer Confidence can be influenced by Real estate values, trends, and spending habits. When property values are increasing, homeowners may feel more financially secure and be more likely to spend money. This can help stimulate economic growth by increasing demand for goods and services.

Additionally, immovable transactions are often subject to taxes and fees, which can generate revenue for governments. When the real estate market is performing well, governments may see increased revenue, that can be used to fund public services and infrastructure projects.

Lastly, immovables are generally one of the largest assets owned by individuals and families. Increases in the prices of immovables can lead to a wealth effect, where individuals feel more financially secure and are more likely to spend money. This can help stimulate economic growth by increasing demand for goods and services. Overall, the immovable market is an important component of the economy and can significantly impact economic growth, of course, when the landholding market is performing well. Real estate can contribute to job creation, investment, consumer confidence, government revenue, and the wealth effect, all of which can help drive economic growth. [25]

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2.6 Economic Recession

An economic recession is a significant decline in economic activity that lasts for an extended period. It is typically characterized by a reduction in the gross domestic product (GDP), high levels of unemployment, and reduced consumer spending. Recessions are usually caused by a combination of factors, such as a decrease in demand for goods and services, a decrease in investment, or an increase in interest rates. They can be triggered by events such as a financial crisis, a natural disaster, public health crises, global destabilization like wars, disruptive changes in technology, a sudden rise in prices for oil or other commodities, and large-scale shifts in consumer confidence and spending habits.

As the Covid-19 pandemic approached no one could have ever imagined what would come next. An economist could have forecast the future due to previous pandemics or epidemics but this time, the exogenous parameters follow one another. From the 2019 pandemic which is a public health crisis to the large-scale shifts in consumer confidence and spending habits to the sudden rise in oil prices. The stop of production all over the world and the invasion of Ukraine increased oil prices in some countries to almost triple their gasoline prices from covid 19 period till the end of 2022 and still going.

As a first thought, this crisis would have been the same as the US great recession 2007-2008 but this recession is still growing but at least is not that high as the US recession. Macroeconomists advise that inflation will most probably be settling by late 2023. Currently, the ECB increases the interest rate so the expected mortgage delinquencies will be soared as interest rates go up because of the significant expansion in mortgage lending as well as in property prices. Similarities faced in the 2008 global recession in the US. When real estate prices come to the highest level, the deflating of the housing bubble and the subsequent price

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collapse has a domino effect on other financial markets both domestically and abroad. Global asset values decline as financial volatility sharply increases. The housing markets, especially those that traditionally have shown greater volatility, will be among the markets where values decline significantly.

Findings from European Central Bank say that in the last 40 years from 2009, the most recent housing booms have been among the longest-lasting. Like previous booms, the size of price deviations from long-term trends has been consistent in housing. The financial implications (measured in terms of GDP losses during the post-boom era) greatly rely on the extent and durability of the boom as well as the evolution of money and credit throughout this time. The likelihood of experiencing booms and busts is substantially influenced by past economic growth, short-term interest rates, local and international money and credit changes, and the frequency of mortgage market deregulation. [26]

2.7 Economic growth applied

2.7.1 Economic Growth and its relationship with inflation

One of the major purposes of both monetary and fiscal policies is economic growth. It is a significant conundrum if economic growth can be maintained despite inflation. The primary goal of the central bank, in addition to the government's fiscal policies, is price index stability. Inflation targeting is one of many strategies that can be used to prevent high inflation rates. The According to the Phillips curriculum, there is a negative correlation between inflation and unemployment. Therefore, during periods of high inflation, unemployment falls, and lower unemployment contributes positively to economic growth. Tobin's Positive Association Statement argues that ascent to infinity results in a decrease in personal wealth. Faced with this

situation, individuals will save more to reclaim old assets, and more savings will lead to more investment and lower interest rates leading to economic growth.

In connection with this, Fischer (1993) noticed that inflation had a damaging effect on economic growth. Inflation rates and real growth rates have an inverse relationship, as demonstrated by Motley (1994). According to Andres and Hermando's (1997) analysis of the relationship between inflation and growth for OECD countries, growth has a negative impact on growth because of inflation's negative effects on investments and productivity factors. Etintas (2003) examined the relationship between inflation growth and the Turkish economy from 1970 to 1996. The findings of that research indicate a long-term antagonistic relationship between inflation and growth. On the premise that other variables are constant, a 10% increase in inflation results in a 0.6% decrease in real GDP per capita.

The relationship between inflation uncertainty and growth was examined by Artan (2008), who put this relationship to the test using time-series analysis. The results of the cointegration analysis emphasize that because inflation has a negative impact on growth, it should not be a cost of rapid growth and that the primary goal of the central bank should be to maintain price stability.

In contrast to studies that looked at the relationship between growth and inflation in Turkey, Türkekul (2007) examined this relationship from a sectoral perspective. They investigated the link between agricultural sector growth and inflation and concluded that it negatively affects inflation. They also found a one-way causal link between economic growth and inflation.

Concluding with all the literature from Yunus Açci et al, research on economic upswing and its effect on inflation the results, I realized that in each period, the consumer price index makes

a positive contribution to economic growth. This is because any increase in the consumer price index increases the desire of individuals for consumption. In addition, the increase in the consumer price index shifts savings from financial markets to the real sector and increases production. [5]

2.7.2 Economic growth and its relationship with Debt

Initiatives for fiscal stimulus have been seen in the countries affected by the COVID-19 pandemic. Fiscal stimulus programs have resulted in significant increases in the public debt/GDP ratios of many nations, and in nations that have been exposed to debt-related crises, debt management has taken on the role of economic management. Numerous developing nations have entered a crisis because of rising public debt-to-GDP ratios, and discussions with the IMF and World Bank have already begun.

The question of whether an economic recession will be faced during an austerity policy or economic growth with this policy is one of the issues discussed in the literature. In Reinhart and Rogoff's (2010) study, which deals with the issue of growth in a time of debt, thresholds were established and the relationships between GDP values larger or smaller than these threshold values and economic growth were established. The following two remarkable findings were obtained in the study:

I) If the public debt / GDP level exceeds 90% in developing and developed country economies, growth targets will be adversely affected.

II) For the external debt parameter, if the value of external debt / GDP exceeds 60% in developing countries, the target of economic growth is adversely affected.

When the relationship between austerity policy and economic development, is examined, the cyclical behavior of fiscal policy becomes important. In the study of Kaminsky et al. (2004), they state that the behavior of the fiscal policy cycle might be either consistent or countercyclical. Also, they state in the same study that the behavior of fiscal policy might be a-cyclical. In terms of reactivity, the cycle being in a good or bad period is important for fiscal policy.

2.7.3 Economic Growth and interest rates

External borrowing affects economic development and growth, but it also has some political and social repercussions. Developing nations in a sense become reliant on the nation they borrow from due to the loans they incurred to achieve their development goals. As a result, these developing nations can provide some economic and political benefits to developed nations. Not only can lending money cause this problem, but it can also result from other complimentary transfer expenses, giving development credits, or assisting defense systems.

If external borrowing has positive and negative effects on economic growth can be seen in Çiçek, Gözegir and Çevik (2010) analysis. It was found that the increase in domestic debt stocks had a positive effect on GDP, but the increase in external debts had a negative effect on GDP.

Errata and Nur (2013) found that developing countries, defined as emerging economies, are dependent on external borrowing due to deteriorating relations between production and markets, and between income, savings and economic growth. China, India, Indonesia, South Korea, Turkey, Poland, Mexico, Brazil, Argentina, and South Africa are designated as emerging market countries by the U.S. Department of Commerce. In this regard, the existence of cointegration between variables was confirmed by the ECM test, and then the prediction of

the long-term regression coefficient by the common correlation effect model showed that excessive borrowing due to external borrowing had a negative impact on economic growth.

2.8 Real Estate "Cycles"

Rental rate definition: The periodic charge per unit for the use of property. The rental rate may be a certain amount per square foot per year (even though paid monthly), per square foot per month, per room, per apartment, or any number of other variations. Calculating the price to rent ratio is easy to do: Median Home Price / Median Annual Rent = Price to Rent relationship. [21]

Real estate markets involve both commercial and residential real estate move in a four-phase wave-like pattern known as a real estate cycle. The immovable cycle is usually recognized to have four phases: recovery, growth, excess or hyper supply, and recession. One consequence of a cycle is that there has never, historically, been a prolonged period of hyper-supply or growth without a subsequent period of recession and recovery. Same as economic cycles, as long as there is a "boom," there will inevitably be a "bust," albeit strictly speaking, the depth of the wave might just as easily be "soft and shallow" as it could be "hard and deep".

The four phases of property cycle are analyzed below:

Recovery: The real estate market's recovery phase starts when it is most destroyed and lasts until it stabilizes. The first cycle's phase is the slowest and frequently takes the longest. It follows the recession phase, where building occupancy and rental rates are low, and development has slowed or halted. Occupancy and rental rates progressively increase after stability, albeit initially rental growth is likely to be below the rate of inflation. Since the entire market may resemble the recession phase little, it might be difficult to tell the difference

between the recovery phase's traits and the latter. However, by examining patterns in occupancy and shifts in demand, researchers will be able to spot the transition into the recovery period. Since prices are low relative to earlier levels, the recovery phase is an ideal time to invest in real estate, especially for distressed houses that may or may not require improvements and are in financial or physical difficulty. The potential future return on investment through operation or resale is considerable for investors purchasing such assets. By increasing the value of these assets, they may bide their time until the economy enters its expansionary phase while still waiting to sell or rent.

Expansion: The real estate market can only be deemed robust during the growth period. Increased housing demand and a rise in the number of tenants seeking for available spaces are two signs worth looking for. Is the point at when the housing market has fully recovered from the recession phase, demand is high, supply cannot keep up with demand, and prices and rents are growing rapidly. Low vacancy rates, rising property values, and many new building initiatives are all present. Since demand is strong and new buyers or renters are frequently available, many investors may acquire new properties or remodel old structures, either to rent out or sell, during this time. With rising consumer confidence, the general economy is strengthening, and employment growth is robust, which in turn has raised demand for office space and housing. While the market is growing, many investors concentrate their efforts on building or renovating homes that fulfill demand in order to resell them or generate lucrative cash flows. As a result, this is the busiest and highest-paying time for immovables development.

Hyper- or over- supply: When there are more unoccupied rental homes and other properties on the market than there are purchasers, this is known as hyper supply. This happened most

recently during the 2020 pandemic in US. Immediately after the period of growth, during which numerous developers or investors raced to produce the new stock. Therefore, when new building projects get closer to completion, supply frequently ends up surpassing demand, which causes vacancies to increase. As a result, rental and price increases will slacken or stop. During this phase, some investors who only want to own properties for a little period of time may contemplate selling them, and there will also be investors who are eager to sell their holdings because they are anxious about the coming recessionary phase. As part of the so-called "buy and hold" strategy, buyers in this phase will hold off on selling until the growth phase. Another tactic that is occasionally used at this stage is to purchase high-quality assets that would not otherwise be on the market, assets that have long-term leases with reliable tenants, in order to provide continuous cash flow throughout the impending recession. An abrupt change in the local or global economy when demand declines may also be the reason for changes from the boom period, in addition to there being too much inventory on the market. Many believe that now is a great opportunity to take an allegedly "opportunistic" stance. use the purchase-and-hold technique to find properties that are anticipated to perform well throughout the expansion phase of the upcoming real estate cycle. The housing market offered buyers a variety of homes, and vacancies were widespread. Overbuilding and growth of the real estate market are frequent causes of hyper-supply.

Recession: There is a vast imbalance between supply and demand, and few individuals buy homes. Some properties reduce their rent to entice new occupants. A recession is a moment of anxiety for many people working in the property sector. However, its familiar with the real estate cycle, everyone should have faith that a recovery will ultimately occur. The pandemic was the cause of the most recent recession. It is impossible to predict when the next recession will officially begin. In fact, until it has already begun, no one will really know when it will

happen. Part of the fault lies with the economy's various dynamic components, which influence our nation to various degrees. A high vacancy rate and lower rental growth - possibly below inflation or even negative growth - occur during this phase because of an excess supply of new properties relative to demand. A few opportunistic investors may hunt for investment possibilities when prices decline, including foreclosures of homes that lenders have taken back in their possession. Following this, investors will adopt a buy-and-hold strategy with the intention of eventually selling once the market and economy start to improve and prices and rents rise.

2.9 Factors that influence real estate cycles

A specific list of all the components that influence the property cycle would be difficult to come up with. However, specialists may all agree that some of the major causes include the following:

Demographics: A market can be greatly influenced by the population's makeup and significant changes in that composition. For instance, the retirement of the baby boomer generation is anticipated to result in significant changes in the housing market as many opt to downsize or relocate to vacation destinations.

Interest rates: Interest rates have a significant impact on prospective homeowners' purchasing capacity. When borrowing rates are high, many prospective purchasers may be discouraged from making a purchase. As a result of the lower long-term cost of financing a home, low interest rates may, on the other hand, inspire a surge in home purchasing activity.

General economic conditions: When it comes to forecasting the housing market cycle, the general state of the economy also plays a significant role. Generally, customers are more

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motivated to purchase residential real estate when the economy is strong or is trending higher. They risk that their property's worth will rise more in the hopes that their own wealth will increase. In general, the real estate market performs well when the whole economy is doing well. The landholdings market frequently mirrors the status of the economy.

Government policies: On occasion, the government will take action to stimulate a market that is exceptionally lax or experiencing a protracted slump. To encourage people to buy real estate, policymakers might enact tax discounts, subsidies, tax credits, and various homebuyer programs. The US housing market cycle may be significantly impacted by these kinds of governance structures.

2.10 Duration of a real estate cycle

A property cycle typically lasts 10 to 18 years. The term "average" in this context is a bit ambiguous because real estate cycles can vary greatly in length. Currently, the US real estate cycle stage is in the late-cycle expansion phase, in the eleventh year of what analysts refer to as a bull market, and in which prices are rising. Numerous people have repeatedly forecast that the bull market will slow over the past few years, but the downturn has not yet materialized. As the effects of the coronavirus epidemic continue to be felt, the real estate market is also changing right now.

2.11 Real Estate Investment

ROI definition: Return on investment (ROI) is an indicator of performance intended for assessing an investment's effectiveness or profitability or to compare the profitability or efficacy of several investments. ROI aims to quantify the amount of return on a certain investment in relation to the cost of the investment. There are several ways to determine ROI. The most popular is ROI = (Net income / Cost of Investment) multiplied by 100. Another

possible method to calculate ROI is investment gain divided by investment base, or ROI = Investment gain / Investment base. ROI calculations that have a positive return proportion indicate that the company, or the ROI metric being examined, is profitable. A negative ROI %, on the other hand, indicates that the company - or the metric it is being assessed against - owes more money than it is bringing in. In other words, if the proportion is positive, returns outweigh the costs. If the percentage is lower than zero, the investment is losing money.

The real estate cycle can offer trustworthy information on the potential returns of a rental property. Identifying if the property is in the recovery, growth, hyper-supply, or recession stages of the property cycle is important for investors. By doing this, it will be easier to estimate how long the property needs to be kept and what kind of exit plan to use with better accuracy. The success of an investment property's income and appreciation may also be predicted by the property cycle. As a result of this, a better capital improvement and the right time decision for investors, developers and consumer are learned below.

Investors have just limited possibility of exploiting forecast decreases in property values, because of the impossibility to short sale a specific asset and the absence of liquid real estate futures contracts.

What actions should developers and investors do during the **recovery** stage?

Many properties will be offered for sale at a discount during the recovery period. Therefore, during the following phase of expansion, with the suitable restoration plan, these properties might be rented or sold for a healthy profit. Kept in mind that timing for a purchase throughout the recuperation phase is crucial. If there is a purchase during the recovery period too early, the ROI can suffer. The higher the ROI the more profitable for the investor.

<u>What actions should developers and investors take when they are **expanding**?</u>

The time has come to sell purchased properties for more than market value if paid attention during the recovery phase. Additionally, now is the time that property developers should be aggressively acquiring and developing properties. During the recovery period, as investor should closely monitor market developments and make any necessary investments in building and restoration.

<u>What should developers and investors do when the **supply** is **excessively high?**</u>

Although it's normal for many investors to feel threatened by rising vacancies and selling off their properties as soon as possible, this isn't a logical course of action. It is advised that during times of extreme supply, investors and developers hang onto their landholdings. The largest advantage of understanding the real estate cycle is, in fact, this. Hyper supply is not a puzzling occurrence. It goes without saying that a recession follows it, which is subsequently followed by a rebound and then another round of growth. Holding onto real estate that is seen as a sound investment and waiting to sell it when the earnings are at their highest.

<u>What should developers and investors do while the economy continues to be in a **slump**?</u>

There are two choices for property syndications, investors, and developers. The first is to optimize return on investment and accumulate as much revenue as possible for the crucial period of the recovery when they should buy up properties below market value. The second is to start early with real estate purchases that are below market value. Developers may make a sizable profit if they have the funds to restore and maintain them till the next expansion phase.

2.12 Forecasting Real Estate Prices

There are several similarities between landholdings forecasting regressions and those used for other asset classes. Regression analysis is performed on the predicted quantity, frequently future changes, or profits using a specified range of factors that are selected to survey some financial speculations. Inefficient markets may have variable risk premiums over time or market inefficiencies, according to Fama (1970), if returns are predictable. Regressions prediction, on the other hand, are essentially reduced-form expressions and are unable to identify the economic drivers of predictability without additional modeling constraints - Fama & French, 1988 a. Based on the predictors and supported assumptions, it could be helpful to categorize forecasted regressions to three groups. The number one category includes lagged returns as the predictor, the second category includes valuation measures, and the third one, incorporating economic variables that are specific to the property and/or region.

2.12.1 The housing profits' sequential dependency and weak-form market efficiency

This category is a weak form market efficiency test case. Be that as it may, testing for basic serial reliance in genuine domain is complicated since the cost changes of certain lists are intrinsically serially connected, doing it challenging to recognize between fraudulent relationships and genuine advertise wasteful aspects. Prove of weak form showcase effectiveness is classified by the only set of data Xt, the set [1] of past returns rt. In this case regression,

$$r_{t+1} = a + \beta' X_t + \varepsilon_{t+1} \qquad\qquad (1)$$

tests continuous relationship of future prices and low advertise proficiency. A few ponders within the genuine bequest writing, Gau (1984, 1985) et al, found that returns (or cost changes) were positive arrangement found to appear a relationship.

In one of the most punctual wastefulness distributions on the United States genuine domain showcase, Gau 1985 looks at the consistency of month to month returns for Vancouver non-residential immovables over the period 1971 - 1980, characterized as the return, balanced for different efficient chance sources. A descriptive chance alteration alters the unrestricted normal of the arrangement of returns, however, has small impact on the forceful. The author of the study states, the forecast error in using historical price information to forecast anomalous returns is as well little to be abused in dealing strategies. Linneman 1986, also apply hedonic costs which are the costs of internal and external factors affecting that costs and are adjusted for risk to examine market productivity within the Philadelphia residential area. Within the information, Linneman finds prove of consecutive conditions, but he comes to a conclusion that consistency is inadequately "to recuperate the tall exchange costs related with genuine bequest exchanges." Guntermann and Smith 1987 used data from the Federal Housing Administration on their sample from 1968 to 1982 to use a portfolio method and discover a link. One of his initial studies, yours is the first, expressly accounts for rental revenue when calculating wages. In a range of 10 years, they show great predictability over the period of first three years and opposite autocorrelation over the last 6 years. That sequence is compatible to both long-term reversals and short-term momentum. When transaction costs are taken into consideration, persistence alone is not enough, according to Linneman 1986, to generate a profit when using diverse trading rules.

Shiller and Case 1989 tested weak form market efficiency for four kinds of single parents' family retails in their key study in the United States: Atlanta, Chicago, Dallas, and San Francisco/Oakland. According to Case and Shiller 1987, they used the weighted repeat sales (WRS) index. To reduce variable errors, they randomly partition their sample of transactions into two groups, and they then generate two related WRS for every single city mentioned

above. Then, they test for observations on quarterly basis on one index's yearly output on the other pointer's annual return with a one-year lag. This method, which may be thought of as instrumental variables (IV), yields reliable estimates of the autoregressive coefficient even when they are biased. Case and Shiller found that they can predict how much money someone can make from buying and selling houses. They were able to predict this between 11% and 48% of the time, which means people could make profits of 1% to 3%. Due to the high noise-to-signal ratio in such data, they also discover that forecasting individual property returns using the city-wide index is much more difficult. Because of quantification inaccuracy when examining the total pointer having just a portion of a sample, out-of-sample performance, is significantly worsened. Furthermore, the random partitioning approach implies that if we change how the data are partitioned, the estimates and forecasts will also change.

Sirmans, Knigh, Hill and others disprove the random walk hypothesis in these price series. The hypothesis behind the test is that repeat-sales indices would exhibit heteroskedasticity if prices were randomly distributed. They also show how adding a stationary, autoregressive component to house prices may improve the Case and Shiller (1989) GLS technique. Recent data from the Case and Shiller reports, real, nominal and log nominal price movements, calculated for the domestic and 20 metropolitan regions indexes, are provided by Schindler (2011). Both non-parametric tests of series independence and parametric variance-ratio tests of serial correlation are applied by him. He discovers considerable evidence for dependency in the price movements, which is not surprising given that several indices show strong positive autocorrelation even at 24 monthly delays. The writer concludes that some marketplaces are exploitable because of the data's significance is maybe more unexpected after evaluating various buy-and-hold and dynamic trading techniques. It is important to note that the markets in Las Vegas, Los Angeles, San Francisco and San Diego have had huge bubbles in addition

to the highest gains from the trading tactics. It is also unclear if these tactics would perform similarly well outside of the sample.

Gu 2002 examines the output from a quarter sample for the 50-state typical loan house price index (CMHPI) of US during the period of 1975 to 1999. This author discovers, the tenancy of commitment and the path of relationship vary over time and regionally. The inconsistent results across places and time periods imply that the real estate data contains a substantial amount of noise that makes inferences questionable. This is especially true considering how little time-series observations are included in most datasets. Gu's findings from 2002 also highlight how challenging it is to compare the outcomes from the weak form efficiency research on immovables when employing data through various retail places, information sets (some overall, others not), time periods and methodology. It is not surprising to see variation in the results given the heterogeneity of the asset and the data's flaws.

Regime-switching models are increasingly being used in literature to describe real estate price movements. Period continuance characteristics of series are determined by the actualisation of a stable factor in the background in a regime-switching model. Therefore, the long cycles of better economy and worsen economy that define property costs serve a logical framework for the application. Due to the dependence of immovables on regional economic and geographic factors, is very logical to anticipate significant differences in regulations between different regions and property kinds. For instance, changes in the relationship between housing, income, and interest rates may cause changes in the dynamics of home prices, as well as changes in the interactions between credit-constrained households, lenders, and developers.

Therefore, the fictionalized data that are revealed in this literature can be summed up as follows: (1) At horizons of up to a few years the serial correlation is positive (2) over long

horizons, they have observed the opposite or a negative continuance correlation in output returns (3) There are still unanswered concerns involving the financial relevance of this cyclical relationship and whether competitors may take advantage of it.

2.12.2. Predictability as per evaluation metrics

This second category is a various valuation measure, like the ratio of the rent to output or the ratio of cost to income, are frequently employed as indicators. Predictive regression with valuation measures is based on the notion that valuation measures can identify deviations and gradual adjustments towards an equilibrium or can serve as proxies for fluctuations in anticipated returns. Overall, the findings suggest that valuation measures are incapable of capturing all the variables in the conditioning set.

According to Engle and Granger 1987, the economic justification for using rates as forecasters at later stage of estimated outcomes is straight forward and is based on the fair assumption that the ratios inputs are co-integrated in logs. "If log rents and log prices are co-integrated, the log rent-price ratio must be a mean-reverting process". In case the ratio at time t is greater than its unconditional mean, the mean reversion predicts either high projected returns, low anticipated rent increases, or a combination of the two, according to Campbell et al. The norm behind almost all estimating ratios is the same. Eric Ghysels, Alberto Plazzi, Walter Torous and Rossen Valkanov in their article "Forecasting Real Estate Prices", to comprehend how useful the rent to price proportion is, for forecasting later period rent increases or returns, they introduced some notation.

Let H_t represent a property's rentals after deducting all operational costs, and P_t represent the property's today's cost. The rent to price rate follows H_t/P_t, and the log transformation is represented as $\ln(H_t)\ln(P_t)$. Sometimes it is referred as the property's capitalization rate, or

cap rate. Campbell, Davis, Gallin, Martin in 2009 and Plazzi Torous, Valkanov in 2010

demonstrate that h_{pt} may be represented as following Campbell and Shiller (1988)

$$h_{pt} = k + E_t \left[\sum_{j=0}^{\infty} \rho^j r_{t+1+j} \right] - E_t \left[\sum_{j=0}^{\infty} \rho^j \Delta h_{t+1+j} \right] \quad (2)$$

where r_{t+1+j} is the future return of the property, Δh_{t+1+j} is the future growth in its rents, and

k and ρ are linearization constants. Putting this a different way, modifications to the log cap

rate must be able to foresee either potential earnings, eventual rent hikes, or both.

$$r_{t+1:t+T} = \beta_r(T) h_{pt} + T^r_{t+1:t+T} \quad (3)$$

$$\Delta h_{t+1:t+T} = \beta_d(T) h_{pt} + T^d_{t+1:t+T} \quad (4)$$

where $r_{t+1:t+T} = \sum_{j=0}^{\infty} \rho^j r_{t+1+j}$ and $\Delta h_{t+1:t+T} = \sum_{j=0}^{\infty} \rho^j \Delta h_{t+1+j}$ approximate,

accordingly, the first and second term in (2) for a large T. Since $r_{t+1:t+T}$ and $\Delta h_{t+1:t+T}$

correspond to the log T-period return and rent growth, respectively, these approximations are

appealing. The forecasting is computed over a range of time horizons, from period one (T =

1) till the future years. The approach utilized to get close to a prediction of REIT, marketing,

retail, and residential outcome returns.

Available research concentrates on the statement of return (or price appreciation)

predictability in expression (3). Gallin in 2008 uses data for a quarter base of the repeat-sales

index during the first quarter of 1970 till the last quarter of 2005 to estimate equations (3) and

(4). Separate estimates for the two equations are made at four-year periods (T = 16).

According to expression (2), he discovers that the rent to price rate has positive association

linked with forecasted estimated returns and negative relationship with future rent growth

rates. In his research, the rent growth regression's coefficient $\beta_d(T)$ is statistically

significant, while the return regression's coefficient $\beta_r(T)$ is not. Therefore, the evidence that rent prices predict future returns is flimsy from a statistical standpoint. Meese and Wallace (1994) developed a new test and applied it to transaction-level data for the Northern California counties of Alameda and San Francisco. They discover support for short term current value connection breaches but long term consistency and they make the case that the discrepancies across horizons may be caused by high transaction costs. According to Capozza and Seguin 1996, it is advisable to assess the cap rate's predictive potential after taking other cross-sectional characteristics between owner-occupied vs rental homes into consideration.

It is identical to assume that all other financial considerations can be effectively condensed by that one number to assume that the sole influencing factor is cap rate. In other words, this ratio is the only state variable that adequately reflects all significant economic variations. The model will be incorrectly described to the degree that part of the most recent economic data is not included in that ratio.

Hamilton and Schwab 1985 paper is the prominent exception. The rent and value of constant-quality homes in 49 metropolitan housing markets investigated by the Annual Housing Survey in the middle of the 1970s are estimated by the authors using a semilogarithmic hedonic model. The capacity of the rental price ratio for predicting rental rise is then investigated. They discover a substantial inverse relationship between expected rent increase and the rent-price ratio (not in logs).

Expression (2) is also used by Davis, Gallin, Martin et al in 2009 as a beginning point to their study in more recent work. The authors follow Cambell approach 1991, and to employ vector autoregression VAR model to predict future prices in (2), as opposed to supposing that

forecasted outcome, are an appropriate substitute to a projected outcome. The log rent-price ratio is one of the foreseeing factors. Based on the VAR estimations, they provide quarterly data for 23 urban areas, four national residentials markets, and other regional housing market from 1975 to 2007 that show predictable fluctuations in expected returns and projected rent increases. In line with Gallin's findings from 2008, a greater proportion to volatility in projected returns than the anticipated rise in rent, is explained by the rentant price ratio.

The percentage of immovables prediction using the log rental price rate is demonstrated by the authors' short time regressions analogues (3). The data is collected every quarter with a T value of 1, and if they forecast returns one quarter in advance. They incorporate the lagged return as well as the lagged log rent to price ratio into the multivariate analysis because of the huge amount of serial correlation mentioned in the division above. While the NCREIF, TBI, and REIT indexes are used to estimate the regressions for commercial properties, the Census, Case-Shiller, and Federal Housing Finance Agency HPIs (FHFA/OFHEO) databases are utilized to estimate the multivariate analyses for residential properties.

The results are that the log rent-price ratio, when included as a stand-alone variable is not a very reliable indicator of future results for any of the three series. For the Census and FHFA/OFEHO series, the coefficient seems positive but not mathematically remarkable, and for the Case-Shiller index, it is basically zero. Lagged returns are included as a control variable in the ensuing specification. From a standpoint of prediction, the results from the Census statistics are now the most depressing. The Census median returns series may lack consistency since it does not account for the quality of properties. The next subsection provides some supporting evidence. According to Malpezzi (1999), the Case-Shiller and FHFA/OFHEO estimations approximate above zero, but they are still statistically

insignificant. The lagged return term, r, which captures the serial correlation in returns, is largely responsible for the significant R^2s of 0.559 and 0.409.

The research that shows that future price fluctuations are related to population and income growth rates that are greater also points to an inelastic housing supply. However, the assumption regarding households' mobility is crucial to the impact of supply shocks. According to Van Nieuwerburgh and Weill (2010), supply shocks have no effect on housing prices if this may occur freely. Finally, lesser price movements are predicted by higher mortgage rates. Employing valuing ratios in predicting regressions offers certain benefits, but there is also an apparent drawback in the fact that the forecast rate could not collect historical modifications to the conditional data set. This is another cause to think that omitted-variable bias may affect the outcomes of such a multivariate study. multivariate analysis in its shortened forms, nonetheless. The economic mechanisms that underpin the predictive relationship are not clear to us because of (10) and (11). Is the forecasting ability affected by changes in the population or further demand surprises? On the other hand, maybe is influenced by surprises to the supply, like tougher zoning anproperty regulations? Only by including additional conditioning factors in the foreseeing regressions will those questions be able to be addressed.

2.12.3 Predictability Based on Economic Variables

Thirdly, a more extensive range of suppositions can be examined by incorporating economic variables that are specific to the property and/or region. There is plenty of knowledge, certain financial factors other than past prices or valuation rates to be linked to potential future increases in immovables costs. These variables are intended to serve as proxies for demand and supply shocks within the real estate market. These predictors have been utilized from various scholars. They comprise demographic and income factors, zoning regulations and building

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expenses. It could be contended that these regressions offer a more comprehensive account of the heterogeneity in real estate investments.

Using a variety of confounding factors, such as lag returns, Shiller and Case in their paper 1990 are examining the case in the excess aggregate forecasted returns, except the treasury bill ratio, of four states, Atlanta, Chicago, Dallas, and San Francisco. Authors test an improved version of the one lasts years research, due to higher information collection. The dataset spans the years 1970 to 1986 and has a quarterly frequency. The majority of the confounding factors are visible at a municipal amount and include: the rent to price proportion, the loan's liquidation-income percentage, construction cost to price percent, pace of employment growth, the growth in real per state income, the percentage of change of construction prices, adult population index from ages of 25 and 44, the marginal tax rate index, and the connection of housing starts to the total population. The excess return over the upcoming four quarters is the forecasting variable of interest.

Case and Shiller's 1990 fully specified predictive multivariate analysis have an R^2 ranging from 0.336 to as high as 0.615, demonstrating that the economic predictors may account for a sizeable portion of the swings in future real estate return. Per country growth of revenues as well as the adult population are highly definitely correlated to estimated yearly excess returns among the variables present. The indication is in line with economic intuition, which holds that rising demand for homes is caused by both demographic booms and better economic conditions. The rent-price proportion and construction expenses as a percentage of price, two metrics of fundamental value, also predict future returns favorably. The solo rent to price ratio has an output R^2 of 0.109, which helps put things into perspective. The growth rate of employment, the marginal rate of personal income tax, and the number of new homes built are

all proven to be significant predictors. In general , the inclusion of control factors causes the in-sample R^2 to rise from around 10% to as much as 60%, contradicting the idea that a market is only partially efficient. However, because their analysis was conducted within a single sample, the pooled regression (across cities) used overlapping observations and did not explicitly consider cross-sectional correlation in the residuals.

Research has also been done on how prices, vacancy rates, transaction volume, housing stock, and rents interact. For instance, Wheaton and Torto 1988 take into account dynamics of adjustment and departures from equilibrium between vacancy and rents in the office market. Even after taking into consideration the likelihood of trends in the structural vacancy rates, they still discover a statistically significant and qualitatively meaningful association between the current excess vacancy and future changes in real rent. The calculated equation is then used to predict vacancy rates and a drop in office rentals six years in the future. A vector autoregression VAR error correction model is used by Zhong-Guo (1997) to examine the interaction between sales volume and median sales prices from the National Association of Realtors. According to Granger-causality experiments, sales have a large impact on price, but housing prices have a minor impact. By using the recursive estimate of the VAR, which is extremely uncommon in the real estate literature, Zhong-Guo (1997) goes one step further and offers out-of-sample evidence for the 1991–1994 period. He provides strong evidence of both sales and median price prediction capacity (R^2= 0.77 and R^2=0.86, respectively). Legislative changes may also have an impact on the demand for rental accommodation. According to DiPasquale and Wheaton (1994), the Tax Reform Act of 1986 had a considerable impact on the rental property markets in terms of supply and demand. According to their projections, actual rents should have risen by 8% as a direct effect of the law during the next 10 years. Though less significant, the FHFA/OFHEO results are comparable. The log rent-price rate is negligible in all parameters.

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Additionally, of the three indices, the Census median price index continues to be the hardest to predict.

The idea that returns are less predictable in certain places than others recur often in the literature on real estate now in publication. Capozza, Hendershott, and Mack 2004 state in a thorough examination of 62 metropolitan locations between 1979 and 1995 that "the dynamic properties of housing markets are specific to the given time and location being considered." Economic factors including demographic shifts, zoning constraints, local economic circumstances, and heterogeneous reactions to macroeconomic shocks on a global scale are the same ones that drive home price dynamics and serve as the economic sources of heterogeneity in predictive multivariate analysis. Quantifying the predictive power of economic factors across metropolitan regions is clearly of interest, notwithstanding the difficulty in comparing results between research due to variations in datasets, variable definitions, and techniques.

3 Methodology

In this section the methodology followed will be presented, the work during data collection up to the production of the equations used. The study area, the data and the tools (software) used to conduct the study as well as the dates of data acquisition will also be mentioned.

3.1. Research design

This thesis uses mixed - methods design, quantitative and qualitative, to estimate the future prices of housing market in Cyprus. The rationale of this mixed - methods approach is simply because many research questions are difficult for quantitative or qualitative approaches alone to adequately address. Two methods combined, qualitative and quantitative components and can be an effective way to investigate the research subject more thoroughly. [19] Once the qualitative research has results for the future prices of housing in Cyprus, then the background knowledge and what already has been examined in the second chapter will come along to have a clear and reasonable answer to the question to invest or to wait? Additionally, it will answer more questions such as what influence the house market.

3.2 Sampling strategy

Cyprus is the country of interest, so all the research is based on the population of Cyprus. Specifically, the population used for the model is the free (not occupied) region of Cyprus, which are the 5 areas following: Nicosia, Limassol, Paphos, Ammochostos and Larnaka. Research methods and the analysis of this study are not influenced by conscious or unconscious factors that can affect the objectivity and accuracy of the results. All models are not biased due to several tests implemented showing the accuracy of the data and the results found. Confirmation bias is not occurred since the information captures all the regions of Cyprus and challenged all the factors available that affect the real estate prices and the economic growth.

3.3 Data collection methods

The data used are collected from the Central Bank of Cyprus, European Commission, Eurostat, Cystat and the Department of Lands and Surveys (DLS) and captures the period from 2010 to 2022. All information that was in annual proportion(i.e unemployment rate), switched to quarterly data with the average tool in excel. House price index is the depended variable of all the models. More analytically, House Price Index (HPI) is a quarterly index that tracks changes in the median prices of homes. It includes both new and old residential homes of every kind. The residential property's land component is included. The information relates to all areas of influence for the Republic of Cyprus government. The information is divided into two strata: old and new dwellings. The sub-indices for each stratum are computed using a rolling window hedonic regression model. The weights for the sub-indices are then calculated using the total value of each stratum's attributes throughout the preceding year. The unit of measurement is the rate of change on a quarterly and yearly basis, with the base years being 2010 and 2015, respectively. When new information becomes available, data that has been tagged as provisional are updated, so the information gathered is the most updated.

3.4 Data analysis methods

Information is analyzed and interpreted in Stata. Four autoregressive models use multivariate analysis and tests the validity and accuracy of the variables. Finding the relationship between changes in the independent variables and changes in the dependent variable is the main goal of multivariate analysis. These changes are described by coefficients, and p-values reveal whether these coefficients are substantially different from zero. Main effects, or the direct correlation between an independent variable and a dependent variable, characterize each of the effects in this post. However, depending on another aspect, the connection between an IV and a DV can occasionally shift. This circumstance is a combinational outcome.

When all the independent variables in your model to zero are set, the constant is sometimes described as the mean of the dependent variable. This definition is accurate in a purely mathematical sense. Unfortunately, because this combination may be illogical or impossible, it is frequently difficult to set all variables to zero. Since some tests are already being made before the model structure, the variables chosen are tested to have statistical significance, and not much difference is appearing in the results. The smaller the model the better the predictions!

Tests indicates the validity, accuracy of the residuals, variables, and the errors. Tests are defined in section 5, with the results of the estimations, however, here are all the tests named: Linearity, heteroskedasticity, autocorrelation, stationarity, normality, robustness of heteroskedasticity and autocorrelation, white test of heteroskedasticity and roots test.

The analysis method used in this paper is the AR (1) autoregressive model and the ARIMA(2,1,1) autoregressive integrated moving average prediction model. The time series model known as an AR (1) autoregressive model is one in which a variable's current value is a linear function of its prior values as well as a white-noise error component. 1 in AR (1) represents a first-order autoregressive process. The dependent variable's p-lagged values are contained in an AR(p) model.

Three little integers p, d, and q as well as the inclusion or exclusion of a constant in the equation serve as the sole inputs for the ARIMA model. The letters "AR", "I," and "MA" make up the acronym ARIMA, where "I" stands for "integrated." The latter word was used since a time series that requires differentiating in order to become stationary is referred to as a "integrated" series. Therefore, ARIMA stands for "Auto-Regressive-Integrated-Moving-Average." It is simple in theory to extend an ARIMA model to include data provided by leading indicators and other exogenous variables because you simply add one or more regressors to the

forecasting equation. An ARIMA model can be thought of as a special type of regression model because the dependent variable has been rationalized and the independent variables are all lags of the dependent variable and/or lags of the errors. [38] [39]

3.5 Data description

1. HPI is the house price index which is the total purchase of new and existing dwellings in a current quarter and is calculated with the difference in prices from one quarter to the previous one.

2. Un. is the unemployment calculated by the average annual data.

3. HCPI is the harmonized indices of consumer prices and is designed for international comparisons of consumer price inflation measured quarterly.

4. Earn. is the average monthly earnings in euros, measured monthly but adjusted in quarters

5. GDP is the Gross domestic product at current prices Euro million measured in quarters

6. Intrate. is the annual percentage rate of change of lending for house perchance interest rates

7. Pop. is the adult population aged 15 to 24, 25 to 49, 50-64, and 65 to 79.

8. Con. is the total construction of new dwellings and another kind of buildings

9. Rest. is all the real estate activities agents or brokers provide such as selling or buying real estate, rental real estate, appraising real estate, or acting as real estate escrow agents and REITS.

10. NewDwel. is the purchase of a new dwelling at the current quarter

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11. ExistDwel. is the purchase of existing dwellings at the current quarter.

3.6 Limitations in data

Best case scenario was to find data for past house prices, past apartment prices and to run an autoregressive model with all related variables such as view of property, square meters per house/apartment, distance from the center, region or place of the property and construction age. As no one has access to the house and apartment prices data used in the construction of the indices, author could use information of past data from other bigger countries such as Germany, US, or China. Although House Price Index does all these steps and calculations for the researchers to analyze and predict other variables instead of those written above. Finally, aic test has not been made and maybe this is crucial to estimate the best model of the research. estat ic calculates two information criteria used to compare models. For the purpose of comparing the information criteria, the models do not need to be nested, in contrast to likelihood-ratio, Wald, and similar testing methods. Because they are based on the log-likelihood function, information criteria are available only following commands that report the log probability. In general, "smaller is better": given two models, the one with the smaller AIC fits the data better than the one with the larger AIC. As with the AIC, a smaller BIC indicates a better-fitting model.

4 Research

To illustrate the findings from literature, author will run three regression models, two simple and a longer one to estimate the best correlations each independent variable has with the dependent variable HPI. The goal is to find the best estimation model that will most accurately estimate the House Price Indexes for 2023, 2024 and 2025. Considering the following autoregression model:

AR(p) model with 1 variable

$$\Delta logHPI_t = \Delta lnP_t = r_t = a + \sum_{i=0}^{p} \beta_i \Delta logHPI_{t-i} + u_t \qquad [1]$$

where $\Delta logHPI_t$ is the dependent variable that means the log change of a house price index over T periods. a is the drift, $\sum_{i=0}^{p} \beta_i \Delta logHPI_{t-i}$ is the total difference of log House Price Indexes over time and u_t is the standard error. For $T = 1$, equation [1] collapses to an AR(1) model. Under the null hypothesis that the HPI has no relationship between response and the predictor variable (the difference in the house price index during time), β_i coefficient should be zero at all horizons. For all the predictor variables, individual hypothesis testing is done to determine whether the relationship between the response and the predictor variable is statistically significant based on the sample data used. A negative coefficient indicates that the dependent variable tends to decline as the independent variable rises. So, in this case the change in house prices will decline because the coefficients are negative.

```
. reg fd_ln_hpi L(1/2).fd_ln_hpi
```

Source	SS	df	MS			
Model	.00613717	2	.003068585	Number of obs	=	49
Residual	.035878491	46	.000779967	F(2, 46)	=	3.93
				Prob > F	=	0.0265
				R-squared	=	0.1461
				Adj R-squared	=	0.1089
Total	.042015661	48	.000875326	Root MSE	=	.02793

fd_ln_hpi	Coefficient	Std. err.	t	P>|t|	[95% conf. interval]	
fd_ln_hpi						
L1.	-.3773201	.1441219	-2.62	0.012	-.6674225	-.0872178
L2.	-.2500036	.1499591	-1.67	0.102	-.5518556	.0518484
_cons	-.0011976	.003996	-0.30	0.766	-.0092411	.006846

AR(p) Model with 2 variables

[2] $\Delta logHPI_t = a + \sum_{i=0}^{p} \beta_i \Delta logHPI_{t-i} + \sum_{i=0}^{q} \gamma_i \Delta logGDP_{t-i} + u_t$

The second model of the research done in this thesis is based on various trials done in order to find the appropriate variable that is statistically significant based on all the variables used in the data. Where $\Delta logHPI_t$ is the dependent variable same as the first model. The independent variables in this model are the total change of the house price index and the total change of log GDP over time. The a is the drift, and u_t is the standard error. For $T = 1$, equation [2] collapses to an AR (1) model.

```
. reg fd_ln_hpi L(1/4).fd_ln_hpi L(1/4).fd_ln_gdp
```

Source	SS	df	MS		Number of obs	=	47
					F(8, 38)	=	5.61
Model	.02274024	8	.00284253		Prob > F	=	0.0001
Residual	.019256986	38	.000506763		R-squared	=	0.5415
					Adj R-squared	=	0.4449
Total	.041997226	46	.000912983		Root MSE	=	.02251

fd_ln_hpi	Coefficient	Std. err.	t	P>|t|	[95% conf. interval]	
fd_ln_hpi						
L1.	-.5871368	.1430757	-4.10	0.000	-.8767784	-.2974953
L2.	-.3481014	.1518479	-2.29	0.028	-.6555014	-.0407013
L3.	-.4269727	.1541454	-2.77	0.009	-.7390237	-.1149216
L4.	-.122783	.1473327	-0.83	0.410	-.4210424	.1754765
fd_ln_gdp						
L1.	.1930236	.0780298	2.47	0.018	.0350606	.3509866
L2.	.0896897	.0781585	1.15	0.258	-.0685339	.2479133
L3.	.1916042	.0780441	2.46	0.019	.0336123	.3495961
L4.	.3678272	.078389	4.69	0.000	.2091369	.5265174
_cons	-.0075601	.0037456	-2.02	0.051	-.0151427	.0000224

AR(2) model with 6 variables

$$\Delta logHPI_t = a + \sum_{i=0}^{p} \beta_i \Delta logHPI_{t-i} +$$
$$\sum_{i=0}^{q} \gamma_i \Delta logGDP_{t-i} + \sum_{i=0}^{q} \kappa_i \Delta logUn_{t-i} + \sum_{i=0}^{q} \kappa_i \Delta logRest_{t-i} +$$
$$\sum_{i=0}^{q} \kappa_i \Delta logAdltPop_{t-i} + \sum_{i=0}^{q} \kappa_i \Delta logNewDwel_{t-i} + u_t \qquad [3]$$

Model 3 follows with more than two variables in the mode, where $\Delta logHPI_t$ is the dependent variable same as the first and second models. The independent variables in this model are the total change of the house price index, the total change of log GDP, the total change of log economic growth, the total change of log construction, the total change of log monthly earnings, the total change of log unemployment and the total change of log adults' population over time. The a is the drift, and u_t is the standard error. For $T = 1$, equation [3] collapses to an AR (1) model.

```
. reg fd_ln_hpi L.fd_ln_hpi L.fd_ln_gdp L.fd_ln_un L.fd_ln_earn L.fd_ln_rest L.fd_ln_NewDwel
```

Source	SS	df	MS			
				Number of obs	=	50
				F(6, 43)	=	4.08
Model	.015250109	6	.002541685	Prob > F	=	0.0025
Residual	.026772939	43	.000622626	R-squared	=	0.3629
				Adj R-squared	=	0.2740
Total	.042023048	49	.000857613	Root MSE	=	.02495

fd_ln_hpi	Coefficient	Std. err.	t	P>|t|	[95% conf. interval]	
fd_ln_hpi						
L1.	-1.236701	.6928175	-1.79	0.081	-2.633901	.1604985
fd_ln_gdp						
L1.	.054534	.0751335	0.73	0.472	-.0969871	.2060551
fd_ln_un						
L1.	-.0588195	.0435046	-1.35	0.183	-.1465549	.0289158
fd_ln_earn						
L1.	-.0953755	.0280715	-3.40	0.001	-.151987	-.0387639
fd_ln_rest						
L1.	.2361729	.1448528	1.63	0.110	-.0559506	.5282963
fd_ln_NewDwel						

ARIMA (2,1,1) model

$$\Delta HPI_{t+1} = a + \sum_{i=0}^{p} \beta_i \Delta HPI_{t-i} + \varepsilon_{t+1} \qquad\qquad [4]$$

where $\Delta log HPI_{t+1}$ is the demanding dependent variable. The independent variable in this model is the total change of the house price index time, a is the drift, and ε_{t+1} is the standard error. For $T = 1$, equation [4] collapses to an ARIMA model.

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Regression 4: Arima (2,1,1) regression, with statistical significance of 0,0016, low volatility, negative coefficients and standard deviation of 2,79

```
ARIMA regression

Sample: 2010q2 thru 2022q4                Number of obs    =        51
                                          Wald chi2(3)     =     15.29
Log likelihood = -124.3986                Prob > chi2      =    0.0016
```

D.HPI	Coefficient	OPG std. err.	z	P>|z|	[95% conf. interval]	
HPI						
_cons	-.1051984	.2089374	-0.50	0.615	-.5147083	.3043114
ARMA						
ar						
L1.	-.0313524	.6358441	-0.05	0.961	-1.277584	1.214879
L2.	-.174601	.2971123	-0.59	0.557	-.7569304	.4077285
ma						
L1.	-.3826039	.5826503	-0.66	0.511	-1.524578	.7593697
/sigma	2.765846	.3347429	8.26	0.000	2.109762	3.42193

```
Note: The test of the variance against zero is one sided, and the two-sided
      confidence interval is truncated at zero.
```

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5 Results

In this section results and tests presented for the models as discussed above. The criterion for choosing the most appropriate model is simple. The best model is the one with the most significant coefficients, least volatility, lowest AIC, and BIC test, and the highest adjusted R^2. The most fitted model which has the least volatility of 0,02251 and the coefficients are the most statistically significant at 5% confidence, has the lowest AIC, second lowest BIC and the highest adjusted and not adjusted R^2 is the model 2. The table below shows the results of each model and why in numbers, the model 2 is the best fitted model. The table below shows the results of each model and why in numbers, the model 2 is the best fitted model. The green highlighted figures are the numbers that shows the most fitted values.

$$\Delta logHPI_t = a + \sum_{i=0}^{p} \beta_i \Delta logHPI_{t-i} + \sum_{i=0}^{q} \gamma_i \Delta logGDP_{t-i} + u_t$$

Table 1 shows the criteria used for choosing the most appropriate model

Model	P-values -Coefficients	AIC	BIC	R^2	Adj R^2	Volatility
1	0,0265	-208,70	-203,02	0,1461	0,1089	0,02793
2	0,0001	-206,69	-197,23	0,5415	0,4449	0,02251
3	0,0025	-210,29	-185,70	0,3629	0,274	0,02495
4	0,0016	-207,58	-198,02			2,79

Is generally observed that changes in the log prices of houses tend to decline due to the negative coefficient of the independent variables. A negative coefficient indicates that the dependent variable tends to decline as the independent variable rises. The coefficient value is the amount that a one-unit change in the independent variable affects the mean of the dependent variable while keeping all other model variables constant. [27]

Figure 8: Log changes in house prices during 2010 quarter 1 till 2022 quarter 2.

5.1 Linearity test

The primary objective of linear multivariate analysis is to investigate two things: 1. How well can a collection of predictor factors predict an outcome (dependent) variable? 2. Which individual factors, as shown by the size and sign of the beta estimates, have a substantial influence on the outcome variable and how do they do so? "Estat ovtest" indicates the Ramsey (1969) RESET test (REgression Specification-Error Test). RESET test is used to check for two different kinds of misspecification. Depending on the test settings selected, it can search for either missing variables or functional form misspecification.

Table 2: The RESET tests the model to ensure that omitted variables are not causing model misspecification.

```
. ovtest

Ramsey RESET test for omitted variables
Omitted: Powers of fitted values of fd_ln_hpi

H0: Model has no omitted variables

F(3, 35) =    0.60
Prob > F = 0.6191
```

Here is the output for the regression analysis of the model [1], followed by the RESET omitted variables test. Using a significance *p-value* of 0,05 the RESET test is not significant, indicating there are no omitted variables in the model and there is a linearity in the model. Meaning that with the total change of log *HPI* which is the independent variable of the model [1] the dependent which is the change in the log *HPI* variable can be well predicted. Also, the individual factor, as shown by the size and sign of the beta estimates is the first lag of the difference between the first and the immediate previous price change of house index and, has a substantial influence on the outcome. [28] [29]

5.2 Heteroskedasticity test

When the variance of the residuals is uneven throughout a range of measured values, this is referred to as heteroskedasticity. The analysis findings may be flawed if heteroskedasticity is present and the population employed in the regression has an uneven variance. The Breusch-Pagan test assists in comparing the alternative hypothesis to the null hypothesis. The alternative hypothesis argues that the error variances are a multiplicative function of one or more variables (heteroscedasticity), whereas the null hypothesis states that the error variances are all equal (homoscedasticity). The output of the heteroskedasticity test in model [1] shows that under the null hypothesis we don't reject that there is constant variance. Given that the *p-value* is 0.7086, higher than the threshold of 0.05 that is selected, this test is no longer

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significant. This shows that the concerns for heteroskedasticity have gone. Heteroskedasticity does not exist and claims that the variance of the residuals is constant. [30] [31] [32]

Table 3: Breusch-Pagan works off the null hypothesis that variance is homoscedastic

```
. hettest

Breusch-Pagan/Cook-Weisberg test for heteroskedasticity
Assumption: Normal error terms
Variable: Fitted values of fd_ln_hpi

H0: Constant variance

    chi2(1) =   0.14
Prob > chi2 = 0.7086
```

Figure 8: The residual plot shows a random scatter of points forming an approximately constant width band around the identity line which is the ideal.
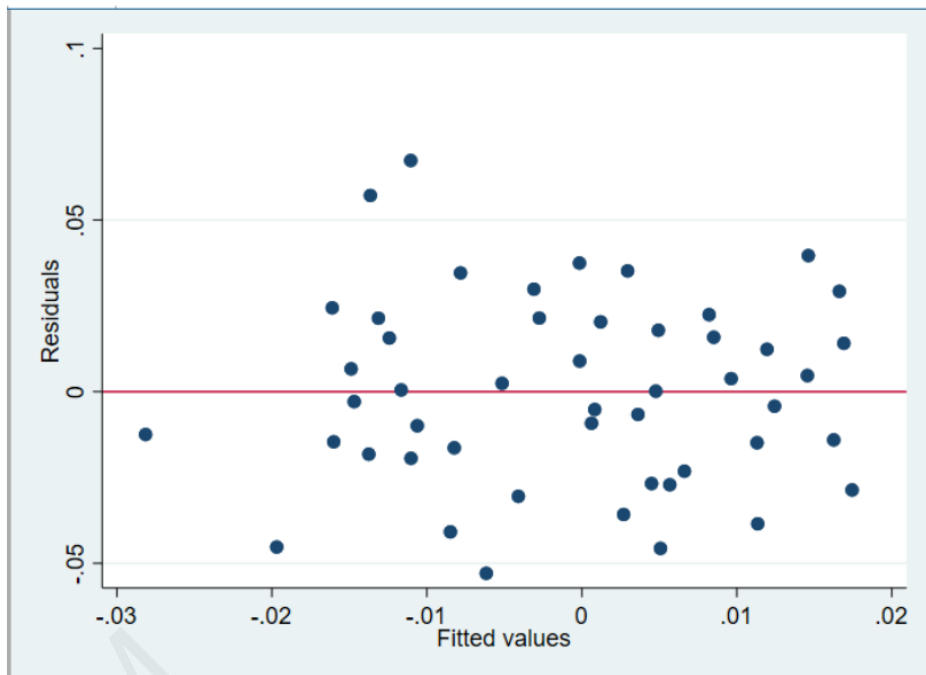
5.3 Autocorrelation test

A time series autocorrelation measures how similar it is to a lagged version of itself across successive time periods. The link between a variable's present value and its previous values is measured by autocorrelation. Breusch-Godfrey LM test for autocorrelation in models with weakly exogenous regressors. There are some advantages of the Breusch-Godfrey LM over the Durbin-Watson test. The Breusch-Godfrey LM test is less susceptible to this assumption than the Durbin-Watson test, which depends on the assumption that the distribution of residuals is normal. This test enables researchers to test for serial correlation via additional lags in addition to the initial lag, which is the correlation between the residuals between time t and t-i (where i is the number of lags), which is another benefit. The null hypothesis claims that there is no serial correlation and the alternative hypothesis that there is a serial correlation.

Table 4: Breusch-Godfrey test shows serial correlation. The null hypothesis is rejected. P-value Is 0,6676 and the chi2 is 0,184 with 1 degree of freedom.

```
. estat bgodfrey

Breusch-Godfrey LM test for autocorrelation
```

lags(p)	chi2	df	Prob > chi2
1	0.184	1	0.6676

```
                 H0: no serial correlation
```

The null hypothesis is rejected since the $chi2$ value in the preceding table is less than 0.05, or 5%. In other words, the model's residuals exhibit serial correlation. [33] [34]

Table 5 shows the serial correlation with 1 lag for the 4 models

Serial Correlation with 1 lag

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	chi^2	prob>chi2
Model 1	4,61	0,0318
Model 2	1,697	0,1926
Model 3	0,066	0,7971
Model 4	15,29	0,1192

5.4 Normality test

"Sktest" presents two tests for normality one based on skewness and the other on kurtosis. Then combines the two tests into an overall test statistic. In this test the null hypothesis states that the variable is normally distributed.

Table 6: Skewness and kurtosis test show that if the pr(skewness) is less than 1 the distribution is left-skewed and for the pr(kurtosis) if is less than 1 the distribution is platykurtic.

```
. sktest errors2

Skewness and kurtosis tests for normality
                                                ─── Joint test ───
    Variable │   Obs   Pr(skewness)  Pr(kurtosis)  Adj chi2(2)  Prob>chi2
─────────────┼──────────────────────────────────────────────────────────
     errors2 │    47       0.8261        0.4372        0.67       0.7143
```

'Sktest' shows the number of observations (which is 47 here) and the probability of skewness which is 0.8261 implying that skewness is asymptotically normally distributed (p-value of skewness > 0.05). Similarly, Pr(Kurtosis) indicates that kurtosis is also asymptotically distributed (p-value of kurtosis > 0.05). Finally, chi(2) is 0.7143 which is greater than 0.05 implying its significance at a 5% level. Consequently, the null hypothesis cannot be rejected. Therefore, according to the Skewness test for normality, the total difference between the house price index over i period show normal distribution. Below it can be shown that the independent variable, residuals "errors1" follows a normal distribution as already explained. [35] [36]

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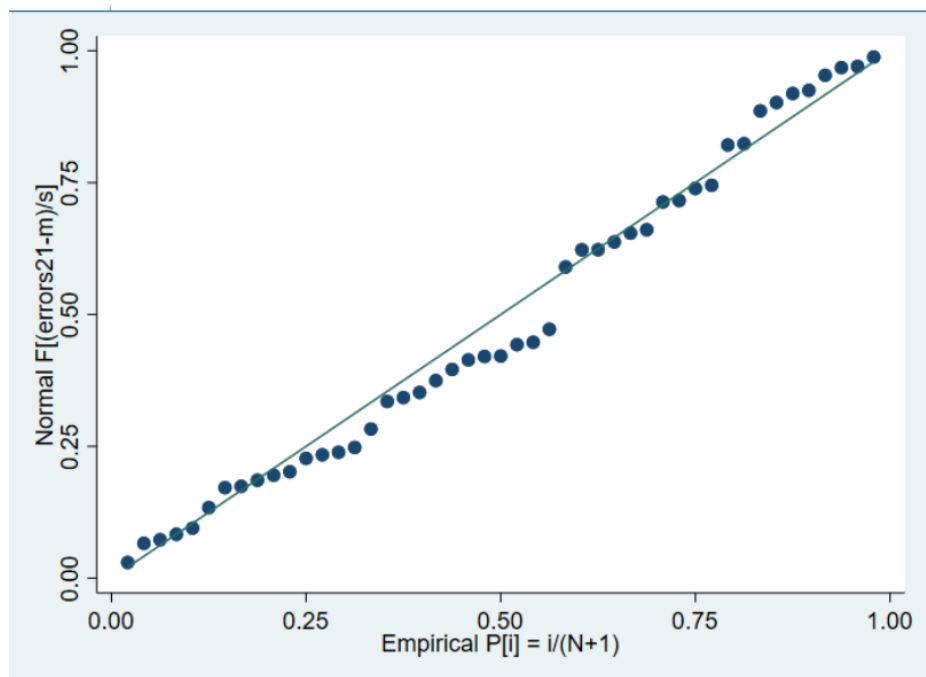
5.5 Stationarity test

Overall, to know how to handle the data, one must grasp stationarity. If the data is non-stationary, some transformations could be able to make it stationary. This time series is stationary, so its mean, variance, and covariance are constant across time. The enhanced Dickey-Fuller "dfuller" test is used to determine if a variable follows a unit-root process. The variable has a unit root, which is the null hypothesis. The alternative is that it was produced by a stationary process and the p-value is as close to zero as possible. The data are already in logs so the p-value which is 0,000 indicate that the data are stationary. [37]

```
. dfuller fd_ln_hpi

Dickey-Fuller test for unit root              Number of obs  = 50
Variable: fd_ln_hpi                           Number of lags =  0

H0: Random walk without drift, d = 0

                                  Dickey-Fuller
                      Test  ─────── critical value ───────
                  statistic       1%        5%       10%
─────────────────────────────────────────────────────────
   Z(t)            -9.377     -3.580    -2.930    -2.600

MacKinnon approximate p-value for Z(t) = 0.0000.
```

5.6 Robust errors to autocorrelation for model with 1 variable

In the presence of heteroskedasticity, the Huber/White/sandwich robust variance estimator (White 1980) yields consistent standard errors for OLS regression coefficient estimations. The Newey-West (1987) variance estimator is an extension that yields accurate results when autocorrelation and potential heteroskedasticity are present. By using the lag() option, the Newey-West variance estimator may handle autocorrelation up to and including a lag of m. As a result, it presupposes that any autocorrelation at delays bigger than m may be disregarded. Same case as the robust errors in heteroskedasticity, the smaller the standard error which is 0.1806588 as compared to the value of the coefficient, which is 0.4271023, the better the reliability with zero lag. With 1 lag the standard error is 0.1535935 smaller than the 0.4271023 which is the coefficient. [41]

```
. newey ln_hpi fd_ln_hpi, lag(1)

Regression with Newey-West standard errors       Number of obs   =         51
Maximum lag = 1                                   F(  1,     49) =       7.73
                                                  Prob > F        =     0.0077

                       Newey-West
     ln_hpi | Coefficient  std. err.     t    P>|t|    [95% conf. interval]
------------+-----------------------------------------------------------------
  fd_ln_hpi |   .4271023    .1535935    2.78   0.008    .1184446    .7357599
      _cons |   4.656914    .0075108  620.03   0.000    4.64182     4.672007

. newey ln_hpi fd_ln_hpi, lag(0)

Regression with Newey-West standard errors       Number of obs   =         51
Maximum lag = 0                                   F(  1,     49) =       5.59
                                                  Prob > F        =     0.0221

                       Newey-West
     ln_hpi | Coefficient  std. err.     t    P>|t|    [95% conf. interval]
------------+-----------------------------------------------------------------
  fd_ln_hpi |   .4271023    .1806588    2.36   0.022    .0640549    .7901497
      _cons |   4.656914    .0055198  843.67   0.000    4.645821    4.668006
```

5.7 Robust errors to heteroskedasticity for the model with 1 variable

Even if there is no need for this test due to a non heteroskedastic model in general is good to test for robustness of errors to heteroskedasticity. A method to achieve unbiased standard errors of OLS coefficients under heteroscedasticity is called "robust" standard errors. The Gauss Markov assumptions that are required to make OLS the best linear unbiased estimator (BLUE) is violated by heteroscedasticity. When an estimate of the asymptotic covariance matrix of the OLS estimator converges asymptotically to the actual value even when the variance of the regression errors is not constant, the estimator is said to be heteroskedasticity-robust in linear regression analysis. In this case, the smaller the standard error which is 0.1806588 as compared to the value of the coefficient, which is 0.4271023, the better the reliability.

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```
. reg ln_hpi fd_ln_hpi,robust

Linear regression                               Number of obs   =        51
                                                F(1, 49)        =      5.59
                                                Prob > F        =    0.0221
                                                R-squared       =    0.0917
                                                Root MSE        =    .03944
```

ln_hpi	Coefficient	Robust std. err.	t	P>|t|	[95% conf. interval]	
fd_ln_hpi	.4271023	.1806588	2.36	0.022	.0640549	.7901497
_cons	4.656914	.0055198	843.67	0.000	4.645821	4.668006

5.8 White test of the ARIMA model

White test, check for the residual errors and for heteroskedasticity. There is a need to confirm that the residuals are white noise. When summarizing these errors Stata comes up with a table showing the observations the mean, and the standard deviation. The mean is negative due to negative numbers in the data and with this mean of -0,02515, Stata is able to produce a graph that can be seen as the mean of the error and the data fluctuating around to this mean (see Figure 12). The disparities between the fitted model and the data are known as residuals. If you have a good fit for the signal in a signal-plus-white noise model, the residuals should be white noise. For a collection of samples that are being compared, Q is calculated by dividing the range of means by the estimated standard error of the mean. In most cases, analysis of variance is used to determine the estimated standard error of the mean for a set of samples. The *P-value* is 0,9801and under the null hypothesis *if p>0.05* the null hypothesis is not rejected and meaning that the residuals are white noise.

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Table 10: Prediction of errors at the top of the table, next summarizing error to provide us with some statistics, mean standard deviation and the white noise test Portmanteau shows that the residuals should be white noise.

```
. predict error,resid
(13 missing values generated)

. summarize error
```

Variable	Obs	Mean	Std. dev.	Min	Max
error	51	-.0251579	2.794822	-5.631658	7.215588

```
. tsline error, yline(-.0251579)

. wntestq error

Portmanteau test for white noise

Portmanteau (Q) statistic =    11.2846
Prob > chi2(23)           =     0.9801
```

Figure 11: The mean of the error= -0,02515 and the data wiggle consistently around this mean. The critical values are in 2020q1,2013q1 till 2015q1, which makes sense because it's the period of the crises.
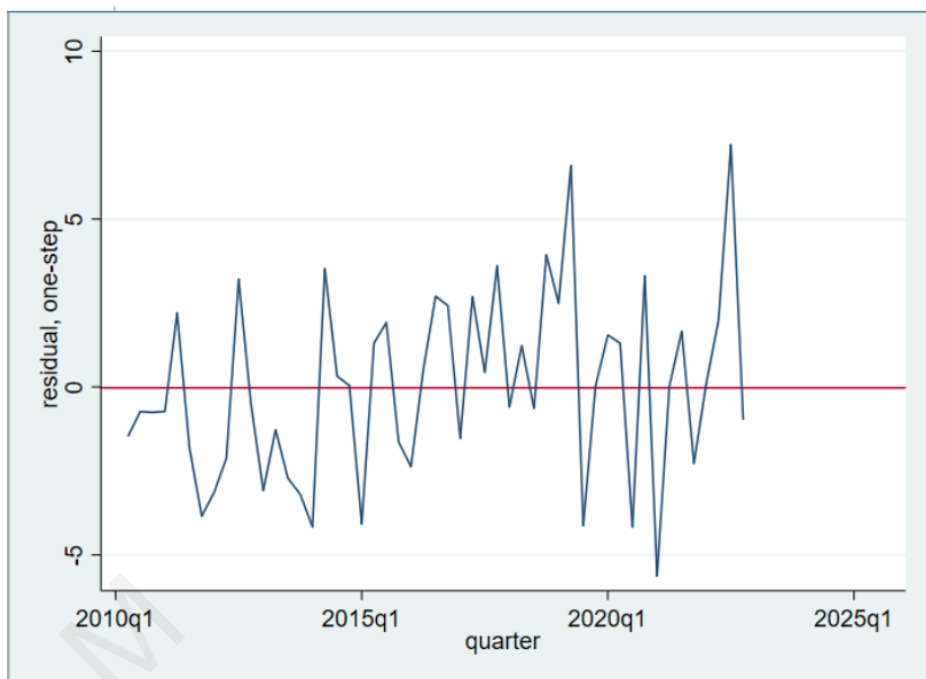
5.9 Unit Root test for ARIMA model

The eigenvalue stability criterion is verified by "estat aroots" after an ARIMA model's parameters are estimated. It also generates a graph of the eigenvalues of the companion matrices for the AR and MA polynomials. Overall, to know how to handle the data, one must grasp stationarity. If the data is non-stationary, some transformations could be able to make it stationary. This time series is stationary, so its mean, variance, and covariance are constant across time.

Table 11: Roots

```
. estat aroots

Eigenvalue stability condition
```

Eigenvalue	Modulus
-.01567618 + .4175586i	.417853
-.01567618 - .4175586i	.417853

```
All the eigenvalues lie inside the unit circle.
AR parameters satisfy stability condition.

Eigenvalue stability condition
```

Eigenvalue	Modulus
.3826039	.382604

```
All the eigenvalues lie inside the unit circle.
MA parameters satisfy invertibility condition.
```

Inverse roots of ARMA polynomials
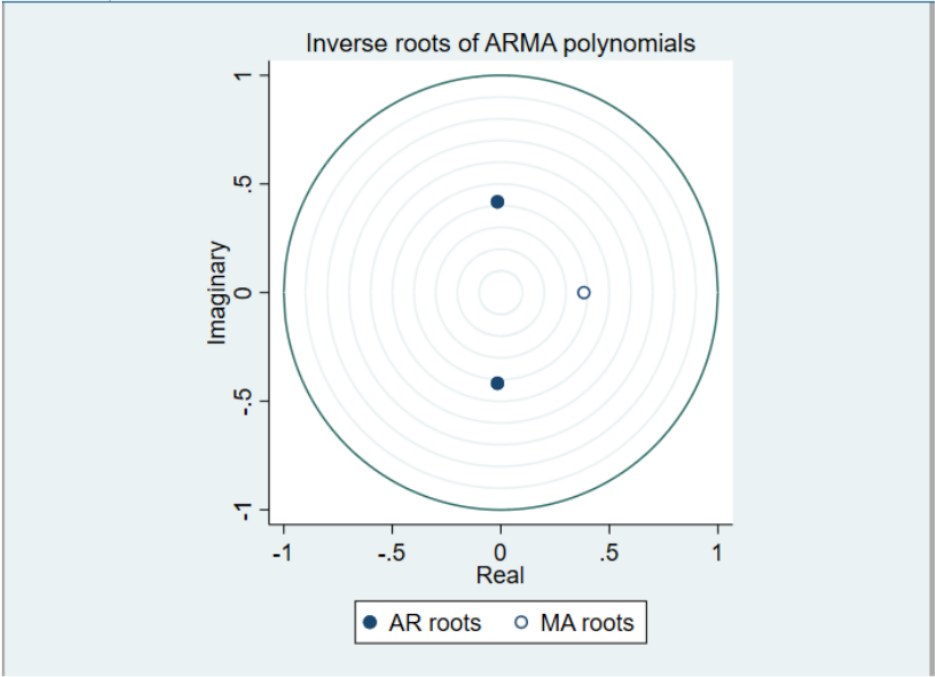
Figure 8:Arima best fits in our data with 95% confidence calculating standard errors for mean predictions
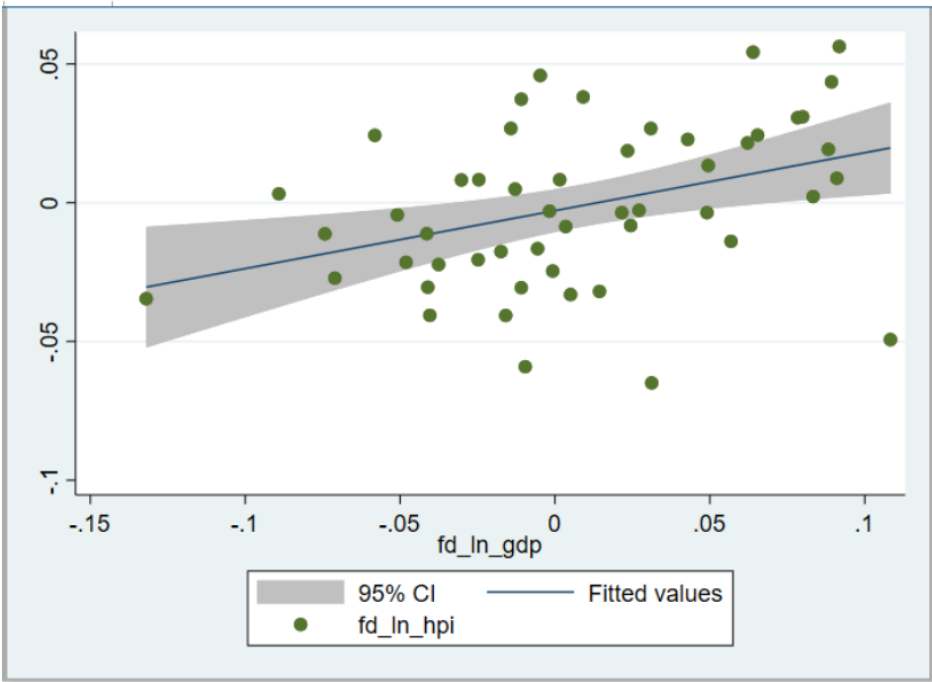
6 Discussion and conclusions

Is generally observed that changes in the log prices of houses tend to decline due to the negative coefficient of the independent variables. A negative coefficient indicates that the dependent variable tends to decline as the independent variable rises. The coefficient value is the amount that a one-unit change in the independent variable affects the mean of the dependent variable while keeping all other model variables constant. [27]

Figure 9: The log change of changes in house prices during 2010 quarter 1 to 2022 quarter 4. With lags, the estimates are shrinking compared to the Figure 2 and it's reasonable because the change in prices is smaller relative to the price itself.
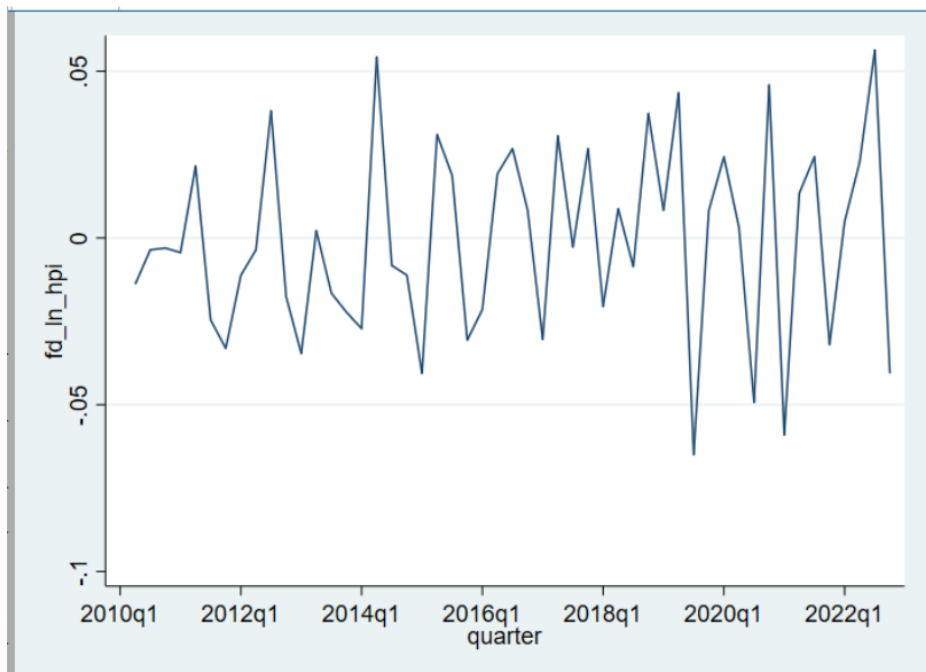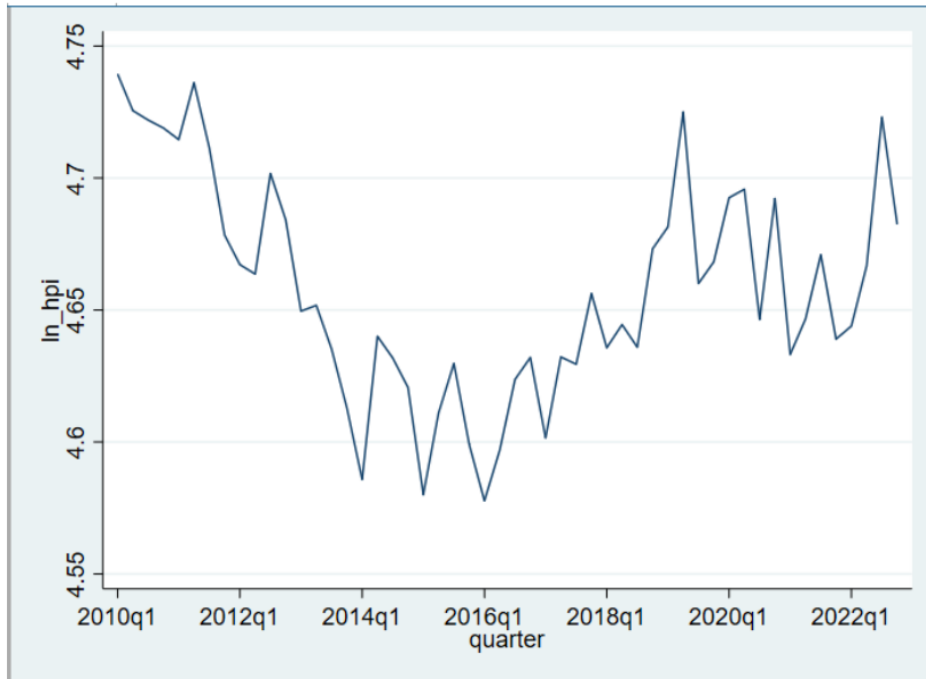
The model chosen for the best fit is the AR(p) model with 2 variables the log changes of HPI and the log changes of GDP. Results of it show that the house price index is declining meaning that during the upcoming 3 years, prices of houses will continue to increase but with a smaller proportion. 2023 the house price average change will be at 8% 108 points (2015=100), 2024 the average change will be 7,5% and in 2025 7%.

Table 12: Forecasted house price indexes

Column1	Column2
2023Q1	107,3431
2023Q2	108,02
2023Q3	107,9918
2023Q4	107,7477
2024Q1	107,6334
2024Q2	107,5527
2024Q3	107,4483
2024Q4	107,3388
2025Q1	107,2336
2025Q2	107,1292
2025Q3	107,024
2025Q4	106,9186

Based on some statistical tests of models, the variables with the most correlation and coefficient with the change of log of HPI are the Gross Domestic Product, the purchases of new dwellings, the average earnings per months, so the income, the real estate activities meaning the residential and business buildings, the unemployment rate and the population of adults in Cyprus. GDP as expected has a bigger coefficient with the change in house prices than other the variables and confirms this thesis questions. It seems that GDP is positively correlated with house price index, and this says that when GDP increasing, house price index also increases. On the other hand, Inflation and interest rate were not correlated with house price index changes even if it was expected to be. Literature link economic growth with inflation and interest rates. Since real estate market is related with the growth rate, it is expected that will be linked with these two variables. This is might not the case either because the tests were not that accurate, or that immovables are not that high related to these variables.

Real estate phase, Cyprus, someone can say from the results and the literature, is in the middle of the expansion where prices are still increasing. Even when the prices tend to increase for the

next three years the prices are still growing and demand for property is high. Investors try to sell properties at a higher market value to increase their ROI and become more profitable. Finally, the question should buy or wait, if investors are selling in a higher value than the average the answer is to wait. Investors watch the trends and if a place is expanding watch and wait the right time to buy, when prices are low, to sell later at a higher price. For example, in Aglatzia where the University of Cyprus is expanding one can say if the investor bought apartments during the period 2020, when the prices were significantly lower e.g., a one-bedroom apartment new build was 95.000 euros now in 2023 prices the one-bedroom apartment is125.000 euros.

Figure 11: Forecasted house price changes
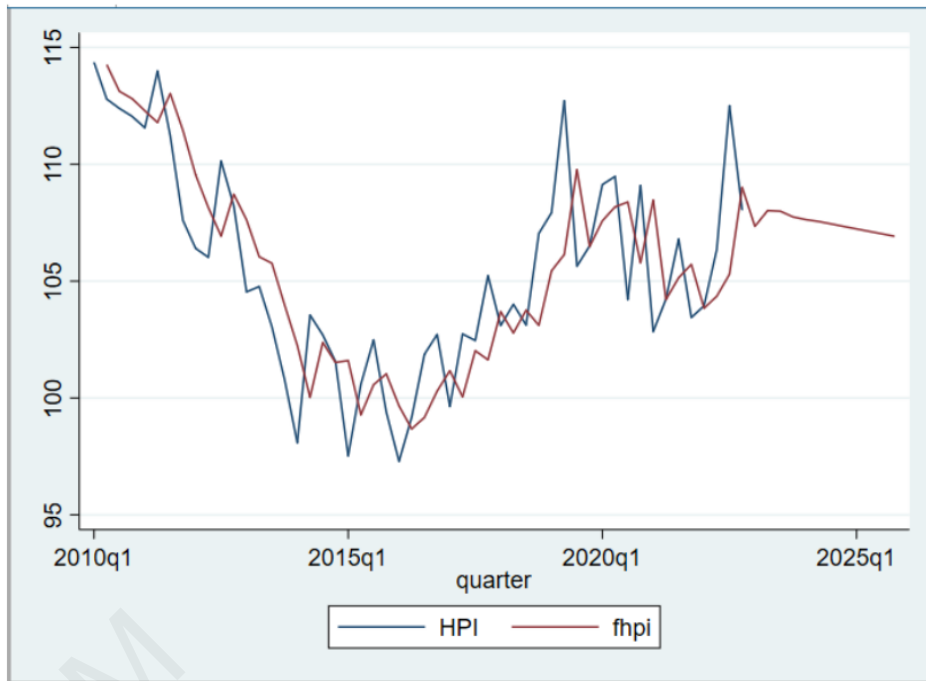
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