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The role of central bank knowledge and trust for the public's inflation expectations

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Non-technical summary

Research Question

In this paper we look at the relationship between individuals' inflation expectations in Germany and their trust in the ECB and the Bundesbank as well as their knowledge of these two institutions. We first investigate how socio-demographic characteristics and interest in monetary policy and economics influence trust and knowledge about the two institutions, before proceeding to analyse how they influence inflation expectations.

Contribution

Using two waves of the new representative Bundesbank survey ("Meinungs- und Imagestudie der Deutschen Bundesbank") from 2016 and 2017, we provide new evidence of the link between trust, knowledge and inflation expectations for Germany. We go beyond the existing studies by undertaking an in-depth investigation of what type of knowledge matters most.

Results

We document that, although most respondents assume that they have a good or very good knowledge of the ECB and the Bundesbank, only about 20 percent cite "price stability" when asked a direct open-ended question about the two central banks' objectives. Our analysis also shows that knowledge of the ECB and the Bundesbank act as significant drivers of trust in these institutions. And greater trust in the ECB and Bundesbank, in turn, lowers individuals' inflation expectations. More specifically, having a greater degree of trust increases the probability of expecting unchanged prices and decreases the likelihood of expecting either slightly or sharply rising prices over the medium term. Interestingly, awareness of price stability as the primary objective of the ECB's monetary policy does not seem to affect inflation expectations directly once we control for trust, socio-demographic characteristics of individuals and their interest in economic topics. However, knowledge of past inflation seems to matter for future expectations. Limited public knowledge of the ECB's and the Bundesbank's main tasks, and our evidence defining the effects of trust on inflation expectations indicate that steering inflation expectations through central bank communication and trust-building seems promising, but may also be complex and resource-intensive.

Nichttechnische Zusammenfassung

Fragestellung

In dieser Arbeit untersuchen wir den Zusammenhang zwischen den Inflationserwartungen von Personen in Deutschland und ihrem Vertrauen in die EZB bzw. Bundesbank sowie deren Wissen über die beiden Zentralbanken. Zunächst betrachten wir sozio-demographische Merkmale und das Interesse an ökonomischen und geldpolitischen Fragestellungen als Bestimmungsgrößen von Wissen über Zentralbanken und Vertrauen in Zentralbanken. Im zweiten Schritt analysieren wir den Einfluss dieses Vertrauens und Wissens auf die Inflationserwartungen der Personen in Deutschland.

Beitrag

Anhand der Daten der neuen Bundesbank-Befragung (“Meinungs- und Imagestudie der Deutschen Bundesbank”) aus den Jahren 2016 und 2017 zeigen wir den Zusammenhang zwischen Vertrauen, Wissen und Inflationserwartungen für Deutschland auf. Wir gehen dabei über bisherige Studien hinaus, indem wir im Detail die Effekte unterschiedlicher Typen von Wissen untersuchen.

Ergebnisse

Wir zeigen zunächst, dass die meisten Befragten angeben, zumindest über eine ungefähre Vorstellung über die Ziele der EZB und der Bundesbank zu verfügen, dann aber nur rund 20 Prozent der Befragten Preisstabilität als Ziel nennen, wenn sie offen danach gefragt werden. Unsere Ergebnisse dokumentieren des Weiteren einen signifikanten Zusammenhang zwischen dem Wissen über die Zentralbanken und Vertrauen in die beiden Institutionen. Vertrauen wiederum hat großen Einfluss auf die Inflationserwartungen der Befragten. Personen mit hohem Vertrauen in die Zentralbanken erwarteten mit höherer Wahrscheinlichkeit unveränderte Preise und mit geringerer Wahrscheinlichkeit steigende oder stark steigende Preise als Personen mit geringem Vertrauen in die EZB und die Bundesbank. Interessanterweise scheint sich Wissen über das Preisziel der EZB nicht direkt auf die Inflationserwartungen auszuwirken, wenn man für Vertrauen in die Zentralbanken, Interesse an ökonomischen Fragen und sozio-demographische Merkmale der Befragten kontrolliert. Dagegen spielt Wissen über die Inflationsrate in der Vergangenheit eine Rolle für die zukünftigen Inflationserwartungen. Insgesamt deuten unsere Ergebnisse darauf hin, dass Zentralbanken durch ihre Kommunikation und Maßnahmen, die das Vertrauen in ihre Arbeit erhöhen, die Inflationserwartungen zwar beeinflussen können, dass dies aber komplex und mit erheblichen Aufwand verbunden sein kann.

The Role of Central Bank Knowledge and Trust for the Public's Inflation Expectations

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Abstract

Since the financial crisis, central banks have stressed the role of trust and communication in connection with their objectives and strategies for aligning the public's inflation expectations with their own and, consequently, improving the effectiveness of monetary policy. Assessing how much the general public knows about and trust in central banks and how these factors influence inflation expectations is thus important. We shed light on these issues by relying on a representative survey conducted among individuals living in Germany. Although most respondents assume that they have a good or very good knowledge of the ECB and the Bundesbank, only about 20 percent cite "price stability" when asked directly about the two central banks' objectives. Knowledge of the ECB's and the Bundesbank's goals act as significant drivers of trust in these institutions, however. And greater trust in the ECB and Bundesbank, in turn, lowers individuals' inflation expectations. More specifically, having greater trust increases the probability of expecting unchanged prices and decreases the likelihood of expecting either slightly or sharply rising prices over the medium term. Interestingly, awareness of price stability as the primary objective of the ECB's monetary policy does not seem to affect inflation expectations directly once we control for trust, individuals' socio-demographic characteristics and their interest in economic topics. Our study indicates that central banks can influence households' inflation expectations through building trust and educating the public about their targets.

Keywords: Inflation Expectations, Trust, Economic Knowledge, Central Bank Communications, European Central Bank, Deutsche Bundesbank.

JEL classification: D12, D84, E52, E58

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1 Introduction

Over the past three decades, many central banks have come to realize that the effectiveness of their policies does not depend solely on the current path of interest rates, but fundamentally on their ability to affect private citizens' and markets' expectations (Woodford, 2004; Bernanke, 2007) and align them with their own expectations. The expectations that matter in this respect are those about inflation and the future path of nominal interest rates. In turn, inflation and interest rate expectations hinge on public expectations of central banks' future policies and actions. In this respect, transparency and trust in central banks and their actions have acquired paramount importance. This awareness has resulted in central banks significantly altering their practices by adopting a constant forward policy signalling and greater openness with the aim of informing market participants and private individuals about the likely future path of monetary policy. They have also implemented strategies to expand public awareness of their targets and strategies and boost the degree of trust placed in them by the general public.

The main focus of this paper is on the role played by the general public's knowledge of and trust in the European Central Bank (ECB) and the Bundesbank for citizens' inflation expectations over the medium term. Only recently, empirical evidence documents what effects the general public's knowledge of (van der Crujisen et al., 2015) and trust (Christelis et al., 2016) in central banks has on individuals' inflation expectations. More specifically, van der Crujisen et al. (2015) show that knowledge related to monetary policy objectives is associated with the formation of inflation expectations. Conversely, Christelis et al. (2016) find that both general economic knowledge and specialized knowledge about the ECB's objectives have no impact on the general public's inflation expectations. They also provide the first survey-based evidence about the effects of trust in the ECB on the quantitative inflation expectations of private individuals. They find that higher levels of trust placed in the ECB reduce uncertainty about its policies and support the anchoring of households' inflation expectations around the ECB's target.

Our study provides new evidence concerning the effects of trust and knowledge on inflation expectations. More specifically, this paper aims to shed light on the evolving debate in the scant literature on the topic by providing new evidence and interpretations regarding the crucial role played by knowledge and trust placed in the ECB and the Bundesbank as drivers of private individuals' price expectations over the medium term. We furthermore contribute to the existing literature by proposing new proxies of public's knowledge about the central banks tasks, knowledge of the definition of stable prices that can be considered consistent with the ECB's price stability objective ("close to but below 2 percent"), and knowledge about past inflation dynamics. Our paper differs from Christelis et al. (2016) by employing qualitative measures of public inflation expectations that offer new empirical interpretations.

We make use of a unique representative survey of German individuals, "Meinungs- und Imagestudie der Deutschen Bundesbank", conducted on the behalf of the Deutsche Bundesbank in February 2016 and again in April 2017. The survey contains a large number

of questions on trust in and knowledge of the ECB and the Bundesbank as well as qualitative inflation expectations.

In line with the findings of Christelis et al. (2016), we document that trust in the ECB lowers individuals' medium-term inflation expectations. More specifically, on average, high levels of trust in the ECB increase the probability of expecting unchanged prices and decreases the likelihood of either slightly or sharply rising prices over the medium term. Interestingly, awareness of price stability as the European Central Banks' primary objective does not seem to affect inflation expectations directly once we control for trust, socio-demographic characteristics of individuals and their interest in economics. However, knowing the definition of stable prices that can be considered consistent with the ECB's mandate, and knowing about past inflation dynamics do significantly lower inflation expectations, even when controlling for trust. Taking together, these results indicate that central banks can influence households' inflation expectations through building trust and educating the public about their targets.

The results concerning trust in and knowledge of central banks more generally can be summarized as follows. First, we find that most German individuals believe that they have a good or very good knowledge of the ECB and Bundesbank, although only around 20 percent cite "price stability" when asked an open-ended question about the two central banks' objectives. We identify substantial heterogeneity in terms of knowledge about the central banks in general and their specific objectives, particularly with regard to socio-economic characteristics and the level of interest in economic issues and monetary policy. Second, in line with the results of Hayo and Neuenkirch (2014), we find that factual knowledge plays a crucial role in boosting the level of trust placed by the general public in the ECB and the Bundesbank.

The remainder of the paper proceeds as follows. The next section provides an overview of earlier empirical studies on public knowledge, trust in central banks, and inflation expectations. Section 3 describes the survey data. Section 4 sets out the results of the effects of socioeconomic determinants on public knowledge. Section 5 reports evidence of the effects of knowledge on trust placed in central banks. Section 6 sets out the findings on inflation expectations. Finally, Section 7 concludes.

2 Related Literature

This paper builds on the rapidly growing literature on central bank design and communication. The first step is related to earlier empirical studies analyzing the drivers of the general public's knowledge of central banks. One of the seminal works in this direction was conducted by Blinder and Krueger (2004). The authors analyze the determinants of the general public's factual knowledge about U.S. economic issues and show that the extent of such knowledge is shaped by individuals' level of education, the desire to be informed, the sources of information, the intensity of information received and demographic variables. Van der Crujssen et al. (2015) extend Blinder and Krueger's framework and focus specifically on knowledge of the European Central Bank's (ECB) policies. They highlight the role of

education, a desire to be informed, the use of different sources of information, and the quantity of information gathered as the main drivers of factual knowledge about the ECB's objectives. Their findings, based on a survey of Dutch households, reveal significantly imperfect public information about the ECB's policy objectives and a better knowledge of the ECB's policies among respondents who desire to be informed.

The next step of our analysis concerns the drivers of trust placed in the European Central Bank and the Bundesbank and builds on a large body of existing literature. Several studies employ data from the European Commission's Eurobarometer survey to investigate trust in the ECB and other European institutions. For instance, Fischer and Hahn (2008) study the drivers of trust in the ECB during the start-up phase during the period from 1999 to 2004, combined with aggregate explanatory factors. The authors document the positive impact of national income on the general public's trust in the ECB and the neutral role played by unemployment in this context. Wälti (2012) looks at citizens' trust in economic institutions a few years later and includes the onset of the crisis. The author documents an erosion of trust in those countries affected by increasing sovereign bond yields and financial market turbulence in the 2007-09 global financial crisis. Ehrmann, Soudan, and Stracca (2013) explicitly look at the events occurring during the global financial crisis and the sovereign debt crisis. Their findings suggest that the degree of trust in the ECB deteriorated dramatically as a result of three main factors: 1) the economic conditions which characterised those years, 2) loss of trust in other European institutions that were directly connected with the global financial crisis, and 3) ECB being associated as the main supervisory and regulatory entity of financial markets, and its policies considered as a bail-out of the banking sector. Focusing on the same analysis period, Bursian and Fürth (2015) take a closer look at the role of macroeconomic conditions in the evolution of European citizens' trust in the ECB during the recent recession. The authors make use of a number of questions from the Eurobarometer survey closely related to this paper. More specifically, their findings show that deviations from the inflation target level do not seem to be a significant determinant of the general public's level of trust. Furthermore, the ECB's performance with regards to its mandate is able to affect the degree of trust only for citizens who have already heard about the ECB. Horvath and Katuscakova (2016) find that the European citizens' perception of the transparency of the ECB's monetary policy produces positive nonlinear effects on their level of trust, meaning that an optimal level of transparency exists (see also van der Cruijssen et al., 2010).

Hayo and Neuenkirch (2014) make a significant contribution to the existing literature by differentiating the role of households' subjective knowledge (what they think they know) and factual knowledge (what they actually know) with regard to the trust-building process concerning the ECB. They find that both types of knowledge matter, although factual knowledge seems to have a greater impact on trust. Furthermore, the authors examine the effects of knowledge of specific central bank topics and goals. They find, for instance, that awareness of the ECB's mandate and independence significantly influences public trust in the institution, whereas general knowledge of monetary policy does not seem to be a significant

factor.

The final step of our analysis is about the effects that trust in central banks has on the general public's inflation expectations. The conventional way of measuring an individual's inflation expectations empirically relies on surveys¹. Adopting this approach, a broad cluster of studies focuses on the anchoring process of individuals' inflation expectations around the inflation target set by a central bank. For instance, Easaw et al. (2012) find that Italian households overreact to the current level of inflation when forming their expectations and, that expectations are consistently higher than the target set by the ECB. van der Cruijssen and Demertzis (2007) look at inflation expectations for the euro area, and note a significant heterogeneity in national inflation expectations, and a weaker anchoring process of expectations for the euro area compared with the average level of inflation expectations within individual euro area countries. Kumar et al. (2015), employing a survey of firm managers based in New Zealand, show that, although New Zealand was the pioneer of inflation targeting, inflation expectations vary significantly across groups of managers. The perception of current levels and forecasts of inflation is, on average, higher than the respective actual and target levels. The authors also document shortcomings in awareness of the main objective of the Reserve Bank of New Zealand. Similarly, Binder (2017) shows empirically that consumers' expectations, based on U.S. consumer survey data, are imperfectly anchored to the Fed's two percent target.

Nevertheless, despite the vast literature on the anchoring process, the number of studies stressing the importance of the link between knowledge and trust in central banks, and public inflation expectations seems to be very limited. Notable exceptions are van der Cruijssen et al. (2015) who conduct a survey-based study and find that a better understanding of the ECB's objectives is connected with an individual's ability to form good inflation expectations. Dräger and Fritsche (2013) investigate the role of trust in people and the ECB for different measures of inflation expectations. Their results, based on a survey representative of the population in the German city of Hamburg, show no effect of trust in the ECB either on inflation perceptions or expectations². Contrary results are obtained by Christelis et al. (2016) who, using a representative survey of the population in Netherlands, find that a higher degree of trust in the ECB reduces inflation expectations and individual uncertainty about price developments. Moreover, they conclude that both respondents' economic knowledge and specialized knowledge about the ECB's objectives have no effect on their inflation expectations. In other words, their results indicate that a more trustworthy central bank is able to manage public expectations more efficiently by lowering both inflation expectations and uncertainty about the future inflation levels; on the other hand, knowledge plays no role in the process of inflation expectations.

¹ ECB (2006) offers a systematic overview of survey-based measures of inflation expectations in the euro area. Potential pitfalls from the use of financial market-based measures are also addressed by the authors.

² The findings might be affected by the fact that the survey suffers from several shortcomings, such as a limited sample size, and from being representative of the population of only a single German city.

3 Database - The Survey “Meinungs- und Imagestudie der Deutschen Bundesbank”

We employ a unique representative survey of German individuals aged 16 years and older at the time of the interview – “Meinungs- und Imagestudie der Deutschen Bundesbank” – conducted for the Bundesbank by the Institut für Demoskopie Allensbach. The survey offers a variety of questions related to our topic of interest. It contains questions about the Bundesbank and the ECB that allow us to extrapolate several different measures of knowledge and trust in these institutions. Furthermore, the survey asks qualitative questions about past inflation and inflation expectations over the medium term. More details of the specific questions are provided in the following sections. The questions mentioned above are supplemented by a rich set of socio-demographic characteristics of the respondents, including their age, level of education, gender and household income, as well as indicators of the region in which they live.

The survey has been conducted twice so far, in January 2016 and April 2017, and the questionnaire has been kept stable to a large degree. In 2016, face-to-face interviews were conducted with 1,521 individuals, and in 2017 the net sample size was 1,407 individuals. For our analysis, we pool the data from the two cross-sections of the survey for a total sample of 2,928 observations. The main survey mode was CAPI, but the interviewers used some cards to illustrate answer options (e.g. to assess respondents’ knowledge of particular institutions). In several sections of the questionnaire a split-half design was used, i.e. only half of the sample answered a particular question. Unfortunately, this also includes a small number of questions relevant for our study, such as the question about factual knowledge of the Bundesbank and the ECB. By pooling the samples from the two waves, we nonetheless end up with a sufficient number of observations for these questions as well.

4 What Does the Public Know about Central Banks?

Before we analyse the role of knowledge and trust in individuals’ inflation expectations we take a closer look at the general public’s knowledge of central banks and how this knowledge influences trust in central banks.

(a) Subjective knowledge about central banks

We start by assessing subjective knowledge about the ECB and the Bundesbank. The survey asks respondents to evaluate how well they know certain European and German institutions and their duties, including the German Federal Constitutional Court (*Bundesverfassungsgericht*) and the European Court of Justice, the European Parliament and the German Parliament (*Bundestag*), as well as the European Commission and the German Cabinet (*Bundesregierung*). The respondents were asked to put these institutions into the following categories: 1) I don’t know the institution, 2) I only know the institution by name, 3) I have an approximate idea or 4) I have a fairly accurate idea of the duties of this institution.

The results for the subjective knowledge of both the ECB and the Bundesbank are reported in Table 1. Of the respondents, more than 70 percent claim to have an approximate or better knowledge of the ECB’s duties, with almost 80 percent claiming this with regard to the Bundesbank’s. Not surprisingly, a larger percentage of German individuals claims to have a better knowledge of their national central bank than of the ECB. However, the gap between seems to be quite close.

Subjective knowledge about the two central banks is highly correlated. About 78 percent of individuals with an accurate knowledge of the ECB also have an accurate knowledge of the Bundesbank’s duties.³

Table 1: Subjective knowledge of the ECB and the Bundesbank

	Category		Frequency	Percent	Cumulative
ECB	0	Unknown	132	5	5
	1	Only known by name	673	23	28
	2	Approximate idea	1,290	45	73
	3	Accurate	779	27	100
	Total		2,874	100	
Bundesbank	0	Unknown	52	2	2
	1	Only known by name	509	18	20
	2	Approximate idea	1,322	46	66
	3	Accurate	969	34	100
	Total		2,852	100	

Source: Authors’ calculations.

(b) Drivers of subjective knowledge of the central banks

The survey allows us to shed some light on the drivers of subjective knowledge about the ECB and the Bundesbank. Besides the standard socio-demographic variables (age, education, gender, income, etc.) we are able to include a measure of an individual’s self-reported interest in economic issues and monetary policy in our regression analysis. This will allow us to assess how general interest in topics relevant to central banks influences the public’s subjective knowledge about the central banks’ tasks. In general, we expect a positive relationship between an interest in economics and *a fortiori* monetary policy and subjective knowledge about central bank’s duties (see, for example, Blinder and Krueger, 2004).

³ A cross-tabulation of the two indicators may be found in Table A1 in the Appendix.

We use the following two questions to measure an individual's interest in economics and monetary policy:

How much interest do you take in economic issues?

- (a) *Much [14 percent]*
- (b) *Some [47 percent]*
- (c) *Little [25 percent]*
- (d) *No interest [13 percent]*
- (e) *I don't know [1 percent]*

And how much interest do you take in questions of monetary policy?

- (a) *Much [13 percent]*
- (b) *Some [44 percent]*
- (c) *Little [28 percent]*
- (d) *No interest [14 percent]*
- (e) *I don't know [1 percent]*

The percentages in square brackets suggest a reasonable overall level of interest in economics and monetary policy topics. More than half of the sample belong to the category “some interest” or “much interest”.

The independent distributions of the responses to the two questions are almost identical and highly correlated.⁴ We therefore combine the answers about economics and monetary policy to create a single indicator of interest by assigning each respondent to the highest category marked for the two questions⁵.

⁴ Descriptive cross-tabulations for interest in economics and monetary policy are displayed in Table A2 in the Appendix.

⁵ To check how this choice affects our findings, we conduct robustness checks by including the indicator of interest of economics and monetary policy separately in all regression models. The results are similar both in terms of significance of size the coefficients to the baseline specifications shown in this paper. The additional regression results are available upon request.

The resulting distribution of answers for the combined indicator is displayed in Table 2.

Table 2: Degree of interest in economics and monetary policy

Category		Frequency	Percent	Cumulative
0	Much	514	18	18
1	Some	1,378	47	65
2	Little	712	25	90
3	No interest	299	10	100
No. of observations		2,903	100	

Source: Authors' calculations.

Having presented our main variables of interest for this part of the study, we can commence estimating the model for identifying the determinants of individuals' subjective knowledge about central bank's duties. To this end, we adapt some models of public knowledge presented in the existing literature (e.g. Blinder and Krueger, 2004; van der Crujisen et al., 2015) with the questions posed in our survey and, then, model our proxy of subjective knowledge by estimating the following ordered probit regression:

$$SK_i = f_1(I_i, \mathbf{X}_i) + \varepsilon_{1i}. \quad (1)$$

Here, SK_i is an ordinal variable capturing the subjective level of knowledge of household i about either the ECB or Bundesbank, I_i represents our measure of interest in economics and monetary policy, and \mathbf{X}_i is a vector of socioeconomic variables⁶. Those factors include education ("little" stands for individuals who do not possess a high school certificate and is the reference group, "medium" stands for individuals possessing a high school certificate, and "high" stands for individuals who have a university degree or a qualification of a comparable standard), age, gender (males form the reference group), household income in brackets (salaries below €2,000 is the reference group), region (West Germany is the reference group), and wave (observations from the 2016 wave form the reference group). The estimated coefficients and average marginal effects are reported in Table 3⁷ (ECB) and Table 4 (Bundesbank), respectively.

⁶ Summary statistics for all variables, including the socioeconomic characteristics, can be found in Table A3 in the Appendix.

⁷ From this table and so on, in the columns referring to the marginal effects the outcome variable is indexed with z_i , where $i = 1, 2, 3, \dots$, representing the four response categories for subjective knowledge: unknown, known by name, approximate knowledge and accurate knowledge of central bank's targets.

Table 3: Ordered probit model – Determinants of subjective knowledge of the ECB

Category		Coefficients	Marginal Effects: Pr(Subjective Knowledge = z)			
			z = 0	z = 1	z = 2	z = 3
		(1)	(2)	(3)	(4)	(5)
Interest in economics & monetary policy	Little	0.629*** (0.085)	-0.104*** (0.017)	-0.132*** (0.017)	0.131*** (0.021)	0.104*** (0.013)
	Some	1.100*** (0.083)	-0.138*** (0.017)	-0.25*** (0.018)	0.152*** (0.021)	0.2356*** (0.013)
	Much	1.593*** (0.100)	-0.152*** (0.017)	-0.35*** (0.021)	0.088*** (0.023)	0.414*** (0.024)
Education	Medium	0.328*** (0.058)	-0.031*** (0.006)	-0.071*** (0.013)	0.016*** (0.005)	0.087*** (0.015)
	High	0.606*** (0.065)	-0.049*** (0.007)	-0.128*** (0.014)	0.004 (0.006)	0.173*** (0.018)
Age	Age	0.039*** (0.007)	-0.003*** (0.001)	-0.008*** (0.001)	-0.0002 (0.0003)	0.011*** (0.002)
	Age squared	-0.0003*** (0.0001)	2.6e-05*** (5.7e-06)	0.0001*** (1.4e-05)	1.2e-06 (2.2e-06)	-0.0001*** (2e-05)
Gender	Female	-0.191*** (0.045)	0.015*** (0.004)	0.039*** (0.009)	0.0007 (0.001)	-0.055*** (0.013)
Household income	€2,000-€3,500	0.039 (0.053)	-0.003 (0.004)	-0.008 (0.011)	0.0001 (0.0004)	0.011 (0.015)
	≥€3,500	0.094 (0.06)	-0.007 (0.005)	-0.019 (0.013)	-0.001 (0.001)	0.027 (0.017)
Region	Eastern Germany	-0.253*** (0.049)	0.02*** (0.004)	0.052*** (0.01)	0.001 (0.002)	-0.072*** (0.014)
Wave	2017	-0.146*** (0.043)	0.012*** (0.004)	0.03*** (0.009)	0.001 (0.001)	-0.042*** (0.012)
No. of observations		2,622				
Pseudo R ²		0.12				
Wald χ^2		726.10 ***				

Source: Authors' calculations.

NOTES: This table reports standard coefficients and average marginal effects from the cross-sectional ordered probit regressions using the delta method. Coefficients are labelled according to two-tailed significance at one / five / ten percent levels (i.e. *** p<0.01, ** p<0.05, * p<0.1) The robust standard errors in parentheses are corrected for heteroskedasticity.

Table 4: Ordered probit model – Determinants of subjective knowledge of the Bundesbank

		Category	Coefficients	Marginal effects: Pr(Subjective Knowledge = z)			
				z = 0	z = 1	z = 2	z = 3
			(1)	(2)	(3)	(4)	(5)
Interest in economics & monetary policy	Little		0.538*** (0.084)	-0.043*** (0.009)	-0.146*** (0.023)	0.066*** (0.016)	0.123*** (0.018)
	Some		0.972*** (0.08)	-0.056*** (0.009)	-0.248*** (0.023)	0.04** (0.016)	0.264*** (0.017)
	Much		1.500*** (0.099)	-0.062*** (0.010)	-0.33*** (0.024)	-0.071*** (0.021)	0.462*** (0.027)
Education	Medium		0.26*** (0.059)	-0.011*** (0.003)	-0.055*** (0.013)	-0.014*** (0.003)	0.08*** (0.018)
	High		0.403*** (0.065)	-0.016*** (0.003)	-0.082*** (0.014)	-0.03*** (0.006)	0.128*** (0.02)
Age	Age		0.045*** (0.007)	-0.002*** (0.0003)	-0.01*** (0.001)	-0.004*** (0.001)	0.014*** (0.002)
	Age squared		-0.0004*** (0.0001)	1.3e-05*** (3.21e-06)	0.0001*** (1.4e-05)	2.9e-05*** (6.2e-06)	-0.0001*** (2.2e-05)
Gender	Female		-0.196*** (0.047)	0.007*** (0.002)	0.039*** (0.009)	0.016*** (0.004)	-0.06*** (0.015)
Household income	€2,000-€3,500		0.131** (0.054)	-0.005** (0.002)	-0.027** (0.011)	-0.01** (0.004)	0.041** (0.017)
	≥€3,500		0.19*** (0.062)	-0.007*** (0.002)	-0.038*** (0.013)	-0.016*** (0.006)	0.061*** (0.02)
Region	Eastern Germany		-0.239*** (0.052)	0.009*** (0.002)	0.047*** (0.01)	0.02*** (0.005)	-0.076*** (0.016)
Wave	2017		-0.184*** (0.045)	0.007*** (0.002)	0.036*** (0.009)	0.015*** (0.004)	-0.059*** (0.014)
No. of observations			2,607				
Pseudo R ²			0.11				
Wald χ^2			633.93 ***				

Source: Authors' calculations.

NOTES: This table reports standard coefficients and average marginal effects from the cross-sectional ordered probit regressions using the delta method. Coefficients are labelled according to two-tailed significance at one / five / ten percent levels (i.e. *** p<0.01, ** p<0.05, * p<0.1) The robust standard errors in parentheses are corrected for heteroskedasticity.

Observing the coefficients reported in columns (1) in both tables, the reader can observe very similar coefficients on the socioeconomic variables in terms of significance and sign. Being an individual with greater interest in economics and monetary policy, of higher education and being male, income rich (does not apply to the ECB), and from the western part of Germany is positively correlated with the level of subjective knowledge about the ECB and the Bundesbank. For age we estimate a hump-shaped effect, with a turning point at age 55. The average marginal effects provide some additional insight. In the Bundesbank's case, most of

the switches in the sign of the marginal effects for the socio-demographic variables occur at the ends of the subjective knowledge scale, i.e. either between “approximate” (outcome 2) and “accurate” knowledge (outcome 3) for positive coefficient estimates or between “unknown” (outcome 0) and “known by name” (outcome 1) for negative coefficient estimates. For the ECB this is not the case. The changes here are more in the middle of the response scale and, in general, the marginal effects for the socio-demographic characteristics are insignificant with regard to the category “approximate knowledge”.

However, the results for our main variable of interest “interest in economics and monetary policy” differ from this general pattern. More specifically, the effects of interest in economic topics change sign when moving from declaring standard knowledge (outcome 2) to accurate knowledge for individuals with some and little interest for both the ECB and the Bundesbank. Put differently, having a stronger interest in economics and monetary policy lowers the probability of claiming “almost unknown” and “only known by name” about the ECB and the Bundesbank, and increases the likelihood related to the “approximate idea” and “accurate idea” categories. These patterns indicate that interest in economics and monetary policy separates individuals with only a very limited subjective knowledge of the two institutions from respondents with some knowledge. For individuals with a very high degree of interest, however, the split for the Bundesbank occurs only between the “approximate knowledge” and “accurate knowledge” categories.

Furthermore, the magnitude of the marginal effects and coefficients for the interest in economics and monetary policy rises as we move from “little interest” to “much interest”, pointing to a strong correlation between interest in economics and monetary policy and subjective knowledge about central banks.

(c) Factual knowledge about central banks’ tasks

The next step in our analysis focuses on assessing how much the general public knows about central banks’ policy tasks. We draw inspiration from the survey-based study conducted by Hayo and Neuenkirch (2014) on the role of knowledge and information search in the trust-building process of German households. To this end, the authors make a significant contribution to the existing literature by differentiating subjective and factual knowledge related to monetary policy. Accordingly, the Bundesbank’s survey also asks about the degree of factual knowledge (“what individuals actually know”) by posing two open-ended questions about the ECB and the Bundesbank’s tasks:

If you go by what you know or think, what are the tasks of the European Central Bank? What is it responsible for?

If you go by what you know or think, what are the tasks of the Bundesbank? What is it responsible for?

These two questions are open-ended questions, i.e. the survey does not provide any pre-specified answer categories, but asks the respondents to describe in their own words the tasks they think the two institutions perform. Furthermore, the interviewers specify and reassure

the respondents that it is not a matter of providing a correct or incorrect answer and/or that it is not a problem if the space provided for an answer is left blank. After all the interviews are completed, the responses to the open-ended questions are classified by the survey agency under 22 categories for each of the two central banks.

From those 22 categories we choose only the two categories⁸ indicating the price stability task as an objective, i.e. “ensure price stability, prevent inflation” and “ensure the stability of the currency”. We focus on the price stability issue, as the main task of central banks, because it represents the primary and explicitly declared goal of the ECB, and is directly connected to the formation of inflation expectations, which is the main variable of interest in this study.

Pooling the answers for both central banks, we build a binary variable describing overall knowledge of the ECB and the Bundesbank’s tasks. Due to the split-half design of the survey⁹ we would otherwise have ended up with too few observations. The question responses for the individual and combined indicator are reported in Table 5.

Table 5: Degree of factual knowledge of the ECB’s and Bundesbank’s main task

Category	ECB		Bundesbank		Combined	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Ensure price stability, prevention of inflation and/or Ensure the stability of the currency	368	27.5	282	17.7	650	22.2
Other tasks	970	72.5	1,308	82.3	2,278	77.8
No. of observations	1,338	100	1,590	100	2,928	100

Source: Authors’ calculations.

The first aspect to notice is the limited public knowledge that exists concerning the main task of the two central banks. The answer “price stability” was in fact provided only by around 28 and 18 percent of respondents for the ECB and the Bundesbank, respectively. Our results reflect the findings of earlier empirical studies (i.e. van der Crujisen et al., 2015; Christelis et al., 2016). Analysing the response percentages for each central bank, it is possible to deduce that German citizens have a better understanding of the ECB’s main task.

⁸ The full list of answers with the relative frequencies are presented in Table A4 in the Appendix.

⁹ These two questions are addressed to a smaller number of respondents. The sample is, in fact, divided randomly into two representative halves, and interviewees belonging to each half-sample reply to only one of the two questions, either the one concerning the tasks of the Bundesbank or the one concerning the tasks of the ECB.

Analogous to the analysis regarding subjective knowledge, we now model factual knowledge as depending on the socio-demographic covariates and the variable measuring interest in economics and monetary policy. We rely on simple probit models, because our dependent variable is binary and not ordered, and apply the same baseline specification adopted for subjective knowledge in equation (1):

$$FK_i = f_2(I_i, \mathbf{X}_i) + \varepsilon_{2i} \quad (2)$$

where FK_i is a binary variable representing the overall level of factual knowledge for household i . Table 6 presents the findings of the regression analysis.

For factual knowledge we find similar correlations than for the subjective knowledge estimation. However, the significance levels of coefficients and marginal effects on the covariates are lower than those estimated in the previous models. Unsurprisingly, comparing with the results of previous estimations, the low value of Pseudo R^2 , 0.05, reflects the weaker explanatory power of the covariates for factual knowledge.

Table 6: Probit model – Determinants of factual knowledge about the ECB and the Bundesbank (combined)

Category		Coefficients	Marginal effects
		(1)	(2)
Interest in economics & monetary policy	Little	0.539*** (0.132)	0.115*** (0.024)
	Some	0.676*** (0.127)	0.154*** (0.022)
	Much	0.766*** (0.14)	0.182*** (0.029)
Education	Medium	0.169** (0.077)	0.045** (0.02)
	High	0.347*** (0.081)	0.098*** (0.022)
Age	Age	0.027*** (0.009)	0.008*** (0.002)
	Age squared	-0.0002*** (0.0001)	-0.0001*** (2e-05)
Gender	Female	-0.203*** (0.057)	-0.058*** (0.016)
Household income	€2,000-€3,500	0.11 (0.068)	0.031 (0.019)
	≥€3,500	0.137* (0.078)	0.039* (0.022)
Region	Eastern Germany	-0.113* (0.066)	-0.032* (0.019)
Wave	2017	-0.144** (0.056)	-0.041** (0.016)
No. of observations		2,673	
Pseudo R ²		0.05	
Wald χ^2		127.44 ***	

Source: Authors' calculations.

NOTES: This table reports standard coefficients and average marginal effects from the cross-sectional probit regression using the delta method. Coefficients are labelled according to two-tailed significance at one / five / ten percent levels (i.e. *** p<0.01, ** p<0.05, * p<0.1). The robust standard errors in parentheses are corrected for heteroskedasticity.

5 Does Knowledge Breed Trust in Central Banks?

Having investigated the determinants of individuals' factual and subjective knowledge, our argument shifts the focus to a recently emerged aspect of central banking practice: the level of trust placed by private individuals in a central bank. As stated earlier, in the 1980s-1990s the new consensus established the importance of managing the public's expectations for the effectiveness of monetary policy. Consequently, in more recent years, an increasing number of policymakers and academics have stressed the importance of trust in central banks inside the complex and evolving monetary policy "architecture". Here, having trust in these institutions is considered as a prerequisite for affecting the state of individuals' expectations. Therefore, this section seeks to contribute to this debate with empirical evidence about the determinants of the general public's trust in central banks. More specifically, we aim to define the role played by knowledge of central banks' tasks in the trust-building process.

(a) The level of trust in the Central Banks

The survey contains the following two questions which aim to assess the level of respondent's trust in the ECB and the Bundesbank:

How much trust do you have in the ECB?

How much trust do you have in the Bundesbank?

Here, respondents were asked to rank their degree of trust on a scale from 0 "no trust" to 4 "very high trust"¹⁰. We provide the distribution of responses in Table 7

Table 7: Degree of trust in the ECB and the Bundesbank

Category		Frequency	Percent	Cumulative
ECB	0 No trust	453	18	18
	1 Low	1,300	51	69
	2 High	656	26	95
	3 Very high	132	5	100
N = 2,541				
Bundesbank	0 No trust	207	8	8
	1 Low	992	37	45
	2 High	1,100	42	87
	3 Very high	354	13	100
N = 2,653				

Source: Authors' calculations.

¹⁰ Please note that only respondents who know the respective institution are asked for an assessment of their degree of trust in these institutions. Individuals who stated that they do not know either the Bundesbank or ECB are not included in the descriptive analysis in this subsection.

Much as in the responses related to subjective knowledge about the two central banks, German citizens express more trust in the Bundesbank than in the ECB. About 55 percent of respondents claim to have either a high or very high degree of trust in the Bundesbank, whereas only 31 percent declare the same levels of trust in the ECB. Conversely, there is a consistent share of respondents, almost 20 percent, who place no trust at all in the ECB, compared with a figure of only 8 percent who similarly place no trust in the Bundesbank.

Trust in the Bundesbank and the ECB are positively correlated, with a significant correlation coefficient of 0.52. Table 8 shows the descriptive cross-tabulations, and also shows that the correlation between the trust measures for the two central banks is strong, since the highest values are the diagonal entries.

Table 8: Cross-tabulation of trust in the ECB and the Bundesbank

Trust in the ECB	Trust in the Bundesbank				Total
	No trust	Low	High	Very high	
No trust	33	37	25	5	100
Low	3	53	36	9	100
High	1	13	68	18	100
Very high	0	4	30	66	100
Total	7	37	42	14	100

Trust in the Bundesbank	Trust in the ECB				Total
	No trust	Low	High	Very high	
No trust	80	19	2	0	100
Low	18	73	9	1	100
High	11	43	42	4	100
Very high	6	32	37	26	100
Total	18	51	26	5	100

Source: Authors' calculations.

Notes: Numbers may not sum to 100 percent because of rounding.

However, the results presented in the top section of Table 8 indicate that roughly 30 percent of individuals that place no trust in the ECB, still trust the Bundesbank, with 25 and 5 percent showing “high” and “very high” levels of trust, respectively. By contrast, only 2 percent of respondents have high degree of trust in the ECB (0 percent “very high”) when they claim no trust in the Bundesbank¹¹.

¹¹ Explaining the higher levels of trust reported by German citizens in the Bundesbank compared with the ECB does lie beyond the scope of this study. However, several hypotheses may be formulated to explain these results, such as the fact that the Bundesbank is an older institution which has a longer successful history of maintaining a stable currency or simply that the survey was conducted among members of the general public in Germany.

(b) The link between knowledge and trust in the Central Banks

To return to the question asked in the title of this section, we estimate the relationship between trust in the two central banks and factual knowledge about their main task of price stability as follows:

$$TR_i = f_3(FK_i, I_i, \mathbf{X}_i) + \varepsilon_{3i} \quad (3)$$

where TR_i is an ordinal variable capturing trust in either the ECB or the Bundesbank for household i .

An econometric issue we face here is a problem of not observing the level of trust for all respondents. Only the interviewees that at least know the ECB and the Bundesbank (see “subjective knowledge” questions above) were asked about their level of trust in these institutions. The reasoning behind this interview approach is that individuals who do not even know an institution by name cannot trust that institution. We control for the selection bias induced by the filtering by applying the Heckman procedure¹². We follow Ehrmann et al. (2013) and include an indicator of knowing the European Parliament and the German parliament (“Bundestag”), respectively, as an extra covariate in the selection equation. Formally, we estimate the parameters of the ordered probit sample-selection models for the outcome of trust in the two central banks with a selection on the fact of knowing the ECB or the Bundesbank. The procedure generates two-step estimates since it requires modelling, first, the sample-selection process and then, jointly the substantive equation with the level of trust.

For both sample-selection models, we run the likelihood-ratio test to verify whether the errors for the outcome and selection are correlated or not. If we cannot reject the null hypothesis of uncorrelated errors of the two models, the simple ordered probit model is advisable. The coefficients and marginal effects are reported in Table 9 and Table 10 for the ECB and the Bundesbank, respectively. The χ^2 for the likelihood ratio test is also reported in the tables and suggests that the Heckman correction procedure should be applied only for the regression explaining trust in the ECB.

In line with the findings of Hayo and Neuenrich (2014), the main feature worth noting in both tables is that factual knowledge is positively and significantly related to trust in both central banks. Once the socioeconomic characteristics are controlled, knowledge of the central banks’ main objective is positively associated with a higher level of trust in both the ECB and the Bundesbank. Additionally, the sign of the marginal effects changes between outcome 1 (low trust) and outcome 2 (high trust) for both central banks. Observing columns (4) and (5) of Table 9 and Table 10, it is possible to note the positive impact of the factual knowledge in more detail. If a respondent answered the question about the main task of the central banks correctly, the probability of having a very high degree of trust (outcome 3) in the ECB increases by almost 3 pp, and almost 6 pp for the Bundesbank, in cases where a respondent provided a correct answer to the question about the main task of the central banks, compared

¹² More details of the Heckman procedure are provided in Appendix A.1.

to a respondent who did not. By the same logic, individuals who know the main mandate are more than 5 pp and almost 5 pp more likely to have a high degree of trust (outcome 2) in the ECB and the Bundesbank, respectively.

Table 9: Ordered probit model (with Heckman correction procedure) – Determinants of trust in the ECB

		Category	Coefficients	Pr(Trust in the ECB = z)			
				z = 0	z = 1	z = 2	z = 3
			(1)	(2)	(3)	(4)	(5)
Factual knowledge	Yes		0.229*** (0.052)	-0.057*** (0.013)	-0.025*** (0.006)	0.054*** (0.13)	0.029*** (0.007)
Interest in economics & monetary policy	Little		0.025 (0.094)	-0.007 (0.026)	-0.002 (0.006)	0.006 (0.022)	0.003 (0.01)
	Some		0.144 (0.097)	-0.037 (0.026)	-0.014** (0.007)	0.034 (0.023)	0.017* (0.01)
	Much		0.208* (0.111)	-0.053* (0.029)	-0.022** (0.011)	0.049* (0.27)	0.026** (0.013)
Education	Medium		0.015 (0.064)	-0.004 (0.019)	-0.002 (0.007)	0.004 (0.015)	0.002 (0.008)
	High		-0.044 (0.069)	0.011 (0.017)	-0.005 (0.007)	-0.01 (0.016)	-0.005 (0.009)
Age	Age		-0.005 (0.007)	0.001 (0.002)	0.001 (0.001)	-0.001 (0.002)	-0.001 (0.001)
	Age squared		3e-05 (0.0001)	-1e-05 (2e-05)	-3e-06 (7e-06)	1-e-05 (2e-05)	3e-06 (8e-06)
Gender	Female		0.117** (0.047)	-0.029** (0.012)	-0.013** (0.005)	0.027** (0.011)	0.015** (0.006)
Household income	€2,000-€3,500		0.0004 (0.055)	-0.0001 (0.014)	-4e-05 (0.006)	0.0001 (0.013)	0.0001 (0.007)
	≥€3,500		0.106* (0.064)	-0.026* (0.016)	-0.013* (0.008)	0.025* (0.015)	0.014* (0.008)
Region	Eastern Germany		-0.142*** (0.054)	0.036*** (0.014)	0.016*** (0.006)	-0.033*** (0.013)	-0.018*** (0.007)
Wave	2017		-0.028 (0.045)	0.007 (0.011)	0.003 (0.005)	-0.007 (0.011)	-0.004 (0.006)
No. of observations			2,502				
Censored observations			173				
χ^2 for likelihood-ratio test			6.22 **				
Wald χ^2 (overall model)			48.82 ***				

Source: Authors' calculations.

NOTES: This table reports the average marginal effects from the cross-sectional ordered probit regression using the delta method. Coefficients are labelled according to two-tailed significance at one / five / ten percent levels (i.e. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$). The robust standard errors in parentheses are corrected for heteroskedasticity. The first stage regression of the Heckman correction procedure (also called *selection*) may be found in Table A5 in the Appendix.

Table 10: Ordered probit model - Determinants of trust in the Bundesbank

Category		Coefficients	Pr(Trust in the Bundesbank = z)			
			z = 0	z = 1	z = 2	z = 3
		(1)	(2)	(3)	(4)	(5)
Factual knowledge	Yes	0.278*** (0.052)	-0.039*** (0.008)	-0.066*** (0.012)	0.047*** (0.009)	0.058*** (0.011)
Interest in economics & monetary policy	Little	0.345*** (0.087)	-0.069*** (0.019)	-0.063*** (0.014)	0.082*** (0.021)	0.049*** (0.011)
	Some	0.515*** (0.082)	-0.093*** (0.018)	-0.104*** (0.13)	0.115*** (0.021)	0.082*** (0.011)
	Much	0.761*** (0.1)	-0.119*** (0.019)	-0.169*** (0.021)	0.146*** (0.022)	0.142*** (0.019)
Education	Medium	0.024 (0.06)	-0.003 (0.008)	-0.006 (0.014)	0.004 (0.01)	0.005 (0.012)
	High	0.022 (0.066)	-0.003 (0.009)	-0.005 (0.016)	0.004 (0.011)	0.004 (0.014)
Age	Age	-0.007 (0.007)	0.001 (0.001)	0.002 (0.002)	-0.001 (0.001)	-0.001 (0.001)
	Age squared	0.0001 (0.0001)	-2e-05** (1e-05)	-3e-05 (2e-05)	2e-05** (1e-05)	2e-05** (1e-05)
Gender	Female	-0.039 (0.046)	0.005 (0.006)	0.009 (0.011)	-0.007 (0.008)	-0.008 (0.01)
Household income	€2,000-€3,500	0.084 (0.054)	-0.013 (0.008)	-0.019 (0.012)	0.016 (0.01)	0.016 (0.01)
	≥€3,500	0.278*** (0.064)	-0.037*** (0.009)	-0.068*** (0.016)	0.045*** (0.011)	0.059*** (0.014)
Region	Eastern Germany	-0.284*** (0.051)	0.039*** (0.007)	0.067*** (0.012)	-0.048*** (0.008)	-0.059*** (0.011)
Wave	2017	-0.181*** (0.044)	0.025*** (0.006)	0.043*** (0.011)	-0.03*** (0.007)	-0.038*** (0.009)
No. of observations		2,440				
Pseudo R ²		0.04				
χ ² for likelihood-ratio test		1.06				
Wald χ ²		215.79 ***				

Source: Authors' calculations.

NOTES: This table reports the average marginal effects from the cross-sectional ordered probit regression using the delta method. Coefficients are labelled according to two-tailed significance at one / five / ten percent levels (i.e. *** p<0.01, ** p<0.05, * p<0.1). The robust standard errors in parentheses are corrected for heteroskedasticity. The alternative estimation of the model via the Heckman correction procedure may be found in Table A6 in the Appendix.

Moving the analysis to the role played by interest in economics and monetary policy, the marginal effects seem to suggest analogous effects. For the Bundesbank, all the categories of this variable are significant, while only the top category of interest in monetary policy and economics (much interest) is significant for the ECB. For instance, the likelihood of having a very high degree of trust in the ECB and the Bundesbank, increases by almost 3 pp and more than 14 pp, respectively, if a respondent claims to have much interest in economics and monetary policy compared to a respondent with no interest in them. Taking the effects estimated for the knowledge and interest variables together, our results indicate that better informed individuals place more trust in central banks than persons who are less informed and less interested.

6 How do Knowledge and Trust Drive Inflation Expectations?

The need for a central bank to take into account the formation and evolution of public expectations has been included in the most recent macroeconomic theory. One of the main reasons for the importance of monitoring the general public's expectations lies in the fact that such expectations contain crucial information for policymakers in pursuing their targets and commitment (for example, the ECB's primary objective is to maintain price stability targeting an inflation rates of below, but close to, 2 percent over the medium term), since firms and individuals base their economic decisions, such as saving, consuming or wage negotiations, not only on realised price changes but also on their expectations. Aligning the public's expectations with those of the central banks is thus beneficial. In this section we look at the role of trust in central banks in the formation of households' medium-term inflation expectations.

An efficient monitoring and management of expectations requires an understanding not only of how such expectations are formed, but also of how to best measure them. Collecting information on expectations and, in particular, inflation expectations has a long history. For instance, the Michigan Survey of Consumer Finances has been collecting quantitative inflation expectations for decades, supporting a vast scholarly literature (Dräger and Lamla, 2014; Kumar et al., 2015; Binder, 2017 are examples of studies investigating the state of inflation anchoring in the U.S. which employ this survey).

The common approach of most survey-based studies is to use an expectation of the level of inflation or change of prices as a percentage, or the related probability associated with them. The main advantage of this strategy lies in the opportunity to extract uncertainty associated with these expectations (say, by calculating the second moment of the distribution). On the other hand, some problems may emerge due to a strong heterogeneity across the responses and unreasonably large or small values. Especially for private individuals, in comparison to professional forecasters, the heterogeneity in responses about future levels of prices tends to be a difficulty. Some surveys also contain (additional) qualitative measures of inflation

expectations. The survey we use is one of them. It only collects qualitative inflation expectations, in a two-step procedure using the two questions below¹³:

How would you expect prices to develop in the medium term: will prices in general rise, fall, or remain the same?

- (a) *Tend to rise [71 percent]*
- (b) *Tend to decline [1 percent]*
- (c) *Stay the same [22 percent]*
- (d) *I don't know [6 percent]*

And would you expect prices to rise sharply or slightly?

- (a) *Sharply [20 percent]*
- (b) *Slightly [74 percent]*
- (c) *I don't know [6 percent]*

A large majority of respondents (71 percent) expects prices to increase in the medium term, one-fifth (22 percent) expect unchanged and 1 percent expect decreasing prices. Individuals unsure of how prices will develop account for 6 percent of all respondents. Among those expecting prices to rise in the medium term, about three-quarters think they will only rise slightly. Taking both questions together, roughly 84 percent of all individuals expect either unchanged or slightly rising prices, as shown in Table 11.

Table 11: Inflation expectations

Category		Frequency	Percent	Cumulative
0	Decline	30	1	1
1	Stay the same	635	25	25
2	Slightly rising	1,538	59	84
3	Sharply rising	421	16	100

N = 2,624

Source: Authors' calculations.

Notes: Numbers may not sum to 100 percent because of rounding.

Given that inflation rates in the euro area were below the ECB's target in both 2016 and 2017, the large share of individuals expecting slightly rising prices might sound promising to the ears of monetary policymakers who aim for a price stability target of inflation rates below, but close to 2 percent over the medium term.

By making use of the indicators presented in the previous chapters we can provide new evidence of how public knowledge and trust influence the formation of inflation

¹³ An alternative to quantitative measures of inflation expectations is based on a quantification process of qualitative responses. See Rosenblatt-Wisch and Scheufele (2015) for a systematic review of quantitative methods applied to qualitative expectations data. See Carlson and Parkin (1975), Scheufele (2011), and Łyziak and Mackiewicz-Łyziak (2014) for practical applications of these methods. Note that these applications imply the availability of inflation expectations data observed over long periods of time.

expectations¹⁴.

Christelis et al. (2016) conduct an empirical study on inflation expectations by employing a survey of Dutch households. In line with their work, we introduce in our model both trust and factual knowledge in the following ordered probit model:

$$EXP_i = f_4(TR_i^{ECB}, FK_i, I_i, X_i) + \varepsilon_{4i} \quad (4)$$

where EXP_i is an ordinal variable and represents inflation expectations for individual i . To model respondents' expectations, we merge the two questions regarding inflation expectations and drop the 1 percent of respondents that expect decreasing prices.¹⁵ Our dependent variable can take three values: 1 "Stay the same", 2 "Rise slightly", or 3 "Rise sharply".

Christelis et al. (2016) also find that the model is weakly affected by endogeneity due to the presence of trust in the ECB as an explanatory variable and, consequently, suggest the use of IV estimation techniques. We also suspect that an endogeneity problem might arise due to the possibility that trust and inflation expectations are jointly determined. To overcome this modelling obstacle, we employ a seemingly unrelated regressions (SUR) setup developed by Roodman (2011) and called conditional mixed-process (CMP)¹⁶. This process allows the estimation of consistent coefficients for specific models, such as probit and ordered probit models that are employed in this paper. More specifically, CMP is appropriate in the presence of simultaneity, and the availability of an instrumental variable (IV) allows the researcher to build a recursive multi-equation model as in a standard two-stage least squares (2SLS) scenario.

Before estimating Equation (4) via CMP, we need to define a valid instrument that is simultaneously correlated with trust in the ECB, and not with the error term. A downside of applying CMP is the unavailability of tests for the IV validity.

We construct instruments by running a principal component analysis (PCA) on degrees of trust in a set of three European institutions (European Parliament, European Commission, and European Court of Justice) and three German institutions (Bundesverfassungsgericht - the Federal Constitutional Court, Bundesregierung - the Federal Cabinet of Germany, and Bundestag - the German Parliament) in order to extrapolate a common component of general institutional trust.¹⁷ We think this variable is a good proxy for general trust in institutions (other than the ECB and Bundesbank) and has the desired properties of an instrument. As

¹⁴ Like in most of the literature, we interpret the answer to the question on "price changes" as individuals' inflation expectations.

¹⁵ To verify whether these choices affect our findings, we conduct robustness checks by including the category "decreasing prices" as a potential outcome for the dependent variable. The results are still consistent with those displayed in the next tables.

¹⁶ More details concerning CMP are provided in Appendix A.2. Refer to Roodman (2011) for a deeper and more technical explanation.

¹⁷ Similarly, Hayo and Neuenrich (2014) use a principal component analysis on degrees of trust in several European and German institutions to extrapolate a common component of general institutional trust as an explanatory variable for modelling trust in the ECB.

Ehrmann et al. (2013) have shown, trust in other institutions is correlated with trust in the ECB. Furthermore, by only using non-financial institutions in the principal components analysis, we aim to measure a general level of trust in institutions and avoid that the instrument is simply a reflection of current economic circumstances, that may also influence inflation expectations directly (see Christelis et al., 2016, p. 10 on this issue).

Christelis et al. (2016) argue that trust in other people would be a strong instrument, as “general trust in other people is likely to influence inflation expectations only through institutional trust in the ECB.” (p. 10). They justify the choice explaining that this indicator embodies a significant intergenerational component which is reflection of social norms, and consequently, is less reactive to economic conditions than an indicator of trust in financial and banking institutions. Such a measure is unfortunately not available in our dataset. However, Knack and Keefer (1997) have documented a positive correlation between interpersonal trust and confidence in government. Accordingly, we assume our proxy of trust in institutions may also be a fair proxy of trust in other people and norms and, consequently, assume that this indicator of trust is likely to affect directly the general public’s inflation expectations only via the ECB.

As support for our IV choice, we find that this variable is significantly correlated with trust in the ECB, with a coefficient of 0.58. Collecting data on trust in different institutions in one single question, as we do, may not be without problems. Ehrmann et al. (2013) ascribe the high correlation of trust indicators in the “Eurobarometer” survey to this feature of the questionnaire. They find that two thirds of their respondents gave the same answer when asked about the level of trust in different institutions. Differently, in our dataset this is only the case for about 10 percent of the respondents, suggesting a sufficiently high degree of heterogeneity.

Finally, further supporting evidence for using the results of the PCA as an instrument derive from significant coefficients of the IV in the first stage regressions of both standard probit and CMP models.¹⁸

Our survey asks about the level of trust in three European institutions (European Parliament, European Commission, and European Court of Justice) and three German institutions (Bundesverfassungsgericht - the Federal Constitutional Court, Bundesregierung - the Federal Cabinet of Germany, and Bundestag - the German Parliament) in the same set of questions about trust in the ECB and the Bundesbank. Given that, we conduct a PCA on the reported trust in these six institutions in order to generate a general measure of trust.

¹⁸ Estimation results are available on request.

The results of the PCA and the relative factor loadings are shown in Table 12.

Table 12: Principal Component Analysis for General Trust

Principal components & correlation				
Component	Eigenvalue	Difference	Proportion	Cumulative
1	3.34	2.45	0.56	0.56
2	0.89	0.03	0.15	0.71
3	0.86	0.47	0.14	0.85
4	0.39	0.08	0.07	0.91
5	0.31	0.09	0.05	0.96
6	0.21	-	0.04	1.00

Principal component loadings (Component 1)		
Variables	Loadings	Square Loadings
Trust in the European Parliament	0.41	0.17
Trust in the European Commission	0.42	0.18
Trust in the European Court of Justice	0.39	0.15
Trust in Bundesverfassungsgericht	0.37	0.14
Trust in Bundesregierung	0.42	0.18
Trust in Bundestag	0.44	0.19

N = 2,133

Source: Authors' calculations.

The eigenvalue of the first component is 3.34, whereas the rest of estimated components have values under 1. The first component also captures 56 percent of variation of the whole set of institutions included in the PCA. Finally, observing the bottom part of Table 12, the first component is able to explain more than 14 percent of the variation for each institution. Taking that, we choose the first component of this PCA as a proxy for general institutional trust.

Taking a step back to the application of CMP, the last important aspect to mention is that error terms of the two equations defining the simultaneous system follow a bivariate normal distribution, with correlation ρ . Consequently, we verify the presence of endogeneity by estimating the significance of the reported *atanhrho*-statistic, i.e. Fisher's *Z* transformation of the correlation between error terms of the two equations. Failing to reject the null hypothesis of exogeneity ($H_0: \text{atanhrho} = 0$), it is possible to conclude that individual estimation of the two equations defining the recursive multi-equation model (i.e. 2SLS where the first-stage is conducted via ordered probit model, and the second-stage via probit model) are more advisable.

Table 13 reports coefficients, marginal effects, and also the *atanhrho*-statistic for comparison test which suggests the rejection of the null hypothesis of exogeneity. In line with the findings of Christelis et al. (2016), the reported coefficients suggest that higher trust consistently lowers households' inflation expectations. The marginal effects provide some additional insights. Firstly, marginal effects of trust in the ECB, with the exception of the category "low trust", change sign when moving from unchanging expected prices (outcome

0) to slightly raising expected prices (outcome 1). Secondly, the results show that having either a high or very high degree of trust in the ECB increases by more than 20 percent the probability of expecting unchanged prices compared with individuals having no trust. Conversely, having a very high degree of trust reduces by 4 percent the likelihood of having slightly rising inflation expectations, which is the outcome that is more consistent with the ECB's definition of price stability, again compared with individuals having no trust. Finally, respondents having a high or very high degree of trust are almost 20 percent less likely to expect high inflation.

In accordance with the results reported by Christelis et al. (2016), our proxy of factual knowledge about the two central banks' main task is not a significant driver of public inflation expectations decisions. Our finding is somewhat in contrast with the findings of Binder (2017) and Kumar et al. (2015) who show that awareness of monetary policies supports the anchoring of inflation expectations in countries with inflation targeting regime such as New Zealand and the U.S., but we are not specifically looking at inflation anchoring.

At this stage of the analysis, policy implications should be drawn with all due caution. Our results merely show that the current state of knowledge about central banks' main objective does not play a significant role for individuals' inflation expectations.

Table 13: Ordered Probit Model (via CMP) - Inflation Expectations

	Category	Coefficients	Marginal effects: Pr(Infl exp = z)		
			z = 0	z = 1	z = 2
		(1)	(2)	(3)	(4)
Trust in the ECB	Low	-0.439*** (0.082)	0.109*** (0.018)	0.013 (0.01)	-0.122*** (0.026)
	High	-0.781*** (0.113)	0.221*** (0.03)	-0.034*** (0.013)	-0.187*** (0.03)
	Very high	-0.821*** (0.161)	0.235*** (0.05)	-0.042* (0.025)	-0.193*** (0.035)
Factual knowledge		0.064 (0.057)	-0.019 (0.017)	0.005 (0.005)	0.014 (0.013)
Interest in economics & monetary policy	Little	0.003 (0.109)	-0.001 (0.033)	0.0003 (0.009)	0.001 (0.024)
	Some	-0.034 (0.104)	0.01 (0.031)	-0.003 (0.009)	-0.007 (0.023)
	Much	0.118 (0.118)	-0.034 (0.035)	0.007 (0.008)	0.027 (0.027)
Education	Medium	-0.134* (0.069)	0.037** (0.019)	-0.005* (0.003)	-0.032* (0.017)
	High	-0.323*** (0.074)	0.096*** (0.021)	-0.024*** (0.006)	-0.072*** (0.017)
Age	Age	0.022*** (0.008)	-0.007*** (0.002)	0.002*** (0.001)	0.005*** (0.002)
	Age squared	-0.0002*** (0.0001)	0.0001*** (2e-05)	-2e-05*** (1e-05)	-0.0001*** (2e-05)
Gender	Female	0.152*** (0.053)	-0.045*** (0.016)	0.012*** (0.004)	0.033*** (0.012)
Household income	€2,000-€3,500	-0.159*** (0.061)	0.046*** (0.017)	-0.009** (0.004)	-0.037*** (0.014)
	≥€3,500	-0.255*** (0.07)	0.076*** (0.021)	-0.019*** (0.006)	-0.057*** (0.015)
Region	Eastern Germany	0.347*** (0.062)	-0.104*** (0.018)	0.027*** (0.006)	0.076*** (0.014)
Wave	2017	0.201*** (0.051)	-0.06*** (0.015)	0.016*** (0.005)	0.044*** (0.011)
No. of observations		2,279			
<i>atanhrho</i> for comparison test		0.154 ***			
Wald χ^2 (model including first stage)		925.87 ***			

Source: Authors' calculations.

NOTES: This table reports the average marginal effects from the cross-sectional ordered probit regression using the delta method. Coefficients are labelled according to two-tailed significance at one / five / ten percent levels (i.e. *** p<0.01, ** p<0.05, * p<0.1). The robust standard errors in parentheses are corrected for heteroskedasticity. The first stage regression of CMP may be found in Table A7 in the Appendix.

So far, our evidence shows that a large part of the general public is unaware of the ECB's main task, and that the latter is not a significant driver of inflation expectations decisions over the medium term. Unlike any other survey data, our dataset allows us to explore other aspects of the relevance of the public's understanding within the context of the ECB's conduct of monetary policy. More specifically, we aim to assess the general public's understanding about the concept of "stable prices". To this end, the survey proposes two definitions about "stable prices" where one of the two alternatives is more consistent with the ECB's primary objective of price stability. Hence, we provide in Table 14 an alternative specification to model individuals' inflation expectations by substituting the prior proxy of factual knowledge with a measure, based on a binary variable, generated from the following question¹⁹ about the personal definition of stable prices:

Two persons are speaking about stable prices. Who do you agree with more?

- (a) *From my point of view, you can speak of stable prices if prices go up only slightly, I mean up to about 2 percent a year. [48 percent]*
- (b) *I do not think so. I think you can only speak of stable prices if prices do not go up at all. [52 percent]*

Roughly half of the total respondents have an opinion about stable prices that is more consistent with the ECB's definition and concept of price stability. The other half of interviewees define stable prices as unchanging prices. Interestingly, this split into the two groups is roughly the same for individuals who know the ECB's target and those who do not. Among the former group, 56 percent agree with statement (a).

Unlike the results of the previous model, the new indicator of knowledge about stable prices is negatively associated with public inflation expectations. Moreover, its marginal effects are in line with the sign of trust in the ECB. In other words, respondents providing their opinion of stable prices, which can be considered consistent with the ECB's definition of stable prices, are around 17 percent more likely to expect unchanging prices in the medium term and around 6 percent less likely to expect slightly rising prices, compared with individuals who provide the alternative choice to the question about stable prices. In a nutshell, these estimated marginal effects show that the respondents' interpretation of stable prices related to the ECB's primary objective of price stability is a factor that influences individuals' inflation expectations.

However, our results are not encouraging for policymakers, given the low inflation environment in 2016 and 2017. First, even for individuals who have an understanding which can be considered consistent with the ECB's monetary policy of price stability, inflation expectations tend towards unchanged prices. Second, it looks as though a rather detailed understanding of central bank policies on the part of individuals is necessary to affect inflation expectations directly. This could pose a challenge to central bank communication. Once again, our conclusions maybe premature, even the well-informed individuals may not

¹⁹ The question was asked only in the first wave of the survey.

Table 14: Ordered Probit Model (via CMP) - Inflation Expectations

	Category	Coefficients	Marginal effects: Pr(Infl exp = z)		
			z = 0	z = 1	z = 2
		(1)	(2)	(3)	(4)
Trust in the ECB	Low	-0.308*** (0.114)	0.085*** (0.029)	-0.008 (0.006)	-0.077** (0.031)
	High	-0.679*** (0.159)	0.166*** (0.023)	-0.066*** (0.018)	-0.143*** (0.037)
	Very high	-0.723*** (0.221)	0.225*** (0.072)	-0.076** (0.036)	-0.149*** (0.043)
Knowledge of stable prices	“up to 2 percent”	-0.537*** (0.077)	0.166*** (0.023)	-0.058*** (0.001)	-0.109*** (0.017)
Interest in economics & monetary policy	Little	0.078 (0.148)	-0.024 (0.046)	0.007 (0.015)	0.016 (0.031)
	Some	-0.065 (0.139)	0.021 (0.043)	-0.008 (0.015)	-0.013 (0.028)
	Much	0.099 (0.163)	-0.03 (0.05)	0.009 (0.016)	0.021 (0.034)
Education	Medium	0.077 (0.103)	-0.023 (0.031)	0.007 (0.01)	0.017 (0.022)
	High	-0.155 (0.11)	0.05 (0.035)	-0.02 (0.013)	-0.03 (0.022)
Age	Age	0.04*** (0.012)	-0.013*** (0.004)	0.004*** (0.001)	0.008*** (0.003)
	Age squared	-0.0004*** (0.0001)	0.0001*** (4e-05)	-0.0001*** (1e-05)	-0.0001*** (3e-05)
Gender	Female	0.154** (0.075)	-0.048** (0.023)	0.017** (0.008)	0.031** (0.015)
Household income	€2,000-€3,500	-0.119 (0.085)	0.036 (0.026)	-0.011 (0.008)	-0.025 (0.018)
	≥€3,500	-0.175* (0.099)	0.054* (0.031)	-0.018 (0.011)	-0.036* (0.02)
Region	Eastern Germany	0.178** (0.086)	-0.055** (0.027)	0.019* (0.01)	0.036** (0.018)
No. of observations		910			
<i>atanhrho</i> for comparison test		0.165 **			
Wald χ^2 (model including first stage)		888.10 ***			

Source: Authors' calculations.

NOTES: This table reports the average marginal effects from the cross-sectional ordered probit regression using the delta method. Coefficients are labelled according to two-tailed significance at one / five / ten percent levels (i.e. *** p<0.01, ** p<0.05, * p<0.1). The robust standard errors in parentheses are corrected for heteroskedasticity.

have been aware of the fact that inflation was below target in the euro area in 2016 and 2017 and thus expected no change in prices. What is more, in April 2017, inflation in Germany was just below 2 percent, while it was 1.9 percent in the euro area as a whole. In February 2016, it was around 0 percent in Germany and just under the 0 percent in the euro area as a whole.

As a final step of the analysis we follow Kumar et al. (2015) and conduct a further investigation into the casual relation between trust and inflation expectations by controlling for knowledge about recent inflation dynamics. In this regard, the survey asks respondents the following question²⁰:

If you think about prices in Germany in general, what is your impression: have prices gone up, gone down or remained the same over the last 12 months?

- (a) *Gone up [56 percent]*
- (b) *Gone down [3 percent]*
- (c) *Remained the same [38 percent]*
- (d) *I don't know [3 percent]*

Once again, a follow-up question addresses the magnitude of price increase experienced:

And do you think that prices have risen sharply or slightly over the last 12 months?

- (a) *Risen sharply [26 percent]*
- (b) *Risen slightly [71 percent]*
- (c) *I don't know [3 percent]*

Considering that Germany's inflation rate (yearly basis) for the past 12 months ending in February 2016 was 0 percent and 1.96 in April 2017 we label responses "correct" for the construction of the indicator displayed in Table 15, if the respondent answered "*Stay the same*" (in 2016) and "*Risen slightly*" (in 2017) respectively.

Table 15: Knowledge of past inflation dynamics

Category		Frequency	Percent
0	Incorrect	734	53
1	Correct	647	47

N = 1,381

Source: Authors' calculations.

The results show clearly that only half of the overall sample of respondents is aware of

²⁰ Similarly to previous questions, this set of questions is asked for a random sub-sample of interviewees.

inflation dynamics over the last 12 months. Taking a step further, Table 16 shows the findings from regressing the standard baseline specification for price expectations with the new proxy of knowledge.

Table 16: Ordered Probit Model – Inflation Expectations

	Category	Coefficients	Marginal effects: Pr(Infl exp = z)		
			z = 0	z = 1	z = 2
Trust in the ECB	Low	-0.323*** (0.1)	0.082*** (0.024)	-0.001 (0.006)	-0.08*** (0.03)
	High	-0.556*** (0.119)	0.135*** (0.032)	-0.028** (0.014)	-0.125*** (0.028)
	Very high	-0.339** (0.169)	0.086* (0.046)	-0.002 (0.012)	-0.084** (0.039)
Knowledge of past prices		-0.462*** (0.076)	0.13*** (0.02)	-0.03*** (0.007)	-0.10*** (0.017)
Interest in economics & monetary policy	Little	0.103 (0.146)	-0.03 (0.043)	0.008 (0.013)	0.022 (0.03)
	Some	0.026 (0.141)	-0.008 (0.042)	0.002 (0.0124)	-0.005 (0.028)
	Much	0.265 (0.164)	-0.072** (0.046)	0.023 (0.009)	0.06* (0.036)
Education	Medium	-0.184* (0.094)	0.048** (0.024)	-0.004 (0.004)	-0.044* (0.023)
	High	-0.38*** (0.105)	0.106*** (0.029)	-0.023** (0.009)	-0.084*** (0.024)
Age	Age	0.017 (0.011)	-0.005 (0.003)	0.001 (0.001)	0.004 (0.003)
	Age squared	-0.0002** (0.0001)	0.0001* (3e-05)	-1e-05 (1e-05)	-4e-05* (3e-05)
Gender	Female	0.244*** (0.077)	-0.069*** (0.021)	0.016*** (0.006)	0.053*** (0.017)
Household income	€2,000-3,500	-0.164* (0.088)	0.049* (0.024)	-0.008 (0.005)	-0.037* (0.02)
	≥€3,500	-0.221** (0.102)	0.062** (0.0279)	-0.013* (0.008)	-0.049** (0.022)
Region	E. Germany	0.238** (0.093)	-0.067*** (0.026)	0.016** (0.007)	0.051** (0.02)
Wave	2017	0.272*** (0.075)	-0.077*** (0.021)	0.018*** (0.006)	0.059*** (0.016)
No. of observations		1,002			
Pseudo R ²		0.07			
atanhrho for comparison test		0.077			
Wald χ^2 (model including first stage)		441.82 ***			

Source: Authors' calculations. NOTES: This table reports the average marginal effects from the cross-sectional ordered probit regression using the delta method. Coefficients are labelled according to two-tailed significance at one / five / ten percent levels (i.e. *** p<0.01, ** p<0.05, * p<0.1). Robust standard errors in parentheses.

Once again, the estimated coefficients and marginal effects of trust in the ECB and

knowledge of past price developments suggest similar relations with inflation expectations. Just as we found for knowledge about the definition of stable prices, knowledge about past prices is also able to explain the outcome variable. Respondents who answered correctly about past inflation dynamics over the past 12 months are 13 percent more likely to expect unchanging prices and 3 percent less likely to expect slightly increasing prices, compared with individuals who have an incorrect belief about past inflation.

To conclude, taking account of the different aspects of public knowledge²¹ about central banks and monetary policy seems to be important when analysing the process by which individuals form inflation expectations.

7 Conclusions and Policy Implications

The past decade has been characterised by non-standard monetary policy measures, and the design of central banking has been constantly and fundamentally evolving, with greater attention being paid by policymakers to the general public's inflation expectations. Inflation expectations are considered by many traditional central banks as a primary source of information for the effectiveness of their price stability objective. In this respect, central banking communication and trust in policymaking institutions play a crucial role in driving such expectations.

This paper provides empirical evidence, based on a survey of a representative sample of the German population, of the role of knowledge and trust in the ECB and the Bundesbank for the formation of public inflation expectations over the medium term. The initial results suggest that respondents' interest in economics and monetary policy and socioeconomic characteristics are relevant determinants for both subjective and factual knowledge about the Bundesbank and the ECB.

Our second set of results stresses the role of knowledge of central banks' main task of maintaining price stability in explaining the degree of trust placed in them by German citizens. The findings reveal that factual knowledge has positive effects on the public's trust in their central banks.

The main part of our analysis presents new findings on the effects of knowledge and trust on inflation expectations. In line with the recent findings of Christelis et al. (2016), we document that higher levels of trust lower such expectations. We find that high levels of trust in the ECB increase the probability of individuals expecting unchanging prices and lower the likelihood of anticipating rising prices, either slightly and sharply, compared with respondents who claim no trust in this institution. Furthermore, public awareness about central banks' main tasks of maintaining stable prices reveals itself not to be a significant

²¹ An interesting idea would be the adoption in our analysis of interaction effects among knowledge indicators and trust. However, there is a long-standing debate on the meaning, interpretation and efficiency of interaction effects in non-linear models. See Buis (2010) for more details. Bursian and Fürth (2015) offers a clear example of interactions effects applied in a probit model. However, to the best of our knowledge, there are no applications in ordered probit models.

factor that is able to explain inflation expectations. However, a large part of the general public seems to have a limited understanding of stable prices. In this regard, we show that, once we control for knowledge about stable prices which can be considered to be consistent with the ECB's definition of price stability, knowledge is a significant driver of inflation expectations, just like trust. In addition, we show that knowledge of past inflation dynamics also has effects on inflation expectations similar to those for trust and detailed knowledge about the ECB's inflation target. In both cases, more knowledge is related to lower inflation expectations, in particular to expecting "unchanged" prices compared with slightly or strongly increasing prices.

Taking our findings together and given that euro area inflation was below the ECB's target in our period of analysis, this is not good news for central banks. Even if individuals know the central bank's target in detail and know the current inflation environment, they do not form the "correct" inflation expectations, but expect too little inflation. The same is true for trust: if individuals place a high degree of trust in the ECB, they tend to expect unchanged prices. While this stabilizing of inflation expectations is helpful in times of high inflation, it may be problematic in the low inflation environment.

The descriptive results on the low level of knowledge point to another issue for central banks communication. Specifically, in a zero lower bound or low-inflation environment, the effectiveness of a central bank's monetary policy would strongly depend on its ability to communicate its objectives and strategies credibly to the general public (see, for instance, Yellen, 2006), especially when measures such as forward guidance are adopted to affect inflation expectations (see for instance Kumar et al., 2015). The limited public knowledge about the ECB's and the Bundesbank's main tasks, and our evidence defining the effects of trust on inflation expectations indicate that steering inflation expectations through communication and trust-building seems promising, but may also be complex and resource-intensive.

References

- [1] Bernanke, B. (2007). Inflation Expectations and Inflation Forecasting. Speech at the Monetary Economics Workshop of the National Bureau of Economic Research Summer Institute, Cambridge, Massachusetts, available at: <https://www.federalreserve.gov/newsevents/speech/bernanke20070710a.htm>.
- [2] Binder, C. (2017). Fed Speak on Main Street: Central Bank Communication and Household Expectations. *Journal of Macroeconomics*, 52, 238-251.
- [3] Blinder, A. S. and Krueger A. B. (2004). What Does the Public Know about Economic Policy, and How Does It Know It? *Brookings Papers on Economic Activity*, 1, 327-87.
- [4] Buis, M. (2010). Interpretation of Interactions in Non-Linear Models. *The Stata Journal*, 10, 305-08.
- [5] Bursian, D. and Fürth, S. (2015). Trust Me! I Am a European Central Banker. *Journal of Money, Credit and Banking*, 47(18), 1503-1530.
- [6] Carlson, J. A. and Parkin, M. (1975). Inflation Expectations. *Economica*, 42, 123-38.
- [7] Christelis, D., Georgarakos, D., Jappelli, T., and van Rooij, M. (2016). Trust in the Central Bank and Inflation Expectations. DNB Working Paper, 496, Amsterdam.
- [8] Dräger, L. and Fritsche U. (2013). Don't Worry, Be Right! Survey Wording Effects on Inflation Perceptions and Expectations. DEP Discussion Papers, Macroeconomics and Finance Series, 8, Hamburg.
- [9] Easaw, J., Golinelli, R., and Malgarini, M. (2012). Do Households Anchor their Inflation Expectations? Theory and Evidence from a Household Survey. Working paper 842, Dipartimento Scienze Economiche, Universita' di Bologna, Bologna.
- [10] ECB (2006). Monthly Bulletin of the ECB, July 2006, 59-67.
- [11] Ehrmann, M., Soudan, M., and Stracca L. (2013). Explaining European Union Citizens' Trust in the European Central Bank in Normal and Crisis Times. *The Scandinavian Journal of Economics*, 115(3), 781-807.
- [12] Fischer, J. and Hahn, V. (2008). Determinants of Trust in the European Central Bank. Working Paper Series in Economics and Finance 695, Stockholm School of Economics, Stockholm.
- [13] Hayo, B. and Neuenkirch, E. (2014). The German Public and Its Trust in the ECB: The Role of Knowledge and Information Search. *Journal of International Money and Finance*, 47, 286-303.
- [14] Horvath, R. and Katuscakova, D. (2016). Transparency and Trust: The Case of the European Central Bank. *Applied Economics*, 48(57), 5625-638.
- [15] Knack, S. and Keefer, P. (1997). Does Social Capital Have an Economic Payoff? A Cross-Country Investigation. *Quarterly Journal of Economics*, 112, 1251-1288.
- [16] Kumar, S., Afrouzi, H., Coibion, O., and Gorodnichenko, Y. (2015). Inflation Targeting Does Not Anchor Inflation Expectations: Evidence from Firms in New Zealand. *Brookings Papers on Economic Activity*, 2015(2), 151-225.

- [17] Łyziak, T. and Mackiewicz-Łyziak, J. (2014). Do Consumers in Europe Anticipate Future Inflation? Has it Changed since the Beginning of the Financial Crisis?. *Eastern European Economics*, 52(3), 5-32.
- [18] Roodman, D. (2011). Fitting Fully Observed Recursive Mixed-process Models with `cmp`. *The Stata Journal*, 11(2), 159-206.
- [19] Rosenblatt-Wisch, R. and Scheufele, R. (2015). Quantification and Characteristics of Household Inflation Expectations in Switzerland. *Applied Economics*, 47(26), 2699-2716.
- [20] Scheufele, R. (2011). Are Qualitative Inflation Expectations Useful to Predict Inflation?. *OECD Journal: Journal of Business Cycle Measurement and Analysis*, 29-53.
- [21] van der Cruijssen, C. and Demertzis, M. (2007). The Impact of Central Bank Transparency on Inflation Expectations. *European Journal of Political Economy*, 23(1), 51-66.
- [22] van der Cruijssen, C., Eijffinger, S. C., and Hoogduin, L. H. (2010). Optimal Central Bank Transparency. *Journal of International Money and Finance*, 29(8), 1482-1507.
- [23] van der Cruijssen, C., Jansen, D., and De Haan, J. (2015) “How Much Does the Public Know about the ECB’s Monetary Policy? Evidence from a Survey of Dutch Households. *International Journal of Central Banking*, December, 169-218.
- [24] Wälti, S. (2012). Trust No More? the Impact of the Crisis on Citizens’ Trust in Central Banks. *Journal of International Money and Finance*, 31(3), 593-605.
- [25] Woodford M. (2004). Inflation Targeting and Optimal Monetary Policy. *Federal Reserve Bank of St. Louis Economic Review*, 86(4), 15-41.
- [26] Yellen, J. (2006). Enhancing Fed Credibility, in Luncheon Keynote Speech to the Annual Washington Policy Conference Sponsored by the National Association for Business Economics, available at: <https://www.frbsf.org/our-district/files/060313.pdf>

Appendix

Table A1. Link between subjective knowledge about the ECB and Bundesbank

Sub. Know. about the ECB	Unknown	Only known by name	Approximate	Accurate
Unknown	23.58	43.09	30.08	3.25
Only known by name	2.83	50.08	40.79	6.30
Approximate	0.31	8.2	66.77	24.71
Accurate	0.00	2.06	20.00	77.94
	1.81	17.50	46.41	34.28

Source: Authors' calculations.

Numbers may not sum to 100 percent because of rounding.

Table A2. Link between interest in economics and interest in monetary policy

Interest in Economics	Interest in Monetary Policy				Total
	Zero	Little	Some	Much	
Zero	77.66	18.09	3.99	0.27	100
Little	12.40	68.94	17.13	1.53	100
Some	1.55	18.29	72.57	7.60	100
Much	0.48	1.67	35.00	62.86	100
Total	14.08	28.50	44.22	13.21	100

Source: Authors' calculations.

Numbers may not sum to 100 percent because of rounding.

Table A3. Summary statistics for key explanatory variables

Variable	Obs	Mean	Std. Dev.
Price expectations	2,594	0.918	0.633
Trust in the ECB	2,541	1.184	0.782
Trust in the Bundesbank	2,653	1.604	0.814
Knowledge about stable prices	1,388	0.481	0.5
Knowledge about past inflation	1,380	0.47	.499
Factual knowledge about central banks	1,990	0.327	0.469
Subjective knowledge about the ECB	2,874	1.945	0.828
Subjective knowledge about the Bundesbank	2,852	2.125	0.759
Interest in economics & monetary policy	2,928	1.726	0.871
Education	2,928	2.084	0.758
Age	2,928	49.773	18.794
Age squared	2,928	2830.478	1867.651
Gender	2,928	0.513	0.5
Household income	2,697	1.937	0.779
Region	2,928	0.256	0.436
Wave	2,928	0.481	0.5

Source: Authors' calculations.

Table A4. Responses about the two European central banks' tasks**Questions:***If you go by what you know or think, what are the tasks of the ECB? What is it responsible for?**If you go by what you know or think, what are the tasks of the Bundesbank? What is it responsible for?*

Task	Frequencies	
	ECB	Bundesbank
Safeguarding price stability, prevention of inflation	133	151
Safeguarding stability of the financial system & regulation of the money market	89	101
Monetary policy	67	69
Definition of policy interest rate	266	135
Regulation of cash flow, money supply, money transfer	130	190
Currency reserves (holding and management)	14	52
Banking supervision, financial management supervision	85	218
Ensure stability of the currency	259	139
Promoting economic development	33	33
Support for individual EU country	87	49
General provision of loans	42	36
European finance, financial policy	70	2
Cash supply, money printing	48	270
Approval of banknotes	5	6
Settlement of payment transactions (between banks)	19	67
Lending money to banks	23	44
Consulting, information on economic and financial questions	17	28
German state government finances	0	56
Representation of Germany in the EU, cooperation with the ECB	0	45
Investment transactions	1	6
Supporting banks	16	7
Other tasks	167	199

Source: Authors' calculations.

Table A5: 1st stage of the ordered probit model (with Heckman correction procedure) – Determinants of trust in the ECB

	Category	Coefficients
Select European Parliament	Yes	1.293*** (0.18)
Interest in economics & monetary policy	Little	0.508*** (0.119)
	Some	0.822*** (0.118)
	Much	0.915*** (0.179)
Education	Medium	0.463*** (0.102)
	High	0.571*** (0.127)
Age	Age	0.043*** (0.012)
	Age squared	-0.0004*** (0.0001)
Gender	Female	-0.205** (0.09)
Household income	€2,000-€3,500	0.203** (0.092)
	≥€3,500	0.287** (0.134)
Region	Eastern Germany	-0.142 (0.102)
Wave	2017	-0.059 (0.086)
No. of observations		2,502
Censored observations		173
χ^2 -test statistic		221.57 ***

Source: Authors' calculations.

NOTES: Coefficients are labelled according to two-tailed significance at one / five / ten percent levels (i.e. *** p<0.01, ** p<0.05, * p<0.1). The robust standard errors in parentheses are corrected for heteroskedasticity.

Table A6a: Ordered probit model (with Heckman correction procedure) – Determinants of trust in the Bundesbank

		Category	Coefficients	Pr(Trust in the Bundesbank = z)			
				z = 0	z = 1	z = 2	z = 3
			(1)	(2)	(3)	(4)	(5)
Factual knowledge	Yes		0.272*** (0.053)	-0.043*** (0.009)	-0.059*** (0.014)	0.047*** (0.009)	0.054*** (0.011)
Interest in economics & monetary policy	Little		0.384*** (0.089)	-0.087*** (0.026)	-0.057*** (0.014)	0.093*** (0.022)	0.05*** (0.011)
	Some		0.583*** (0.092)	-0.119*** (0.031)	-0.101*** (0.014)	0.133*** (0.023)	0.088*** (0.011)
	Much		0.824*** (0.104)	-0.148*** (0.033)	-0.163*** (0.024)	0.166*** (0.24)	0.145*** (0.018)
Education	Medium		0.054 (0.064)	-0.009 (0.011)	-0.012 (0.013)	0.01 (0.012)	0.011 (0.013)
	High		0.054 (0.07)	-0.009 (0.012)	-0.012 (0.015)	0.01 (0.013)	-0.011 (0.014)
Age	Age		-0.002 (0.008)	0.0004 (0.001)	0.001 (0.002)	-0.0004 (0.001)	-0.001 (0.002)
	Age squared		0.0001 (0.0001)	-1e-05 (1e-05)	-1e-05 (2e-05)	1e-05 (1e-05)	1e-05 (2e-05)
Gender	Female		-0.046 (0.046)	0.007 (0.007)	0.01 (0.01)	-0.008 (0.008)	0.009 (0.009)
Household income	€2,000-€3,500		0.091* (0.054)	-0.016 (0.01)	-0.019* (0.011)	0.018* (0.011)	0.017* (0.01)
	≥€3,500		0.282*** (0.063)	-0.043*** (0.011)	-0.063*** (0.016)	0.048*** (0.011)	0.058*** (0.013)
Region	Eastern Germany		-0.288*** (0.05)	0.045*** (0.01)	0.062*** (0.013)	-0.05*** (0.009)	-0.058*** (0.01)
Wave	2017		-0.187*** (0.044)	0.029*** (0.008)	0.04*** (0.01)	-0.033 (0.008)	-0.037*** (0.009)
No. of observations			2,554				
Censored observations			114				
χ^2 for likelihood-ratio test			1.06				
Wald χ^2 (model including selection)			232.55 ***				

Source: Authors' calculations.

NOTES: This table reports the average marginal effects from the cross-sectional ordered probit regression using the delta method. Coefficients are labelled according to two-tailed significance at one / five / ten percent levels (i.e. *** p<0.01, ** p<0.05, * p<0.1). The robust standard errors in parentheses are corrected for heteroskedasticity.

**Table A6b: 1st stage of the ordered probit model (with Heckman correction procedure)
– Determinants of trust in the Bundesbank**

	Category	Coefficients
Select Bundestag	Yes	1.491*** (0.338)
Interest in economics & monetary policy	Little	0.297** (0.131)
	Some	0.659*** (0.136)
	Much	0.752*** (0.206)
Education	Medium	0.336*** (0.115)
	High	0.403*** (0.134)
Age	Age	0.047*** (0.013)
	Age squared	-0.0004*** (0.0001)
Gender	Female	-0.14 (0.1)
Household income	€2,000-€3,500	0.088 (0.116)
	≥€3,500	0.144 (0.137)
Region	Eastern Germany	-0.153 (0.115)
Wave	2017	-0.111 (0.098)
No. of observations		2,554
Censored observations		114
χ^2 -test statistic		127.08***

Source: Authors' calculations.

NOTES: Coefficients are labelled according to two-tailed significance at one / five / ten percent levels (i.e. *** p<0.01, ** p<0.05, * p<0.1). The robust standard errors in parentheses are corrected for heteroskedasticity.

Table A7: 1st stage of the ordered probit model (via CMP) – Inflation Expectations

		Coefficients
		Dependent: Trust in the ECB
	Category	
Trust in institutions		0.48*** (0.018)
Interest in economics & monetary policy	Little	-0.155 (0.106)
	Some	-0.066 (0.097)
	Much	-0.014 (0.113)
Education	Medium	0.033 (0.073)
	High	-0.187** (0.078)
Age	Age	-0.003 (0.008)
	Age squared	0.0001 (0.0001)
Gender	Female	-0.015 (0.054)
Household income	€2,000-€3,500	-0.015 (0.054)
	≥€3,500	0.043 (0.072)
Region	Eastern Germany	0.009 (0.061)
Wave	2017	-0.251*** (0.052)
No. of observations		2,554
Censored observations		114
χ^2 -test statistic		729.57 ***

Source: Authors' calculations.

NOTES: Coefficients are labelled according to two-tailed significance at one / five / ten percent levels (i.e. *** p<0.01, ** p<0.05, * p<0.1). The robust standard errors in parentheses are corrected for heteroskedasticity.

A.1. Heckman correction procedure

The first stage of this procedure involves modelling the probability of knowing the ECB (the Bundesbank), via the standard baseline specification displayed in Equation (1). For the Heckman procedure to work, we need an identifying restriction in this first stage, i.e. a variable that only influences the probability of knowing the Bundesbank/ECB, but not the trust placed in the Bundesbank/ECB. We follow Ehrmann et al. (2013) and include an indicator of knowing the European Parliament and the German Parliament (“Bundestag”), respectively, as an extra covariate in the selection equation. This choice is based on the assumption that the probability to know the European Parliament/Bundestag is independent of the degree of trust placed in the ECB/the Bundesbank, but is able to explain respondents’ knowing the ECB/ Bundesbank. Finally, in the second stage we model the ordinal outcome of respondents’ trust on the same set of covariances plus the estimated probabilities from the first stage.

A.2. Conditional mixed process (CMP)

This process allows the estimation of consistent coefficients for specific models, such as probit, ordered probit, rank-ordered probit, multinomial probit, and tobit models. However, these models have to satisfy two conditions: 1) recursivity that defines a multi-equation system where the matrix of coefficients of one endogenous variable in one another’s equation is triangular; 2) full observability, which implies the endogenous variable is posited on the right-hand side of the equation only as observed. Given that, CMP is appropriate in the presence of simultaneity, and the availability of an instrumental variable (IV) allows the researcher to build a recursive multi-equation model as in a standard two-stage least squares (2SLS) scenario. Under these circumstances, CMP applies a limited-information maximum likelihood (ML) estimation. Therefore, if the simultaneous system is defined by the two aforementioned properties, the researcher is able to estimate consistent parameters within a maximum likelihood SUR framework. This ML SUR framework is needed since the standard 2SLS is not mathematically feasible because of the limited nature of the first-stage dependent variable (i.e. trust in the ECB). By employing CMP, we can take into account the potential endogeneity of the polychotomous variable, TR_i^{ECB} , in the right-hand side of Equation (3).