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Effects of Macro Uncertainty on Mean Expectation and Subjective Uncertainty: Evidence from Households and Professional Forecasters

Abstract

Macroeconomic uncertainty affects the subjective distribution of individual expectations. Using four panel datasets, we document the effects of macro uncertainty on the mean expectation (first moment) and subjective uncertainty (second moment) of income forecasts. We find that macro uncertainty reduces the mean expectation of income when using professional forecasters' data as most macroeconomic models assume. However, macro uncertainty does not have a monotonic effect on subjective uncertainty. This finding is at odds with most models, which assume higher individual subjective uncertainty as the microfoundation for the impact of uncertainty on decision-making.

JEL-Codes: D800, D900, E700.

Keywords: macroeconomic uncertainty, subjective uncertainty.

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1 Introduction

Recent empirical literature provides substantial evidence that macroeconomic uncertainty (macro uncertainty)[1], measured using a range of proxies, has a negative impact on economic activities (Baker, Bloom, and Davis, 2016; Bloom, 2009; Born, Breuer, and Elstner, 2018; Brogaard, Dai, Ngo, and Zhang, 2020; Ilut and Schneider, 2014; Jurado, Ludvigson, and Ng, 2015). In the field of theoretic macroeconomic models, it is common to connect macro uncertainty to reduced expected utility (first moment) (Gilboa and Schmeidler, 1989; Ilut and Schneider, 2014; Klibanoff et al., 2005) and to increased subjective uncertainty (second moment) (Altug et al., 2020; Bloom, 2014). These relationships lead to decisions that lower economic growth, such as an increase in precautionary saving (Fernández-Villaverde and Guerrón-Quintana, 2020), a delay of investment (Bloom, 2014) and a decrease in asset valuation (Ozoguz, 2009). However, there is a gap in the literature on how uncertainty affects the human learning process. For example, in experimental economics, decision-making under uncertainty could depend on the fairness of choices (Ruz, Moser, and Webster, 2011) and ambiguity aversion (Piccillo and Van Den Hurk, 2020). In cognitive science literature, intolerance to uncertainty (Cristaldi, Mento, Sarlo, and Buodo, 2021), and spatial distancing (Glaser, Lewandowski, and Düsing, 2015) also impact on the perception of uncertainty. The complex mechanism behind how the brain reacts to resolve uncertainty indicates that the assumptions about the monotonic relationships between macro uncertainty and individual expectations might not hold. Hence, this paper contributes to closing the gap in macroeconomic literature dealing with macro uncertainty by providing new empirical evidence on these relationships.

In macroeconomic models, there are two main methods to model macro uncertainty and the effects of macro uncertainty highly depend on the assumed mechanisms specific to the models. The first way is to model macro uncertainty as a shock to the time-varying volatility. In Born and Pfeifer (2021), macro uncertainty shocks variances of total factor productivity and government spending process and can generate limited effects of macro uncertainty on the economy. Fernández-Villaverde and Guerrón-Quintana (2020) introduces macro uncertainty in the volatility of TFP, financial frictions and preference processes and can capture a significant part of economic dynamics. Another way to model macro uncertainty is to impose multiple scenarios and specific microfoundations. Ilut and Schneider (2014) incorporate the multiple prior theory[2] (Gilboa and Schmeidler, 1989) and the Maxmin criterion. They find that macro uncertainty, proxied by forecast disagreement, can explain a significant part of the business cycle variation. Altug, Collard, Çakmaklı, Mukerji, and Özsöylev (2020) applies the smooth ambiguity preference[3] (Klibanoff, Marinacci, and Mukerji, 2005), and macro uncertainty is proxied by

[1] Knight (1921) defines uncertainty as the agent's inability to forecast the likelihood of the events, and Knightian uncertainty is often referred as ambiguity. Ambiguity is different from risks, and Knight defines the concept of risk as a known likelihood of the events. Although the concepts of risk and ambiguity are clearly distinct, they are often difficult to distinguish in the real world. Therefore, in this study, we will refer to uncertainty as a combination of risk and ambiguity, as done in Bloom (2014).

[2] The multiple prior theory states that agents form expectations based on multiple scenarios or priors, and adopt the Maxmin criterion. If the agents are ambiguity averse, they will forecast as if they are in the worst-case scenario.

[3] In the smooth ambiguity preference, ambiguity averse agents prefer to make robust forecasts to reduce their exposures

the standard deviation of the agent's prior which endogenously evolves with the learning process. Their simulations show that lower initial macro uncertainty decreases output volatility.

To shed light on the link between macro uncertainty and individual expectations, we study four panel survey datasets which are EU and US professional forecasters surveys, and Dutch and US household surveys. In the surveys, respondents are asked about the point estimates of their expected incomes or GDP growths. These income expectations are our first dependent variable. Moreover, the surveys provide probabilistic distributions of the respondent's forecasts. From this distribution, we can calculate the standard deviation which is a quantitative measure of subjective uncertainty, our second dependent variable.

Overall, we find evidence supporting that macro uncertainty reduces income expectations when using professional forecaster surveys. Our results also show that macro uncertainty does not always increase and might actually decrease subjective uncertainty in households. We also discuss why ambiguity aversion could possibly explain this puzzle. The outline of this paper is as follows. Section 2 discusses the literature on macro uncertainty, expectations and subjective uncertainty. In section 3, we describe the data and methodology. Section 4 presents our hypotheses and section 5 reports the empirical results. In section 6, we discuss our results, and finally, section 7 concludes.

2 Literature Review

In this section we highlight the empirical literature that is closest to our paper. We focus on studies that use survey data in relation to our three main variables: macro uncertainty, mean expectations and subjective uncertainty.

2.1 Macro uncertainty

Given the broad definition of uncertainty, researchers use several indices for macro uncertainty to study its relationship with economic and financial variables. These indices can be classified into two types. The first type is computed from quantitative data such as stock price volatility and economic forecasts. The second type uses mostly qualitative data and it focuses on the source of uncertainty, such as a policy changes.

One of the most notable consequences of macro uncertainty is financial market volatility, therefore this is one of most common indices, as used in Bloom (2009). Bloom shows that a rise in financial market volatility is often associated with sudden drops and subsequent rebounds in economic activities. Another consequence of macro uncertainty is the reduction in the ability to forecast the economy. Using a broad set of economic data and large scale factor models, Jurado et al. (2015) show that the unfore-

to uncertainty, specifically ambiguity. The extreme ambiguity aversion leads to the Maxmin criterion.

seeable component of financial and macro series can explain economic activities better than the financial market volatility. Finally, the disagreement among the professional forecasters is a famous proxy for macro uncertainty as it reflects the diverse opinion amongst professional forecasters. Ilut and Schneider (2014) demonstrate that SPF disagreement can explain a significant part of the variation in economic growth.

Among the second type of uncertainty indices, the most common one is the Economic Policy Uncertainty (EPU) index. Baker et al. (2016) introduce this index, which is based on the frequency of the news articles containing words related to economy, policy and uncertainty. The authors demonstrate that the rise in policy uncertainty reduces the US's economic activities, especially the sectors that are sensitive to government policy. Moreover, Brogaard et al. (2020) measure the world political uncertainty by the US election cycle. They find that the stock returns of non-US markets fall when the US elections approach, i.e., the uncertainty is high.

All indices are negatively associated with economic growth, confirming the counter-cyclical effect of macro uncertainty. However, the magnitude is sensitive to the assumptions specific to the models (Altug et al., 2020; Bloom, 2014; Born et al., 2018; Born and Pfeifer, 2021; Fernández-Villaverde and Guerrón-Quintana, 2020).

2.2 Expectations

The expectation is the point estimate of the future economic condition made by an individual. The modern theories of decision-making under uncertainty predict that macro uncertainty worsens the expectations of economic prospects (Bloom, 2014; Fernández-Villaverde and Guerrón-Quintana, 2020; Gilboa and Schmeidler, 1989). To empirically study how people form expectations, researchers use survey data of professional forecasters, firms, and households. The forecasting variables range from inflation, GDP to individual income. The following paragraphs highlight relevant stylized facts of point expectations from survey data.

Expectations are asymmetrically sensitive to economic news. Studying GDP expectation revisions of professional forecasters, Dovern (2013) shows that forecasters are more likely to revise their forecasts down during the recessions than to revise them up during the booms. Manzan (2011) demonstrates that US professional forecasters are highly dependent on their priors, and heterogeneously interpret the same information based on their priors. Consequently, an optimistic agent tends to put a relatively low weight on negative signals because these signals do not match with their prior believes.

Based on firms' and households' data, research has shown that asymmetric responses to signals are due to the forecasters' current beliefs and socio-economic status. Using New Zealand firm's survey, Coibion et al. (2018) find that the beliefs about current economic conditions, rather than the actual economic conditions, is positively associated with the predictions of future economic conditions. Baqaee

(2019) shows that US households' inflation forecasts are more responsive to an inflation signal than a deflation signal since people perceive inflation as bad news. Das, Kuhnen, and Nagel (2020) point out that socioeconomic status (SES), consisting of income and education, can substantially explain individual macroeconomic expectations. Using the Michigan Survey of Consumers, they find that low-SES respondents are generally more pessimistic than high-SES respondents. However, during recessions, low-SES agents perceive less negative news than high-SES agents do. In other words, socioeconomic status has an impact on the mean expectation but at a different magnitude across the boom-bust cycle.

Expectations become better when the cost of information decreases. Carroll (2003) compares the forecasts of US households from Michigan's Survey to that of the US professional forecasters. The author finds that household expectation on the US inflation converges to that of the professional forecasters when the news increasingly reports related issues. The intensity of news coverage helps decrease the cost of information, so households have a better forecast that is closer to that of the professional forecasters. Studying the same topic, Lamla and Lein (2014) use German consumer data and investigate both the intensity and content of inflation news. Their finding is consistent that of Carroll (2003). Furthermore, the result suggests that the news intensity improves the households' inflation forecast only if the news does not assess inflation as a bad event.

2.3 Subjective uncertainty

Modern theories of decision-making under uncertainty are not conclusive on how macro uncertainty affects subjective uncertainty (Gilboa and Schmeidler, 1989; Hansen and Sargent, 2019, 2011; Klibanoff et al., 2005; Sims, 2003; Tuckett and Nikolic, 2017). At the same time, empirical studies on subjective uncertainty are few. Subjective uncertainty is proxied by the second moment of subjective forecast distribution. To obtain the subjective forecast distribution, survey respondents have to state the probabilistic histogram of their forecasts. Such information is costly and its quality highly depends on the capacity of forecasters. For example, Clements (2010) find that the US professional forecasters update their point estimates more frequently than their forecast distributions although the survey always asks for both. The author suggests that it is because the cost of updating the distribution is higher than that of the point estimate. This section highlights relevant stylized facts of subjective uncertainty.

Subjective uncertainty depends on economic conditions and the firm's performance. Employing the EU professional forecasters data, Glas and Hartmann (2016) discover that the subjective uncertainty of the inflation forecasts depends negatively on economic growth and positively on monetary policy surprises. However, according to Glas and Hartmann (2016), the change in macro uncertainty, measured in the Economic Policy Uncertainty Index, has no impact on inflation's subjective uncertainty. Altig, Barrero, Bloom, Davis, Meyer, and Parker (2019) use the US firms' survey of business uncertainty. The authors report that the sales' subjective uncertainty increases when their sale growths are volatile. In line with this finding, Bachmann, Carstensen, Lautenbacher, and Schneider (2021) use the survey of

German manufacturing firms and find that the sales' subjective uncertainty increases when the absolute sales growth rate or the absolute forecast error increase.

Subjective uncertainty is found to be negatively associated with forecasters' confidence and is improved when the forecast horizon is shorter. Using the US and EU surveys of professional forecasters, Manzan (2014) discovers that subjective uncertainty is persistent and reduces when the forecast horizon shortens as the forecasters gather more information. In general, forecasters are overconfident (Giordani and Söderlind, 2003), and the overconfidence is stronger in the long forecasting horizon than in the short forecasting horizon (Clements, 2014).

Finally, subjective uncertainty is influenced by socioeconomic status and individual characteristics, regardless of the variables that is forecasted. Ben-David, Fermand, Kuhnen, and Li (2018) use the US consumer expectation survey and document that socioeconomic situations have an impact on households' subjective uncertainty. The households were asked to forecast several variables such as personal income, inflation rate, and unemployment rate. For all forecasting variables, employed people have smaller subjective uncertainty than unemployed people have. Importantly, a person's subjective uncertainties of individual variables are positively correlated although these variables may not be fundamentally related. The authors argue that there is a personal trait that simultaneously influences individual subjective uncertainty across variables.

3 Data and Measurement

In this section, we define the empirical measures we use for the three main variables in this study - macro uncertainty, individual expectations and subjective uncertainty - and provide some stylized facts and a discussion on each of them.

3.1 Macro Uncertainty

In line with section 2 we use four macro uncertainty indices:

1. EPU: News-based component of the Economic Policy Uncertainty Index by Baker et al. (2016). This is the most common measure used in the literature on macro uncertainty.
2. JU: 1-month ahead Macroeconomic Uncertainty Index by Jurado et al. (2015) (only available for the US);
3. VIX/STOXX: stock volatility indices of US (VIX) and Europe (STOXX);
4. Disagreement from the survey of professional forecasters in US and Europe.

Figures 1 and 2 plot the indices above for the US and Europe over time, including information on recessions and well known events commonly associated with rising uncertainty. Notably, all indices rise with these events. Table 1 shows the correlation between indices. While most indices are significantly positively related for the US, only STOXX, disagreement and Netherlands' EPU are positively related for the EU. As we can see from figure 2, NL EPU and EU EPU diverge from STOXX and disagreement after the Global Financial crisis, but the NL EPU converges to those two indices after the European crisis. This is because the sources of uncertainty are different. STOXX, by definition, is the uncertainty in the financial markets. The forecast disagreement is based on professional forecasters working in the financial sector, so they are highly exposed to the shock of the financial markets. Therefore, STOXX and forecast disagreement mainly represent the uncertainty in financial markets. On the other hand, EPU indices capture policy uncertainty which was dominated by Brexit and trade war after the EU crisis. As a result, NL EPU declined while EU EPU continued rising.

Figure 1: US Macro Uncertainty Indices

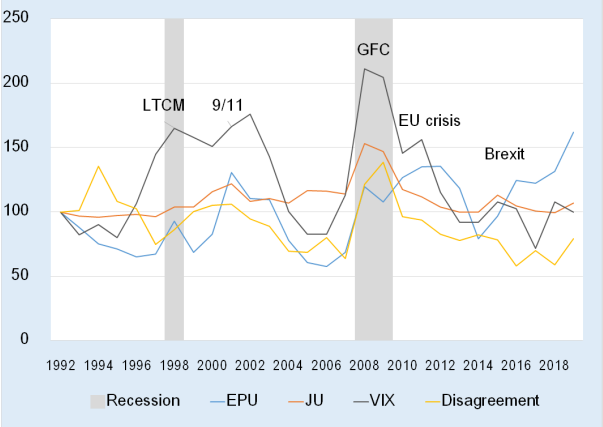
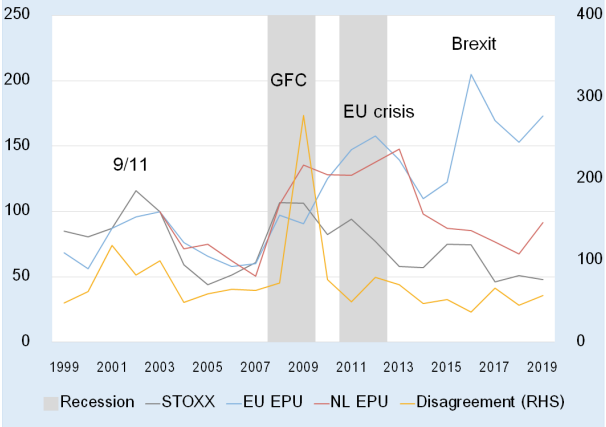


Figure 2: EU Macro Uncertainty Indices



Note: The US indices are rebased to 100 at 1992 and the EU indices are rebased to 100 at 2003. EPU stands for Economic Policy Uncertainty index (Baker et al., 2016). JU stands for 1-month ahead Macroeconomic Uncertainty Index (Jurado et al., 2015). GFC is the Global Financial Crisis and LTCM is Long Term Capital Management Fund Crisis.

Table 1: Correlations among the macro uncertainty indices

US indices	US EPU	VIX	Disagreement	JU	EU indices	EU EPU	STOXX	Disagreement	NL EPU
US EPU	1				EU EPU	1			
VIX	0.32***	1			STOXX	0.03	1		
	(0.09)					(0.11)			
Disagreement	0.008	0.36***	1		Disagreement	-0.14	0.48***	1	
	(0.09)	(0.09)				(0.11)	(0.10)		
JU	0.23**	0.69***	0.36***	1	NL EPU	0.34***	0.55***	0.61***	1
	(0.09)	(0.07)	(0.09)			(0.11)	(0.10)	(0.11)	

* p < 0.1, ** p < 0.05, *** p< 0.01, ( ) is S.E.

3.2 Survey data

Before describing how we measure expectations and subjective uncertainty, we briefly introduce our four surveys datasets. The respondents are professional forecasters and households. The details of each dataset are in appendix A.

The surveys of professional forecasters (SPF) come from the US and Europe, and they are collected quarterly by the respective central banks. For example, in every quarter of 2010, the surveys asked for the 2011 annual GDP forecast. For each respondent, we have four forecasts for 2011 annual GDP with different horizons. The answer collected in Q4 has a shorter horizon than the one collected in Q1.

The EU SPF contains the point forecast and probabilistic distribution of the next-calendar-year real GDP growth. Its time frame is from 1999Q1 to 2020Q1. The US SPF data provides the point forecast of the next-calendar-year real GDP level, and the probabilistic distribution of the next-calendar-year real GDP growth. For consistency, we will transform the point forecast of the level to the point forecast of growth. The US SPF data are from 1992Q1 to 2020Q1.

The household datasets are from the US and the Netherlands. The US household data is from the Survey of Consumer Expectations (SCE) owned by the Federal Reserve Bank of New York. The survey provides the point forecast of the next-12-months gross personal income growth and its probabilistic distribution. Moreover, SCE contains information about the respondent's socioeconomic status and the expectation of personal income growth and the US economy. This survey's drawback is its short time series that only starts in 2013M6 and therefore does not cover recession periods. The timeline of SCE data in this study is from 2013M6 to 2019M10.

For the Dutch household data, we make use of the DNB Household Survey administered by Centerdata (Tilburg University, The Netherlands). The survey started in 1993 and, to the best of our knowledge, it is the longest household survey that contains probabilistic distribution, socioeconomic status and personal financial data. This survey provides the probabilistic distribution of the next-12-month net household income forecast but does not provide the point forecast. Thus, we measure the point forecast from the probabilistic distribution. However, we cannot transform a level forecast into a growth's forecast because there is no data of household's income in the current year. Another drawback of this survey is its annual frequency and the lack of information at what moment during the year households respond to the survey. Consequently, the same year's respondents might have different economic information, but we cannot identify it. Moreover, the sample periods are 1997 - 2002 and 2008-2018 because the questionnaires have different structures in the excluded years.

Section 3.3 and 3.4 describe how we measure expectations and subjective uncertainty from our four survey datasets.

3.3 Expectations

In this paper we use income expectations because they can be directly connected to expected utility. A decrease in income expectation leads to a lower expected utility, ceteris paribus. We study two income expectations: the next-calendar-year real GDP growth expectation from the (US and EU) survey of professional forecasters, and the next-12-months individual income expectation from the household surveys. We will sometimes call both variables income expectations interchangeably. The following table summarizes income expectation of each dataset.

Table 2: Income Expectations of Each Dataset

Dataset	Income expectations	Measurement	Timeline	Frequency
EU SPF	Next-calendar-year real GDP growth	Provided by respondents	A1999Q1-A2020Q1	Q
US SPF	Next-calendar-year real GDP growth	Transform expected level into expected growth	A1992Q1-A2020Q1	Q
NL household	Next-12-month net household income level	Calculate from probabilistic histogram	A1993-A2018	A
US household	Next-12-month gross personal income growth	Provided by respondents	A2013M6-A2019M10	M

Note: A= Annual, Q= Quarter, M= Month

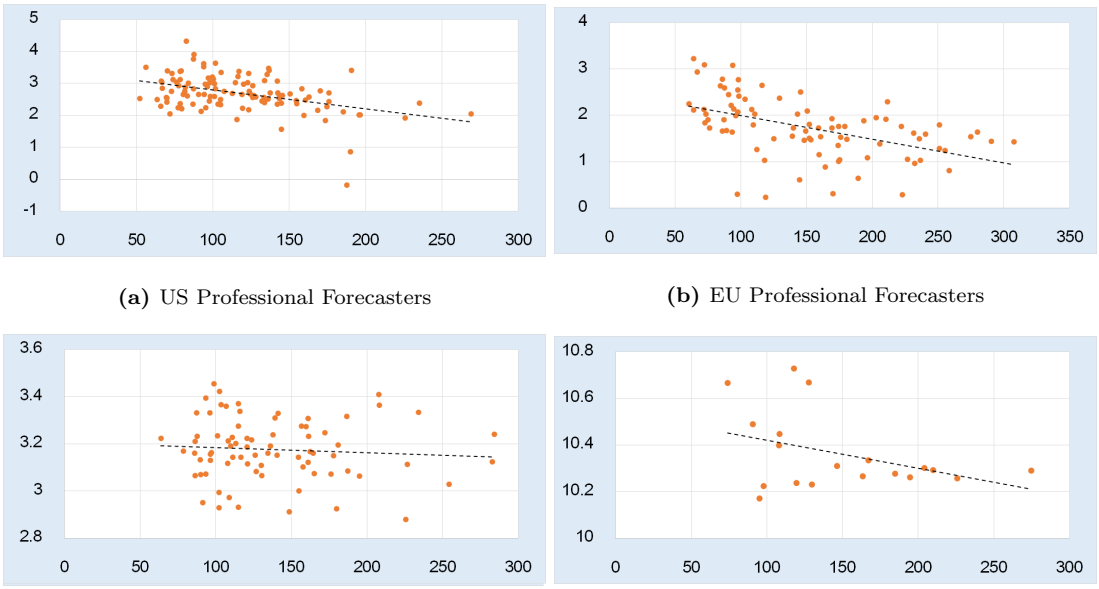
Except for the Dutch household survey, three surveys provide point estimates of income expectations. For example, the US household survey says "Twelve months from now, I expect my earnings to have [increased/decreased] by _____ %" and the respondents have to fill in the blank. The US SPF provides the forecasts of the current and the next-year GDP level. We compute the next-year expected level as a percentage of current-year expected level. We do not use the expected GDP level because the growth variable is consistent with that of the EU professional forecasters. It also is more common to discuss GDP growth.

Instead of the point estimates, the Dutch household survey provides probabilistic histograms and Max/Min income expectation. The survey asks 1) the expected minimum income, 2) the expected maximum income and 3) a range of probabilities for specific income ranges. In particular, it asks what is the probability that the expected household income will be less than 20% of (Maximum expected income - Minimum expected income) + Minimum expected income? The percentage ranges from 20%, 40%, 60% and 80% (more detail in appendix A.2.2). For example, if the minimum and maximum expected income is €0 and €100k respectively. The probabilities provided are for expected income less than €20k, €40k, €60k and €80k. In this example, the mid points are €10k, €30k, €50k, €70k and €90k. The expected household income of Dutch respondents is computed as follows:

$$\text{Mean}_{t,i} = E_{t,i}(\text{household income}) = \sum_{range} \text{Probability}_{range,t,i} \times \text{Mid Point}_{range,t,i}$$

The following figures show a negative correlation between income expectations and EPU across all four datasets. This negative correlation is significant for all measures of income expectations except for US households.

Figure 3: Scatter plots between income expectations and EPU



(a) US Professional Forecasters

(b) EU Professional Forecasters

(c) US Households

(d) Dutch Households

Note: The Y-axis of each graph is the cross-sectional average of individual income expectations and the X-axis is the US and EU Economic Policy Uncertainty indices. The Dutch households' expected income is in log scale.

3.4 Subjective Uncertainty

Subjective uncertainty is the perceived uncertainty of an individual about his or her economic forecast which is usually measured as the second moment of a subjective forecast distribution (Altig, Barrero, Bloom, Davis, Meyer, and Parker, 2019; Ben-David, Fermand, Kuhnen, and Li, 2018; Enke and Graeber, 2019; Giordani and Söderlind, 2003; Glas and Hartmann, 2016). Along with most literature, we use the second moment of the subjective forecast histogram as the measure of subjective uncertainty. The second moment can be measured in two ways, which we explain in the following subsections.

In our datasets, the respondents are asked for their point forecasts and probabilistic histogram of future income or GDP. The surveys provide ranges of forecasting bins where the respondents fill in the probability that their forecast will fall in each bin. For example, the US household survey says, "Suppose again that, 12 months from now, you are working in the exact same main job...Your earnings on this job, before taxes and deductions, will have increased by 0% to 1% (bin 6) _____ percent chance." The questionnaire asks for 12 bins from 12% to -12%, and the respondents have to fill in the blank areas. The US and EU professional forecasters surveys have the same pattern of questions. Implicitly, the surveys ask respondents to provide a probability density function of income forecasts. The Dutch household survey asks questions differently, which instead give a cumulative probability density. This difference does not affect the measurement of subjective uncertainty, however.

Generalized Beta Distribution (GBD)

The first method is the fitting of a generalized Beta distribution to each individual forecaster's histogram at each time. This method is proposed by Engelberg, Manski, and Williams (2009) and has been adopted by, for instance, Clements (2014) and Glas and Hartmann (2016). Fitting generalized Beta distribution yields a full analytical distribution so the researchers can study more than the second moment[4]. We fit generalized beta distribution to the US and EU survey of professional forecasters and the Dutch household data. The US household data already provides the fitted estimations. We adopt the fitting method of Armantier, Topa, van der Klaauw, and Zafar (2017) which is used in the US household data and follows Engelberg et al. (2009).

Simple Standard Deviation (SSD)

The second method is a simple standard deviation. It assumes that all mass distribution is at the midpoint of the forecasting bin. Although this method does not provide a full analytical distribution, it does not suffer from the discontinuity problem in the first method. The formula of this method is as follows.

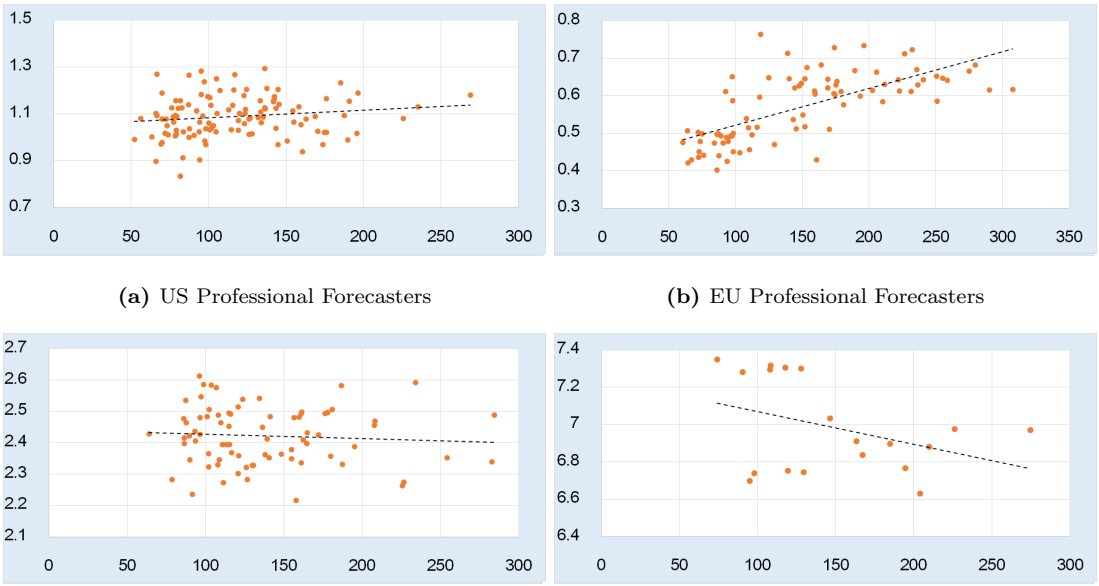
$$\text{Subjective Uncertainty}_{t,i} = \sqrt{\sum_{range} \text{Probability}_{range,t,i} \times (\text{Mid Point}_{range,t,i} - \text{Mean}_{t,i})^2}$$

We acknowledge that the validity of subjective uncertainty highly depends on the statistical knowledge of respondents and the structure of the surveys. Knowing this limit, we use both methods to measure subjective uncertainty, which are, to our knowledge, the only available methods. The correlation between these two measures is quite high (between 0.57 and 0.99).

The following figures report the scatter plots between SSD subjective uncertainty and EPU. Here the results are not so uniform as with mean expectations. EU SPF's subjective uncertainty is positively related to EPU, while the Dutch households data is significantly negative correlated. For the US data, we do not observe a strong relationship. We explore this relationship in detail in section 5.2.

[4]The fitting quality much depends on the number of forecasting bins reported by the forecasters. If the forecasters report their probabilities in less than 3 intervals, the histogram will be approximated by the triangular distribution. If the forecasting bins are at least 3 bins, the histogram will be approximated by the beta distribution. Compared to the three other datasets, the discontinuity is more pronounced in the US household survey since half of the respondents report less than 3 bins.

Figure 4: Scatter plots between subjective uncertainty and EPU



(a) US Professional Forecasters

(b) EU Professional Forecasters

(c) US Households

(d) Dutch Households

Note: The Y-axis of each graph is the cross-sectional average of individual subjective uncertainty, measured in S.D. The X-axis is the US and EU Economic Policy Uncertainty indices. The Dutch households' subjective uncertainty is in log scale.

The relationship between expectations and subjective uncertainty is positive. When the income expectation increases, the subjective uncertainty also increases. It means that both variables are affected by the same information. However, the correlations are higher in the households (0.60-0.66) than the professional forecasters (0.12-0.15). The difference in the level of correlations could be due to two reasons. First of all, the households forecast their own income while SPFs forecast GDP growths. The cost of forecasting an individual income is lower than the cost of forecasting GDP. Moreover, the revision of subjective uncertainty is more costly than the revision of the fixed point forecast (Clements, 2010). As a result, it is easier for households to update both mean expectations and subjective uncertainty, so the correlations between the two variables are higher in households' data. Secondly, the households' learning process is different from the SPFs and is largely affected by the individual characteristics(Ben-David et al., 2018). As a result, households' first and second moments mainly co move while the SPFs do not. This insight highlights the heterogeneity in our data set regarding the forecasting variables (individual income and GDP) and the types of respondents (households and SPFs).

4 Hypotheses and Empirical Methods

In this section, we introduce two hypotheses and variables used for testing. The first hypothesis (H1) is macro uncertainty reduces income expectations, and the second hypothesis (H2) is macro uncertainty increases subjective uncertainty.

H1: Macro uncertainty reduces income expectations

The first hypothesis is that macro uncertainty has a negative impact on income expectations. Households and firms become pessimistic when uncertainty rises, so they spend less. As a result, economic growth declines. The theoretical models in macroeconomics have often adopted this mechanism to demonstrate that macro uncertainty adversely affects the economy (Bloom, 2009; Fernández-Villaverde and Guerrón-Quintana, 2020; Ilut and Schneider, 2014)

The literature shows that individual expectations are persistent (Manzan, 2011) and depend on macroeconomic variables (Dovern, 2013), personal variables (Das et al., 2020), and good or bad news (Baqaee, 2019; Coibion et al., 2018). Therefore, we include these control variables in our model when we identify the additional impact of macro uncertainty. The core equation of the first hypothesis is the following.

$$\text{Income expectation}_{i,t+1|t} = A\ \text{Macro uncertainty}_{t} + B\ \text{Macro uncertainty}_{t-1}$$
$$+ C\ \text{Income expectation}_{i,t|t-1} + D\ \text{Macroeconomic variables}_{t-1} + E\ \text{Personal variables}_{i,t-1}$$

H2: Macro uncertainty increases subjective uncertainty

The second hypothesis is that macro uncertainty increases subjective uncertainty, which reflects the loss in forecasting confidence. The underlying concept of this hypothesis is based on the assumptions in most theoretical macroeconomic models (Bloom, 2009, 2014; Fernández-Villaverde and Guerrón-Quintana, 2020). For example, Bloom (2009) states that macro uncertainty increases the probability of the default outcome, resulting in higher borrowing costs. Alternatively, Fernández-Villaverde and Guerrón-Quintana (2020) argue that macro uncertainty increase the range of expected marginal utility of future consumption. With different assumptions, both mechanisms imply the loss in forecasting confidence. A decrease in forecasting confidence can be proxied by an increase in subjective uncertainty.

Previous research shows that subjective uncertainty is persistent and depends on the macroeconomic variables (Glas and Hartmann, 2016) and personal variables (Ben-David et al., 2018). The core equation of the second hypothesis is the following.

$$\text{Subjective uncertainty}_{i,t+1|t} = A\ \text{Macro uncertainty}_{t} + B\ \text{Macro uncertainty}_{t-1}$$
$$+ C\ \text{Subjective uncertainty}_{i,t|t-1} + D\ \text{Macroeconomic variables}_{t-1} + E\ \text{Personal variables}_{i,t-1}$$

The following table summarizes the independent variables we use in our regressions and the measurement of each variable is in appendix B.

Table 3: Independent Variables

Types	Variables	Note
Macro uncertainty	Economic policy index (EPU)	Available for EU, NL and the US
	Stock market volatility	VIX and STOXX
	Macroeconomic uncertainty index (JU)	Only available for the US
	Forecast disagreement	
Macroeconomic variables	GDP growth	
	GDP deceleration dummy	Control asymmetric response to GDP growth
	High (low) GDP growth dummy	Proxy of good (bad) news
	Recession dummy	Control economic crises
	Quarterly dummy	Control forecast horizon and only applicable in SPF
Personal variables	Good (bad) financial situation dummy	Control households' view on their financial situations
only available for households	Unemployment dummy	Control vulnerability to macro uncertainty
	University education dummy	Control literacy and socio-economic status
	Net personal income	
	Decreased net personal income dummy	Control asymmetric response to personal income
	Deficit balance sheet dummy	Control vulnerability to macro uncertainty

We use high and low GDP growths as proxies for good and bad news. For SPFs, we use real GDP growth since they forecast real GDP growths. A high real GDP growth is above 4% and a low real GDP growth is below 1%. For households, we use nominal GDP per capita growths since they forecast their nominal incomes. A high GDP per capita growth is above 4% and a low GDP per capita growth is below 2%. These thresholds are derived from the top and bottom 20 percentile of growths since the sample started. For the US households, we include the growth samples from 2010 to 2019.

We include a quarterly fixed effect in the regressions concerning professional forecasters to account for the difference in forecast horizon. For example, in 2010, a forecaster expected the 2011 GDP growth; thus in the 4^{th} quarter of 2010, the forecaster possess better information of 2011 forecast than he or she did in the 1^{st} quarter of 2010. Previous research also suggests that the forecasting horizon impacts subjective uncertainty and income expectations (Clements, 2014; Manzan, 2014).

The Dutch household data are collected throughout a year, so respondents in the same year might have different information about that year's economy. Thus, to present the best information available to the respondents, we run regressions with independent variables of the same year when the forecast was made, instead of lagged data. Moreover, we will test the hypotheses with EU EPU and NL EPU in the Dutch households. Although NL EPU would be better fit for the Dutch data, it starts in 2003 and we exclude 2003-2007 from the Dutch dataset due to inconsistent questionnaires. Consequently, the regression with NL EPU covers only 2008-2018 while that with EU EPU covers 1997-2002 and 2008-2018.

We use panel OLS regressions that include individual fixed effects, and the standard errors are clustered at the individual level and corrected for heteroskedasticity of both time and cross-section. Moreover, it is unlikely that the expectations and subjective uncertainty of an individual will affect macro uncertainty. Thus, we can assume that the causal relationships between dependent variables and macro uncertainty are likely to be one way: from the macro uncertainty to dependent variables.

5 Results

We discuss the regressions of two hypotheses, discuss the results and point our remaining puzzles.

5.1 H1: Macro uncertainty reduces income expectations

Using fixed effect OLS panel regressions, we explore H1 hypothesis if macro uncertainty reduces income expectations. We report the results from surveys of professional forecasters, and then from the household surveys.

Professional Forecasters

Table 4 shows the impact of macro uncertainty on the expected real GDP growth. As macro uncertainty increases, the growth expectations become lower, and this result holds across different macro uncertainty indices. For example, the 1% increase in EPU leads to 0.05% and 0.54% decreases in the GDP growth expectations of EU SPFs and US SPFs, respectively. Moreover, the current and lagged effects of macro uncertainty have opposite signs except for the EU EPU (column 2a). It suggests the increase in macro uncertainty lowers GDP forecasts. Therefore, the evidence supporting the first hypothesis is strong for the SPFs.

The coefficients on the control variables are in line with previous literature (Dovern, 2013; Manzan, 2011), and adding macro uncertainty does not change the signs of control variables. The GDP expectations are persistent. A 1% increases in the previous forecast lead to around 0.67% and 0.59% increases in the current forecast of EU SPFs and US SPFs, respectively. GDP growth positively impacts the GDP expectations, while the GDP deceleration dummy has a negative impact except when using the Macroeconomic Uncertainty index (column 5).

We find that two groups of SPFs respond to news asymmetrically. When there is a recession in the last quarter, the US SPFs expect GDP to grow faster, while the EU SPFs expect otherwise. Moreover, the US SPFs negatively react to the bad GDP growth news while the EU SPFs positively react to the good GDP growth news. It implies that the US SPFs become pessimistic when getting bad news while becoming optimistic during the recession. This is in line with Bianchi et al. (2020) that

US SPFs were optimistic when forecasting GDP, especially during the Great Recession. However, we observe the opposite in EU SPFs, perhaps because two SPFs have different priors, so they respond to the same signal differently (Manzan, 2011).

Table 4: SPF Real GDP Growth Expectation

Expected Real GDP Growth	EU SPF (1999Q1-2020Q1)				US SPF (1992Q1-2020Q1)				
	(1a)	(2a)	(3a)	(4a)	(1b)	(2b)	(3b)	(4b)	(5)
Economic Policy Uncertainty index (EU, US)$_t$		-0.05*				-0.54***			
		(0.03)				(0.04)			
Economic Policy Uncertainty index (EU, US)$_{t-1}$		-0.20***				0.34***			
		(0.02)				(0.04)			
Stock market volatility (STOXX, VIX)$_t$			-0.24***				-0.60***		
			(0.02)				(0.05)		
Stock market volatility (STOXX, VIX)$_{t-1}$			0.20***				0.35***		
			(0.03)				(0.04)		
Forecast disagreement$_t$				-1.28***				-0.98***	
				(0.12)				(0.12)	
Forecast disagreement$_{t-1}$				1.50***				0.21**	
				(0.10)				(0.10)	
Macroeconomic Uncertainty index$_t$									-3.63***
									(0.33)
Macroeconomic Uncertainty index$_{t-1}$									2.19***
									(0.44)
Expected growth$_{t-1}$	0.68***	0.61***	0.69***	0.67***	0.60***	0.58***	0.58***	0.59***	0.57***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
GDP growth$_{t-1}$	0.03***	0.03***	0.03***	0.03**	0.09***	0.07***	0.09***	0.08***	0.12***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
GDP deceleration D$_{t-1}$	-0.10***	-0.07***	-0.09***	-0.08***	-0.06***	-0.06***	-0.05***	-0.05**	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Above 4 % GDP growth D$_{t-1}$	0.19***	0.09***	0.19***	0.19***	-0.06**	-0.04	-0.03	-0.01	-0.11***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Below 1% GDP growth D$_{t-1}$	-0.02	0.002	0.01	0.03	-0.37***	-0.35***	-0.21***	-0.27***	-0.09
	(0.02)	(0.02)	(0.02)	(0.02)	(0.09)	(0.09)	(0.07)	(0.08)	(0.07)
Recession D$_{t-1}$	-0.16***	-0.19***	-0.17***	-0.25***	1.06***	0.89***	0.95***	1.16***	1.00***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.14)	(0.13)	(0.13)	(0.14)	(0.15)
Constant	Y	Y	Y	Y	Y	Y	Y	Y	Y
Quarter FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Individual FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Observations	3,917	3,917	3,917	3,917	3,431	3,431	3,431	3,431	3,431
R-squared	0.74	0.76	0.75	0.76	0.48	0.50	0.50	0.49	0.51

* p $<$ 0.1, **p $<$ 0.05, *** p$<$ 0.01, ( ) is S.E.

Note: The columns regress next year real GDP growth expectation of professional forecasters, against different macro uncertainty indices. Economic Policy Uncertainty indices (Baker et al., 2016) are from EU (2a) and US (2b). Stock market volatility indices are STOXX (3a) and VIX (3b). Forecast disagreements are from professional forecasters in EU (4a) and US (4b). Macroeconomic Uncertainty index (Jurado et al., 2015) is only available in the US (5). All independent variables ending with D are dummies. The detail description of each variable is in the appendix B.

Households

Table 5 shows the impact of macro uncertainty on households' expectations of income level (Dutch) and income growth (US). For the US households, only US EPU significantly reduces income expectations

while other indices are insignificant. For the Dutch households, the EU EPU has a negative impact on their expectations, STOXX and forecast disagreement positively impact the expectations, and the NL EPU has no effect. The different coefficients in the Dutch dataset are not due to the different time frames (more detail in appendix C.1 table 14), but rather the different sources of uncertainties. As discussed in section 3, EPU captures uncertainty in economic policy while STOXX and forecast disagreement capture uncertainty in financial markets. This result points that households do not respond to different uncertainties in the same way as SPFs do. Therefore, we find the evidence from households does not support the first hypothesis that macro uncertainty reduces income expectations.

Dutch households' expectations are lagged dependent, but the US household's expectations are not. If Dutch households increased their income expectations in the previous year, they will decrease their current income expectations by approximately 0.10%. We do not observe this pattern in US households. The reason might be that US households predict the growth of income. Compared to the income level, income growth is more volatile and is less likely to have a trend.

We investigate the relationships between expected income and macroeconomic variables. Including EU EPU and forecast disagreement, we find that GDP per capita positively impacts the Dutch expectations. However, GDP per capita does not affect the US expectations. Moreover, we observe asymmetric responses to the GDP growth. On the one hand, when GDP per capita grows more than 4%, the Dutch households increase their income expectations by 0.10% - 0.28%, except when including NL EPU (column 2b). On the other hand, when GDP per capita grows less than 2%, Dutch households' responses are not robust. Instead, the US households optimistically respond to low GDP growth with an increase in their income growth expectations by 0.20% (columns 1b to 5).

Table 5 reports the results of respondents' view on their household incomes. The view on their past and future financial situations impact households' income expectations with expected signs. The Dutch households lower their household income expectations around -0.20% if their households were in a bad financial situation. US households only respond to the good household financial situation in the past. The expected household financial situation has larger impacts on their income expectations. If the US respondents agree that their households' future financial situations will be better (worse), the personal income expectations will change by 0.36% (-0.20%).

Lastly, we study the effects of personal variables, which are insignificant in general. The reason might be that we include the individual fixed effect that already controls for most personal traits, which are important factors in households' forecasts (Ben-David et al., 2018). Moreover, this might explain why the household's R-squared is very low (0-0.06) compared to SPFs (0.5-0.7). We observe the significant coefficients in the net personal income, which the fixed effect cannot capture. A 1% increase in the net personal income leads to around 0.02% increase in the Dutch household income expectations, except when including NL EPU and forecast disagreement (columns 2b and 4a).

Table 5: Expected Income of Households

Expected Income$_{t+1\|t}$	Dutch households					US households				
	(1997-2018)		(2008-2018)	(1999-2018)		(2013M6 - 2019M10)				
	(1a)	(2a)	(2b)	(3a)	(4a)	(1b)	(2c)	(3b)	(4b)	(5)
Economic Policy Uncertainty index (EU, NL, US)$_t$		-0.46***	0.03				-0.09*			
		(0.08)	(0.14)				(0.04)			
Economic Policy Uncertainty index (EU, NL, US)$_{t-1}$		0.01	-0.76***				0.05			
		(0.06)	(0.26)				(0.03)			
Stock market volatility (STOXX, VIX)$_t$				0.19**				-0.08		
				(0.08)				(0.06)		
Stock market volatility (STOXX, VIX)$_{t-1}$				0.21**				-0.02		
				(0.09)				(0.06)		
Forecast disagreement$_t$					2.62***				0.15	
					(0.33)				(0.17)	
Forecast disagreement$_{t-1}$					-0.75***				0.15	
					(0.22)				(0.18)	
Macroeconomic Uncertainty index$_t$										-0.82
										(1.04)
Macroeconomic Uncertainty index$_{t-1}$										0.40
										(1.02)
Expected income$_{t\|t-1}$	-0.10*	-0.12**	-0.15***	-0.10*	-0.13**	0.00	0.00	0.00	0.00	0.00
	(0.05)	(0.05)	(0.06)	(0.05)	(0.05)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
GDP per cap growth$_{t,t-1}$	0.01	0.05***	0.002	0.02	0.10***	0.02	0.02	0.02	0.01	0.02
	(0.01)	(0.05)	(0.01)	(0.01)	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
GDP per cap deceleration D$_{t,t-1}$	0.07***	0.15***	-0.05*	-0.01	0.05*	-0.04	-0.04	-0.03	-0.05	-0.03
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Above 4% GDP per cap growth D$_{t,t-1}$	0.21***	0.13*	0.04	0.28***	0.10**	0.01	0.01	0.02	0.00	0.004
	(0.04)	(0.04)	(0.06)	(0.05)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Below 2% GDP per cap growth D$_{t,t-1}$	-0.05	-0.05*	0.30***	-0.08**	0.01	0.20***	0.20***	0.20***	0.19**	0.19***
	(0.03)	(0.04)	(0.12)	(0.04)	(0.05)	(0.05)	(0.05)	(0.05)	(0.06)	(0.06)
Recession D$_{t,t-1}$	-0.04	0.03	-0.10**	-0.03	-0.15***					
	(0.03)	(0.04)	(0.05)	(0.04)	(0.04)					
Good financial situation in the past 12 months D$_t$	-0.08	-0.56	-0.03	-0.06	-0.06	0.12***	0.12***	0.12***	0.12***	0.11***
	(0.09)	(0.08)	(0.09)	(0.08)	(0.08)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Bad financial situation in the past 12 months D$_t$	-0.20*	-0.19*	-0.17	-0.19*	-0.18	0.01	0.02	0.02	0.01	0.01
	(0.11)	(0.11)	(0.12)	(0.11)	(0.11)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Good financial situation in the next 12 months D$_t$						0.36***	0.36***	0.36***	0.36***	0.36***
						(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Bad financial situation in the next 12 months D$_t$						-0.20***	-0.20***	-0.20***	-0.20***	-0.20***
						(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Unemployed D$_t$	-0.10	-0.02	-0.02	-0.7	-0.02	-0.16	-0.16	-0.15	-0.15	-0.16
	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.19)	(0.19)	(0.19)	(0.19)	(0.19)
College education D$_t$	-0.27	-0.15	-0.29	-0.21	-0.15					
	(0.24)	(0.24)	(0.18)	(0.24)	(0.24)					
Net personal income$_t$	0.03**	0.02*	0.01	0.02*	0.02					
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)					
Decreased net personal income D$_t$	0.03	0.03	0.01	0.03	0.04*					
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)					
Deficit balance sheet D$_t$	-0.04	-0.05	-0.16*	-0.05	-0.03					
	(0.10)	(0.10)	(0.09)	(0.10)	(0.10)					
Constant	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Individual FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
HH income categories	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Observations	3,756	3,756	3,327	3,724	3,724	45,686	45,686	45,686	45,686	45,686
R-squared	0.00	0.006	0.02	0.00	0.01	0.06	0.06	0.06	0.06	0.06

* p $<$ 0.1, **p $<$ 0.05, *** p$<$ 0.01, ( ) is S.E.

Note: The columns regress next 12 months net household income expectation of Dutch household and next 12 months personal income expectation of US household, against different macro uncertainty indices. Economic Policy Uncertainty indices (Baker et al., 2016) are from three regions: EU (2a), Netherlands (2b) and US (2c). Stock market volatility indices are STOXX (3a) and VIX (3b). Forecast disagreements are from professional forecasters in EU (4a) and US (4b). Macroeconomic Uncertainty index (Jurado et al., 2015) is only available in the US (5). The difference in the Dutch time frame is due the availability of macro uncertainty indices. All independent variables ending with D are dummies. The detail description of each variable is in the appendix B.

To summarize the impact of macro uncertainty on income expectations, we observe a robust negative impact in the SPFs. All four macro uncertainties decrease the SPFs' expectations of real GDP growth. For households, the results are not robust. We only find the negative impacts hold when studying EU and US EPU indices.

5.2 H2: Macro uncertainty increases subjective uncertainty

Using fixed effect OLS panel regressions, we investigate the H2 hypothesis whether macro uncertainty increases subjective uncertainty. We present the results from surveys of professional forecasters, and then from the household surveys.

Professional Forecasters

Table 6 reports the regressions of macro uncertainty and subjective uncertainty based on the surveys of professional forecasters. EU EPU, US EPU, and VIX significantly increase the SPFs' subjective uncertainty (columns 2a, 2b, and 3b), while other indices have insignificant effects. For example, a 1% rise in EPU increases the subjective uncertainty of professional forecasters by 0.04%. Therefore, the evidence from SPFs does not support the second hypothesis.

The SPFs' subjective uncertainty is persistent. The coefficients of lagged subjective uncertainty are around 0.30% for the US SPFs and 0.69% for the EU SPFs. We also explore macroeconomic variables. On the one hand, the US subjective uncertainty does not significantly respond to macroeconomic variables. On the other hand, the EU subjective uncertainty significantly responds to some of those variables. The EU subjective uncertainty reduces by 0.01% when GDP growth increases by 1% and further decreases by around 0.02% when GDP growth was low. The recession dummy generally increases the EU subjective uncertainty by 2%, except when including EU EPU (column 2a).

Table 6: SPF Subjective Uncertainty

Real GDP Growth	EU SPF (1999Q1-2020Q1)				US SPF (1992Q1-2020Q1)				
Subjective Uncertainty	(1a)	(2a)	(3a)	(4a)	(1b)	(2b)	(3b)	(4b)	(5)
Economic Policy Uncertainty index (EU, US)$_t$		0.04***				0.04*			
		(0.01)				(0.02)			
Economic Policy Uncertainty index (EU, US)$_{t-1}$		0.01				-0.02			
		(0.01)				(0.02)			
Stock market volatility (STOXX, VIX)$_t$			-0.001				0.06*		
			(0.009)				(0.03)		
Stock market volatility (STOXX, VIX)$_{t-1}$			0.004				-0.02		
			(0.01)				(0.03)		
Forecast disagreement$_t$				0.05				0.04	
				(0.04)				(0.08)	
Forecast disagreement$_{t-1}$				-0.05				-0.05	
				(0.04)				(0.06)	
Macroeconomic Uncertainty index$_t$									-0.12
									(0.16)
Macroeconomic Uncertainty index$_{t-1}$									0.46*
									(0.24)
Subjective uncertainty$_{t-1}$	0.69***	0.67***	0.69***	0.69***	0.30***	0.30***	0.30***	0.30***	0.30***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
GDP growth$_{t-1}$	-0.01***	-0.01***	-0.01***	-0.01***	-0.001	0.00	-0.001	-0.002	-0.01
	(0.002)	(0.002)	(0.003)	(0.003)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
GDP deceleration D$_{t-1}$	0.01*	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.003
	(0.004)	(0.004)	(0.004)	(0.004)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Above 4 % GDP growth D$_{t-1}$	-0.00	0.02**	-0.001	-0.001	0.01	0.01	0.003	0.01	0.02
	(0.009)	(0.01)	(0.009)	(0.009)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Below 1% GDP growth D$_{t-1}$	-0.02*	-0.01*	-0.02*	-0.02**	0.05	0.05	0.02	0.04	-0.02
	(0.008)	(0.008)	(0.008)	(0.008)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
Recession D$_{t-1}$	0.02*	0.02	0.02*	0.02**	-0.02	-0.002	-0.01	-0.01	-0.09
	(0.01)	(0.01)	(0.01)	(0.009)	(0.07)	(0.07)	(0.06)	(0.07)	(0.07)
Constant	Y	Y	Y	Y	Y	Y	Y	Y	Y
Quarter FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Individual FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Observations	3,559	3,559	3,559	3,559	3,056	3,056	3,056	3,056	3,056
R-squared	0.76	0.76	0.76	0.76	0.44	0.44	0.43	0.43	0.43

* p $<$ 0.1, **p $<$ 0.05, *** p$<$ 0.01, ( ) is S.E.

Note: The columns regress subjective uncertainty of professional forecasters, against different macro uncertainty indices. Economic Policy Uncertainty indices (Baker et al., 2016) are from EU (2a) and US (2b). Stock market volatility indices are STOXX (3a) and VIX (3b). Forecast disagreements are from professional forecasters in EU (4a) and US (4b). Macroeconomic Uncertainty index (Jurado et al., 2015) is only available in the US (5). All independent variables end with D are dummies.The detail description of each variable is in the appendix B.

Households

Table 7 reports the effects of macro uncertainty on the households' subjective uncertainty. For the Dutch households, EU EPU decreases their subjective uncertainty (column 2a), but forecast disagreement increases it (column 4a). The different coefficients in the Dutch dataset are not due to the different time frames (see appendix C.1 table 15), but rather the different sources of uncertainty as discussed before. For the US households, US EPU decreases the US subjective uncertainty (column 2c), while other indices

are insignificant. Since we observe only one significant positive relationship (column 4a), the evidence from households does not support the second hypothesis. The two negative relationships (columns 2a and 2c) also indicate macro uncertainty could even decrease subjective uncertainty.

The Dutch subjective uncertainty is lagged dependent, while the US subjective uncertainty is not. If the Dutch subjective uncertainty increases by 1% in the previous year, their subjective uncertainty will decreases by around 0.07% in the current year.

We explore the effects of macroeconomic variables on subjective uncertainty. The US households' subjective uncertainty does not respond to macroeconomic variables in general. The exception is that when GDP per capita growth is below 2% their subjective uncertainty will robustly increase by approximately 0.07%. The subjective uncertainty of Dutch households significantly responds to some macroeconomic variables. For example, when GDP per capita growth is above 4%, the Dutch subjective uncertainty will robustly decrease. When GDP per capita growth decelerates, the Dutch subjective uncertainty will increase in general except when using NL EPU and forecast disagreement (columns 2b and 4a). The significant coefficients show that the bad economic signal generally increases subjective uncertainty while the good economic signal does otherwise.

Table 7 includes the effects of household views on their financial situations. The Dutch subjective uncertainty does not respond to the views of households' financial situation. For the US households, the bad household's financial situation does not impact their subjective uncertainty, but a good view on financial situation leads to higher subjective uncertainty by around 0.06% and 0.10%. It implies that optimistic households are more uncertain. This is not in line with the finding in Altig et al. (2019); Bachmann et al. (2021) that the firm's subjective uncertainty increases with both positive and negative views.

Finally, table 7 also shows the effects of personal variables, which are mostly insignificant. The effects are insignificant in general. This is perhaps due to the individual fixed effect that already captures most personal traits.

Table 7: Subjective Uncertainty of Households

Subjective uncertainty$_{t+1\|t}$	Dutch households					US households				
	(1997-2018)		(2008-2018)	(1999-2018)		(2013M6 - 2019M10)				
	(1a)	(2a)	(2b)	(3a)	(4a)	(1b)	(2c)	(3b)	(4b)	(5)
Economic Policy Uncertainty index (EU, NL, US)$_t$		-0.58**	-0.11				-0.08***			
		(0.14)	(0.25)				(0.03)			
Economic Policy Uncertainty index (EU, NL, US)$_{t-1}$		-0.23**	-0.54				-0.01			
		(0.10)	(0.39)				(0.03)			
Stock market volatility (STOXX, VIX)$_t$				0.17				-0.07		
				(0.15)				(0.05)		
Stock market volatility (STOXX, VIX)$_{t-1}$				0.37***				0.03		
				(0.14)				(0.05)		
Forecast disagreement$_t$					3.23***				0.13	
					(0.61)				(0.14)	
Forecast disagreement$_{t-1}$					-0.74*				0.05	
					(0.40)				(0.15)	
Macroeconomic Uncertainty index$_t$										-0.92
										(0.84)
Macroeconomic Uncertainty index$_{t-1}$										0.78
										(0.83)
Subjective uncertainty$_{t\|t-1}$	-0.06*	-0.07**	-0.09***	-0.06*	-0.07**	0.00	0.00	0.00	0.00	0.00
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
GDP per cap growth$_{t,t-1}$	0.03	0.07**	-0.025	0.03	0.13***	-0.02	-0.02	-0.01	-0.02	-0.01
	(0.02)	(0.02)	(0.02)	(0.05)	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
GDP per cap deceleration D$_{t,t-1}$	0.18***	0.25***	0.07	0.17***	-0.15***	0.01	0.01	0.01	0.003	0.01
	(0.04)	(0.05)	(0.05)	(0.05)	(0.04)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Above 4% GDP per cap growth D$_{t,t-1}$	-0.35***	-0.48***	-0.66***	-0.23**	-0.48***	0.03	0.03	0.03	0.02	0.02
	(0.08)	(0.07)	(0.11)	(0.09)	(0.08)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Below 2% GDP per cap growth D$_{t,t-1}$	0.03	0.02	0.30	-0.02	0.08	0.08**	0.07*	0.08*	0.09*	0.08*
	(0.06)	(0.06)	(0.19)	(0.06)	(0.08)	(0.04)	(0.04)	(0.04)	(0.05)	(0.04)
Recession D$_{t,t-1}$	-0.09	0.07	-0.17*	-0.12	-0.22***					
	(0.07)	(0.07)	(0.09)	(0.08)	(0.08)					
Good financial situation in the past 12 months D$_t$	0.19	0.23*	0.19	0.20	0.22	0.06**	0.05**	0.06**	0.06**	0.06**
	(0.13)	(0.13)	(0.14)	(0.13)	(0.13)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Bad financial situation in the past 12 months D$_t$	-0.05	-0.03	-0.05	-0.03	-0.01	0.04	0.04	0.04	0.04	0.04
	(0.15)	(0.15)	(0.15)	(0.15)	(0.15)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Good financial situation in the next 12 months D$_t$						0.11***	0.10***	0.10***	0.10***	0.10***
						(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Bad financial situation in the next 12 months D$_t$						0.004	0.01	0.004	0.004	0.004***
						(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Unemployed D$_t$	-0.30**	-0.16	-0.18	-0.25*	-0.19	-0.02	-0.02	-0.02	-0.02	-0.02
	(0.13)	(0.13)	(0.13)	(0.13)	(0.13)	(0.15)	(0.15)	(0.15)	(0.15)	(0.15)
College education D$_t$	-0.45	-0.24	-0.49**	-0.37	-0.30					
	(0.33)	(0.32)	(0.21)	(0.33)	(0.32)					
Net personal income$_t$	0.05*	0.04	0.03	0.05*	0.03					
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)					
Decreased net personal income D$_t$	0.02	0.02	-0.01	0.02	0.02					
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)					
Deficit balance sheet D$_t$	-0.03	-0.06	-0.21	-0.04	-0.02					
	(0.18)	(0.18)	(0.17)	(0.19)	(0.19)					
Constant	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Individual FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
HH income categories	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Observations	3,703	3,703	3,279	3,671	3,671	45,203	45,203	45,203	45,203	45,203
R-squared	0.001	0.004	0.02	0.001	0.006	0.02	0.02	0.02	0.02	0.02

* p $<$ 0.1, **p $<$ 0.05, *** p$<$ 0.01, ( ) is S.E.

Note: The columns regress next 12 months net household income expectation of Dutch household and next 12 months personal income expectation of US household, against different macro uncertainty indices. Economic Policy Uncertainty indices (Baker et al., 2016) are from three regions: EU (2a), Netherlands (2b) and US (2c). Stock market volatility indices are STOXX (3a) and VIX (3b). Forecast disagreements are from professional forecasters in EU (4a) and US (4b). Macroeconomic Uncertainty index (Jurado et al., 2015) is only available in the US (5). The difference in the Dutch time frame is due the availability of macro uncertainty indices. All independent variables end with D are dummies.The detail description of each variable is in the appendix B.

To summarize the impact of macro uncertainty on subjective uncertainty, we do not observe a robust positive effect. To be specific, we find a positive relationship for the survey of professional forecasters, using the EPU (EU SPF) or the EPU and VIX (US SPF), and for the Dutch households using the forecast disagreement. When we use the EU (US) EPU, the Dutch (US) households' subjective uncertainty actually decreases. In appendix C.3, we test the robustness of this result, using the generalized-beta-distribution fitted subjective uncertainty. The positive relationship in the US SPFs do not hold anymore. Therefore we conclude that there is no evidence supporting the second hypothesis. In the next section, we discuss these results.

6 Discussion

Using four panel datasets, we study individual income expectations (first moment) and subjective uncertainty (second moment). This section discusses our main findings, the impact of macro uncertainty on income expectations and subjective uncertainty.

The study of income expectation shows some evidence that macro uncertainty reduces income expectations. For professional forecasters, the results are robust across macro uncertainty indices. For households, this result holds significantly only for EPU. The negative impact of macro uncertainty on income expectations is in line with the Maxmin criterion in multiple prior theory (Gilboa and Schmeidler, 1989) and smooth ambiguity theory (Klibanoff et al., 2005).[5] However, we observe that STOXX and forecast disagreement increase the Dutch income expectations. This finding indicates that the Dutch households' expectations respond to the different uncertainties differently, while the SPFs expectations do not. The STOXX and forecast disagreement mostly capture the uncertainty in financial markets while EPU captures the policy uncertainty. As seen in section 3, these two uncertainties diverge in Europe but mostly move together in the US. The mixed responses of households could explain why the uncertainty indices capture only a small part of economic downturns, as found in Born et al. (2018). Moreover, this result could also indicate that the exposures to macro uncertainty of households and professional forecasters are different.

The analysis of subjective uncertainty suggests a mixed evidence that macro uncertainty increases subjective uncertainty. The positive relationship holds for the SPFs when using EPU and VIX, and for the Dutch households when using forecast disagreement. We actually observe a negative relationship in both Dutch and US households when using EPU of EU and US, respectively. Therefore, the effect of macro uncertainty on subjective uncertainty is insignificant and it can either be positive or negative.

Interestingly, our mixed result of subjective uncertainty might be explained by ambiguity averse

[5] In the smooth ambiguity theory, Maxmin criterion is achieved when ambiguity aversion approaches infinite (Marinacci, 2015).

agents subjects to different exposure to uncertainty. Piccillo and Van Den Hurk (2020) show that ambiguity averse agents perceive noises to be signals more than they actually are[6]. Ambiguity averse agents have a preference for certainty over ambiguity, and this preference shapes their view of the world, by making them more defined even in the lack of a structured signal. Therefore, SPFs and households' diverging responses to macro uncertainty can be due to the difference in their ambiguity aversions or in their exposure to uncertainty.

Using ambiguity aversion, we can elaborate on how households' subjective uncertainty decreases when macro uncertainty increases. Professional forecasters have a stable job, compared to households. Thus, households tend to be more ambiguity averse and expose to higher macro uncertainty than SPFs do. In the smooth ambiguity theory (Klibanoff et al., 2005), ambiguity averse households try to avoid the spread of forecast distribution and prefer forecasts robust to uncertainty. Robustness to uncertainty means that the forecast does not change drastically given different situations. For example, the households have robust income forecasts if they expect their worst-case incomes are not much different from their normal incomes. A smaller spread of forecast distribution gives a higher expected utility to ambiguity averse people (Baliga et al., 2013; Klibanoff et al., 2005; Marinacci, 2015). The aversion to the spreads of forecast distribution can be interpreted as a preference for a low subjective uncertainty. We could say that a low subjective uncertainty makes ambiguity averse households feel better under uncertainty. Therefore, as macro uncertainty increases, they seek solutions that have low subjective uncertainty.

7 Conclusion

This paper empirically documents the effects of macro uncertainty on income expectations and subjective uncertainty using the surveys of EU and US professional forecasters and the Netherlands and US household data. Our main findings are the following. First of all, macro uncertainty reduces income expectations, when using the surveys of professional forecasters. The households' income expectations show mixed responses to uncertainties that come from different sources of shocks. Secondly, macro uncertainty does not always increase subjective uncertainty, as most macroeconomic models assume. Instead, we even observe a negative relationship in the household data. Finally, we discuss that the mixed results observed in subjective uncertainty could be due to the ambiguity aversion and exposure to macro uncertainty.

As this study shows, the relation between macroeconomic, income expectation and subjective uncertainty is not empirically quite as straightforward as currently implied by most macroeconomic models. This insight has direct consequences for our understanding of the impact of uncertainty in subjective decision making and its consequences on the economy at large.

[6] In their experiments, Piccillo and Van Den Hurk (2020) find that ambiguity averse participants who are facing a salient uncertainty detect patterns in blurry pictures, even when these contain only noise. The higher ambiguity aversion, the more illusory patterns are perceived.

A Data

We test our hypotheses on four data sets, which are the survey of professional forecasters of (1) US and (2) EU, and (3) US and (4) the Netherlands' household survey. Data from US and EU professional forecasters are widely used in the economic literature for examining the expectation of GDP growth. The US household data, one of the most popular sets of household data, contains useful questions about the respondent's socioeconomic status and the expectation of personal income growth and growth of the US economy. Socioeconomic status consists of age, gender, education, employment, categories of household incomes, and the view of the respondents on their household financial situations. However, the US household data does not provide the actual data of personal finance, and it starts in 2013, which does not cover recession periods.

We also use the Dutch household data because it includes all of the necessary aspects we require. First of all, the Dutch survey asks respondents to assess the probabilistic distributions of their household income expectations. Secondly, it provides a socioeconomic status and personal financial data. From the financial data, we can see the amount of money in the checking account and personal incomes earned from jobs and financial assets. Finally, since it was started in 1993, it covers crucial events such as the Dot-Com crisis, the Global Financial crisis, and the European Sovereign Debt crisis. The Dutch household data provides the level of income forecast, which is different from the growth forecasts of the surveys mentioned above. However, to the best of our knowledge, the Dutch household data is the longest household survey that contains subjective histogram and personal financial data. Therefore, adding the Dutch data set will complement the robustness of our results. In the following sections, we describe survey questions and summary statistics of each dataset.

A.1 Survey of Professional Forecasters

A.1.1 US Professional Forecasters

We use the forecast of the next-calendar-year real GDP. If the survey was conducted in 2010 the next-calendar-year real GDP growth was the growth rate of 2011. The real GDP series of US professional forecasters started in 1968Q4 but only from 1992, the forecasting variable becomes consistent. We, therefore, employ the time series from 1992 onward. The US SPF only provides the point forecast of GDP *level*. The GDP *growth* forecast is calculated from dividing the next year's GDP level by the forecasts of the current year GDP level.

The survey also asks for the probability of the next year's real GDP growth falling into the interval ranging from $(-\infty$, -3%), [x%, x+0.9%] for x = -3, -2,. . . , and [6%, ∞). Prior to 2009, the lowest interval was $(-\infty$, -2%). We use this subjective histogram to measure subjective uncertainty. The following table is a summary statistics of the GDP expectations and subjective uncertainty.

Table 8: Summary statistics

		Mean	Std Dev.	Min	Max	N
Real GDP growth expectation (%)	overall	2.68	0.79	-1.75	7.16	4,237
	between		0.51	0.40	6.74	170
	within		0.73	-1.71	6.30	avg. 24.92
Subjective uncertainty (%)	overall	1.07	0.46	0.005	5.27	3,856
	between		0.39	0.39	2.49	169
	within		0.32	0.03	5.29	avg. 22.82

Note: Subjective uncertainty is measured in standard deviation. N of within statistics are the average number of samples of each individual.

A.1.2 European Professional Forecasters

We use the forecast of the next-calendar-year real GDP growth. If the survey is conducted in 2010 the next-calendar-year real GDP growth is the growth rate of 2011. The real GDP series of EU professional forecasters started in 1999Q1, providing point estimates and probabilistic distribution. The interval of the distribution ranges from $(-\infty$, -1%), [x%, x+0.4%] for x = -1, -0.5, ..., and [4%, ∞). The minimum interval covered to $(-\infty$, -6%) from 2009Q2 to 2009Q3. The following table is a summary statistics of the GDP expectations and subjective uncertainty.

Table 9: Summary statistics

		Mean	Std Dev.	Min	Max	N
Subjective uncertainty (%)	overall	0.57	0.28	0.08	2.53	4,246
	between		0.21	0.24	1.33	105
	within		0.21	-0.01	3.22	avg. 40.44
Real GDP growth expectation (%)	overall	1.77	0.71	-2	4.87	4,591
	between		0.44	0.7	3.1	106
	within		0.66	-1.91	3.84	avg. 43.31

Note: Subjective uncertainty is measured in standard deviation. N of within statistics are the average number of samples of each individual.

A.2 Households data

A.2.1 US Households Data

The US household data comes from the survey of consumer expectations which is an online survey conducted monthly since 2013 by the federal reserve of New York. The respondents who are the heads of the households are surveyed for up to 12 consecutive months. The respondents provide point estimates and probabilistic distributions of their next-12-months personal income growth. The interval of the distribution ranges from -12% to 12%. We exclude samples that are over the top and bottom fifth percentile, and have invalid probabilistic distribution.

Since 2017, the number of respondents has increased substantially from around 700 to 850. The increased samples are mainly people who have worked at the same place longer than 1 year. This change leads to a significant decrease in the average income expectation and subjective uncertainty by 0.82% and 0.07% respectively. However, our fixed effect panel regressions are not affected because the working time is constant for all respondents.

Table 10: Summary statistics

		Mean	Std Dev.	Min	Max	N
Panel A: Gross Personal Income Growth Expectations						
Gross personal income growth expectation (%)	overall	3.17	2.70	-1	14	59,295
	between		2.56	-1	14	9,942
	within		1.61	-5.58	14.59	avg.5.96
Subjective uncertainty (%)	overall	2.42	2.42	0	26	59,295
	between		2.42	0	20.981	9,942
	within		1.35	-8.83	18.74	avg.5.96
Panel B: Demographics						
Female		47.5%				59,291
Age (Less than 40 : 40-60 : More than 60)		36%	:48%	: 16%		59,267
Panel C: Socioeconomic status						
Past household income (50k or less : 50k-100k : 100k or more)		27%	:38%	: 35%		58,850
College education		60%				59,295
Employment (Full time: Part time: Unemployed)		97%	:2.4%	: < 1%		59,295

Note: Subjective uncertainty is measured in standard deviation. N of within statistics are the average number of samples of each individual.

A.2.2 Dutch Households Data

Having been conducted annually since 1993, the survey consists of 6 questionnaires about the economic and psychological status of the households. The questions about income expectations started in 1995.

The survey changed questions about income expectations for three times. The first time was 1997, the second time was 2003 and in 2008 ,they switched back to 1997 version. Inconsistent questions significantly affect the answers of income expectations so we exclude them. Our sample periods are 1997 - 2002, and 2008 - 2018. We also exclude respondents that wrongly filled in the probability and received no income. The income sources include work, financial investment, pension fund, unemployment benefits and so forth.

Unlike other surveys, the Netherlands' household survey does not ask for the point estimates of income expectation. Respondents give the maximum and minimum expected incomes, and the probability of their future household income to fall in subranges over the minimum and maximum estimates. The relevant questions are:

- What do you expect to be the lowest total net yearly income your household may realize in the next 12 months?
- What do you expect to be the highest total net yearly income your household may realize in the next 12 months?
- What do you think is the probability (in percent) that the net yearly income of your household will be less than € Lowest income + 20 % × (Highest income - Lowest income)? The question also asked for 40%, 60%, and 80%.

If the lowest and highest expected income is €0 and €100k respectively. The probabilities provided are for expected income less than €20k, €40k, €60k and €80k. We remove samples that do not provide valid probabilities and measure the mean expectation using the mid point of each range. In this example, the mid points are €10k, €30k, €50k, €70k and €90k. Therefore, the expected household income is computed as follows:

$$\text{Mean}_{t,i} = E_{t,i}(\text{household income}) = \sum_{range} \text{Probability}_{range,t,i} \times \text{Mid Point}_{range,t,i}$$

Table 11: Summary statistics

		Mean	Std Dev.	Min	Max	N
Panel A: Net Household Income Expectations						
Net HH income expectation (EUR)	overall	43,014	$1.8x10^5$	8.14	$1.27x10^7$	5,380
	between		$1.17x10^5$	49	$4.2x10^6$	2,189
	within		$1.4x10^5$	$-4.2x10^6$	$8.4x10^6$	avg.2.5
Subjective uncertainty (EUR)	overall	2,656	25,699	0	$1.63x10^6$	5,380
	between		25,699	0	$1.05x10^6$	2,189
	within		18,363	$-5.4x10^5$	$1.08x10^6$	avg.2.5
Maximum net HH income (EUR)		49,537	241,698	10	$1.50x10^7$	5,841
Minimum net HH income (EUR)		36,878	121,526	0	$9x10^6$	5,841
Panel B: Demographics						
Female		40%				5,380
Age		54	14.9	21	91	5,380
Panel C: Socioeconomic status						
Head of household		74%				5,377
Past household income (43k or less : 43k-80k : 80k or more)		25%	:43%	: 32%		5,380
College education		51%				5,841
Employed		62%				5,377
Deficit balance sheet		5%				5,010
Annual net personal income (EUR)		31,319	21,376	-4,155	$4.6x10^5$	4,398
Annual gross personal income (EUR)		40,734	26,106	2	$3.0x10^5$	4,993

Note: Subjective uncertainty is measured in standard deviation. N of within statistics are the average number of samples of each individual.

B Variable Descriptions

B.1 H1 variables

Table 12: H1 Variables

	US SPF	EU SPF	US households	Dutch households
Mean expectation	Point forecasts provided by respondents			Mean expectation calculated from subjective histogram (log)
GDP deceleration dummy	1 if GDP growth of current period is less than GDP growth of the last period and 0 otherwise			
Recession dummy	1 if GDP growth of current period is less than 0% and 0 otherwise			
GDP growth	US real GDP growth (real time)	EU real GDP growth (real time)	US nominal GDP per capita growth	Dutch nominal GDP per capita growth
Good (bad) financial situation dummy	NA		1 if the respondent's family is financially better (worst) off and 0 otherwise	1 if the respondent's household income is unusually high (low) household income in the past 12 months and 0 otherwise
Unemployed dummy	NA		1 if the respondent is not working either full time or part time and 0 otherwise	
College education dummy	NA			1 if the respondent has a college education and 0 otherwise
Net personal income	NA			Actual personal income from jobs or financial assets after adjusting for taxes, rent, interest, scholarship, and so forth (log)
Decreased net personal income dummy	NA			1 if net personal income decreased from last year or 0 otherwise
Deficit balance sheet dummy	NA			1 if the respondent's balance sheet is negative or 0 otherwise

B.2 H2 variables

Table 13: H2 Variables

	US SPF	EU SPF	US households	Dutch households
Subjective uncertainty	Standard deviation of subjective histogram			Standard deviation of subjective histogram (log)
GDP deceleration dummy	1 if GDP growth of current period is less than GDP growth of the last period and 0 otherwise			
Recession dummy	1 if GDP growth of current period is less than 0% and 0 otherwise			
GDP growth	US real GDP growth (real time)	EU real GDP growth (real time)	US nominal GDP per capita growth	Dutch nominal GDP per capita growth
Good (bad) financial situation dummy	NA		1 if the respondent's family is financially better (worst) off and 0 otherwise	1 if the respondent's household income is unusually high (low) household income in the past 12 months and 0 otherwise
Unemployed dummy	NA		1 if the respondent is not working either full time or part time and 0 otherwise	
College education dummy	NA			1 if the respondent has a college education and 0 otherwise
Net personal income	NA			Actual personal income from jobs or financial assets after adjusting for taxes, rent, interest, scholarship, and so forth (log)
Decreased net personal income dummy	NA			1 if net personal income decreased from last year or 0 otherwise
Deficit balance sheet dummy	NA			1 if the respondent's balance sheet is negative or 0 otherwise

C Robustness Checks

C.1 Robustness checks for H1

Table 14: Expected Income of Dutch Households

	(1999-2018)		(2008-2018)	
EU Economic Policy Uncertainty index $_t$		-0.46***		0.14
		(0.08)		(0.12)
EU Economic Policy Uncertainty index $_{t-1}$		0.01		0.14**
		(0.06)		(0.06)
Expected income$_{t\|t-1}$	-0.10*	-0.12**	-0.14**	-0.15**
	(0.05)	(0.06)	(0.06)	(0.06)
GDP per cap growth$_{t,t-1}$	0.01	0.05***	-0.02	-0.05**
	(0.01)	(0.01)	(0.01)	(0.02)
GDP per cap deceleration D$_{t,t-1}$	0.07***	0.15***	-0.01	-0.05
	(0.03)	(0.03)	(0.03)	(0.05)
Above 4% GDP per cap growth D$_{t,t-1}$	0.21***	0.13***	0.19***	0.21***
	(0.04)	(0.04)	(0.03)	(0.04)
Below 2% GDP per cap growth D$_{t,t-1}$	-0.05	-0.06*	-0.03*	
	(0.03)	(0.04)	(0.04)	(0.04)
Recession D$_{t,t-1}$	-0.04	0.03	0.07*	-0.16***
	(0.04)	(0.04)	(0.04)	(0.05)
Good financial situation in the past 12 months D$_t$	-0.08	-0.06	-0.03	-0.03
	(0.09)	(0.08)	(0.09)	(0.09)
Bad financial situation in the past 12 months D$_t$	-0.20*	-0.19*	-0.18	-0.18
	(0.11)	(0.11)	(0.12)	(0.12)
Unemployed D$_t$	-0.11	-0.03	-0.03	-0.04
	(0.07)	(0.07)	(0.07)	(0.07)
College education D$_t$	-0.27	-0.15	-0.29	-0.31
	(0.24)	(0.24)	(0.19)	(0.19)
Net personal income$_t$	0.03**	0.02*	0.01	0.01
	(0.01)	(0.01)	(0.01)	(0.01)
Decreased net personal income D$_t$	0.03	0.03	0.01	0.01
	(0.02)	(0.02)	(0.02)	(0.02)
Deficit balance sheet D$_t$	-0.04	-0.06	-0.17*	-0.16*
	(0.10)	(0.10)	(0.09)	(0.09)
Constant	Y	Y	Y	Y
Individual FE	Y	Y	Y	Y
HH income categories	Y	Y	Y	Y
Observations	3,730	3,730	3,327	3,327
R-squared	0.00	0.006	0.04	0.04

* p $<$ 0.1, **p $<$ 0.05, *** p$<$ 0.01

Note: The columns regress next 12 months net household income expectation of Dutch household with different timelines. All independent variables end with D are dummies.The detail description of each variable is in the appendix B.

C.2 Robustness checks for H2

Table 15: Subjective Uncertainty of Dutch Households

	(1999-2018)		(2008-2018)	
EU Economic Policy Uncertainty index $_t$		-0.57***		0.14
		(0.14)		(0.23)
EU Economic Policy Uncertainty index $_{t-1}$		0.23**		0.10
		(0.10)		(0.11)
Subjective uncertainty$_{t\|t-1}$	-0.05	-0.07**	-0.09***	-0.09***
	(0.03)	(0.03)	(0.03)	(0.03)
GDP per cap growth$_t$	0.02	0.09***	-0.03	-0.07
	(0.02)	(0.02)	(0.02)	(0.04)
GDP per cap deceleration D$_t$	0.18***	0.25***	0.02	-0.03
	(0.04)	(0.05)	(0.05)	(0.09)
Above 4% GDP per cap growth D$_t$	-0.36***	-0.48***	-0.52***	-0.50***
	(0.08)	(0.08)	(0.08)	(0.08)
Below 2% GDP per cap growth D$_t$	0.02	0.02	0.02	0.03
	(0.06)	(0.06)	(0.06)	(0.06)
Recession D$_t$	-0.10	0.07	-0.18***	-0.25**
	(0.07)	(0.07)	(0.07)	(0.10)
Good financial situation in the past 12 months D$_t$	0.19	0.22*	0.19	0.19
	(0.13)	(0.13)	(0.14)	(0.14)
Bad financial situation in the past 12 months D$_t$	-0.05	-0.03	-0.05	-0.06
	(0.15)	(0.15)	(0.15)	(0.15)
Unemployed D$_t$	-0.30**	-0.16	-0.18	-0.19
	(0.13)	(0.13)	(0.13)	(0.13)
College education D$_t$	-0.45	-0.25	-0.49**	-0.49**
	(0.33)	(0.32)	(0.21)	(0.21)
Net personal income$_t$	0.05*	0.03	0.03	0.03
	(0.03)	(0.03)	(0.03)	(0.03)
Decreased net personal income D$_t$	0.01	0.02	-0.01	-0.01
	(0.04)	(0.04)	(0.04)	(0.04)
Deficit balance sheet D$_t$	-0.03	-0.06	-0.22	-0.21
	(0.19)	(0.19)	(0.17)	(0.17)
Constant	Y	Y	Y	Y
Individual FE	Y	Y	Y	Y
HH income categories	Y	Y	Y	Y
Observations	3,677	3,677	3,279	3,2379
R-squared	0.001	0.004	0.02	0.02

* p $<$ 0.1, **p $<$ 0.05, *** p$<$ 0.01

Note: The columns regress the subjective uncertainty of Dutch household with different timelines. All independent variables end with D are dummies.The detail description of each variable is in the appendix B.

C.3 Generalized Beta Distribution for H2 robustness check

In this section, we present the results of H2 using the generalized Beta distribution.

Table 16: SPF Subjective Uncertainty

Real GDP Growth	EU SPF (1999Q1-2020Q1)				US SPF (1992Q1-2020Q1)				
Subjective Uncertainty	(1a)	(2a)	(3a)	(4a)	(1b)	(2b)	(3b)	(4b)	(5)
Economic Policy Uncertainty index (EU, US)$_t$		0.03**				-0.02			
		(0.01)				(0.02)			
Economic Policy Uncertainty index (EU, US)$_{t-1}$		0.004				-0.009			
		(0.01)				(0.02)			
Stock market volatility (STOXX, VIX)$_t$			-0.001				-0.01		
			(0.007)				(0.02)		
Stock market volatility (STOXX, VIX)$_{t-1}$			0.008				0.03*		
			(0.01)				(0.02)		
Forecast disagreement$_t$				0.04				-0.03	
				(0.04)				(0.04)	
Forecast disagreement$_{t-1}$				-0.06				0.01	
				(0.04)				(0.04)	
Macroeconomic Uncertainty index$_t$									-0.35***
									(0.11)
Macroeconomic Uncertainty index$_{t-1}$									0.41**
									(0.17)
Subjective uncertainty$_{t-1}$	0.74***	0.72***	0.74***	0.74***	0.45***	0.45***	0.45***	0.45***	0.45***
	(0.04)	(0.05)	(0.04)	(0.05)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
GDP growth$_{t-1}$	-0.01***	-0.01***	-0.005**	-0.006*	0.004	-0.006	-0.004	-0.004	-0.004
	(0.001)	(0.002)	(0.002)	(0.003)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
GDP deceleration D$_{t-1}$	0.004	0.00	0.004	0.004	0.005	0.004	0.003	0.005	0.004
	(0.003)	(0.003)	(0.003)	(0.003)	(0.006)	(0.006)	(0.006)	(0.006)	(0.007)
Above 4 % GDP growth D$_{t-1}$	-0.01	0.01	-0.01	-0.01	0.003	0.003	0.00	0.004	0.005
	(0.009)	(0.009)	(0.009)	(0.009)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Below 1% GDP growth D$_{t-1}$	-0.01	-0.01	-0.1	-0.01	-0.02	-0.04	-0.02	-0.008	-0.03
	(0.008)	(0.008)	(0.008)	(0.008)	(0.02)	(0.03)	(0.02)	(0.03)	(0.03)
Recession D$_{t-1}$	0.02**	0.02**	0.02***	0.03***	0.04	0.02	0.02	0.04	-0.007
	(0.009)	(0.009)	(0.009)	(0.008)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Constant	Y	Y	Y	Y	Y	Y	Y	Y	Y
Quarter FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Individual FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Observations	3,058	3,058	3,058	3,058	2,405	2,405	2,405	2,405	2,405
R-squared	0.79	0.79	0.79	0.79	0.55	0.55	0.55	0.55	0.55

* p $<$ 0.1, **p $<$ 0.05, *** p$<$ 0.01

Note: The columns regress subjective uncertainty of professional forecasters, against different macro uncertainty indices. Economic Policy Uncertainty indices (Baker et al., 2016) are from EU (2a) and US (2b). Stock market volatility indices are STOXX (3a) and VIX (3b). Forecast disagreements are from professional forecasters in EU (4a) and US (4b). Macroeconomic Uncertainty index (Jurado et al., 2015) is only available in the US (5). All independent variables end with D are dummies.The detail description of each variable is in the appendix B.

Table 17: Subjective Uncertainty of Households

Subjective uncertainty$_{t+1\|t}$	Dutch households					US households				
	(1997-2018)		(2008-2018)	(1999-2018)		(2013M6 - 2019M10)				
	(1a)	(2a)	(2b)	(3a)	(4a)	(1b)	(2c)	(3b)	(4b)	(5)
Economic Policy Uncertainty index (EU, NL, US)$_t$		-0.44***	-0.18				-0.08***			
		(0.15)	(0.28)				(0.02)			
Economic Policy Uncertainty index (EU, NL, US)$_{t-1}$		-0.28**	-0.19				-0.01			
		(0.11)	(0.43)				(0.02)			
Stock market volatility (STOXX, VIX)$_t$				0.18				-0.07**		
				(0.15)				(0.04)		
Stock market volatility (STOXX, VIX)$_{t-1}$				0.31**				0.04		
				(0.15)				(0.04)		
Forecast disagreement$_t$					2.31***				0.09	
					(0.67)				(0.11)	
Forecast disagreement$_{t-1}$					-0.33				0.06	
					(0.44)				(0.12)	
Macroeconomic Uncertainty index$_t$										-0.88
										(0.66)
Macroeconomic Uncertainty index$_{t-1}$										0.64
										(0.66)
Subjective uncertainty$_{t\|t-1}$	-0.07**	-0.09**	-0.11***	-0.08**	-0.08**	0.05***	0.05***	0.05***	0.05***	0.05***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
GDP per cap growth$_{t,t-1}$	0.02	0.08***	-0.02	0.02	0.09***	-0.001	-0.004	0.004	-0.006	0.00
	(0.02)	(0.02)	(0.03)	(0.02)	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
GDP per cap deceleration D$_{t,t-1}$	0.13***	0.17***	-0.01	0.03	0.12**	0.00	-0.00	0.005	-0.006	0.002
	(0.05)	(0.06)	(0.06)	(0.06)	(0.05)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Above 4% GDP per cap growth D$_{t,t-1}$	-0.24***	-0.35***	-0.48***	-0.14	-0.33***	0.02	0.02	0.02	0.02	0.02
	(0.08)	(0.08)	(0.12)	(0.10)	(0.09)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Below 2% GDP per cap growth D$_{t,t-1}$	-0.01	0.01	0.11	-0.05	0.01	0.06*	0.06	0.07*	0.06	0.06
	(0.06)	(0.06)	(0.21)	(0.07)	(0.09)	(0.03)	(0.03)	(0.03)	(0.04)	(0.04)
Recession D$_{t,t-1}$	-0.05	0.11	-0.09	-0.12	-0.22***					
	(0.07)	(0.08)	(0.10)	(0.09)	(0.09)					
Good financial situation in the past 12 months D$_t$	0.15	0.19	0.18	0.17	0.18	0.07***	0.06***	0.07***	0.07***	0.07***
	(0.15)	(0.15)	(0.15)	(0.15)	(0.14)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Bad financial situation in the past 12 months D$_t$	-0.08	-0.05	-0.06	-0.06	-0.05	0.03	0.03	0.03	0.03	0.03
	(0.15)	(0.15)	(0.15)	(0.15)	(0.15)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Good financial situation in the next 12 months D$_t$						0.08***	0.08***	0.08***	0.08***	0.08***
						(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Bad financial situation in the next 12 months D$_t$						-0.009	-0.007	-0.009	-0.009	-0.009
						(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Unemployed D$_t$	-0.29**	-0.16	-0.14	-0.24*	-0.20	-0.15	-0.14	-0.14	-0.14	0.14
	(0.14)	(0.14)	(0.14)	(0.14)	(0.14)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)
College education D$_t$	-0.55*	-0.39	-0.57***	-0.49	-0.45					
	(0.32)	(0.32)	(0.22)	(0.31)	(0.31)					
Net personal income$_t$	0.05	0.04	0.03	0.05	0.04					
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)					
Decreased net personal income D$_t$	0.01	0.01	-0.03	0.01	0.01					
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)					
Deficit balance sheet D$_t$	0.08	0.05	-0.11	0.06	0.08					
	(0.19)	(0.19)	(0.17)	(0.20)	(0.20)					
Constant	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Individual FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
HH income categories	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Observations	3,470	3,470	3,069	3,439	3,439	45,081	45,081	45,081	45,081	45,081
R-squared	0.002	0.001	0.04	0.003	0.001	0.38	0.37	0.38	0.38	0.38

* p $<$ 0.1, **p $<$ 0.05, *** p$<$ 0.01

Note: The columns regress next 12 months net household income expectation of Dutch household and next 12 months personal income expectation of US household, against different macro uncertainty indices. Economic Policy Uncertainty indices (Baker et al., 2016) are from three regions: EU (2a), Netherlands (2b) and US (2c). Stock market volatility indices are STOXX (3a) and VIX (3b). Forecast disagreements are from professional forecasters in EU (4a) and US (4b). Macroeconomic Uncertainty index (Jurado et al., 2015) is only available in the US (5). The difference in the Dutch time frame is due the availability of macro uncertainty indices. All independent variables end with D are dummies.The detail description of each variable is in the appendix B.

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