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Faculty of Social Sciences
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MASTER'S THESIS

The effect of monetary stimulus on housing prices and the relationship of housing and rental prices in European countries

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Declaration of Authorship

The author hereby declares that he compiled this thesis independently; using only the listed resources and literature, and the thesis has not been used to obtain a different or the same degree.

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Prague, July 27, 2021 Maximilian Hönig

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Abstract

As real estate is an important part of the wealth composition of households, this Master's thesis focuses on this asset class in particular. The main focus hereby lies on the impact of the financial stimulus that was observed throughout 2020 and how it might have affected housing prices in various European countries. For this the thesis runs a Vector Error Correction Model with the following independent variables: population, exchange rate, inflation, short-term interest rate, unemployment rate and the compensation of employees. The time frame for this regression is restricted to 2000Q1 to 2019Q4 in order to exclude the housing price development throughout 2020 that is already affected by the financial stimulus. These regression results are then used in combination with the 2020 actuals of all independent variables to approximate the expected housing price without financial stimulus. This gives an indication of a potential overpricing in the markets and provides an understanding of how financial stimulus might be connected to housing prices. Another analysis in this thesis then provides an understanding of the leader-follower relationship of housing prices and rental prices and provides an analysis on how this might be connected to the level of home ownership in a particular market.

JEL Classification	F62, J11, R30
Keywords	Real Estate, Covid-19, Financial Stimulus
Title	The effect of monetary stimulus on housing prices and the relationship of housing and rental prices in European countries

Abstrakt

Protože nemovitosti jsou důležitou součástí složení majetku domácností, zaměřuje se tato magisterská práce zejména na tuto třídu aktiv. Hlavní důraz je zde kladen na dopad finančních stimulů, které byly pozorovány v průběhu roku 2020, a na to, jak mohly ovlivnit ceny nemovitostí v různých evropských zemích. Za tímto účelem je v práci použit vektorový model korekce chyb s následujícími nezávislými proměnnými: počet obyvatel, směnný kurz, inflace, krátkodobá úroková míra, míra nezaměstnanosti a náhrady zaměstnancům. Časový rámec této regrese je omezen na období od 1. čtvrtletí 2000 do 4. čtvrtletí 2019, aby se vyloučil vývoj cen bydlení v průběhu roku 2020, který je již ovlivněn finančními stimuly. Tyto výsledky regrese jsou pak použity v kombinaci s aktuálními hodnotami všech nezávislých proměnných v roce 2020 k aproximaci očekávané ceny bydlení bez finančního stimulu. To naznačuje potenciální nadhodnocení cen na trzích a umožňuje pochopit, jak mohou finanční stimuly souviset s cenami bydlení. Další analýza v této práci pak poskytuje pochopení vztahu leader-follower vztah mezi cenami bydlení a cenami nájemného, a také poskytuje analýzu, jak by toto mohlo souviset s úrovní vlastnictví bydlení na daném trhu.

Klasifikace	F62, J11, R30
Klíčová slova	Nemovitosti, Covid-19, Finanční stimulace
Název práce	Vliv měnové intervence na ceny nemovitostí a vztah cen nemovitostí a nájmů v evropských zemích

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Acronyms

LHP	Housing Price
INF	Inflation
ER	Exchange Rate
COMP	Employee Compensation
POP	Population level
STIR/SRI	Short-term interest Rate
COMP	Employee Compensation
UNEMPL	Unemployment Rate
VECM	Vector Error Correction Model

Master's Thesis Proposal

Author:	Bc. Maximilian Hönig
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Defense Planned:	September 2021

Proposed Topic:
Determinants of Housing Prices in various international countries and cities

Motivtion:
This thesis is split into four main areas of research.

This thesis aims to analyze how macroeconomic and socioeconomic variables are correlated to the pricing of housing.

The second part is then aiming to explore the correlation between the pricing of housing in major cities and the pricing of housing in the rest of the country. Hereby, different markets are analyzed in which some cities enjoy a great focus within the country, such as Prague in the Czech Republic and others play a less important role within the country, such as New York in the United States.

The third part of the thesis is then focused on understanding the potential impact Covid might have had on housing prices if the monetary stimulus would not have taken place in the way it did throughout 2020 and 2021.

The last part of the thesis is then focused on exploring the correlation between rental prices and the price of housing. Hereby the thesis is exploring which variable plays a leading role in which market, as some of the analyzed markets have a majority of housing devoted to rentals, while others have a share of rentals that lies below 50% and aims to describe the lag that occurs between these two variables.

To give a global understanding and comparison of the findings above, different international countries and cities are analyzed. These will include Prague and the Czech Republic, Los Angeles plus New York and the United States, Paris and France, Toronto and Canada, Madrid and Spain.

Hypotheses:
1. Hypothesis #1: The monetary interventions connected to the Covid-19 pandemic increased housing prices, independently of the main macro- and socioeconomic drivers
2. Hypothesis #2: The housing price leads the correlations with rental prices in countries with a large percentage of homeownership

Methodology:
The data is taken mostly from the national statistical institutes, as well as from databases provided by National Central Banks.

Hereby the first part of the thesis is conducted using Vector Autoregression (VAR) for each country.

The second part is then using Dynamic OLS or first differences depending on the outcomes of the ADF and Johansen tests.

For the Covid extension, the regressions from the first part are combined with actuals and forecasts of the macroeconomic variables used in the regressions to get an understanding of how the impacts of Covid would have affected housing prices without the monetary interventions throughout the last year.

For the last part, a Granger Causality Test between the rental and housing prices in every previously mentioned city is conducted to understand which of the variables play a leading role in the correlation. Then a leader-follower regression is run, to understand the magnitude of the correlation and understand potential lags.

Expected Contribution:
This thesis aims to give owners of real estate, which is the cornerstone of the wealth composition of many households internationally a better understanding of what affects this assets class and build on the already conducted research to provide a truly global picture. Another large contribution is also given through the Covid extension, which will use the previous regressions to provide estimates on how the Covid pandemic would have impacted the pricing of real estate without monetary interventions.

Further contributions are aiming to give a better understanding of market behavior in areas that saw little research on a global scale prior to this thesis. This includes, on one hand, the correlation between the pricing of housing in major cities and how these affect the pricing in the rest of the country. On the other hand, the thesis aims to improve the understanding of the correlation between rental and housing prices within the previously named cities. The results of the provided regressions are giving insights into, which variable is the leading one in which types of markets and give more details in regards to the magnitudes and lags of the variables' relationship.

Outline:
1. Introduction
2. Literature Review
3. Data
4. Correlation of macroeconomic/socioeconomic variables and national housing prices
5. Correlation of housing prices in major cities and the rest of the country
6. Predicted Covid impact on housing prices
7. Correlation between rental and housing prices in major cities
8. Conclusion

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1 Introduction

1.1 Research background

Individuals' housing expenses make up a significant portion of their living costs and buying a house can be one of the most important financial decisions of their lives (Oh et al., 2021). According to Turner and Luea (2009), who used U.S. households as the focus of their study, homeownership increases wealth creation. Furthermore, Killewald and Bryan (2016) argue that home ownership is regarded as one of the most critical wealth accumulation mechanisms. In addition, using a comprehensive panel data set, Haurin et al. (2002) argue that homeowners enjoy a 13 to 23% higher quality of their neighborhood, fewer behavior problems with children, and greater cognitive abilities than renters. However, fluctuations in housing prices can not only have significant impacts on the financial wealth of households but can also majorly influence the financial sector. A good example of this can be found in the financial crisis of 2008, which was characterized by falling house prices combined with a high level of borrowing and a high unemployment rate (Nakajima, 2011). When considering the importance of homeownership, it is important to analyze how historical changes in macroeconomic and socioeconomic conditions in the past affected housing prices.

In many studies, macroeconomic and socioeconomic variables were found to have a significant impact on housing prices. It appears that interest rates have a substantial effect on house prices, and there is a negative relationship between interest rates and house prices (Sutton, 2002; Ferrero, 2015; Tsatsaronis and Zhu, 2004; Savva, 2015; Örsal, 2014; Arestis and Gonzalez-Martinez, 2016; Leung and Ng, 2019; Girouard et al., 2006). The exchange rate has also been widely discussed in the empirical literature, where despite the majority of literature finding a positive correlation between exchange rates and housing prices, there is still value in recognizing the existence of literature that indicates a negative correlation (Benson et al., 1999; Lipscomb et al., 2003; Wang and Wang, 2017; Meidani et al., 2011). Due to the logical endogeneity between changes in housing prices and inflation, inflation is an interesting variable that calls for careful consideration; however, the literature generally finds that there is a positive correlation between house prices and inflation (Anari and Kolari, 2002; Meidani et al., 2011; Zhang, 2012; Frappa and Mésonnier 2010). It would also be interesting to discuss socioeconomic variables, as some literature suggests that population and house prices are positively related (Capozza et al., 2002; Miles, 2012). A second important variable to consider when discussing house prices is unemployment. The majority of the literature suggests a negative correlation between unemployment and housing prices (Zhu, 2010; Riley et al., 2015; Geerolf and Grjebine, 2014). Wage is another socioeconomic variable often cited as having a positive relationship with rising house prices (Jacobsen and Naug, 2005; Weale, 2007; Savva, 2015). Given this, further empirical research into the determinants of housing prices is still necessary to enhance the existing literature discussion and provide an updated analysis.

Apart from macroeconomic and socioeconomic variables, exceptional events, such as pandemics, can significantly affect housing prices. Although the amount of literature relating to this topic is still quite limited, a few critical studies attempt to analyze the impact of the pandemic on house pricing. One of the first studies on the matter was conducted by D'Lima et al. (2020) on the effects of Covid-19 on housing markets in the United States (U.S). Using historical outbreaks in Paris and Amsterdam to compare home price changes, Francke and Korevaar (2021) note that house prices in heavily affected areas would drop during the first half-year of an epidemic. In addition, Qian et al. (2021) examined the impact of Covid-19 on housing prices in China. As a result of this study, upon the confirmation of Covid-19 cases, the housing prices should drop in communities impacted. In light of this, research on this area would be highly relevant to add some novel analysis and perspectives about how the Covid-19 pandemic can impact housing prices.

In addition, it is also interesting to observe the correlation between housing rent prices and housing prices since studies about it come up with mixed results. According to some studies, housing prices and rent are independent variables and do not impact each other, such as Himmelberg, Mayer, and Sinai (2005) and Dong and Liu (2010). On the other hand, other studies have found that rent and housing prices have a cointegrated relationship, such as Gallin (2008) and Yu and Chen (2009). Moreover, it is also interesting to note that several studies have found that housing prices are influenced by housing rent, but not the other way around, such as Liu (2007) and Du and Ma (2009). There is also research that shows rents are positively influenced by both apartment supply and housing price levels, such as Hanink et al. (2010). In addition, with the help of the Hausman test, Zhai et al. (2018) demonstrate that rent prices and housing prices are endogenously correlated. Therefore, it is essential to continue research on the topic to provide more up-to-date findings and an in-depth understanding of the relationship between rent and housing prices.

1.2 Research questions

With regard to the discussion above, it has become clear that homeownership is a fundamental issue. Therefore, evaluating the determinant factors that affect the price of a house is highly essential. Furthermore, it is also necessary to analyze the determinant factors of housing pricing, such as macroeconomic and socioeconomic variables, as well as other significant variables to provide a better understanding of the determinant factors of house prices. In this regard, the questions of the research can be described as follows:

1. How do the macroeconomic and socioeconomic variables impact housing prices?
2. How would have Covid-19 impacted housing prices without the monetary stimulus observed throughout 2020?
3. Does the lead variable between housing prices and rental prices change in different markets?

1.3 Research aims and objectives

This research is aimed to provide a deeper understanding of the factors that determine the market price for housing. As a result, these are the research objectives:

1. Examine the impact of macroeconomic and socioeconomic variables on housing prices;
2. Provide a framework estimating the housing price development throughout 2020, when excluding money supply;
3. Discuss the correlation between rental prices and housing prices and examine the potential impact of homeownership in the market.

1.4 Overview of the research data and methodology

This research focuses on the housing prices on a national level in selected European countries within The Organization for Economic Cooperation and Development (OECD) from 2000 to 2019 on a quarterly basis as the dependent variable. The independent variables will include real effective exchange rates obtained from the World Bank database and inflation rates, short-term interest rates, population growth, unemployment rates, wages, and rental prices from OECD countries. In terms of the econometric regression, this research will employ Vector Error Correction Model

(VECM) to analyze the determinant factors of housing prices, both in the short and long term. As an extension of this regression, this research will provide an estimation framework of how Covid-19 would have affected housing prices throughout 2020 in the absence of the monetary stimulus observed throughout the year. To analyze the leader and follower correlation between rent prices and housing prices, this study will use the Granger Causality Test.

1.5 The contribution of research

This research contributes to the existing literature about the determinant factors of the housing prices in three distinct ways: (i) providing the analysis on the correlation of macroeconomic and socioeconomic variables on housing prices in different European markets; (ii) developing a framework to estimate the effects of Covid-19 on housing prices throughout 2020 with the absence of monetary stimulus; (iii) assessing the leader and follower relation between rental prices and housing prices in countries with varying levels of home ownership.

1.6 The structure of research

This research is structured into eight chapters. In the following chapter, relevant literature is reviewed to form the basis of the study. The third chapter outlines the data and methodology used by this research. The fourth chapter analyzes the impact of macroeconomic and socioeconomic variables on housing prices without monetary intervention. In the fifth chapter, this research will develop an econometric model to predict the effect of Covid-19 on housing prices. This research will examine the correlation between rental house prices and home prices in major cities in the sixth chapter. In the final chapter, this research will provide the conclusion and recommendations for further investigation.

2 Literature Review

Research has been conducted on several determinant factors that affect the real estate market and determine the property's price. In light of this, it is necessary to comprehensively understand the existing literature on the determinant factors that influence housing prices before proceeding to further analysis. To offer a comprehensive overview of the literature connected to the research conducted in this thesis, it has been divided into three parts. This literature review will cover the updated studies on the macroeconomic and socioeconomic impact on housing prices. In addition, as well as discussing the existing literature on the impact of previous pandemics on housing prices, this chapter will also address the impact of the current Covid-19 pandemic. A discussion about the correlation between rental house prices and housing prices will also be discussed in this chapter. Lastly, the thesis outlines the potential components that determine housing prices and its contribution to existing literature.

2.1 Macroeconomic and socioeconomic impact on housing prices

2.1.1 Interest rate

There seems to be every indication that macroeconomic variables significantly correlate to housing prices in many studies. According to Case (2000), housing prices tend to be highly associated with the global macroeconomic variables even though they are tied to a particular location. The degree of correlation of those global factors is determined by the degree of globalization of the country. A further argument made by Sutton (2002) is that there is a significant impact of macroeconomic variables on house prices in six developed countries (United States, Canada, United Kingdom, Ireland, Netherlands, and Australia). Using the Vector Auto Regression (VAR) econometric model to analyze quarterly data from 1995 to 2002, this study found national incomes, interest rates, and stock prices being significant determinants of the housing market price.

It is also important to point out that Tsatsaronis and Zhu (2004) also highlighted specific country macroeconomic variable correlations with housing prices in their empirical study. This study examines correlations between housing prices and Gross Domestic Product (GDP), inflation, short-term interest rates, term spread, and bank credit in 17 industrialized countries from 1970 to 2003. It has been demonstrated by this study that inflation and interest rates have a strong correlation with housing prices. In addition, The Markov-Switching model has been applied to quarterly housing price data from 2001 to 2014 in Cyprus, in the study by Savva (2015). This study aims to analyze how macroeconomic variables such as the lending rate, consumption, stock returns, exchange rate, unemployment rate, and inflation impact housing prices. In this study, it was found that macroeconomic variables have a regime-dependent effect on housing prices in Cyprus, in which the variables are only statistically significant during boom times. Furthermore, this research indicates that there are negative correlations between housing prices and housing lending rates, stock returns, and unemployment rates. On the other hand, the study also reveals positive correlations between housing prices and consumption, exchange rate, disposable income, and inflation.

Furthermore, Örsal (2014) also developed determinants of housing prices between 1989 and 2010 for 12 OECD countries by observing quarterly data from 1989 to 2010, using VAR econometric models. This study found that interest rates and GDP per capita are significantly related to housing prices. It is also interesting to note that Arestis and Gonzalez-Martinez (2016) examine the determinant variables of house pricing in 17 OECD countries from 1970 to 2003 using the Autoregressive Distributed Lag (ARDL) econometric model. In this study, real disposable income and interest rates were found to play a significant role in determining housing prices.

Furthermore, the study of Leung and Ng (2019) is also noteworthy. It examines the correlation of macroeconomic variables with housing prices using quarterly data from 1991 to 2017 divided into two sampling periods to obtain a more precise picture of housing prices before and after the global financial crisis. This study found that interest rates have been highly correlated with housing prices after the global financial crisis. In addition, using data from 1970 to 2005 from 18 OECD countries, Girouard et al. (2006) evaluate key macroeconomic variables that affect housing prices. According to the results of this study, the real interest rate has a direct impact on housing prices.

Moreover, it is also interesting to note the analysis of Ferrero (2015) that examines the housing price in the United States from 2001 to 2006 and determines that many macroeconomic variables determine housing prices. The results of this study indicate that low real interest rates and house prices have a negative correlation. The research also suggests that while domestic variables such as credit and preference shocks increase the price of housing in the United States, an exchange rate regime that pegs the dollar to foreign currencies also increased the impact of domestic expands shocks.

2.1.2 Exchange rate

Regarding the correlation between exchange rate and housing prices, Benson et al. (1999) examined the effect of exchange rate fluctuations on housing prices in Bellingham, Washington, between 1984 and 1994. According to the study, a 10% increase in the exchange rate will approximately result in a 7.7% rise in housing prices. Lipscomb et al. (2003) have also documented a similar finding using housing data in Mexico, showing that appreciation in the exchange rate increases real estate prices.

Some interesting points to note are that the studies carried out by Wang and Wang (2017) focus on the relationship between the exchange rate and housing prices in China using quarterly data from 2005 to 2014. In line with previous research results, this study found that the exchange rate has a statistically significant positive impact on housing prices in China. Furthermore, the study revealed that housing prices, exchange rates, and disposable income are in equilibrium over the long run. In addition, this study found that the exchange rate was also an important determinant of housing prices. However, housing prices are not an essential determinant of the exchange rate. Furthermore, it is also interesting to note that the findings of Meidani et al. (2011) suggest that there is no significant correlation between exchange rate and housing prices, which differs from the findings of previous research on the relationship between exchange rate and housing price.

2.1.3 Inflation

It is important to consider the logical endogeneity between housing price changes and inflation when discussing the relationship between housing prices and inflation. The study by Anari and Kolari (2002) uses ARDL econometric model to examine the correlation between inflation and housing prices using monthly data from 1968 to 2000 in the U.S. It is also important to note that this research did not include the housing prices in the Consumer Price Index (CPI) variables to avoid potential bias. According to this study, the price of housing is positively correlated with inflation and offers a stable inflation hedge over the long term. Based on quarterly data from 1990 to 2008 in Iran, Meidani et al. (2011) examined the correlation between housing prices and macroeconomic variables such as GDP, exchange rate, and inflation using the VAR econometric model. The results of this study revealed a statistically significant correlation between housing prices and macroeconomic variables, especially GDP and inflation, where each variable has a positive impact on housing prices.

On the other hand, the paper finds no evidence that real housing price changes have an impact on GDP and inflation. Zhang (2012) suggests slightly different findings when assessing the correlation between housing prices and inflation in China using quarterly housing price data from 1998 to 2010. Study results indicate that changes in housing prices in China have a noticeable impact on inflation.

It is also interesting to note that Frappa and Mésonnier (2010) attempted to analyze the impact of the inflation-targeting framework on the housing price from a policy standpoint. Using data and information from 1980 to 2007, this research shows that inflation targeting policies are significantly positively correlated with real housing price growth in 17 industrial countries. During this research, it was also found that inflation targeting policies have a significant impact on the housing price-to-rent ratio.

2.1.4 Socioeconomic variables

Based on panel data from metro areas in the U.S. for the period of 1979 to 1995 of single-family housing prices, Capozza et al. (2002) looked at the determinants of real housing price dynamics. The findings of this study indicated that a rise in real income and population growth has a positive impact on housing prices. This study also highlighted that the cost of construction is a critical factor in determining housing prices. Furthermore, there are interesting findings to be noted in the study by Miles (2012) about the influence of population density on housing prices. According to this study, increasing population size and incomes generate an increase in housing prices and a decreasing housing stock. Another finding of this study is that the likelihood of rising housing prices exceeding the growth of average incomes increases with a higher population density.

To explore the nature of the relationship between unemployment and housing prices in the United Kingdom's housing market, Zhu (2010) examined regional panel data for the United Kingdom from 1997 to 2011. In this study, unemployment has been found to significantly and negatively impact housing prices at the national level. Despite this finding, this study failed to find an indication of regional housing prices being related to unemployment. Similarly, Riley et al. (2015) found a negative correlation between housing prices and unemployment between 2005 and 2012 in the United States. In addition, Geerolf and Grjebine (2014) examined cross-country data from 34 countries from 1970 to 2010 to observe the correlation between housing prices and unemployment dynamics. The results of this study also demonstrate a negative correlation between housing prices and unemployment.

By looking at macroeconomic data and housing prices in Norway from 1990 to 2004, Jacobsen and Naug (2005) identified determinant factors influencing housing prices. A positive correlation between total wage income and housing prices is reported in the research. Additionally, this study found that housing prices had a negative relationship with unemployment and interest rates. It is suggested by Weale (2007) that housing prices are heavily influenced by real income since the rise of real income leads to an increase in consumer demand and, therefore, a rise in housing prices.

Given the literature discussion above, it is an encouraging sign that housing prices are affected by many macroeconomics and socioeconomic variables. Given the literature discussion above, interest rates are one of the primary variables which influence housing prices. There is almost no disagreement in the literature regarding the relationship between interest rates and home prices being negative. The next variable that needs to be observed is the exchange rate, which has also been widely discussed and addressed in the empirical literature. Even though most of the literature that reviews the relationship between exchange rates and housing prices is positive, there is still value in paying attention to literature that states a negative relationship between the two. Inflation is a very interesting variable and requires careful consideration due to the logical endogeneity between housing prices and inflation changes. The literature generally agrees that there is a positive correlation between housing prices and inflation. However, there are somewhat different perspectives about this correlation. Socioeconomic variables are also interesting to discuss, as some literature suggests a positive relationship between population growth and housing prices.

Moreover, unemployment is another crucial variable when it comes to discussing housing prices. Almost all literature suggests a negative relationship between the unemployment rate and housing prices. Another socioeconomic variable is wages, which is generally discussed as having a positive relationship with housing prices.

2.2 Impact of the Covid-19 pandemic on the price of housing

As Covid-19 has officially been recognized as a worldwide pandemic since March 2020, the impact on assets is expected to be significant. The housing market is one of the many sectors affected by this pandemic, even though its economic effects haven't yet been fully realized. There is still a relatively small amount of literature relating to this topic. Despite this, a few studies have examined the impact of the pandemic on housing prices. A study conducted by D'Lima et al. (2020) focused on the effect of Covid-19 on housing markets in the United States (U.S) was among the first to address this subject. The study analyzes the transaction data of Multiple Listing Services (MLS) from 31 states of the United States to examine the impacts of the Covid-19 pandemic on housing prices. The sample of MLS transactions is analyzed to compare states that experienced state-wide shutdowns with those that did not. As a result, this research found that in states where there were shutdowns, home prices fell more both on the effective and expiration dates of the shutdowns than in those that did not have shutdowns. In addition, research reveals that sales declined during both shutdowns and re-openings. The research indicates that besides affecting prices, the shutdowns affect the volume of real estate transactions.

Using data from the outbreaks of the plague in Amsterdam (16^{th} – 17^{th} centuries) and cholera in Paris (1832 and 1849), Francke & Korevaar (2021) investigate the effect on housing prices of pandemics. The study covers ten outbreaks with an adequate number of transactions that can be used to examine the impact of pandemics on housing prices in Amsterdam. This research covers only two outbreaks in Paris, but it provides a lot more insight into how the pandemics spread geographically. As well as examining the impact of pandemics on housing prices, this research also investigates how pandemics affect rent prices. Francke & Korevaar (2021) find that plague outbreaks in Amsterdam and cholera outbreaks in Paris led to a 13% and 10% decrease in housing prices, respectively.

Furthermore, despite these pandemics being statistically and economically significant, housing prices declined for only a short time afterward. In areas where there has been an extensive pandemic impact, housing prices fall most precipitously just after the disease outbreak. Price growth does not differ significantly from its normal trend after one to two years following the end of a pandemic. In addition, the research also found that rental prices were unlikely to be adversely affected by pandemics. According to this study, both cities have proven to be resistant to major shocks, which might explain why there is no apparent long-term effect on housing prices and rents. A large number of migrants continued to come to both Amsterdam and Paris despite the outbreaks.

In a related study, Qian et al. (2021) conducted another study regarding the pandemic, which focused specifically on the effect that Covid-19 had on China's housing prices. This study focuses on the impact of Covid -19 on Chinese housing prices by analyzing monthly data regarding confirmed Covid -19 cases at a community level. According to this research, the prices of housing decline by 2.47% in a community with confirmed Covid-19. Compared with Francke & Korevaar (2021), these findings of the fall in housing prices appear to be lower. Furthermore, according to this research, the effects of the pandemic on the housing market in China will last for three months after the event.

From this perspective, it is easy to see how a pandemic is likely to impact housing prices in many different aspects. A wide range of macroeconomic variables have changed throughout the pandemic. On the microeconomic level, transactions tend to decrease or even completely cease during the event, as some of the key aspects of the transactions have been discouraged or even banned. In light of the discussion discussed above, it can be inferred that there is limited literature on the impact of pandemics, particularly Covid-19, on the housing price. Due to this, this thesis will be one of the first studies to discuss the impact Covid-19 has on housing prices. This thesis also provides econometric models that enable us to predict the impact of Covid-19 on housing prices by extending the previous regression model of housing price determinants.

2.3 Correlation between Housing and Rental Prices

Housing prices and rent indicate how the real estate market has evolved. A wide range of studies have been conducted on the growth of the real estate market. However, prior literature has divided opinion as to whether housing prices are correlated with rental prices. Some research has shown that housing prices and rental prices are independent and not causally related. Himmelberg, Mayer, and Sinai (2005) examined 25 years of data over 46 metropolitan areas in the United States and discovered that there is no correlation between housing prices and rental prices. It is also supported by Dong and Liu (2010), who present evidence from China and suggest that housing rental prices and housing prices can temporarily deviate from one another.

The opposite is also true, as some research has found that housing prices and rental prices are cointegrated. Gallin (2008) analyzed the correlation between housing prices and rents from 1970 to 2005 using the Error Correction Model (ECM). According to this research, it was proven that housing prices and housing rent are cointegrated, as well as they are also interdependent. This research is also supported by Yu and Chen (2009), who provided evidence that housing rent and prices are interrelated in China.

Moreover, it is also interesting to note that Liu (2007) supplies evidence from China indicating that housing prices impact housing rent, but that rent does not affect housing prices. A similar finding has been reported by Du and Ma (2009), who state that an increasing housing price leads to a growing housing rent, but the housing rent does not affect the housing prices in any significant way. Furthermore, Hanink et al. (2010) demonstrate that rents are influenced positively by both apartment supply on the market and housing price levels. In addition, Zhai et al. (2018) also showed that there is an endogenous relationship between housing rent and housing prices by applying the Hausman test to panel data of 30 cities in China from 2008 to 2013.

Given the discussion above, it appears that there are still divergent views about the correlation between rent and housing prices in the existing literature. Accordingly, this thesis tries to contribute to the existing literature discussion on correlations between rent and housing prices based on a cross-country analysis of the rental and housing prices. Besides providing an in-depth understanding of the relationship between rent and housing costs, this thesis also aims to provide a more recent analysis based on the latest data.

2.4 The determinant variables of housing prices

Having reviewed the literature discussed above, it is encouraging to see how housing prices are affected by a wide range of variables. Some of those variables will be included in the regression. Among macroeconomic variables influencing housing prices, the interest rate is one of the most discussed variables (Sutton, 2002; Ferrero, 2015; Tsatsaronis and Zhu, 2004; Savva, 2015; Örsal, 2014; Arestis and Gonzalez-Martinez, 2016; Leung and Ng, 2019; Girouard et al., 2006). It is expected that the correlation between housing prices and interest rates will be negative. The second variable, the exchange rate, is also discussed in the literature as a factor influencing housing prices. It is generally reported in the literature that interest rates and housing prices correlate positively (Benson et al., 1999; Lipscomb et al., 2003; Wang and Wang, 2017). However, it may be that exchange rates and housing prices have a different relationship, as Meidani et al. (2011) found. The third variable is inflation, which is perceived as having a positive impact on housing prices (Anari and Kolari, 2002; Meidani et al., 2011; Zhang, 2012; Frappa and Mésonnier, 2010). The next variable is population (Capozza et al., 2002; Miles, 2012) and wages (Jacobsen and Naug, 2005; Weale, 2007; Savva, 2015) which are considered to have a positive relationship with housing prices. The unemployment rate is a socioeconomic variable that is thought to negatively influence housing prices (Zhu, 2010; Riley et al., 2015; Geerolf and Grjebine, 2014).

2.5 Contribution

Given the literature discussion above, it is important to note that the contribution of this research to the existing literature on the determinant factors of housing prices would be possible in three distinct ways. This research will provide a better understanding of what influences housing prices on a global scale. For this purpose, the thesis investigates the correlations between macroeconomic variables and housing prices across different countries using Vector Error Correction Model to assess both short-term and long-term correlations. The second contribution is that by extending the regression model of housing price determinants, this thesis provides econometric models that can be used to predict the impact of Covid-19 on housing prices. As a final contribution, this thesis aims to contribute to the existing literature discussion on the correlation between rent and housing prices by providing an updated cross-country comparison of rental and housing prices.

3 Determinant factors of housing prices

3.1 Data and methodology

In previous chapters, it was discussed how this thesis focused on the price of housing and its determinant factors, and therefore the primary data needed to conduct analysis is the housing prices on a national level for each country. For this reason, it is necessary to collect housing and macroeconomic data from the national bureau of statistics and the national central bank of each OECD country being examined. Therefore, the variables previously listed in the literature review are obtained, such as housing price, inflation, exchange rate, short-term interest rate, population, compensation of an employee, and unemployment rate.

As for the period covered by this study, it ranges from 2000Q1 to 2019Q4. Since this research covers an extended period, which is nearly 20 years long, it is expected to produce more reliable findings and be in line with actual events. It is also expected that this thesis will provide an updated analysis of the factors that drive housing prices in the study's analysis countries. Also included in this period is the 2008 global financial crisis that was brought about by the subprime mortgage crisis to illustrate the consequences of the worldwide shock on the variables examined in this thesis.

With the use of the Vector Error Correction Model (VECM), this thesis examines the determinant factor for housing prices and examines both short-term and long-term relationships. This methodology has been chosen as the data for most countries shows co-integration, as well as some forms of non-stationarity (see Appendix A for Johansen and ADF tests). There has been previous research using VECM within the context of examining the relationship between macroeconomic variables and housing prices. The research conducted by Panagiotidis and Printzism (2016) on the macroeconomic factors affecting Greece's housing market has used the VECM econometric model. A VECM approach to explain the correlation of the housing price and macroeconomic variables in this research is given by the following equation:

$$\Delta Y_t = \alpha\beta' Y_{t-1} + \sum_{i=1}^{p} \beta_i \Delta Y_{t-1} + \sum_{i=0}^{q} \beta_i \Delta M_{t-1} + CD_t + \epsilon_t$$

Where Y_t is a proxy of the variable for housing price (H.P.) at the time t and M_{t-1} is a vector of macroeconomic and socioeconomic variables which consists of inflation (INF), the exchange rate (E.R.), short-term interest rate (STIR), population growth (POP), compensation of employees (COMP), and unemployment rate (UNEM). Consequently, the vector equations above indicate that housing price, macroeconomic, socioeconomic variables influence one another. For instance, housing price at the time t was influenced by housing price in the previous period (γ_{t-1}) and also by macroeconomic and socioeconomic variables in the previous period (M_{t-1}). At the same time, macroeconomic and socioeconomic variables at the time t were influenced by other variables in the previous period. These countries whose economies are being examined by this thesis are several OECD countries, including Austria, Belgium, Denmark, Finland, France, Greece, Switzerland, and Spain.

3.2 Austria

Based on the estimation results, all variables have statistically significant effects on the Austrian housing price at a 5% significance level, as shown in Table 3.1. Despite some differences, these results are in agreement with the literature that has previously been reviewed regarding several macroeconomic and socioeconomic variables.

Table 3.1 VECM Regression Result (Austria)

Vector Error Correction Estimates
Date: 06/28/21 Time: 10:19
Sample (adjusted): 2000Q3 2019Q4
Included observations: 78 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1
LHP(-1)	1.000000
INF(-1)	0.043518
	(0.01411)
	[3.08331]
ER(-1)	0.025405
	(0.00472)
	[5.37907]
COMP(-1)	1.98E-07
	(1.2E-05)
	[0.01710]
POP(-1)	-0.000518
	(0.00029)
	[-1.77561]
SRI(-1)	0.030633
	(0.01141)
	[2.68583]
UNEMPL(-1)	-0.006747
	(0.02789)
	[-0.24192]
C	-2.800087

Error Correction:	D(LHP)	D(INF)	D(ER)	D(COMP)	D(POP)	D(SRI)	D(UNEMPL)
CointEq1	-0.092886	-2.724709	-1.542816	-475.1530	-11.79680	-1.533333	1.269846
	(0.03065)	(0.63561)	(1.61913)	(340.654)	(7.36991)	(0.44810)	(0.38709)
	[-3.03093]	[-4.28675]	[-0.95287]	[-1.39482]	[-1.60067]	[-3.42184]	[3.28052]
D(LHP(-1))	-0.404811	-4.641977	5.436747	798.8563	11.07347	-3.000694	-0.303578
	(0.09894)	(2.05210)	(5.22744)	(1099.82)	(23.7941)	(1.44672)	(1.24973)
	[-4.09139]	[-2.26206]	[1.04004]	[0.72635]	[0.46539]	[-2.07414]	[-0.24292]
D(INF(-1))	0.010162	0.236280	-0.241654	14.84011	-0.333471	0.177355	-0.156103
	(0.00542)	(0.11245)	(0.28644)	(60.2657)	(1.30382)	(0.07927)	(0.06848)
	[1.87442]	[2.10126]	[-0.84364]	[0.24624]	[-0.25576]	[2.23723]	[-2.27954]
D(ER(-1))	-0.005804	0.110807	0.288872	31.29175	0.380142	0.055498	-0.030483
	(0.00229)	(0.04758)	(0.12121)	(25.5009)	(0.55170)	(0.03354)	(0.02898)
	[-2.52992]	[2.32880]	[2.38332]	[1.22709]	[0.68904]	[1.65448]	[-1.05199]
D(COMP(-1))	1.35E-05	-0.000152	0.000815	0.125804	-0.000727	0.000245	-0.000455
	(1.0E-05)	(0.00022)	(0.00055)	(0.11601)	(0.00251)	(0.00015)	(0.00013)
	[1.29444]	[-0.70337]	[1.47748]	[1.08445]	[-0.28950]	[1.60503]	[-3.45550]
D(POP(-1))	-0.000103	-0.016642	-0.021641	0.312993	0.717786	-0.006881	0.014880
	(0.00036)	(0.00746)	(0.01900)	(3.99651)	(0.08646)	(0.00526)	(0.00454)
	[-0.28682]	[-2.23170]	[-1.13926]	[0.07832]	[8.30169]	[-1.30883]	[3.27667]
D(SRI(-1))	-0.006212	0.366009	0.370007	236.5344	1.370750	0.468294	-0.316556
	(0.00717)	(0.14868)	(0.37875)	(79.6871)	(1.72400)	(0.10482)	(0.09055)
	[-0.86649]	[2.46165]	[0.97691]	[2.96829]	[0.79510]	[4.46753]	[-3.49597]
D(UNEMPL(-1))	0.005512	-0.279104	0.705475	8.227310	0.023598	-0.114898	-0.368790
	(0.00895)	(0.18564)	(0.47290)	(99.4946)	(2.15252)	(0.13088)	(0.11306)
	[0.61586]	[-1.50345]	[1.49181]	[0.08269]	[0.01096]	[-0.87791]	[-3.26201]
C	0.004571	0.262268	0.023158	263.4835	3.510654	-0.015158	-0.039958
	(0.00505)	(0.10474)	(0.26680)	(56.1325)	(1.21440)	(0.07384)	(0.06378)
	[0.90523]	[2.50411]	[0.08680]	[4.69396]	[2.89085]	[-0.20529]	[-0.62647]
R-squared	0.378195	0.422550	0.130199	0.222484	0.644262	0.527172	0.399103
Adj. R-squared	0.306101	0.355599	0.029353	0.132337	0.603017	0.472352	0.329433
Sum sq. resids	0.020407	8.778522	56.96414	2521538.	1180.217	4.363064	3.255777
S.E. equation	0.017198	0.356686	0.908607	191.1649	4.135770	0.251461	0.217222
F-statistic	5.245901	6.311357	1.291066	2.468014	15.62039	9.616320	5.728532
Log likelihood	211.0169	-25.48558	-98.42002	-515.6404	-216.6302	1.780629	13.19763
Akaike AIC	-5.179922	0.884246	2.754359	13.45232	5.785391	0.185112	-0.107631
Schwarz SC	-4.907994	1.156173	3.026287	13.72424	6.057319	0.457040	0.164297
Mean dependent	0.005377	-0.010165	0.036664	296.6731	11.38846	-0.059820	0.008120
S.D. dependent	0.020645	0.444333	0.922243	205.2261	6.564030	0.346178	0.265266

Determinant resid covariance (dof adj.)	0.030958
Determinant resid covariance	0.013124
Log likelihood	-605.7405
Akaike information criterion	17.32668
Schwarz criterion	19.44168
Number of coefficients	70

These findings confirm that the interest rate, the most widely discussed macroeconomic variable associated with housing prices, has a negative effect on housing prices in the long-term, as indicated by previously discussed studies (Sutton 2002; Tsatsaronis and Zhu, 2004; Girouard et al., 2006; Örsal, 2014; Ferrero, 2015; Savva, 2015; Arestis and Gonzalez-Martinez, 2016; Leung and Ng, 2019). According to literature, housing prices and interest rates are negatively correlated, as lower interest rates make borrowing cheaper, making mortgages more affordable, resulting in more people buying houses. Nonetheless, this study also found that interest rates have a positive correlation with home prices in the short run. An interpretation of this can be drawn by considering the trends of Austrian housing prices and short-term interest rates during the observation period. During the observation period, Austrian housing prices first experienced a slight decline in 2004 but gradually began rising from 2005 to 2008. After 2008, Austrian housing prices experienced a significant increase. While Austrian interest rates were relatively high at the beginning of the observation period (2000 Q1), they declined until 2004. They then rose again in 2005 until the global financial crisis in 2008 and then fell sharply after that. Given this, it can be seen that housing prices and interest rates moved in the same direction until 2004, but following the 2008 global financial crisis, they turned in the opposite direction.

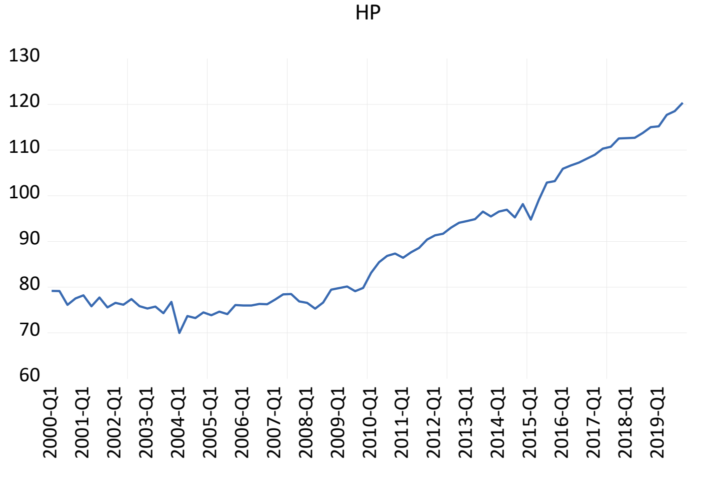


Figure 3.1: Austria housing prices

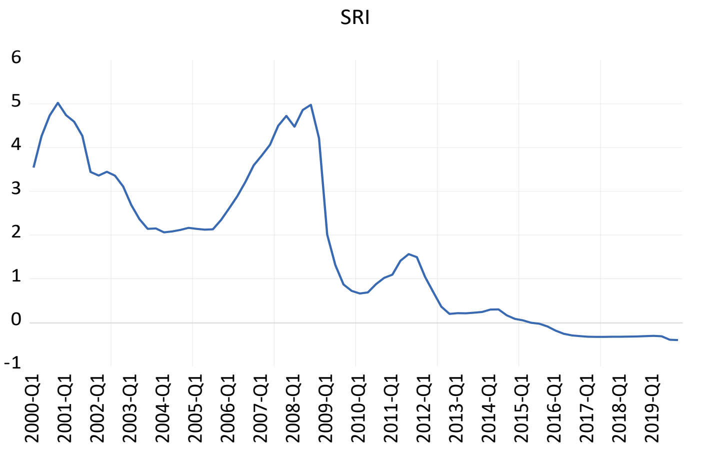


Figure 3.2: Austria short term interest rate

Furthermore, the result indicated that the exchange rate has a positive correlation with housing prices in the short term which is consistent with the previous research (Benson et al., 1999; Lipscomb et al., 2003; Wang and Wang, 2017). Nonetheless, housing prices and the exchange rate in Austria showed a negative relationship over the long run, which differs from previous studies. Differences between the results may be attributed to the different exchange rate policies adopted by the central banks, where Austria adopted a coordinated exchange rate policy (Gluck et al. 1992). In addition, the results of the estimation also indicated that inflation has a positive correlation with the housing price, both in the short term and the long term, consistent with Kolari (2012) and Meidani et al. (2011).

It is interesting to find out that the estimation results show that population growth has a negative correlation with housing prices, in contrast to previous studies (Capozza et al., 2002; Miles, 2012). The difference in results may be explained by examining housing conditions in Austria which are already overcrowded, which will bring down housing prices as the population increases. As a result of the estimation, the compensation of the employee variables revealed the same findings as previous literature discussed. They positively correlate with housing prices (Jacobsen and Naug, 2005; Weale, 2007; Savva, 2015). Furthermore, as a result of the estimation results, it is demonstrated that the unemployment rate is negatively correlated with housing price in the short term, which is consistent with previous studies (Zhu, 2010; Riley et al., 2015; Geerolf and Grjebine, 2014). On the other hand, the unemployment rate has a positive correlation with housing prices over the long term. This difference in the relationship between the short term and the long term might be due to the error correction mechanism in the VECM model.

According to the estimation results of determinant factors of housing prices in Austria, it is interesting to note that inflation has a short-term impact with coefficient correlation at 0.043, followed by interest rates at 0.030, exchange rates at 0.025, and unemployment at -0.006. The long-term effect of inflation on housing prices in Austria is 0.010, followed by the unemployment rate with 0.005 and negatively by interest rate with -0.006, the exchange rate with -0.005, and population growth with -0.0001. The coefficient correlation shows that macroeconomic variables such as interest rate, inflation, and exchange rate have a stronger impact on housing prices in Austria than socioeconomic variables such as populations, wages, and unemployment rates. It is also important to note that variables assessed in the estimation are indexed, except the compensation of the employees. Therefore, the compensation of employees cannot be fully compared with the other variables.

Since each variable in the VECM model is explained by its past value as well as the past value of the other variables in the model, it is crucial to test the optimum lag of the model. Using the lag order selection criteria test, it can be seen that the optimum lag of the VECM model for determinant variables of housing price in Austria is lag 4, which is indicated by the lowest level of Akaike information criterion as shown in Table 3.4. Since the variables of this study are quarterly data, it can be seen that the housing price in Austria is influenced by other variables from the previous year.

Table 3.2: Optimum lag of VECM estimation (Austria)

VAR Lag Order Selection Criteria
Endogenous variables: LHP INF ER COMP POP SRI UNEMPL
Exogenous variables: C
Date: 07/03/21 Time: 23:11
Sample: 2000Q1 2019Q4
Included observations: 76

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1350.104	NA	7634095.	35.71326	35.92794	35.79906
1	-648.3246	1255.816	0.265856	18.53486	20.25224*	19.22121
2	-548.7254	159.8830	0.072433	17.20330	20.42339	18.49020*
3	-507.5831	58.46541	0.096732	17.41008	22.13288	19.29754
4	-405.6063	126.1292*	0.028308*	16.01595*	22.24147	18.50397

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

3.3 Belgium

The estimation results indicate that all variables that were assessed are statistically significant at a significance level of 5% in affecting the housing price in Belgium (see Table 3.3). The findings of VECM econometric models produce both short and long-term relationships. Considering this, it is also interesting to note that some variables differ in their impact on housing prices over different periods in Belgium. Some variables have a positive relationship in the short term, and conversely, a negative relationship in the long term.

Table 3.3: VECM Regression Result (Belgium)

Vector Error Correction Estimates
Date: 06/28/21 Time: 10:32
Sample (adjusted): 2000Q3 2019Q1
Included observations: 75 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1
LHP(-1)	1.000000
INF(-1)	-0.026835
	(0.01226)
	[-2.18973]
ER(-1)	-0.029622
	(0.00680)
	[-4.35332]
COMP(-1)	6.99E-05
	(2.6E-05)
	[2.72712]
POP(-1)	-0.002130
	(0.00051)
	[-4.16903]
SRI(-1)	-0.116135
	(0.01831)
	[-6.34257]
UNEM(-1)	-0.017539
	(0.01790)
	[-0.98008]
C	18.76572

Error Correction:	D(LHP)	D(INF)	D(ER)	D(COMP)	D(POP)	D(SRI)	D(UNEM)
CointEq1	0.034954	1.946097	2.363580	-165.2784	21.30988	1.442469	0.232105
	(0.01124)	(0.77471)	(1.41909)	(285.430)	(10.2265)	(0.32775)	(0.50808)
	[3.11088]	[2.51203]	[1.66556]	[-0.57905]	[2.08380]	[4.40110]	[0.45683]
D(LHP(-1))	0.118215	-8.921401	-3.443656	1634.217	-147.9728	-7.941654	-1.233679
	(0.12681)	(8.74361)	(16.0162)	(3221.44)	(115.419)	(3.69910)	(5.73428)
	[0.93221]	[-1.02033]	[-0.21501]	[0.50729]	[-1.28205]	[-2.14692]	[-0.21514]
D(INF(-1))	0.000819	0.349348	-0.155264	87.87108	1.677090	0.108727	-0.000651
	(0.00177)	(0.12199)	(0.22346)	(44.9468)	(1.61036)	(0.05161)	(0.08001)
	[0.46313]	[2.86365]	[-0.69480]	[1.95500]	[1.04144]	[2.10665]	[-0.00813]
D(ER(-1))	0.000303	0.112900	0.283598	13.45202	0.523653	0.067977	-0.004214
	(0.00094)	(0.06470)	(0.11852)	(23.8381)	(0.85408)	(0.02737)	(0.04243)
	[0.32295]	[1.74496]	[2.39289]	[0.56431]	[0.61312]	[2.48339]	[-0.09930]
D(COMP(-1))	7.45E-06	-0.000420	0.001453	0.104400	0.002560	4.61E-05	-0.000351
	(4.9E-06)	(0.00033)	(0.00061)	(0.12339)	(0.00442)	(0.00014)	(0.00022)
	[1.53460]	[-1.25365]	[2.36891]	[0.84610]	[0.57918]	[0.32524]	[-1.59970]
D(POP(-1))	-0.000160	8.77E-05	-0.006697	-2.623970	0.389675	-0.002527	-0.000651
	(0.00012)	(0.00839)	(0.01537)	(3.09131)	(0.11076)	(0.00355)	(0.00550)
	[-1.31765]	[0.01045]	[-0.43571]	[-0.84882]	[3.51831]	[-0.71195]	[-0.11829]
D(SRI(-1))	0.004233	0.508724	-0.077060	172.6290	-0.054923	0.612201	-0.275254
	(0.00368)	(0.25376)	(0.46482)	(93.4930)	(3.34969)	(0.10736)	(0.16642)
	[1.15011]	[2.00476]	[-0.16578]	[1.84644]	[-0.01640]	[5.70256]	[-1.65396]
D(UNEM(-1))	5.80E-05	-0.279991	-0.258231	-25.78572	-1.776777	0.053912	-0.380632
	(0.00266)	(0.18375)	(0.33658)	(67.6985)	(2.42552)	(0.07774)	(0.12051)
	[0.02178]	[-1.52379]	[-0.76722]	[-0.38089]	[-0.73254]	[0.69352]	[-3.15863]
C	0.005799	0.200332	-0.300602	349.9561	9.883780	0.036638	0.100417
	(0.00251)	(0.17340)	(0.31762)	(63.8857)	(2.28891)	(0.07336)	(0.11372)
	[2.30591]	[1.15533]	[-0.94641]	[5.47785]	[4.31811]	[0.49943]	[0.88303]
R-squared	0.254765	0.314118	0.174264	0.270902	0.253678	0.534455	0.216382
Adj. R-squared	0.164434	0.230980	0.074175	0.182526	0.163214	0.478025	0.121398
Sum sq. resids	0.005045	23.98605	80.48159	3255951.	4179.544	4.293078	10.31655
S.E. equation	0.008743	0.602847	1.104273	222.1094	7.957790	0.255042	0.395362
F-statistic	2.820340	3.778301	1.741085	3.065346	2.804205	9.471155	2.278089
Log likelihood	253.8333	-63.66979	-109.0657	-506.8644	-257.1880	0.847765	-32.03019
Akaike AIC	-6.528888	1.937861	3.148417	13.75638	7.098346	0.217393	1.094138
Schwarz SC	-6.250789	2.215960	3.426516	14.03448	7.376445	0.495492	1.372237
Mean dependent	0.006287	-0.002089	0.102266	346.7733	16.25333	-0.060954	-0.016889
S.D. dependent	0.009565	0.687446	1.147656	245.6575	8.699322	0.353010	0.421793

Determinant resid covariance (dof adj.)	0.553232
Determinant resid covariance	0.226092
Log likelihood	-689.1873
Akaike information criterion	20.24499
Schwarz criterion	22.40798
Number of coefficients	70

It can be seen that the interest rate has a negative correlation with the housing price in the short term, as has been shown in previous studies discussed in the literature review chapter. On the other hand, the Belgian interest rate tends to correlate positively with the housing price over the long term. One reason for the difference between the long-term relationship and some literature studies is that since 2015, short-term interest rates have been recorded below zero percent or negative in several countries, including Belgium. There are certainly differences here from previous studies (Sutton, 2002; Ferrero, 2015; Tsatsaronis and Zhu, 2004; Savva, 2015; Örsal, 2014) that used data before 2015 when most or almost all interest rates were still positive.

Furthermore, the dynamic relationship is also demonstrated in the estimation results for exchange rate variables. The estimates suggest that the exchange rate has a positive correlation with housing prices over the long run but a negative correlation over the short run. These findings are in line with those in Austria. Based on the literature review, there have been varying results of studies on the relationship between exchange rates and housing prices. Literature generally reports a positive correlation between interest rates and prices of housing, such as that demonstrated by Benson et al. (1999), Lipscomb et al. (2003), and Wang and Wang (2017). However, exchange rates and housing prices may have a negative correlation, as found by Meidani et al. (2011). As a result, these findings may enrich existing literature by providing results on both long and short-term correlations.

A dynamic relationship is also seen between the short-term and long-term estimation results of the inflation variable on housing prices in Belgium. These findings suggest that inflation is negatively correlated with the housing price in the short term but positively correlated with the housing price in the long run. Although several previous studies have demonstrated that inflation generally affects home prices positively, the effects of inflation on home prices themselves should be carefully examined, considering their logical endogeneity. In light of the results of the estimation of dynamic inflation variables, the findings of this study suggest that the relationship between inflation and housing prices cannot be described in linear terms in Belgium. The negative correlation between inflation and housing price may exist because people want to invest their money in more liquid assets due to the anticipated inflation, such as stocks, which decreases the demand for housing.

In line with the Austrian estimation results, it is interesting to note that both short and long-term housing prices are correlated negatively with population growth in Belgium. The overcrowding issue may have contributed to this finding as more people will bring down housing prices. It will also be interesting to observe the data on the development of housing prices and population in Belgium during the observation period to discover the reasons behind this finding. After experiencing a rapid increase from 2000 to 2007, Belgium's housing prices remained relatively stable until 2018 before showing an upward trend again in 2019. Meanwhile, data on population show a constant increase from the beginning to the end of the observation period. The fact that there are times when population growth is increasing, but housing prices are relatively constant (2007 - 2018) helps explain why there is a negative correlation between them.

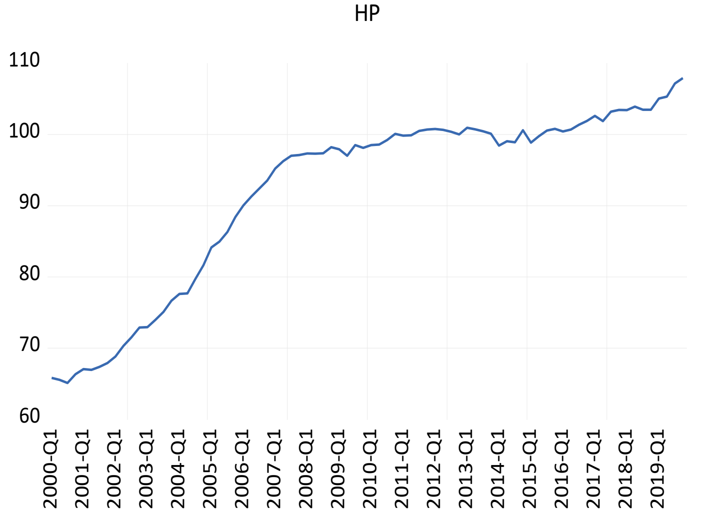


Figure 3.3: Belgium housing prices

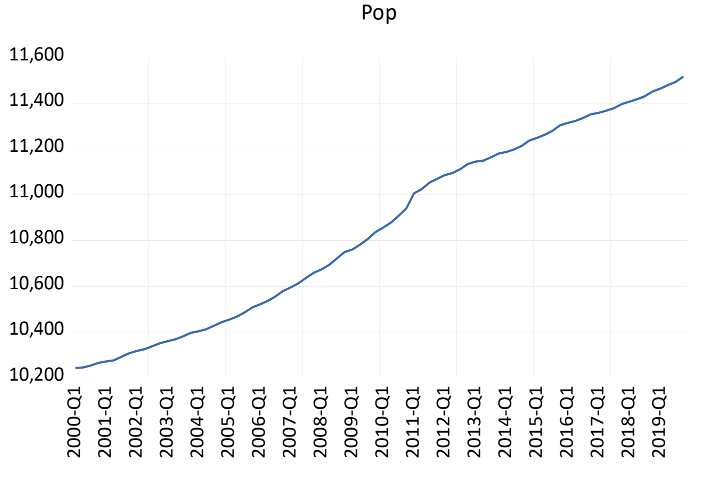


Figure 3.4: Population growth Belgium

Based on the estimation findings, it is also important to note that the compensation of employees correlates positively with the housing price both in the short term and long term in Belgium, which is consistent with findings in Austria and the literature discussed in the previous chapter. This finding could suggest an increase in wages in Belgium may increase purchasing power, which would increase housing prices. As a result of the estimation results, it appears that the unemployment rate has a positive correlation with housing price in the short term, and it has a negative correlation with housing price in the long term in Belgium.

The coefficient correlation indicates that housing prices in Belgium are negatively influenced by interest rate (-0.116), the exchange rate (-0.029), inflation (-0.026), unemployment rate (-0.017), and population growth (-0.002) in the short term. Among the factors affecting housing rates long-term in Belgium are interest rate (0.004), inflation (0.0008), the exchange rate (0.0003), and population growth (-0.0001). The compensation of employees cannot be compared to other variables since it is not indexed. Due to this, macroeconomic variables such as interest rate, inflation, and exchange rate have a more significant impact on housing prices in Belgium than socioeconomic variables such as population, wages, and unemployment rate. Using the lag order selection criteria test, the optimum lag for the VECM model for housing prices in Belgium is lag 2. This means that housing prices in Belgium are affected by other variables over the previous two quarters.

Table 3.4: Optimum lag of VECM estimation (Belgium)

VAR Lag Order Selection Criteria
Endogenous variables: LHP INF ER COMP POP SRI UNEM
Exogenous variables: C
Date: 07/03/21 Time: 23:12
Sample: 2000Q1 2019Q4
Included observations: 76

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1473.101	NA	1.94e+08	38.95003	39.16471	39.03583
1	-705.4612	1373.672	1.195774	20.03845	21.75584*	20.72480
2	-627.4643	125.2057*	0.575208*	19.27538*	22.49547	20.56228*
3	-586.1472	58.71374	0.764656	19.47756	24.20036	21.36502
4	-540.3771	56.61041	0.982160	19.56255	25.78807	22.05057

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

3.4 Denmark

The estimate reveals that all evaluated variables are statistically significant in Denmark at a significance level of 5%, which is supported by a relatively high adjusted R-squared value of 0.69. In addition to containing findings that differ from previous research, the estimation results also confirm some findings from earlier research on the determinants of housing prices.

Table 3.5 VECM regression result (Denmark)

Vector Error Correction Estimates
Date: 06/28/21 Time: 10:42
Sample (adjusted): 2000Q3 2019Q4
Included observations: 78 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1
LHP(-1)	1.000000
INF(-1)	-0.051472
	(0.01994)
	[-2.58189]
ER(-1)	-0.011005
	(0.00661)
	[-1.66585]
COMP(-1)	-1.03E-05
	(2.5E-06)
	[-4.14706]
POP(-1)	0.001393
	(0.00081)
	[1.72253]
STIR(-1)	-0.021940
	(0.02955)
	[-0.74257]
UNEM(-1)	-0.012903
	(0.01821)
	[-0.70856]
C	-8.616524

Error Correction:	D(LHP)	D(INF)	D(ER)	D(COMP)	D(POP)	D(STIR)	D(UNEM)
CointEq1	0.028496	1.662938	2.060254	10375.60	4.454709	0.558831	-0.018225
	(0.01859)	(0.61195)	(1.66825)	(2022.05)	(5.31502)	(0.43247)	(0.38788)
	[1.53282]	[2.71742]	[1.23498]	[5.13122]	[0.83814]	[1.29219]	[-0.04699]
D(LHP(-1))	0.700456	-1.360259	-14.16472	-13560.75	-34.60919	2.652339	-5.991149
	(0.09537)	(3.13923)	(8.55785)	(10372.8)	(27.2653)	(2.21850)	(1.98978)
	[7.34495]	[-0.43331]	[-1.65517]	[-1.30733]	[-1.26935]	[1.19556]	[-3.01097]
D(INF(-1))	-0.005283	0.290634	-0.205234	1398.057	1.006659	0.286489	-0.112543
	(0.00356)	(0.11729)	(0.31975)	(387.568)	(1.01873)	(0.08289)	(0.07435)
	[-1.48265]	[2.47783]	[-0.64185]	[3.60726]	[0.98815]	[3.45619]	[-1.51378]
D(ER(-1))	-0.001490	-0.033574	0.177850	-98.79781	-0.490722	-0.012723	0.013318
	(0.00132)	(0.04330)	(0.11804)	(143.074)	(0.37607)	(0.03060)	(0.02745)
	[-1.13261]	[-0.77537]	[1.50670]	[-0.69054]	[-1.30485]	[-0.41580]	[0.48527]
D(COMP(-1))	-1.05E-06	-6.58E-05	8.37E-05	-0.434420	1.02E-05	-7.82E-06	-4.60E-06
	(9.2E-07)	(3.0E-05)	(8.2E-05)	(0.09994)	(0.00026)	(2.1E-05)	(1.9E-05)
	[-1.14601]	[-2.17460]	[1.01459]	[-4.34671]	[0.03868]	[-0.36594]	[-0.23977]
D(POP(-1))	-0.000493	-0.003400	-0.016133	-19.35061	0.195102	-0.006345	-0.007001
	(0.00041)	(0.01355)	(0.03694)	(44.7732)	(0.11769)	(0.00958)	(0.00859)
	[-1.19684]	[-0.25093]	[-0.43674]	[-0.43219]	[1.65780]	[-0.66256]	[-0.81512]
D(STIR(-1))	-0.015454	-0.074798	-0.318288	842.5841	0.377534	0.234830	-0.148098
	(0.00435)	(0.14328)	(0.39061)	(473.446)	(1.24447)	(0.10126)	(0.09082)
	[-3.55045]	[-0.52203]	[-0.81486]	[1.77968]	[0.30337]	[2.31911]	[-1.63069]
D(UNEM(-1))	-0.010916	0.117589	-0.349811	-417.2294	0.359000	-0.201812	0.019379
	(0.00580)	(0.19084)	(0.52024)	(630.575)	(1.65748)	(0.13486)	(0.12096)
	[-1.88296]	[0.61618]	[-0.67240]	[-0.66167]	[0.21659]	[-1.49640]	[0.16021]
C	0.005727	0.118573	0.047032	2788.677	5.333236	-0.006571	0.087724
	(0.00363)	(0.11955)	(0.32590)	(395.012)	(1.03830)	(0.08448)	(0.07577)
	[1.57710]	[0.99185]	[0.14432]	[7.05972]	[5.13650]	[-0.07778]	[1.15771]
R-squared	0.726415	0.200195	0.109121	0.497577	0.116211	0.485009	0.366958
Adj. R-squared	0.694695	0.107464	0.005830	0.439325	0.013743	0.425299	0.293562
Sum sq. resids	0.010183	11.03397	82.00015	1.20E+08	832.3478	5.510671	4.432961
S.E. equation	0.012148	0.399891	1.090141	1321.341	3.473185	0.282604	0.253468
F-statistic	22.90086	2.158876	1.056447	8.541793	1.134119	8.122850	4.999687
Log likelihood	238.1294	-34.40373	-112.6277	-666.4351	-203.0113	-7.326332	1.160793
Akaike AIC	-5.875112	1.112916	3.118659	17.31885	5.436188	0.418624	0.201005
Schwarz SC	-5.603184	1.384844	3.390586	17.59078	5.708116	0.690552	0.472933
Mean dependent	0.006494	-0.032287	0.023104	1723.779	6.282051	-0.065997	0.008120
S.D. dependent	0.021986	0.423281	1.093333	1764.653	3.497299	0.372784	0.301568

Determinant resid covariance (dof adj.)	2.220581
Determinant resid covariance	0.941343
Log likelihood	-772.3830
Akaike information criterion	21.59956
Schwarz criterion	23.71456
Number of coefficients	70

VECM estimation in Denmark confirms previous literature findings, which have shown that interest rates negatively correlate with housing prices both in the long and short term. The correlation coefficient indicates that interest rates are the primary determinant of housing price movements in Denmark compared to other variables. Even though the estimation results support those found in previous studies, it is still important to observe Denmark's housing price and interest rate data. It is interesting to note that from 2001 to 2006, Denmark experienced a property bubble, when Danish property prices rose faster than at any time in history, in some years increasing by more than 25% as reported by Bergman et al. (2011) and shown in Table 3.6. A study by Dam et al. (2011) demonstrates that price increases are associated with a decrease in interest rates, as shown in Table 3.7, where interest rates have fallen steeply since 2001. After the rise in interest rates from 2006 to 2008, housing prices decreased in Denmark from 2007 to 2012.

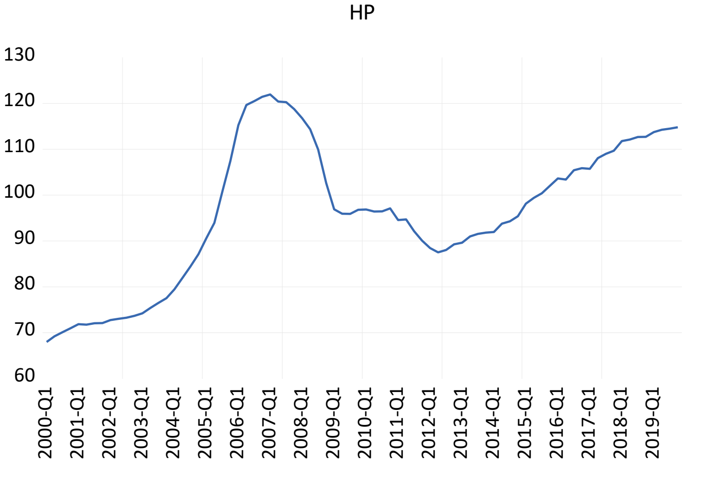


Figure 3.5: Denmark housing prices

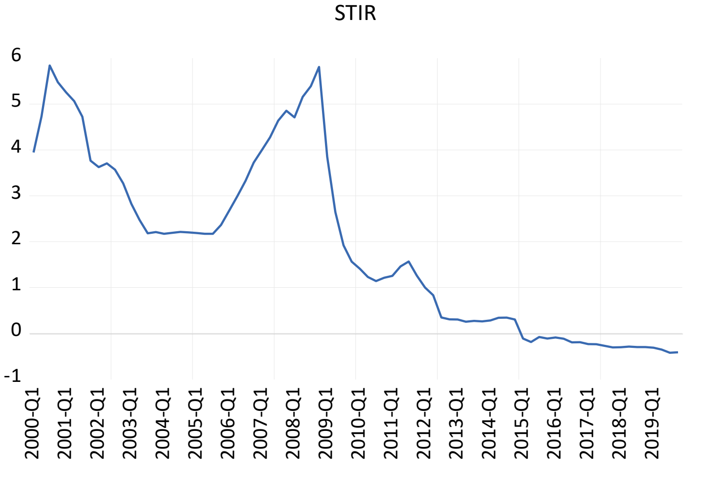


Figure 3.6: Denmark short term interest rate

Comparatively to the interest rate variable results, the results for the exchange rate and inflation variables indicate interesting findings that differ from those in previous studies. The estimation results for the exchange rate and inflation variables indicate that it negatively correlates with Denmark's long and short-term housing prices. The results demonstrate that this research has a significant added value since studies on the relationship between exchange rates and housing prices have not been able to find agreement, as discussed in the literature review chapter. With respect to the relationship between the inflation and housing prices variables, it is necessary to examine their endogeneity. As a result, this study adds a new perspective to the fact that the relationship between housing prices and inflation is not always positive, as revealed by the findings in Denmark.

According to the correlation coefficient, the influence of several socioeconomic variables assessed in this estimation on Danish housing prices is not as large as the influence of macroeconomic variables. Nevertheless, it is necessary to evaluate some socioeconomic variables, such as the Danish population growth, which has a positive correlation in the short term and a negative correlation in the long term. Furthermore, it is also interesting to note that other socioeconomic variables such as salaries and unemployment rates are negatively correlated with housing prices both in the short term and long term. In addition, using the lag order selection criteria test, it has been determined that the optimum lag of the VECM model in Denmark is lag one as outlined in Table 3.6, which indicates that variables from the previous quarter influence the housing prices in Denmark.

Table 3.6: Optimum lag of VECM estimation (Denmark)

VAR Lag Order Selection Criteria
Endogenous variables: LHP INF ER COMP POP STIR UNEM
Exogenous variables: C
Date: 07/03/21 Time: 23:06
Sample: 2000Q1 2019Q4
Included observations: 76

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1574.795	NA	2.82e+09	41.62618	41.84086	41.71198
1	-736.0158	1500.973	2.672093*	20.84252*	22.55990*	21.52887*
2	-687.1614	78.42420*	2.767530	20.84635	24.06645	22.13326
3	-646.9145	57.19302	3.784107	21.07670	25.79950	22.96416
4	-594.6870	64.59716	4.100903	20.99176	27.21727	23.47978

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

3.5 Finland

The estimation results indicate that all variables included in the estimation in Finland are statistically significant at a significance level of 5%. This estimation study not only confirms several findings from earlier research on factors driving housing prices, but it also comes up with findings that differ from previous research. These variables show dynamic results, especially for macroeconomic variables such as interest rates, inflation, and exchange rates. All of them have different relationships in the short term and the long term. Furthermore, it is important to note the correlation coefficient value of population growth in Finland provides evidence that it has a greater impact on housing prices in the short run than macroeconomic variables such as interest rates, exchange rates, and inflation.

Table 3.7: VECM regression result (Finland)

Vector Error Correction Estimates
Date: 06/28/21 Time: 10:46
Sample (adjusted): 2000Q3 2019Q4
Included observations: 75 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1
LHP(-1)	1.000000
INF(-1)	0.017121
	(0.09850)
	[0.17382]
ER(-1)	0.039603
	(0.03093)
	[1.28047]
COMP(-1)	0.001401
	(0.00024)
	[5.87298]
POP(-1)	-0.041349
	(0.00697)
	[-5.93041]
STIR(-1)	0.025316
	(0.11364)
	[0.22278]
UNEM(-1)	0.846430
	(0.21547)
	[3.92839]
C	174.2512

Error Correction:	D(LHP)	D(INF)	D(ER)	D(COMP)	D(POP)	D(STIR)	D(UNEM)
CointEq1	0.000685	0.052117	-0.232838	-1.489796	2.462870	-0.076939	0.072944
	(0.00263)	(0.10985)	(0.36622)	(33.5230)	(0.37309)	(0.06675)	(0.06391)
	[0.26072]	[0.47442]	[-0.63578]	[-0.04444]	[6.60126]	[-1.15263]	[1.14138]
D(LHP(-1))	0.509040	17.03140	-20.61815	2583.553	-22.24399	13.46587	-4.781869
	(0.10057)	(4.20561)	(14.0204)	(1283.39)	(14.2833)	(2.55549)	(2.44664)
	[5.06144]	[4.04969]	[-1.47058]	[2.01307]	[-1.55734]	[5.26938]	[-1.95446]
D(INF(-1))	-0.001915	0.230604	0.121909	23.11492	-0.671433	0.145033	-0.175278
	(0.00302)	(0.12645)	(0.42155)	(38.5872)	(0.42945)	(0.07684)	(0.07356)
	[-0.63324]	[1.82370]	[0.28919]	[0.59903]	[-1.56346]	[1.88759]	[-2.38270]
D(ER(-1))	-0.000393	0.020811	0.159626	-2.676971	-0.097225	0.018197	0.004196
	(0.00089)	(0.03703)	(0.12345)	(11.2998)	(0.12576)	(0.02250)	(0.02154)
	[-0.44342]	[0.56203]	[1.29309]	[-0.23690]	[-0.77310]	[0.80876]	[0.19480]
D(COMP(-1))	6.37E-06	0.000373	0.000157	0.234742	-0.003326	1.04E-05	-0.000761
	(1.0E-05)	(0.00042)	(0.00140)	(0.12800)	(0.00142)	(0.00025)	(0.00024)
	[0.63466]	[0.88846]	[0.11234]	[1.83396]	[-2.33449]	[0.04061]	[-3.11849]
D(POP(-1))	-0.000629	-0.006415	-0.021045	-2.778535	0.088110	0.010816	0.039988
	(0.00074)	(0.03111)	(0.10372)	(9.49450)	(0.10567)	(0.01891)	(0.01810)
	[-0.84581]	[-0.20618]	[-0.20290]	[-0.29265]	[0.83384]	[0.57210]	[2.20926]
D(STIR(-1))	-0.007818	0.551207	-0.228334	148.6350	0.950250	0.462840	-0.312553
	(0.00445)	(0.18623)	(0.62086)	(56.8312)	(0.63250)	(0.11316)	(0.10834)
	[-1.75535]	[2.95976]	[-0.36777]	[2.61538]	[1.50238]	[4.09004]	[-2.88485]
D(UNEM(-1))	0.000745	-0.059496	-0.242743	-39.94626	-2.451881	0.075547	-0.498006
	(0.00520)	(0.21752)	(0.72517)	(66.3796)	(0.73876)	(0.13218)	(0.12655)
	[0.14324]	[-0.27352]	[-0.33474]	[-0.60179]	[-3.31890]	[0.57156]	[-3.93538]
C	0.003111	-0.075403	0.098000	132.2010	4.769787	-0.126901	-0.129347
	(0.00426)	(0.17814)	(0.59386)	(54.3603)	(0.60500)	(0.10824)	(0.10363)
	[0.73019]	[-0.42329]	[0.16502]	[2.43194]	[7.88399]	[-1.17237]	[-1.24814]

	D(LHP)	D(INF)	D(ER)	D(COMP)	D(POP)	D(STIR)	D(UNEM)
R-squared	0.374828	0.480938	0.090605	0.407853	0.561848	0.542912	0.505989
Adj. R-squared	0.299050	0.418022	-0.019625	0.336077	0.508739	0.487507	0.446109
Sum sq. resids	0.006527	11.41405	126.8544	1062913.	131.6558	4.214361	3.862989
S.E. equation	0.009945	0.415861	1.386375	126.9045	1.412369	0.252693	0.241930
F-statistic	4.946373	7.644062	0.821961	5.682343	10.57909	9.799027	8.450043
Log likelihood	244.1762	-35.82126	-126.1286	-464.8842	-127.5218	1.541739	4.806369
Akaike AIC	-6.271365	1.195234	3.603429	12.63691	3.640580	0.198887	0.111830
Schwarz SC	-5.993266	1.473332	3.881527	12.91501	3.918679	0.476986	0.389929
Mean dependent	0.003358	-0.021665	-0.032481	158.4933	4.640000	-0.061128	-0.041333
S.D. dependent	0.011878	0.545123	1.372968	155.7464	2.015078	0.352980	0.325071

Determinant resid covariance (dof adj.)	0.001994
Determinant resid covariance	0.000815
Log likelihood	-478.2196
Akaike information criterion	14.61919
Schwarz criterion	16.78218
Number of coefficients	70

The estimation results indicate that interest rates in Finland are positively related to housing prices on a short term basis. This finding is quite interesting considering the results of previous studies that show a negative relationship between interest rates and housing prices. However, the long term relationship between interest rates and housing prices is negative, which is consistent with the literature previously discussed. There is a possibility that the dynamic correlation of the estimated results is due to an error correction element during the observation period. The same explanation can be given by the dynamic relationship between other macroeconomic variables, such as inflation and exchange rates. According to the estimation results, these two variables influence housing prices positively in the short term while negatively influencing them over the long run. The error correction elements in the VECM model can be used not only to deal with the problem of data stationarity but also to deal with the problem of short-term versus long-term disequilibrium. As a result, this model can explain both short-term and long-term relationships between variables, such as macroeconomic variables and housing prices in Finland.

Furthermore, it is also interesting to note that estimations of the correlation between socioeconomic variables and housing prices in Finland indicate different results. There is a consistent relationship between these socioeconomic variables and housing prices in both the short and long term. The short-term and long-term population growth estimates for Finland show a negative correlation. Considering that this variable has the highest correlation coefficient value, especially in the short term, the effect of population growth on housing prices in Finland deserves further analysis. The negative correlation between housing prices and population growth is intriguing to observe in more detail since it differs from the literature that has argued that an increase in population would increase demand for housing, which would lead to rising housing prices. Based on the data shown in Graph 3.7, housing prices in Finland had experienced a high increase from 2002 to 2007 and then experienced a slight fluctuation until 2009. After that, housing prices in Finland showed a stagnant trend and a downward trend until the end of the observation period. On the other hand, the population data in Finland showed an increasing trend until the end of the observation period, as shown in Figure 3.8. As a result, the negative relationship between population growth and housing prices can be caused by overcrowding. An increase in population causes housing prices not to increase and even experience a downward trend, as happened in Austria and Belgium.

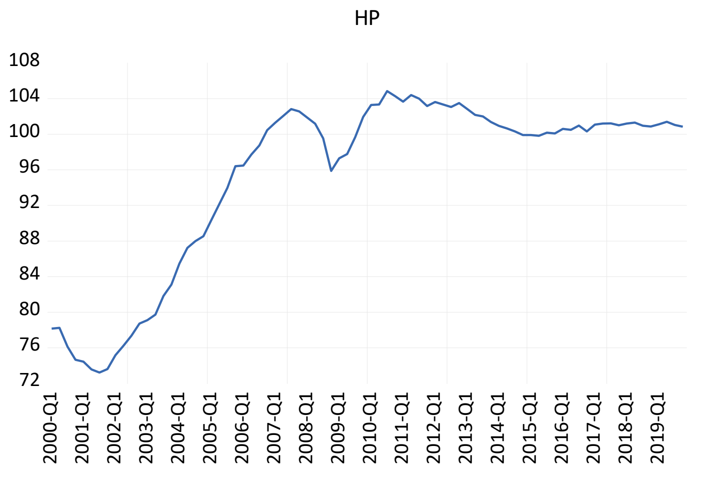


Figure 3.7: Housing prices Finland

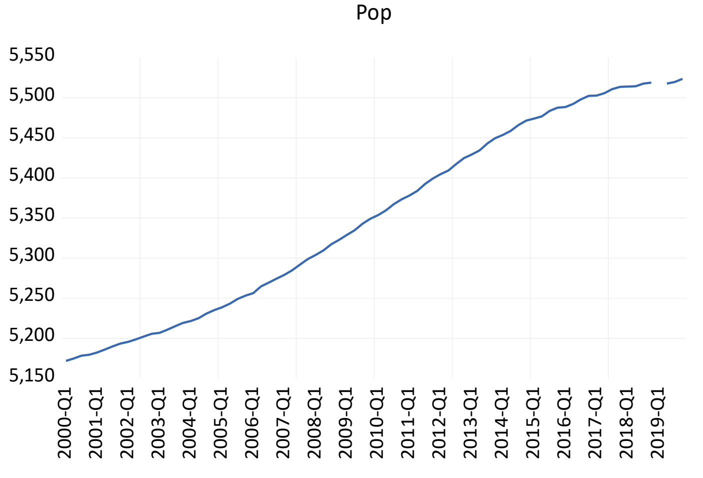


Figure 3.8: Population growth Finland

As the population growth variable, the relationships of other socioeconomic variables such as compensation of employees and unemployment rate have also been consistent over the short and long run. According to the estimation results, the compensation of employees has a positive correlation with housing prices in the short and long term. This can be explained by the fact that the higher income will increase purchasing power, resulting in higher housing prices. It is estimated that the unemployment rate has a positive relationship with housing prices both in the short and the long term. The findings of this study are interesting because they differ from previous studies that demonstrated a negative relationship between the unemployment rate and housing prices. These results may be the consequence of over-correction for another variable. Using the lag order selection criteria test, the optimum lag for the VECM model for determinant factors of housing price in Finland is lag 3. This means that housing prices in Finland are affected by other variables over the previous three quarters.

Table 3.8: Optimum lag of VECM estimation (Finland)

VAR Lag Order Selection Criteria
Endogenous variables: LHP INF ER COMP POP STIR UNEM
Exogenous variables: C
Date: 07/03/21 Time: 23:06
Sample: 2000Q1 2019Q4
Included observations: 72

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1224.238	NA	1682725.	34.20105	34.42239	34.28917
1	-459.4485	1359.625	0.003924	14.31802	16.08876*	15.02295*
2	-396.9641	98.93364	0.002799	13.94345	17.26359	15.26521
3	-331.6768	90.67692*	0.001964*	13.49102*	18.36056	15.42960
4	-283.1240	57.99354	0.002422	13.50345	19.92238	16.05884

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

3.6 France

Based on the estimated results, all variables that were estimated are statistically significant in France at a significance level of 10%, which is supported by a very high adjusted R-squared value of 0.90. It is also interesting to note that the estimation indicates the dynamic results, in which all macroeconomic variables show different relationships both in the short-term and the long-term.

Table 3.9: VECM regression result (France)

Vector Error Correction Estimates
Date: 06/28/21 Time: 10:50
Sample (adjusted): 2000Q3 2019Q4
Included observations: 78 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1
LHP(-1)	1.000000
INF(-1)	-0.105475
	(0.03775)
	[-2.79377]
ER(-1)	-0.059152
	(0.00765)
	[-7.73694]
COMP(-1)	-8.15E-05
	(1.7E-05)
	[-4.86864]
POP(-1)	0.001006
	(0.00030)
	[3.38273]
STIR(-1)	-0.524648
	(0.04130)
	[-12.7040]
UNEMP(-1)	-0.754320
	(0.07751)
	[-9.73226]
C	-35.08411

Error Correction:	D(LHP)	D(INF)	D(ER)	D(COMP)	D(POP)	D(STIR)	D(UNEMP)
CointEq1	0.021412	0.065794	1.874210	633.5020	2.784746	0.311149	0.080374
	(0.00251)	(0.24305)	(0.62271)	(426.582)	(1.16482)	(0.15917)	(0.09772)
	[8.51592]	[0.27070]	[3.00976]	[1.48507]	[2.39072]	[1.95480]	[0.82245]
D(LHP(-1))	0.184186	9.641474	-70.86124	-5141.580	-67.85196	-4.335231	-5.761407
	(0.09766)	(9.44091)	(24.1881)	(16569.8)	(45.2452)	(6.18275)	(3.79595)
	[1.88593]	[1.02124]	[-2.92959]	[-0.31030]	[-1.49965]	[-0.70118]	[-1.51778]
D(INF(-1))	0.001725	0.136605	-0.302131	443.4668	0.450464	0.088186	-0.069763
	(0.00138)	(0.13351)	(0.34206)	(234.327)	(0.63985)	(0.08744)	(0.05368)
	[1.24874]	[1.02317]	[-0.88326]	[1.89251]	[0.70402]	[1.00859]	[-1.29957]
D(ER(-1))	0.000631	0.059874	0.302514	152.4113	0.129568	0.043489	-0.033807
	(0.00044)	(0.04260)	(0.10915)	(74.7735)	(0.20418)	(0.02790)	(0.01713)
	[1.43200]	[1.40538]	[2.77149]	[2.03831]	[0.63459]	[1.55873]	[-1.97358]
D(COMP(-1))	6.29E-07	4.55E-05	0.000197	0.091954	0.000283	6.91E-05	-8.41E-06
	(8.3E-07)	(8.1E-05)	(0.00021)	(0.14146)	(0.00039)	(5.3E-05)	(3.2E-05)
	[0.75385]	[0.56394]	[0.95584]	[0.65005]	[0.73201]	[1.30917]	[-0.25942]
D(POP(-1))	0.000234	-0.006296	0.027856	11.66495	1.026953	-0.000762	0.003302
	(4.2E-05)	(0.00402)	(0.01031)	(7.06053)	(0.01928)	(0.00263)	(0.00162)
	[5.63082]	[-1.56495]	[2.70266]	[1.65214]	[53.2670]	[-0.28917]	[2.04119]
D(STIR(-1))	0.010464	0.032964	0.579485	830.9983	0.156835	0.593049	-0.175820
	(0.00247)	(0.23901)	(0.61237)	(419.495)	(1.14547)	(0.15653)	(0.09610)
	[4.23210]	[0.13791]	[0.94630]	[1.98095]	[0.13692]	[3.78878]	[-1.82953]
D(UNEMP(-1))	-0.001546	-0.153308	-1.374648	-6.125909	0.149503	-0.053959	0.105295
	(0.00302)	(0.29161)	(0.74711)	(511.802)	(1.39752)	(0.19097)	(0.11725)
	[-0.51236]	[-0.52573]	[-1.83995]	[-0.01197]	[0.10698]	[-0.28255]	[0.89806]
C	-0.014954	0.407772	-2.278094	524.0433	-3.078685	-0.039501	-0.262289
	(0.00323)	(0.31259)	(0.80088)	(548.636)	(1.49809)	(0.20471)	(0.12569)
	[-4.62434]	[1.30448]	[-2.84448]	[0.95518]	[-2.05507]	[-0.19296]	[-2.08686]

	D(LHP)	D(INF)	D(ER)	D(COMP)	D(POP)	D(STIR)	D(UNEMP)
R-squared	0.915004	0.203051	0.244123	0.392805	0.991112	0.457482	0.441552
Adj. R-squared	0.905149	0.110651	0.156485	0.322406	0.990081	0.394581	0.376805
Sum sq. resids	0.001249	11.67260	76.62014	35956259	268.0929	5.006141	1.887040
S.E. equation	0.004255	0.411301	1.053773	721.8762	1.971143	0.269356	0.165374
F-statistic	92.85015	2.197521	2.785582	5.579666	961.7579	7.273083	6.819602
Log likelihood	319.9618	-36.59808	-109.9811	-619.2803	-158.8276	-3.581514	34.46907
Akaike AIC	-7.973381	1.169182	3.050797	16.10975	4.303271	0.322603	-0.653053
Schwarz SC	-7.701453	1.441110	3.322725	16.38168	4.575199	0.594531	-0.381125
Mean dependent	0.007720	-0.004336	-0.052199	1613.538	87.85000	-0.059820	-0.018803
S.D. dependent	0.013815	0.436137	1.147362	876.9561	19.79198	0.346178	0.209486

Determinant resid covariance (dof adj.)	0.005361
Determinant resid covariance	0.002272
Log likelihood	-537.3512
Akaike information criterion	15.57311
Schwarz criterion	17.68810
Number of coefficients	70

The estimation of macroeconomic variables shows that interest rate, exchange rate, and inflation have a negative relationship in the short term but a positive relationship in the long term. The negative correlation between inflation and housing prices could be explained by an expected inflation reason, in which people want to invest their money in more liquid assets, which lowers the demand for housing. While in the short run, the relationship between interest rate and housing price is as expected from the literature review chapter, the relationship between inflation and the variable exchange rate is inconsistent. As for the long-term relationship, the opposite is true except for the interest rate, and the other two macroeconomic variables are in line with the literature review. It may have the same reason as the estimates for Finland, that the dynamic relationship of macroeconomy variables with housing prices in France is part of the error correction process during the observation period.

VECM estimates show interesting results for the socioeconomic variable, namely the unemployment rate, which has a negative relationship with the housing price in France. This socioeconomic variable has a correlation coefficient of -0.75 in the short term and is the independent variable with the greatest influence on the price movement of houses in France. In agreement with the results in the short term, the unemployment rate is also negatively correlated with housing prices in the long term. This finding is consistent with previous studies which pointed to a negative relationship between housing prices and unemployment rates, such as Zhu (2010) in the United Kingdom, Riley et al. (2015) in the United States, and Geerolf and Grjebine (2014) examining cross-country data from 34 countries. The data analysis of these two variables seems to support the estimation results and previous findings in the literature. French housing prices rose from 2000 to 2007 while the unemployment rate declined. Following the 2008 global financial crisis, France’s unemployment rate increased as housing prices fell. Housing prices rose in France in 2015, and the unemployment rate declined from that year until the end of the observation period. Considering a trending analysis, it is intriguing that France's housing prices and unemployment rates always move in opposite directions.

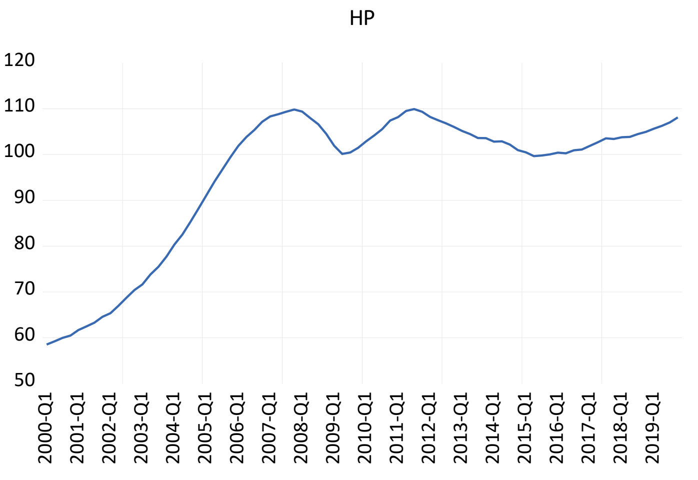


Figure 3.9: France housing prices

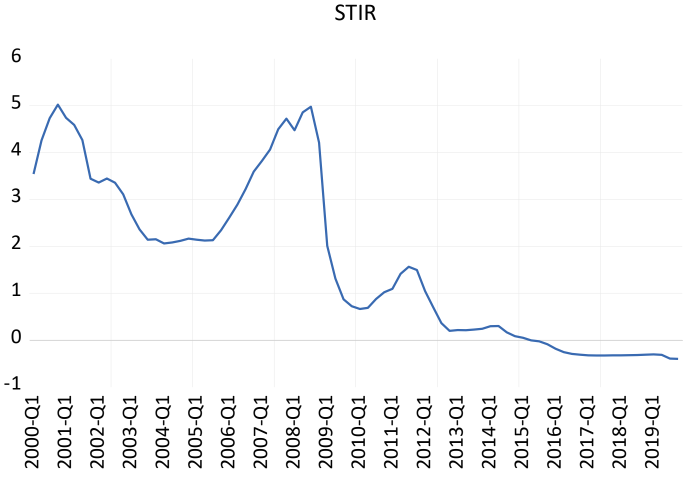


Figure 3.10: France short term interest rate

The next socioeconomic variable is population growth, which is positively correlated with housing prices in the short and long run. This is consistent with previous research where an increase in population led to increased demand, which led to a rise in housing prices. While compensation of employees and housing prices have a negative correlation in the short term, the relationship shows a positive correlation over the long term, which confirms previous studies by Jacobsen and Naug (2005), Weale (2007), Savva (2015). In addition, using the lag order selection criteria test, it has been determined that the optimum lag of the VECM model in France is lag three as outlined in Table 3.10, which indicates that variables from the previous three quarters influence the housing prices in France.

Table 3.10: Optimum lag of VECM estimation (France)

VAR Lag Order Selection Criteria
Endogenous variables: LHP INF ER COMP POP STIR UNEMP
Exogenous variables: C
Date: 07/03/21 Time: 23:04
Sample: 2000Q1 2019Q4
Included observations: 76

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1624.626	NA	1.05e+10	42.93753	43.15220	43.02333
1	-636.8353	1767.626	0.196488	18.23251	19.94989	18.91886
2	-442.6735	311.6807	0.004445	14.41246	17.63255*	15.69937*
3	-372.2269	100.1084*	0.002745*	13.84808*	18.57088	15.73554
4	-323.5511	60.20416	0.003267	13.85661	20.08212	16.34462

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

3.7 Greece

At the significance level of 5%, the estimation results indicate that all variables included in the estimation in Greece are statistically significant. As well as making several confirmations of earlier research findings on factors driving housing prices, this study also discusses new findings that differ from previous research. According to the estimation results, macroeconomic variables are more influential on housing prices in Greece than socioeconomic variables. Although only a few, the results also indicate a dynamic relationship between housing prices in Greece and several other variables in the short and long term.

Table 3.11: VECM Regression Result (Greece)

Vector Error Correction Estimates
Date: 07/14/21 Time: 01:05
Sample (adjusted): 2000Q3 2019Q4
Included observations: 78 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1
LHP(-1)	1.000000
INF(-1)	0.219509 (0.02951) [7.43923]
ER(-1)	-0.068286 (0.01940) [-3.52025]
COMP(-1)	8.43E-06 (2.2E-05) [0.38145]
POP(-1)	0.002197 (0.00070) [3.14248]
STIR(-1)	-0.146868 (0.02613) [-5.62143]
UNEMP(-1)	0.040057 (0.01932) [2.07341]
C	-23.37517

Error Correction:	D(LHP)	D(INF)	D(ER)	D(COMP)	D(POP)	D(STIR)	D(UNEMP)
CointEq1	0.000673 (0.00637) [0.10563]	-1.204732 (0.29879) [-4.03198]	1.336642 (0.40704) [3.28383]	-241.5131 (206.819) [-1.16775]	-1.460175 (0.77430) [-1.88581]	0.280897 (0.14492) [1.93829]	0.615855 (0.19921) [3.09152]
D(LHP(-1))	0.258894 (0.11740) [2.20527]	8.564834 (5.50339) [1.55628]	-6.492284 (7.49710) [-0.86597]	-576.0520 (3809.33) [-0.15122]	8.766792 (14.2615) [0.61472]	2.304956 (2.66923) [0.86353]	-6.010156 (3.66914) [-1.63803]
D(INF(-1))	0.001610 (0.00248) [0.64850]	0.364488 (0.11638) [3.13182]	-0.187960 (0.15854) [-1.18554]	-43.65367 (80.5574) [-0.54190]	0.113666 (0.30159) [0.37689]	0.001114 (0.05645) [0.01973]	-0.136842 (0.07759) [-1.76359]
D(ER(-1))	0.000108 (0.00171) [0.06304]	0.082514 (0.08036) [1.02682]	0.099242 (0.10947) [0.90656]	91.50346 (55.6232) [1.64506]	0.292273 (0.20824) [1.40351]	0.095747 (0.03898) [2.45659]	-0.030525 (0.05358) [-0.56975]
D(COMP(-1))	1.94E-06 (3.7E-06) [0.52743]	-0.000235 (0.00017) [-1.35798]	0.000166 (0.00024) [0.70359]	-0.267663 (0.11955) [-2.23886]	-9.14E-05 (0.00045) [-0.20412]	0.000146 (8.4E-05) [1.74688]	-4.33E-05 (0.00012) [-0.37592]
D(POP(-1))	0.000505 (0.00020) [2.47881]	0.009542 (0.00955) [0.99903]	0.018134 (0.01301) [1.39373]	13.81318 (6.61107) [2.08940]	0.956975 (0.02475) [38.6646]	-0.013029 (0.00463) [-2.81248]	0.005758 (0.00637) [0.90426]
D(STIR(-1))	-0.007936 (0.00419) [-1.89583]	0.340179 (0.19624) [1.73353]	-0.444649 (0.26732) [-1.66333]	-173.5419 (135.830) [-1.27764]	0.493776 (0.50852) [0.97100]	0.518154 (0.09518) [5.44410]	-0.029944 (0.13083) [-0.22888]
D(UNEMP(-1))	-0.011569 (0.00376) [-3.07665]	0.442839 (0.17628) [2.51213]	-0.700486 (0.24014) [-2.91698]	-214.7915 (122.017) [-1.76034]	-0.691442 (0.45681) [-1.51363]	-0.029954 (0.08550) [-0.35034]	0.455776 (0.11753) [3.87806]
C	-0.000121 (0.00172) [-0.07076]	0.015491 (0.08044) [0.19259]	0.025813 (0.10958) [0.23558]	106.7264 (55.6764) [1.91691]	-0.133303 (0.20844) [-0.63952]	-0.076315 (0.03901) [-1.95614]	0.037034 (0.05363) [0.69059]
R-squared	0.603301	0.259580	0.287159	0.300933	0.978614	0.495767	0.654552
Adj. R-squared	0.557307	0.173734	0.204511	0.219881	0.976134	0.437306	0.614500
Sum sq. resids	0.013260	29.13948	54.07629	13961073	195.6816	6.854783	12.95239
S.E. equation	0.013863	0.649855	0.885276	449.8160	1.684033	0.315190	0.433262
F-statistic	13.11693	3.023789	3.474479	3.712867	394.6764	8.480203	16.34257
Log likelihood	227.8318	-72.27722	-96.39100	-582.3851	-146.5486	-15.83848	-40.65550
Akaike AIC	-5.611072	2.084031	2.702333	15.16372	3.988426	0.636884	1.273218
Schwarz SC	-5.339144	2.355959	2.974261	15.43565	4.260354	0.908812	1.545146
Mean dependent	-0.000188	-0.033122	0.038641	81.77821	-1.010256	-0.114556	0.066239
S.D. dependent	0.020835	0.714918	0.992572	509.2775	10.90097	0.420181	0.697812

Determinant resid covariance (dof adj.)	0.272034
Determinant resid covariance	0.115320
Log likelihood	-690.4987
Akaike information criterion	19.49997
Schwarz criterion	21.61496

The VECM estimation results indicate that inflation has a significant positive effect on housing prices in Greece in the short term. These findings are consistent with those found by Panagiotidis and Printzism (2016), who also applied VECM econometric model to examine housing price data in Greece. Using monthly data from 1997 to 2003, Panagiotidis and Printzism (2016) discovered that the consumer price index is the variable that influences housing prices the most in Greece in the short term. The results of long-term estimation provide consistent findings that inflation increases housing prices along with a confirmation of what was previously discussed in the literature discussion.

The interest rate is a macroeconomic variable that has a strong negative impact on housing prices both short and long term in Greece. In the short run, the effect of the exchange rate on the housing market is negative, but it has a positive impact in the long run, which is consistent with the findings of previous studies. As discussed in the analysis of the estimated results for the previous countries, these dynamic results may be due to error correction elements. This estimation of three socioeconomic variables reveals consistent findings in the short and long term. Housing prices are positively influenced by population growth and employee compensation, while the unemployment rate negatively affects them. Based on the lag order selection criteria test, it was determined that the optimum lag for the VECM model for the determinant variables of housing prices in Greece is lag 4, which indicates that other determinant variables from the previous year influence the housing prices in Greece.

Table 3.12: Optimum lag of VECM estimation (Greece)

VAR Lag Order Selection Criteria
Endogenous variables: LHP INF ER COMP POP STIR UNEMP
Exogenous variables: C
Date: 07/03/21 Time: 23:03
Sample: 2000Q1 2019Q4
Included observations: 76

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1592.073	NA	4.45e+09	42.08087	42.29555	42.16667
1	-707.5295	1582.868	1.262662	20.09288	21.81026*	20.77923
2	-609.0650	158.0615	0.354441	18.79118	22.01128	20.07809*
3	-552.3240	80.63199	0.313984	18.58747	23.31028	20.47493
4	-496.2338	69.37467*	0.307382*	18.40089*	24.62640	20.88891

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

3.8 Spain

The estimate reveals that all variables were statistically significant in Spain at a significance level of 5%, which is supported by a relatively high adjusted R-squared value of 0.79. The estimation results of this study contain both new findings and confirmation of findings from earlier research on the determinants of housing prices.

Table 3.13: VECM Regression Result (Spain)

Vector Error Correction Estimates
Date: 06/28/21 Time: 11:49
Sample (adjusted): 2000Q3 2019Q4
Included observations: 78 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1
LHP(-1)	1.000000
INF(-1)	-0.154019
	(0.03267)
	[-4.71424]
ER(-1)	-0.017924
	(0.01186)
	[-1.51089]
COM(-1)	-6.69E-06
	(1.4E-05)
	[-0.47323]
POP(-1)	-0.000208
	(0.00014)
	[-1.43535]
STIR(-1)	-0.217774
	(0.04062)
	[-5.36145]
UNEMP(-1)	0.012689
	(0.02736)
	[0.46386]
C	7.622650

Error Correction:	D(LHP)	D(INF)	D(ER)	D(COM)	D(POP)	D(STIR)	D(UNEMP)
CointEq1	0.012164	1.507348	-0.108246	-693.9247	-6.313195	0.288328	-0.695891
	(0.00514)	(0.29514)	(0.48863)	(456.922)	(14.7594)	(0.12787)	(0.15610)
	[2.36760]	[5.10719]	[-0.22153]	[-1.51869]	[-0.42774]	[2.25480]	[-4.45806]
D(LHP(-1))	0.567817	-23.67883	11.50970	31525.90	622.3111	-2.988337	-1.797158
	(0.11252)	(6.46373)	(10.7012)	(10006.8)	(323.235)	(2.80046)	(3.41859)
	[5.04646]	[-3.66334]	[1.07556]	[3.15046]	[1.92526]	[-1.06709]	[-0.52570]
D(INF(-1))	-0.001805	0.210394	0.017867	-26.43468	-3.280600	0.068364	-0.021658
	(0.00188)	(0.10815)	(0.17905)	(167.429)	(5.40825)	(0.04686)	(0.05720)
	[-0.95896]	[1.94542]	[0.09979]	[-0.15789]	[-0.60659]	[1.45902]	[-0.37864]
D(ER(-1))	-2.48E-05	0.080263	0.201521	-2.145464	1.439249	0.055499	-0.052750
	(0.00130)	(0.07484)	(0.12390)	(115.860)	(3.74248)	(0.03242)	(0.03958)
	[-0.01900]	[1.07249]	[1.62648]	[-0.01852]	[0.38457]	[1.71166]	[-1.33271]
D(COM(-1))	3.75E-06	8.67E-05	-0.000131	-0.000464	0.004551	5.87E-05	-7.88E-05
	(1.3E-06)	(7.4E-05)	(0.00012)	(0.11528)	(0.00372)	(3.2E-05)	(3.9E-05)
	[2.89296]	[1.16382]	[-1.06057]	[-0.00403]	[1.22208]	[1.82069]	[-2.00075]
D(POP(-1))	2.11E-05	0.003863	0.001542	3.564498	0.795984	-2.51E-05	0.001469
	(2.5E-05)	(0.00144)	(0.00238)	(2.22188)	(0.07177)	(0.00062)	(0.00076)
	[0.84508]	[2.69136]	[0.64902]	[1.60427]	[11.0907]	[-0.04035]	[1.93570]
D(STIR(-1))	-0.005998	0.409179	0.126998	231.7010	1.585806	0.479855	-0.204547
	(0.00540)	(0.31004)	(0.51329)	(479.980)	(15.5042)	(0.13433)	(0.16397)
	[-1.11136]	[1.31978]	[0.24742]	[0.48273]	[0.10228]	[3.57233]	[-1.24743]
D(UNEMP(-1))	-0.002441	-0.020144	0.085694	-777.1256	4.809999	-0.005538	0.411840
	(0.00399)	(0.22910)	(0.37929)	(354.676)	(11.4566)	(0.09926)	(0.12117)
	[-0.61210]	[-0.08793]	[0.22593]	[-2.19109]	[0.41984]	[-0.05579]	[3.39894]
C	-0.002903	-0.292867	-0.007846	406.1476	10.64605	-0.069816	-0.040962
	(0.00210)	(0.12084)	(0.20005)	(187.071)	(6.04272)	(0.05235)	(0.06391)
	[-1.38002]	[-2.42367]	[-0.03922]	[2.17108]	[1.76180]	[-1.33355]	[-0.64095]
R-squared	0.814417	0.365002	0.138521	0.629343	0.892017	0.468799	0.789658
Adj. R-squared	0.792900	0.291379	0.038639	0.586369	0.879497	0.407211	0.765270
Sum sq. resids	0.007913	26.11284	71.57320	62585832	65301.98	4.901706	7.304342
S.E. equation	0.010709	0.615180	1.018476	952.3870	30.76370	0.266532	0.325361
F-statistic	37.85021	4.957723	1.386847	14.64452	71.24881	7.611805	32.37955
Log likelihood	247.9660	-68.00023	-107.3237	-640.8955	-373.1499	-2.759312	-18.31585
Akaike AIC	-6.127332	1.974365	2.982658	16.66399	9.798715	0.301521	0.700406
Schwarz SC	-5.855404	2.246293	3.254586	16.93591	10.07064	0.573449	0.972334
Mean dependent	0.005436	-0.035080	0.086067	850.9359	86.40513	-0.059820	0.024359
S.D. dependent	0.023532	0.730795	1.038741	1480.835	88.62177	0.346178	0.671555

Determinant resid covariance (dof adj.)	121.9471
Determinant resid covariance	51.69550
Log likelihood	-928.6099
Akaike information criterion	25.60538
Schwarz criterion	27.72038
Number of coefficients	70

According to the correlation coefficient generated by the estimation, interest rates have the largest negative effect on housing prices in the short term. The same result is also seen in the long run when interest rates negatively affect housing prices. Other macroeconomic variables that heavily influence housing prices in Spain include inflation and the exchange rate. It is interesting to note that the relationship between these two variables and housing price is negative, which is contrary to previous studies.

An analysis of the socioeconomic variables reveals dynamic results over the short and long terms. In the short term, population growth and compensation of employees negatively affect housing price movements, whereas the unemployment rate is positively correlated with housing price movements. It is important to note that the relationship between the three socioeconomic variables reverses in the long term, where the effect of population growth becomes positive while the correlation of unemployment becomes negative. Besides the issue of error correction, it is also interesting to take a look at the movement of housing prices in Spain, which has declined significantly since the 2008 global financial crisis. Between 2011 and 2017, the population of Spain decreased as well.

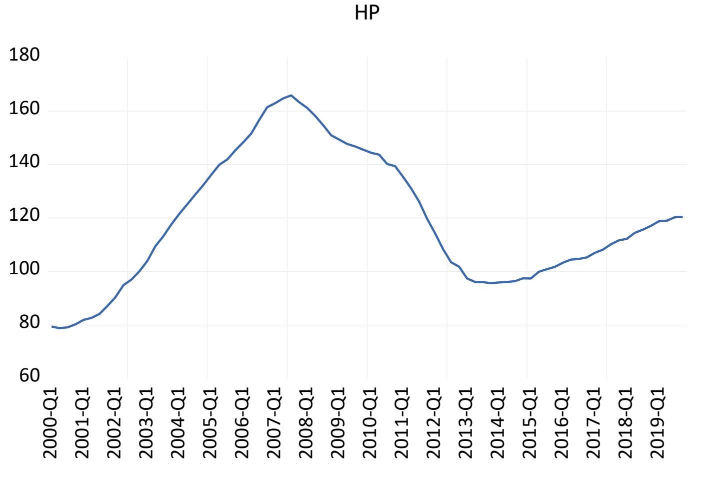


Figure 3.11: Spain housing prices

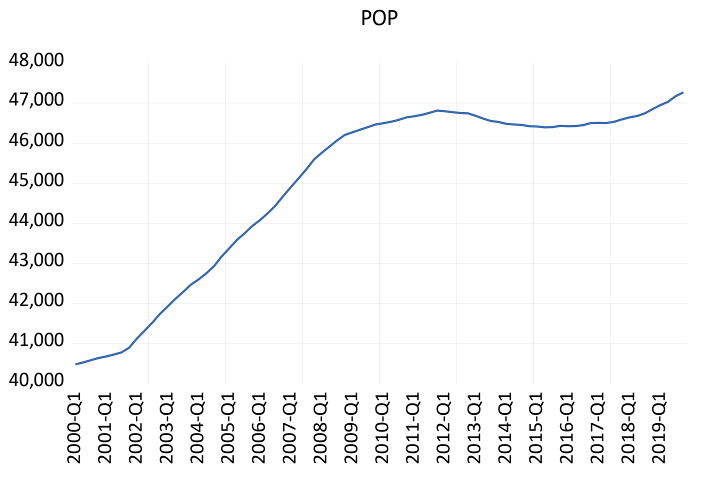


Figure 3.12: Spain population growth Spain

According to a lag order selection criteria test, the optimum lag for the VECM model for determining the housing prices in Spain is lag 2, which implies that housing prices are influenced by determinant variables from the previous two quarters.

Table 3.14: Optimum lag of VECM estimation (Spain)

VAR Lag Order Selection Criteria
Endogenous variables: LHP INF POP ER COM STIR UNEMP
Exogenous variables: C
Date: 07/03/21 Time: 22:55
Sample: 2000Q1 2019Q4
Included observations: 76

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1912.948	NA	2.07e+13	50.52494	50.73961	50.61073
1	-936.1520	1747.950	517.8076	26.10926	27.82665*	26.79561
2	-845.8130	145.0180*	180.0070*	25.02139*	28.24149	26.30830*
3	-802.4147	61.67115	226.5401	25.16881	29.89161	27.05627
4	-756.6096	56.65366	290.7111	25.25289	31.47840	27.74090

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

3.9 Switzerland

Based on the estimation results with a significance level of 5%, all variables included in the estimation in Switzerland are statistically significant. It is also important to note that the R-square for this estimate is relatively low, at 0.006. In addition to confirming several earlier research findings on factors that drive housing prices, this study also points out some new findings that differ from those of previous studies.

Table 3.15: VECM regression result (Switzerland)

Vector Error Correction Estimates
Date: 06/28/21 Time: 11:02
Sample (adjusted): 2000Q3 2019Q4
Included observations: 78 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1
LHP(-1)	1.000000
INF(-1)	0.019978
	(0.00389)
	[5.13917]
ER(-1)	-0.000337
	(0.00071)
	[-0.47445]
COMP(-1)	-4.91E-07
	(1.6E-06)
	[-0.29916]
POP(-1)	-0.000400
	(4.5E-05)
	[-8.83645]
STIR(-1)	-0.001844
	(0.00756)
	[-0.24393]
UNEM(-1)	0.026656
	(0.00855)
	[3.11608]
C	-1.305293

Error Correction:	D(LHP)	D(INF)	D(ER)	D(COMP)	D(POP)	D(STIR)	D(UNEM)
CointEq1	0.075478	-5.937419	-9.210011	3032.125	98.28374	3.071568	-6.711137
	(0.06912)	(3.22772)	(14.9949)	(1160.30)	(18.3133)	(1.65140)	(2.33053)
	[1.09202]	[-1.83951]	[-0.61421]	[2.61323]	[5.36678]	[1.85998]	[-2.87967]
D(LHP(-1))	0.039568	-2.077755	28.30843	-1163.745	-70.79975	-4.856384	5.209545
	(0.14537)	(6.78879)	(31.5384)	(2440.43)	(38.5180)	(3.47335)	(4.90174)
	[0.27218]	[-0.30606]	[0.89759]	[-0.47686]	[-1.83810]	[-1.39818]	[1.06280]
D(INF(-1))	-0.000803	0.194534	1.377319	-24.17660	1.254657	-0.138769	0.096246
	(0.00282)	(0.13189)	(0.61273)	(47.4127)	(0.74833)	(0.06748)	(0.09523)
	[-0.28439]	[1.47494]	[2.24784]	[-0.50992]	[1.67661]	[-2.05644]	[1.01066]
D(ER(-1))	0.000416	-0.004563	-0.068081	-4.325550	0.309246	0.018179	0.016573
	(0.00057)	(0.02654)	(0.12332)	(9.54217)	(0.15061)	(0.01358)	(0.01917)
	[0.73247]	[-0.17190]	[-0.55209]	[-0.45331]	[2.05333]	[1.33857]	[0.86472]
D(COMP(-1))	-8.38E-08	-0.000215	0.001243	0.734397	0.001497	-0.000169	-0.000146
	(4.0E-06)	(0.00019)	(0.00087)	(0.06763)	(0.00107)	(9.6E-05)	(0.00014)
	[-0.02080]	[-1.14058]	[1.42211]	[10.8588]	[1.40219]	[-1.76016]	[-1.07844]
D(POP(-1))	-5.41E-05	0.009341	0.010013	-13.31356	0.593460	-0.010706	0.017339
	(0.00025)	(0.01157)	(0.05377)	(4.16088)	(0.06567)	(0.00592)	(0.00836)
	[-0.21813]	[0.80706]	[0.18620]	[-3.19969]	[9.03667]	[-1.80788]	[2.07474]
D(STIR(-1))	0.006000	0.572516	-2.264366	97.47076	-5.588139	0.590998	-0.488272
	(0.00517)	(0.24129)	(1.12094)	(86.7376)	(1.36900)	(0.12345)	(0.17422)
	[1.16115]	[2.37276]	[-2.02007]	[1.12374]	[-4.08190]	[4.78736]	[-2.80266]
D(UNEM(-1))	-0.002901	-0.008963	-1.040836	-43.62372	-1.288852	0.090235	-0.517985
	(0.00277)	(0.12925)	(0.60047)	(46.4643)	(0.73336)	(0.06613)	(0.09333)
	[-1.04809]	[-0.06934]	[-1.73336]	[-0.93887]	[-1.75746]	[1.36450]	[-5.55026]
C	0.007691	-0.024397	-0.905865	390.4822	6.544539	0.274304	-0.243219
	(0.00564)	(0.26332)	(1.22328)	(94.6567)	(1.49399)	(0.13472)	(0.19012)
	[1.36395]	[-0.09265]	[-0.74052]	[4.12525]	[4.38056]	[2.03610]	[-1.27927]
R-squared	0.109793	0.238303	0.136254	0.751649	0.831900	0.367007	0.516869
Adj. R-squared	0.006581	0.149990	0.036109	0.722855	0.812410	0.293617	0.460854
Sum sq. resids	0.006170	13.45522	290.3927	1738754.	433.1451	3.522121	7.014659
S.E. equation	0.009456	0.441592	2.051485	158.7430	2.505487	0.225932	0.318844
F-statistic	1.063759	2.698397	1.360571	26.10410	42.68372	5.000749	9.227308
Log likelihood	257.6694	-42.14087	-161.9437	-501.1441	-177.5374	10.13097	-16.73764
Akaike AIC	-6.376139	1.311304	4.383172	13.08062	4.783010	-0.028999	0.659940
Schwarz SC	-6.104211	1.583232	4.655100	13.35254	5.054938	0.242929	0.931868
Mean dependent	0.006726	-0.021588	0.157492	545.3744	17.36795	-0.051156	0.017854
S.D. dependent	0.009487	0.478971	2.089558	301.5372	5.784787	0.268817	0.434236

Determinant resid covariance (dof adj.)	0.027425
Determinant resid covariance	0.011626
Log likelihood	-601.0143
Akaike information criterion	17.20550
Schwarz criterion	19.32049
Number of coefficients	70

An estimation of macroeconomic variables in Switzerland shows similar results with those in Finland and France, in which all of them indicate different relationships both in the short-term and long-term. Concerning the short term, interest rates and exchange rates affect housing prices negatively, while inflation has a positive effect. In the long run, interest rates and exchange rates impact housing prices positively, while inflation negatively affects them. The results of the estimation of the socioeconomic variable show consistent results both short and long term for population growth and compensation of employees, which are negatively related to housing prices. The unemployment rate variable indicates a positive relationship with the housing price in Switzerland in the short term but negative results in the long term. A lag order selection criteria test suggests that the lag four lag is the optimum time lag for a VECM model for determinants of housing prices in Switzerland, which implies that housing prices are influenced by variables from the previous year.

Table 3.16: Optimum lag of VECM estimation (Switzerland)

VAR Lag Order Selection Criteria
Endogenous variables: LHP INF ER COMP POP STIR UNEM
Exogenous variables: C
Date: 07/03/21 Time: 23:00
Sample: 2000Q1 2019Q4
Included observations: 76

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1423.917	NA	53254176	37.65572	37.87039	37.74151
1	-619.8835	1438.797	0.125776	17.78641	19.50379*	18.47276
2	-524.1309	153.7081	0.037918	16.55608	19.77617	17.84298*
3	-474.6907	70.25715	0.040705	16.54449	21.26729	18.43195
4	-400.6022	91.63569*	0.024816*	15.88427*	22.10978	18.37229

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

4 Covid-19 Pandemic Impact on Housing Prices

After estimating the coefficients of all macroeconomic and socioeconomic variables, we can now use these to estimate the impact the Covid-19 pandemic would have had on housing prices, if the monetary interventions would not have occurred. As there is still relatively little literature available on this subject, this thesis aims to provide a large contribution to understand these unprecedented monetary interventions and their impact on one of the most important asset classes, which is housing real estate.

4.1 Estimating results

This chapter extends the VECM econometric model from the previous chapter to generate an estimation of the housing price development from 2020Q1 until 2020Q4, when monetary stimulus is not accounted for. The estimation of the housing prices is based on the coefficients from the regression results, as well as 2020 actuals of each independent variable.

The way the results were estimated is the following. Change of variable is obtained from the value of the independent variable minus the value of the independent variable of the previous quarter. It is then multiplied by the coefficient from the VECM econometric model estimation. The change of variables from all independent variables is then summed up to estimate the housing prices for each quarter of 2020 (see Appendix B). A further important point to note is that the estimation of housing prices for this period is based on the assumption that there is no monetary intervention or stimulus. The VECM econometric model also allows producing estimations for the short and long term. Nevertheless, it should be noted that this chapter primarily focuses on statistical and econometric analyses. Because of this, several factors, such as government policies regarding the pandemic, the level of readiness of health workers, and other factors other than economic variables have not been included in the analysis.

4.2 Short-term estimations

Looking at the short-term housing estimation results, it can be seen that the estimations of housing prices without any monetary intervention are lower than the actual housing prices figure for all countries, except for France in 2020Q2. Therefore, the monetary stimulus can be seen as one of the reasons for the inflation of the housing prices. There can also potentially be other reasons for this such as the ones mentioned earlier in this chapter, but the monetary stimulus seems to be the most likely explanation for the increasing housing price actuals, the presence of which actually contradicts the findings of previous studies, where it was concluded that the pandemic induced a decline in housing prices in the short term, such as in studies by D'Lima et.al (2020), Francke and Korevaar (2021) and Qian et.al (2021).

Table 4.1: 2020 short-term estimation Austria

	HP without Monetary Invervention				
	2019Q4	2020Q1	2020Q2	2020Q3	2020Q4
Estimated HP	120.36	120.39	120.38	120.43	120.42
	Difference to actual HP				
	2019Q4	2020Q1	2020Q2	2020Q3	2020Q4
Actual HP	120.36	122.32	124.81	127.14	127.71
Difference	0.00	1.93	4.44	6.71	7.28

Table 4.2: 2020 short-term estimation Belgium

	HP without Monetary Invervention				
	2019Q4	2020Q1	2020Q2	2020Q3	2020Q4
Estimated HP	107.94	107.81	107.50	107.72	107.70
	Difference to actual HP				
	2019Q4	2020Q1	2020Q2	2020Q3	2020Q4
Actual HP	107.94	107.83	109.50	109.76	113.48
Difference	0.00	0.01	2.00	2.04	5.79

Table 4.3: 2020 short-term estimation Denmark

	HP without Monetary Invervention				
	2019Q4	2020Q1	2020Q2	2020Q3	2020Q4
	114.82	114.82	114.87	114.77	114.73
	Difference to actual HP				
	2019Q4	**2020Q1**	**2020Q2**	**2020Q3**	**2020Q4**
Actual HP	114.82	115.37	115.83	120.78	126.04
Difference	0.00	0.56	0.96	6.00	11.31

Table 4.4: 2020 short-term estimation Finland

	HP without Monetary Invervention				
	2019Q4	2020Q1	2020Q2	2020Q3	2020Q4
	100.85	100.67	99.29	101.59	101.37
	Difference to actual HP				
	2019Q4	**2020Q1**	**2020Q2**	**2020Q3**	**2020Q4**
Actual HP	100.85	102.06	101.87	102.25	103.70
Difference	0.00	1.40	2.58	0.65	2.33

Table 4.5: 2020 short-term estimation France

	HP without Monetary Invervention				
	2019Q4	2020Q1	2020Q2	2020Q3	2020Q4
Estimated HP	108.11	109.13	112.23	107.73	108.72
	Difference to actual HP				
	2019Q4	**2020Q1**	**2020Q2**	**2020Q3**	**2020Q4**
Actual HP	108.11	109.90	111.43	112.08	114.52
Difference	0.00	0.77	-0.80	4.36	5.80

Table 4.6: 2020 short-term price estimation Greece

	HP without Monetary Invervention				
	2019Q4	2020Q1	2020Q2	2020Q3	2020Q4
Estimated HP	107.96	108.03	107.66	107.53	107.46
	Difference to actual HP				
	2019Q4	**2020Q1**	**2020Q2**	**2020Q3**	**2020Q4**
Actual HP	107.96	109.29	107.87	116.04	115.13
Difference	0.00	1.27	0.21	8.51	7.68

Table 4.7: 2020 short-term price estimation Spain

	HP without Monetary Invervention				
	2019Q4	2020Q1	2020Q2	2020Q3	2020Q4
Estimated HP	120.45	120.44	120.75	120.65	120.67
	Difference to actual HP				
	2019Q4	2020Q1	2020Q2	2020Q3	2020Q4
Actual HP	120.45	121.38	121.56	122.58	122.98
Difference	0.00	0.95	0.81	1.94	2.31

Table 4.8: 2020 short-term price estimation Switzerland

	HP without Monetary Invervention				
	2019Q4	2020Q1	2020Q2	2020Q3	2020Q4
Estimated HP	109.68	109.67	109.67	109.67	109.67
	Difference to actual HP				
	2019Q4	2020Q1	2020Q2	2020Q3	2020Q4
Actual HP	109.68	111.61	112.90	115.16	116.57
Difference	0.00	1.94	3.24	5.50	6.90

A more thorough study is necessary to ascertain the relationship between the monetary stimulus and housing prices more deeply because there are also other variables that should be considered throughout the Covid-19 pandemic such as the state conditions, government policies regarding the pandemic, public awareness, and other factors. However, this study would be able to demonstrate econometrically that there has indeed been an inflation of housing prices due to the monetary stimulus throughout the pandemic.

4.3 Long-term estimations

The results of the long-term estimations of the VECM model are in line with the results of the short-term estimations. It can be again seen that the estimations of housing prices, without taking monetary stimulus into account, are lower than the actual figures for all countries except for Belgium in 2020Q2 and Greece in 2020Q2, where the estimations are higher than the actual housing prices. Based on these results, it can be stated that the monetary intervention and/or stimulus during the pandemic have had an impact on the housing prices, resulting in higher prices, in the eight countries examined in this study.

Table 4.9: 2020 long-term estimation Austria

	HP without Monetary Invervention				
	2019Q4	2020Q1	2020Q2	2020Q3	2020Q4
	120.36	120.37	120.31	120.33	120.34
	Difference to actual HP				
	2019Q4	**2020Q1**	**2020Q2**	**2020Q3**	**2020Q4**
Actual HP	120.36	122.32	124.81	127.14	127.71
Difference	0.00	1.95	4.51	6.81	7.36

Table 4.10: 2020 long-term estimation Belgium

	HP without Monetary Invervention				
	2019Q4	2020Q1	2020Q2	2020Q3	2020Q4
	107.94	107.92	107.90	107.93	107.92
	Difference to actual HP				
	2019Q4	**2020Q1**	**2020Q2**	**2020Q3**	**2020Q4**
Actual HP	107.94	107.83	109.50	109.76	113.48
Difference	0.00	-0.10	1.60	1.83	5.56

Table 4.11: 2020 long-term estimation Denmark

	HP without Monetary Invervention				
	2019Q4	2020Q1	2020Q2	2020Q3	2020Q4
Estimated HP	114.818329	114.820128	114.814837	114.795616	114.788503
	Difference to actual HP				
	2019Q4	2020Q1	2020Q2	2020Q3	2020Q4
Actual HP	114.818329	115.373711	115.832143	120.777867	126.042568
Difference	0.00	0.55	1.02	5.98	11.25

Table 4.12: 2020 long-term estimation Finland

	HP without Monetary Invervention				
	2019Q4	2020Q1	2020Q2	2020Q3	2020Q4
Estimated HP	100.85	100.85	100.84	100.85	100.85
	Difference to actual HP				
	2019Q4	**2020Q1**	**2020Q2**	**2020Q3**	**2020Q4**
Actual HP	100.85	102.06	101.87	102.25	103.70
Difference	0.00	1.21	1.03	1.39	2.85

Table 4.13: 2020 long-term estimation France

	HP without Monetary Invervention				
	2019Q4	2020Q1	2020Q2	2020Q3	2020Q4
	108.11	108.11	108.11	108.14	108.15
	Difference to actual HP				
	2019Q4	2020Q1	2020Q2	2020Q3	2020Q4
Actual HP	108.11	109.90	111.43	112.08	114.52
Difference	0.00	1.79	3.33	3.94	6.38

Table 4.14: 2020 long-term price estimation Greece

	HP without Monetary Invervention				
	2019Q4	2020Q1	2020Q2	2020Q3	2020Q4
	107.96	107.97	107.95	107.95	107.95
	Difference to actual HP				
	2019Q4	2020Q1	2020Q2	2020Q3	2020Q4
Actual HP	107.96	109.29	107.87	116.04	115.13
Difference	0.00	1.32	-0.08	8.09	7.18

Table 4.15: 2020 long-term price estimation Spain

	HP without Monetary Invervention				
	2019Q4	2020Q1	2020Q2	2020Q3	2020Q4
	120.45	120.45	120.37	120.42	120.43
	Difference to actual HP				
	2019Q4	2020Q1	2020Q2	2020Q3	2020Q4
Actual HP	120.45	121.38	121.56	122.58	122.98
Difference	0.00	0.93	1.19	2.16	2.55

Table 4.16: 2020 long-term price estimation Switzerland

	HP without Monetary Invervention				
	2019Q4	2020Q1	2020Q2	2020Q3	2020Q4
	109.68	109.68	109.68	109.67	109.67
	Difference to actual HP				
	2019Q4	2020Q1	2020Q2	2020Q3	2020Q4
Actual HP	109.68	111.61	112.90	115.16	116.57
Difference	0.00	1.93	3.23	5.49	6.89

Due to the fact that this prediction model is based on the VECM econometric model, it is also important to note that the long-term coefficient has an error correction element that can better explain the statistical relationship. Therefore, it is important to compare the results of the short-term and long-term housing price estimates. The difference between estimated housing prices and the actual housing prices in the long term is also greater than the difference between the actuals and the estimates in the short-term. According to these findings, it is also possible to conclude that the effects of the monetary stimulus connected to the Covid-19 pandemic on the price of housing in the long-term is greater than the short-term effect.

Furthermore, it is important to note that the results of this study differ from those found by Francke & Korevaar (2021), which concluded that the negative effect of pandemics on housing prices would only last for a short period of time. The difference in results between this study and Francke & Korevaar (2021) can be explained by the fact that these two studies focus on different pandemics. Unlike this thesis, which has taken the Covid-19 pandemic as a focus of analysis, Francke & Korevaar (2021) examined the outbreaks of the plague in Amsterdam and cholera in Paris as te focus of their analysis. Nevertheless, this study's estimation supports previous findings made by D'Lima et.al (2020) and Qian et.al (2021) which have indicated that the Covid-19 pandemic has a slightly negative impact on housing prices in both the short and long term.

4.4 Discussion

Both of the short-run and long-run estimations provide valuable results. The difference between the actual and estimated housing prices indicates that there is an unobserved effect that is not explained by the usual macroeconomic indicators. One major contribution to this price increase might be caused by the monetary stimulus that we saw in connection to the Covid-19 pandemic. However, also public policy variables, health factors and other aspects can be the reason for the difference in actuals and estimates.

Another possibility might be that the unobserved effect can also simply represent a bubble, the severity of which can be roughly quantified by the difference between the estimated housing prices and the actual housing prices.

For all of this, it is important to note that this research is among the first attempts at assessing the relationship between the monetary stimulus connected to the Covid-19 pandemic and housing prices. Due to the fact that the combination of Covid-19 and the unprecedented monetary stimulus has created an extraordinary situation and a complex issue that does not only involve economic variables, it can be stated that further research is needed, which takes into account public policy variables, health factors and other aspects.

5 Correlation between Rental and Housing Prices

Rental and housing prices provide insight into the dynamics of the housing market over time. There has been a wide range of studies performed with respect to the real estate market growth. It was discussed in the previous literature review that there were differing opinions on the correlation between housing and rental prices. According to some research, housing prices and rental prices are independent of one another. Other papers state that the opposite is true and have shown that housing prices and rental prices are cointegrated. According to some studies, the price of housing affects rental prices, but not the other way around. On the other side, there is also research that shows rental prices affecting housing prices rather than vice versa. As a result, the purpose of this thesis is to contribute to the existing literature's discussion on correlations between rental and housing prices by investigating the rental and housing price data across each of the countries previously analyzed, using the Granger causality test. For this, the Augmented Dickey-Fuller test has been run on both the housing price variable, as well as the rental price variable, in order to check for non-stationary variables (see Appendix D). If this was detected, the Granger causality test was run at first or second difference.

This analysis again uses quarterly data from 2000Q1 to 2019Q4. The use of updated data is expected to provide more current results than previous studies, so that the results may be used as references for future research. Furthermore, the thesis tries to establish a connection between the level of homeownership in a country and the relationship between rental prices and housing prices.

5.1 Granger causality test results – Austria

According to the Granger causality test results for Austria, with a significance level of 10%, the housing prices do not statistically significantly affect the rental price (Prob: 0.5211), thereby not rejecting the null hypothesis. The housing price is also not statistically significantly affected by the rental price (Prob: 0.2384), so the null hypothesis is again not rejected. It is interesting to note that these results are consistent with the previous studies of Himmelberg et al. (2005), as well as Dong and Liu (2010), which indicate the housing prices and rental prices not being affected by each other.

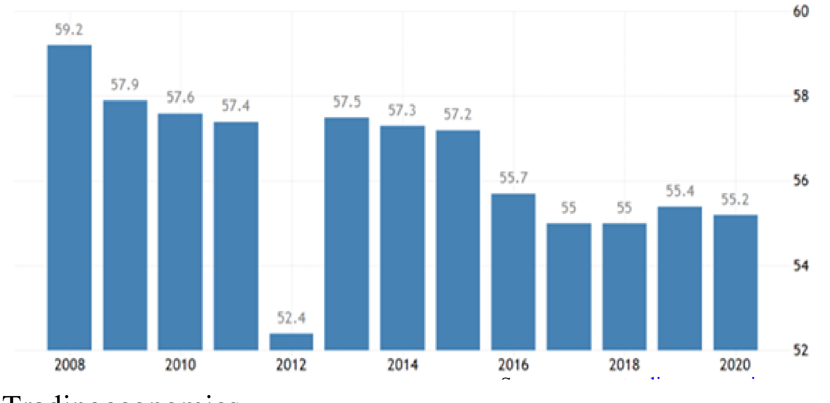
Table 5.1: Granger causality test Austria

Pairwise Granger Causality Tests
Date: 07/27/21 Time: 00:24
Sample: 2000Q1 2019Q4
Lags: 4

Null Hypothesis:	Obs	F-Statistic	Prob.
DRENT does not Granger Cause DHP	75	1.41588	0.2384
DHP does not Granger Cause DRENT		0.81340	0.5211

The homeownership in Austria is relatively high, being above 50% for years 2018 to 2020. Even though the level of homeownership in Austria shows a negative trend, decreasing from 59.2% in 2008 to 55.2% in 2020, it consistently remained above 50%, making every second Austrian a homeowner.

Figure 5.1: Austria homeownership rate



Source: Tradingeconomics

5.2 Granger causality test results – Belgium

For Belgium, the Granger causality test results for Austria show, with a significance level of 5%, that the housing prices statistically significantly affect the rental price (Prob: 0.0115). However, it also shows that the housing prices are not statistically significantly affected by the rental prices (Prob: 0.9809). It has to be said that these results are also in line with the previous studies. Using data from China, Liu (2007) and Du and Ma (2009) found that housing prices influence housing rent, but that rent does not affect housing prices.

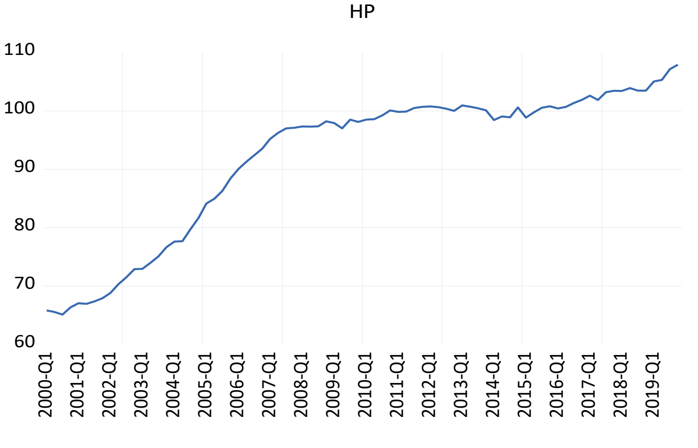
Table 5.2: Granger causality test Belgium

Pairwise Granger Causality Tests
Date: 07/27/21 Time: 00:58
Sample: 2000Q1 2019Q4
Lags: 4

Null Hypothesis:	Obs	F-Statistic	Prob.
DHP does not Granger Cause DRENT	75	3.52085	0.0115
DRENT does not Granger Cause DHP		0.10338	0.9809

This finding is reinforced by looking at the movement of housing prices in Belgium throughout the last 20 years. Belgian housing prices have shown an increasing trend from the early 2000s until the end of 2020Q4, although the growth slowed down after the 2008 financial crisis. Such a strong positive increase in housing prices might also contribute to the relationship with the rental rates. These might have to adjust according to the market value of housing and therefore can help stimulate rental growth.

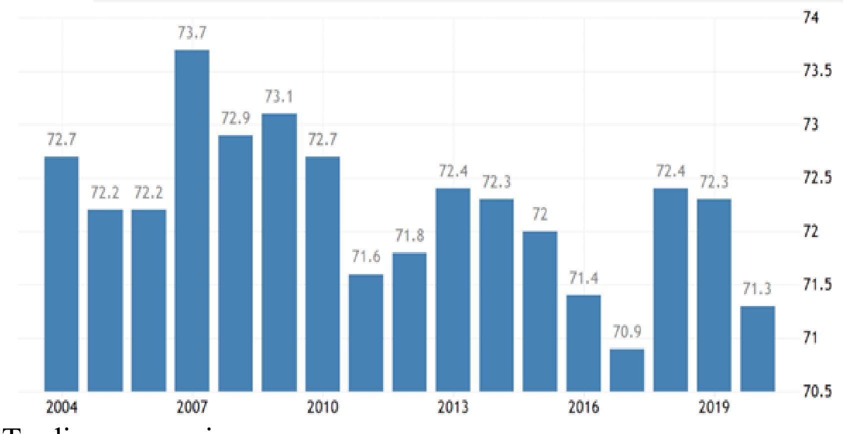
Figure 5.2: Belgium housing price



When looking at the homeownership rates in Belgium, we can again see a decreasing trend, with homeownership levels falling from 72.8% in 2004 to only 71.3%

in 2020. However, even though there is a negative trend in the ownership rate, it has to be said that Belgium shows a very high level of homeownership of over 70%.

Figure 5.3: Belgium homeownership rate in percent



Source: Tradingeconomics

5.3 Granger causality test results – Denmark

The Granger causality test on housing prices and rental prices in Denmark shows the same results as the one conducted on Belgium, and has a notably higher significance level.

Table 5.3: Granger causality test Denmark

Pairwise Granger Causality Tests
Date: 07/27/21 Time: 00:48
Sample: 2000Q1 2019Q4
Lags: 4

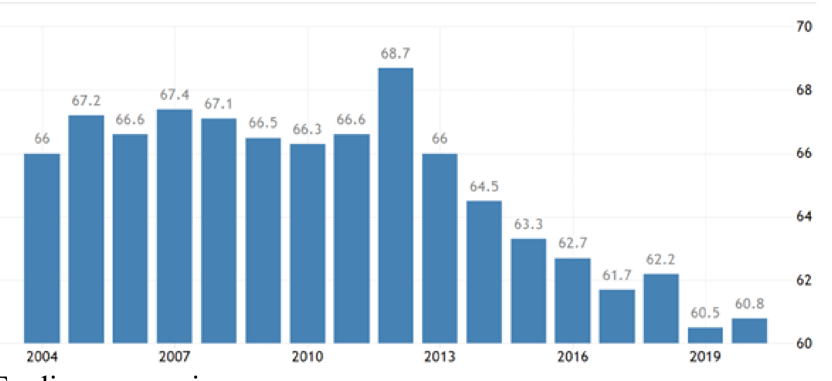
Null Hypothesis:	Obs	F-Statistic	Prob.
DHP does not Granger Cause DRENT	74	3.41672	0.0135
DRENT does not Granger Cause DHP		2.36699	0.0618

At the significance level of 5%, the results also show that the housing prices are statistically significant in affecting the rental prices in Belgium (Prob: 0.0135). On the other hand, housing prices are not statistically significantly correlated to the rental price (Prob: 0.0618).

These results also make it interesting to look at the homeownership rate in Denmark. Like in Belgium, we can see that there is a downwards trend, while

Denmark's homeownership rate is still relatively high and consistently exceeds 60 percent.

Figure 5.4: Denmark homeownership rate in percent



Source: Tradingeconomics

Moreover, after observing these results, it would be worthwhile to closely examine the housing price and rental price data in Denmark. As illustrated in Figure 5.5, housing prices in Denmark have declined dramatically since 2007, despite showing an increase after 2013. In the meantime, as illustrated in Figure 5.6, rental prices continued to increase from 2000 to 2019.

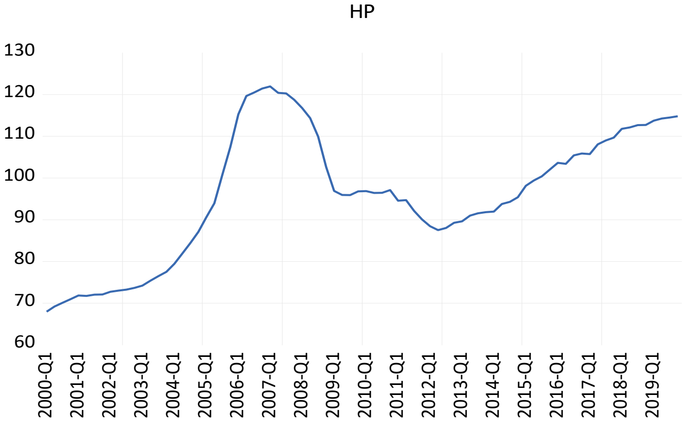


Figure 5.5: Denmark housing price

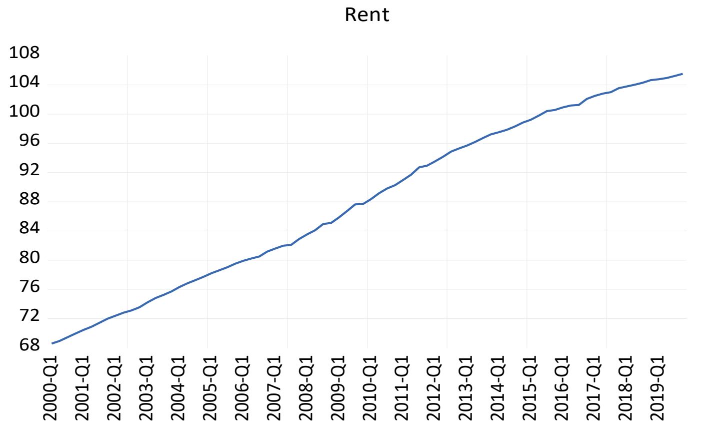


Figure 5.6: Denmark rental price

5.4 Granger causality test results – Finland

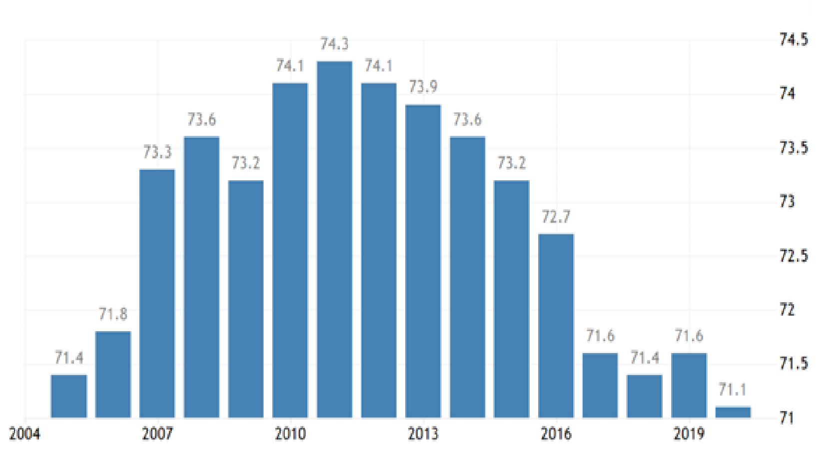
The results in Finland are different from those in Austria, Belgium and Denmark. The Granger causality test in Finland, with a significance level of 5%, indicates that the housing prices statistically significantly influence the rental prices (Prob: 0.0032). The rental prices also statistically significantly influence the housing prices (Prob: 0.000005). These findings are in line with previous studies that found that housing prices and housing rents are interdependent, such as Gallin (2008) as well as Yu and Chen (2009).

Table 5.3: Granger causality test Finland

Pairwise Granger Causality Tests
Date: 07/27/21 Time: 00:40
Sample: 2000Q1 2019Q4
Lags: 4

Null Hypothesis:	Obs	F-Statistic	Prob.
RENT does not Granger Cause DHP	75	4.41962	0.0032
DHP does not Granger Cause RENT		9.24254	5.E-06

Figure 5.4: Finland homeownership rate in percent



Source: Tradingeconomics

Taking a look at the homeownership rate in Finland, it is also interesting to see that it has a relatively high home ownership rate, which is over 70 percent. Throughout the analyzed period, we can also first observe an increasing trend until 2011, when it peaked at 74.3%, followed by the fall of the homeownership rate to 71.6% in 2019.

It is also interesting to observe that housing prices in Finland have experienced an increasing trend since the beginning of the observation period until 2007. After that, housing prices in Finland declined and remained relatively stagnant until the end of the observation period. Meanwhile, rental prices in Finland continued to rise through the end of the observation period, even as a slight decline was observed in 2008-2010. As a result, examining the trend in housing and rental prices in Finland might provide some support for the finding that rental prices can affect house prices.

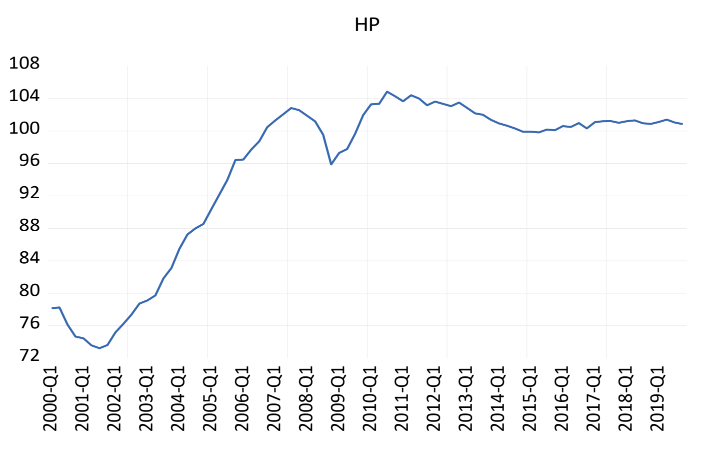


Figure 5.5: Finland housing price

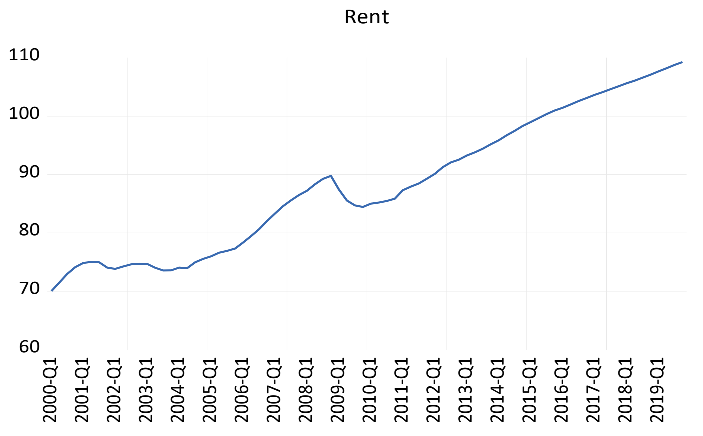


Figure 5.6: Finland rental price

5.5 Granger causality test results – France

The Granger causality tests conducted for France reveal a different result. The housing prices do not statistically significantly affect the rental prices (Prob: 0.2318). The effect of rental prices on housing prices is also not statistically significant (Prob: 0.4259). The findings of this study support previous research that indicated that rental prices do not correlate with housing prices, such as in the studies by Himmelberg et al. (2005) and Dong and Liu (2010).

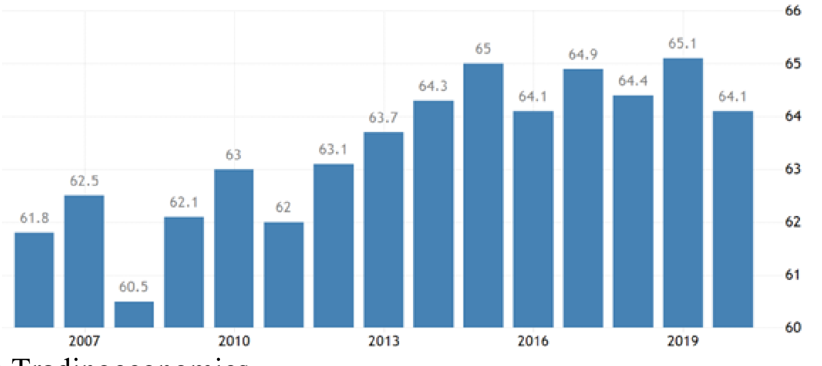
Table 5.4: Granger causality test France

Pairwise Granger Causality Tests
Date: 07/27/21 Time: 00:32
Sample: 2000Q1 2019Q4
Lags: 4

Null Hypothesis:	Obs	F-Statistic	Prob.
DRENT does not Granger Cause DHP	75	0.97757	0.4259
DHP does not Granger Cause DRENT		1.43636	0.2318

The results made it interesting to take a look at the data of homeownership rates. In France, homeownership rates are still relatively high and always exceed 60 percent, with a growing trend being visible in the timeframe of 2006 to 2020.

Figure 5.7: France homeownership in percent



Source: Tradingeconomics

As a result of these findings, it would be worthwhile to examine France's housing prices and rental prices in greater detail. Figure 5.11 illustrates two drops in housing prices in France, once in 2008 and another time in 2011. In general, the rental prices in France have increased since 2000, even though they were relatively stagnant from 2011 to 2019.

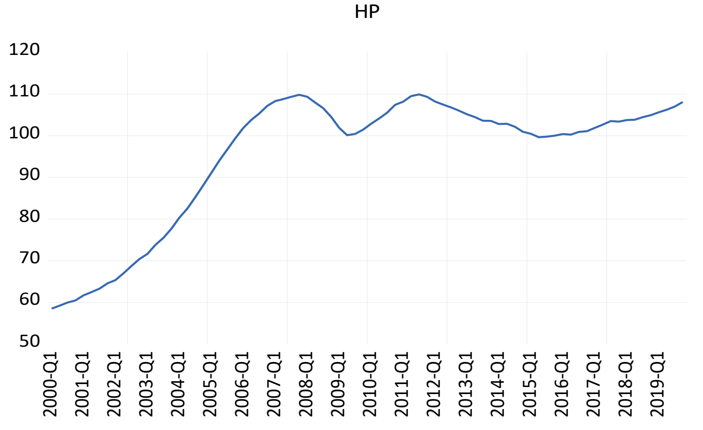


Figure 5.8: France housing price

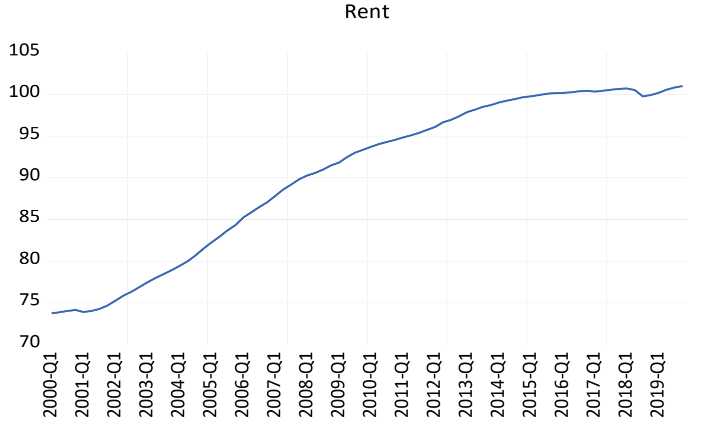


Figure 5.9: France rental price

5.6 Granger causality test results – Greece

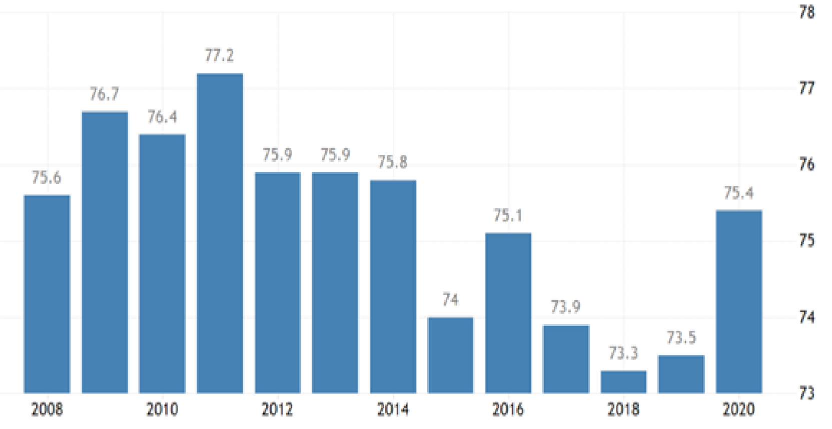
Similar to the results for Austria, the Granger causality tests conducted for Greek data revealed that housing prices do not statistically significantly affect the rental price (Prob: 0.8719). It is also not statistically significant that the rental price affects the housing price (Prob: 0.0931). This further reinforces the findings of Himmelberg et al. (2005) and Dong and Liu (2010). In addition, it is also noteworthy that the homeownership rate in Greece is quite high, and that this percentage is consistently above 70 percent from 2008 until 2019.

Table 5.5: Granger causality test Greece

Pairwise Granger Causality Tests
Date: 07/26/21 Time: 23:59
Sample: 2000Q1 2019Q4
Lags: 4

Null Hypothesis:	Obs	F-Statistic	Prob.
DRENT does not Granger Cause DHP	74	0.30755	0.8719
DHP does not Granger Cause DRENT		2.08335	0.0931

Figure 5.10: Greece homeownership rate in percent



Source: Tradingeconomics

Furthermore, it is important to examine Greece's housing prices and rental prices in more detail to understand how rental prices influence housing prices. As can be seen from Figure 5.14, housing prices in Greece experienced a steep decline from 2007 to 2018. Nevertheless, after experiencing relatively constant increases from 2000 to 2011, the rent in Greece has been falling since 2012. Although rental prices declined, it was not as severe as the decline in housing prices in Greece.

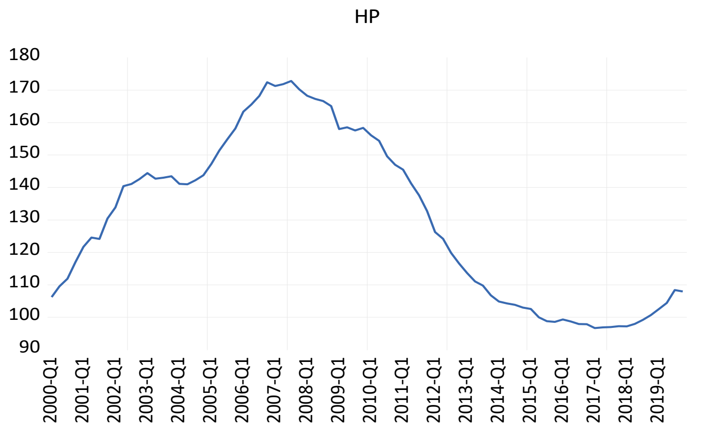


Figure 5.11: Greece housing price

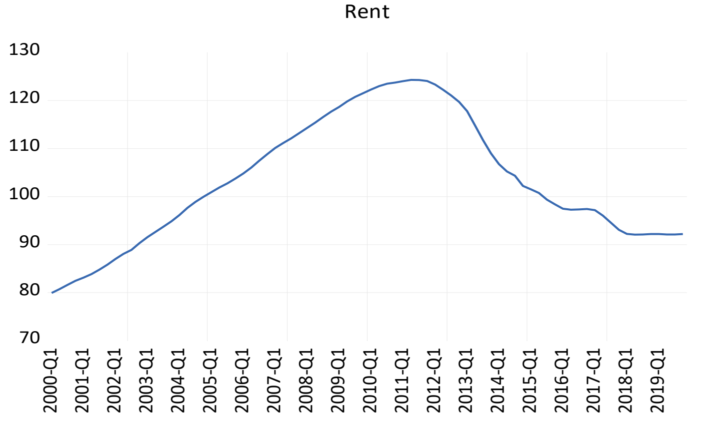


Figure 5.12: Greece rental price

5.7 Granger causality test results – Spain

According to the Granger causality test results in Spain, the impact of housing prices on rental prices is statistically significant (Prob: 0.0014) at a 5% significance level. In contrast, at a significance level of 5%, the rental prices do not statistically significantly affect the housing prices (Prob: 0.9518). These results are in line with the ones from Denmark.

Table 5.6: Granger causality test Spain

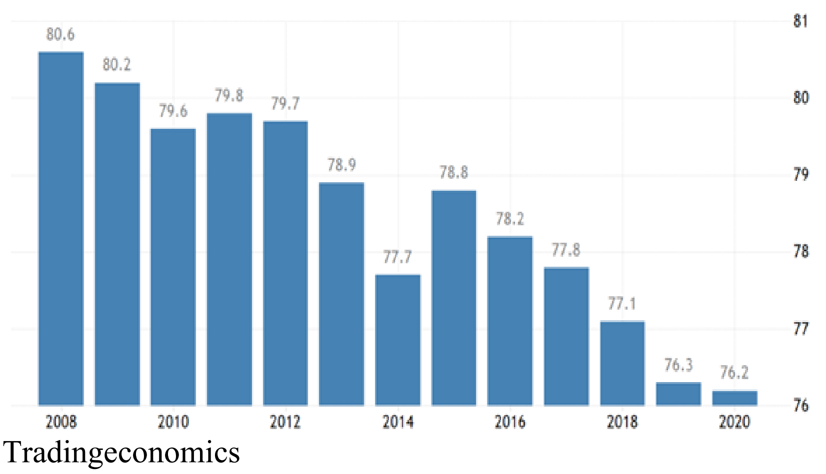
Granger Causality at level:

Pairwise Granger Causality Tests
Date: 07/27/21 Time: 00:10
Sample: 2000Q1 2019Q4
Lags: 4

Null Hypothesis:	Obs	F-Statistic	Prob.
DHP does not Granger Cause DRENT	74	5.02043	0.0014
DRENT does not Granger Cause DHP		0.17237	0.9518

The homeownership also develops similarly to the one in Denmark, as the homeownership rate in Spain has also remained relatively high from 2008 to 2019, being consistently above 70 percent, but showing a downwards trend.

Figure 5.13: Spain homeownership rate in percent



Source: Tradingeconomics

The housing price development is again also in line with the one in Denmark, as the data throughout the observation period in Spain shows a significant decline from 2007 to 2013. As these two countries show fairly similar developments in all variables and give the same results when running the Granger causality test, it might be a valuable finding in this analysis.

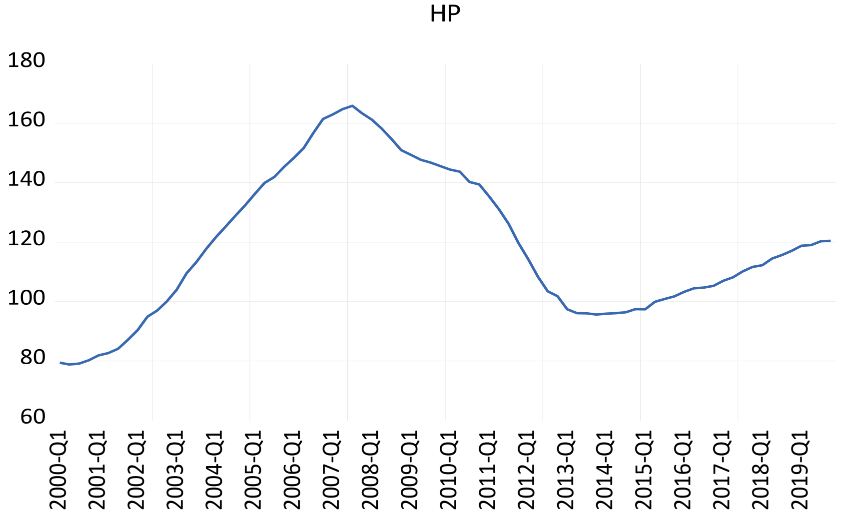


Figure 5.14: Spain housing price

5.8 Granger causality test results – Switzerland

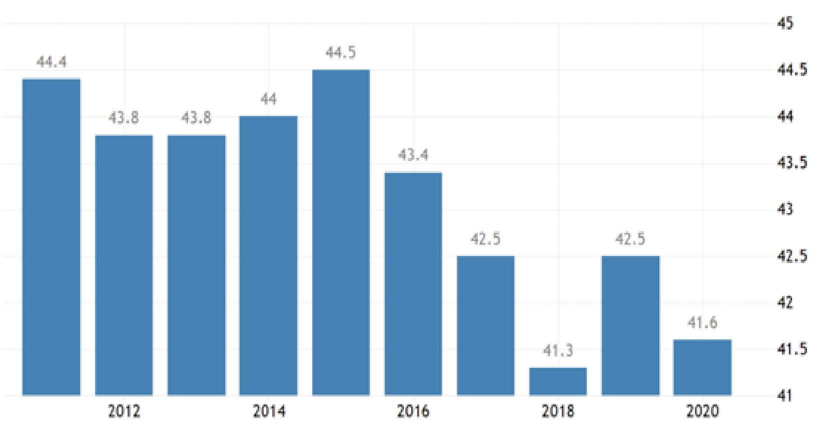
Granger causality tests conducted for Swiss data resulted in the same outcomes as in the cases of Austria, France and Greece. The housing prices do not statistically significantly affect the rental prices (Prob: 0.1395), and the rental prices do not statistically significantly affect the housing prices (Prob: 0.1243). The findings of this study again support previous research that indicated that rental prices do not correlate with housing prices, such as in the studies by Himmelberg et al. (2005) and Dong and Liu (2010). In addition, it is also noteworthy that the homeownership rate in Switzerland is relatively low and that this percentage is consistently below 45 percent from 2011 until 2019.

Table 5.7: Correlation between rental and housing prices Switzerland

Pairwise Granger Causality Tests
Date: 07/27/21 Time: 00:17
Sample: 1 80
Lags: 4

Null Hypothesis:	Obs	F-Statistic	Prob.
HP does not Granger Cause RENT	76	1.79817	0.1395
RENT does not Granger Cause HP		1.87932	0.1243

Figure 5.15: Switzerland homeownership rate in percent



Source: Tradingeconomics

Looking at the housing prices and rental prices during the observation period in Switzerland, it is also important to note that both of these prices have been increasing steadily over time. Interestingly, although both the housing price and rental price data align with each other, no statistically significant relationship exists between them.

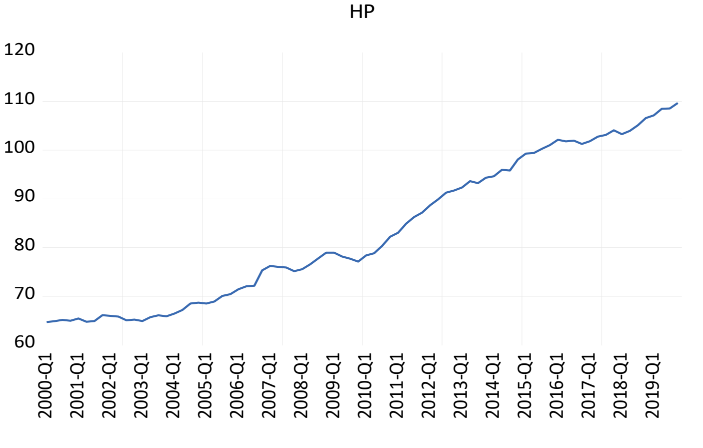


Figure 5.16: Switzerland housing price

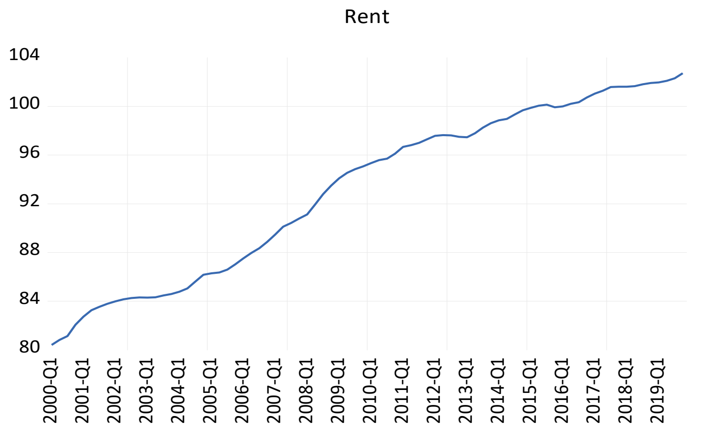


Figure 5.17: Switzerland rental price

5.9 The influence of homeownership on the correlation between housing and rental prices

After running the Granger causality test on all analyzed countries and looking at the homeownership levels of each of them, it has to be said that there is no visible connection between the relationship of the variables and the level of homeownership in most of the analyzed countries. However, when looking at the price developments, homeownership trends and Granger causality results all together, it can be said that Spain and Denmark show similar developments in all of these metrics and results. Therefore, there might be a link between all of these variables and relationships, however further research is needed in order to fully understand this claim.

Table 5.8: Overview of housing and rental price correlation and home level ownership

	Housing affects rental	Rental affects housing	Homeownership level (2019)
Austria	No	No	55.4%
Belgium	Yes	No	72.3%
Denmark	Yes	No	60.5%
Finland	Yes	Yes	71.6%
France	No	No	65.1%

Greece	No	No	75.4%
Spain	Yes	No	76.3%
Switzerland	No	No	41.6%

5.10 Discussion

With regard to the data and information discussed above, it is an intriguing fact that the results of this study generally confirm previous findings that had different conclusions. The only findings, that could not be confirmed by the analysis, are the ones of Zhai et al. (2018) where rental prices affected housing prices, but not the other way around. However, the Granger causality test results for Belgium, Denmark and Spain align with what was found in Liu (2007) and Du and Ma (2009), which found that housing prices influence rental prices, but that rent does not influence housing prices. The results in Finland support previous studies which found that housing prices and housing rent are interdependent and statistically significantly influenced each other, such as Gallin (2009) and Yu and Chen (2009). Granger causality test results for Austria, France, Greece and Switzerland, which indicate the housing price and rental price are not affected by each other, are consistent with those of Himmelberg et al. (2005) as well as Dong and Liu (2010).

Data on the homeownership rates in the countries analyzed in this study, on the other hand, does not seem to explain the correlation between the rental and housing prices in most cases. The only exception here could be the cases of Denmark and Spain, which show the same downwards trend in homeownership and return the same results for the Granger causality test. However, the role of the level of homeownership in these two countries needs to be researched further to confirm this suspicion. It might also be interesting for future research to run analyses for different countries, such as the U.S., which show a lower homeownership rate. This might lead to different conclusions.

The findings of this chapter also indicate that in order to understand the relationship between housing prices and rental prices, it is necessary to observe housing price movements closely. Interesting are again the findings from Denmark and Spain, that show a similar price development, which might be connected to similar Granger causality results. The Granger causality results of France and Switzerland also seem intriguing, as the housing prices and rental prices develop very similarly, however the

Granger causality test in both cases does not show any significant effect of one variable on the other.

6 Conclusion

In conclusion, it is encouraging to see macroeconomic variables and socioeconomic factors play significant roles in determining housing prices. Within the eight European countries that have been the focus of this study, macroeconomic variables influence housing prices in all cases. According to this thesis, housing prices are more influenced by macroeconomic factors, such as interest rates, exchange rates, and inflation, in Austria, Belgium, Denmark, Greece, and Spain. On the other hand, in Finland, France, and Switzerland, housing prices are more closely tied to socioeconomic factors such as population growth, compensation of employees, and unemployment rates. Further, this study examines how these macroeconomic and socioeconomic variables interact with housing prices. As well as confirming several previous studies related to the determinants of housing prices, this study also presented new findings that are distinct from previous studies. The VECM econometric model has been used in this study to gain a more comprehensive understanding of the housing price determinant variables by explaining both short- and long-term relationships.

Chapter 4 discusses the potential impacts of the monetary stimulus during the Covid-19 pandemic on housing price movements using the regression results from the VECM model from chapter 3. It also provides estimates for housing prices for the four quarters of 2020. The thesis shows that the monetary interventions indeed led to an increase in housing prices, which were significantly over the estimated price, that excluded the monetary effects. For all the countries assessed, housing prices are estimated to be lower than the actual prices recorded throughout 2020, both in the short and long term. It is also important to note that the results of this research demonstrate the long-term impact of the monetary stimulus during the Covid-19 pandemic on house prices is greater than the short-term impact.

A causality assessment of the relationship between housing prices and rental prices using the Granger causality test is also included in this thesis. Based on the Granger causality test results from eight of the countries that were evaluated during this study, three of them have shown that housing prices can predict rental prices and not vice versa. An analysis of Granger causality tests for one country shows that housing prices and rental prices are interdependent and are correlated to one another. Finally, the Granger causality tests for four other countries have found no correlation between housing prices and rental prices. All these results align with previously done research on this topic. Additionally, the study points out that seven of the eight countries evaluated have relatively high homeownership rates above 50 percent. However, no apparent link between the homeownership level and the correlation between rental and housing prices could be found.

6.1 Suggestions for future research

There are multiple ways on how to expand on this thesis with future research. The first way could be to reuse the estimations from the Vector Error Correction Model of the thesis and update the estimations from chapter four with the 2021 actuals as soon as these are released by the OECD. This might be particularly interesting as the largest difference between the estimates and the actuals appears in Q4 of 2020. Therefore, it would be interesting to see whether this trend continues in 2021.

Also, chapter 5 has potential for future research. The study results reveal that further observation of the movements of housing prices is needed to show the relationship between housing prices and rental prices, as this thesis found first indications of such a development having an impact on the correlations of housing and rental prices. However, another angle that might be interesting to look at would be the role that the homeownership level plays in the correlation of housing and rental prices. This thesis exclusively ran this analysis for eight European countries, however looking at nations with lower homeownership rates, such as the U.S., might bring more clarity into the importance of the homeownership level.

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Appendix A: Co-integration and non-stationarity tests (chapter 3)

Austria – ADF test

Null Hypothesis: HOUSING has a unit root
Exogenous: Constant
Lag Length: 2 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.935304	0.3148
Test critical values:	1% level	-3.513344	
	5% level	-2.897678	
	10% level	-2.586103	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(HOUSING)
Method: Least Squares
Date: 05/18/21 Time: 11:28
Sample (adjusted): 2000Q4 2020Q4
Included observations: 81 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
HOUSING(-1)	-0.013741	0.007100	-1.935304	0.0566
D(HOUSING(-1))	0.939708	0.103554	9.074589	0.0000
D(HOUSING(-2))	-0.356853	0.102869	-3.468992	0.0009
C	1.495354	0.621587	2.405703	0.0185

R-squared	0.590036	Mean dependent var	0.740677
Adjusted R-squared	0.574063	S.D. dependent var	1.624319
S.E. of regression	1.060093	Akaike info criterion	3.002711
Sum squared resid	86.53231	Schwarz criterion	3.120956
Log likelihood	-117.6098	Hannan-Quinn criter.	3.050152
F-statistic	36.94043	Durbin-Watson stat	1.970706
Prob(F-statistic)	0.000000		

Null Hypothesis: COMPENSATION has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.438227	0.9835
Test critical values:	1% level	-3.510259	
	5% level	-2.896346	
	10% level	-2.585396	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(COMPENSATION)
Method: Least Squares
Date: 05/18/21 Time: 11:28
Sample (adjusted): 2000Q2 2021Q1
Included observations: 84 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
COMPENSATION(-1)	0.003562	0.008129	0.438227	0.6624
C	0.355481	0.724402	0.490723	0.6249

R-squared	0.002337	Mean dependent var	0.666843
Adjusted R-squared	-0.009830	S.D. dependent var	1.287997
S.E. of regression	1.294312	Akaike info criterion	3.377358
Sum squared resid	137.3700	Schwarz criterion	3.435234
Log likelihood	-139.8490	Hannan-Quinn criter.	3.400624
F-statistic	0.192043	Durbin-Watson stat	2.389221
Prob(F-statistic)	0.662374		

Null Hypothesis: FX has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.910263	0.0484
Test critical values:	1% level	-3.511262	
	5% level	-2.896779	
	10% level	-2.585626	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(FX)
Method: Least Squares
Date: 05/18/21 Time: 11:29
Sample (adjusted): 2000Q3 2021Q1
Included observations: 83 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
FX(-1)	-0.144218	0.049555	-2.910263	0.0047
D(FX(-1))	0.318581	0.107409	2.966048	0.0040
C	14.63793	5.012773	2.920127	0.0045

R-squared	0.145405	Mean dependent var	0.068405
Adjusted R-squared	0.124040	S.D. dependent var	0.933275
S.E. of regression	0.873477	Akaike info criterion	2.602806
Sum squared resid	61.03701	Schwarz criterion	2.690234
Log likelihood	-105.0164	Hannan-Quinn criter.	2.637930
F-statistic	6.805814	Durbin-Watson stat	2.016011
Prob(F-statistic)	0.001864		

Null Hypothesis: INFLATION has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.134119	0.0015
Test critical values:	1% level	-3.511262	
	5% level	-2.896779	
	10% level	-2.585626	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(INFLATION)
Method: Least Squares
Date: 05/18/21 Time: 11:29
Sample (adjusted): 2000Q3 2021Q1
Included observations: 83 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
INFLATION(-1)	-0.238613	0.057718	-4.134119	0.0001
D(INFLATION(-1))	0.444648	0.099649	4.462128	0.0000
C	0.446248	0.117837	3.786992	0.0003

R-squared	0.263216	Mean dependent var	-0.009323
Adjusted R-squared	0.244796	S.D. dependent var	0.447111
S.E. of regression	0.388551	Akaike info criterion	0.982690
Sum squared resid	12.07774	Schwarz criterion	1.070117
Log likelihood	-37.78161	Hannan-Quinn criter.	1.017813
F-statistic	14.29000	Durbin-Watson stat	2.176476
Prob(F-statistic)	0.000005		

Null Hypothesis: IR has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.100724	0.2450
Test critical values:	1% level	-3.511262	
	5% level	-2.896779	
	10% level	-2.585626	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(IR)
Method: Least Squares
Date: 05/18/21 Time: 11:29
Sample (adjusted): 2000Q3 2021Q1
Included observations: 83 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
IR(-1)	-0.035453	0.016876	-2.100724	0.0388
D(IR(-1))	0.577117	0.086701	6.656420	0.0000
C	0.025759	0.040259	0.639843	0.5241

R-squared	0.366700	Mean dependent var	-0.057897
Adjusted R-squared	0.350868	S.D. dependent var	0.336259
S.E. of regression	0.270920	Akaike info criterion	0.261485
Sum squared resid	5.871792	Schwarz criterion	0.348913
Log likelihood	-7.851648	Hannan-Quinn criter.	0.296609
F-statistic	23.16126	Durbin-Watson stat	1.884501
Prob(F-statistic)	0.000000		

Null Hypothesis: POPULATION has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.039807	0.2696
Test critical values:	1% level	-3.510259	
	5% level	-2.896346	
	10% level	-2.585396	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(POPULATION)
Method: Least Squares
Date: 05/18/21 Time: 20:40
Sample (adjusted): 2000Q2 2021Q1
Included observations: 84 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
POPULATION(-1)	-0.087262	0.042779	-2.039807	0.0446
C	0.012393	0.006306	1.965370	0.0528

R-squared	0.048291	Mean dependent var	0.000679
Adjusted R-squared	0.036685	S.D. dependent var	0.024323
S.E. of regression	0.023873	Akaike info criterion	-4.608657
Sum squared resid	0.046732	Schwarz criterion	-4.550780
Log likelihood	195.5636	Hannan-Quinn criter.	-4.585391
F-statistic	4.160814	Durbin-Watson stat	1.900371
Prob(F-statistic)	0.044589		

Null Hypothesis: UNEMPLOYMENT has a unit root
Exogenous: Constant
Lag Length: 4 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.567404	0.1040
Test critical values:	1% level	-3.514426	
	5% level	-2.898145	
	10% level	-2.586351	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(UNEMPLOYMENT)
Method: Least Squares
Date: 05/18/21 Time: 11:30
Sample (adjusted): 2001Q2 2021Q1
Included observations: 80 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
UNEMPLOYMENT(-1)	-0.136935	0.053336	-2.567404	0.0123
D(UNEMPLOYMENT(-1))	0.142865	0.099472	1.436236	0.1551
D(UNEMPLOYMENT(-2))	0.147735	0.100204	1.474348	0.1446
D(UNEMPLOYMENT(-3))	0.190891	0.100679	1.896034	0.0619
D(UNEMPLOYMENT(-4))	-0.402651	0.109847	-3.665566	0.0005
C	0.708936	0.269824	2.627400	0.0105

R-squared	0.295884	Mean dependent var	0.025417
Adjusted R-squared	0.248308	S.D. dependent var	0.284738
S.E. of regression	0.246868	Akaike info criterion	0.112116
Sum squared resid	4.509856	Schwarz criterion	0.290768
Log likelihood	1.515378	Hannan-Quinn criter.	0.183742
F-statistic	6.219256	Durbin-Watson stat	1.831672
Prob(F-statistic)	0.000072		

Austria – Johansen test

Date: 05/18/21 Time: 11:32
Sample (adjusted): 2000Q4 2020Q4
Included observations: 81 after adjustments
Trend assumption: Linear deterministic trend
Series: COMPENSATION FX HOUSING INFLATION IR POPULATION UNEMPLOYMENT
Lags interval (in first differences): 1 to 2

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.368835	139.3176	125.6154	0.0056
At most 1 *	0.344791	102.0424	95.75366	0.0172
At most 2	0.292155	67.79550	69.81889	0.0717
At most 3	0.209597	39.80757	47.85613	0.2295
At most 4	0.146298	20.75541	29.79707	0.3731
At most 5	0.087396	7.943382	15.49471	0.4715
At most 6	0.006591	0.535637	3.841465	0.4642

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.368835	37.27523	46.23142	0.3254
At most 1	0.344791	34.24690	40.07757	0.1959
At most 2	0.292155	27.98793	33.87687	0.2141
At most 3	0.209597	19.05216	27.58434	0.4105
At most 4	0.146298	12.81203	21.13162	0.4697
At most 5	0.087396	7.407745	14.26460	0.4421
At most 6	0.006591	0.535637	3.841465	0.4642

Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

COMPENSAT...	FX	HOUSING	INFLATION	IR	POPULATION	UNEMPLOYMENT
0.107942	-0.380936	-0.122823	-1.002183	0.474028	-14.83595	3.229112
-0.174952	-0.378727	0.222433	0.022283	0.360339	8.536977	-0.421405
-0.091359	-0.221437	0.128583	0.373968	-0.100979	-20.02081	0.162988
0.002523	-0.324537	0.038653	-1.252805	0.536291	1.452798	-1.573861
-0.151592	0.158612	0.085083	-1.528006	-0.941186	4.866726	-2.559274
-0.038686	-0.323558	-0.024727	0.772823	-0.925309	-4.280143	-0.192928
-0.124527	-0.029844	0.060743	0.310303	-0.211156	-3.666503	-0.103253

Unrestricted Adjustment Coefficients (alpha):

D(COMPENS...	0.298545	0.407683	0.107890	-0.182808	-0.058549	-0.026452	0.044878
D(FX)	0.031347	0.203299	0.161771	0.222096	-0.021607	0.105673	-0.032072
D(HOUSING)	0.411341	-0.003397	-0.260919	0.121963	-0.054870	0.000293	0.016924
D(INFLATION)	0.101549	0.017471	0.074521	0.020750	0.109196	-0.017303	0.005793
D(IR)	0.072459	-0.023504	-0.009850	-0.063226	0.038883	0.022420	-0.008208
D(POPULATI...	0.000361	-0.007654	0.003482	0.000755	-0.000277	0.005399	0.001230
D(UNEMPLO...	-0.111445	0.002729	-0.066677	0.022784	0.017675	0.024802	-0.001467

1 Cointegrating Equation(s): Log likelihood -144.6589

Normalized cointegrating coefficients (standard error in parentheses)

COMPENSAT...	FX	HOUSING	INFLATION	IR	POPULATION	UNEMPLOYMENT
1.000000	-3.529071	-1.137857	-9.284422	4.391490	-137.4433	29.91514
	(1.12360)	(0.19878)	(3.60149)	(2.11620)	(40.6250)	(5.30033)

Adjustment coefficients (standard error in parentheses)

D(COMPENS...	0.032226
	(0.01449)
D(FX)	0.003384
	(0.01147)
D(HOUSING)	0.044401
	(0.01086)
D(INFLATION)	0.010961
	(0.00482)
D(IR)	0.007821
	(0.00318)
D(POPULATI...	3.90E-05
	(0.00037)
D(UNEMPLO...	-0.012030
	(0.00295)

2 Cointegrating Equation(s): Log likelihood -127.5354

Normalized cointegrating coefficients (standard error in parentheses)

COMPENSAT...	FX	HOUSING	INFLATION	IR	POPULATION	UNEMPLOYMENT
1.000000	0.000000	-1.220627	-3.608813	0.393026	-82.49916	12.86644
		(0.10655)	(1.98406)	(1.08677)	(20.0349)	(2.57595)
0.000000	1.000000	-0.023454	1.608244	-1.133008	15.56900	-4.830931
		(0.04029)	(0.75021)	(0.41093)	(7.57558)	(0.97402)

Adjustment coefficients (standard error in parentheses)

D(COMPENS...	-0.039099	-0.268127
	(0.02556)	(0.06678)
D(FX)	-0.032184	-0.088936
	(0.02121)	(0.05543)
D(HOUSING)	0.044995	-0.155408
	(0.02068)	(0.05403)
D(INFLATION)	0.007905	-0.045300
	(0.00917)	(0.02396)
D(IR)	0.011933	-0.018700
	(0.00602)	(0.01573)
D(POPULATI...	0.001378	0.002761
	(0.00068)	(0.00179)
D(UNEMPLO...	-0.012507	0.041420
	(0.00561)	(0.01467)

4 Cointegrating Equation(s): Log likelihood -104.0154

Normalized cointegrating coefficients (standard error in parentheses)

COMPENSAT...	FX	HOUSING	INFLATION	IR	POPULATION	UNEMPLOYMENT
1.000000	0.000000	0.000000	0.000000	-10.51648	-1036.815	-38.65647
				(9.25838)	(270.517)	(32.7717)
0.000000	1.000000	0.000000	0.000000	-0.378962	65.32377	-9.356755
				(0.46475)	(13.5793)	(1.64506)
0.000000	0.000000	1.000000	0.000000	-7.239289	-661.8224	-48.44167
				(6.96917)	(203.630)	(24.6687)
0.000000	0.000000	0.000000	1.000000	-0.574436	-40.58894	2.107695
				(0.27321)	(7.98273)	(0.96707)

Adjustment coefficients (standard error in parentheses)

D(COMPENS...	-0.049417	-0.232690	0.060821	-0.020743
	(0.02734)	(0.08086)	(0.03492)	(0.20018)
D(FX)	-0.046403	-0.196836	0.070756	-0.244631
	(0.02191)	(0.06482)	(0.02799)	(0.16047)
D(HOUSING)	0.069140	-0.137212	-0.080113	-0.662686
	(0.02115)	(0.06257)	(0.02702)	(0.15490)
D(INFLATION)	0.001149	-0.068536	0.001798	-0.099508
	(0.00980)	(0.02899)	(0.01252)	(0.07176)
D(IR)	0.012674	0.004000	-0.017838	0.002386
	(0.00634)	(0.01876)	(0.00810)	(0.04644)
D(POPULATI...	0.001062	0.001746	-0.001270	-0.000175
	(0.00074)	(0.00219)	(0.00095)	(0.00543)
D(UNEMPLO...	-0.006358	0.048790	0.006602	0.058271
	(0.00582)	(0.01722)	(0.00743)	(0.04262)

5 Cointegrating Equation(s): Log likelihood -97.60939

Normalized cointegrating coefficients (standard error in parentheses)

COMPENSAT...	FX	HOUSING	INFLATION	IR	POPULATION	UNEMPLOYMENT
1.000000	0.000000	0.000000	0.000000	0.000000	-389.8730	-40.21990
					(157.530)	(16.4053)
0.000000	1.000000	0.000000	0.000000	0.000000	88.63636	-9.413093
					(15.9569)	(1.66176)
0.000000	0.000000	1.000000	0.000000	0.000000	-216.4831	-49.51790
					(131.706)	(13.7160)
0.000000	0.000000	0.000000	1.000000	0.000000	-5.251343	2.022297
					(3.98316)	(0.41481)
0.000000	0.000000	0.000000	0.000000	1.000000	61.51700	-0.148665
					(12.6893)	(1.32147)

Adjustment coefficients (standard error in parentheses)

D(COMPENS...	-0.040542	-0.241977	0.055839	0.068721	0.234596
	(0.03290)	(0.08298)	(0.03635)	(0.27253)	(0.15042)
D(FX)	-0.043127	-0.200264	0.068918	-0.211615	0.211225
	(0.02641)	(0.06661)	(0.02918)	(0.21878)	(0.12076)
D(HOUSING)	0.077458	-0.145915	-0.084782	-0.578844	0.337161
	(0.02544)	(0.06416)	(0.02811)	(0.21072)	(0.11631)
D(INFLATION)	-0.015404	-0.051217	0.011088	-0.266360	-0.044738
	(0.01123)	(0.02832)	(0.01241)	(0.09302)	(0.05134)
D(IR)	0.006780	0.010167	-0.014530	-0.057027	-0.043631
	(0.00753)	(0.01900)	(0.00832)	(0.06241)	(0.03445)
D(POPULATI...	0.001104	0.001702	-0.001294	0.000248	-0.002274
	(0.00089)	(0.00226)	(0.00099)	(0.00741)	(0.00409)
D(UNEMPLO...	-0.009037	0.051594	0.008106	0.031263	-0.049529
	(0.00699)	(0.01763)	(0.00773)	(0.05792)	(0.03197)

6 Cointegrating Equation(s): Log likelihood -93.90552

Normalized cointegrating coefficients (standard error in parentheses)

COMPENSAT...	FX	HOUSING	INFLATION	IR	POPULATION	UNEMPLOYMENT
1.000000	0.000000	0.000000	0.000000	0.000000	0.000000	-86.56170
						(17.1443)
0.000000	1.000000	0.000000	0.000000	0.000000	0.000000	1.122563
						(1.24501)
0.000000	0.000000	1.000000	0.000000	0.000000	0.000000	-75.24990
						(13.2335)
0.000000	0.000000	0.000000	1.000000	0.000000	0.000000	1.398102
						(0.28501)
0.000000	0.000000	0.000000	0.000000	1.000000	0.000000	7.163481
						(1.31732)
0.000000	0.000000	0.000000	0.000000	0.000000	1.000000	-0.118864
						(0.02315)

Adjustment coefficients (standard error in parentheses)

D(COMPENS...	-0.039518	-0.233418	0.056493	0.048278	0.259072	-3.546183
	(0.03322)	(0.09176)	(0.03646)	(0.28810)	(0.18761)	(3.29354)
D(FX)	-0.047215	-0.234455	0.066305	-0.129948	0.113444	-2.203081
	(0.02644)	(0.07302)	(0.02901)	(0.22925)	(0.14929)	(2.62085)
D(HOUSING)	0.077447	-0.146010	-0.084789	-0.578618	0.336889	-0.998934
	(0.02570)	(0.07097)	(0.02820)	(0.22283)	(0.14511)	(2.54747)
D(INFLATION)	-0.014735	-0.045618	0.011516	-0.279732	-0.028728	-2.213771
	(0.01133)	(0.03129)	(0.01243)	(0.09824)	(0.06397)	(1.12309)
D(IR)	0.005912	0.002913	-0.015084	-0.039701	-0.064376	-1.077028
	(0.00757)	(0.02091)	(0.00831)	(0.06566)	(0.04276)	(0.75068)
D(POPULATI...	0.000895	-4.54E-05	-0.001427	0.004420	-0.007270	-0.163769
	(0.00088)	(0.00244)	(0.00097)	(0.00767)	(0.00500)	(0.08771)
D(UNEMPLO...	-0.009997	0.043569	0.007493	0.050430	-0.072478	3.024568
	(0.00701)	(0.01937)	(0.00770)	(0.06081)	(0.03960)	(0.69519)

Belgium – ADF test

Null Hypothesis: COMPENSATION has a unit root
Exogenous: Constant
Lag Length: 2 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.374534	0.5908
Test critical values:	1% level	-3.513344	
	5% level	-2.897678	
	10% level	-2.586103	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(COMPENSATION)
Method: Least Squares
Date: 05/18/21 Time: 11:40
Sample (adjusted): 2000Q4 2020Q4
Included observations: 81 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
COMPENSATION(-1)	-0.013606	0.009899	-1.374534	0.1733
D(COMPENSATION(-1))	-0.322799	0.109945	-2.936013	0.0044
D(COMPENSATION(-2))	-0.359287	0.145495	-2.469415	0.0157
C	2.229729	0.914741	2.437553	0.0171

R-squared	0.140702	Mean dependent var	0.624191
Adjusted R-squared	0.107223	S.D. dependent var	1.391188
S.E. of regression	1.314490	Akaike info criterion	3.432896
Sum squared resid	133.0471	Schwarz criterion	3.551141
Log likelihood	-135.0323	Hannan-Quinn criter.	3.480337
F-statistic	4.202679	Durbin-Watson stat	1.958441
Prob(F-statistic)	0.008288		

Null Hypothesis: HOUSING has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.826619	0.3653
Test critical values:	1% level	-3.511262	
	5% level	-2.896779	
	10% level	-2.585626	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(HOUSING)
Method: Least Squares
Date: 05/18/21 Time: 11:41
Sample (adjusted): 2000Q2 2020Q4
Included observations: 83 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
HOUSING(-1)	-0.013610	0.007451	-1.826619	0.0714
C	1.835194	0.697100	2.632613	0.0101

R-squared	0.039562	Mean dependent var	0.574103
Adjusted R-squared	0.027705	S.D. dependent var	0.891049
S.E. of regression	0.878619	Akaike info criterion	2.602871
Sum squared resid	62.52971	Schwarz criterion	2.661156
Log likelihood	-106.0191	Hannan-Quinn criter.	2.626287
F-statistic	3.336537	Durbin-Watson stat	1.610894
Prob(F-statistic)	0.071441		

Null Hypothesis: FX has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.881862	0.0518
Test critical values:	1% level	-3.511262	
	5% level	-2.896779	
	10% level	-2.585626	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(FX)
Method: Least Squares
Date: 05/18/21 Time: 11:41
Sample (adjusted): 2000Q3 2021Q1
Included observations: 83 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
FX(-1)	-0.108930	0.037798	-2.881862	0.0051
D(FX(-1))	0.328821	0.103068	3.190323	0.0020
C	10.90981	3.761302	2.900542	0.0048

R-squared	0.166636	Mean dependent var	0.103903
Adjusted R-squared	0.145802	S.D. dependent var	1.132381
S.E. of regression	1.046578	Akaike info criterion	2.964404
Sum squared resid	87.62608	Schwarz criterion	3.051832
Log likelihood	-120.0228	Hannan-Quinn criter.	2.999528
F-statistic	7.998251	Durbin-Watson stat	1.988519
Prob(F-statistic)	0.000681		

Null Hypothesis: INFLATION has a unit root
Exogenous: Constant
Lag Length: 8 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.112934	0.2403
Test critical values:	1% level	-3.519050	
	5% level	-2.900137	
	10% level	-2.587409	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(INFLATION)
Method: Least Squares
Date: 05/18/21 Time: 11:42
Sample (adjusted): 2002Q2 2021Q1
Included observations: 76 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
INFLATION(-1)	-0.210331	0.099545	-2.112934	0.0384
D(INFLATION(-1))	0.438061	0.115157	3.804024	0.0003
D(INFLATION(-2))	0.273126	0.126270	2.163025	0.0342
D(INFLATION(-3))	0.118558	0.130549	0.908151	0.3671
D(INFLATION(-4))	-0.594736	0.128528	-4.627302	0.0000
D(INFLATION(-5))	0.155724	0.109143	1.426788	0.1584
D(INFLATION(-6))	0.108154	0.110680	0.977172	0.3321
D(INFLATION(-7))	0.196384	0.111301	1.764451	0.0823
D(INFLATION(-8))	-0.411968	0.110787	-3.718558	0.0004
C	0.379522	0.199103	1.906160	0.0610

R-squared	0.576657	Mean dependent var	-0.028947
Adjusted R-squared	0.518929	S.D. dependent var	0.677910
S.E. of regression	0.470194	Akaike info criterion	1.450735
Sum squared resid	14.59142	Schwarz criterion	1.757411
Log likelihood	-45.12793	Hannan-Quinn criter.	1.573297
F-statistic	9.989125	Durbin-Watson stat	1.732783
Prob(F-statistic)	0.000000		

Null Hypothesis: IR has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.100724	0.2450
Test critical values:	1% level	-3.511262	
	5% level	-2.896779	
	10% level	-2.585626	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(IR)
Method: Least Squares
Date: 05/18/21 Time: 11:43
Sample (adjusted): 2000Q3 2021Q1
Included observations: 83 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
IR(-1)	-0.035453	0.016876	-2.100724	0.0388
D(IR(-1))	0.577117	0.086701	6.656420	0.0000
C	0.025759	0.040259	0.639843	0.5241

R-squared	0.366700	Mean dependent var	-0.057897
Adjusted R-squared	0.350868	S.D. dependent var	0.336259
S.E. of regression	0.270920	Akaike info criterion	0.261485
Sum squared resid	5.871792	Schwarz criterion	0.348913
Log likelihood	-7.851648	Hannan-Quinn criter.	0.296609
F-statistic	23.16126	Durbin-Watson stat	1.884501
Prob(F-statistic)	0.000000		

Null Hypothesis: UNEMPLOYMENT has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.037223	0.7366
Test critical values:	1% level	-3.511262	
	5% level	-2.896779	
	10% level	-2.585626	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(UNEMPLOYMENT)
Method: Least Squares
Date: 05/18/21 Time: 11:44
Sample (adjusted): 2000Q3 2021Q1
Included observations: 83 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
UNEMPLOYMENT(-1)	-0.048143	0.046415	-1.037223	0.3028
D(UNEMPLOYMENT(-1))	-0.233845	0.110320	-2.119699	0.0371
C	0.343148	0.350450	0.979164	0.3305

R-squared	0.081321	Mean dependent var	-0.013253
Adjusted R-squared	0.058354	S.D. dependent var	0.428173
S.E. of regression	0.415492	Akaike info criterion	1.116769
Sum squared resid	13.81069	Schwarz criterion	1.204197
Log likelihood	-43.34590	Hannan-Quinn criter.	1.151892
F-statistic	3.540774	Durbin-Watson stat	1.931955
Prob(F-statistic)	0.033617		

Null Hypothesis: POPULATION has a unit root
Exogenous: Constant
Lag Length: 4 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.152091	0.2254
Test critical values:	1% level	-3.514426	
	5% level	-2.898145	
	10% level	-2.586351	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(POPULATION)
Method: Least Squares
Date: 05/18/21 Time: 20:42
Sample (adjusted): 2001Q2 2021Q1
Included observations: 80 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
POPULATION(-1)	-0.058329	0.027103	-2.152091	0.0347
D(POPULATION(-1))	0.016916	0.097756	0.173046	0.8631
D(POPULATION(-2))	0.016844	0.097753	0.172312	0.8637
D(POPULATION(-3))	0.016772	0.097750	0.171580	0.8642
D(POPULATION(-4))	0.494682	0.094265	5.247787	0.0000
C	0.008716	0.004134	2.108421	0.0384

R-squared	0.298165	Mean dependent var	0.000521
Adjusted R-squared	0.250743	S.D. dependent var	0.010637
S.E. of regression	0.009208	Akaike info criterion	-6.465540
Sum squared resid	0.006274	Schwarz criterion	-6.286888
Log likelihood	264.6216	Hannan-Quinn criter.	-6.393913
F-statistic	6.287566	Durbin-Watson stat	2.009249
Prob(F-statistic)	0.000065		

Belgium – Johansen test

Date: 05/18/21 Time: 11:45
Sample (adjusted): 2000Q4 2020Q4
Included observations: 81 after adjustments
Trend assumption: Linear deterministic trend
Series: COMPENSATION FX IR INFLATION HOUSING POPULATION UNEMPLOYMENT
Lags interval (in first differences): 1 to 2

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.548955	155.7121	125.6154	0.0002
At most 1	0.368142	91.22083	95.75366	0.0985
At most 2	0.251420	54.03455	69.81889	0.4601
At most 3	0.165322	30.57874	47.85613	0.6890
At most 4	0.126666	15.94127	29.79707	0.7164
At most 5	0.051277	4.970842	15.49471	0.8119
At most 6	0.008692	0.707162	3.841465	0.4004

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.548955	64.49126	46.23142	0.0002
At most 1	0.368142	37.18628	40.07757	0.1022
At most 2	0.251420	23.45580	33.87687	0.4959
At most 3	0.165322	14.63748	27.58434	0.7763
At most 4	0.126666	10.97042	21.13162	0.6503
At most 5	0.051277	4.263680	14.26460	0.8305
At most 6	0.008692	0.707162	3.841465	0.4004

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

COMPENSAT...	FX	IR	INFLATION	HOUSING	POPULATION	UNEMPLOYMENT
0.253883	0.110929	0.755034	1.241704	-0.217502	1.832792	0.758228
-0.566247	-0.244587	-0.558372	-0.213851	0.618339	-52.02714	-0.764252
-0.043857	-0.389355	0.178048	0.307980	0.190450	-4.167262	0.439939
-0.106662	-0.341248	-0.273200	-0.010979	0.063011	16.81512	-0.586384
0.181366	-0.044685	1.440920	-0.655449	-0.047590	-8.103488	0.301279
-0.019135	0.113341	0.468413	-0.038134	0.061049	2.267823	0.466741
-0.224825	-0.036344	-0.551814	-0.180153	0.223204	-1.291930	-1.497931

Unrestricted Adjustment Coefficients (alpha):

D(COMPENS...	0.170808	0.346370	0.045560	0.136708	-0.121016	0.192577	-0.015170
D(FX)	0.109466	0.132631	0.174178	0.284566	0.115455	-0.125615	-0.019531
D(IR)	-0.106263	0.054080	0.027821	-0.013835	-0.051111	-0.014214	8.17E-06
D(INFLATION)	-0.368226	0.034598	-0.069565	0.060558	0.042216	0.035471	-0.004408
D(HOUSING)	0.154677	0.051668	-0.229925	0.003305	-0.078493	-0.078304	-0.020285
D(POPULATI...	0.000797	0.007392	-0.001320	-0.004839	0.002808	-0.000134	-0.000161
D(UNEMPLO...	0.059480	0.033743	-0.081790	0.040879	0.012110	0.012398	0.026435

1 Cointegrating Equation(s): Log likelihood -180.1924

Normalized cointegrating coefficients (standard error in parentheses)

COMPENSAT...	FX	IR	INFLATION	HOUSING	POPULATION	UNEMPLOYMENT
1.000000	0.436931	2.973944	4.890848	-0.856703	7.219036	2.986525
	(0.22483)	(0.60840)	(0.60998)	(0.09609)	(17.4944)	(0.61968)

Adjustment coefficients (standard error in parentheses)

D(COMPENS...	0.043365
	(0.03641)
D(FX)	0.027791
	(0.03340)
D(IR)	-0.026978
	(0.00676)
D(INFLATION)	-0.093486
	(0.01397)
D(HOUSING)	0.039270
	(0.02119)
D(POPULATI...	0.000202
	(0.00060)
D(UNEMPLO...	0.015101
	(0.01123)

2 Cointegrating Equation(s): Log likelihood -161.5992

Normalized cointegrating coefficients (standard error in parentheses)

COMPENSAT...	FX	IR	INFLATION	HOUSING	POPULATION	UNEMPLOYMENT
1.000000	0.000000	-171.2064	-390.5652	-21.47372	7425.477	-140.4378
		(61.4078)	(63.0082)	(8.73143)	(1794.58)	(63.7588)
0.000000	1.000000	398.6447	905.0761	47.18595	-16978.09	328.2538
		(141.680)	(145.373)	(20.1452)	(4140.47)	(147.104)

Adjustment coefficients (standard error in parentheses)

D(COMPENS...	-0.152766	-0.065770
	(0.08490)	(0.03674)
D(FX)	-0.047311	-0.020297
	(0.08100)	(0.03505)
D(IR)	-0.057601	-0.025015
	(0.01598)	(0.00692)
D(INFLATION)	-0.113078	-0.049309
	(0.03405)	(0.01474)
D(HOUSING)	0.010013	0.004521
	(0.05164)	(0.02235)
D(POPULATI...	-0.003983	-0.001720
	(0.00135)	(0.00059)
D(UNEMPLO...	-0.004006	-0.001655
	(0.02734)	(0.01183)

3 Cointegrating Equation(s): Log likelihood -149.8713

Normalized cointegrating coefficients (standard error in parentheses)

COMPENSAT...	FX	IR	INFLATION	HOUSING	POPULATION	UNEMPLOYMENT
1.000000	0.000000	0.000000	-2.067077	-1.074000	144.6298	0.904601
			(0.81163)	(0.06266)	(16.6610)	(0.78380)
0.000000	1.000000	0.000000	0.479508	-0.313679	-25.03523	-0.854291
			(0.80688)	(0.06229)	(16.5636)	(0.77922)
0.000000	0.000000	1.000000	2.269180	0.119153	-42.52672	0.825567
			(0.35399)	(0.02733)	(7.26662)	(0.34185)

Adjustment coefficients (standard error in parentheses)

D(COMPENS...	-0.154764	-0.083509	-0.056326
	(0.08504)	(0.06465)	(0.13065)
D(FX)	-0.054950	-0.088114	0.039605
	(0.08008)	(0.06089)	(0.12303)
D(IR)	-0.058821	-0.035847	-0.105476
	(0.01587)	(0.01207)	(0.02439)
D(INFLATION)	-0.110027	-0.022224	-0.309728
	(0.03371)	(0.02563)	(0.05180)
D(HOUSING)	0.020097	0.094043	0.046999
	(0.04863)	(0.03698)	(0.07472)
D(POPULATI...	-0.003925	-0.001206	-0.003761
	(0.00135)	(0.00103)	(0.00208)
D(UNEMPLO...	-0.000419	0.030190	0.011506
	(0.02667)	(0.02028)	(0.04097)

4 Cointegrating Equation(s): Log likelihood -142.5526

Normalized cointegrating coefficients (standard error in parentheses)

COMPENSAT...	FX	IR	INFLATION	HOUSING	POPULATION	UNEMPLOYMENT
1.000000	0.000000	0.000000	0.000000	-1.545861	189.8567	-1.176572
				(0.11812)	(30.5428)	(1.38520)
0.000000	1.000000	0.000000	0.000000	-0.204219	-35.52669	-0.371513
				(0.05092)	(13.1676)	(0.59719)
0.000000	0.000000	1.000000	0.000000	0.637148	-92.17552	3.110220
				(0.13541)	(35.0132)	(1.58795)
0.000000	0.000000	0.000000	1.000000	-0.228274	21.87962	-1.006819
				(0.06133)	(15.8591)	(0.71925)

Adjustment coefficients (standard error in parentheses)

D(COMPENS...	-0.169345	-0.130161	-0.093674	0.150552
	(0.08561)	(0.07911)	(0.13483)	(0.17593)
D(FX)	-0.085302	-0.185221	-0.038139	0.158079
	(0.07813)	(0.07220)	(0.12306)	(0.16057)
D(IR)	-0.057346	-0.031126	-0.101696	-0.134793
	(0.01607)	(0.01485)	(0.02531)	(0.03302)
D(INFLATION)	-0.116486	-0.042889	-0.326272	-0.486716
	(0.03388)	(0.03130)	(0.05335)	(0.06962)
D(HOUSING)	0.019745	0.092916	0.046096	0.110165
	(0.04934)	(0.04560)	(0.07771)	(0.10140)
D(POPULATI...	-0.003409	0.000446	-0.002439	-0.000945
	(0.00132)	(0.00122)	(0.00208)	(0.00271)
D(UNEMPLO...	-0.004779	0.016240	0.000338	0.041002
	(0.02687)	(0.02483)	(0.04231)	(0.05521)

5 Cointegrating Equation(s): Log likelihood -137.0674

Normalized cointegrating coefficients (standard error in parentheses)

COMPENSAT...	FX	IR	INFLATION	HOUSING	POPULATION	UNEMPLOYMENT
1.000000	0.000000	0.000000	0.000000	0.000000	1.152010	7.327768
					(71.1368)	(3.40354)
0.000000	1.000000	0.000000	0.000000	0.000000	-60.45592	0.751971
					(16.8353)	(0.80549)
0.000000	0.000000	1.000000	0.000000	0.000000	-14.39828	-0.394962
					(9.11440)	(0.43608)
0.000000	0.000000	0.000000	1.000000	0.000000	-5.986018	0.249000
					(3.00213)	(0.14364)
0.000000	0.000000	0.000000	0.000000	1.000000	-122.0709	5.501363
					(61.7999)	(2.95681)

Adjustment coefficients (standard error in parentheses)

D(COMPENS...	-0.191294	-0.124753	-0.268049	0.229872	0.200073
	(0.08853)	(0.07885)	(0.23598)	(0.19591)	(0.09263)
D(FX)	-0.064362	-0.190381	0.128223	0.082404	0.103811
	(0.08075)	(0.07193)	(0.21525)	(0.17870)	(0.08449)
D(IR)	-0.066615	-0.028842	-0.175343	-0.101292	0.063411
	(0.01619)	(0.01442)	(0.04316)	(0.03584)	(0.01694)
D(INFLATION)	-0.108829	-0.044775	-0.265442	-0.514387	0.090042
	(0.03508)	(0.03124)	(0.09350)	(0.07763)	(0.03670)
D(HOUSING)	0.005509	0.096423	-0.067006	0.161613	-0.041540
	(0.05094)	(0.04537)	(0.13579)	(0.11273)	(0.05330)
D(POPULATI...	-0.002900	0.000320	0.001607	-0.002785	0.003707
	(0.00135)	(0.00120)	(0.00360)	(0.00299)	(0.00141)
D(UNEMPLO...	-0.002583	0.015699	0.017787	0.033064	-0.005650
	(0.02794)	(0.02488)	(0.07447)	(0.06182)	(0.02923)

6 Cointegrating Equation(s): Log likelihood -134.9355

Normalized cointegrating coefficients (standard error in parentheses)

COMPENSAT...	FX	IR	INFLATION	HOUSING	POPULATION	UNEMPLOYMENT
1.000000	0.000000	0.000000	0.000000	0.000000	0.000000	7.308807
						(3.23954)
0.000000	1.000000	0.000000	0.000000	0.000000	0.000000	1.747027
						(1.66719)
0.000000	0.000000	1.000000	0.000000	0.000000	0.000000	-0.157978
						(0.52762)
0.000000	0.000000	0.000000	1.000000	0.000000	0.000000	0.347525
						(0.21813)
0.000000	0.000000	0.000000	0.000000	1.000000	0.000000	7.510553
						(4.21237)
0.000000	0.000000	0.000000	0.000000	0.000000	1.000000	0.016459
						(0.02622)

Adjustment coefficients (standard error in parentheses)

D(COMPENS...	-0.194979	-0.102926	-0.177843	0.222528	0.211830	-14.18130
	(0.08716)	(0.07905)	(0.24041)	(0.19287)	(0.09152)	(7.36405)
D(FX)	-0.061958	-0.204618	0.069384	0.087195	0.096142	-3.861100
	(0.08013)	(0.07267)	(0.22102)	(0.17732)	(0.08414)	(6.77012)
D(IR)	-0.066344	-0.030453	-0.182001	-0.100750	0.062544	-2.975014
	(0.01616)	(0.01465)	(0.04457)	(0.03576)	(0.01697)	(1.36519)
D(INFLATION)	-0.109508	-0.040755	-0.248827	-0.515739	0.092207	-1.428407
	(0.03497)	(0.03172)	(0.09646)	(0.07739)	(0.03672)	(2.95479)
D(HOUSING)	0.007007	0.087548	-0.103685	0.164599	-0.046320	-0.932409
	(0.05056)	(0.04585)	(0.13946)	(0.11188)	(0.05309)	(4.27173)
D(POPULATI...	-0.002898	0.000305	0.001544	-0.002780	0.003699	-0.482046
	(0.00135)	(0.00123)	(0.00373)	(0.00299)	(0.00142)	(0.11425)
D(UNEMPLO...	-0.002820	0.017104	0.023595	0.032591	-0.004893	-0.688308
	(0.02793)	(0.02533)	(0.07703)	(0.06180)	(0.02933)	(2.35965)

Denmark – ADF test

Null Hypothesis: HOUSING has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.378726	0.5889
Test critical values:	1% level	-3.512290	
	5% level	-2.897223	
	10% level	-2.585861	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(HOUSING)
Method: Least Squares
Date: 05/18/21 Time: 13:13
Sample (adjusted): 3 84
Included observations: 82 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
HOUSING(-1)	-0.014284	0.010360	-1.378726	0.1719
D(HOUSING(-1))	0.793277	0.071537	11.08911	0.0000
C	1.564233	1.019122	1.534883	0.1288

R-squared	0.610986	Mean dependent var	0.690974
Adjusted R-squared	0.601138	S.D. dependent var	2.294084
S.E. of regression	1.448841	Akaike info criterion	3.615304
Sum squared resid	165.8321	Schwarz criterion	3.703355
Log likelihood	-145.2275	Hannan-Quinn criter.	3.650655
F-statistic	62.03885	Durbin-Watson stat	2.096420
Prob(F-statistic)	0.000000		

Null Hypothesis: FX has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.475536	0.1251
Test critical values:	1% level	-3.511262	
	5% level	-2.896779	
	10% level	-2.585626	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(FX)
Method: Least Squares
Date: 05/18/21 Time: 13:12
Sample (adjusted): 3 85
Included observations: 83 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
FX(-1)	-0.095165	0.038442	-2.475536	0.0154
D(FX(-1))	0.254462	0.106371	2.392216	0.0191
C	9.363945	3.769974	2.483822	0.0151

R-squared	0.113778	Mean dependent var	0.044789
Adjusted R-squared	0.091622	S.D. dependent var	1.088837
S.E. of regression	1.037758	Akaike info criterion	2.947477
Sum squared resid	86.15529	Schwarz criterion	3.034905
Log likelihood	-119.3203	Hannan-Quinn criter.	2.982601
F-statistic	5.135407	Durbin-Watson stat	1.978399
Prob(F-statistic)	0.007975		

Null Hypothesis: COMPENSATION has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.383689	0.9062
Test critical values:	1% level	-3.511262	
	5% level	-2.896779	
	10% level	-2.585626	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(COMPENSATION)
Method: Least Squares
Date: 05/18/21 Time: 13:11
Sample (adjusted): 2 84
Included observations: 83 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
COMPENSATION(-1)	-0.002124	0.005534	-0.383689	0.7022
C	0.839259	0.500573	1.676596	0.0975

R-squared	0.001814	Mean dependent var	0.649868
Adjusted R-squared	-0.010509	S.D. dependent var	0.754437
S.E. of regression	0.758391	Akaike info criterion	2.308566
Sum squared resid	46.58770	Schwarz criterion	2.366851
Log likelihood	-93.80548	Hannan-Quinn criter.	2.331982
F-statistic	0.147218	Durbin-Watson stat	2.094041
Prob(F-statistic)	0.702214		

Null Hypothesis: INFLATION has a unit root
Exogenous: Constant
Lag Length: 4 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.717080	0.4189
Test critical values:	1% level	-3.514426	
	5% level	-2.898145	
	10% level	-2.586351	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(INFLATION)
Method: Least Squares
Date: 05/18/21 Time: 13:13
Sample (adjusted): 6 85
Included observations: 80 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
INFLATION(-1)	-0.090237	0.052552	-1.717080	0.0901
D(INFLATION(-1))	0.260527	0.104020	2.504578	0.0145
D(INFLATION(-2))	-0.076909	0.107903	-0.712756	0.4782
D(INFLATION(-3))	0.162452	0.107059	1.517408	0.1334
D(INFLATION(-4))	-0.415510	0.107036	-3.881961	0.0002
C	0.116010	0.094041	1.233612	0.2213

R-squared	0.273624	Mean dependent var	-0.021022
Adjusted R-squared	0.224544	S.D. dependent var	0.422174
S.E. of regression	0.371766	Akaike info criterion	0.930934
Sum squared resid	10.22753	Schwarz criterion	1.109586
Log likelihood	-31.23735	Hannan-Quinn criter.	1.002561
F-statistic	5.575110	Durbin-Watson stat	1.976404
Prob(F-statistic)	0.000206		

Null Hypothesis: IR has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.871484	0.3441
Test critical values:	1% level	-3.511262	
	5% level	-2.896779	
	10% level	-2.585626	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(IR)
Method: Least Squares
Date: 05/18/21 Time: 13:14
Sample (adjusted): 3 85
Included observations: 83 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
IR(-1)	-0.034287	0.018321	-1.871484	0.0649
D(IR(-1))	0.464815	0.094374	4.925267	0.0000
C	0.024507	0.048345	0.506911	0.6136

R-squared	0.247229	Mean dependent var	-0.059772
Adjusted R-squared	0.228409	S.D. dependent var	0.363140
S.E. of regression	0.318983	Akaike info criterion	0.588116
Sum squared resid	8.140000	Schwarz criterion	0.675544
Log likelihood	-21.40681	Hannan-Quinn criter.	0.623239
F-statistic	13.13698	Durbin-Watson stat	2.069820
Prob(F-statistic)	0.000012		

Null Hypothesis: POPULATION has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.526891	0.5153
Test critical values:	1% level	-3.510259	
	5% level	-2.896346	
	10% level	-2.585396	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(POPULATION)
Method: Least Squares
Date: 05/18/21 Time: 20:51
Sample (adjusted): 2 85
Included observations: 84 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
POPULATION(-1)	-0.050741	0.033231	-1.526891	0.1306
C	0.006306	0.004059	1.553814	0.1241

R-squared	0.027646	Mean dependent var	0.000401
Adjusted R-squared	0.015788	S.D. dependent var	0.011365
S.E. of regression	0.011275	Akaike info criterion	-6.108948
Sum squared resid	0.010424	Schwarz criterion	-6.051072
Log likelihood	258.5758	Hannan-Quinn criter.	-6.085682
F-statistic	2.331397	Durbin-Watson stat	1.958894
Prob(F-statistic)	0.130636		

Null Hypothesis: UNEMPLOYMENT has a unit root
Exogenous: Constant
Lag Length: 4 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.995712	0.2882
Test critical values:	1% level	-3.514426	
	5% level	-2.898145	
	10% level	-2.586351	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(UNEMPLOYMENT)
Method: Least Squares
Date: 05/18/21 Time: 13:14
Sample (adjusted): 6 85
Included observations: 80 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
UNEMPLOYMENT(-1)	-0.046688	0.023394	-1.995712	0.0496
D(UNEMPLOYMENT(-1))	0.312969	0.105545	2.965261	0.0041
D(UNEMPLOYMENT(-2))	0.109663	0.102154	1.073507	0.2865
D(UNEMPLOYMENT(-3))	0.479279	0.105134	4.558768	0.0000
D(UNEMPLOYMENT(-4))	-0.292531	0.115439	-2.534072	0.0134
C	0.271470	0.136357	1.990880	0.0502

R-squared	0.380299	Mean dependent var	0.020417
Adjusted R-squared	0.338428	S.D. dependent var	0.311906
S.E. of regression	0.253695	Akaike info criterion	0.166672
Sum squared resid	4.762734	Schwarz criterion	0.345324
Log likelihood	-0.666888	Hannan-Quinn criter.	0.238299
F-statistic	9.082500	Durbin-Watson stat	1.973452
Prob(F-statistic)	0.000001		

Denmark – Johansen test

Date: 05/18/21 Time: 20:52
Sample (adjusted): 4 84
Included observations: 81 after adjustments
Trend assumption: Linear deterministic trend
Series: COMPENSATION FX HOUSING INFLATION IR POPULATION UNEMPLOYMENT
Lags interval (in first differences): 1 to 2

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.498786	152.5104	125.6154	0.0004
At most 1 *	0.356354	96.56180	95.75366	0.0439
At most 2	0.268995	60.87263	69.81889	0.2095
At most 3	0.169419	35.49250	47.85613	0.4223
At most 4	0.157592	20.45647	29.79707	0.3924
At most 5	0.077289	6.565680	15.49471	0.6286
At most 6	0.000618	0.050086	3.841465	0.8229

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.498786	55.94856	46.23142	0.0035
At most 1	0.356354	35.68917	40.07757	0.1438
At most 2	0.268995	25.38013	33.87687	0.3598
At most 3	0.169419	15.03603	27.58434	0.7454
At most 4	0.157592	13.89079	21.13162	0.3741
At most 5	0.077289	6.515593	14.26460	0.5480
At most 6	0.000618	0.050086	3.841465	0.8229

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

COMPENSAT...	FX	HOUSING	INFLATION	IR	POPULATION	UNEMPLOYMENT
-0.005394	-0.029748	0.071143	-2.083835	1.070024	-21.79726	0.490217
0.080361	0.169501	-0.090615	1.022147	0.125398	26.55109	-1.084582
0.277666	0.244925	-0.169296	-1.167846	1.958539	-12.59451	0.709855
-0.011127	0.203809	-0.072969	-0.336101	-1.143985	-10.44865	-1.285902
0.115833	0.464321	-0.069319	0.812696	0.112130	11.74729	-0.248253
-0.185494	0.003444	0.032413	0.019509	-0.904044	45.24281	-0.113003
0.272270	-0.055675	-0.076418	-0.540097	1.538491	-14.32892	0.328418

Unrestricted Adjustment Coefficients (alpha):

D(COMPENS...	0.051055	0.065757	-0.086272	-0.089643	-0.039219	0.068112	-0.009554
D(FX)	-0.083189	0.152730	-0.172762	0.037670	-0.306334	-0.118797	0.006395
D(HOUSING)	0.215598	-0.130325	-0.022353	0.408428	-0.139573	0.039969	-0.012224
D(INFLATION)	0.192319	-0.045449	0.024781	-0.038583	-0.035158	0.051388	0.002810
D(IR)	0.036975	-0.068933	-0.087086	-0.014686	0.030985	-0.009796	0.001168
D(POPULATI...	0.001422	-0.003319	0.002161	-0.001262	-0.000401	-0.001739	-9.46E-05
D(UNEMPLO...	0.060551	0.106209	-0.020920	0.006321	0.020878	-0.029143	0.000206

1 Cointegrating Equation(s): Log likelihood -56.92350

Normalized cointegrating coefficients (standard error in parentheses)

COMPENSAT...	FX	HOUSING	INFLATION	IR	POPULATION	UNEMPLOYMENT
1.000000	5.514668	-13.18868	386.3059	-198.3634	4040.824	-90.87752
	(12.2556)	(3.31552)	(62.8088)	(39.6203)	(1289.68)	(43.4626)

Adjustment coefficients (standard error in parentheses)

D(COMPENS...	-0.000275
	(0.00037)
D(FX)	0.000449
	(0.00068)
D(HOUSING)	-0.001163
	(0.00081)
D(INFLATION)	-0.001037
	(0.00022)
D(IR)	-0.000199
	(0.00016)
D(POPULATI...	-7.67E-06
	(7.2E-06)
D(UNEMPLO...	-0.000327
	(0.00015)

2 Cointegrating Equation(s): Log likelihood -39.07892

Normalized cointegrating coefficients (standard error in parentheses)

COMPENSAT...	FX	HOUSING	INFLATION	IR	POPULATION	UNEMPLOYMENT
1.000000	0.000000	6.342762	-218.6715	125.3887	-1967.756	34.43174
		(1.57340)	(37.9857)	(21.7236)	(734.940)	(23.3588)
0.000000	1.000000	-3.541726	109.7033	-58.70745	1089.563	-22.72290
		(0.72906)	(17.6013)	(10.0660)	(340.546)	(10.8237)

Adjustment coefficients (standard error in parentheses)

D(COMPENS...	0.005009	0.009627
	(0.00550)	(0.01175)
D(FX)	0.012722	0.028363
	(0.01005)	(0.02148)
D(HOUSING)	-0.011636	-0.028504
	(0.01203)	(0.02570)
D(INFLATION)	-0.004690	-0.013425
	(0.00326)	(0.00697)
D(IR)	-0.005739	-0.012784
	(0.00221)	(0.00472)
D(POPULATI...	-0.000274	-0.000605
	(0.00010)	(0.00022)
D(UNEMPLO...	0.008208	0.016201
	(0.00199)	(0.00426)

3 Cointegrating Equation(s): Log likelihood -26.38885

Normalized cointegrating coefficients (standard error in parentheses)

COMPENSAT...	FX	HOUSING	INFLATION	IR	POPULATION	UNEMPLOYMENT
1.000000	0.000000	0.000000	-23.67212	15.12981	-375.0781	14.82922
			(4.65960)	(2.39973)	(85.8806)	(2.56743)
0.000000	1.000000	0.000000	0.817868	2.859866	200.2301	-11.77708
			(5.75003)	(2.96131)	(105.978)	(3.16826)
0.000000	0.000000	1.000000	-30.74362	17.38342	-251.1016	3.090534
			(5.73881)	(2.95552)	(105.771)	(3.16207)

Adjustment coefficients (standard error in parentheses)

D(COMPENS...	-0.018946	-0.011503	0.012279
	(0.01949)	(0.02018)	(0.01381)
D(FX)	-0.035248	-0.013951	0.009490
	(0.03555)	(0.03681)	(0.02518)
D(HOUSING)	-0.017843	-0.033979	0.030932
	(0.04317)	(0.04470)	(0.03058)
D(INFLATION)	0.002191	-0.007355	0.013605
	(0.01168)	(0.01210)	(0.00827)
D(IR)	-0.029920	-0.034114	0.023620
	(0.00729)	(0.00755)	(0.00517)
D(POPULATI...	0.000326	-7.55E-05	3.60E-05
	(0.00036)	(0.00037)	(0.00025)
D(UNEMPLO...	0.002400	0.011077	-0.001775
	(0.00711)	(0.00736)	(0.00504)

4 Cointegrating Equation(s): Log likelihood -18.87084

Normalized cointegrating coefficients (standard error in parentheses)

COMPENSAT...	FX	HOUSING	INFLATION	IR	POPULATION	UNEMPLOYMENT
1.000000	0.000000	0.000000	0.000000	17.41118	205.0460	2.992174
				(2.85834)	(110.313)	(3.56205)
0.000000	1.000000	0.000000	0.000000	2.781045	180.1869	-11.36811
				(2.27501)	(87.7999)	(2.83510)
0.000000	0.000000	1.000000	0.000000	20.34629	502.3210	-12.28255
				(6.23344)	(240.569)	(7.76808)
0.000000	0.000000	0.000000	1.000000	0.096374	24.50664	-0.500042
				(0.16480)	(6.36030)	(0.20538)

Adjustment coefficients (standard error in parentheses)

D(COMPENS...	-0.017948	-0.029773	0.018820	0.091705
	(0.01924)	(0.02408)	(0.01446)	(0.17424)
D(FX)	-0.035667	-0.006274	0.006741	0.518564
	(0.03555)	(0.04450)	(0.02671)	(0.32192)
D(HOUSING)	-0.022387	0.049263	0.001129	-0.693651
	(0.04064)	(0.05087)	(0.03054)	(0.36802)
D(INFLATION)	0.002620	-0.015219	0.016421	-0.463189
	(0.01161)	(0.01453)	(0.00872)	(0.10512)
D(IR)	-0.029756	-0.037107	0.024692	-0.040869
	(0.00728)	(0.00911)	(0.00547)	(0.06593)
D(POPULATI...	0.000340	-0.000333	0.000128	-0.008457
	(0.00035)	(0.00044)	(0.00027)	(0.00320)
D(UNEMPLO...	0.002329	0.012366	-0.002236	0.004690
	(0.00711)	(0.00890)	(0.00534)	(0.06439)

5 Cointegrating Equation(s): Log likelihood -11.92544

Normalized cointegrating coefficients (standard error in parentheses)

COMPENSAT...	FX	HOUSING	INFLATION	IR	POPULATION	UNEMPLOYMENT
1.000000	0.000000	0.000000	0.000000	0.000000	-549.3990	42.58603
					(228.194)	(7.74297)
0.000000	1.000000	0.000000	0.000000	0.000000	59.68127	-5.043881
					(27.7677)	(0.94220)
0.000000	0.000000	1.000000	0.000000	0.000000	-379.3055	33.98588
					(182.036)	(6.17677)
0.000000	0.000000	0.000000	1.000000	0.000000	20.33067	-0.280883
					(3.61904)	(0.12280)
0.000000	0.000000	0.000000	0.000000	1.000000	43.33106	-2.274048
					(15.6220)	(0.53008)

Adjustment coefficients (standard error in parentheses)

D(COMPENS...	-0.022491	-0.047983	0.021539	0.059832	-0.007938
	(0.02067)	(0.03906)	(0.01513)	(0.18194)	(0.16672)
D(FX)	-0.071150	-0.148511	0.027976	0.269608	-0.485666
	(0.03642)	(0.06881)	(0.02666)	(0.32053)	(0.29371)
D(HOUSING)	-0.038555	-0.015544	0.010804	-0.807082	-0.312312
	(0.04344)	(0.08208)	(0.03181)	(0.38238)	(0.35038)
D(INFLATION)	-0.001452	-0.031544	0.018858	-0.491762	0.288817
	(0.01243)	(0.02349)	(0.00910)	(0.10941)	(0.10026)
D(IR)	-0.026167	-0.022720	0.022544	-0.015688	-0.119368
	(0.00775)	(0.01464)	(0.00567)	(0.06822)	(0.06251)
D(POPULATI...	0.000293	-0.000519	0.000156	-0.008783	0.006737
	(0.00038)	(0.00072)	(0.00028)	(0.00335)	(0.00307)
D(UNEMPLO...	0.004748	0.022060	-0.003683	0.021658	0.032246
	(0.00762)	(0.01439)	(0.00558)	(0.06705)	(0.06144)

6 Cointegrating Equation(s): Log likelihood -8.667643

Normalized cointegrating coefficients (standard error in parentheses)

COMPENSAT...	FX	HOUSING	INFLATION	IR	POPULATION	UNEMPLOYMENT
1.000000	0.000000	0.000000	0.000000	0.000000	0.000000	-397.8972
						(77.4736)
0.000000	1.000000	0.000000	0.000000	0.000000	0.000000	42.80586
						(8.59685)
0.000000	0.000000	1.000000	0.000000	0.000000	0.000000	-270.1240
						(53.0176)
0.000000	0.000000	0.000000	1.000000	0.000000	0.000000	16.01932
						(3.07653)
0.000000	0.000000	0.000000	0.000000	1.000000	0.000000	32.46683
						(6.21324)
0.000000	0.000000	0.000000	0.000000	0.000000	1.000000	-0.801755
						(0.15293)

Adjustment coefficients (standard error in parentheses)

D(COMPENS...	-0.035126	-0.047749	0.023747	0.061161	-0.069514	5.277132
	(0.02386)	(0.03874)	(0.01516)	(0.18047)	(0.17573)	(3.96521)
D(FX)	-0.049114	-0.148920	0.024126	0.267290	-0.378268	-1.322598
	(0.04204)	(0.06826)	(0.02672)	(0.31798)	(0.30964)	(6.98676)
D(HOUSING)	-0.045969	-0.015406	0.012100	-0.806302	-0.348445	-11.97705
	(0.05052)	(0.08203)	(0.03211)	(0.38215)	(0.37212)	(8.39661)
D(INFLATION)	-0.010984	-0.031367	0.020523	-0.490760	0.242360	-3.395800
	(0.01428)	(0.02319)	(0.00907)	(0.10801)	(0.10518)	(2.37323)
D(IR)	-0.024350	-0.022754	0.022227	-0.015879	-0.110512	-1.465138
	(0.00901)	(0.01463)	(0.00572)	(0.06814)	(0.06635)	(1.49718)
D(POPULATI...	0.000616	-0.000525	9.95E-05	-0.008817	0.008309	-0.216560
	(0.00044)	(0.00071)	(0.00028)	(0.00330)	(0.00321)	(0.07244)
D(UNEMPLO...	0.010153	0.021959	-0.004628	0.021089	0.058592	0.624304
	(0.00877)	(0.01423)	(0.00557)	(0.06631)	(0.06457)	(1.45698)

Finland – ADF test

Null Hypothesis: HOUSING has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.611258	0.4723
Test critical values:	1% level	-3.512290	
	5% level	-2.897223	
	10% level	-2.585861	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(HOUSING)
Method: Least Squares
Date: 05/18/21 Time: 13:23
Sample (adjusted): 2000Q3 2020Q4
Included observations: 82 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
HOUSING(-1)	-0.016767	0.010406	-1.611258	0.1111
D(HOUSING(-1))	0.472351	0.097942	4.822769	0.0000
C	1.776269	1.004787	1.767806	0.0810

R-squared	0.260291	Mean dependent var	0.309509
Adjusted R-squared	0.241564	S.D. dependent var	1.044273
S.E. of regression	0.909439	Akaike info criterion	2.683923
Sum squared resid	65.33932	Schwarz criterion	2.771973
Log likelihood	-107.0408	Hannan-Quinn criter.	2.719274
F-statistic	13.89934	Durbin-Watson stat	2.110283
Prob(F-statistic)	0.000007		

Null Hypothesis: COMPENSATION has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.730632	0.4123
Test critical values:	1% level	-3.511262	
	5% level	-2.896779	
	10% level	-2.585626	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(COMPENSATION)
Method: Least Squares
Date: 05/18/21 Time: 13:22
Sample (adjusted): 2000Q2 2020Q4
Included observations: 83 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
COMPENSATION(-1)	-0.013528	0.007817	-1.730632	0.0873
C	1.778373	0.700807	2.537609	0.0131

R-squared	0.035658	Mean dependent var	0.581875
Adjusted R-squared	0.023752	S.D. dependent var	1.057125
S.E. of regression	1.044495	Akaike info criterion	2.948745
Sum squared resid	88.36854	Schwarz criterion	3.007031
Log likelihood	-120.3729	Hannan-Quinn criter.	2.972161
F-statistic	2.995087	Durbin-Watson stat	2.322642
Prob(F-statistic)	0.087325		

Null Hypothesis: FX has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.995451	0.2883
Test critical values:	1% level	-3.511262	
	5% level	-2.896779	
	10% level	-2.585626	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(FX)
Method: Least Squares
Date: 05/18/21 Time: 13:23
Sample (adjusted): 2000Q3 2021Q1
Included observations: 83 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
FX(-1)	-0.078929	0.039554	-1.995451	0.0494
D(FX(-1))	0.221840	0.108006	2.053951	0.0432
C	7.955481	3.994855	1.991432	0.0498

R-squared	0.079690	Mean dependent var	-0.016691
Adjusted R-squared	0.056682	S.D. dependent var	1.335382
S.E. of regression	1.296984	Akaike info criterion	3.393435
Sum squared resid	134.5733	Schwarz criterion	3.480863
Log likelihood	-137.8276	Hannan-Quinn criter.	3.428559
F-statistic	3.463596	Durbin-Watson stat	2.002610
Prob(F-statistic)	0.036089		

Null Hypothesis: INFLATION has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.446166	0.0120
Test critical values:	1% level	-3.511262	
	5% level	-2.896779	
	10% level	-2.585626	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(INFLATION)
Method: Least Squares
Date: 05/18/21 Time: 13:24
Sample (adjusted): 2000Q3 2021Q1
Included observations: 83 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
INFLATION(-1)	-0.147008	0.042658	-3.446166	0.0009
D(INFLATION(-1))	0.485315	0.099142	4.895149	0.0000
C	0.203499	0.080119	2.539963	0.0130

R-squared	0.272709	Mean dependent var	-0.020882
Adjusted R-squared	0.254526	S.D. dependent var	0.541271
S.E. of regression	0.467338	Akaike info criterion	1.351947
Sum squared resid	17.47239	Schwarz criterion	1.439375
Log likelihood	-53.10581	Hannan-Quinn criter.	1.387071
F-statistic	14.99859	Durbin-Watson stat	2.135374
Prob(F-statistic)	0.000003		

Null Hypothesis: IR has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.100724	0.2450
Test critical values:	1% level	-3.511262	
	5% level	-2.896779	
	10% level	-2.585626	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(IR)
Method: Least Squares
Date: 05/18/21 Time: 13:24
Sample (adjusted): 2000Q3 2021Q1
Included observations: 83 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
IR(-1)	-0.035453	0.016876	-2.100724	0.0388
D(IR(-1))	0.577117	0.086701	6.656420	0.0000
C	0.025759	0.040259	0.639843	0.5241

R-squared	0.366700	Mean dependent var	-0.057897
Adjusted R-squared	0.350868	S.D. dependent var	0.336259
S.E. of regression	0.270920	Akaike info criterion	0.261485
Sum squared resid	5.871792	Schwarz criterion	0.348913
Log likelihood	-7.851648	Hannan-Quinn criter.	0.296609
F-statistic	23.16126	Durbin-Watson stat	1.884501
Prob(F-statistic)	0.000000		

Null Hypothesis: UNEMPLOYMENT has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.298204	0.1750
Test critical values:	1% level	-3.510259	
	5% level	-2.896346	
	10% level	-2.585396	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(UNEMPLOYMENT)
Method: Least Squares
Date: 05/18/21 Time: 13:36
Sample (adjusted): 2000Q2 2021Q1
Included observations: 84 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
UNEMPLOYMENT(-1)	-0.086794	0.037766	-2.298204	0.0241
C	0.690737	0.314094	2.199143	0.0307

R-squared	0.060514	Mean dependent var	-0.026587
Adjusted R-squared	0.049057	S.D. dependent var	0.330096
S.E. of regression	0.321897	Akaike info criterion	0.594354
Sum squared resid	8.496674	Schwarz criterion	0.652231
Log likelihood	-22.96287	Hannan-Quinn criter.	0.617620
F-statistic	5.281741	Durbin-Watson stat	1.645156
Prob(F-statistic)	0.024097		

Null Hypothesis: POPULATION has a unit root
Exogenous: Constant
Lag Length: 4 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.677279	0.4388
Test critical values:	1% level	-3.514426	
	5% level	-2.898145	
	10% level	-2.586351	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(POPULATION)
Method: Least Squares
Date: 05/18/21 Time: 20:57
Sample (adjusted): 2001Q2 2021Q1
Included observations: 80 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
POPULATION(-1)	-0.022102	0.013177	-1.677279	0.0977
D(POPULATION(-1))	0.016195	0.076034	0.212991	0.8319
D(POPULATION(-2))	0.016202	0.076035	0.213081	0.8318
D(POPULATION(-3))	0.016208	0.076035	0.213171	0.8318
D(POPULATION(-4))	0.759591	0.075293	10.08846	0.0000
C	0.001763	0.001169	1.508587	0.1357

R-squared	0.579719	Mean dependent var	-0.000171
Adjusted R-squared	0.551322	S.D. dependent var	0.004735
S.E. of regression	0.003172	Akaike info criterion	-8.597156
Sum squared resid	0.000744	Schwarz criterion	-8.418504
Log likelihood	349.8862	Hannan-Quinn criter.	-8.525529
F-statistic	20.41457	Durbin-Watson stat	2.066972
Prob(F-statistic)	0.000000		

Finland – Johansen test

Date: 05/18/21 Time: 13:38
Sample (adjusted): 2000Q4 2020Q4
Included observations: 81 after adjustments
Trend assumption: Linear deterministic trend
Series: COMPENSATION FX HOUSING IR POPULATION UNEMPLOYMENT
Lags interval (in first differences): 1 to 2

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.400469	116.6360	95.75366	0.0009
At most 1 *	0.343605	75.19581	69.81889	0.0174
At most 2	0.206106	41.09546	47.85613	0.1857
At most 3	0.131068	22.40021	29.79707	0.2768
At most 4	0.096057	11.02046	15.49471	0.2102
At most 5	0.034458	2.840328	3.841465	0.0919

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.400469	41.44015	40.07757	0.0349
At most 1 *	0.343605	34.10034	33.87687	0.0470
At most 2	0.206106	18.69526	27.58434	0.4384
At most 3	0.131068	11.37975	21.13162	0.6094
At most 4	0.096057	8.180131	14.26460	0.3607
At most 5	0.034458	2.840328	3.841465	0.0919

Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

COMPENSAT...	FX	HOUSING	IR	POPULATION	UNEMPLOYMENT
0.420498	0.257221	-0.442813	1.009834	68.38245	0.396108
-0.339225	-0.038239	0.216800	-0.906286	-31.81830	-1.734954
-0.021768	0.449615	0.026489	-0.564970	-23.95148	0.480453
0.134536	-0.079121	-0.105458	0.978870	-14.16788	0.529884
0.035879	0.100502	0.248007	1.375542	-29.85965	1.522981
-0.008257	0.092614	0.127595	0.239923	-49.77381	-0.442011

Unrestricted Adjustment Coefficients (alpha):

D(COMPENS...	-0.188334	0.153787	0.041197	-0.040990	0.232640	-0.075025
D(FX)	-0.188370	0.294210	-0.344549	0.288990	-0.056983	-0.021279
D(HOUSING)	-0.173125	0.205653	0.172749	0.016990	-0.106233	-0.060399
D(IR)	-0.093915	-0.020013	-0.035841	-0.050876	-0.005789	0.007880
D(POPULATI...	-0.000960	0.001407	0.000965	0.000428	0.000346	0.000730
D(UNEMPLO...	0.101611	0.062554	-0.030606	-0.036101	-0.028346	0.007789

1 Cointegrating Equation(s): Log likelihood 4.395169

Normalized cointegrating coefficients (standard error in parentheses)

COMPENSAT...	FX	HOUSING	IR	POPULATION	UNEMPLOYMENT
1.000000	0.611707	-1.053070	2.401520	162.6227	0.941998
	(0.18138)	(0.11500)	(0.54303)	(25.9319)	(0.68770)

Adjustment coefficients (standard error in parentheses)

D(COMPENS...	-0.079194
	(0.04791)
D(FX)	-0.079209
	(0.06427)
D(HOUSING)	-0.072799
	(0.03769)
D(IR)	-0.039491
	(0.01059)
D(POPULATI...	-0.000404
	(0.00028)
D(UNEMPLO...	0.042727
	(0.01165)

2 Cointegrating Equation(s): Log likelihood 21.44534

Normalized cointegrating coefficients (standard error in parentheses)

COMPENSAT...	FX	HOUSING	IR	POPULATION	UNEMPLOYMENT
1.000000	0.000000	-0.545583	2.732659	78.24863	6.057071
		(0.19710)	(0.91385)	(42.9278)	(1.17409)
0.000000	1.000000	-0.829623	-0.541335	137.9321	-8.361964
		(0.39256)	(1.82010)	(85.4983)	(2.33841)

Adjustment coefficients (standard error in parentheses)

D(COMPENS...	-0.131362	-0.054324
	(0.06071)	(0.02922)
D(FX)	-0.179013	-0.059703
	(0.08026)	(0.03863)
D(HOUSING)	-0.142561	-0.052396
	(0.04649)	(0.02238)
D(IR)	-0.032702	-0.023392
	(0.01354)	(0.00652)
D(POPULATI...	-0.000881	-0.000301
	(0.00035)	(0.00017)
D(UNEMPLO...	0.021507	0.023745
	(0.01439)	(0.00693)

3 Cointegrating Equation(s): Log likelihood 30.79297

Normalized cointegrating coefficients (standard error in parentheses)

COMPENSAT...	FX	HOUSING	IR	POPULATION	UNEMPLOYMENT
1.000000	0.000000	0.000000	2.363762	-40.35436	12.21066
			(1.01313)	(63.6360)	(1.77170)
0.000000	1.000000	0.000000	-1.102285	-42.41752	0.995281
			(0.36929)	(23.1956)	(0.64579)
0.000000	0.000000	1.000000	-0.676150	-217.3875	11.27891
			(1.13473)	(71.2741)	(1.98436)

Adjustment coefficients (standard error in parentheses)

D(COMPENS...	-0.132259	-0.035801	0.117829
	(0.06070)	(0.05831)	(0.05543)
D(FX)	-0.171512	-0.214618	0.138071
	(0.07703)	(0.07400)	(0.07034)
D(HOUSING)	-0.146322	0.025275	0.125824
	(0.04510)	(0.04333)	(0.04119)
D(IR)	-0.031922	-0.039506	0.036299
	(0.01335)	(0.01282)	(0.01219)
D(POPULATI...	-0.000902	0.000133	0.000756
	(0.00034)	(0.00033)	(0.00031)
D(UNEMPLO...	0.022174	0.009984	-0.032244
	(0.01426)	(0.01370)	(0.01302)

4 Cointegrating Equation(s): Log likelihood 36.48284

Normalized cointegrating coefficients (standard error in parentheses)

COMPENSAT...	FX	HOUSING	IR	POPULATION	UNEMPLOYMENT
1.000000	0.000000	0.000000	0.000000	124.4325	11.47984
				(95.3424)	(2.66061)
0.000000	1.000000	0.000000	0.000000	-119.2620	1.336082
				(42.4093)	(1.18347)
0.000000	0.000000	1.000000	0.000000	-264.5245	11.48796
				(72.8573)	(2.03314)
0.000000	0.000000	0.000000	1.000000	-69.71380	0.309177
				(28.7274)	(0.80166)

Adjustment coefficients (standard error in parentheses)

D(COMPENS...	-0.137774	-0.032558	0.122152	-0.392959
	(0.06249)	(0.05892)	(0.05662)	(0.19805)
D(FX)	-0.132633	-0.237483	0.107594	0.020683
	(0.07691)	(0.07252)	(0.06969)	(0.24374)
D(HOUSING)	-0.144036	0.023931	0.124032	-0.442175
	(0.04646)	(0.04381)	(0.04210)	(0.14726)
D(IR)	-0.038767	-0.035481	0.041664	-0.106253
	(0.01331)	(0.01255)	(0.01206)	(0.04218)
D(POPULATI...	-0.000845	9.94E-05	0.000711	-0.002372
	(0.00035)	(0.00033)	(0.00032)	(0.00111)
D(UNEMPLO...	0.017317	0.012840	-0.028437	0.027872
	(0.01449)	(0.01366)	(0.01313)	(0.04592)

5 Cointegrating Equation(s): Log likelihood 40.57291

Normalized cointegrating coefficients (standard error in parentheses)

COMPENSAT...	FX	HOUSING	IR	POPULATION	UNEMPLOYMENT
1.000000	0.000000	0.000000	0.000000	0.000000	13.53425
					(2.33484)
0.000000	1.000000	0.000000	0.000000	0.000000	-0.632961
					(0.69394)
0.000000	0.000000	1.000000	0.000000	0.000000	7.120602
					(2.15048)
0.000000	0.000000	0.000000	1.000000	0.000000	-0.841814
					(0.38852)
0.000000	0.000000	0.000000	0.000000	1.000000	-0.016510
					(0.01003)

Adjustment coefficients (standard error in parentheses)

D(COMPENS...	-0.129427	-0.009177	0.179848	-0.072953	-25.12449
	(0.06058)	(0.05803)	(0.06103)	(0.24285)	(9.30409)
D(FX)	-0.134677	-0.243210	0.093462	-0.057699	-16.38290
	(0.07697)	(0.07374)	(0.07754)	(0.30856)	(11.8216)
D(HOUSING)	-0.147848	0.013254	0.097685	-0.588303	-19.58847
	(0.04599)	(0.04406)	(0.04633)	(0.18438)	(7.06406)
D(IR)	-0.038974	-0.036063	0.040228	-0.114216	-4.033250
	(0.01333)	(0.01277)	(0.01343)	(0.05345)	(2.04758)
D(POPULATI...	-0.000832	0.000134	0.000797	-0.001896	-0.149960
	(0.00035)	(0.00034)	(0.00035)	(0.00141)	(0.05400)
D(UNEMPLO...	0.016300	0.009991	-0.035467	-0.011119	7.048992
	(0.01439)	(0.01379)	(0.01450)	(0.05769)	(2.21020)

France – ADF test

Null Hypothesis: HOUSING has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.927398	0.3184
Test critical values:	1% level	-3.512290	
	5% level	-2.897223	
	10% level	-2.585861	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(HOUSING)
Method: Least Squares
Date: 05/18/21 Time: 13:44
Sample (adjusted): 2000Q3 2020Q4
Included observations: 82 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
HOUSING(-1)	-0.008785	0.004558	-1.927398	0.0575
D(HOUSING(-1))	0.851063	0.057191	14.88113	0.0000
C	0.967381	0.458374	2.110460	0.0380

R-squared	0.777487	Mean dependent var	0.675836
Adjusted R-squared	0.771853	S.D. dependent var	1.246843
S.E. of regression	0.595551	Akaike info criterion	1.837240
Sum squared resid	28.01981	Schwarz criterion	1.925291
Log likelihood	-72.32686	Hannan-Quinn criter.	1.872591
F-statistic	138.0173	Durbin-Watson stat	2.043050
Prob(F-statistic)	0.000000		

Null Hypothesis: FX has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.476713	0.5405
Test critical values:	1% level	-3.511262	
	5% level	-2.896779	
	10% level	-2.585626	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(FX)
Method: Least Squares
Date: 05/18/21 Time: 13:44
Sample (adjusted): 2000Q3 2021Q1
Included observations: 83 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
FX(-1)	-0.040145	0.027185	-1.476713	0.1437
D(FX(-1))	0.298904	0.105495	2.833341	0.0058
C	3.952266	2.687784	1.470455	0.1454

R-squared	0.103404	Mean dependent var	-0.023638
Adjusted R-squared	0.080989	S.D. dependent var	1.139058
S.E. of regression	1.091959	Akaike info criterion	3.049299
Sum squared resid	95.38992	Schwarz criterion	3.136727
Log likelihood	-123.5459	Hannan-Quinn criter.	3.084422
F-statistic	4.613158	Durbin-Watson stat	1.982468
Prob(F-statistic)	0.012702		

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Null Hypothesis: COMPENSATION has a unit root
Exogenous: Constant
Lag Length: 6 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.940361	0.3124
Test critical values:	1% level	-3.517847	
	5% level	-2.899619	
	10% level	-2.587134	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(COMPENSATION)
Method: Least Squares
Date: 05/18/21 Time: 13:43
Sample (adjusted): 2001Q4 2020Q4
Included observations: 77 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
COMPENSATION(-1)	-0.027578	0.014213	-1.940361	0.0564
D(COMPENSATION(-1))	-0.507137	0.108545	-4.672144	0.0000
D(COMPENSATION(-2))	-0.278281	0.200498	-1.387948	0.1696
D(COMPENSATION(-3))	-0.626495	0.604267	-1.036786	0.3035
D(COMPENSATION(-4))	0.569218	0.601878	0.945736	0.3476
D(COMPENSATION(-5))	2.705365	0.606125	4.463379	0.0000
D(COMPENSATION(-6))	-2.261638	0.618782	-3.654984	0.0005
C	3.150286	1.490705	2.113286	0.0382

R-squared	0.497592	Mean dependent var	0.504820
Adjusted R-squared	0.446623	S.D. dependent var	1.834886
S.E. of regression	1.364959	Akaike info criterion	3.558219
Sum squared resid	128.5548	Schwarz criterion	3.801732
Log likelihood	-128.9915	Hannan-Quinn criter.	3.655622
F-statistic	9.762643	Durbin-Watson stat	1.997016
Prob(F-statistic)	0.000000		

Null Hypothesis: INFLATION has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.392372	0.0140
Test critical values:	1% level	-3.511262	
	5% level	-2.896779	
	10% level	-2.585626	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(INFLATION)
Method: Least Squares
Date: 05/18/21 Time: 13:45
Sample (adjusted): 2000Q3 2021Q1
Included observations: 83 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
INFLATION(-1)	-0.195964	0.057766	-3.392372	0.0011
D(INFLATION(-1))	0.335332	0.108255	3.097606	0.0027
C	0.267356	0.091760	2.913640	0.0046

R-squared	0.169343	Mean dependent var	-0.008198
Adjusted R-squared	0.148577	S.D. dependent var	0.441428
S.E. of regression	0.407317	Akaike info criterion	1.077027
Sum squared resid	13.27260	Schwarz criterion	1.164455
Log likelihood	-41.69663	Hannan-Quinn criter.	1.112151
F-statistic	8.154654	Durbin-Watson stat	2.044560
Prob(F-statistic)	0.000598		

Null Hypothesis: IR has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.100724	0.2450
Test critical values:	1% level	-3.511262	
	5% level	-2.896779	
	10% level	-2.585626	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(IR)
Method: Least Squares
Date: 05/18/21 Time: 13:45
Sample (adjusted): 2000Q3 2021Q1
Included observations: 83 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
IR(-1)	-0.035453	0.016876	-2.100724	0.0388
D(IR(-1))	0.577117	0.086701	6.656420	0.0000
C	0.025759	0.040259	0.639843	0.5241

R-squared	0.366700	Mean dependent var	-0.057897
Adjusted R-squared	0.350868	S.D. dependent var	0.336259
S.E. of regression	0.270920	Akaike info criterion	0.261485
Sum squared resid	5.871792	Schwarz criterion	0.348913
Log likelihood	-7.851648	Hannan-Quinn criter.	0.296609
F-statistic	23.16126	Durbin-Watson stat	1.884501
Prob(F-statistic)	0.000000		

Null Hypothesis: POPULATION has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.804420	0.0619
Test critical values:	1% level	-3.510259	
	5% level	-2.896346	
	10% level	-2.585396	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(POPULATION)
Method: Least Squares
Date: 05/18/21 Time: 21:00
Sample (adjusted): 2000Q2 2021Q1
Included observations: 84 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
POPULATION(-1)	-0.176802	0.063044	-2.804420	0.0063
C	0.023902	0.009224	2.591292	0.0113

R-squared	0.087518	Mean dependent var	-0.000802
Adjusted R-squared	0.076390	S.D. dependent var	0.026089
S.E. of regression	0.025073	Akaike info criterion	-4.510562
Sum squared resid	0.051548	Schwarz criterion	-4.452686
Log likelihood	191.4436	Hannan-Quinn criter.	-4.487297
F-statistic	7.864773	Durbin-Watson stat	1.837084
Prob(F-statistic)	0.006292		

Null Hypothesis: UNEMPLOYMENT has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.900437	0.3307
Test critical values:	1% level	-3.510259	
	5% level	-2.896346	
	10% level	-2.585396	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(UNEMPLOYMENT)
Method: Least Squares
Date: 05/18/21 Time: 13:46
Sample (adjusted): 2000Q2 2021Q1
Included observations: 84 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
UNEMPLOYMENT(-1)	-0.083644	0.044013	-1.900437	0.0609
C	0.732090	0.401212	1.824696	0.0717

R-squared	0.042187	Mean dependent var	-0.027381
Adjusted R-squared	0.030506	S.D. dependent var	0.331366
S.E. of regression	0.326272	Akaike info criterion	0.621353
Sum squared resid	8.729203	Schwarz criterion	0.679230
Log likelihood	-24.09684	Hannan-Quinn criter.	0.644619
F-statistic	3.611661	Durbin-Watson stat	2.084900
Prob(F-statistic)	0.060890		

France – Johansen test

Date: 05/18/21 Time: 21:03
Sample (adjusted): 2000Q4 2020Q4
Included observations: 81 after adjustments
Trend assumption: Linear deterministic trend
Series: COMPENSATION FX HOUSING INFLATION IR POPULATION UNEMPLOYMENT
Lags interval (in first differences): 1 to 2

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.513084	193.5549	125.6154	0.0000
At most 1 *	0.425284	135.2621	95.75366	0.0000
At most 2 *	0.309412	90.39798	69.81889	0.0005
At most 3 *	0.250451	60.41085	47.85613	0.0022
At most 4 *	0.216087	37.05989	29.79707	0.0061
At most 5 *	0.139460	17.33991	15.49471	0.0261
At most 6 *	0.061881	5.174126	3.841465	0.0229

Trace test indicates 7 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.513084	58.29275	46.23142	0.0017
At most 1 *	0.425284	44.86415	40.07757	0.0134
At most 2	0.309412	29.98714	33.87687	0.1359
At most 3	0.250451	23.35095	27.58434	0.1590
At most 4	0.216087	19.71999	21.13162	0.0778
At most 5	0.139460	12.16578	14.26460	0.1046
At most 6 *	0.061881	5.174126	3.841465	0.0229

Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

COMPENSAT...	FX	HOUSING	INFLATION	IR	POPULATION	UNEMPLOYMENT
0.473326	0.205248	-0.067917	2.386837	3.194004	-7.825274	4.423970
0.264202	0.158420	-0.180892	0.072121	0.889911	-16.69080	-0.093110
0.099835	0.394301	-0.106499	0.696643	-0.194163	8.270035	0.915602
0.496288	0.131972	-0.110049	-0.849018	3.033726	22.95800	2.649085
-0.275884	-0.508017	0.132641	-0.363951	-0.790634	24.99891	-2.298884
-0.223046	-0.176142	0.073402	-0.389305	-0.235940	-9.079996	0.277188
-0.014521	-0.191468	-0.006765	0.757223	-0.235749	5.593926	0.570066

Unrestricted Adjustment Coefficients (alpha):

D(COMPENS...	0.104504	-0.106172	0.257667	0.213006	-0.138416	0.479816	-0.044196
D(FX)	-0.127684	-0.014550	-0.076331	-0.055430	0.371785	0.101864	0.117829
D(HOUSING)	-0.202654	0.082641	0.089687	-0.019435	-0.037107	-0.005221	0.045942
D(INFLATION)	-0.148968	-0.076810	-0.077848	0.054876	-0.030561	0.056864	-0.047034
D(IR)	-0.022289	-0.126862	-0.028009	-0.015514	-0.052727	-0.002724	0.014440
D(POPULATI...	0.005273	0.005763	-0.005241	-0.007553	-0.002082	0.003721	0.000883
D(UNEMPLO...	0.027103	-0.021126	0.061310	-0.025652	0.021050	0.033827	-0.019591

1 Cointegrating Equation(s): Log likelihood -63.55194

Normalized cointegrating coefficients (standard error in parentheses)

COMPENSAT...	FX	HOUSING	INFLATION	IR	POPULATION	UNEMPLOYMENT
1.000000	0.433629	-0.143488	5.042691	6.748001	-16.53253	9.346561
	(0.13921)	(0.04101)	(0.64404)	(0.42555)	(10.4412)	(0.76539)

Adjustment coefficients (standard error in parentheses)

D(COMPENS...	0.049465
	(0.08715)
D(FX)	-0.060436
	(0.05828)
D(HOUSING)	-0.095921
	(0.02061)
D(INFLATION)	-0.070510
	(0.02115)
D(IR)	-0.010550
	(0.01415)
D(POPULATI...	0.002496
	(0.00138)
D(UNEMPLO...	0.012829
	(0.01066)

2 Cointegrating Equation(s): Log likelihood -41.11986

Normalized cointegrating coefficients (standard error in parentheses)

COMPENSAT...	FX	HOUSING	INFLATION	IR	POPULATION	UNEMPLOYMENT
1.000000	0.000000	1.270309	17.50318	15.57721	105.3153	34.68435
		(0.21639)	(4.25502)	(2.12268)	(62.6911)	(5.08650)
0.000000	1.000000	-3.260387	-28.73538	-20.36123	-280.9959	-58.43201
		(0.46258)	(9.09611)	(4.53772)	(134.017)	(10.8736)

Adjustment coefficients (standard error in parentheses)

D(COMPENS...	0.021414	0.004629
	(0.09955)	(0.04762)
D(FX)	-0.064280	-0.028512
	(0.06674)	(0.03192)
D(HOUSING)	-0.074087	-0.028502
	(0.02294)	(0.01097)
D(INFLATION)	-0.090804	-0.042744
	(0.02367)	(0.01132)
D(IR)	-0.044067	-0.024672
	(0.01378)	(0.00659)
D(POPULATI...	0.004018	0.001995
	(0.00153)	(0.00073)
D(UNEMPLO...	0.007247	0.002216
	(0.01213)	(0.00580)

3 Cointegrating Equation(s): Log likelihood -26.12630

Normalized cointegrating coefficients (standard error in parentheses)

COMPENSAT...	FX	HOUSING	INFLATION	IR	POPULATION	UNEMPLOYMENT
1.000000	0.000000	0.000000	5.093363	7.996871	-25.73259	9.945032
			(0.91688)	(0.34674)	(13.7101)	(0.89062)
0.000000	1.000000	0.000000	3.115756	-0.905455	55.35293	5.064160
			(1.56966)	(0.59361)	(23.4710)	(1.52470)
0.000000	0.000000	1.000000	9.769128	5.967321	103.1622	19.47504
			(2.95452)	(1.11733)	(44.1787)	(2.86989)

Adjustment coefficients (standard error in parentheses)

D(COMPENS...	0.047138	0.106228	-0.015333
	(0.09968)	(0.08535)	(0.03990)
D(FX)	-0.071901	-0.058609	0.019433
	(0.06766)	(0.05793)	(0.02708)
D(HOUSING)	-0.065134	0.006861	-0.010737
	(0.02250)	(0.01927)	(0.00901)
D(INFLATION)	-0.098576	-0.073439	0.032302
	(0.02347)	(0.02009)	(0.00939)
D(IR)	-0.046863	-0.035716	0.027445
	(0.01388)	(0.01188)	(0.00556)
D(POPULATI...	0.003495	-7.14E-05	-0.000842
	(0.00152)	(0.00130)	(0.00061)
D(UNEMPLO...	0.013368	0.026391	-0.004549
	(0.01160)	(0.00993)	(0.00464)

4 Cointegrating Equation(s): Log likelihood -14.45082

Normalized cointegrating coefficients (standard error in parentheses)

COMPENSAT...	FX	HOUSING	INFLATION	IR	POPULATION	UNEMPLOYMENT
1.000000	0.000000	0.000000	0.000000	7.698670	48.94622	8.421214
				(0.42516)	(15.6624)	(0.91328)
0.000000	1.000000	0.000000	0.000000	-1.087873	101.0361	4.131998
				(0.71481)	(26.3326)	(1.53547)
0.000000	0.000000	1.000000	0.000000	5.395368	246.3970	16.55234
				(1.46578)	(53.9970)	(3.14860)
0.000000	0.000000	0.000000	1.000000	0.058547	-14.66198	0.299177
				(0.08589)	(3.16388)	(0.18449)

Adjustment coefficients (standard error in parentheses)

D(COMPENS...	0.152850	0.134339	-0.038774	0.240434
	(0.13270)	(0.08767)	(0.04411)	(0.47025)
D(FX)	-0.099410	-0.065924	0.025533	-0.311924
	(0.09090)	(0.06006)	(0.03022)	(0.32214)
D(HOUSING)	-0.074779	0.004296	-0.008598	-0.398761
	(0.03023)	(0.01997)	(0.01005)	(0.10712)
D(INFLATION)	-0.071341	-0.066197	0.026263	-0.461926
	(0.03117)	(0.02060)	(0.01036)	(0.11047)
D(IR)	-0.054563	-0.037763	0.029152	-0.068689
	(0.01862)	(0.01230)	(0.00619)	(0.06600)
D(POPULATI...	-0.000254	-0.001068	-1.11E-05	0.015762
	(0.00192)	(0.00127)	(0.00064)	(0.00680)
D(UNEMPLO...	0.000637	0.023005	-0.001726	0.127658
	(0.01543)	(0.01019)	(0.00513)	(0.05467)

5 Cointegrating Equation(s): Log likelihood -4.590826

Normalized cointegrating coefficients (standard error in parentheses)

COMPENSAT...	FX	HOUSING	INFLATION	IR	POPULATION	UNEMPLOYMENT
1.000000	0.000000	0.000000	0.000000	0.000000	-4572.849	5.131613
					(988.166)	(47.0100)
0.000000	1.000000	0.000000	0.000000	0.000000	754.1266	4.596840
					(158.004)	(7.51674)
0.000000	0.000000	1.000000	0.000000	0.000000	-2992.641	14.24693
					(675.087)	(32.1159)
0.000000	0.000000	0.000000	1.000000	0.000000	-49.80992	0.274160
					(9.20017)	(0.43768)
0.000000	0.000000	0.000000	0.000000	1.000000	600.3368	0.427295
					(128.579)	(6.11691)

Adjustment coefficients (standard error in parentheses)

D(COMPENS...	0.191037	0.204656	-0.057134	0.290811	0.944912
	(0.14093)	(0.12570)	(0.04986)	(0.47254)	(0.81337)
D(FX)	-0.201980	-0.254797	0.074847	-0.447235	-0.868057
	(0.08986)	(0.08015)	(0.03179)	(0.30131)	(0.51864)
D(HOUSING)	-0.064542	0.023147	-0.013520	-0.385256	-0.620771
	(0.03204)	(0.02858)	(0.01134)	(0.10745)	(0.18495)
D(INFLATION)	-0.062910	-0.050671	0.022210	-0.450803	-0.338401
	(0.03313)	(0.02955)	(0.01172)	(0.11107)	(0.19118)
D(IR)	-0.040017	-0.010977	0.022159	-0.049499	-0.184028
	(0.01918)	(0.01711)	(0.00679)	(0.06433)	(0.11072)
D(POPULATI...	0.000321	-1.04E-05	-0.000287	0.016520	0.001719
	(0.00204)	(0.00182)	(0.00072)	(0.00683)	(0.01176)
D(UNEMPLO...	-0.005170	0.012311	0.001066	0.119997	-0.038601
	(0.01633)	(0.01456)	(0.00578)	(0.05475)	(0.09424)

6 Cointegrating Equation(s): Log likelihood 1.492064

Normalized cointegrating coefficients (standard error in parentheses)

COMPENSAT...	FX	HOUSING	INFLATION	IR	POPULATION	UNEMPLOYMENT
1.000000	0.000000	0.000000	0.000000	0.000000	0.000000	-6.362814
						(4.06541)
0.000000	1.000000	0.000000	0.000000	0.000000	0.000000	6.492432
						(1.08279)
0.000000	0.000000	1.000000	0.000000	0.000000	0.000000	6.724552
						(3.89042)
0.000000	0.000000	0.000000	1.000000	0.000000	0.000000	0.148957
						(0.15533)
0.000000	0.000000	0.000000	0.000000	1.000000	0.000000	1.936316
						(0.51758)
0.000000	0.000000	0.000000	0.000000	0.000000	1.000000	-0.002514
						(0.00991)

Adjustment coefficients (standard error in parentheses)

D(COMPENS...	0.084016	0.120141	-0.021914	0.104016	0.831704	0.158454
	(0.13800)	(0.12211)	(0.04858)	(0.45014)	(0.76763)	(6.80286)
D(FX)	-0.224700	-0.272740	0.082324	-0.486891	-0.892090	7.707482
	(0.09278)	(0.08210)	(0.03266)	(0.30265)	(0.51611)	(4.57383)
D(HOUSING)	-0.063377	0.024067	-0.013903	-0.383223	-0.619540	-0.378224
	(0.03329)	(0.02945)	(0.01172)	(0.10859)	(0.18517)	(1.64102)
D(INFLATION)	-0.075593	-0.060688	0.026384	-0.472940	-0.351818	1.783454
	(0.03392)	(0.03002)	(0.01194)	(0.11066)	(0.18870)	(1.67232)
D(IR)	-0.039409	-0.010498	0.021959	-0.048439	-0.183385	0.410649
	(0.01993)	(0.01763)	(0.00702)	(0.06501)	(0.11086)	(0.98245)
D(POPULATI...	-0.000509	-0.000666	-1.42E-05	0.015071	0.000841	-0.440022
	(0.00208)	(0.00184)	(0.00073)	(0.00679)	(0.01158)	(0.10266)
D(UNEMPLO...	-0.012715	0.006353	0.003549	0.106828	-0.046582	0.277721
	(0.01661)	(0.01470)	(0.00585)	(0.05418)	(0.09239)	(0.81882)

Greece – ADF test

Null Hypothesis: HOUSING has a unit root
Exogenous: Constant
Lag Length: 3 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.699508	0.4277
Test critical values:	1% level	-3.514426	
	5% level	-2.898145	
	10% level	-2.586351	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(HOUSING)
Method: Least Squares
Date: 05/18/21 Time: 14:11
Sample (adjusted): 2001Q1 2020Q4
Included observations: 80 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
HOUSING(-1)	-0.014161	0.008332	-1.699508	0.0934
D(HOUSING(-1))	0.296457	0.110114	2.692285	0.0087
D(HOUSING(-2))	0.310791	0.109808	2.830304	0.0060
D(HOUSING(-3))	0.215684	0.110617	1.949820	0.0549
C	1.781449	1.104716	1.612585	0.1110

R-squared	0.544341	Mean dependent var	-0.042203
Adjusted R-squared	0.520039	S.D. dependent var	2.674943
S.E. of regression	1.853180	Akaike info criterion	4.132145
Sum squared resid	257.5707	Schwarz criterion	4.281021
Log likelihood	-160.2858	Hannan-Quinn criter.	4.191834
F-statistic	22.39916	Durbin-Watson stat	2.070308
Prob(F-statistic)	0.000000		

Null Hypothesis: COMPENSATION has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.798789	0.8141
Test critical values:	1% level	-3.510259	
	5% level	-2.896346	
	10% level	-2.585396	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(COMPENSATION)
Method: Least Squares
Date: 05/18/21 Time: 14:10
Sample (adjusted): 2000Q2 2021Q1
Included observations: 84 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
COMPENSATION(-1)	-0.064133	0.080288	-0.798789	0.4267
C	6.081600	8.715982	0.697753	0.4873

R-squared	0.007721	Mean dependent var	-0.794831
Adjusted R-squared	-0.004380	S.D. dependent var	12.47504
S.E. of regression	12.50233	Akaike info criterion	7.913229
Sum squared resid	12817.28	Schwarz criterion	7.971105
Log likelihood	-330.3556	Hannan-Quinn criter.	7.936495
F-statistic	0.638063	Durbin-Watson stat	1.072218
Prob(F-statistic)	0.426720		

Null Hypothesis: FX has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.463845	0.5470
Test critical values:	1% level	-3.511262	
	5% level	-2.896779	
	10% level	-2.585626	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(FX)
Method: Least Squares
Date: 05/18/21 Time: 14:10
Sample (adjusted): 2000Q3 2021Q1
Included observations: 83 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
FX(-1)	-0.030531	0.020857	-1.463845	0.1472
D(FX(-1))	0.296948	0.104311	2.846763	0.0056
C	2.880004	1.959341	1.469884	0.1455

R-squared	0.106919	Mean dependent var	0.018014
Adjusted R-squared	0.084592	S.D. dependent var	0.973431
S.E. of regression	0.931349	Akaike info criterion	2.731109
Sum squared resid	69.39283	Schwarz criterion	2.818537
Log likelihood	-110.3410	Hannan-Quinn criter.	2.766233
F-statistic	4.788793	Durbin-Watson stat	2.037902
Prob(F-statistic)	0.010855		

Null Hypothesis: INFLATION has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.712646	0.4212
Test critical values:	1% level	-3.511262	
	5% level	-2.896779	
	10% level	-2.585626	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(INFLATION)
Method: Least Squares
Date: 05/18/21 Time: 14:11
Sample (adjusted): 2000Q3 2021Q1
Included observations: 83 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
INFLATION(-1)	-0.064736	0.037799	-1.712646	0.0907
D(INFLATION(-1))	0.258871	0.110323	2.346484	0.0214
C	0.077160	0.102780	0.750731	0.4550

R-squared	0.080268	Mean dependent var	-0.051813
Adjusted R-squared	0.057275	S.D. dependent var	0.722475
S.E. of regression	0.701480	Akaike info criterion	2.164227
Sum squared resid	39.36594	Schwarz criterion	2.251655
Log likelihood	-86.81541	Hannan-Quinn criter.	2.199350
F-statistic	3.490930	Durbin-Watson stat	2.031123
Prob(F-statistic)	0.035193		

Null Hypothesis: IR has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.356535	0.0154
Test critical values:	1% level	-3.511262	
	5% level	-2.896779	
	10% level	-2.585626	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(IR)
Method: Least Squares
Date: 05/18/21 Time: 14:12
Sample (adjusted): 2000Q3 2021Q1
Included observations: 83 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
IR(-1)	-0.057741	0.017202	-3.356535	0.0012
D(IR(-1))	0.534472	0.085658	6.239585	0.0000
C	0.047631	0.043880	1.085494	0.2810

R-squared	0.444444	Mean dependent var	-0.109336
Adjusted R-squared	0.430555	S.D. dependent var	0.408285
S.E. of regression	0.308098	Akaike info criterion	0.518679
Sum squared resid	7.593962	Schwarz criterion	0.606107
Log likelihood	-18.52518	Hannan-Quinn criter.	0.553803
F-statistic	31.99998	Durbin-Watson stat	1.790521
Prob(F-statistic)	0.000000		

Null Hypothesis: POPULATION has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.566908	0.4950
Test critical values:	1% level	-3.510259	
	5% level	-2.896346	
	10% level	-2.585396	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(POPULATION)
Method: Least Squares
Date: 05/18/21 Time: 21:08
Sample (adjusted): 2000Q2 2021Q1
Included observations: 84 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
POPULATION(-1)	-0.054747	0.034939	-1.566908	0.1210
C	-0.004809	0.004321	-1.112998	0.2690

R-squared	0.029071	Mean dependent var	-0.002921
Adjusted R-squared	0.017230	S.D. dependent var	0.038359
S.E. of regression	0.038028	Akaike info criterion	-3.677490
Sum squared resid	0.118580	Schwarz criterion	-3.619613
Log likelihood	156.4546	Hannan-Quinn criter.	-3.654224
F-statistic	2.455200	Durbin-Watson stat	1.953979
Prob(F-statistic)	0.120987		

Null Hypothesis: UNEMPLOYMENT has a unit root
Exogenous: Constant
Lag Length: 3 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.308805	0.1718
Test critical values:	1% level	-3.514426	
	5% level	-2.898145	
	10% level	-2.586351	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(UNEMPLOYMENT)
Method: Least Squares
Date: 05/18/21 Time: 14:12
Sample (adjusted): 2001Q1 2020Q4
Included observations: 80 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
UNEMPLOYMENT(-1)	-0.017455	0.007560	-2.308805	0.0237
D(UNEMPLOYMENT(-1))	0.386549	0.111333	3.471995	0.0009
D(UNEMPLOYMENT(-2))	0.192513	0.117514	1.638210	0.1056
D(UNEMPLOYMENT(-3))	0.293249	0.115680	2.535004	0.0133
C	0.289360	0.129542	2.233714	0.0285

R-squared	0.617984	Mean dependent var	0.068750
Adjusted R-squared	0.597610	S.D. dependent var	0.700319
S.E. of regression	0.444241	Akaike info criterion	1.275564
Sum squared resid	14.80128	Schwarz criterion	1.424441
Log likelihood	-46.02257	Hannan-Quinn criter.	1.335253
F-statistic	30.33177	Durbin-Watson stat	2.034080
Prob(F-statistic)	0.000000		

Greece – Johansen test

Date: 05/18/21 Time: 14:16
Sample (adjusted): 2000Q4 2020Q4
Included observations: 81 after adjustments
Trend assumption: Linear deterministic trend
Series: COMPENSATION FX HOUSING INFLATION IR POPULATION UNEMPLOYMENT
Lags interval (in first differences): 1 to 2

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.527707	192.0055	125.6154	0.0000
At most 1 *	0.470232	131.2429	95.75366	0.0000
At most 2 *	0.373435	79.78232	69.81889	0.0065
At most 3	0.193426	41.91464	47.85613	0.1611
At most 4	0.134234	24.50286	29.79707	0.1800
At most 5	0.106848	12.82750	15.49471	0.1213
At most 6	0.044352	3.674600	3.841465	0.0552

Trace test indicates 3 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.527707	60.76266	46.23142	0.0008
At most 1 *	0.470232	51.46053	40.07757	0.0018
At most 2 *	0.373435	37.86768	33.87687	0.0158
At most 3	0.193426	17.41178	27.58434	0.5447
At most 4	0.134234	11.67536	21.13162	0.5799
At most 5	0.106848	9.152901	14.26460	0.2736
At most 6	0.044352	3.674600	3.841465	0.0552

Max-eigenvalue test indicates 3 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

COMPENSAT...	FX	HOUSING	INFLATION	IR	POPULATION	UNEMPLOYMENT
0.018062	-0.405926	0.128996	1.060651	-1.009952	0.669941	0.408700
0.041645	0.075465	-0.098389	0.426329	0.273224	2.992363	-0.131652
-0.042030	-0.357428	0.092232	0.212691	-0.101855	-1.700582	0.007369
0.070599	-0.047158	-0.051646	0.811246	0.378873	-0.953767	0.228002
-0.001156	0.445256	-0.054085	0.233822	0.169576	-0.179057	-0.077487
0.083693	-0.257013	0.062866	0.002917	0.653508	0.216469	0.400230
-0.094220	0.186453	0.037235	0.193113	-0.105079	0.295210	0.153661

Unrestricted Adjustment Coefficients (alpha):

D(COMPENS...	-0.288746	-0.193256	0.571127	-0.634062	0.224745	-0.056025	0.371379
D(FX)	0.288859	0.119495	0.330650	-0.096669	-0.154477	0.051650	-0.034615
D(HOUSING)	-0.318158	0.038589	0.086698	-0.082525	0.003824	-0.481430	0.098387
D(INFLATION)	-0.214254	-0.072271	-0.069044	-0.236192	-0.053283	0.011108	-0.039867
D(IR)	0.107489	-0.099543	-0.073178	-0.054983	0.016983	-0.022162	0.009408
D(POPULATI...	-0.027851	-0.173934	0.094187	0.053169	0.015619	-0.009363	-0.010017
D(UNEMPLO...	0.071076	0.061720	0.041420	0.042543	0.097036	-0.013429	-0.054593

1 Cointegrating Equation(s): Log likelihood -556.2098

Normalized cointegrating coefficients (standard error in parentheses)

COMPENSAT...	FX	HOUSING	INFLATION	IR	POPULATION	UNEMPLOYMENT
1.000000	-22.47463	7.142063	58.72436	-55.91732	37.09215	22.62824
	(4.85230)	(1.35495)	(9.00258)	(7.68110)	(23.1270)	(3.95923)

Adjustment coefficients (standard error in parentheses)

D(COMPENS...	-0.005215
	(0.00576)
D(FX)	0.005217
	(0.00184)
D(HOUSING)	-0.005746
	(0.00357)
D(INFLATION)	-0.003870
	(0.00144)
D(IR)	0.001941
	(0.00059)
D(POPULATI...	-0.000503
	(0.00074)
D(UNEMPLO...	0.001284
	(0.00091)

2 Cointegrating Equation(s): Log likelihood -530.4796

Normalized cointegrating coefficients (standard error in parentheses)

COMPENSAT...	FX	HOUSING	INFLATION	IR	POPULATION	UNEMPLOYMENT
1.000000	0.000000	-1.653412	13.85513	1.899111	69.26098	-1.237051
		(0.31978)	(3.94885)	(3.01142)	(10.1867)	(1.50979)
0.000000	1.000000	-0.391351	-1.996439	2.572520	1.431340	-1.061877
		(0.03208)	(0.39616)	(0.30211)	(1.02196)	(0.15147)

Adjustment coefficients (standard error in parentheses)

D(COMPENS...	-0.013263	0.102625
	(0.01445)	(0.13141)
D(FX)	0.010194	-0.108237
	(0.00458)	(0.04165)
D(HOUSING)	-0.004139	0.132061
	(0.00896)	(0.08154)
D(INFLATION)	-0.006879	0.081517
	(0.00359)	(0.03264)
D(IR)	-0.002204	-0.051145
	(0.00138)	(0.01257)
D(POPULATI...	-0.007746	-0.001821
	(0.00157)	(0.01431)
D(UNEMPLO...	0.003854	-0.024194
	(0.00226)	(0.02060)

3 Cointegrating Equation(s): Log likelihood -511.5457

Normalized cointegrating coefficients (standard error in parentheses)

COMPENSAT...	FX	HOUSING	INFLATION	IR	POPULATION	UNEMPLOYMENT
1.000000	0.000000	0.000000	12.70561	-10.76817	44.95452	4.749949
			(3.69028)	(2.77502)	(9.40740)	(0.94680)
0.000000	1.000000	0.000000	-2.268524	-0.425737	-4.321832	0.355204
			(0.91289)	(0.68648)	(2.32718)	(0.23422)
0.000000	0.000000	1.000000	-0.695245	-7.661294	-14.70079	3.620996
			(2.76413)	(2.07857)	(7.04641)	(0.70918)

Adjustment coefficients (standard error in parentheses)

D(COMPENS...	-0.037268	-0.101511	0.034443
	(0.01919)	(0.16945)	(0.05791)
D(FX)	-0.003704	-0.226421	0.056001
	(0.00570)	(0.05034)	(0.01720)
D(HOUSING)	-0.007783	0.101072	-0.036842
	(0.01220)	(0.10769)	(0.03680)
D(INFLATION)	-0.003978	0.106196	-0.026895
	(0.00486)	(0.04292)	(0.01467)
D(IR)	0.000872	-0.024989	0.016910
	(0.00180)	(0.01587)	(0.00542)
D(POPULATI...	-0.011705	-0.035486	0.022208
	(0.00202)	(0.01782)	(0.00609)
D(UNEMPLO...	0.002113	-0.038999	0.006916
	(0.00307)	(0.02710)	(0.00926)

4 Cointegrating Equation(s): Log likelihood -502.8398

Normalized cointegrating coefficients (standard error in parentheses)

COMPENSAT...	FX	HOUSING	INFLATION	IR	POPULATION	UNEMPLOYMENT
1.000000	0.000000	0.000000	0.000000	29.42839	-237.9321	10.10832
				(13.9500)	(52.2779)	(4.19967)
0.000000	1.000000	0.000000	0.000000	-7.602637	46.18620	-0.601506
				(2.62850)	(9.85040)	(0.79132)
0.000000	0.000000	1.000000	0.000000	-9.860832	0.778644	3.327789
				(1.93692)	(7.25866)	(0.58311)
0.000000	0.000000	0.000000	1.000000	-3.163687	22.26471	-0.421733
				(1.15966)	(4.34586)	(0.34912)

Adjustment coefficients (standard error in parentheses)

D(COMPENS...	-0.082032	-0.071610	0.067190	-0.781557
	(0.02817)	(0.16452)	(0.05812)	(0.42555)
D(FX)	-0.010528	-0.221862	0.060994	0.349226
	(0.00858)	(0.05010)	(0.01770)	(0.12958)
D(HOUSING)	-0.013609	0.104964	-0.032580	-0.369511
	(0.01849)	(0.10794)	(0.03813)	(0.27921)
D(INFLATION)	-0.020652	0.117334	-0.014697	-0.464356
	(0.00685)	(0.03998)	(0.01412)	(0.10340)
D(IR)	-0.003010	-0.022396	0.019750	0.011401
	(0.00265)	(0.01548)	(0.00547)	(0.04004)
D(POPULATI...	-0.007951	-0.037993	0.019462	-0.040527
	(0.00300)	(0.01751)	(0.00619)	(0.04530)
D(UNEMPLO...	0.005117	-0.041005	0.004719	0.145023
	(0.00463)	(0.02705)	(0.00955)	(0.06996)

5 Cointegrating Equation(s): Log likelihood -497.0021

Normalized cointegrating coefficients (standard error in parentheses)

COMPENSAT...	FX	HOUSING	INFLATION	IR	POPULATION	UNEMPLOYMENT
1.000000	0.000000	0.000000	0.000000	0.000000	-34.90543	6.381505
					(17.4708)	(1.24216)
0.000000	1.000000	0.000000	0.000000	0.000000	-6.264449	0.361292
					(2.34959)	(0.16705)
0.000000	0.000000	1.000000	0.000000	0.000000	-67.25131	4.576565
					(12.1757)	(0.86568)
0.000000	0.000000	0.000000	1.000000	0.000000	0.438412	-0.021083
					(0.98298)	(0.06989)
0.000000	0.000000	0.000000	0.000000	1.000000	-6.899007	0.126640
					(1.35543)	(0.09637)

Adjustment coefficients (standard error in parentheses)

D(COMPENS...	-0.082292	0.028459	0.055035	-0.729006	-0.021472
	(0.02805)	(0.21105)	(0.06008)	(0.42943)	(0.33776)
D(FX)	-0.010350	-0.290644	0.069349	0.313106	-0.355583
	(0.00839)	(0.06311)	(0.01797)	(0.12841)	(0.10100)
D(HOUSING)	-0.013614	0.106667	-0.032786	-0.368617	0.292419
	(0.01849)	(0.13907)	(0.03959)	(0.28298)	(0.22257)
D(INFLATION)	-0.020591	0.093610	-0.011815	-0.476814	0.105151
	(0.00682)	(0.05129)	(0.01460)	(0.10437)	(0.08209)
D(IR)	-0.003030	-0.014834	0.018831	0.015372	-0.146254
	(0.00264)	(0.01989)	(0.00566)	(0.04047)	(0.03183)
D(POPULATI...	-0.007970	-0.031038	0.018617	-0.036875	-0.006195
	(0.00299)	(0.02252)	(0.00641)	(0.04582)	(0.03604)
D(UNEMPLO...	0.005004	0.002201	-0.000529	0.167712	-0.026566
	(0.00449)	(0.03379)	(0.00962)	(0.06876)	(0.05409)

6 Cointegrating Equation(s): Log likelihood -492.4257

Normalized cointegrating coefficients (standard error in parentheses)

COMPENSAT...	FX	HOUSING	INFLATION	IR	POPULATION	UNEMPLOYMENT
1.000000	0.000000	0.000000	0.000000	0.000000	0.000000	4.982252
						(0.75667)
0.000000	1.000000	0.000000	0.000000	0.000000	0.000000	0.110170
						(0.18736)
0.000000	0.000000	1.000000	0.000000	0.000000	0.000000	1.880665
						(0.83748)
0.000000	0.000000	0.000000	1.000000	0.000000	0.000000	-0.003509
						(0.06572)
0.000000	0.000000	0.000000	0.000000	1.000000	0.000000	-0.149920
						(0.09442)
0.000000	0.000000	0.000000	0.000000	0.000000	1.000000	-0.040087
						(0.01887)

Adjustment coefficients (standard error in parentheses)

D(COMPENS...	-0.086980	0.042858	0.051513	-0.729170	-0.058085	-1.190606
	(0.03758)	(0.22453)	(0.06294)	(0.42931)	(0.39005)	(1.08892)
D(FX)	-0.006027	-0.303919	0.072596	0.313256	-0.321830	0.119833
	(0.01121)	(0.06698)	(0.01878)	(0.12808)	(0.11636)	(0.32486)
D(HOUSING)	-0.053906	0.230401	-0.063052	-0.370021	-0.022200	-0.271302
	(0.02360)	(0.14103)	(0.03953)	(0.26965)	(0.24500)	(0.68396)
D(INFLATION)	-0.019661	0.090755	-0.011117	-0.476782	0.112409	-0.005165
	(0.00913)	(0.05457)	(0.01530)	(0.10435)	(0.09481)	(0.26467)
D(IR)	-0.004884	-0.009138	0.017438	0.015307	-0.160737	-0.056811
	(0.00352)	(0.02106)	(0.00590)	(0.04027)	(0.03659)	(0.10215)
D(POPULATI...	-0.008753	-0.028632	0.018028	-0.036902	-0.012314	-0.754840
	(0.00401)	(0.02395)	(0.00671)	(0.04579)	(0.04161)	(0.11615)
D(UNEMPLO...	0.003881	0.005652	-0.001373	0.167673	-0.035341	0.101010
	(0.00601)	(0.03594)	(0.01007)	(0.06872)	(0.06244)	(0.17431)

Spain – ADF test

Null Hypothesis: HOUSING has a unit root
Exogenous: Constant
Lag Length: 2 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.545496	0.0091
Test critical values:	1% level	-3.513344	
	5% level	-2.897678	
	10% level	-2.586103	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(HOUSING)
Method: Least Squares
Date: 05/18/21 Time: 15:15
Sample (adjusted): 2000Q4 2020Q4
Included observations: 81 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
HOUSING(-1)	-0.020019	0.005646	-3.545496	0.0007
D(HOUSING(-1))	0.504010	0.102325	4.925593	0.0000
D(HOUSING(-2))	0.407600	0.101727	4.006785	0.0001
C	2.459488	0.692098	3.553672	0.0007

R-squared	0.828047	Mean dependent var	0.541211
Adjusted R-squared	0.821347	S.D. dependent var	2.762963
S.E. of regression	1.167831	Akaike info criterion	3.196296
Sum squared resid	105.0149	Schwarz criterion	3.314540
Log likelihood	-125.4500	Hannan-Quinn criter.	3.243737
F-statistic	123.5986	Durbin-Watson stat	2.092322
Prob(F-statistic)	0.000000		

Null Hypothesis: UNEMPLOYMENT has a unit root
Exogenous: Constant
Lag Length: 3 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.885435	0.3375
Test critical values:	1% level	-3.513344	
	5% level	-2.897678	
	10% level	-2.586103	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(UNEMPLOYMENT)
Method: Least Squares
Date: 05/18/21 Time: 15:23
Sample (adjusted): 2001Q1 2021Q1
Included observations: 81 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
UNEMPLOYMENT(-1)	-0.016217	0.008601	-1.885435	0.0632
D(UNEMPLOYMENT(-1))	0.874742	0.110445	7.920139	0.0000
D(UNEMPLOYMENT(-2))	-0.294115	0.148813	-1.976405	0.0517
D(UNEMPLOYMENT(-3))	0.239546	0.118746	2.017294	0.0472
C	0.269077	0.144896	1.857038	0.0672

R-squared	0.641923	Mean dependent var	0.049794
Adjusted R-squared	0.623077	S.D. dependent var	0.694205
S.E. of regression	0.426200	Akaike info criterion	1.191926
Sum squared resid	13.80515	Schwarz criterion	1.339732
Log likelihood	-43.27301	Hannan-Quinn criter.	1.251228
F-statistic	34.06128	Durbin-Watson stat	2.024517
Prob(F-statistic)	0.000000		

Null Hypothesis: FX has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.525527	0.1132
Test critical values:	1% level	-3.511262	
	5% level	-2.896779	
	10% level	-2.585626	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(FX)
Method: Least Squares
Date: 05/18/21 Time: 15:14
Sample (adjusted): 2000Q3 2021Q1
Included observations: 83 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
FX(-1)	-0.066410	0.026296	-2.525527	0.0135
D(FX(-1))	0.286300	0.102925	2.781631	0.0067
C	6.549269	2.565861	2.552464	0.0126

R-squared	0.147135	Mean dependent var	0.101394
Adjusted R-squared	0.125814	S.D. dependent var	1.022310
S.E. of regression	0.955839	Akaike info criterion	2.783020
Sum squared resid	73.09018	Schwarz criterion	2.870448
Log likelihood	-112.4953	Hannan-Quinn criter.	2.818143
F-statistic	6.900765	Durbin-Watson stat	2.023086
Prob(F-statistic)	0.001719		

Null Hypothesis: POPULATION has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.139504	0.6968
Test critical values:	1% level	-3.510259	
	5% level	-2.896346	
	10% level	-2.585396	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(POPULATION)
Method: Least Squares
Date: 05/18/21 Time: 21:18
Sample (adjusted): 2000Q2 2021Q1
Included observations: 84 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
POPULATION(-1)	-0.031261	0.027434	-1.139504	0.2578
C	0.005720	0.007217	0.792537	0.4303

R-squared	0.015588	Mean dependent var	-4.16E-05
Adjusted R-squared	0.003583	S.D. dependent var	0.047285
S.E. of regression	0.047200	Akaike info criterion	-3.245322
Sum squared resid	0.182683	Schwarz criterion	-3.187446
Log likelihood	138.3035	Hannan-Quinn criter.	-3.222056
F-statistic	1.298469	Durbin-Watson stat	1.969051
Prob(F-statistic)	0.257811		

Null Hypothesis: IR has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.100724	0.2450
Test critical values:	1% level	-3.511262	
	5% level	-2.896779	
	10% level	-2.585626	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(IR)
Method: Least Squares
Date: 05/18/21 Time: 15:15
Sample (adjusted): 2000Q3 2021Q1
Included observations: 83 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
IR(-1)	-0.035453	0.016876	-2.100724	0.0388
D(IR(-1))	0.577117	0.086701	6.656420	0.0000
C	0.025759	0.040259	0.639843	0.5241

R-squared	0.366700	Mean dependent var	-0.057897
Adjusted R-squared	0.350868	S.D. dependent var	0.336259
S.E. of regression	0.270920	Akaike info criterion	0.261485
Sum squared resid	5.871792	Schwarz criterion	0.348913
Log likelihood	-7.851648	Hannan-Quinn criter.	0.296609
F-statistic	23.16126	Durbin-Watson stat	1.884501
Prob(F-statistic)	0.000000		

Null Hypothesis: INFLATION has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.900853	0.0495
Test critical values:	1% level	-3.511262	
	5% level	-2.896779	
	10% level	-2.585626	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(INFLATION)
Method: Least Squares
Date: 05/18/21 Time: 15:14
Sample (adjusted): 2000Q3 2021Q1
Included observations: 83 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
INFLATION(-1)	-0.141626	0.048822	-2.900853	0.0048
D(INFLATION(-1))	0.328644	0.108942	3.016679	0.0034
C	0.262660	0.123492	2.126938	0.0365

R-squared	0.148261	Mean dependent var	-0.031136
Adjusted R-squared	0.126967	S.D. dependent var	0.737032
S.E. of regression	0.688655	Akaike info criterion	2.127324
Sum squared resid	37.93969	Schwarz criterion	2.214752
Log likelihood	-85.28393	Hannan-Quinn criter.	2.162447
F-statistic	6.962722	Durbin-Watson stat	2.030835
Prob(F-statistic)	0.001630		

Null Hypothesis: COMPENSATION has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.097608	0.2462
Test critical values:	1% level	-3.510259	
	5% level	-2.896346	
	10% level	-2.585396	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(COMPENSATION)
Method: Least Squares
Date: 05/18/21 Time: 15:13
Sample (adjusted): 2000Q2 2021Q1
Included observations: 84 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
COMPENSATION(-1)	-0.038607	0.018405	-2.097608	0.0390
C	4.298652	1.784718	2.408589	0.0183

R-squared	0.050925	Mean dependent var	0.598208
Adjusted R-squared	0.039351	S.D. dependent var	2.527885
S.E. of regression	2.477648	Akaike info criterion	4.676018
Sum squared resid	503.3768	Schwarz criterion	4.733895
Log likelihood	-194.3928	Hannan-Quinn criter.	4.699284
F-statistic	4.399960	Durbin-Watson stat	2.307578
Prob(F-statistic)	0.039019		

Spain – Johansen test

Date: 05/18/21 Time: 15:24
Sample (adjusted): 2000Q4 2021Q1
Included observations: 82 after adjustments
Trend assumption: Linear deterministic trend
Series: COMPENSATION FX IR POPULATION UNEMPLOYMENT
Lags interval (in first differences): 1 to 2

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.419597	99.41375	69.81889	0.0000
At most 1 *	0.284204	54.80304	47.85613	0.0097
At most 2	0.188995	27.38551	29.79707	0.0925
At most 3	0.111603	10.20807	15.49471	0.2651
At most 4	0.006134	0.504499	3.841465	0.4775

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.419597	44.61071	33.87687	0.0018
At most 1	0.284204	27.41753	27.58434	0.0525
At most 2	0.188995	17.17744	21.13162	0.1638
At most 3	0.111603	9.703570	14.26460	0.2321
At most 4	0.006134	0.504499	3.841465	0.4775

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

COMPENSAT...	FX	IR	POPULATION	UNEMPLOYMENT
0.114943	-0.119063	0.901437	8.896612	0.168455
-0.063251	-0.041139	0.007514	-8.556887	-0.307207
-0.057230	0.412014	0.202755	-13.98357	-0.371141
0.119064	-0.279837	1.060463	1.122065	0.254239
-0.027922	0.040624	0.414282	5.628736	0.317911

Unrestricted Adjustment Coefficients (alpha):

D(COMPENS...	0.428487	0.233985	0.157325	-0.610966	0.097053
D(FX)	0.184042	0.148783	-0.362526	0.008899	-9.69E-05
D(IR)	-0.008884	-0.053859	-0.017774	-0.051518	-0.012870
D(POPULATI...	-0.009744	0.019772	0.006778	0.000540	-0.000581
D(UNEMPLO...	0.137362	0.002085	0.065527	0.086336	-0.008921

1 Cointegrating Equation(s): Log likelihood -152.8198

Normalized cointegrating coefficients (standard error in parentheses)

COMPENSAT...	FX	IR	POPULATION	UNEMPLOYMENT
1.000000	-1.035845	7.842472	77.40021	1.465551
	(0.44231)	(1.19202)	(18.3972)	(0.59805)

Adjustment coefficients (standard error in parentheses)

D(COMPENS...	0.049252
	(0.03210)
D(FX)	0.021154
	(0.01245)
D(IR)	-0.001021
	(0.00344)
D(POPULATI...	-0.001120
	(0.00058)
D(UNEMPLO...	0.015789
	(0.00493)

2 Cointegrating Equation(s): Log likelihood -139.1110

Normalized cointegrating coefficients (standard error in parentheses)

COMPENSAT...	FX	IR	POPULATION	UNEMPLOYMENT
1.000000	0.000000	2.951954	112.9577	3.548840
		(1.78023)	(26.6242)	(0.87519)
0.000000	1.000000	-4.721286	34.32706	2.011198
		(1.79804)	(26.8904)	(0.88394)

Adjustment coefficients (standard error in parentheses)

D(COMPENS...	0.034452	-0.060643
	(0.03645)	(0.03500)
D(FX)	0.011744	-0.028033
	(0.01401)	(0.01346)
D(IR)	0.002385	0.003273
	(0.00384)	(0.00368)
D(POPULATI...	-0.002371	0.000347
	(0.00059)	(0.00057)
D(UNEMPLO...	0.015657	-0.016441
	(0.00562)	(0.00540)

3 Cointegrating Equation(s): Log likelihood -130.5223

Normalized cointegrating coefficients (standard error in parentheses)

COMPENSAT...	FX	IR	POPULATION	UNEMPLOYMENT
1.000000	0.000000	0.000000	140.5570	4.818689
			(35.9132)	(1.21738)
0.000000	1.000000	0.000000	-9.814634	-0.019770
			(9.62426)	(0.32624)
0.000000	0.000000	1.000000	-9.349507	-0.430173
			(4.36316)	(0.14790)

Adjustment coefficients (standard error in parentheses)

D(COMPENS...	0.025448	0.004177	0.419911
	(0.03968)	(0.11943)	(0.25612)
D(FX)	0.032491	-0.177399	0.093516
	(0.01398)	(0.04207)	(0.09021)
D(IR)	0.003403	-0.004050	-0.012017
	(0.00418)	(0.01257)	(0.02695)
D(POPULATI...	-0.002759	0.003139	-0.007261
	(0.00063)	(0.00191)	(0.00409)
D(UNEMPLO...	0.011907	0.010557	0.137125
	(0.00603)	(0.01816)	(0.03894)

4 Cointegrating Equation(s): Log likelihood -125.6705

Normalized cointegrating coefficients (standard error in parentheses)

COMPENSAT...	FX	IR	POPULATION	UNEMPLOYMENT
1.000000	0.000000	0.000000	0.000000	7.001683
				(1.83446)
0.000000	1.000000	0.000000	0.000000	-0.172201
				(0.16567)
0.000000	0.000000	1.000000	0.000000	-0.575380
				(0.15056)
0.000000	0.000000	0.000000	1.000000	-0.015531
				(0.01120)

Adjustment coefficients (standard error in parentheses)

D(COMPENS...	-0.047296	0.175148	-0.227996	-1.075609
	(0.04979)	(0.13738)	(0.37611)	(4.99666)
D(FX)	0.033551	-0.179890	0.102953	5.443625
	(0.01818)	(0.05016)	(0.13732)	(1.82431)
D(IR)	-0.002731	0.010367	-0.066650	0.572568
	(0.00531)	(0.01465)	(0.04010)	(0.53276)
D(POPULATI...	-0.002694	0.002988	-0.006689	-0.350051
	(0.00082)	(0.00227)	(0.00622)	(0.08268)
D(UNEMPLO...	0.022186	-0.013603	0.228681	0.384795
	(0.00761)	(0.02099)	(0.05747)	(0.76345)

Switzerland – ADF test

Null Hypothesis: HOUSING has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		2.579649	1.0000
Test critical values:	1% level	-3.511262	
	5% level	-2.896779	
	10% level	-2.585626	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(HOUSING)
Method: Least Squares
Date: 05/18/21 Time: 14:35
Sample (adjusted): 2 84
Included observations: 83 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
HOUSING(-1)	0.013971	0.005416	2.579649	0.0117
C	-0.554410	0.464671	-1.193124	0.2363

R-squared	0.075918	Mean dependent var	0.624303
Adjusted R-squared	0.064510	S.D. dependent var	0.795699
S.E. of regression	0.769606	Akaike info criterion	2.337925
Sum squared resid	47.97573	Schwarz criterion	2.396210
Log likelihood	-95.02387	Hannan-Quinn criter.	2.361340
F-statistic	6.654588	Durbin-Watson stat	1.677570
Prob(F-statistic)	0.011697		

Null Hypothesis: FX has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.702885	0.4261
Test critical values:	1% level	-3.510259	
	5% level	-2.896346	
	10% level	-2.585396	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(FX)
Method: Least Squares
Date: 05/18/21 Time: 14:35
Sample (adjusted): 2 85
Included observations: 84 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
FX(-1)	-0.059013	0.034655	-1.702885	0.0924
C	6.102724	3.488212	1.749528	0.0839

R-squared	0.034156	Mean dependent var	0.174719
Adjusted R-squared	0.022377	S.D. dependent var	2.055630
S.E. of regression	2.032500	Akaike info criterion	4.279932
Sum squared resid	338.7467	Schwarz criterion	4.337809
Log likelihood	-177.7571	Hannan-Quinn criter.	4.303198
F-statistic	2.899816	Durbin-Watson stat	1.840489
Prob(F-statistic)	0.092377		

Null Hypothesis: COMPENSATION has a unit root
Exogenous: Constant
Lag Length: 7 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.407239	0.5746
Test critical values:	1% level	-3.517847	
	5% level	-2.899619	
	10% level	-2.587134	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(COMPENSATION)
Method: Least Squares
Date: 05/18/21 Time: 14:34
Sample (adjusted): 9 85
Included observations: 77 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
COMPENSATION(-1)	-0.026610	0.018910	-1.407239	0.1639
D(COMPENSATION(-1))	1.089878	0.245759	4.434749	0.0000
D(COMPENSATION(-2))	-5.234720	0.287134	-18.23091	0.0000
D(COMPENSATION(-3))	13.24187	0.658215	20.11784	0.0000
D(COMPENSATION(-4))	-4.169386	1.581485	-2.636375	0.0104
D(COMPENSATION(-5))	-2.588763	1.641947	-1.576642	0.1195
D(COMPENSATION(-6))	-4.526911	1.653564	-2.737669	0.0079
D(COMPENSATION(-7))	4.398522	1.286503	3.418975	0.0011
C	1.560702	1.832710	0.851582	0.3974

R-squared	0.976946	Mean dependent var	-0.920938
Adjusted R-squared	0.974234	S.D. dependent var	12.13731
S.E. of regression	1.948266	Akaike info criterion	4.281225
Sum squared resid	258.1104	Schwarz criterion	4.555177
Log likelihood	-155.8272	Hannan-Quinn criter.	4.390803
F-statistic	360.1992	Durbin-Watson stat	1.930598
Prob(F-statistic)	0.000000		

Null Hypothesis: INFLATION has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.693024	0.0059
Test critical values:	1% level	-3.511262	
	5% level	-2.896779	
	10% level	-2.585626	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(INFLATION)
Method: Least Squares
Date: 05/18/21 Time: 14:38
Sample (adjusted): 3 85
Included observations: 83 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
INFLATION(-1)	-0.205257	0.055580	-3.693024	0.0004
D(INFLATION(-1))	0.377437	0.103370	3.651319	0.0005
C	0.071617	0.053425	1.340530	0.1839

R-squared	0.209969	Mean dependent var	-0.024559
Adjusted R-squared	0.190219	S.D. dependent var	0.482340
S.E. of regression	0.434047	Akaike info criterion	1.204150
Sum squared resid	15.07178	Schwarz criterion	1.291578
Log likelihood	-46.97221	Hannan-Quinn criter.	1.239273
F-statistic	10.63096	Durbin-Watson stat	2.050656
Prob(F-statistic)	0.000080		

Null Hypothesis: IR has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.717747	0.0753
Test critical values:	1% level	-3.511262	
	5% level	-2.896779	
	10% level	-2.585626	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(IR)
Method: Least Squares
Date: 05/18/21 Time: 14:38
Sample (adjusted): 3 85
Included observations: 83 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
IR(-1)	-0.052086	0.019165	-2.717747	0.0081
D(IR(-1))	0.488310	0.087722	5.566556	0.0000
C	-0.001475	0.026480	-0.055721	0.9557

R-squared	0.312083	Mean dependent var	-0.048438
Adjusted R-squared	0.294885	S.D. dependent var	0.261074
S.E. of regression	0.219227	Akaike info criterion	-0.161946
Sum squared resid	3.844827	Schwarz criterion	-0.074518
Log likelihood	9.720752	Hannan-Quinn criter.	-0.126822
F-statistic	18.14657	Durbin-Watson stat	2.016916
Prob(F-statistic)	0.000000		

Null Hypothesis: POPULATION has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.529084	0.0000
Test critical values:	1% level	-3.510259	
	5% level	-2.896346	
	10% level	-2.585396	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(POPULATION)
Method: Least Squares
Date: 05/18/21 Time: 21:12
Sample (adjusted): 2 85
Included observations: 84 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
POPULATION(-1)	-0.684082	0.104775	-6.529084	0.0000
C	2.787989	2.607522	1.069210	0.2881

R-squared	0.342047	Mean dependent var	0.001906
Adjusted R-squared	0.334023	S.D. dependent var	28.88972
S.E. of regression	23.57615	Akaike info criterion	9.181870
Sum squared resid	45578.46	Schwarz criterion	9.239747
Log likelihood	-383.6385	Hannan-Quinn criter.	9.205136
F-statistic	42.62894	Durbin-Watson stat	2.032029
Prob(F-statistic)	0.000000		

Null Hypothesis: UNEMPLOYMENT has a unit root
Exogenous: Constant
Lag Length: 5 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.767349	0.0048
Test critical values:	1% level	-3.515536	
	5% level	-2.898623	
	10% level	-2.586605	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(UNEMPLOYMENT)
Method: Least Squares
Date: 05/18/21 Time: 14:40
Sample (adjusted): 7 85
Included observations: 79 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
UNEMPLOYMENT(-1)	-0.162576	0.043154	-3.767349	0.0003
D(UNEMPLOYMENT(-1))	0.558661	0.093289	5.988479	0.0000
D(UNEMPLOYMENT(-2))	-0.161391	0.099716	-1.618504	0.1099
D(UNEMPLOYMENT(-3))	0.030644	0.101936	0.300616	0.7646
D(UNEMPLOYMENT(-4))	0.662554	0.095504	6.937467	0.0000
D(UNEMPLOYMENT(-5))	-0.388053	0.109669	-3.538416	0.0007
C	0.504509	0.132998	3.793360	0.0003

R-squared	0.757082	Mean dependent var	0.024051
Adjusted R-squared	0.736839	S.D. dependent var	0.310589
S.E. of regression	0.159330	Akaike info criterion	-0.751249
Sum squared resid	1.827788	Schwarz criterion	-0.541298
Log likelihood	36.67434	Hannan-Quinn criter.	-0.667136
F-statistic	37.39940	Durbin-Watson stat	1.964950
Prob(F-statistic)	0.000000		

Appendix B: Group Statistics

Austria

	HP	RENT	POP	ER	INF	SRI	UNEMPL	COMP
Mean	88.62546	84.27363	8397.603	101.0356	1.922700	1.686542	4.987083	35134.15
Median	81.62450	81.65761	8351.650	101.5100	1.863393	1.361133	4.966667	34200.95
Maximum	120.3648	115.4427	8896.400	104.6416	3.728705	5.024167	6.200000	48856.90
Minimum	69.96275	61.35935	8003.000	97.24416	0.030989	-0.402967	3.633333	25572.40
Std. Dev.	14.42376	16.36385	262.2315	1.969046	0.781809	1.769476	0.634553	6796.867
Skewness	0.701060	0.376300	0.394780	-0.135711	0.186043	0.439262	-0.225168	0.308803
Kurtosis	2.121714	1.913784	2.088484	1.866272	2.884373	1.828165	2.195558	1.967648
Jarque-Bera	9.124418	5.820906	4.847556	4.530028	0.506058	7.150008	2.833103	4.823959
Probability	0.010439	0.054451	0.088586	0.103829	0.776445	0.028015	0.242549	0.089638
Sum	7090.037	6741.890	671808.2	8082.844	153.8160	134.9233	398.9667	2810732.
Sum Sq. Dev.	16435.54	21154.28	5432464.	306.2943	48.28677	247.3525	31.80999	3.65E+09
Observations	80	80	80	80	80	80	80	80

Belgium

	HP	RENT	POP	ER	INF	SRI	UNEM	COMP
Mean	92.04614	91.26891	10856.68	99.33922	1.968462	1.686542	7.568750	45418.01
Median	98.48764	92.73104	10846.50	100.0234	1.995420	1.361133	7.800000	45523.00
Maximum	107.9352	104.7556	11517.00	105.4362	5.588540	5.024167	8.866667	59355.00
Minimum	65.11792	75.05686	10242.00	91.85067	-1.218893	-0.402967	5.200000	31723.00
Std. Dev.	12.86219	9.005601	415.9688	3.154175	1.151864	1.769476	0.932826	7894.248
Skewness	-0.976401	-0.259872	0.005273	-0.563334	0.090624	0.439262	-0.782012	-0.093355
Kurtosis	2.429690	1.796068	1.525255	2.697600	4.120276	1.828165	2.786815	1.799679
Jarque-Bera	13.79562	5.731954	7.249949	4.536088	4.292896	7.150008	8.305407	4.918774
Probability	0.001010	0.056927	0.026650	0.103514	0.116899	0.028015	0.015722	0.085487
Sum	7363.691	7301.513	868534.0	7947.138	157.4770	134.9233	605.5000	3633441.
Sum Sq. Dev.	13069.45	6406.967	13669374	785.9566	104.8164	247.3525	68.74299	4.92E+09
Observations	80	80	80	80	80	80	80	80

Denmark

	HP	RENT	POP	ER	INF	STIR	UNEM	COMP
Mean	96.05270	88.11954	5547.337	98.06273	1.665184	1.905295	5.638333	231745.5
Median	96.19059	88.02546	5535.500	97.87675	1.693884	1.566133	5.433333	238969.8
Maximum	121.9643	105.5220	5825.000	105.1280	4.182655	5.844900	8.100000	298952.7
Minimum	67.95215	68.57837	5331.000	91.62316	0.132890	-0.423333	3.200000	163387.7
Std. Dev.	15.54036	11.64975	150.0294	3.076762	0.931223	1.925319	1.358177	38430.86
Skewness	-0.149432	-0.064700	0.340185	0.092509	0.213577	0.457419	0.235801	-0.119201
Kurtosis	2.005934	1.639167	1.879519	2.364353	2.178085	1.948016	1.915025	1.989491
Jarque-Bera	3.591624	6.228704	5.727942	1.460932	2.860014	6.478660	4.665264	3.593212
Probability	0.165993	0.044407	0.057042	0.481685	0.239307	0.039190	0.097040	0.165861
Sum	7684.216	7049.563	443787.0	7845.018	133.2147	152.4236	451.0667	18539640
Sum Sq. Dev.	19078.72	10721.61	1778196.	747.8508	68.50700	292.8414	145.7269	1.17E+11
Observations	80	80	80	80	80	80	80	80

Finland

	HP	RENT	POP	ER	INF	STIR	UNEM	COMP
Mean	95.28845	88.19036	5350.228	101.0654	1.499006	1.686542	8.305833	22389.20
Median	100.4753	87.26447	5349.200	100.3155	1.309592	1.361133	8.566667	22907.50
Maximum	104.8445	109.2776	5523.600	108.4609	4.568690	5.024167	10.16667	28162.00
Minimum	73.22185	70.03815	5172.000	94.36496	-1.038485	-0.402967	6.166667	15452.00
Std. Dev.	9.997599	11.73527	118.7439	3.691152	1.239654	1.769476	0.945695	3709.272
Skewness	-1.158957	0.228225	0.018934	0.342737	0.408519	0.439262	-0.587309	-0.327191
Kurtosis	2.743675	1.771814	1.537732	1.970522	2.441692	1.828165	2.441386	1.797647
Jarque-Bera	18.12809	5.722626	7.043051	5.098994	3.264201	7.150008	5.639264	6.246225
Probability	0.000116	0.057194	0.029554	0.078121	0.195518	0.028015	0.059628	0.044020
Sum	7623.076	7055.228	422668.0	8085.234	119.9205	134.9233	664.4667	1791136.
Sum Sq. Dev.	7896.206	10879.62	1099809.	1076.344	121.4027	247.3525	70.65284	1.09E+09
Observations	80	80	79	80	80	80	80	80

France

	HP	RENT	POP	ER	INF	STIR	UNEMP	COMP
Mean	95.43502	90.51447	64632.46	98.95586	1.423583	1.686542	9.131250	254156.6
Median	102.4299	93.54744	64851.95	98.43365	1.578309	1.361133	9.066667	256664.0
Maximum	109.9364	101.0200	67699.50	106.3339	3.304873	5.024167	10.50000	312212.0
Minimum	58.52547	73.71329	60738.00	91.13356	-0.423247	-0.402967	7.266667	184206.0
Std. Dev.	15.90246	9.509546	2060.002	4.459000	0.798592	1.769476	0.783198	37058.31
Skewness	-1.247066	-0.532369	-0.270118	0.086557	-0.270722	0.439262	-0.117515	-0.217513
Kurtosis	3.017734	1.802417	1.878448	1.690857	2.793922	1.828165	2.659276	1.910196
Jarque-Bera	20.73670	8.559576	5.165779	5.812748	1.118767	7.150008	0.571105	4.589731
Probability	0.000031	0.013846	0.075555	0.054674	0.571561	0.028015	0.751599	0.100775
Sum	7634.801	7241.158	5170597.	7916.469	113.8866	134.9233	730.5000	20332526
Sum Sq. Dev.	19978.18	7144.086	3.35E+08	1570.732	50.38218	247.3525	48.45849	1.08E+11
Observations	80	80	80	80	80	80	80	80

Greece

	HP	RENT	POP	ER	INF	STIR	UNEMP	COMP
Mean	130.2642	103.3167	10931.46	94.03886	1.918084	1.861186	15.66208	16574.59
Median	131.5841	101.2149	10936.85	95.64784	2.677417	1.361133	11.51667	16332.95
Maximum	172.8359	124.2832	11122.90	101.9725	5.533818	8.914449	27.86667	21898.90
Minimum	96.67687	79.94526	10719.30	83.89651	-2.377871	-0.402967	7.533333	10328.70
Std. Dev.	25.61434	13.07841	130.2196	4.907706	2.020146	2.171444	6.832926	2708.328
Skewness	0.134887	0.141400	-0.126645	-0.275041	-0.449335	1.166762	0.483423	-0.183871
Kurtosis	1.579683	1.863008	1.731132	1.866348	2.167981	4.182560	1.637168	2.802193
Jarque-Bera	6.966926	4.575755	5.580609	5.292524	4.999551	22.81260	9.307005	0.581204
Probability	0.030701	0.101482	0.061403	0.070916	0.082103	0.000011	0.009528	0.747813
Sum	10421.14	8265.336	874516.4	7523.108	153.4467	148.8949	1252.967	1325967.
Sum Sq. Dev.	51831.47	13512.54	1339614.	1902.761	322.3981	372.4983	3688.422	5.79E+08
Observations	80	80	80	80	80	80	80	80

Switzerland

	HP	RENT	POP	ER	INF	STIR	UNEM	COMP
Mean	83.28633	93.17817	7852.125	100.0680	0.490122	0.621280	3.941413	84992.12
Median	78.89976	95.20447	7809.700	99.07600	0.520518	0.250278	4.252211	85924.70
Maximum	109.6770	102.7156	8603.900	115.4599	2.974479	3.503890	5.074066	106140.3
Minimum	64.71661	80.40201	7239.400	88.68879	-1.374063	-0.839333	1.600000	62986.90
Std. Dev.	14.92490	6.991209	429.6188	6.354885	0.877113	1.275723	0.969089	12651.04
Skewness	0.255896	-0.289107	0.252286	0.114636	0.151406	0.843110	-0.872307	-0.103376
Kurtosis	1.591382	1.591662	1.729683	2.080878	3.214156	2.591986	2.681880	1.656540
Jarque-Bera	7.487117	7.725826	6.227661	2.991172	0.458528	10.03272	10.48293	6.158769
Probability	0.023670	0.021007	0.044430	0.224117	0.795118	0.006629	0.005292	0.045988
Sum	6662.906	7454.254	628170.0	8005.443	39.20977	49.70238	315.3130	6799369.
Sum Sq. Dev.	17597.45	3861.283	14581210	3190.380	60.77684	128.5700	74.19161	1.26E+10
Observations	80	80	80	80	80	80	80	80

Spain

	HP	RENT	POP	ER	INF	STIR	UNEMP	COM
Mean	118.9251	92.00497	44987.44	97.46702	2.099181	1.686542	15.81958	117310.0
Median	114.4240	99.25422	46397.75	98.06513	2.438182	1.361133	14.36667	122504.5
Maximum	165.8736	103.6749	47266.00	105.1203	4.905376	5.024167	26.23333	144818.0
Minimum	78.82855	67.48961	40478.60	88.04796	-1.068739	-0.402967	7.966667	76894.00
Std. Dev.	24.76080	11.36398	2198.671	4.183170	1.553313	1.769476	5.783301	18178.20
Skewness	0.297263	-0.854834	-0.922874	-0.458739	-0.455851	0.439262	0.347501	-0.741518
Kurtosis	1.971163	2.208638	2.291474	2.619858	2.151599	1.828165	1.767587	2.424639
Jarque-Bera	4.706560	11.83072	13.02931	3.287586	5.169948	7.150008	6.672902	8.434790
Probability	0.095057	0.002698	0.001482	0.193246	0.075398	0.028015	0.035563	0.014737
Sum	9514.007	7360.397	3598995.	7797.361	167.9345	134.9233	1265.567	9384802.
Sum Sq. Dev.	48434.69	10202.07	3.82E+08	1382.414	190.6097	247.3525	2642.279	2.61E+10
Observations	80	80	80	80	80	80	80	80

Appendix C: Estimation model excluding monetary interventions

Austria

	Change of Variable				SHORT TERM CHANGE			
	2020Q1	2020Q2	2020Q3	2020Q4	2020Q1	2020Q2	2020Q3	2020Q4
INF(-1)	0.55	-0.83	0.37	-0.21	0.02	-0.04	0.02	-0.01
ER(-1)	0.23	1.23	1.95	0.28	0.01	0.03	0.05	0.01
COMP(-1)	-270.50	-3,477.10	2,451.70	974.30	0.00	0.00	0.00	0.00
POP(-1)	9.00	6.60	13.00	8.90	0.00	0.00	-0.01	0.00
SRI(-1)	0.00	0.10	-0.17	-0.05	0.00	0.00	-0.01	0.00
UNEMPL(-1)	0.23	1.00	0.07	-0.07	0.00	-0.01	0.00	0.00

	HP without Monetary Inververtion				
	2019Q4	2020Q1	2020Q2	2020Q3	2020Q4
Estimated HP	120.36	120.39	120.38	120.43	120.42
	Difference to actual HP				
	2019Q4	2020Q1	2020Q2	2020Q3	2020Q4
Actual HP	120.36	122.32	124.81	127.14	127.71
Difference	0.00	1.93	4.44	6.71	7.28

	Change of Variable				LONG-TERM CHANGE			
	2020Q1	2020Q2	2020Q3	2020Q4	2020Q1	2020Q2	2020Q3	2020Q4
D(INF(-1))	0.55	-0.83	0.37	-0.21	0.01	-0.01	0.00	0.00
D(ER(-1))	0.23	1.23	1.95	0.28	0.00	-0.01	-0.01	0.00
D(COMP(-1))	-270.50	-3,477.10	2,451.70	974.30	0.00	-0.05	0.03	0.01
D(POP(-1))	9.00	6.60	13.00	8.90	0.00	0.00	0.00	0.00
D(SRI(-1))	0.00	0.10	-0.17	-0.05	0.00	0.00	0.00	0.00
D(UNEMPL(-1))	0.23	1.00	0.07	-0.07	0.00	0.01	0.00	0.00

	HP without Monetary Inververtion				
	2019Q4	2020Q1	2020Q2	2020Q3	2020Q4
	120.36	120.37	120.31	120.33	120.34
	Difference to actual HP				
	2019Q4	2020Q1	2020Q2	2020Q3	2020Q4
Actual HP	120.36	122.32	124.81	127.14	127.71
Difference	0.00	1.95	4.51	6.81	7.36

Belgium

	Change of Variable				SHORT TERM CHANGE			
	2020Q1	2020Q2	2020Q3	2020Q4	2020Q1	2020Q2	2020Q3	2020Q4
INF(-1)	0.50	-0.49	0.27	-0.26	-0.01	0.01	-0.01	0.01
ER(-1)	0.19	1.68	1.77	-0.16	-0.01	-0.05	-0.05	0.00
COMP(-1)	-1,236.00	-3,857.00	4,370.00	-235.00	-0.09	-0.27	0.31	-0.02
POP(-1)	10.00	-1.00	11.00	13.00	-0.02	0.00	-0.02	-0.03
SRI(-1)	0.00	0.10	-0.17	-0.05	0.00	-0.01	0.02	0.01
UNEMPL(-1)	-0.20	0.07	1.23	-0.47	0.00	0.00	-0.02	0.01

	HP without Monetary Inververtion				
	2019Q4	2020Q1	2020Q2	2020Q3	2020Q4
Estimated HP	107.94	107.81	107.50	107.72	107.70
	Difference to actual HP				
	2019Q4	2020Q1	2020Q2	2020Q3	2020Q4
Actual HP	107.94	107.83	109.50	109.76	113.48
Difference	0.00	0.01	2.00	2.04	5.79

	Change of Variable				LONG-TERM CHANGE			
	2020Q1	2020Q2	2020Q3	2020Q4	2020Q1	2020Q2	2020Q3	2020Q4
D(INF(-1))	0.50	-0.49	0.27	-0.26	0.00	0.00	0.00	0.00
D(ER(-1))	0.19	1.68	1.77	-0.16	0.00	0.00	0.00	0.00
D(COMP(-1))	-1,236.00	-3,857.00	4,370.00	-235.00	-0.01	-0.03	0.03	0.00
D(POP(-1))	10.00	-1.00	11.00	13.00	0.00	0.00	0.00	0.00
D(SRI(-1))	0.00	0.10	-0.17	-0.05	0.00	0.00	0.00	0.00
D(UNEMPL(-1))	-0.20	0.07	1.23	-0.47	0.00	0.00	0.00	0.00

	HP without Monetary Inververtion				
	2019Q4	2020Q1	2020Q2	2020Q3	2020Q4
	107.94	107.92	107.90	107.93	107.92
	Difference to actual HP				
	2019Q4	2020Q1	2020Q2	2020Q3	2020Q4
Actual HP	107.94	107.83	109.50	109.76	113.48
Difference	0.00	-0.10	1.60	1.83	5.56

Denmark

	Change of Variable				SHORT TERM CHANGE			
	2020Q1	2020Q2	2020Q3	2020Q4	2020Q1	2020Q2	2020Q3	2020Q4
INF(-1)	-0.07	-0.52	0.42	-0.06	0.00	0.03	-0.02	0.00
ER(-1)	0.05	1.44	1.42	0.08	0.00	-0.02	-0.02	0.00
COMP(-1)	457.20	-5,178.40	5,805.20	5,498.30	0.00	0.05	-0.06	-0.06
POP(-1)	-1.00	1.00	6.00	8.00	0.00	0.00	0.01	0.01
SRI(-1)	0.02	0.25	-0.07	-0.01	0.00	-0.01	0.00	0.00
UNEMPL(-1)	-0.17	0.63	0.63	-0.20	0.00	-0.01	-0.01	0.00

	HP without Monetary Invervention				
	2019Q4	2020Q1	2020Q2	2020Q3	2020Q4
	114.82	114.82	114.87	114.77	114.73

	Difference to actual HP				
	2019Q4	2020Q1	2020Q2	2020Q3	2020Q4
Actual HP	114.82	115.37	115.83	120.78	126.04
Difference	0.00	0.56	0.96	6.00	11.31

	Change of Variable				LONG-TERM CHANGE			
	2020Q1	2020Q2	2020Q3	2020Q4	2020Q1	2020Q2	2020Q3	2020Q4
D(INF(-1))	-0.07	-0.52	0.42	-0.06	0.00	0.00	0.00	0.00
D(ER(-1))	0.05	1.44	1.42	0.08	0.00	0.00	0.00	0.00
D(COMP(-1))	457.20	-5,178.40	5,805.20	5,498.30	0.00	0.01	-0.01	-0.01
D(POP(-1))	-1.00	1.00	6.00	8.00	0.00	0.00	0.00	0.00
D(SRI(-1))	0.02	0.25	-0.07	-0.01	0.00	0.00	0.00	0.00
D(UNEMPL(-1))	-0.17	0.63	0.63	-0.20	0.00	-0.01	-0.01	0.00

	HP without Monetary Invervention				
	2019Q4	2020Q1	2020Q2	2020Q3	2020Q4
Estimated HP	114.818329	114.820128	114.814837	114.795616	114.788503

	Difference to actual HP				
	2019Q4	2020Q1	2020Q2	2020Q3	2020Q4
Actual HP	114.818329	115.373711	115.832143	120.777867	126.042568
Difference	0.00	0.55	1.02	5.98	11.25

Finland

	Change of Variable				SHORT TERM CHANGE			
	2020Q1	2020Q2	2020Q3	2020Q4	2020Q1	2020Q2	2020Q3	2020Q4
INF(-1)	0.03	-0.99	0.49	-0.11	0.00	-0.02	0.01	0.00
ER(-1)	0.02	1.37	1.83	0.02	0.00	0.05	0.07	0.00
COMP(-1)	-96.00	-1,544.00	1,230.00	110.00	-0.13	-2.16	1.72	0.15
POP(-1)	2.00	0.40	1.50	4.20	-0.08	-0.02	-0.06	-0.17
SRI(-1)	0.00	0.10	-0.17	-0.05	0.00	0.00	0.00	0.00
UNEMPL(-1)	0.03	0.90	0.67	-0.23	0.03	0.76	0.56	-0.20

	HP without Monetary Invervention				
	2019Q4	2020Q1	2020Q2	2020Q3	2020Q4
	100.85	100.67	99.29	101.59	101.37

	Difference to actual HP				
	2019Q4	2020Q1	2020Q2	2020Q3	2020Q4
Actual HP	100.85	102.06	101.87	102.25	103.70
Difference	0.00	1.40	2.58	0.65	2.33

	Change of Variable				LONG-TERM CHANGE			
	2020Q1	2020Q2	2020Q3	2020Q4	2020Q1	2020Q2	2020Q3	2020Q4
D(INF(-1))	0.03	-0.99	0.49	-0.11	0.00	0.00	0.00	0.00
D(ER(-1))	0.02	1.37	1.83	0.02	0.00	0.00	0.00	0.00
D(COMP(-1))	-96.00	-1,544.00	1,230.00	110.00	0.00	-0.01	0.01	0.00
D(POP(-1))	2.00	0.40	1.50	4.20	0.00	0.00	0.00	0.00
D(SRI(-1))	0.00	0.10	-0.17	-0.05	0.00	0.00	0.00	0.00
D(UNEMPL(-1))	0.03	0.90	0.67	-0.23	0.00	0.00	0.00	0.00

	HP without Monetary Invervention				
	2019Q4	2020Q1	2020Q2	2020Q3	2020Q4
Estimated HP	100.85	100.85	100.84	100.85	100.85

	Difference to actual HP				
	2019Q4	2020Q1	2020Q2	2020Q3	2020Q4
Actual HP	100.85	102.06	101.87	102.25	103.70
Difference	0.00	1.21	1.03	1.39	2.85

France

	Change of Variable			
	2020Q1	2020Q2	2020Q3	2020Q4
INF(-1)	0.11	-0.90	0.05	-0.27
ER(-1)	-0.27	1.16	1.78	-0.03
COMP(-1)	-7,607.00	-32,253.00	37,376.00	-1,739.00
POP(-1)	45.70	45.60	45.50	45.40
SRI(-1)	0.00	0.10	-0.17	-0.05
UNEMPL(-1)	-0.47	-0.60	1.97	-1.00

SHORT TERM CHANGE			
2020Q1	2020Q2	2020Q3	2020Q4
-0.01	0.09	-0.01	0.03
0.02	-0.07	-0.11	0.00
0.62	2.63	-3.05	0.14
0.05	0.05	0.05	0.05
0.00	-0.06	0.09	0.03
0.35	0.45	-1.48	0.75

	HP without Monetary Invervention				
	2019Q4	2020Q1	2020Q2	2020Q3	2020Q4
Estimated HP	108.11	109.13	112.23	107.73	108.72
	Difference to actual HP				
	2019Q4	2020Q1	2020Q2	2020Q3	2020Q4
Actual HP	108.11	109.90	111.43	112.08	114.52
Difference	0.00	0.77	-0.80	4.36	5.80

	Change of Variable			
	2020Q1	2020Q2	2020Q3	2020Q4
D(INF(-1))	0.11	-0.90	0.05	-0.27
D(ER(-1))	-0.27	1.16	1.78	-0.03
D(COMP(-1))	-7,607.00	-32,253.00	37,376.00	-1,739.00
D(POP(-1))	45.70	45.60	45.50	45.40
D(SRI(-1))	0.00	0.10	-0.17	-0.05
D(UNEMPL(-1))	-0.47	-0.60	1.97	-1.00

LONG-TERM CHANGE			
2020Q1	2020Q2	2020Q3	2020Q4
0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00
0.00	-0.02	0.02	0.00
0.01	0.01	0.01	0.01
0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00

	HP without Monetary Invervention				
	2019Q4	2020Q1	2020Q2	2020Q3	2020Q4
	108.11	108.11	108.11	108.14	108.15
	Difference to actual HP				
	2019Q4	2020Q1	2020Q2	2020Q3	2020Q4
Actual HP	108.11	109.90	111.43	112.08	114.52
Difference	0.00	1.79	3.33	3.94	6.38

Greece

	Change of Variable			
	2020Q1	2020Q2	2020Q3	2020Q4
INF(-1)	0.27	-1.74	-0.52	-0.15
ER(-1)	-0.49	-0.12	0.32	-0.05
COMP(-1)	218.50	-938.90	557.30	-138.40
POP(-1)	-2.70	-3.80	-7.50	-10.90
SRI(-1)	0.00	0.10	-0.17	-0.05
UNEMPL(-1)	-0.63	0.93	-0.17	-0.63

SHORT TERM CHANGE			
2020Q1	2020Q2	2020Q3	2020Q4
0.06	-0.38	-0.11	-0.03
0.03	0.01	-0.02	0.00
0.00	-0.01	0.00	0.00
-0.01	-0.01	-0.02	-0.02
0.00	-0.02	0.03	0.01
-0.03	0.04	-0.01	-0.03

	HP without Monetary Invervention				
	2019Q4	2020Q1	2020Q2	2020Q3	2020Q4
Estimated HP	107.96	108.03	107.66	107.53	107.46
	Difference to actual HP				
	2019Q4	2020Q1	2020Q2	2020Q3	2020Q4
Actual HP	107.96	109.29	107.87	116.04	115.13
Difference	0.00	1.27	0.21	8.51	7.68

	Change of Variable			
	2020Q1	2020Q2	2020Q3	2020Q4
D(INF(-1))	0.27	-1.74	-0.52	-0.15
D(ER(-1))	-0.49	-0.12	0.32	-0.05
D(COMP(-1))	218.50	-938.90	557.30	-138.40
D(POP(-1))	-2.70	-3.80	-7.50	-10.90
D(SRI(-1))	0.00	0.10	-0.17	-0.05
D(UNEMPL(-1))	-0.63	0.93	-0.17	-0.63

LONG-TERM CHANGE			
2020Q1	2020Q2	2020Q3	2020Q4
0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00
0.00	0.00	0.00	-0.01
0.00	0.00	0.00	0.00
0.01	-0.01	0.00	0.01

	HP without Monetary Invervention				
	2019Q4	2020Q1	2020Q2	2020Q3	2020Q4
	107.96	107.97	107.95	107.95	107.95
	Difference to actual HP				
	2019Q4	2020Q1	2020Q2	2020Q3	2020Q4
Actual HP	107.96	109.29	107.87	116.04	115.13
Difference	0.00	1.32	-0.08	8.09	7.18

Switzerland

	Change of Variable				SHORT TERM CHANGE			
	2020Q1	2020Q2	2020Q3	2020Q4	2020Q1	2020Q2	2020Q3	2020Q4
INF(-1)	-0.05	-1.09	0.36	0.17	0.00	-0.02	0.01	0.00
ER(-1)	2.50	1.35	0.52	-0.39	0.00	0.00	0.00	0.00
COMP(-1)	-1,944.00	-5,624.10	6,937.90	-1,970.00	0.00	0.00	0.00	0.00
POP(-1)	15.40	13.40	22.40	12.00	-0.01	-0.01	-0.01	0.00
SRI(-1)	0.03	0.06	-0.10	-0.04	0.00	0.00	0.00	0.00
UNEMPL(-1)	0.16	0.68	0.15	0.06	0.00	0.02	0.00	0.00

	HP without Monetary Invervention				
	2019Q4	2020Q1	2020Q2	2020Q3	2020Q4
Estimated HP	109.68	109.67	109.67	109.67	109.67
	Difference to actual HP				
	2019Q4	2020Q1	2020Q2	2020Q3	2020Q4
Actual HP	109.68	111.61	112.90	115.16	116.57
Difference	0.00	1.94	3.24	5.50	6.90

	Change of Variable				LONG-TERM CHANGE			
	2020Q1	2020Q2	2020Q3	2020Q4	2020Q1	2020Q2	2020Q3	2020Q4
D(INF(-1))	-0.05	-1.09	0.36	0.17	0.00	0.00	0.00	0.00
D(ER(-1))	2.50	1.35	0.52	-0.39	0.00	0.00	0.00	0.00
D(COMP(-1))	-1,944.00	-5,624.10	6,937.90	-1,970.00	0.00	0.00	0.00	0.00
D(POP(-1))	15.40	13.40	22.40	12.00	0.00	0.00	0.00	0.00
D(SRI(-1))	0.03	0.06	-0.10	-0.04	0.00	0.00	0.00	0.00
D(UNEMPL(-1))	0.16	0.68	0.15	0.06	0.00	0.00	0.00	0.00

	HP without Monetary Invervention				
	2019Q4	2020Q1	2020Q2	2020Q3	2020Q4
	109.68	109.68	109.68	109.67	109.67
	Difference to actual HP				
	2019Q4	2020Q1	2020Q2	2020Q3	2020Q4
Actual HP	109.68	111.61	112.90	115.16	116.57
Difference	0.00	1.93	3.23	5.49	6.89

Spain

	Change of Variable				SHORT TERM CHANGE			
	2020Q1	2020Q2	2020Q3	2020Q4	2020Q1	2020Q2	2020Q3	2020Q4
INF(-1)	0.16	-1.26	0.15	-0.22	-0.02	0.19	-0.02	0.03
ER(-1)	-0.23	0.93	1.37	-0.10	0.00	-0.02	-0.02	0.00
COMP(-1)	-1,753.00	-20,607.00	13,854.00	1,991.00	0.01	0.14	-0.09	-0.01
POP(-1)	52.10	5.80	54.80	6.80	-0.01	0.00	-0.01	0.00
SRI(-1)	0.00	0.10	-0.17	-0.05	0.00	-0.02	0.04	0.01
UNEMPL(-1)	0.13	1.53	1.07	-0.40	0.00	0.02	0.01	-0.01

	HP without Monetary Invervention				
	2019Q4	2020Q1	2020Q2	2020Q3	2020Q4
Estimated HP	120.45	120.44	120.75	120.65	120.67
	Difference to actual HP				
	2019Q4	2020Q1	2020Q2	2020Q3	2020Q4
Actual HP	120.45	121.38	121.56	122.58	122.98
Difference	0.00	0.95	0.81	1.94	2.31

	Change of Variable				LONG-TERM CHANGE			
	2020Q1	2020Q2	2020Q3	2020Q4	2020Q1	2020Q2	2020Q3	2020Q4
D(INF(-1))	0.16	-1.26	0.15	-0.22	0.00	0.00	0.00	0.00
D(ER(-1))	-0.23	0.93	1.37	-0.10	0.00	0.00	0.00	0.00
D(COMP(-1))	-1,753.00	-20,607.00	13,854.00	1,991.00	-0.01	-0.08	0.05	0.01
D(POP(-1))	52.10	5.80	54.80	6.80	0.00	0.00	0.00	0.00
D(SRI(-1))	0.00	0.10	-0.17	-0.05	0.00	0.00	0.00	0.00
D(UNEMPL(-1))	0.13	1.53	1.07	-0.40	0.00	0.00	0.00	0.00

	HP without Monetary Invervention				
	2019Q4	2020Q1	2020Q2	2020Q3	2020Q4
	120.45	120.45	120.37	120.42	120.43
	Difference to actual HP				
	2019Q4	2020Q1	2020Q2	2020Q3	2020Q4
Actual HP	120.45	121.38	121.56	122.58	122.98
Difference	0.00	0.93	1.19	2.16	2.55

Appendix C: Non-stationarity tests (chapter 5)

Austria – ADF tests

Null Hypothesis: HP has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=4)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.974490	0.6058
Test critical values:	1% level	-4.080021	
	5% level	-3.468459	
	10% level	-3.161067	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(HP)
Method: Least Squares
Date: 07/27/21 Time: 00:19
Sample (adjusted): 2000Q3 2019Q4
Included observations: 78 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
HP(-1)	-0.062540	0.031674	-1.974490	0.0521
D(HP(-1))	-0.412469	0.102748	-4.014361	0.0001
C	3.553299	2.087908	1.701847	0.0930
@TREND("2000Q1")	0.066872	0.019686	3.396965	0.0011

R-squared	0.290437	Mean dependent var	0.528589
Adjusted R-squared	0.261671	S.D. dependent var	1.698522
S.E. of regression	1.459474	Akaike info criterion	3.643949
Sum squared resid	157.6247	Schwarz criterion	3.764806
Log likelihood	-138.1140	Hannan-Quinn criter.	3.692331
F-statistic	10.09650	Durbin-Watson stat	1.950648
Prob(F-statistic)	0.000012		

Null Hypothesis: D(HP) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=4)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-11.96254	0.0001
Test critical values:	1% level	-3.516676	
	5% level	-2.899115	
	10% level	-2.586866	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(HP,2)
Method: Least Squares
Date: 07/27/21 Time: 00:20
Sample (adjusted): 2000Q3 2019Q4
Included observations: 78 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(HP(-1))	-1.309520	0.109468	-11.96254	0.0000
C	0.684825	0.192250	3.562157	0.0006

R-squared	0.653130	Mean dependent var	0.023822
Adjusted R-squared	0.648566	S.D. dependent var	2.743272
S.E. of regression	1.626263	Akaike info criterion	3.835754
Sum squared resid	200.9997	Schwarz criterion	3.896182
Log likelihood	-147.5944	Hannan-Quinn criter.	3.859944
F-statistic	143.1022	Durbin-Watson stat	1.842484
Prob(F-statistic)	0.000000		

Null Hypothesis: RENT has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 4 (Automatic - based on SIC, maxlag=4)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.851754	0.9555
Test critical values:	1% level	-4.085092	
	5% level	-3.470851	
	10% level	-3.162458	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RENT)
Method: Least Squares
Date: 07/27/21 Time: 00:22
Sample (adjusted): 2001Q2 2019Q4
Included observations: 75 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RENT(-1)	-0.018523	0.021747	-0.851754	0.3973
D(RENT(-1))	0.598521	0.112646	5.313289	0.0000
D(RENT(-2))	-0.645735	0.132218	-4.883885	0.0000
D(RENT(-3))	0.200309	0.129610	1.545472	0.1269
D(RENT(-4))	-0.369564	0.112964	-3.271531	0.0017
C	1.438132	1.192082	1.206403	0.2318
@TREND("2000Q1")	0.023448	0.015251	1.537444	0.1288

R-squared	0.517564	Mean dependent var	0.700316
Adjusted R-squared	0.474996	S.D. dependent var	0.576498
S.E. of regression	0.417714	Akaike info criterion	1.180646
Sum squared resid	11.86497	Schwarz criterion	1.396945
Log likelihood	-37.27423	Hannan-Quinn criter.	1.267012
F-statistic	12.15856	Durbin-Watson stat	1.911218
Prob(F-statistic)	0.000000		

Null Hypothesis: D(RENT) has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=4)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.127117	0.0000
Test critical values:	1% level	-3.517847	
	5% level	-2.899619	
	10% level	-2.587134	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RENT,2)
Method: Least Squares
Date: 07/27/21 Time: 00:23
Sample (adjusted): 2000Q4 2019Q4
Included observations: 77 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(RENT(-1))	-0.761460	0.106840	-7.127117	0.0000
D(RENT(-1),2)	0.427311	0.103831	4.115429	0.0001
C	0.532008	0.090524	5.876995	0.0000

R-squared	0.408399	Mean dependent var	0.006115
Adjusted R-squared	0.392409	S.D. dependent var	0.590033
S.E. of regression	0.459920	Akaike info criterion	1.322652
Sum squared resid	15.65294	Schwarz criterion	1.413969
Log likelihood	-47.92211	Hannan-Quinn criter.	1.359178
F-statistic	25.54210	Durbin-Watson stat	1.908321
Prob(F-statistic)	0.000000		

Belgium – ADF tests

Null Hypothesis: HP has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=4)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.994530	0.9384
Test critical values:	1% level	-4.078420	
	5% level	-3.467703	
	10% level	-3.160627	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(HP)
Method: Least Squares
Date: 07/27/21 Time: 00:51
Sample (adjusted): 2000Q2 2019Q4
Included observations: 79 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
HP(-1)	-0.016015	0.016103	-0.994530	0.3231
C	2.084352	1.169803	1.781797	0.0788
@TREND("2000Q1")	-0.002013	0.008994	-0.223793	0.8235

R-squared	0.089750	Mean dependent var	0.532937
Adjusted R-squared	0.065796	S.D. dependent var	0.826531
S.E. of regression	0.798877	Akaike info criterion	2.426014
Sum squared resid	48.50349	Schwarz criterion	2.515993
Log likelihood	-92.82757	Hannan-Quinn criter.	2.462063
F-statistic	3.746780	Durbin-Watson stat	1.705223
Prob(F-statistic)	0.028061		

Null Hypothesis: D(HP) has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=4)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.035760	0.0021
Test critical values:	1% level	-3.517847	
	5% level	-2.899619	
	10% level	-2.587134	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(HP,2)
Method: Least Squares
Date: 07/27/21 Time: 00:57
Sample (adjusted): 2000Q4 2019Q4
Included observations: 77 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(HP(-1))	-0.562653	0.139417	-4.035760	0.0001
D(HP(-1),2)	-0.306713	0.111128	-2.760003	0.0073
C	0.328224	0.115312	2.846399	0.0057

R-squared	0.463458	Mean dependent var	0.015762
Adjusted R-squared	0.448957	S.D. dependent var	1.051114
S.E. of regression	0.780266	Akaike info criterion	2.379819
Sum squared resid	45.05235	Schwarz criterion	2.471136
Log likelihood	-88.62302	Hannan-Quinn criter.	2.416345
F-statistic	31.96008	Durbin-Watson stat	2.042317
Prob(F-statistic)	0.000000		

Null Hypothesis: RENT has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=4)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.006319	0.9955
Test critical values:	1% level	-4.078420	
	5% level	-3.467703	
	10% level	-3.160627	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RENT)
Method: Least Squares
Date: 07/27/21 Time: 00:51
Sample (adjusted): 2000Q2 2019Q4
Included observations: 79 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RENT(-1)	-0.000125	0.019738	-0.006319	0.9950
C	0.491513	1.493088	0.329192	0.7429
@TREND("2000Q1")	-0.002605	0.007682	-0.339153	0.7354

R-squared	0.119580	Mean dependent var	0.375934
Adjusted R-squared	0.096411	S.D. dependent var	0.176112
S.E. of regression	0.167407	Akaike info criterion	-0.699541
Sum squared resid	2.129911	Schwarz criterion	-0.609562
Log likelihood	30.63189	Hannan-Quinn criter.	-0.663493
F-statistic	5.161229	Durbin-Watson stat	1.620756
Prob(F-statistic)	0.007911		

Null Hypothesis: D(RENT) has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=4)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.811892	0.0042
Test critical values:	1% level	-3.517847	
	5% level	-2.899619	
	10% level	-2.587134	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RENT,2)
Method: Least Squares
Date: 07/27/21 Time: 00:53
Sample (adjusted): 2000Q4 2019Q4
Included observations: 77 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(RENT(-1))	-0.506334	0.132830	-3.811892	0.0003
D(RENT(-1),2)	-0.291768	0.111105	-2.626060	0.0105
C	0.191679	0.053379	3.590895	0.0006

R-squared	0.412189	Mean dependent var	0.000627
Adjusted R-squared	0.396302	S.D. dependent var	0.213069
S.E. of regression	0.165550	Akaike info criterion	-0.720901
Sum squared resid	2.028111	Schwarz criterion	-0.629584
Log likelihood	30.75471	Hannan-Quinn criter.	-0.684375
F-statistic	25.94537	Durbin-Watson stat	2.013591
Prob(F-statistic)	0.000000		

Denmark – ADF test

Null Hypothesis: HP has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=4)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.116372	0.2390
Test critical values:	1% level	-3.516676	
	5% level	-2.899115	
	10% level	-2.586866	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(HP)
Method: Least Squares
Date: 07/27/21 Time: 00:43
Sample (adjusted): 2000Q3 2019Q4
Included observations: 78 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
HP(-1)	-0.021087	0.009964	-2.116372	0.0376
D(HP(-1))	0.794016	0.067928	11.68910	0.0000
C	2.138904	0.971254	2.202208	0.0307

R-squared	0.653671	Mean dependent var	0.585037
Adjusted R-squared	0.644435	S.D. dependent var	2.237687
S.E. of regression	1.334316	Akaike info criterion	3.452418
Sum squared resid	133.5300	Schwarz criterion	3.543060
Log likelihood	-131.6443	Hannan-Quinn criter.	3.488704
F-statistic	70.77842	Durbin-Watson stat	2.124756
Prob(F-statistic)	0.000000		

Null Hypothesis: RENT has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=4)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.973698	0.9999
Test critical values:	1% level	-4.078420	
	5% level	-3.467703	
	10% level	-3.160627	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RENT)
Method: Least Squares
Date: 07/27/21 Time: 00:45
Sample (adjusted): 2000Q2 2019Q4
Included observations: 79 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RENT(-1)	0.027340	0.028078	0.973698	0.3333
C	-1.302883	1.904432	-0.684132	0.4960
@TREND("2000Q1")	-0.015815	0.014138	-1.118661	0.2668

R-squared	0.067237	Mean dependent var	0.467641
Adjusted R-squared	0.042691	S.D. dependent var	0.202677
S.E. of regression	0.198304	Akaike info criterion	-0.360800
Sum squared resid	2.988648	Schwarz criterion	-0.270821
Log likelihood	17.25162	Hannan-Quinn criter.	-0.324752
F-statistic	2.739191	Durbin-Watson stat	1.908230
Prob(F-statistic)	0.071008		

Null Hypothesis: D(HP) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=4)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.947337	0.0446
Test critical values:	1% level	-3.516676	
	5% level	-2.899115	
	10% level	-2.586866	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(HP,2)
Method: Least Squares
Date: 07/27/21 Time: 00:43
Sample (adjusted): 2000Q3 2019Q4
Included observations: 78 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(HP(-1))	-0.204730	0.069463	-2.947337	0.0043
C	0.110205	0.159971	0.688907	0.4930

R-squared	0.102576	Mean dependent var	-0.012033
Adjusted R-squared	0.090767	S.D. dependent var	1.431004
S.E. of regression	1.364515	Akaike info criterion	3.484782
Sum squared resid	141.5045	Schwarz criterion	3.545210
Log likelihood	-133.9065	Hannan-Quinn criter.	3.508972
F-statistic	8.686798	Durbin-Watson stat	2.048382
Prob(F-statistic)	0.004255		

Null Hypothesis: D(RENT) has a unit root
Exogenous: Constant
Lag Length: 3 (Automatic - based on SIC, maxlag=4)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.779105	0.3880
Test critical values:	1% level	-3.520307	
	5% level	-2.900670	
	10% level	-2.587691	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RENT,2)
Method: Least Squares
Date: 07/27/21 Time: 00:46
Sample (adjusted): 2001Q2 2019Q4
Included observations: 75 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(RENT(-1))	-0.344058	0.193388	-1.779105	0.0796
D(RENT(-1),2)	-0.596457	0.180268	-3.308731	0.0015
D(RENT(-2),2)	-0.555747	0.152596	-3.641958	0.0005
D(RENT(-3),2)	-0.431049	0.112617	-3.827553	0.0003
C	0.153425	0.094610	1.621658	0.1094

R-squared	0.542707	Mean dependent var	-0.002506
Adjusted R-squared	0.516576	S.D. dependent var	0.273260
S.E. of regression	0.189994	Akaike info criterion	-0.419308
Sum squared resid	2.526840	Schwarz criterion	-0.264809
Log likelihood	20.72406	Hannan-Quinn criter.	-0.357618
F-statistic	20.76870	Durbin-Watson stat	2.147211
Prob(F-statistic)	0.000000		

Finland – ADF test

Null Hypothesis: HP has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 2 (Automatic - based on SIC, maxlag=4)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.600899	0.7837
Test critical values:	1% level	-4.081666	
	5% level	-3.469235	
	10% level	-3.161518	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(HP)
Method: Least Squares
Date: 07/27/21 Time: 00:35
Sample (adjusted): 2000Q4 2019Q4
Included observations: 77 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
HP(-1)	-0.025633	0.016011	-1.600899	0.1138
D(HP(-1))	0.371589	0.107154	3.467811	0.0009
D(HP(-2))	0.210916	0.108409	1.945558	0.0556
C	2.576073	1.311534	1.964168	0.0534
@TREND("2000Q1")	0.000570	0.007240	0.078703	0.9375

R-squared	0.357968	Mean dependent var	0.320996
Adjusted R-squared	0.322299	S.D. dependent var	1.027951
S.E. of regression	0.846236	Akaike info criterion	2.566693
Sum squared resid	51.56028	Schwarz criterion	2.718889
Log likelihood	-93.81770	Hannan-Quinn criter.	2.627570
F-statistic	10.03598	Durbin-Watson stat	2.160698
Prob(F-statistic)	0.000002		

Null Hypothesis: D(HP) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=4)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.976659	0.0001
Test critical values:	1% level	-3.516676	
	5% level	-2.899115	
	10% level	-2.586866	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(HP,2)
Method: Least Squares
Date: 07/27/21 Time: 00:38
Sample (adjusted): 2000Q3 2019Q4
Included observations: 78 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(HP(-1))	-0.492681	0.098998	-4.976659	0.0000
C	0.140895	0.107930	1.305426	0.1957

R-squared	0.245786	Mean dependent var	-0.003618
Adjusted R-squared	0.235862	S.D. dependent var	1.050239
S.E. of regression	0.918066	Akaike info criterion	2.692212
Sum squared resid	64.05628	Schwarz criterion	2.752641
Log likelihood	-102.9963	Hannan-Quinn criter.	2.716403
F-statistic	24.76714	Durbin-Watson stat	2.136164
Prob(F-statistic)	0.000004		

Null Hypothesis: RENT has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=4)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.346492	0.0665
Test critical values:	1% level	-4.080021	
	5% level	-3.468459	
	10% level	-3.161067	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RENT)
Method: Least Squares
Date: 07/27/21 Time: 00:39
Sample (adjusted): 2000Q3 2019Q4
Included observations: 78 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RENT(-1)	-0.074730	0.022331	-3.346492	0.0013
D(RENT(-1))	0.714066	0.077943	9.161393	0.0000
C	5.144676	1.519327	3.386156	0.0011
@TREND("2000Q1")	0.038836	0.011254	3.450932	0.0009

R-squared	0.552336	Mean dependent var	0.484702
Adjusted R-squared	0.534188	S.D. dependent var	0.631666
S.E. of regression	0.431115	Akaike info criterion	1.205035
Sum squared resid	13.75363	Schwarz criterion	1.325892
Log likelihood	-42.99637	Hannan-Quinn criter.	1.253416
F-statistic	30.43419	Durbin-Watson stat	1.952710
Prob(F-statistic)	0.000000		

France – ADF test

Null Hypothesis: HP has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=4)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.484971	0.1230
Test critical values:	1% level	-3.516676	
	5% level	-2.899115	
	10% level	-2.586866	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(HP)
Method: Least Squares
Date: 07/27/21 Time: 00:28
Sample (adjusted): 2000Q3 2019Q4
Included observations: 78 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
HP(-1)	-0.010845	0.004364	-2.484971	0.0152
D(HP(-1))	0.842725	0.054095	15.57872	0.0000
C	1.141274	0.435996	2.617625	0.0107

R-squared	0.811227	Mean dependent var	0.626996
Adjusted R-squared	0.806193	S.D. dependent var	1.249832
S.E. of regression	0.550220	Akaike info criterion	1.680704
Sum squared resid	22.70562	Schwarz criterion	1.771347
Log likelihood	-62.54745	Hannan-Quinn criter.	1.716990
F-statistic	161.1514	Durbin-Watson stat	2.129694
Prob(F-statistic)	0.000000		

Null Hypothesis: D(HP) has a unit root
Exogenous: None
Lag Length: 0 (Automatic - based on SIC, maxlag=4)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.812684	0.0667
Test critical values:	1% level	-2.594946	
	5% level	-1.945024	
	10% level	-1.614050	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(HP,2)
Method: Least Squares
Date: 07/27/21 Time: 00:28
Sample (adjusted): 2000Q3 2019Q4
Included observations: 78 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(HP(-1))	-0.084087	0.046388	-1.812684	0.0738

R-squared	0.040853	Mean dependent var	0.005058
Adjusted R-squared	0.040853	S.D. dependent var	0.580601
S.E. of regression	0.568618	Akaike info criterion	1.721522
Sum squared resid	24.89614	Schwarz criterion	1.751736
Log likelihood	-66.13936	Hannan-Quinn criter.	1.733617
Durbin-Watson stat	2.111740		

Null Hypothesis: RENT has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=4)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.007689	0.9957
Test critical values:	1% level	-4.080021	
	5% level	-3.468459	
	10% level	-3.161067	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RENT)
Method: Least Squares
Date: 07/27/21 Time: 00:30
Sample (adjusted): 2000Q3 2019Q4
Included observations: 78 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RENT(-1)	6.58E-05	0.008555	0.007689	0.9939
D(RENT(-1))	0.675433	0.087728	7.699142	0.0000
C	0.205122	0.620856	0.330386	0.7420
@TREND("2000Q1")	-0.002416	0.003745	-0.645174	0.5208

R-squared	0.635771	Mean dependent var	0.348244
Adjusted R-squared	0.621005	S.D. dependent var	0.271796
S.E. of regression	0.167325	Akaike info criterion	-0.687843
Sum squared resid	2.071814	Schwarz criterion	-0.566986
Log likelihood	30.82587	Hannan-Quinn criter.	-0.639462
F-statistic	43.05627	Durbin-Watson stat	2.187365
Prob(F-statistic)	0.000000		

Null Hypothesis: D(RENT) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=4)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.084326	0.0319
Test critical values:	1% level	-3.516676	
	5% level	-2.899115	
	10% level	-2.586866	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RENT,2)
Method: Least Squares
Date: 07/27/21 Time: 00:30
Sample (adjusted): 2000Q3 2019Q4
Included observations: 78 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(RENT(-1))	-0.221717	0.071885	-3.084326	0.0028
C	0.077440	0.031671	2.445127	0.0168

R-squared	0.111247	Mean dependent var	0.000293
Adjusted R-squared	0.099553	S.D. dependent var	0.180815
S.E. of regression	0.171579	Akaike info criterion	-0.662242
Sum squared resid	2.237385	Schwarz criterion	-0.601813
Log likelihood	27.82743	Hannan-Quinn criter.	-0.638051
F-statistic	9.513068	Durbin-Watson stat	2.252151
Prob(F-statistic)	0.002844		

Switzerland – ADF test

Null Hypothesis: HP has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=4)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.515676	0.3200
Test critical values:	1% level	-4.078420	
	5% level	-3.467703	
	10% level	-3.160627	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(HP)
Method: Least Squares
Date: 07/27/21 Time: 00:12
Sample (adjusted): 2 80
Included observations: 79 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
HP(-1)	-0.079361	0.031547	-2.515676	0.0140
C	4.844589	1.828152	2.649992	0.0098
@TREND("1")	0.057693	0.020229	2.851947	0.0056

R-squared	0.124431	Mean dependent var	0.569119
Adjusted R-squared	0.101390	S.D. dependent var	0.769952
S.E. of regression	0.729876	Akaike info criterion	2.245351
Sum squared resid	40.48667	Schwarz criterion	2.335330
Log likelihood	-85.69138	Hannan-Quinn criter.	2.281400
F-statistic	5.400361	Durbin-Watson stat	1.746517
Prob(F-statistic)	0.006413		

Null Hypothesis: D(HP) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=4)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.334307	0.0000
Test critical values:	1% level	-3.516676	
	5% level	-2.899115	
	10% level	-2.586866	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(HP,2)
Method: Least Squares
Date: 07/27/21 Time: 00:13
Sample (adjusted): 3 80
Included observations: 78 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(HP(-1))	-0.830855	0.113283	-7.334307	0.0000
C	0.478953	0.107727	4.445986	0.0000

R-squared	0.414448	Mean dependent var	0.012144
Adjusted R-squared	0.406743	S.D. dependent var	0.996594
S.E. of regression	0.767608	Akaike info criterion	2.334231
Sum squared resid	44.78087	Schwarz criterion	2.394660
Log likelihood	-89.03502	Hannan-Quinn criter.	2.358422
F-statistic	53.79206	Durbin-Watson stat	2.042775
Prob(F-statistic)	0.000000		

Spain – ADF test

Null Hypothesis: HP has a unit root
Exogenous: None
Lag Length: 2 (Automatic - based on SIC, maxlag=4)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.307076	0.5719
Test critical values:	1% level	-2.595340	
	5% level	-1.945081	
	10% level	-1.614017	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(HP)
Method: Least Squares
Date: 07/27/21 Time: 00:02
Sample (adjusted): 2000Q4 2019Q4
Included observations: 77 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
HP(-1)	-0.000372	0.001212	-0.307076	0.7596
D(HP(-1))	0.600995	0.110132	5.457054	0.0000
D(HP(-2))	0.325028	0.110507	2.941243	0.0044

R-squared	0.801045	Mean dependent var	0.536564
Adjusted R-squared	0.795668	S.D. dependent var	2.833497
S.E. of regression	1.280828	Akaike info criterion	3.371072
Sum squared resid	121.3985	Schwarz criterion	3.462390
Log likelihood	-126.7863	Hannan-Quinn criter.	3.407598
Durbin-Watson stat	1.993118		

Null Hypothesis: D(HP) has a unit root
Exogenous: None
Lag Length: 3 (Automatic - based on SIC, maxlag=4)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.009149	0.0433
Test critical values:	1% level	-2.596160	
	5% level	-1.945199	
	10% level	-1.613948	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(HP,2)
Method: Least Squares
Date: 07/27/21 Time: 00:03
Sample (adjusted): 2001Q2 2019Q4
Included observations: 75 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(HP(-1))	-0.103924	0.051725	-2.009149	0.0483
D(HP(-1),2)	-0.308705	0.115369	-2.675804	0.0092
D(HP(-2),2)	0.130935	0.120199	1.089320	0.2797
D(HP(-3),2)	0.326696	0.112163	2.912687	0.0048

R-squared	0.252639	Mean dependent var	-0.020659
Adjusted R-squared	0.221060	S.D. dependent var	1.389179
S.E. of regression	1.226056	Akaike info criterion	3.297340
Sum squared resid	106.7281	Schwarz criterion	3.420940
Log likelihood	-119.6503	Hannan-Quinn criter.	3.346692
Durbin-Watson stat	2.018082		

Null Hypothesis: RENT has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=4)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.908582	0.1656
Test critical values:	1% level	-4.080021	
	5% level	-3.468459	
	10% level	-3.161067	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RENT)
Method: Least Squares
Date: 07/27/21 Time: 00:05
Sample (adjusted): 2000Q3 2019Q4
Included observations: 78 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RENT(-1)	-0.006083	0.002091	-2.908582	0.0048
D(RENT(-1))	0.945065	0.035935	26.29916	0.0000
C	0.499953	0.161353	3.098499	0.0027
@TREND("2000Q1")	0.002024	0.001113	1.819103	0.0729

R-squared	0.955031	Mean dependent var	0.455803
Adjusted R-squared	0.953208	S.D. dependent var	0.400215
S.E. of regression	0.086573	Akaike info criterion	-2.005748
Sum squared resid	0.554616	Schwarz criterion	-1.884891
Log likelihood	82.22415	Hannan-Quinn criter.	-1.957366
F-statistic	523.8573	Durbin-Watson stat	2.127165
Prob(F-statistic)	0.000000		

Null Hypothesis: D(RENT) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=4)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.013233	0.7450
Test critical values:	1% level	-3.516676	
	5% level	-2.899115	
	10% level	-2.586866	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RENT,2)
Method: Least Squares
Date: 07/27/21 Time: 00:08
Sample (adjusted): 2000Q3 2019Q4
Included observations: 78 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(RENT(-1))	-0.026162	0.025820	-1.013233	0.3142
C	0.008039	0.015699	0.512065	0.6101

R-squared	0.013328	Mean dependent var	-0.003990
Adjusted R-squared	0.000346	S.D. dependent var	0.090737
S.E. of regression	0.090721	Akaike info criterion	-1.936747
Sum squared resid	0.625504	Schwarz criterion	-1.876319
Log likelihood	77.53313	Hannan-Quinn criter.	-1.912556
F-statistic	1.026641	Durbin-Watson stat	1.953109
Prob(F-statistic)	0.314164		