Inflation uncertainty of Dutch households in COVID-19 pandemic. An empirical analysis

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Abstract

The level of inflation uncertainty among households can partly define their future economic decisions and behavior that leads to changes in real inflation. At the same time inflation uncertainty itself is highly dependent on multiple factors, such as households' economic and demographic characteristics, previous level of inflation, and previous forecast errors of the households. The degree of impact of the above-mentioned factors may vary depending on the current economic situation of the country. Government authorities don't stop discussions on the significance of inflation uncertainty for the levels of future real inflation. Coibion et al. (2020) have even suggested expectation management as a policy tool for Central banks to affect consumers' behavior that could be an innovative approach to control inflation. Therefore, it's highly important to understand the inflation uncertainty of economic participants and how it's being formed.

This paper analyses dependency of inflation uncertainty on microeconomic characteristics of Dutch households and how this uncertainty changed from year 2019 to 2020. The biggest circumstantial difference between these years is the start of a health and economic crisis in 2020 (i.e., the COVID-19 pandemic). The analysis is based on microdata from the Household Survey performed by Dutch National Bank. The main finding of this paper is that there is a weak connection between inflation uncertainty and personal characteristics of a household, and it decreases in the first year of the COVID-19 crisis. The highest uncertainty is observed among male and older respondents, with low education level and those who are retired, though these characteristics appear to be insignificant. It was also found that respondents with higher previous forecast mistakes, with a higher saving incentive and those living in a rented house, have lower uncertainty.

Table of Contents

1. Introduction

From 2014 and up to 2019 the Dutch economy was continuously growing with an average of 2.15% per year and the Netherlands was considered to have a good economic position in the world with stable economic growth (CBS, 2019). In 2019, the annual inflation rate based on consumer prices was 2.67% (O'Neill, 2021). Despite the consecutively positive years, the growth expectations for 2020 were pessimistic. Rabobank predicted that in 2020 the economic growth in the Netherlands would slow down, wages would increase, and the inflation rate would decrease (Nauta, 2020). These expectations contravene the suggestions made by Pettinger et al. (2017) where expectations for higher and not lower inflation led to higher wages.

More than once The Board of Governors of the Federal Reserve System of the United States of America discussed the essence of inflation expectations and the degree of its impact on actual inflation (Rudd (2021)). “If consumers have higher inflation expectations, they are more likely to bargain for higher wages. Higher wages lead to increased costs for firms. The firms, at the same time, increase their prices to protect their profit. This leads to unsatisfied consumers and again for demand for higher wages,” - this explanation was used by Pettinger (2017) in the article on the theoretical role of price expectations in inflation. Considering the importance given to inflation expectations of firms and households for the future actual inflation (Rudd (2021)) and the high heterogeneity in inflation expectations formation between firms and households (Quaiyyum, 2021), it’s crucial to understand what determines and drives households’ inflation uncertainty.

A lot of research has been done to determine how inflation expectations are formed and how they should be measured (Grimme, Henzel, and Wieland (2012), Lyziak (2010)). According to the article of Armantier (2016) which is based on data from the United States, inflation expectations are highly impacted by the combination of current prices of the expenditure basket. Besides the current prices, the inflation expectations can also be impacted by other factors, such as the personal situation of the economic participant, the information he receives and his personal characteristics.

The reason for changes in inflation expectation may also be a crisis situation, such as a newly discovered and spreading virus, coronavirus or COVID-19, that grew into the world pandemic in 2020. The COVID-19 pandemic of 2020 disrupted the economic stability of

many countries around the globe including the Netherlands. This required implementation of emergency plans and radical actions. Numerous enterprises supporting, worker protection and economy stimulating measures were applied to outweigh the negative impact of the pandemic outbreak and lockdown (ILO, 2021). Inflation uncertainty of households is impacted by both, their socioeconomic characteristics such as age, education level, income, the environment they live in (Rumler and Valderrama (2020), Conrad, et al. (2020)), and the current situation in the world is the current inflation rate, implemented monetary policy measures and media coverage of inflation (de Castro Camposa and Teppa (2016), Du Plessis, et al. (2018). This paper analyses the impact of all the above-mentioned factors on households' inflation uncertainty in the Netherlands in 2019 and 2020 considering the start of the COVID-19 pandemic. The paper will investigate if the currently existing findings on inflation uncertainty are true for the Netherlands. This can help to better understand inflation uncertainty as a risk factor that affects macroeconomic variables in the markets that are sensitive to price changes.

2. Literature review

This section presents an overview of the methodologies and the outcomes of published studies to support the hypotheses of the research.

2.1 Households' uncertainty

Jurado et al. (2015) defined economic uncertainty as "the conditional volatility of a disturbance that is unforecastable from the perspective of economic agents". In other words, uncertainty is the future volatility of economic outcomes that is difficult or almost impossible to predict according to the market participants. There are multiple economic identifiers and depending on which element a household is considering, there are several types of uncertainty: inflation uncertainty, income uncertainty, uncertainty in future prices of houses, stock market uncertainty, and uncertainty in social security benefits. All of them are considered important research topics in economics.

Ben-David, Fermand, Kuhnen, and Li (2018) studied US households' uncertainty in their expectations for personal income growth, national house prices growth, and national inflation. The authors analysed the dependency of US households' uncertainty on household characteristics and macroeconomic factors. They used the Survey of consumer expectations from the Federal Reserve Bank in New York to obtain data on households' key personal

characteristics and expectations. The data was pooled for the period from June 2013 to December 2017. They proved that the level of uncertainty depends on the location of the household; uncertainty is lower for households with higher income and individuals holding a college degree. The impact of a college degree on income uncertainty is especially more significant when tested for households with lower income. Using the ordinary least squares (OLS) regressions the authors found that female, non-white, non-college-educated, non-working individuals have a higher level of uncertainty. Besides, age has a U-shaped pattern of expectations uncertainty, which means that young and old individuals are more uncertain than middle-aged ones. Looking at the macroeconomic variables, the authors empirically proved that there is a positive relationship between the country's unemployment rate and expectations uncertainty.

The study of Liberda, Gorecli, and Pechkowski (2002) particularly concentrated on income uncertainty. The paper evaluated income uncertainty in the countries of the European Union. The study used data from 1995 to 1998 which was based on the Household Budget Survey conducted in 12 different European countries. The authors estimated variances of shocks to permanent and transitory income and their average uncertainties. Breaking down the results based on multiple household characteristics offered a better overview of the study outcomes. First, in their findings, the authors reported that the younger in age the head of a household, the higher the estimated variance of the permanent income or the lower the uncertainty of transitory income. Second, the previous findings differ in the case that the head of the family is a female. In that case, the income uncertainty is higher for the permanent component of income. Third, households, where individuals are self-employed, were characterized by higher uncertainty in the transitory component of income compared to the uncertainty level of the permanent component. Finally, households with lower education levels have lower permanent income uncertainty.

Das and van Soest (1997) analysed the subjective expectations of future income of Dutch households using the CentER Internet panel data that at that time was called the Dutch Socio-Economic Panel. The authors tested three income variables: realized income changes in 1984 and 1985, and expected income change in 1985. The results showed that half of the population did not expect any change in their income and that more people expected it to increase rather than decrease. Moreover, households with higher income levels are more likely to expect an increase compared to households with lower income levels. Besides, the income expectations of Dutch households tend to be worse than the actual realized income and tend to be lower for households that experienced a negative income change before.

Christelis, Georgarakos, Jappelli, and van Rooij (2016) investigated consumption uncertainty and how it affects consumer behavior and saving by investigating the household subjective consumption expectations in 2014-2015. The data used in the publication was based on the same CentER Internet panel and focused on Dutch households. The authors estimated the Euler equation framework based on consumption and income risk, but also used other statistical methods, such as OLS, robust regression, and instrumental variables to analyse the data. The study found that subjective consumption expectation data is highly correlated with households' characteristics and points out the existence of a precautionary motive in the households' saving behavior.

Hurd, van Rooij and Winter (2011) used datasets based on US and Dutch households to estimate the relationship between the stock market expectations and future realized investment returns. They found that Dutch households tend to be pessimistic about future returns, so they are not likely to buy stocks. Besides, the stock market price movements have shifted the households' expectations to be more optimistic between 2004 and 2006. Checking on the individual households' characteristics, the paper showed that women have lower expected returns, so they are less likely to own stocks. On the other side, active traders have higher expected returns, so they are more likely to own stocks. The impact of the stock market expectations on the actual stock ownership was estimated as follows: an increase in the expected rate of return of 0.02 increases the stock ownership rate by 0.006 in 2004 and by 0.010 in 2006.

Guiso, Jappelli and Padula (2012) and Dominitz and Manski (2006) analysed the uncertainty of social security benefits. Guiso et al. (2012) concentrated on Italian investors. Their sample included 940 observations of individuals answering the questions of their minimum and maximum expected fraction of labor income, as well as the probabilistic questions about the fraction of labor income being higher than a certain level. Relying on the same assumptions and methods that were previously applied in Guiso et al. (2002), by calculating the subjective distribution of the replacement rate for each individual to define pension uncertainty, the authors investigated the relationship of pension uncertainty with individual characteristics. The main findings were that pension uncertainty had a negative relationship with the age of a person – the closer he was to retirement, the lower the uncertainty was; the pension uncertainty was found to be higher for self-employed and lower for public sector employees; heterogeneity in pension uncertainty was only particularly explained by sociodemographic variables. Dominitz and Manski (2006) used the Survey of Economic Expectations (SEE). They analysed the probabilistic expectations of social security

retirement benefits of 1621 respondents. The respondents were asked similar questions to the ones in the Guiso (2012) paper. The questions were about the highest and the lowest amount of money they would be able to collect from Social Security benefits and the percentage probability that this amount would be higher than a certain level. The findings showed that a big portion of young Americans believed that social security benefits may not have existed when they reached the age of 70. But if the system stayed in place, the respondents expected the future benefits to stay at the same level. One more finding was that the middle-aged people who were nearing their retirement had very little uncertainty about their labor future earnings.

2.2 Inflation uncertainty

The inflation uncertainty has been of longstanding interest to academics. Douglas Mitchell wrote a paper in 1981 (Mitchell, 1981) trying to find the main components that define inflation uncertainty. He tested the cross-sectional standard deviation, as an indicator of inflation uncertainty, of 6-month implied inflation predictions of individuals by constructing three equations: the first one included the average level of expectations as an independent variable, the second one included the variability of inflation, and the third one combined both variables. The result confirmed that the combined equation had the most significant implication. Besides this result, the first two equations with only one of the variables showed that inflationary policies and highly variable past inflation lead to the undesirably higher uncertainty of future inflation rates.

De Castro Camposa and Teppa (2016) also focused on inflation expectations in the Netherlands. They used the answers to the Dutch Household Survey from 2008 to 2014 to analyse the determinants of households' inflation expectations. The authors considered multiple inflation expectation indicators, such as changes in consumer prices in general in the next twelve months, changes in the aggregate real estate price in the next two years, and changes in the price of the own house in the next two years. They concluded that the inflation expectations are formed based on the real market situation and that the housing prices are better tracked by individuals than the prices in general. Also, it was highlighted that even though the inflation rates of the analysed period were relatively low, individuals don't tend to expect deflation.

Rumler and Valderrama (2020) hypothesized that inflation uncertainty is dependent on the people's knowledge of the inflation process and awareness of the Central Bank's actions. The authors created a certain indicator of "financial literacy" based on the households' answers to the Austrian Household Survey. In the Survey the respondents were asked about the inflation indicators, the importance of inflation, their inflation forecast, and their opinion on the optimal level of inflation. The paper converted the answer to all questions into scores that were used to quantify the indicator of financial literacy. The main finding of the paper was that inflation literacy increases the quality of a household's inflation forecasts. Regressions performed by the authors have also shown that people with higher literacy are less certain about their inflation expectations than people with lower inflation literacy. This was explained by the overconfidence of certain individuals.

Du Plessis, Reid, and Siklos (2018) concentrated on household surveys in South Africa from 2006 to 2016 to determine the drivers of inflation expectations. The authors confirmed the previously mentioned studies by proving that demographic characteristics have an impact on inflation expectations. The difference in the results from South Africa was that younger individuals have lower inflation expectations than older ones. Another finding was that the communications of the South African Reserve Bank in interaction with race and income variables are also highly correlated with inflation expectations. This highlights the importance of media coverage of inflation in the formation of households' expectations.

Another study that analysed the impact of information on households' inflation expectations was presented by Conrad, Enders, and Glas (2020). They used the data from the Bundesbank Online Pilot Survey on Consumer Expectations that was conducted in Germany in 2019. The results of this study showed that people of older age, with higher income, higher education level and those in search of a new house tend to be more aware of the current inflation situation and rely on their inflation expectations more on traditional media or the direct channels of the European Central Bank. The younger generation either uses social media as a source of information on monetary policy or isn't interested in it at all. The authors also confirmed that the information channels used by the respondents influence their quantitative predictions more than their life experiences. At the same time, the direction of future inflation is more impacted by the experience, while the information channel is not that important.

Considering the fact that the inflation expectations were often found to be in a relationship with socioeconomic and demographic characteristics of households, Menz and Poppitz (2016) looked for the reasons why inflation expectations and forecast errors were

higher for the households with lower income, lower age and unemployed individuals based on data from Germany in 1999 till 2010. The main determinants of the variability of expectations of this group were found to be household-specific inflation rates and heterogeneous news media consumption. This finding means that the inflation expectations of certain groups of households were highly dependent on the media and that the central banks should consider paying more attention to media coverage.

2.3 Measures of uncertainty

Even though there is a lot of research on inflation, there is no definite and commonly used measure of inflation uncertainty. The measures can be derived from either time-series models, realized forecast errors, or survey-based measures (Grimme, Henzel and Wieland (2012)).

Ben-David et al. (2018) defined the uncertainty in macroeconomic or individual outcomes measure as a standard deviation of the subjective distribution of 12-month expectations provided by the respondents in the Survey of Consumer Expectations for each expectation variable. The paper of Christelis et al. (2016) estimated the distribution of expected consumption using the Dutch National Bank Survey questions on the minimum and maximum next year's consumption, but also the probabilities of the consumption level being higher than certain points. Assuming the subjective distribution is triangular, they defined the mean and standard deviation of expected consumption per household. A similar method was used by Guiso et al. (2002, 2012).

Das and van Soest (1997) used quite a different approach to define the future income uncertainty distribution. If in the previously mentioned papers the authors used the quantitative survey questions that asked households about the probability of their future income being higher than a certain level, Das and Soest (1997) used the qualitative survey questions asking just the expected direction of the change of their future income. They used this variable as an income uncertainty for each household that is positively correlated with the subjective future income distribution and took the actual household's income change in the past as an explanatory variable. Hurd et al. (2011) used the questions from the survey on the probabilities of future stock market returns. The authors estimated a parametric model to obtain the means and variances of the distributions of expected stock market return for everyone.

Binder (2017) suggested a new method of quantifying the uncertainty associated with rounded responses in the previously existing survey data. The author constructed an uncertainty proxy and a time series uncertainty index by dividing all survey respondents into two types: high and low levels of uncertainty. He used a combination of two probability mass functions to define a cross-sectional distribution of survey responses in a certain month. Binder (2017) confirmed the validity of this variable by comparing it with other uncertainty proxies, such as the Economic Policy Uncertainty index and the one-year-horizon macro uncertainty index described by Jurado et al. (2015). Rossmann (2019) analysed the presence of heterogeneity of individual uncertainty calculated according to Binder's (2017) approach. The author separated the survey respondents into three groups: the ones that rounded their answers on inflation expectations, the ones that didn't round and the group that had a "don't know" answer. The paper results showed that the male respondents and the ones with higher education level are significantly less likely to round their answers to the survey. Besides, rounding in survey answers is more likely when there is a higher economic uncertainty in the country.

Quite often the Household Surveys ask their respondents to answer questions on expected price changes in a qualitative format. These are the questions that respondents are asked to answer in words about the degree of future price change. Lyziak (2010) described three types of methods to transform qualitative survey data into quantitative (numerical) measures of inflation expectations: probability, regressions, and logistic function types of methods. The logic of the probability methods is to assign the individual percentages of respondents to the probabilities of future inflation being in certain intervals, also called "sensitivity intervals". This type very much relies on the rate of inflation perceived by each individual before answering the questionnaire and responses of the households. The regression type of method assumes that the relationship between qualitative responses on the future price changes to the survey and expected inflation is the same as the relationship between the current official inflation rates and their perception by the individuals. This relationship can be defined through regression models. And the last type of method is the logistic function. In this case, the quantification is based on three assumptions: there is a common component in the individual's perceived and expected inflation; there is a number assigned to each fraction of respondents with a constant difference from the previous one; all responses are dependent on the difference between the perceived inflation and expected one. A combination of all three assumptions results in inflation expectations to be derived from the survey responses and the perceived inflation. Lyziak (2010) identified the positive and

negative sides of each method and highlighted that each researcher needs to know the method's nature and the assumptions it is based on.

By taking Friedman's (1977) seminal speech on what is the cause and what are the consequences between inflation and inflation uncertainty, Grimme, Henzel, and Wieland (2012) questioned eight different inflation uncertainty measures suggested by the literature. They stated that each calculation is based on a certain assumption, therefore the reliability of each measure needs an analysis. But the research shows that each measure of inflation uncertainty holds valuable information. All measures appear to have a common element, the authors named it "indicator of inflation uncertainty", which eliminates the measurement error. Nevertheless, it was also found that measures differentiate more when the inflation uncertainty is higher. Friedman-Ball hypothesis states that it's more difficult to predict inflation in times when the inflation rates are high, because of the possible change in monetary policy. Grimme et al. (2012) tested this statement and found that inflation uncertainty is higher following increased inflation rates implemented by central banks. At the same time misallocations due to increased inflation uncertainty result in additional economic costs. Therefore, the Friedman-Ball hypothesis was not rejected.

To sum up, there are multiple ways of inflation uncertainty computation existing in the literature. The choice of which measure to use should be made by a researcher based on the data he has, his purposes, and the analysed time frame.

2.4 COVID-19 pandemic

On January the 9th 2020, the World Health Organization (WHO) started talks about the spread of, at that time still unknown, coronavirus in Wuhan, China. Just in a month, the virus (later known as COVID-19) spread to Thailand, Japan, the US, and Europe. On March the 11th 2020, WHO announced the world COVID-19 pandemic.

The Netherlands declared its first coronavirus case on February 27th, 2020, and the first death from COVID-19 on March 6, 2020. Multiple measures directly followed the tragic cases: the Dutch government advised people to work from home if possible, imposed travel restrictions, and announced the closure of schools, restaurants, and other places of social interaction. At that time residents of the Netherlands were lost, nobody knew what to expect, how much time the restrictions would be in place, and how they would impact everyday life. And not only people but also firms and institutions were preparing for a questionable future.

The uncertainty grew not only in personal life but also in the economic environment, which means that inflation would be one of the first economic identifications to be impacted. But the direction of the impact was unknown.

Leandro and Llorens i Jimeno (2020) in their article discussed the uncertain consequences of the COVID-19 outbreak for European inflation from the supply and demand perspective. They argued about the dominance of either upward or downward pressures on inflation and the time-length of the resulting effects. The upward pressures were introduced by decreased production, closure of factories, and disruptions in the supply chain due to the travel restrictions, while downward pressures were from reduced consumption due to countries' lockdowns. It was not clear which of the forces would guide the inflation levels, therefore it was difficult to predict the direction of change. The empirical analysis based on German data in the article showed that the increase in uncertainty caused by the crisis decreases inflation in industrial goods and the service sector while increasing inflation in unprocessed food, increasing unemployment and pushing households to change their behavior toward precautionary saving. The results of Leandro and Llorens i Jimeno (2020) paper were consistent with the research of the Federal Reserve Bank in San Francisco. Leduc and Liu (2020) highlighted a very sharp increase at the beginning of 2020 of the Chicago Board Options Exchange's Volatility Index (VIX) which is a real-time market index representing the market's expectations for volatility over the coming 30 days and is an often-used measure of macroeconomic uncertainty. Besides the conclusion about the impact of COVID-19 uncertainty on the unemployment rate and inflation, the authors estimated the definite numbers: the unemployment rate was assessed to increase by 1 percentage point in 12 months and the inflation was expected to decrease by 2 percentage points in 6 months.

It appears that a rapid shift of consumption and production disruptions create additional uncertainty in economic predictions. Especially people who don't have specific education may feel difficulty trying to forecast the economic outcomes. Interestingly, during the lockdown in France, the inflation fell sharply while the households expected a sharp increase (Gautier, Ulgazi, Vertier (2020)).

Armantier et. al. (2021) analysed how the COVID-19 crisis impacted inflation beliefs in the first 6 months of the COVID-19 pandemic based on the New York Fed's Survey on Consumer Expectations. The 1-month interval of the Survey allowed the authors to analyse the changes in inflation uncertainty throughout the pandemic in 5 different circumstances: before the pandemic was declared by WHO, through the initial pandemic before the lockdown, during the lockdown period, during the re-opening period and in the rebound

period when the number of cases started increasing again. The authors confirmed higher inflation uncertainty in the pandemic and higher inflation disagreement at the short- and medium-term horizons. A big share of households expected the pandemic to result in higher inflation, at the same time the other group of households, especially college-educated, forecasted a decrease in inflation or even deflation. The forecasts of the second group of Survey respondents were closer to the predictions of firms and professional forecasters. The findings also agreed with the results of Leandro and Llorens i Jimeno (2020) on higher precautionary savings by the households in terms of increased uncertainty and added to the existing literature the conclusion about the unchanged heterogeneity in inflation beliefs among different demographic groups before and during the COVID-19 crisis.

Coibion, Gorodnichenko, and Weber (2020) studied the impact of lockdowns on firms, household expectations and behavior. Focusing on households and inflation, the analysis showed that survey participants presented higher uncertainty about future inflation. The authors also stated that such change in households' estimates may have a great impact on the economy, therefore they highlighted the importance of not only evaluating the positive sides of lockdowns, such as saved lives but also considering the negative economic consequences that may happen, such as unemployment and bankruptcy.

So, the COVID-19 pandemic has created huge uncertainty in the world, the changes are dramatic and will last for a prolonged period.

3. Hypotheses

Based on the reviewed literature, it's possible to construct assumptions that are believed to be true for the inflation uncertainty in general. The accuracy of these hypotheses will be tested on the data from the Netherlands.

The effect of household characteristics was studied based on datasets from various countries: Rumler and Valderrama (2020) for data from Austria, Du Plessis et al. (2018) used data from South Africa, Conrad et al. (2020), and Menz et al. (2016) chose data from Germany. Most of them concluded that the inflation uncertainty is higher among the older generation, female heads of households, lower educated people, and persons with low working rank. The impact of inflation shock on inflation uncertainty was studied by Grimme, Henzel, and Wieland (2012). They found that in the short-term inflation uncertainty decreases. But in the long-term, the result became the opposite and showed an increased

inflation uncertainty. From these findings, it's possible to assume that the inflation uncertainty of each group should decrease in 2020 when the world COVID-19 pandemic started. So, the first hypothesis is constructed as follows.

Hypothesis 1. Inflation uncertainty should be higher among the less educated people, younger, females, unemployed, and it should decrease in 2020 compared to 2019 due to the COVID-19 crisis

Grimme, Henzel, and Wieland (2012) stated that high forecast errors in the past increase an individual forecaster's uncertainty about his current point estimate. This can be explained by the decreased confidence that market participants experience after making an inaccurate prediction. Mankiw et al. (2003), on the other hand, tested a rationality null hypothesis stating that previous forecast errors can predict future mispredictions. The autocorrelation results, in this case, showed that individuals don't base their future forecasts on previous errors. It will be interesting to test how the estimations of Dutch households are being impacted by their previous experiences. Therefore the second hypothesis is the following.

Hypothesis 2. Higher forecast errors in the past will lead to increased inflation uncertainty in the following period

High inflation creates a higher uncertainty among households. Grier and Perry (1998) tested this relationship in G7 countries (United States, Germany, Japan, the United Kingdom, Canada, Italy, and France) by calculating monthly inflation uncertainty from 1948 to 1993. The results of the analysis proved the statement: an increase in inflation indeed caused higher inflation uncertainty in all seven countries. In more recent research, Chowdhury (2014) estimated the relationship between inflation and inflation uncertainty in India from 1951 to 2010. The results of his generalized autoregressive conditional heteroscedasticity (GARCH) model were consistent with Grier and Perry (1998) showing a strong positive relationship between inflation and its uncertainty. The same results were shown by Keskek and Orhan (2010) with data from Turkey, Kontonikas (2004) with data from the United Kingdom, and Albulescu et al. (2019) with data from the United States.

When inflation is high, households tend to save more. This statement was proved by Patra et al. (2015). They investigated relationships between savings, growth, and inflation based on panel data from Asia. Even though growth was found not to have an impact on

savings, inflation had a significantly positive influence. On the contrary, Alvi and Fatima's (2017) findings disagree with this hypothesis. They used data from Pakistan from 1972 to 2013 and showed that inflation has a significant and negative impact on domestic savings. Rocher and Stierle (2015) also discuss that for precautionary motives, individuals tend to save more when they expect worse inflation. The estimation of panel data from 25 European Union member states from 2000 to 2012 showed that inflation had a positive impact on savings before the crisis of 2008 but didn't determine the saving levels afterward.

By combining the research discussed, the third hypothesis is constructed.

Hypothesis 3. Households with higher uncertainty will save more

De Castro Camposa and Teppa (2016) showed that households tend to track house prices more than prices in general. From this finding, the last assumption will be that people that own a house will track the changes in the housing market and will be more confident in their inflation forecast.

Hypothesis 4. Households that own a house tend to have lower inflation uncertainty

4. Data and method

4.1 Descriptive statistics

The first step in performing an analysis of inflation uncertainty is to define its calculation mechanism. This paper used the survey-based approach introduced by Bomberger and Frazer (1981) and Batchelor and Dua (1993, 1996). The inflation uncertainty, in this case, relies on the individual forecast at time *t* and the realized inflation at the time point *t*+12 months and is calculated as follows:

$$IU_t^s = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(\pi_{t+12} - \pi_{i,t}^e)^2}$$

Where IU – inflation uncertainty;

π_{t+12} – is the realized 12-month ahead CPI inflation;

$\pi_{i,t}^e$ - is the individual point forecast made at time t.

This study uses data from the 27th (the year 2019) and 28th (the year 2020) Waves of Household Survey conducted by the Dutch National Bank (DNB). The DNB Household Survey (DHS) provides a wide overview of the economic and psychological factors of Dutch households. The DHS consists of 6 questionnaires, but this paper will use data only from 4 of them: General Information on the Household, Household, and Work, Health and Income, and Economic and Psychological Concepts.

The Household's prediction of future inflation is based on the answers of the Head of the Household to the following questions:

- What will be the minimum percentage prices will increase over the next twelve months, do you think?
- What is the maximum percentage prices will increase over the next twelve months, do you think?
- What are the most likely (consumer) price increases over the next twelve months, do you think?

If the respondent thinks the prices will decrease, he can fill in a negative percentage.

Besides the households' answers about the expected price change, the real inflation rate 12 months after the survey took place was needed to calculate the inflation uncertainty. Dutch households were giving answers to the DNB Survey from March to December 2019 and 2020. The Survey provided a week of the year when the respondent filled in his answers. It was defined, which week is related to which month, therefore the inflation rate of the same month in the following year was used as π_{+12}. The inflation rates were taken from the "Centraal Bureau voor de Statistiek" StatLine - the electronic database of Statistics Netherlands (CBS). The March-December 2020 consumer price index (CPI) average reported by CBS was 1,19% and March-December 2021 average CPI was 2,87%. This means that the price of a basket of goods and services consumed by households has increased on average by 1,19% in March-December 2020 and by 2,87% in March-October 2021.

Based on the accessible data two values of uncertainty were calculated. One of them used the minimum and maximum percentages of a price increase according to the respondents. The average of both responses was used as $\pi_{i,t}^{e}$ to calculate the first uncertainty measure, *uncertavepr*. For the second uncertainty measure, *uncertpr0*, the response on the most likely price increase was used as $\pi_{i,t}^{e}$.

As independent variables, the following characteristics of the heads of households were obtained from the same Survey: age, gender, the highest completed level of education, and occupation of the head of the household. Unfortunately, the Survey doesn't provide data on the amount of savings that Dutch households have. But the households were asked about their opinion on the importance of saving and if they were going to save in the following 12 months. The questions were formulated as follows:

- Do you think it makes sense to save money, considering the current general economic situation?
- Is your household planning to put money aside in the next 12 months?

Answers to both questions were used as variables that determine the saving incentive of households.

The definition of each variable and its measurement units can be found in Table 4.1.

Variable	Definition	Value
ID	Unique identifier of the respondent	Numeric value
weeknr	Number of the week when the respons was received	Numeric value: the first four digits identify the year and the last two digits identify the week number
geslacht	Gender of the respondent	Equals 0 if the respondent is female; equals 1 if the respondent is male
age	Age of the respondent	Numeric value
oplmet	Highest level of education completed by the respondent	Equals 0 if the answer is "other"; equals 1 if it's a kindergarden or primary education; equals 2 if it's pre-vocational or pre-university education (VMBO/HAVO/VWO); equals 3 if it's a senior vocational training or vocational college or university education (MBO/HBO/WO)
bezighei	Primary occupation of the respondent	Equals 0 if the answer is "other"; equals 1 if the respondent has a paid job or self-employed; equals 2 if the respondent is looking for a job; equals 3 if the respondent is a student, has an unpaid work, keeping benefit payments or working as a volunteer; equals 4 if the respondent is retired.
woning	Type of the respondent's accomodation	Equals 0 if the house is owner-occupied; equals 1 if the respondent lives in a rented house.

Variable	Definition	Value
laagpr	The minimum percentage prices could increase over the next 12 months after the questionnaire according to the respondent.	Numeric value with one decimal
hoogpr	The maximum percentage prices would increase over the next twelve months after the questionnaire according to the respondent	Numeric value with one decimal
avepr	The average of laagpr and hoogpr	Numeric value with one decimal
pr0	The most likely (consumer)prices increase over the next twelve months after the questionnaire according to the respondent	Numeric value with one decimal
zinvol	Respondent's opinion if it makes sense to save money, considering the current general economic situation	Equals 1 if the respondent answered "certainly no"; equals 2 if the respondent answered "probably no"; equals 3 if the respondent answered "yes, perhaps"; equals 4 if the respondent answered "yes, certainly"; equals 0 if the respondent answered "don't know".
opzij12	Respondent's answer if the household was planning to put money aside in the next 12 months.	Equals 1 if the respondent answered "certainly no"; equals 2 if the respondent answered "probably no"; equals 3 if the respondent answered "yes, perhaps"; equals 4 if the respondent answered "yes, certainly"; equals 0 if the respondent answered "don't know".
InflRateplusyear	Inflation rate (CPI) 12 months after the respondent took the questionnaire	Numeric value with one decimal
uncertavepr	Uncertainty level calculated based on avepr	Numeric value with one decimal
cbuncertavepr	Cube root of uncertavepr	Numeric value with one decimal
uncertpr0	Uncertainty level calculated based on pr0	Numeric value with one decimal
cbuncertpr0	Cube root of uncertpr0	Numeric value with one decimal

Table 4.1 Variables' definitions and measure units

The number of households that participated in the DHS in 2019 and 2020 was 2535 and 2417 respectively. The data was filtered only on the answers from heads of households; rows with empty or irrelevant replies, such as higher than 100 percentages, were deleted. These corrections have decreased the sample of 2019 to 1884 unique answers and the sample

of 2020 was decreased to 1783 observations. The data includes two types of variables: scale and nominal. Scale variables are *age*, *laagpr*, *hoogpr*, *avepr*, *pr0*, *InflRateplusyear*, *uncertavepr* and *uncertpr0*. All others are identified as nominal variables. *Table 4.2* is the summary statistics of the scale variables in 2019 and 2020. Descriptive statistics show that the means of minimum and maximum expected inflation change is comparable in 2019 and 2020 and that there is no big difference. Though it's possible to observe a slight increase of expected inflation change in 2020 by some decimals (for instance, the mean of *hoogpr* is 4.412 in 2019 and is 4.678 in 2020). At the same time, the uncertainty appears to be slightly lower in 2020 (for instance, the mean of *uncertavepr* equals 2.36 in 2019 and equals 2.15 in 2020). Standard deviation is higher in 2020 compared to 2019 for uncertainty calculated based on the most probable inflation rate change (*uncertpr0* is 1.54 in 2020 compared to 1.49 in 2019). While the standard deviation of uncertainty calculated based on the minimum and maximum expected inflation change is lower in 2020 than in 2019 (*uncertavepr* is 4.79 in 2020 compared to 5.27 in 2019). And in total standard deviation is much lower for uncertainty based on the most probable expected inflation change (1.52) than for uncertainty based on minimum and maximum expected inflation change (5.04). This may show that respondents were more consistent about the most probable inflation change in the following year than in its minimum and maximum.

Year	stats	age	laagpr	hoogpr	avepr	pr0	InflRa~r	uncertavepr	uncertpr0
2019	N	1884	1884	1884	1884	1884	1884	1884	1884
	mean	59.33280	2.52217	4.41271	3.46744	2.74045	1.21667	2.36004	1.60828
	sd	16.40192	5.17458	6.09949	5.32080	1.58124	0.10367	5.27152	1.49149
	min	23.0	-6.0	-3.0	-2.5	0.0	0.7	0.0	0.1
	max	96.0	65.0	85.0	66.0	10.0	1.7	64.8	8.9
2020	N	1783	1783	1783	1783	1783	1783	1783	1783
	mean	58.83287	2.52070	4.67812	3.59941	2.97813	2.02210	2.15494	1.35266
	sd	16.10341	5.34204	5.84069	5.00938	1.80692	0.20869	4.78846	1.54523
	min	22.0	-7.1	-5.0	-5.0	0.0	1.4	0.0	0.0
	max	96.0	90.0	80.0	67.5	10.0	3.4	65.6	8.6
Total	N	3667	3667	3667	3667	3667	3667	3667	3667
	mean	59.08972	2.52145	4.54176	3.53161	2.85601	1.60829	2.26031	1.48399
	sd	16.25717	5.25595	5.97572	5.17144	1.69865	0.43450	5.04278	1.52307
	min	22.0	-7.1	-5.0	-5.0	0.0	0.7	0.0	0.0
	max	96.0	90.0	85.0	67.5	10.0	3.4	65.6	8.9

Table 4.2 Descriptive statistics for scale variables

Table 4.3 shows the descriptive statistics for each nominal variable. Reviewing the tables, it's possible to see that:

- there are two times more male heads of households than females;

- the majority of respondents (63.57% in 2019 and 63.6% in 2020) has university or vocational education as the highest completed level;
- the most popular occupation is employment on a contract basis (53.31% in 2019 and 54.29% in 2020);
- most respondents strongly agree that it makes sense to save money in the current economic situation (48.09% in 2019 and 47.06% in 2020);
- most respondents also planned to put money aside in the following 12 months (47.29% in 2019 and 46.72% in 2020);
- around 66% of respondents in both 2019 and 2020 lived in a rented house.

Year	geslacht		
	0	1	Total
2019	33.33	66.67	100
2020	32.75	67.25	100
Total	33.05	66.95	100

Year	oplmet				
	0	1	2	3	Total
2019	0.76	2.44	33.22	63.57	100
2020	0.9	2.36	33.15	63.6	100
Total	0.83	2.4	33.19	63.59	100

Year	bezighei					
	0	1	2	3	4	Total
2019	5.81	53.31	1.63	5.59	33.66	100
2020	6.17	54.29	1.96	4.71	32.87	100
Total	5.99	53.79	1.79	5.16	33.27	100

Year	zinvol					
	0	1	2	3	4	Total
2019	6.32	5.15	14.07	26.38	48.09	100
2020	6.11	5.22	15.93	25.69	47.06	100
Total	6.22	5.18	14.97	26.04	47.59	100

Year	opzij12					
	0	1	2	3	4	Total
2019	6.74	5.04	12.15	28.77	47.29	100
2020	6.28	4.21	13.52	29.28	46.72	100
Total	6.52	4.64	12.82	29.02	47.01	100

Year	woning		
	0	1	Total
2019	33.65	66.35	100
2020	33.54	66.46	100
Total	33.6	66.4	100

Table 4.3 Descriptive statistics for nominal variables

For the comparison, the means of uncertainty per each subgroup were plotted for both years. The plots can be seen in Table 4.4. In 2019 the *uncertavepr* was the highest for

females, for people with kindergarden as the highest education level and those with "other" jobs. In 2020 the plot also showed the highest uncertainty for females, with "other education level" and those looking for a job. The lowest uncertainty in both years was among male respondents, those with unpaid work and people with a university degree. *Uncertpr0* showed a decrease in most of the subgroups. The mean uncertainty of females in 2019 was around 1.7 while the mean of females in 2020 is around 1.4. While checking the education levels, the kindergarden shows the highest uncertainty level in both years and the university/vocational level has the lowest. People searching for a job have the highest uncertainty in 2019, but in 2020 they showed the lowest level.

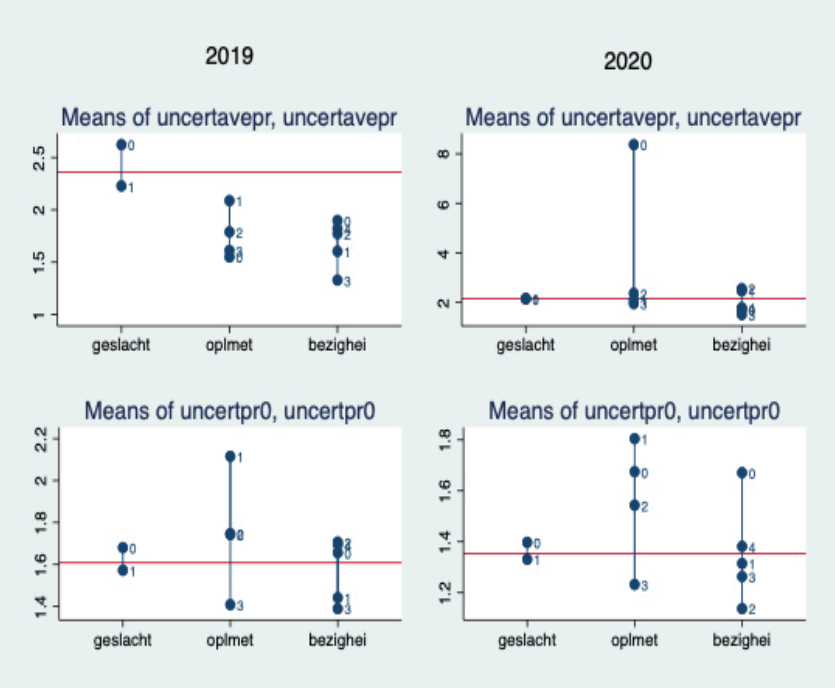

Table 4.4 Means of uncertainty per subgroup

To understand the previous forecast errors made by the households, it was also necessary to obtain the inflation expectations of Dutch Households in 2018 from Wave 26th of DHS. In total 2164 heads of households participated in the questionnaire, but 634 of them didn't answer the questions on inflation expectations, which decreased the sample to 1530 observations. Some households didn't answer questions on inflation expectations in 2019 therefore they were also deleted. This decreased the final dataset to 1223 observations. The inflation rates for 2019 were also obtained from CBS Statline. The average inflation rate in March-December 2019 was 2,67%.

4.2 Data transformation

It's important to understand the dependent variables' distributions. This paper uses the quantile plots to compare the distributions of dependent variables *uncertavepr* and *uncertpr0* with the normal distribution. The quantiles of uncertainties are plotted against the quantiles of a normal distribution. If both illustrated lines lay on each other, then the uncertainty would be normally distributed. The plots of quantile distributions of *uncertavepr* and *uncertpr0* in the first and the third columns of Table 4.5 show that the distributions deviate from the norm and are skewed. The data requires transformation. To bring the distributions closer to normal two new variables were created:

$$cbuncertavepr = \sqrt[4]{uncertavepr}$$

and

$$cbuncertpr0 = \sqrt[4]{uncertpr0}$$

The result of the adjusted distribution can be seen in the second and the fourth columns of Table 4.5. The distributions of *cbuncertavepr* and *cbuncertpr0* are more aligned with normal distribution and already show a data improvement. Nevertheless, the tails of the distributions still deviate a bit and some plotted quantiles are far from the main distribution line. This points out that the data may have outliers. The next step of data transformation is to delete them.

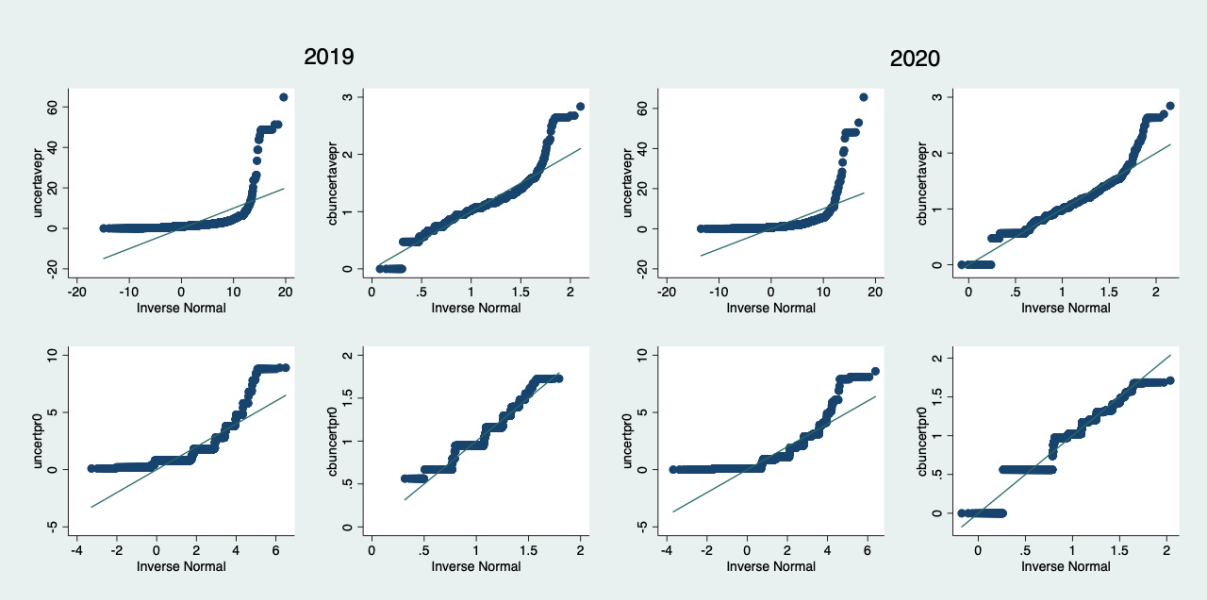

Table 4.5 Distribution plots of dependent variables

To define the outliers this paper uses histograms. The tails of a histogram can clearly illustrate which observations need to be excluded to get rid of the outliers. For *cbuncertavepr* of 2019 the values that are higher than 2 and lower than 0.4 were deleted. While plotting the histogram of cbuncertpr0 of 2019, there were no outliers to delete. The result can be seen in Table 4.6.

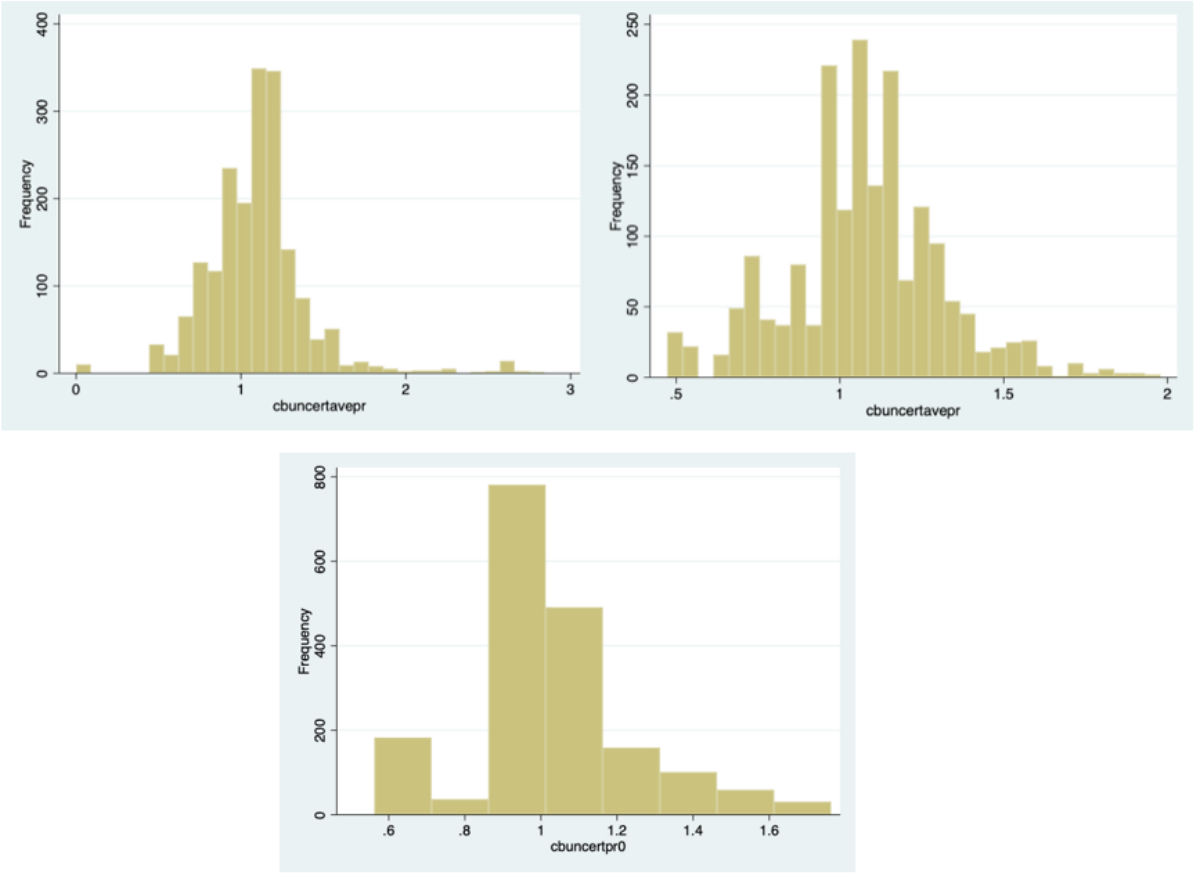

Table 4.6 Histograms of Cbuncertavepr (before and after exclusion of outliers) & Cbuncertpr0 in 2019

The same outliers check was made based on data for 2020. In 2020 the outliers were deleted for both uncertainty variables. For uncertainty *cbuncertavepr* the values lower than 0.5 and higher than 2 were deleted. The variable *cbuncertpr0* didn't show a standard distribution, it had two peak answers that respondents chose the most. This may have happened because people tend to experience extreme response bias while answering a questionnaire (Culpepper, Zimmerman (2006)). This will stay as a limit of the estimations. Still the values lower than 0.4 were excluded. The results can be seen in Table 4.7.

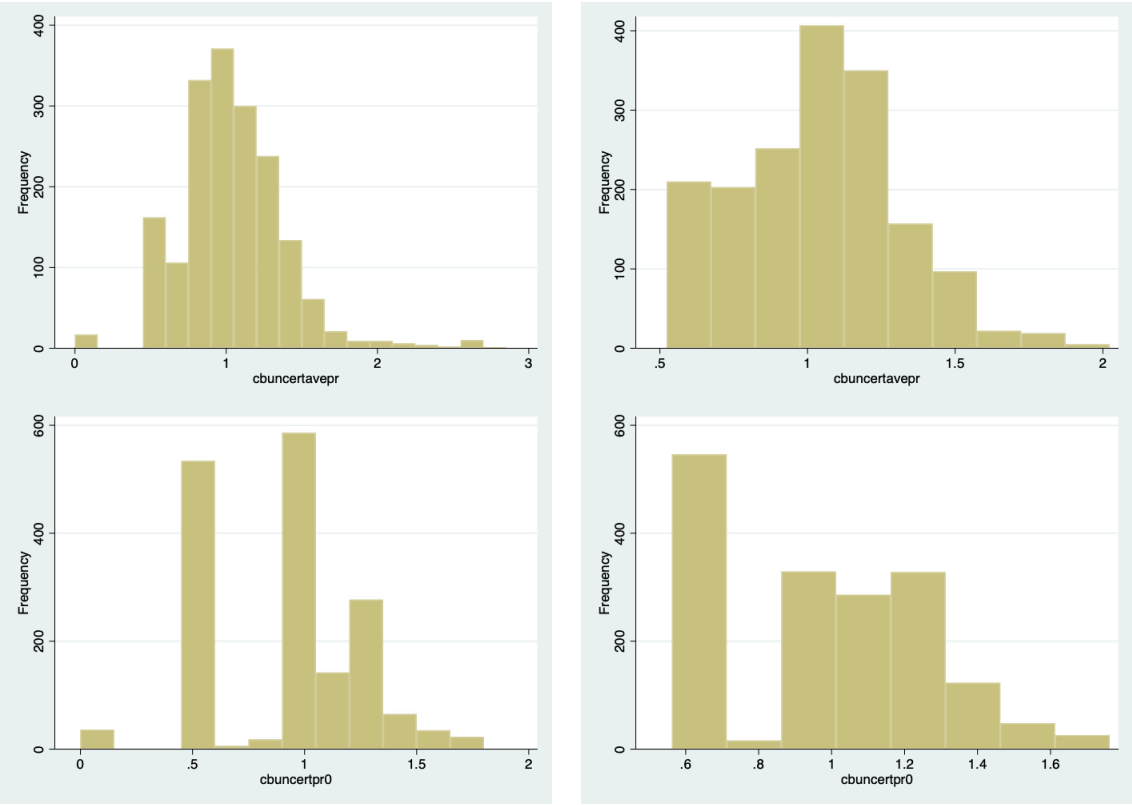

Table 4.7 Histograms of Cbuncertavepr & Cbuncertpr0 before and after exclusion of outliers in 2020

5. Empirical results

After the data transformation and description, the hypotheses were tested.

The first Hypothesis assessed the relationship between a respondent's age, gender, employment and education level, and the inflation uncertainty. The analysis was conducted based on data from two different years (2019 and 2020) with two variables of uncertainty. Therefore, the results consist of four models and can be found in the first four columns of Table 5.1. The findings show a weak connection between both uncertainties and the personal characteristics of the respondent: they explain only 2-3% of uncertainty in 2019 while in 2020 the personal characteristics don't explain the uncertainty almost at all. The 2019 analysis included 1832 observations and 2020 regression data had 1702 observations. While analyzing the *cbuncertavepr* from 2019 (model 1.1), age, the "other" education level and having an unpaid job appeared to be significant at a 5% significance level. Age has a positive coefficient. This means that the higher the age of the respondent, the higher his uncertainty. The "other" education level and having an unpaid job appeared to be with a negative coefficient. This showed that people with "other" education level and people with an unpaid

job have lower uncertainty compared to those with kindergarden and primary school education and those with paid jobs respectively. The gender of the respondent, the pre-university and university education levels, people searching for a job and retirement appear to be insignificant at the 5% significance level. The coefficient of being a male is positive which means that male respondents had higher uncertainty than females. Having a pre-vocational, pre-university, vocational, or university degree has a negative coefficient meaning that these respondents have lower uncertainty than those with the kindergarden or primary school highest completed education. People searching for a job have a negative coefficient while retired respondents have a positive coefficient. This means that these people have lower and higher uncertainty respectively compared to those who have a paid job.

When the *cbuncertpr0* was used as a dependent variable (model 1.2), most coefficients of the independent variables kept the same signs. Only the "searching for a job" answer changed its coefficient from negative to positive, while still being insignificant. The dependence of *cbuncertpr0* on age in 2019 stayed significant and with a positive coefficient. Being a student or having unpaid work lost its significance, while the university degree became significant with a negative coefficient. This means that respondents with a university degree have lower uncertainty than those with kindergarten or primary school education. The age and university or vocational degree are the only significant items in the model. The employment types didn't show any significant impact on *cbuncertpr0*.

The models 1.3 and 1.4 represent data from 2020 and the dependent variables *cbuncertavepr* and *cbuncertpr0*. In model 1.3 age had a positive coefficient while in model 1.4 the coefficient appeared to be negative. The same as the age variable, the male gender had a positive coefficient in model 1.3 and negative in model 1.4. Employment also showed coefficients with different signs while comparing models 1.3 and 1.4. In model 1.3 respondents searching for a job had a positive coefficient while those with an unpaid job or retired had a negative one. In model 1.4 all the employment types had a positive coefficient. The education levels all had a negative coefficient in both models. But all the independent variables in models 1.3&1.4 were insignificant at the 5% significance level.

	2019				2020				2019&2020			
	Model 1.1 cbuncertavepr obs = 1832 R-squared = 0.0269		Model 1.2 cbuncertpr0 obs = 1832 R-squared = 0.0353		Model 1.3 cbuncertavepr obs = 1702 R-squared = 0.0079		Model 1.4 cbuncertpr0 obs = 1832 R-squared = 0.0084		Model 1.5 cbuncertavepr obs = 3504 R-squared = 0.0181		Model 1.6 cbuncertpr0 obs = 3504 R-squared = 0.0467	
	Coef.	P>|t|	Coef.	P>|t|	Coef.	P>|t|	Coef.	P>|t|	Coef.	P>|t|	Coef.	P>|t|
geslacht												
0	0 (base)		0 (base)		0 (base)		0 (base)		0 (base)		0 (base)	
1	0.21676	0.064	0.00810	0.457	0.02758	0.065	-0.00156	0.924	0.02242	0.016	0.00135	0.888
age	0.00118	0.015	0.00109	0.015	0.00068	0.275	-0.00053	0.437	0.00090	0.020	0.00034	0.390
oplmet												
0	-0.16501	0.020	-0.08720	0.185	-0.05548	0.537	-0.12818	0.190	-0.12918	0.023	-0.12021	0.041
1	0 (base)		0 (base)		0 (base)		0 (base)		0 (base)		0 (base)	
2	-0.04902	0.170	-0.05033	0.129	-0.03796	0.406	-0.05450	0.272	-0.04059	0.155	-0.05048	0.087
3	-0.06303	0.075	-0.09679	0.003	-0.06392	0.158	-0.09202	0.062	-0.05792	0.040	-0.09123	0.002
bezighei												
0	0.02550	0.287	0.03159	0.155	-0.01132	0.698	0.07282	0.022	0.00476	0.799	0.04858	0.012
1	0 (base)		0 (base)		0 (base)		0 (base)		0 (base)		0 (base)	
2	-0.00561	0.898	0.04825	0.233	0.03879	0.440	0.00119	0.983	0.01768	0.590	0.02132	0.530
3	-0.05132	0.033	-0.02157	0.334	-0.02869	0.380	0.02498	0.482	-0.04399	0.025	-0.00356	0.861
4	0.01621	0.330	0.01514	0.327	-0.01412	0.507	0.01852	0.423	0.00134	0.920	0.01415	0.302
YearDummy												
0									0 (base)		0 (base)	
1									-0.03820	0.000	-0.09927	0.000

Table 5.1 Regression predicting uncertainty based on household's gender, age, education and employment in 2019 and 2020

As previously mentioned, the models for data from 2020 showed a very low explanation power with R-squared 0.0079 and 0.0084 when the dependent variables were *cbunceravepr* and *cbuncertpr0* respectively. It may have happened because the other not analysed here factors created a higher impact on the uncertainty. Such factors can be changes in a country's economy, personal sudden events, or global economic fluctuations. Indeed in 2020 the spread of the new virus, COVID-19, may have had the biggest impact. When the world enters a global crisis with unknown consequences, people tend to make more chaotic decisions and estimations.

The next step will check how much the mean of the uncertainty for year 2019 is different from the mean of the uncertainty for 2020. As the uncertainty variable is still not normally distributed, Wilcoxon Signed Rank Test, as a non-parametric kind of t-test, was chosen. For clearer results, a new dataset was created: with the use of each household's ID, it was possible to compare the uncertainty of each household in 2019 and 2020. In Table 5.2 the results of the test are illustrated. The null hypothesis of the test was the following: the mean of uncertainty in 2019 is equal to the mean of uncertainty in 2020 (i. e. "H0: cbuncertpr019 = cbuncertpr020" at the bottom of the table). A total of 1582 households were examined. In both cases, while using *uncertpr0* and *uncertavepr* for the comparison, the test showed that there is a significant difference of means in 2019 and 2020 ($z = 13.876$, $p = 0.0000$ for

uncertpr0 and z = 6.616, p = 0.0000 for *uncertavepr*). These results reveal that the COVID year, 2020, had a significant effect on the uncertainty of households.

Wilcoxon signed-rank test			
cbuncertpr0			
sign	obs	sum ranks	expected
positive	894	878052	626058.5
negative	680	374065	626058.5
zero	8	36	36
all	1582	1252153	6572125
H0: cbuncertpr019 = cbuncertpr020 z = 13.876 Prob > |z| = 0.0000			
uncertavepr			
sign	obs	sum ranks	expected
positive	887	746245.5	626008.5
negative	679	505771.5	626008.5
zero	16	136	136
all	1582	1252153	1252153
H0: cbuncertavepr19 = cbuncertavepr20 z = 6.616 Prob > |z| = 0.0000			

Table 5.2 Wilcoxon signed rank test

To understand how much the year impacted uncertainties, additional regressions with the combined 2019 and 2020 datasets were run with a dummy for a year as an additional independent variable. The dummy variable took a value of 0 or 1 if the year was 2019 or 2020 respectively. The results can be seen in the last two columns of Table 5.1: model 1.5 has *uncertavepr* as a dependent variable and model 1.6 has *uncertpr0* as a dependent variable. The regression indicated a significance of a year for both uncertainties at the 5% significance level. Both coefficients were negative, so both variables of uncertainty show a decrease in the COVID year. This result is in line with the hypothesis suggestion and the previous studies on this subject. Regarding the other independent variables, when the *uncertavepr* was taken as a dependent variable, the gender became significant with a positive coefficient for male respondents. This means that men have higher uncertainty than women. The same as in the test results of data from 2019, age is also a significant factor with a positive coefficient, showing that older people have higher uncertainty. Respondents with a university degree or unpaid work have significant negative coefficients, meaning that they have lower uncertainty. The results of the combined dataset with the dependent variable *cbuncertpr0* showed a

significance of a university degree with a negative coefficient. Gender, age and occupation appear to be mainly insignificant.

The Hypothesis 2 analyses the impact of previous forecast mistakes on the current uncertainty. It included 1202 observations in 2019 and 1514 observations in 2020. In Table 5.3 it's possible to see that forecast mistakes of the inflation rate in 2019 (predictions were made in 2018) based on the average of the highest and lowest possible inflation rate (*PredErrorAve19*) appear to be insignificant at the 5% significance level. But if the prediction errors on the most probable change in the inflation rate (*PredErrorPr019*) and uncertainty calculated based on the most probable inflation rate change (*cbuncertpr0*) are taken, the coefficient of the errors appears to be negative and significant with R-squared equal 17.6%. Analysis of 2020 data showed significance for both types of uncertainty with an R-squared of 1% for *cbuncertavepr* and 8% for *cbuncertpr0*. The coefficient of the previous errors is also negative in both cases. This shows that the higher the previous inflation forecast error, the lower uncertainty the respondent has in the current year. The findings contradict the previously defined hypothesis. The explanation of such a result may be that the households consider the previous mistakes in prediction and pay attention to more factors in the following period leads to decreased uncertainty. The lower R-squared in data from 2020 may also suggest that additional important factors appeared that impacted household uncertainty, such as the global pandemic.

	2019		2020	
	Model 2.1 cbuncertavepr obs = 1202 R-squared = 0.0018	Model 2.2 cbuncertpr0 obs = 1202 R-squared = 0.1759	Model 2.3 cbuncertavepr obs = 1514 R-squared = 0.0115	Model 2.4 cbuncertpr0 obs = 1514 R-squared = 0.0840
	Coef. P>|t|	Coef. P>|t|	Coef. P>|t|	Coef. P>|t|
PredErrorAve19	-0.00065 0.143			
PredErrorPr019		-0.06126 0.000		
PredErrorAve20			-0.00556 0.000	
PredErrorPr020				-0.05715 0.000

Table 5.3 Regression analysis of uncertainty based on the previous forecast errors

The 3rd hypothesis examines the saving incentive of households in the Netherlands. As the dependent variables, in this case, were categorical and ordered (*zinvol* and *opzij12*), an ordered logit model was used to make the analysis. The results can be found in Table 5.4 with independent variable *cbuncertavepr* and in Table 5.5 with independent variable *cbuncertpr0*. The model from 2019 showed that the uncertainty, calculated based on the average of the lowest and highest inflation predictions (*cbuncertavepr)*, doesn't impact the intention of

households to save. The coefficients for both *zinvol* and *opzij12* appeared to be insignificant. But the uncertainty based on the predictions of the most probable inflation change (*cbuncertpr0*) showed an opposite, significant, result. The coefficient of *cbuncertpr0* was negative in both cases when the dependent variable was *zinvol* and *opzij12*. This means that the respondents who are more confident that it makes sense to save in the current economic conditions have lower inflation uncertainty. Also, people who plan to put money aside in the following 12 months, have lower uncertainty. The result of the analysis of data from 2020 was consistent with 2019, even though *cbuncertpr0* appeared to be insignificant for *opzij12*. The findings contradict the 3rd hypothesis. The reason for the opposite result to the initially formulated hypothesis can be the unfavorable economic situation. And households that are more confident in the upcoming economic difficulties may save more.

	2019				2020			
	Model 3.1 zinvol obs = 1842 Pseudo R2 = 0.0001		Model 3.2 opzij12 obs = 1842 Pseudo R2 = 0.0001		Model 3.3 zinvol obs = 1686 Pseudo R2 = 0.0007		Model 3.4 opzij12 obs = 1686 Pseudo R2 = 0.0001	
	Coef.	P>|z|	Coef.	P>|z|	Coef.	P>|z|	Coef.	P>|z|
cbuncertavepr	-0.12588	0.482	-0.1479	0.413	-0.27989	0.086	-0.09994	0.538

Table 5.4 Regression analysis of saving incentives with independent variable cbuncertavepr

	2019				2020			
	Model 3.5 zinvol obs = 1842 Pseudo R2 = 0.0012		Model 3.6 opzij12 obs = 1842 Pseudo R2 = 0.0008		Model 3.7 zinvol obs = 1686 Pseudo R2 = 0.0001		Model 3.8 opzij12 obs = 1686 Pseudo R2 = 0.0003	
	Coef.	P>|z|	Coef.	P>|z|	Coef.	P>|z|	Coef.	P>|z|
cbuncertpr0	-0.46633	0.019	-0.66903	0.001	-0.46633	0.019	-0.16523	0.261

Table 5.5 Regression analysis of saving incentives with independent variable cbuncertpr0

With the last regressions, the impact of house ownership by a household on its uncertainty was estimated. The regression was performed to check the final, 4th hypothesis and the results can be seen in Table 5.6. Both uncertainty variables were regressed on *woning*. With the base value, 1 – household lives in a rented house, the coefficient for the owner-occupied house was positive while regressing it with the dependent variable *cbuncertpr0* in both years. Coefficients of *woning* with the dependent variable *cbuncertavepr* were also positive, but insignificant with 5% significance level. It means that households living in owner-occupied houses appear to have higher uncertainty than those living in rented houses.

This may happen, because respondents without their own accommodation may be searching for the best moment to purchase their own home. By analyzing the market, they become more aware of the economic situation and predict inflation better. This result also contradicts the previously defined hypothesis.

	2019				2020			
	Model 4.1 cbuncertavepr obs = 1842 R-squared = 0.0005		Model 4.2 cbuncertpr0 obs = 1842 R-squared = 0.0126		Model 4.3 cbuncertavepr obs = 1686 R-squared = 0.0013		Model 4.4 cbuncertpr0 obs = 1686 R-squared = 0.0117	
	Coef.	P>|t|	Coef.	P>|t|	Coef.	P>|t|	Coef.	P>|t|
0.woning	0.011189	0.346	0.052369	0.000	0.021412	0.136	0.070328	0.000

Table 5.6 Regression analysis of uncertainty based on a house ownership by a household

6. Conclusion

Each market participant bases his decisions partly on the uncertainty he experiences, which leads to trends and changes affecting firms, households, and financial markets. It's possible to say that uncertainty plays a significant role in all economies. There are multiple kinds of uncertainty existing: income, social security, consumption, stock market, or inflation uncertainty. All are being constantly tracked and analysed by governments' researchers, and official organizations to make decisions on countries' economic strategies. They check all the components and factors impacting an uncertainty, which becomes difficult in cases of crisis or shocking events.

2020 was a time that shook the world economy. It became a year of the start of the world pandemic when a newly discovered virus spread through the countries. The virus is widely known as COVID-19 or Coronavirus. Many countries introduced a full lockdown, public places were closed, and people were sent to work from home. The emergence of such an unusual phenomenon as a pandemic, and a sharp change in lifestyle made it hard to predict the behavior of economic participants. As a result, it became more complicated for global and economic leaders to make the right decisions.

This paper focuses on inflation uncertainty. The research analyses the dependency of inflation uncertainty on microeconomic characteristics of households in 2019 and 2020 in the Netherlands. The examined data is taken from the 27th and 28th Waves of Household Survey conducted by the Dutch National Bank. It was found that there is a weak connection between

inflation uncertainty and the personal characteristics of a household. The highest uncertainty is observed among male and older respondents, with low education level and those who are retired. But most of the characteristics appeared to be insignificant. While comparing the uncertainty of Dutch households in 2019 and 2020, the result indicated a significant negative change from one year to another. This part of analysis was in line with existing research by Grimme, Henzel, and Wieland (2012) who concluded that uncertainty lowers in the short-term after a crisis. This means that in the first year the decrease in consumption due to the lockdowns appeared to be a stronger inflation pressure than a pressure of decreased production that was pushing inflation up. The impact of the previous forecast errors on the current uncertainty of households was also examined. The result showed that respondents with higher previous mistakes have lower uncertainty in the current year. The reason for this may be that the households consider the previous mistakes in their predictions and pay attention to more factors in the following period leads to decreased uncertainty. In addition, this paper checked the level of uncertainty experienced by the respondents with saving incentives and by those owning a house. The regressions showed that people that have higher saving incentives tend to have lower uncertainty, even though the impact is mostly insignificant. This one more time contradicts the previously formulated hypothesis based on the existing research. This paper suggests that in case of unfavorable economic situation households that are more confident in the upcoming economic difficulties may save more. The analysis of house ownership by the households also showed contradicted the previous research results. Households living in owner-occupied houses appear to have higher uncertainty than those living in rented houses. This result may indicate that respondents without their own accommodation may be searching for the best moment to purchase their own home. By analyzing the market, they become more aware of the economic situation and predict inflation better.

Existing literature on uncertainty suggests multiple ways, techniques, and options of analysis, so it's recognizable that this paper has its limitations. There is no commonly defined uncertainty measure in the literature. Considering the data accessibility, this research used quite an old approach to calculate uncertainty, which could in some cases be ineffective. The second thing worth mentioning is that the data appeared to be not normally distributed and bi-median. This could become a reason for decreased reliability. The suggestion for further research will be to test more updated uncertainty measures, use a larger dataset that will represent all groups of respondents and will have a longer timeframe to include also long-term effects of the COVID-19 crisis.

7. References

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