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Trust in the Central Bank and Inflation Expectations

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Consumption Uncertainty and Precautionary Saving

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Abstract

Using micro data from the 2015 Dutch CentERpanel, we examine whether trust in the European Central Bank (ECB) influences individuals' expectations and uncertainty about future inflation, and also whether it anchors inflation expectations. We find that higher trust in the ECB lowers inflation expectations on average, and significantly reduces uncertainty about future inflation. Moreover, results from quantile regressions suggest that trusting the ECB increases (lowers) inflation expectations when the latter are below (above) the ECB's inflation target. These findings hold after controlling for people's knowledge about the objectives of the ECB. In addition, higher trust in the ECB raises expectations about GDP growth. The findings suggest that a central bank can influence the economy through people's expectations, even in times when conventional monetary policy tools likely have weak effects.

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1. Introduction

For central banks, the management of economic expectations has become a key tool in conducting monetary policy (Blinder et al., 2008). To effectively manage expectations, a high level of public trust in central banks is necessary. For instance, a high level of trust in the commitment and ability of the European Central Bank (ECB) to keep inflation below, but close to, 2 percent can anchor medium and long term inflation expectations on this target, and make the public view deviations from the target as temporary ones. More generally, a trustworthy central bank is able to increase public confidence about future price stability and the prospects of the economy, thereby boosting economic growth.[1]

A number of recent studies document that individual inflation expectations feed into important household financial decisions. Malmendier and Nagel (2016) show that households with higher inflation expectations are less likely to invest in long-term bonds and more likely to borrow through fixed-rate mortgages compared to their counterparts with low inflation expectations. Armantier et al. (2015) conduct a financially incentivized investment experiment and find that individuals' reported inflation expectations influence their investment choices in a consistent way with economic theory. Moreover, D'Acunto et al. (2016) show that an increase in inflation expectations implies a higher readiness to purchase durable goods.

To the best of our knowledge, existing literature does not provide direct empirical evidence on the relationship between trust in central banks and inflation expectations.[2] Our paper aims to fill this gap by investigating whether public trust in the ECB contributes to individuals' expectations and uncertainty about price growth and the extent to which these expectations are anchored at the ECB's medium term inflation target of 2 percent.

We use recent micro data from the CentERpanel, a representative survey of the Dutch-speaking population in the Netherlands, sponsored by the Dutch National Bank. We survey

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[1] For instance, persistently high inflation has been historically linked to increased uncertainty about price evolution and low public confidence in economy's prospects. Such an environment has typically adverse effects on individuals' saving, consumption and investment decisions. As Bernanke (2013) states: "Expectations matter so much that a central bank may be able to help make policy more effective by working to shape those expectations."

[2] The relation between trust and inflation expectations has been recently recognized as a highly policy relevant topic that merits empirical investigation: "Another field in which public trust in central banks might prove important is for the understanding of the formation of household inflation expectations [….] If low public trust in central banks is associated with higher household inflation expectations, then swings in public trust in ECB also directly affect its ability to deliver on its mandate, although the empirical relevance of this proposition has yet to be tested" (Ehrmann et al., 2013, pp. 782-783).

individuals during the first half of 2015 and ask them a set of specially designed questions that allow us to construct individual-specific measures of expected inflation and inflation uncertainty. In addition, given that the ECB's policy impacts a broad range of economic outcomes, we also collect similar information on expectations regarding economic growth. Moreover, we ask how much individuals trust the ECB. Similar trust questions are regularly asked in Eurobarometer surveys since early 2000s to measure public trust in the ECB and in other European institutions. Existing literature has used this information to examine possible determinants of the ECB trust (Bursian and Fürth, 2015; Ehrmann et al., 2013). Instead, our paper explores the role of trust in the ECB for inflation expectations.

Our analysis offers a number of novel findings. First, higher trust in the ECB induces, on average, lower inflation expectations one year ahead. As we show, however, this relationship is not uniform across different percentiles of the distribution of inflation expectations. Second, higher trust contributes significantly to lower individual uncertainty about future price growth, thus implying a form of anchoring of inflation expectations. Third, higher trust in the ECB is associated with higher inflation expectations when the latter are at the lower end of the sample distribution, while the opposite is true when people have inflation expectations at the upper end. This effect is particularly strong for those who report inflation expectations above the ECB's target, while it is less robust for the part of the distribution that corresponds to expected inflation that is below, but close to, 2 percent.

Taken together, these results point to the role that trust in the ECB can play in anchoring consumers' inflation expectations to around the ECB's medium-term inflation target. If expectations are well-anchored around the target, the public should be confident about its inflation estimate and react little to short movements of higher or lower than expected inflation. Moreover, if anchoring of public expectations occurs close to central bank's inflation target, equilibrium prices should adjust faster towards this target (Bernanke, 2013).

As the survey has been conducted in the first half of 2015, one should also note that we find the effect of trust on anchoring inflation expectations to be economically important in an environment of low interest rates and inflation. This suggests that factors such as public trust in the central bank can be particularly important when conventional monetary policy tools turn out to be least effective.

Fourth, we show that the estimated effect of trust in the ECB is not driven by respondents' knowledge regarding the ECB's functions or financial sophistication. This suggests that institutional credibility can influence people's expectations independently from their own knowledge about the specific objectives of the institution. Fifth, trust in the ECB is also associated with expectations about economic growth, but not to the individual expected variability of output growth.

In the empirical investigation, we estimate various models in order to make sure that the effects we uncover are due to public trust in the ECB as an institution and not to other possible confounding factors. As we discuss in detail in this paper, we identify our parameters of interest through IV estimation that utilizes information on the incidents of cheating that respondents have witnessed in the past few years by repair persons. We assume that exposure to such unintended events is likely to correlate with the social-capital component of trust in the ECB, but it is quite unlikely to have an independent effect on inflation expectations. We also use as a second instrument the trust that respondents have in other people, as interpersonal trust is unlikely to directly shape inflation expectations. The overidentification test results strongly suggest that the null hypothesis of the exogeneity of these instruments cannot be rejected.

Moreover, we control not only for standard socio-economic characteristics but also for respondents' general economic knowledge by means of three standard questions that are widely used to measure financial literacy (developed by Lusardi and Mitchell, 2011). In a related vein, we measure and control for individuals' specialized knowledge about the ECB's objectives. The main findings for the role of trust in the ECB remain unaffected when we control for both the indicator of knowledge about the ECB and financial literacy, suggesting that it is genuine trust in the institution, and not knowledge about its mission or economics in general, that impacts inflation expectations. Furthermore, the main findings are unaffected when a measure of individual optimism is included in the specifications.

The remainder of the paper is organized as follows. Section 2 reviews relevant studies on inflation expectations and trust in institutions. Section 3 describes the survey data. Section 4 presents the baseline empirical results on inflation expectations, uncertainty and anchoring. Section 5 presents a number of robustness checks, and Section 6 presents additional results on expectations about economic growth and output variability. Section 7 offers concluding remarks.

2. Related Literature

Our paper links different strands in the literature. Recent studies explore the links between survey-based inflation expectations and anchoring to central bank's inflation target. In particular, Kumar et al. (2015) survey firms' managers in New Zealand and find evidence that their inflation expectations are not anchored, despite Reserve Bank's inflation targeting for more than twenty-five years. Binder (2016), using US data from the Michigan Survey of Consumers, finds no evidence of anchoring of inflation expectations to the FED target among a majority of the public. Binder attributes this to a lack of knowledge and awareness of the FED target – which was announced to be 2 percent in 2012 - due to ineffective use of media channels, consumer inattention and low economic literacy.

While there are only few studies using survey-based information on inflation expectations, there are various studies on anchoring and inflation expectations based upon financial market instruments such as inflation options, swaps and index linked securities. Some of these studies discuss central bank credibility, mostly by deducing credibility from the financial market based expectations, e.g., Galati et al. (2016), Gerlach-Kristen and Moessner (2014), or Gürkaynak et al. (2010).

A related cluster of studies focuses on the role of central bank communication for financial market outcomes (Blinder et al., 2008, provide a thorough review). For example, Ehrmann and Fratzscher (2005) show that press statements by central banks have an immediate impact on financial markets and also affect the latter's ability to anticipate future monetary policy decisions. As opposed to the aforementioned studies, we use directly elicited consumer expectations on future inflation and its uncertainty and link them to reported trust in the ECB.

There is also a large body of literature studying the implications of trust in other people and social capital in different domains, e.g., economic growth (Zak and Knack, 2001; Guiso et al., 2004; Tabellini, 2010); confidence in government (Knack and Keefer, 1997); financial integration (Ekinci et al., 2009); cross-country trade (Guiso et al., 2008); or household portfolios (Guiso et al., 2008; Georgarakos and Pasini, 2011). Another group of studies explores the determinants of trust in institutions and in particular in central banks (Bursian and Fürth, 2015; Wälti, 2012; Fischer and Hahn, 2008; Ehrmann, Soudan and Stracca, 2013; Van der Cruijsen et

al., 2016). A robust finding of the literature on social capital is that trust in other people changes slowly over time, given that social capital consists of a large inherited component of social values and norms (Tabellini, 2010). On the other hand, specific trust in financial institutions is more responsive to prevailing economic conditions (Stevenson and Wolfers, 2011).

3. The CentER Internet panel

We use data from the CentER Internet panel, which is sponsored by the Dutch National Bank and maintained by CentERdata at Tilburg University.[3] The baseline survey is conducted annually, and collects detailed information on a range of demographic and economic variables for a representative sample of Dutch-speaking households. In addition to the baseline survey, respondents participate during the course of a year in special purpose surveys.

We designed the survey with questions aimed at measuring individual expectations and uncertainty about future price growth as well as trust in the ECB. We administered the special survey to every panel participant aged 18 and older in January 2015. The survey was repeated in June 2015 to account for a possible seasonal pattern in responses and to increase the sample size used in our analysis.

To elicit the distribution of expected inflation we follow a similar procedure as in Guiso et al. (2002, 2013) and Christelis et al. (2016) whose interest is in approximating the subjective distribution of expected income, pension replacement rate and consumption, respectively. Specifically, we asked respondents first to report the minimum (y_m) and the maximum (y_M) values of percentage change in the level of prices twelve months ahead. Subsequently, we ask them to indicate on a 0-100 scale the probability that the average change in prices in the next twelve months will be higher than the mid-point between the reported minimum and maximum, i.e., $\pi = Prob(y > (y_m + y_M)/2)$. The questions used are reported in Appendix A.1.

To estimate the moments of the subjective distribution of expected inflation we rely on the assumptions and methods used by Guiso et al. (2002) and Christelis et al. (2016) for the subjective distribution of future income and consumption. We assume that the subjective

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[3] Panel members are recruited in personal or telephone interviews. If, after being selected for participation in the panel, it turns out that respondents do not have a computer with access to the Internet, CentERdata provides them with the necessary equipment. For more information on the CentERdata panel see Teppa and Vis (2012).

distribution is either simple triangular (i.e., symmetric around $(y_m + y_M)/2$, assuming $\pi = 0.5$), or split triangular ($\pi \neq 0.5$; see Fig. A.1. in Appendix A.1). Based on the elicited values of y_m, y_M (and of π if we assume a split triangular distribution) we compute the individual-specific mean and standard deviation of the distribution of expected inflation one year ahead. The formulae of these statistics are reported in Appendix A.2.[4]

We set to missing values observations where y_m, y_M or π are missing, or when respondents chose the 'don't know' option. The original sample includes 4,333 observations in the two survey waves. Due to missing values, the estimation sample includes 2,938 individual-level observations that allow the computation of inflation expectations using simple triangular distribution, and 3,179 observations using the split triangular distribution.

The survey also asks individuals to indicate their level of trust in the ECB on a 0 to 10 scale, where 0 denotes no trust in the ECB whatsoever, while 10 denotes full trust. The same question has been regularly asked in Eurobarometer surveys since early 2000s so as to measure public trust in the ECB as well as in other institutions such as the United Nations, the European Union or the national Parliament and the national government. Eurobarometer data have been used by several studies to examine determinants of trust in the ECB or its evolution over time (see, e.g., Bursian and Fürth, 2015; Ehrmann et al., 2013; Wälti, 2012).

Moreover, we ask a series of questions to measure knowledge about the ECB's objectives and basic financial literacy (see Appendix A.1 for the exact wording of these questions). Other studies have included related questions that capture knowledge of the ECB's objectives. For instance, Van der Cruijsen et al. (2015) find that the knowledge of the ECB's objectives is limited. In our survey, we show to the respondents six statements on the ECB's objectives. These statements mention specific numerical targets, e.g., for unemployment, in order to make sure that individuals are not confused with the fact that the ECB's policies can have broader positive economic consequences beyond price stability.

To measure financial literacy, we ask the three basic financial literacy questions introduced by Lusardi and Mitchell (2011). The questions relate to the numeracy of consumers and their

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[4] We assume that y_m and y_M represent the actual minimum and maximum of the distribution. This is potentially a strong assumption. Dominitz and Manski (1997) use the percentage chance format to elicit the subjective income distribution, and show that individuals associate the "lowest possible" (and "highest possible") with low (respectively high) probability.

understanding of basic economic concepts such as interest rates, inflation and risk diversification, and have been used in many studies and countries (see Lusardi and Mitchell, 2014, for an overview).

Figures 1 and 2 show the distribution of the expected minimum and maximum levels of inflation 12 months ahead. For each observation in the sample, the maximum is greater than the minimum. Figure 3 illustrates the distribution of the probability that the expected inflation is above the mid-point of the expected minimum and maximum values. As can be seen, there is a prevalence of "50 percent" responses but also a sizable number of responses representing values larger or smaller than 50 percent. It should be noted that information from the question on this probability, which is arguably more difficult to answer, is not used in our baseline regressions based on the simple triangular distribution.

Table 1 reports cross-sectional statistics of the central tendency and dispersion of the subjective distributions of expected inflation and expected growth, assuming that the underlying distribution is a simple (i.e., symmetric) triangular. At the median, the minimum expected inflation is 1 percent, while the maximum is 2 percent (the means are equal to 1.33 percent and 2.65 percent, respectively). The median probability is 0.50 (average 0.47). Assuming that the distribution is simple triangular, we estimate that the sample median of expected inflation is 1.65 percent (average 1.99 percent), while the median (mean) variance of the distribution of expected inflation is 0.04 percent (0.18 percent). The respective sample median (and mean) of expected growth is 1.5 percent, while the median (mean) variance of the distribution of expected growth is 0.01 percent (0.1 percent). As regards trust in ECB (asked on a 0 to 10 scale), the mean and median are about 6 and the standard deviation is 2.17. The table also shows summary statistics on socio-economic characteristics that are taken into account in the estimation (age, household size, marital status, education and income).

Cross-sectional averages summarize the expected inflation distribution of a typical individual but they hide important heterogeneity across individuals. Assuming that the underlying distribution is simple triangular, Figures 4 and 5 plot the histogram of the means and variances, respectively, of the 2,938 individual-specific distributions of expected inflation. Both figures highlight considerable heterogeneity in the responses. For instance, for 7 percent of individuals the mean expected inflation is 0 or negative, for another 20 percent it is between 0 and 1 percent,

for another 40 percent it is between 1 and 2 percent, and for the remaining 33 percent the mean expected inflation is higher than 2 percent. The cross-sectional distribution of variances is also heterogeneous, with roughly 13 percent of respondents having zero variance (i.e., they do not report any uncertainty about future inflation).

4. Empirical results

4.1 Regression analysis

Before moving to regression analysis, we look at patterns in the raw data by plotting the mean of expected inflation and its variance by bins of trust in the ECB. The results are shown in Figures 6 and 7, respectively. The figures suggest a clear negative association between trust in the ECB and both expected inflation and the variance of expected inflation.

Since the relations in Figures 6 and 7 might be influenced by other confounding variables, we estimate the relation between average expected inflation or the variance of expected inflation and reported trust in the ECB by running the following regression:

$$g_i(\pi_i^e) = \alpha + \beta trust\_ECB_i + \gamma X_i + \varepsilon_i \tag{1}$$

where *g* is a function denoting either mean or variance of expected inflation π^e deduced from a simple triangular or split triangular distribution and takes values that are individual-specific. Variables in X include demographics, such as age (by means of a second order polynomial) and gender of the respondent, whether (s)he has a partner, size of the household, whether the respondent is a high school graduate or has a college degree, household income as well as a survey wave dummy and region fixed effects.

In order to reduce the influence of outliers, we winsorize mean and variance of expected inflation at the top and bottom 0.5 percent of the observations; i.e., we set the values of those observations equal to those at the 99.5[th] and 0.5[th] percentiles, respectively. We also use Huber-White robust standard errors clustered at the household level to take into account that some multiple household members can participate in the survey.

First, we estimate (1) for mean expected inflation using conventional OLS. Results are shown in the columns 1 and 2 of Table 2. We find a negative association between trust in the

ECB and average inflation expectations that is statistically significant at the 1 percent level. The OLS coefficient of trust in the ECB is equal to 0.055 percentage points, which implies that a one standard deviation increase in trust (equal to 2.17) is associated with a reduction in expected inflation of 0.12 percent, which corresponds to 6 percent of the sample average of expected inflation. As we show below, the average response obtained by OLS is not uniform across different percentiles of the expected inflation distribution. The coefficients of demographic variables (with the exception of family size) are not statistically different from zero.

Next, we use an IV approach in order to address endogeneity concerns that relate to the estimation of equation (1), and which could arise due to omitted variables and/ or reverse causality. Finding valid instruments in our context requires finding variables that correlate with trust in the ECB, but do not have a direct association with inflation expectations. The latter condition precludes the use as instruments of variables that might correlate with institutional or economic knowledge, such as own experience with retail banking services or credit card fraud, as these might have an independent impact on the formation of inflation expectations. Instead, one can exploit variation in the component of trust in the ECB that relates to social capital. The latter typically reflects prevailing social values and tends to be resilient to temporary variations in financial conditions.

Respondents in our survey are asked about the frequency they have been cheated by a plumber, builder, car mechanic or other repair person over the past five years. Roughly one out of five respondents report that they have been cheated by a repair person at least once. The identifying assumption is that those who have been cheated tend to trust less, and that part of this mistrust carries over to the trust they show in institutions. Cheating experiences on some common everyday exchanges are arguably exogenous to own actions, so that instrument validity rests upon the assumption that exposure to such incidents does not have a direct impact (i.e. other than through trust in the ECB) on individuals' inflation expectations.

To increase the efficiency of the estimates and generate overidentifying restrictions, we also employ as an instrument the reported trust in other people. Trust in other people has a strong intergenerational component that consists of inherited social norms. Thus, it is likely to respond less to contemporaneous economic and personal conditions than trust attached to financial institutions (see Tabellini, 2010 and Stevenson and Wolfers, 2011). Accordingly, we assume that

general trust in other people is likely to influence inflation expectations only through institutional trust in the ECB.

The IV results are shown in columns 3 and 4 of Table 2. We first note that the F-test statistic from the first stage regressions is equal to about 86, which suggests that the instruments are quite strong (results are shown in Appendix Table A1). In addition, both instruments are correlated with trust in the ECB in an expected way. Moreover, a test of overidentifying restrictions (Hansen's J-test) fails to reject the null hypothesis of joint instrument validity with high confidence. Hence, we find no evidence of consistency problems in the IV estimates. Finally, a Hausman test of the endogeneity of the variable of interest, i.e., trust in the ECB, has a p-value equal to 0.046, which implies that one can marginally reject the null of exogeneity of trust in the ECB at the 5 percent significance level, and thus that IV estimation is likely advisable.

The IV estimate of the effect of trust in the ECB on expected inflation is -0.17 percentage points, i.e., somewhat larger in absolute value than the OLS one. The IV estimate implies that an increase in trust in the ECB of one standard deviation reduces expected inflation by 0.38 percentage points, which is 19 percent of its sample mean value. The larger absolute value of the IV estimate compared to the OLS one could be due to the presence of unobserved variables that affect positively both trust in the ECB and inflation expectations, thus leading to an algebraically larger (i.e., less negative, but smaller in absolute value) OLS estimate. Such unobservable variables could include, for instance, expectations about unemployment or the general state of the economy. Alternatively, the difference between OLS and IV estimates could be due to the fact that in the presence of a heterogeneous effect of trust in the ECB this estimate represents a local average treatment effect, i.e., the effect of trust in the ECB on inflation for those who change their trust in the ECB due to changes in the values of the instruments. On the other hand, the OLS estimate represents the overall average treatment effect.

Having examined the role of trust in the ECB on average inflation, we focus next on the role of trust on inflation uncertainty. Recall that the survey design allows us to deduce a measure of uncertainty about inflation that is individual-specific. That is, we can estimate a version of equation (1) in which the dependent variable represents the individual-specific expected variance

of inflation. As it was the case for the expected mean inflation, its variance is calculated using a simple triangular distribution.

OLS estimates are reported in columns 5 and 6 in Table 2. Higher trust in the ECB leads to a lower variance of inflation expectations. The effect is precisely estimated (p-value < 0.01) and implies that a one standard deviation increase in trust in the ECB decreases uncertainty about inflation by 15 percent of its sample mean.

The corresponding IV estimate (shown in columns 7-8 of Table 2) is once more precisely estimated (p-value < 0.05) and implies that a one standard deviation increase in the ECB reduces inflation uncertainty by 25 percent of its sample mean. Once more, according to the test of overidentified restrictions it is clear that the null hypothesis of joint instrument validity cannot be refuted. The Hausman test for endogeneity suggests that the null cannot be rejected. Based on these results, the preferred estimates are those derived under standard OLS.

4.2 Quantile Regressions

Results thus far suggest that higher trust in the ECB lowers inflation expectations on average. Nevertheless, this effect may not the symmetric across the distribution of expected inflation, i.e., it might differ between those who have high and those who have low inflation expectations. In fact, the negative average estimated effect might simply reflect the public view that central banks are primarily concerned about inflation exceeding target inflation, and therefore they are committed to raise interest rates to restrain inflation. That is, central banks have traditionally built their reputation as safeguards of price stability in situations when inflation tends to exceed their medium-term target. Consequently, a high level of public trust in the ECB might reflect trust in the ECB's commitment and ability to fight high inflation and thereby induces lower inflation expectations.[5]

Results also show that trust in the ECB lowers significantly inflation uncertainty, suggesting that trust may induce a form of anchoring of inflation expectations. We shed more light on this important policy issue, by examining whether trust in the ECB contributes to anchoring of expectations to around the ECB's target for an inflation below, but close to, 2

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[5] This is also consistent with the important role of social capital in shaping trust in institutions as it makes public trust in ECB to respond slowly to contemporaneous economic conditions.

percent. To that effect, we estimate a series of Quantile Regressions (QR) to evaluate the effect of trust in the ECB across various percentiles of the expected inflation distribution.

Figure 8 plots the estimates and associated 95 percent confidence intervals of the effect of trust in the ECB from QR evaluated at every five percentiles of the conditional inflation distribution (the respective estimates are reported in Appendix Table A2). The figure also plots the OLS estimate and confidence band from the baseline specification discussed above. The vertical line is drawn at the percentile of the expected inflation distribution that corresponds to a 2 percent inflation, i.e., the ceiling of the medium-term ECB target.

The QR estimates imply that trust in the ECB raises inflation expectations among individuals with low inflation expectations. In particular, a one standard deviation increase in trust has a positive and strongly statistically significant effect at the 10th and 20th quantiles of the expected inflation distribution (corresponding to 0.35 percent and 0.85 percent expected inflation, respectively), which is equal to 0.16 percent and 0.08 percent, respectively. On the other hand, QR estimates at the sixth and higher deciles display a negative sign, suggesting a progressively stronger negative association of trust in the ECB with inflation expectations among those with higher inflation expectations. Notably, the magnitude of the QR coefficients is stronger on the upper part of the distribution compared to the lower one: a one standard deviation increase in trust in the ECB decreases inflation expectations by 0.28 percent and 0.44 percent at the 80th and 90th percentiles of the expected inflation distribution, respectively.

Finally, QR estimates in the middle part of the expectation distribution are not statistically significant. This part of the distribution includes those who have inflation expectation around 2 percent (denoted by the vertical line), which implies that those who have expectations already aligned with the ECB target do not change them if their trust in the ECB increases.

Taken together, results from QR point into the role that trust in the ECB could have in anchoring consumers' inflation expectations around the ECB's inflation target. In addition, the fact that estimated effects are stronger among those with high inflation expectations suggests that higher trust in the ECB can be more effective in lowering high inflation expectations than rising low inflation expectations. This finding may be a cause for concern in current circumstances, in which inflation in the euro area is below the ECB's medium target.

We also apply an IV approach to the QR estimates, using the two instruments employed earlier in standard IV. Available IV methods for QR require some modifications of the original specification. In particular, both the trust in the ECB variable and our two instruments have to be redefined as binary variables. Hence, the modified trust in the ECB variable is equal to zero for values of trust below 7, while it is equal to 1 for values higher than or equal to 7. This implies that a change from 0 to 1 in the modified trust in the ECB variable corresponds to a change of about 5 units (or 2.3 standard deviations) in the original variable.

The IV QR estimates for various percentiles are shown in Figure 9, and also in Appendix Table A2. The estimated coefficients are larger in absolute terms compared to the respective ones from standard QR, as they reflect a much larger underlying change in the trust in the ECB variable. Moreover, IV QR estimates suggest a similar pattern for the role of trust in the ECB across percentiles of the expected inflation distribution to the one derived using standard QR estimates: the results at the upper part of the expectation distribution are quite stronger than those at the lower part, which are statistically significant at percentiles below the 10th one.

5. Robustness checks

In this section we discuss three additional specifications that we have estimated so as to examine whether the baseline results reflect alternative factors that may influence inflation expectations and its uncertainty.[6]

One potential channel through which trust in the ECB can influence inflation expectations is through the knowledge about the ECB's objectives. Earlier research has found a positive correlation between trust in the ECB and knowledge about the ECB (Ehrmann et al., 2013). More broadly, general economic knowledge is likely to influence economic expectations (Christensen et al., 2006). To that effect, we investigate whether specific knowledge of the ECB's objectives in particular, or economic literacy in general, influence inflation expectations as well as the estimated effect of trust in the ECB.

To measure knowledge about the ECB's objectives we ask respondents six true-false questions about these objectives and construct an index representing the number of correct

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[6] Detailed results are available from the authors upon request.

responses (see appendix A.1 for the wording of these questions).[7] A correlation analysis shows that knowledge and trust are positively associated. Moreover, our results confirm that knowledge on the ECB goals is limited, as documented by Van der Cruijsen et al. (2015). In fact, in most of questions, around 40 percent of respondents report that they do not know the answer. The average number of correct answers is 2.8, out of a maximum score of 6. Nevertheless, almost one every two respondents (46 percent) correctly indicates that that an inflation rate below, but close to, 2 percent is a goal of the ECB.[8]

We add the index of the number of correct questions as an additional regressor to the baseline specification. OLS and IV results, both for expected inflation and variance of inflation expectations, are virtually unchanged. The estimated effect of the variable denoting knowledge of the ECB objectives suggests that higher knowledge is associated with higher expected inflation and less inflation uncertainty, but both coefficients are not statistically different from zero. These results suggest that it is the institutional credibility aspect of the trust in the ECB that affects inflation expectations, and not knowledge about the ECB goals per se.

Second, we measure respondents' financial literacy as regards some basic economic concepts using three standard questions extensively used in the related literature (see Lusardi and Mitchell, 2011). When including financial literacy in our specifications we find that its estimated coefficient is not statistically different from zero and that the estimated effects of trust in the ECB on inflation expectations are once again unchanged.

A third factor that may correlate with trust in the ECB and/ or inflation expectations is individual optimism. We construct an indicator of optimism by taking the difference between subjective life expectancy (i.e., self-reported probability to survive upon age 65, 80 or 90, depending on the current age) and objective life expectancy (by gender and age) in official mortality tables. The OLS estimation results suggest that optimism reduces the uncertainty of inflation expectations somewhat (significant at the 10 percent level). However, in all cases the coefficient of trust in the ECB is hardly affected.[9] Overall, our findings suggest that trust in the

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[7] Possible answers include a "do not know" option, which we consider to be equivalent to an erroneous response.

[8] This may also reflect the fact that the ECB has set an explicit numerical inflation target.

[9] Estimated effects of the trust in the ECB variable are still statistically significant, but the significance level is lower compared to the baseline specification. This is due to the lower number of observations used, as there are missing values of the variable denoting subjective life expectancy.

ECB has an effect on economic expectations over and above the effect of knowledge about the ECB's functions, financial literacy, and optimism.

As a last robustness check, we have repeated the baseline analysis using the split triangular distribution instead of the simple one. We find that the results on inflation expectations, uncertainty and anchoring remain unchanged.

6. GDP growth

The broader objectives of monetary policy are not limited to price stability but include also other macroeconomic variables, among which economic growth is of course prominent. Hence, it is instructive to examine whether trust in the ECB impacts also individual expectations regarding economic growth and economic fluctuations (e.g., GDP growth volatility). To elicit the distribution of expected growth, we ask individuals the same sequence of three questions as for inflation: the minimum and maximum expected GDP growth rate, and the chance that GDP growth exceeds the midpoint of the reported minimum and maximum.

As is the case with inflation expectations, we plot the mean of expected growth and its variance by bins of trust in the ECB, and the results are shown in Figures 10 and 11, respectively. We note that there is a clear positive association between trust in the ECB and expected growth, suggesting that trust in the Central Bank makes individuals more positive about the economy's prospects. On the other hand, we find essentially no association between trust in the ECB and the variance of expected growth.

The pattern of associations shown in the two figures is verified when we estimate multivariate regressions with expected growth and its variance as dependent variables. Table 3 reports OLS and IV regressions for the mean (columns 1-4) and variance of expected GDP growth (columns 5-8). As is the case with inflation expectations, we cluster Huber-White robust standard errors at the household level, and winsorize the dependent variables at the top and bottom 1 percent of observations.[10] The test statistics for the IV regressions suggest again that the instruments are strong and that one cannot reject instrument exogeneity. At the same time, the Hausman test does not reject the null hypothesis that trust in the ECB is exogenous. Therefore,

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[10] The number of observations is slightly higher as the number of "do not know" responses to the GDP growth questions is lower than for the inflation questions (see also Christensen et al., 2006).

one could restrict attention to the OLS estimates. Yet, to maintain consistency with our analysis of expected inflation and its variance, we present both OLS and IV results. In any case, both analyses lead to qualitatively similar estimates of the effects of trust in the ECB.

In particular, we find that trust in the ECB increases expected GDP growth. According to the baseline OLS estimate, a one standard deviation higher trust in the ECB implies an increase in expected GDP growth by 17 basis points. The coefficient is statistically significant from zero at the 1 percent level and the effect corresponds to 12 percent of the sample mean of expected GDP growth. The corresponding IV estimate is somewhat higher (27 basis points, corresponding to 18 percent of the sample mean). Thus, trust in the ECB influences mean expectations of both inflation and growth. However, in contrast to the results for inflation uncertainty, trust in the ECB has no effect on the uncertainty about expected GDP growth.[11]

7. Conclusions

Historically, central banks have paid a lot of attention to inflation expectations formed in financial markets and by professional forecasters. More recently, central banks have shown increased interest in consumer expectations and beliefs because they can help make policy more effective (Bernanke, 2013; Blinder et al., 2008). In this paper, we investigate the extent to which trust in the ECB impacts consumers' expectations and uncertainty about future inflation and induces inflation anchoring at the ECB's inflation target of below, but close to, 2 percent. The empirical evidence draws upon a special questionnaire module introduced in a recent survey of a representative sample of the Dutch population.

A first finding of our analysis is that a high level of trust lowers inflation expectations. This result may be due to the fact that traditionally central banks have been mainly concerned about inflation exceeding their target and communicated to the public their commitment to raise interest rates to restrain inflation. Consequently, a high level of public trust in the ECB is likely

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[11] We have also estimated a series of QR regressions to examine whether estimates of trust in the ECB display a pattern of anchoring around a specific value of the expected GDP growth distribution. In this case we do not find any evidence for anchoring. QR estimates are always positive and decline across percentiles, suggesting that higher trust in the ECB associates with higher expected GDP growth, and more so among those with low GDP growth expectations.

to reflect trust in the ECB's commitment and ability to fight high inflation and thereby induces lower inflation expectations on average.

Recently, central banks have been using unconventional policy instruments to cope with a long period of low inflation and near zero interest rates. Based upon a survey among central bank presidents and academic experts, Blinder et al. (2016) argue that these new policy instruments as well as the increased use of communication will permanently remain in the toolkit of central banks. Communication is, among others, important for central banks as to anchor inflation expectations around the target inflation rate and prevent medium term inflation expectations from falling below target.

Our findings are directly related to this desired anchoring of inflation expectations because we show that trust induces anchoring around the medium term inflation target. Specifically, we show that the effect of trust is not uniform across the distribution of inflation expectations: at the lower end of the distribution, an increase in trust increases inflation expectations, while the opposite is true at the higher end of the distribution of inflation expectations. Estimated effects are particularly strong among respondents with high inflation expectations, suggesting that higher trust in the ECB matters more for lowering high inflation expectations as opposed to increasing low inflation expectations. This finding may be a cause for concern in a low interest rate environment, especially as regards the segment of the population with quite low inflation expectations. It suggests that central banks may benefit from effectively communicating their commitment to raise prices towards their target as they have forcefully communicated their commitment to fight high inflation in previous times.

In a related vein, we also find that trust in the ECB reduces individual uncertainty about future inflation, thus contributing to public confidence about future price stability and the prospects of the economy.[12] Taken together, our findings suggest that a high level of trust supports the monetary policy task of the ECB as it contributes to the anchoring of inflation expectations among the general public around the target of below, but close to, 2 percent.

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[12] From a monetary policy perspective, this reduced uncertainty strengthens the anchoring around a medium term inflation target inducing equilibrium prices to converge faster towards this target (see Bernanke, 2013). From a broader perspective, reduced uncertainty is beneficial for economic welfare as it helps financial planning by households and lowers the need for precautionary savings (see e.g., Christelis et al., 2016, on the effect of consumption uncertainty).

One may argue that it is not the institutional credibility of the ECB that matters for the findings, but instead knowledge about the tasks and the goals of the ECB (or the knowledge about economic concepts in general). While there is a positive association between knowledge of the ECB goals and trust in the ECB, the estimate is virtually unaffected when knowledge about its objectives and financial literacy are taken into account. Hence, it appears that the institutional credibility component of trust in the ECB influences inflation expectations.

These findings suggest that the monetary policy tasks by central banks could benefit from investing in the build-up of trust and institutional credibility. This build-up of trust and credibility seems especially important in the current environment of low interest rates where standard monetary policy measures are difficult to implement and likely to be less effective.

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Table 1. Descriptive Statistics

Variable	Mean	Median	Std. Deviation
Minimum expected inflation level	1.330	1.000	1.817
Maximum expected inflation level	2.649	2.000	2.592
Probability that the expected inflation level is above the average of the expected minimum and maximum values	0.465	0.500	0.185
Expected inflation	1.990	1.650	2.088
Variance of expected inflation	0.181	0.042	0.778
Minimum expected growth rate	1.028	1.000	1.424
Maximum expected growth rate	1.972	2.000	1.747
Probability that the expected growth Rate is above the average of the expected minimum and maximum values	0.409	0.400	0.185
Expected growth rate	1.498	1.500	1.477
Variance of expected growth rate	0.100	0.010	0.560
Trust in the ECB	5.919	6.0	2.174
Age	56.0	59.0	15.6
Female householder	0.423	0.0	0.494
Household size	2.401	2.0	1.182
Has a spouse/partner	0.778	1.0	0.415
High school graduate	0.297	0.0	0.457
University graduate	0.433	0.0	0.496
Household income	2,937.8	2,745.0	2,397.0
Number of Observations	2,938		

Notes: All magnitudes related to the expected inflation and growth rate are expressed in percentage points.

Table 2. OLS and IV results for expected inflation and its variance

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Average of expected inflation				Variance of expected inflation			
	OLS		IV		OLS		IV	
	Coeff.	Std. error	Coeff.	Std. error	Coeff.	Std. error	Coeff.	Std. error
Trust_ECB	-0.0552	0.0190 ***	-0.1736	0.0597 ***	-0.0120	0.0030 ***	-0.0210	0.0100 **
Age	0.0155	0.0152	0.0090	0.0170	-0.0040	0.0030	-0.0040	0.0030
Age squared	-0.0001	0.0001	-0.0001	0.0002	0.0000	0.0000	0.0000	0.0000
Female	0.0041	0.0717	-0.0591	0.0812	0.0170	0.0130	0.0090	0.0150
Couple	0.0922	0.1013	0.0726	0.1108	0.0080	0.0200	0.0090	0.0210
Household size	-0.1331	0.0353 ***	-0.1505	0.0401 ***	-0.0170	0.0080 **	-0.0220	0.0090 **
High school graduate	0.1093	0.0989	0.1851	0.1175	0.0010	0.0180	0.0130	0.0210
College graduate	0.0976	0.0929	0.2550	0.1259 **	0.0180	0.0170	0.0400	0.0210 *
Logarithm of household net income	0.0066	0.0343	0.0275	0.0340	-0.0080	0.0090	-0.0040	0.0100
constant	1.5528	0.5116 ***	2.1168	0.6219 ***	0.4700	0.1210 ***	0.4880	0.1430 ***
Region/ wave dummies	yes		yes		yes		yes	
First-stage F test			86.433				86.433	
Endogeneity test			3.971				0.974	
P value			0.046				0.324	
Test of overidentifying restrictions			0.766				0.314	
P value			0.381				0.575	
Observations	3,055		2,632		3,055		2,632	

Notes: This table shows OLS and IV estimation results from models using expected inflation and its variance (both measured in percentage points) as dependent variables. ***, **, * denote statistical significance at 1%, 5% and 10%, respectively.

Table 3. OLS and IV results for expected growth and its variance

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Mean of expected growth rate				**Variance of expected growth rate**			
Variable	**OLS**		**IV**		**OLS**		**IV**	
	Coeff.	Std. error	Coeff.	Std. error	Coeff.	Std. error	Coeff.	Std. error
Trust in the ECB	0.0792	0.0106 ***	0.1250	0.0347 ***	-0.0010	0.0010	-0.0030	0.0050
Age	-0.0104	0.0102	-0.0088	0.0107	-0.0040	0.0020 **	-0.0030	0.0020 *
Age squared	0.0001	0.0001	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000
Female	-0.1481	0.0433 ***	-0.1950	0.0466 ***	0.0130	0.0060 **	0.0100	0.0060
Couple	0.0336	0.0682	0.0415	0.0707	0.0080	0.0090	-0.0010	0.0100
Household size	-0.0034	0.0283	-0.0081	0.0295	-0.0030	0.0040	0.0000	0.0040
High school graduate	0.0520	0.0631	0.0786	0.0692	-0.0040	0.0080	0.0010	0.0090
College graduate	0.0738	0.0595	0.0710	0.0745	0.0040	0.0080	0.0120	0.0100
Logarithm of household net income	0.0220	0.0232	0.0287	0.0243	0.0020	0.0030	0.0040	0.0020 **
constant	0.9066	0.3309 ***	0.5269	0.3845	0.2060	0.0540 ***	0.1780	0.0600 ***
Region/ wave dummies	yes		yes		yes		yes	
First-stage F test			92.332				92.332	
Endogeneity test			2.070				0.019	
P value			0.150				0.890	
Test of overidentifying restrictions			0.297				1.419	
P value			0.586				0.234	
Observations	3,145		2,716		3,145		2,716	

Notes: This table shows OLS and IV estimation results from models using the expected growth rate and its variance (both measured in percentage points) as dependent variables. ***, **, * denote statistical significance at 1%, 5% and 10%, respectively.

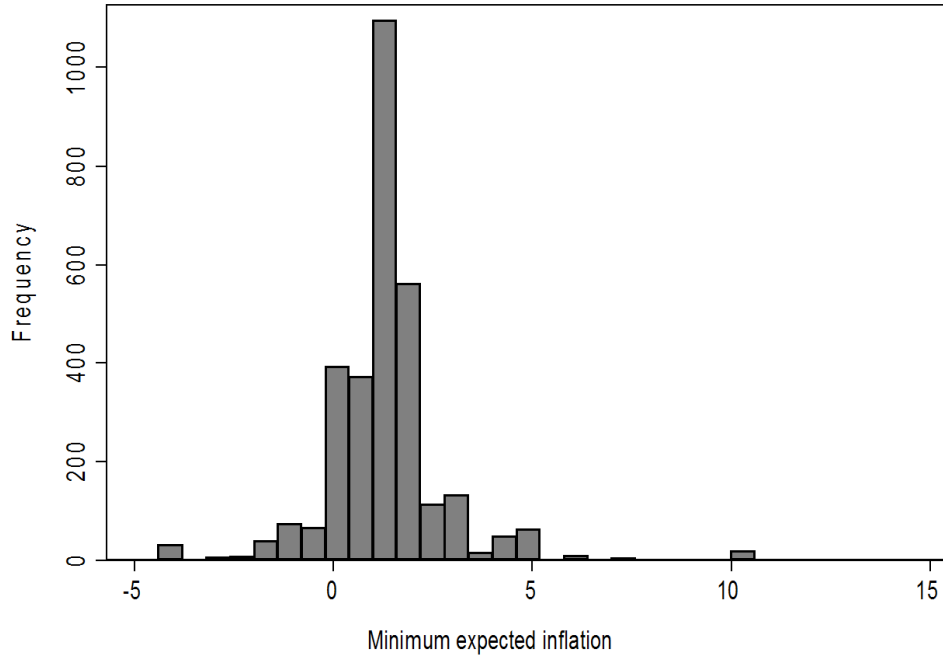**Figure 1. Histogram of the minimum expected inflation level**

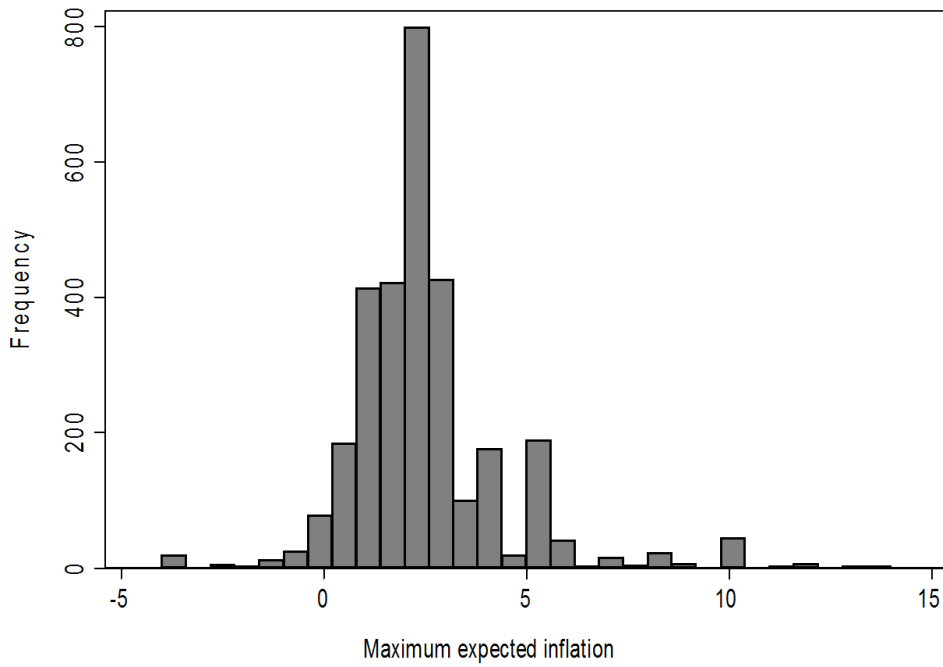**Figure 2. Histogram of the maximum expected inflation level**

Figure 3. Histogram of the probability that expected inflation is above the average of the expected minimum and maximum values
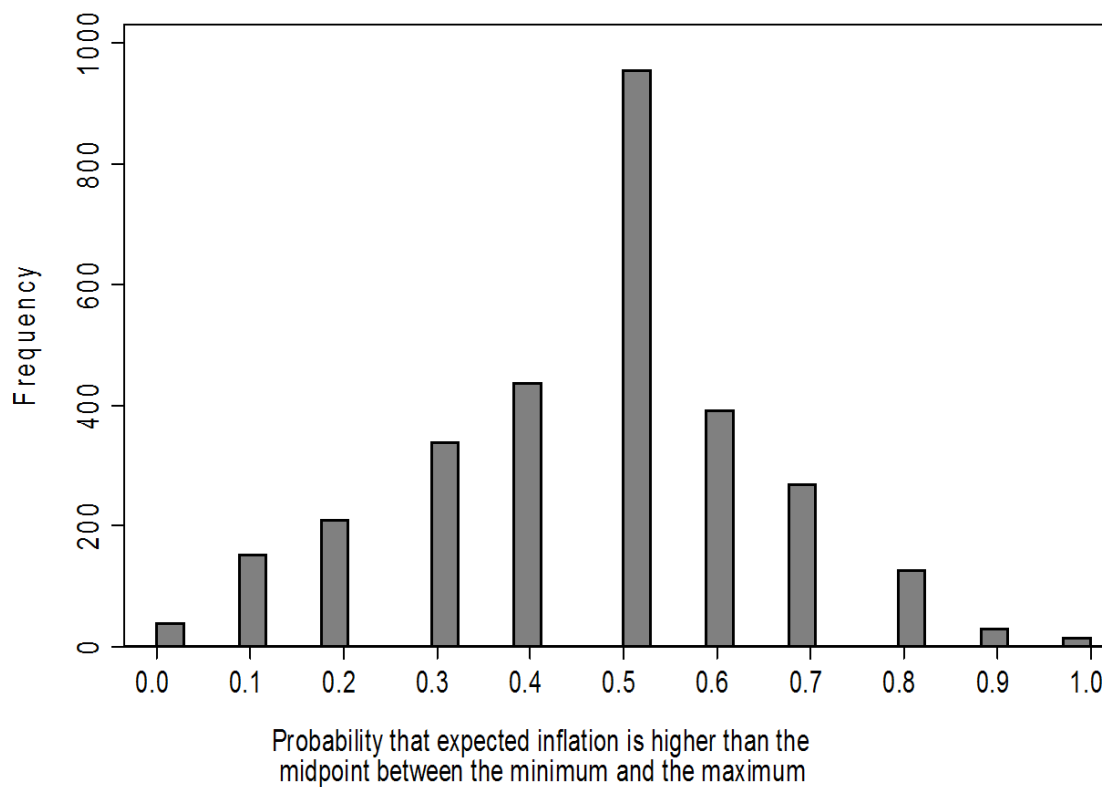

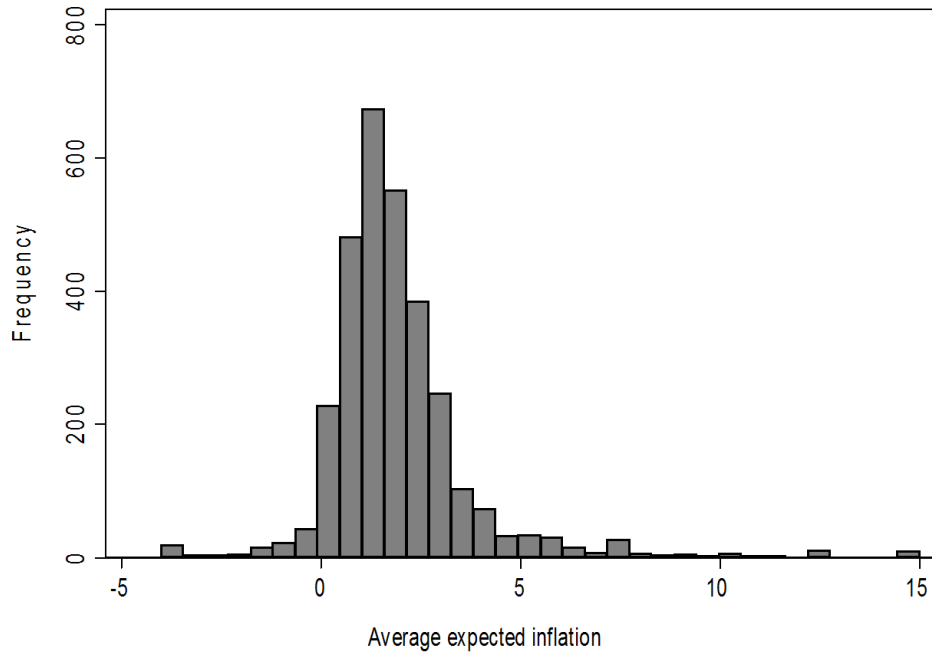Probability that expected inflation is higher than the midpoint between the minimum and the maximum

Figure 4. Histogram of the mean of expected inflation

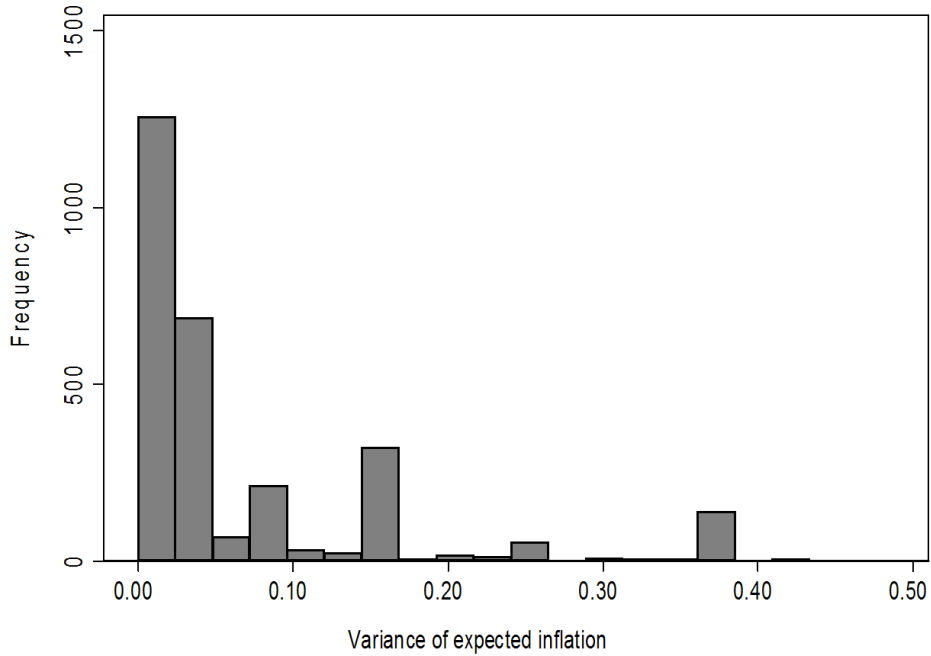**Figure 5. Histogram of the variance of expected inflation**

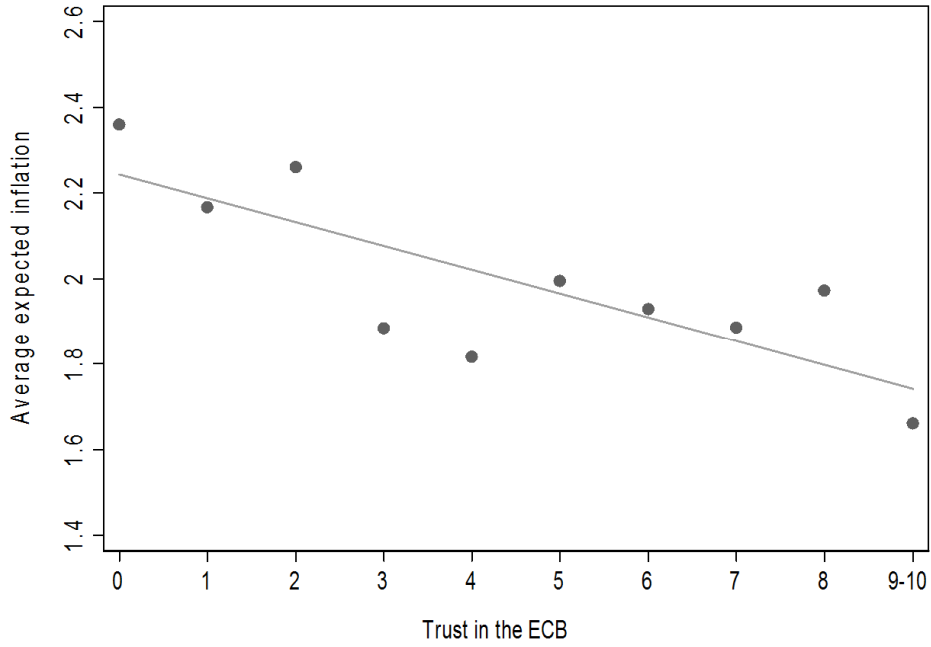**Figure 6. Average expected inflation by levels of trust in the ECB**

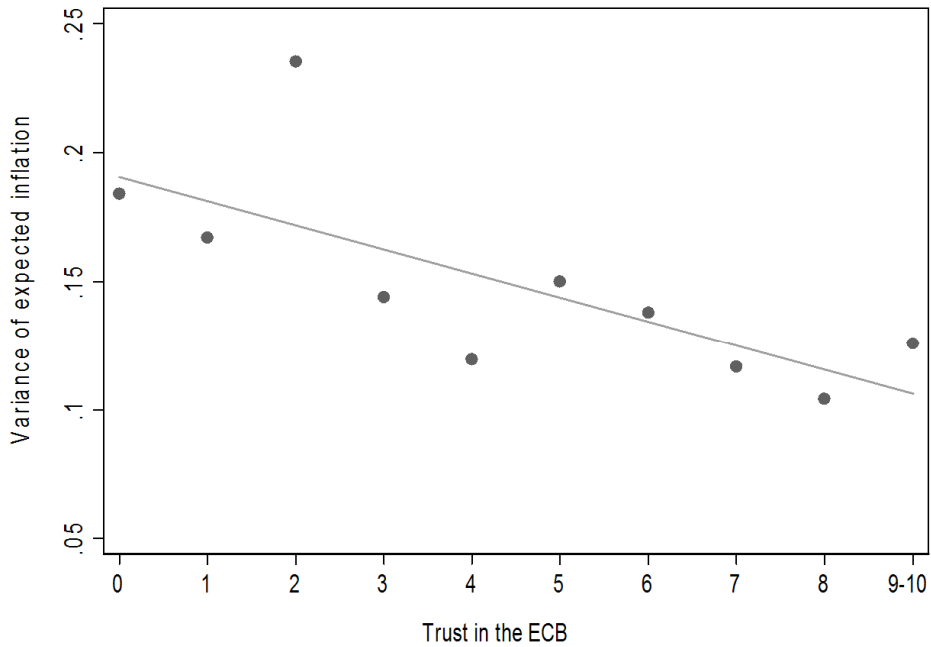**Figure 7. Variance of expected inflation by levels of trust in the ECB**

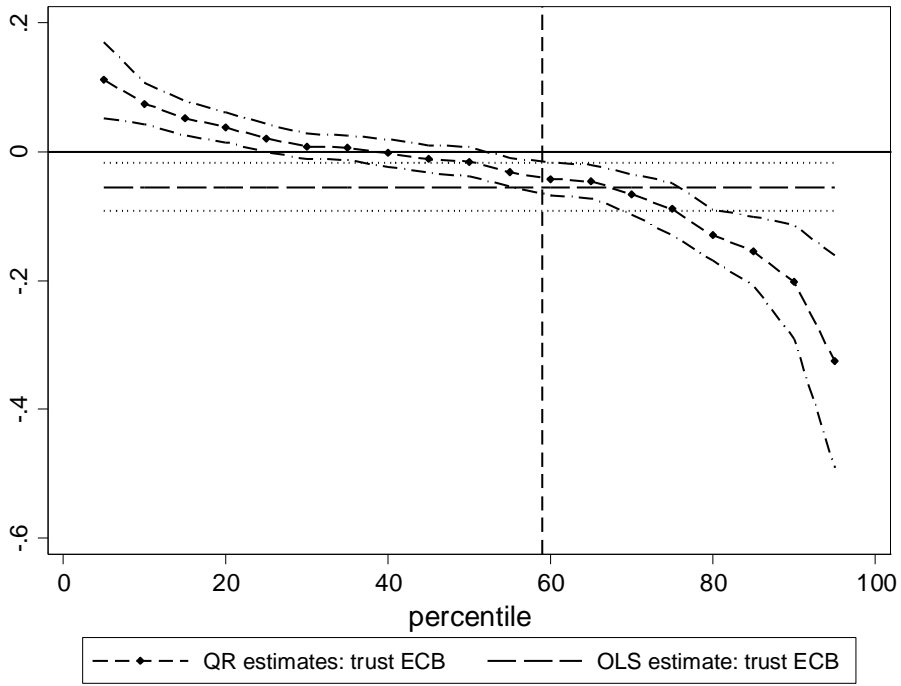**Figure 8. Quantile regression estimates for expected inflation**

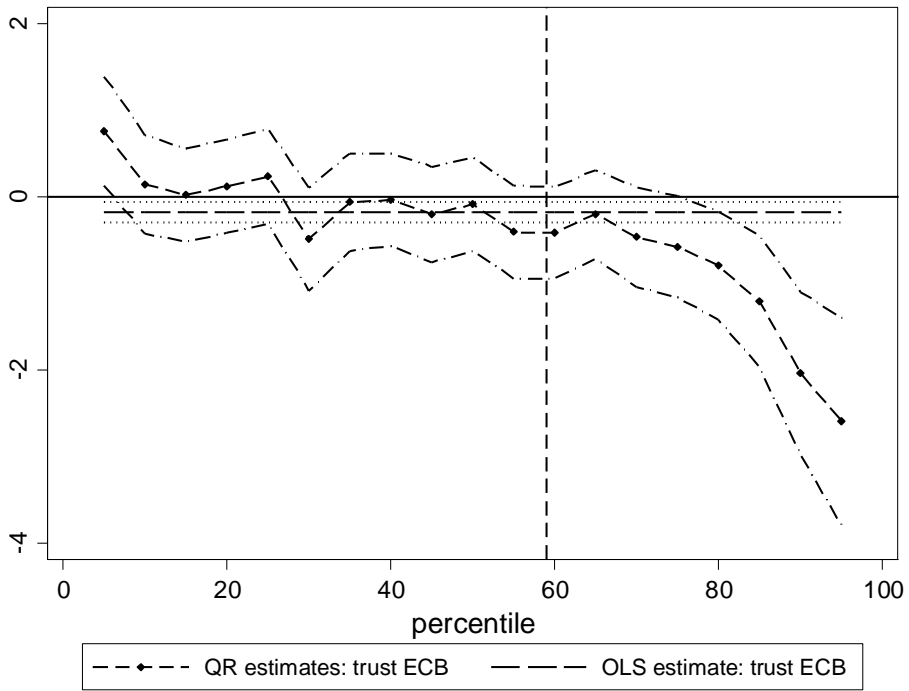**Figure 9. IV quantile regression estimates for expected inflation**

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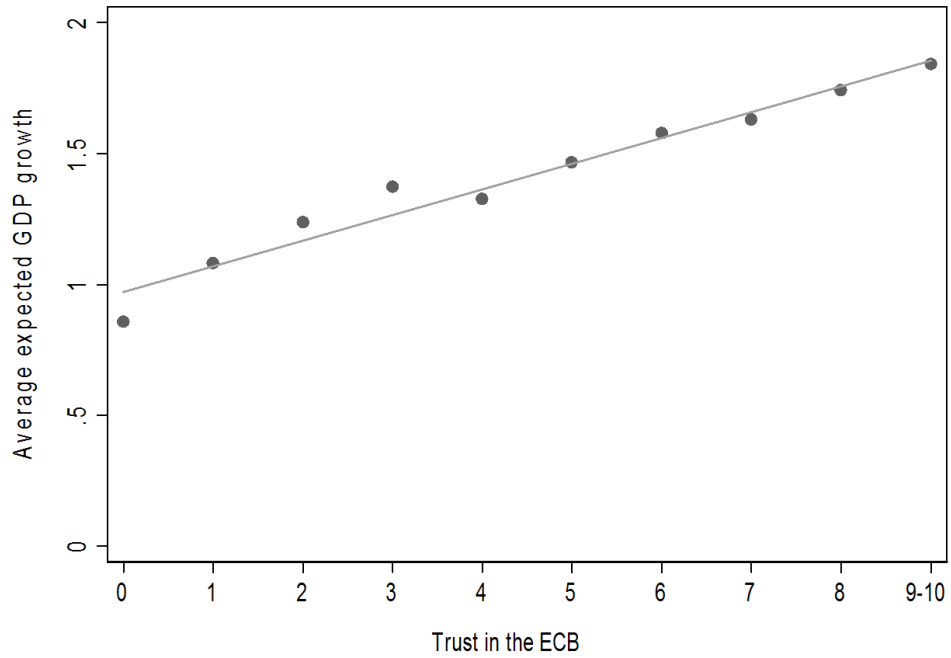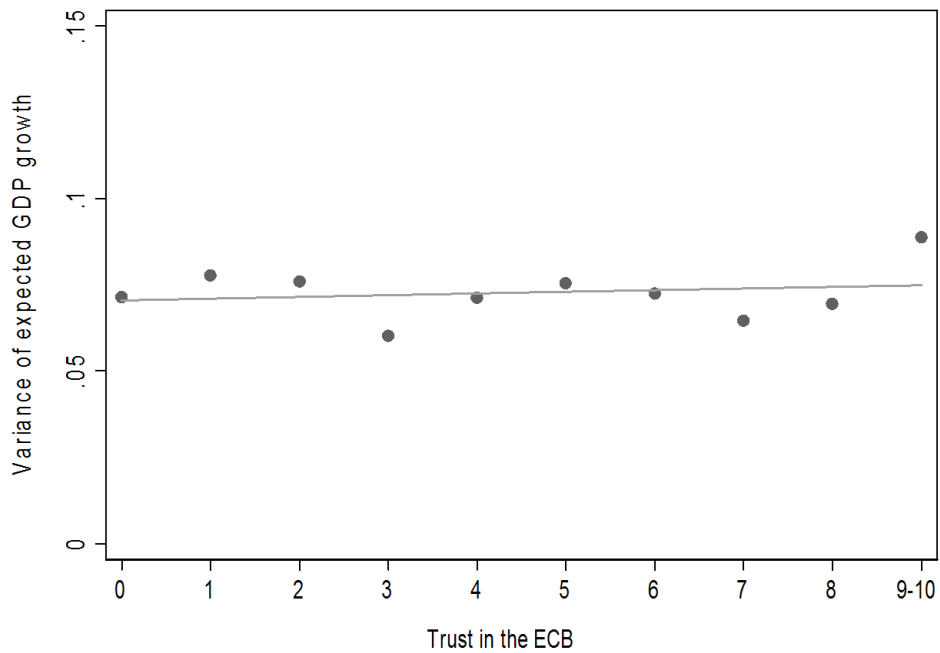**Figure 10. Average expected GDP growth rate by levels of trust in the ECB**

Figure 11. Variance of expected GDP growth rate by levels of trust in the ECB

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Appendix

A.1 Wording of the questions used in the analysis

a.   Questions on inflation expectations

Respondents to the survey were asked about inflation expectations as follows:

We are interested in your opinion on what will happen to the general level of consumer prices in the next 12 months. What do you think will be the percentage change in the level of prices in the next twelve months? If you think prices on average will decrease, you can fill in a negative percentage.

(a) Please give the minimum value: …. percent (y_m)
(b) Please give the maximum value: …. percent (y_M)
(c) What is the probability that the average increase in prices in the next 12 months is greater than X percent? (where X is automatically computed as $(y_m + y_M)/2$ and appears to the respondents' screen)

Please provide an answer on a scale from 0 to 100, where 0 means 'absolutely no chance' and 100 means 'absolutely certain':

Absolutely no chance   *Absolutely certain*
[ ] 0 [ ] 10 [ ] 20 [ ] 30 [ ] 40 [ ] 50 [ ] 60 [ ] 70 [ ] 80 [ ] 90 [ ] 100

b.   Question on ECB trust

How much do you trust the European Central Bank (ECB)? Please indicate your level of trust on a scale from 0 to 10, where 0 means you cannot trust at all and 10 means that you fully trust.

Cannot trust at all   *Fully trust*

[ ] 0 [ ] 1 [ ] 2 [ ] 3 [ ] 4 [ ] 5 [ ] 6 [ ] 7 [ ] 8 [ ] 9 [ ] 10

c.   Question on cheating by repairmen

How often, if ever, has it happened to you that a plumber, builder, car mechanic or other repair person overcharged you or did unnecessary work in the past five years?

Never	Once	Twice	3 or 4 times	5 times or more
[ ]	[ ]	[ ]	[ ]	[ ]

d.   Question on general trust

The next question is about how you view other people. Generally speaking, would you say that most people can be trusted or that you cannot trust people and need to be very careful in dealing with people?

Please indicate your level of trust on a scale from 0 to 10, where 0 means 'you cannot trust/ need to be very careful' and 10 means 'most people can be trusted'.

Need to be very careful   *Most people can be trusted*

[ ] 0 [ ] 1 [ ] 2 [ ] 3 [ ] 4 [ ] 5 [ ] 6 [ ] 7 [ ] 8 [ ] 9 [ ] 10

e.   Questions about knowledge on ECB objectives

Can you please indicate which of the statements below on the main objectives/tasks of the European Central Bank (ECB) are true or false?

The main objectives/tasks of the ECB are ..

	True	False	Do not know
- .. an unemployment of at most 5%	[ ]	[ ]	[ ]
- .. setting the income tax rates	[ ]	[ ]	[ ]

- .. an inflation rate that is close to but below 2%   [ ]   [ ]   [ ]

- .. an economic growth rate of at least 3%   [ ]   [ ]   [ ]

- .. to keep interest rates constant across time   [ ]   [ ]   [ ]

- .. supervision of large European banks   [ ]   [ ]   [ ]

f.   Questions on basic financial literacy

1) Suppose you have €100 in a savings account and the interest rate is 2% per year. After 5 years, how much do you think you would have in the account if you left the money to grow: more than €102, exactly €102, less than €102?

[ ] More than €102

[ ] Exactly €102

[ ] Less than €102

[ ] Do not know

[ ] Refuse to answer

2) Imagine you open a bank account that pays 1% interest and has no charges. Today, you put €1000 on this bank account and leave it there for a year. Imagine that inflation is running at 2%. If you withdraw the total amount of money from this bank account a year from now, would you then be able to buy the same amount of goods as if you spend the € 1000 euro today?

[ ] Yes, I would be able to buy the same amount

[ ] No, a year from now I would be able to buy less

[ ] No, a year from now I would be able to buy more

[ ] Do not know

[ ] Refuse to answer

3) Which of the two following investment strategies entails the greatest risk of losing your money?

[ ] Investing in the shares of a single company

[ ] Investing in the shares of several companies

[ ] Do not know

[ ] Refuse to answer

A.2. The subjective distribution of expected inflation

Let $f(y)$ denote the distribution of expected inflation for each individual. The survey provides information on the support of the distribution $[y_m, y_M]$ and on the probability mass to the right of the mid-point of the support $\pi = Prob(y > (y_m + y_M)/2)$. Knowing the support of the distribution, the expected value and variance of y can be expressed as:

$$E(y) = \int_{y_m}^{y_M} yf(y)dy \tag{A.1}$$

$$Var(y) = \int_{y_m}^{y_M} y^2 f(y)dy - \left(\int_{y_m}^{y_M} yf(y)dy \right)^2 \tag{A.2}$$

We assume that the distribution $f(y)$ is triangular over each of the two intervals $[y_m, (y_m + y_M)/2]$ and $[(y_m + y_M)/2, y_M]$, as shown in Figure A1. If $\pi = 0.5$ the distribution collapses to a simple triangular distribution over the interval $[y_m, y_M]$. Note that $E(y)$ and $Var(y)$ depend only on the three known parameters (y_m, y_M, and π). The triangular distribution is a plausible description of the probability distribution of expected inflation because outcomes farther from the mid-point receive less weight.

Table A1. Results from first stage regressions in IV estimation

Variable	(1) Trust in the ECB - expected inflation specification	(2)	(3) Trust in the ECB - expected growth specification	(4)
	Coeff.	Std. error	Coeff.	Std. error
Age	-0.058	0.020 ***	-0.050	0.020 **
Age squared	0.001	0.000 ***	0.000	0.000 **
Female	-0.189	0.090 **	-0.177	0.089 **
Couple	-0.161	0.143	-0.175	0.142
Household size	0.015	0.057	0.025	0.055
High school graduate	0.493	0.126 ***	0.500	0.122 ***
College graduate	0.863	0.129 ***	0.836	0.125 ***
Logarithm of household net income	0.055	0.058	0.046	0.051
Times cheated by repair persons	*-0.191*	*0.089* **	*-0.187*	*0.088* **
Trust in other people	*0.358*	*0.028* ***	*0.363*	*0.028* ***
constant	3.723	0.729 ***	3.593	0.683 ***
Region/ wave dummies	yes		yes	
F-test	86.433		92.332	
Observations	2,632		2,716	

Notes: This table shows first stage results from IV regressions with expected inflation and its variance (columns 1-2) and expected growth and its variance (columns 3-4) as dependent variables in the second stage regression. ***, **, * denote statistical significance at 1%, 5% and 10%, respectively.

Table A2. Quantile regression results

	(1)	(2)	(3)	(4)
Percentile	Quantile Regressions		IV Quantile Regressions	
	Coeff.	Std. error	Coeff.	Std. error
5	0.1109	0.0300 ***	0.7585	0.3220 **
10	0.0742	0.0163 ***	0.1398	0.2909
15	0.0513	0.0136 ***	0.0215	0.2732
20	0.0373	0.0117 ***	0.1239	0.2756
25	0.0208	0.0111 *	0.2344	0.2805
30	0.0080	0.0100	-0.4893	0.3033
35	0.0061	0.0096	-0.0613	0.2858
40	-0.0027	0.0107	-0.0334	0.2708
45	-0.0119	0.0110	-0.2041	0.2820
50	-0.0156	0.0113	-0.0846	0.2736
55	-0.0320	0.0115 ***	-0.4076	0.2731
60	-0.0428	0.0127 ***	-0.4148	0.2690
65	-0.0463	0.0133 ***	-0.2023	0.2616
70	-0.0666	0.0159 ***	-0.4650	0.2940
75	-0.0895	0.0209 ***	-0.5779	0.2981 *
80	-0.1303	0.0202 ***	-0.7942	0.3206 **
85	-0.1543	0.0274 ***	-1.2088	0.3876 ***
90	-0.2028	0.0450 ***	-2.0341	0.4797 ***
95	-0.3256	0.0841 ***	-2.5914	0.6097 ***

Notes: This table displays the coefficients of the variable denoting trust in ECB, estimated using both regular and IV quantile regressions and for various percentiles of the distribution of expected inflation. ***, **, * denote statistical significance at 1%, 5% and 10%, respectively.

Figure A1
The split triangular distribution