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The impact of guidance, short-term dynamics and individual characteristics on firms' long-term inflation expectations[a]

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Abstract

Long-term inflation expectations are an essential element in the transmission of a central bank's monetary policy. However, it is not fully understood how these long-term inflation expectations behave, as well as whether and how they can be managed.

In this paper, we shed light on possible drivers of long-term inflation expectations of firms using information from the Swiss National Bank (SNB) regional network survey. We extended the standard survey with questions to test whether the long-term inflation expectations of firms can be actively influenced by providing information regarding long-term average inflation, the central bank's objective and past performance.

We find that this type of information, which we call guidance: a) can influence the long-term inflation expectations of firms to a certain extent; and b) surprisingly, it does not have an impact on the uncertainty surrounding the expectations. However, c) uncertainty itself is positively correlated with the level of inflation expectations, and respondents who are more uncertain place greater weight on the information that they receive. Furthermore, d) short-term inflation expectations; e) the individual characteristics of the firms related to prices; and f) a large unexpected shock, in our case, a large shock to the exchange rate, can help to explain the behaviour of long-term inflation expectations.

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1 Introduction

Long-term inflation expectations are an essential element in the transmission of a central bank's monetary policy. Central banks thus have a natural interest in understanding, monitoring and possibly managing long-term inflation expectations. However, the – possibly changing – behaviour of long-term inflation expectations is not yet fully understood. Unclear aspects include questions regarding how long-term inflation expectations – be they of households, professional forecasters or firms – are formed and how they are influenced by the monetary policy set-up (for a recent overview, see, e.g. Coibion and Gorodnichenko, 2015).

There are basically two general views of what drives long-term inflation expectations. The first focuses on long-term factors, such as the monetary policy set-up, the credibility and performance of the central bank and long-term average inflation. It suggests that long-term inflation expectations have become more stable and less sensitive to various forms of shocks as a result of the increased credibility of monetary policy. The adoption of explicit guidance in the form of a formal inflation target or an otherwise defined inflation objective is considered an essential element of these developments (see e.g. Mehrotra and Yetman, 2014; Davis, 2014; Mehra and Herrington, 2008; Guerkaynak et al., 2010). Recently, proposals to raise the inflation target to attenuate the zero-lower-bound problem have emerged (see e.g. Blanchard et al., 2010; Ball, 2014). The underlying assumption of these proposals is that inflation expectations would follow the adjustment of the target in the desired direction.

The second view focuses on the impact of short-term dynamics and/or individual characteristics as drivers of long-term inflation expectations. Kumar et al. (2015) argued that twenty-five years of inflation targeting have not allowed managers to form reasonable long-term inflation expectations. Trehan (2015) found evidence that, even in recent periods, survey participants (both households and professional forecasters) still place a disproportionately high weight on recent inflation data when forming their expectations, i.e., adopting a short-sighted, backward-looking behaviour. Nishiguchi et al. (2014) showed that the shift in the Bank of Japan's inflation target has possibly reduced, but not eliminated, deflation expectations among households. They found that younger survey participants,

who have essentially experienced only periods of negative inflation in their lifetimes, tend to have more persistent deflationary expectations than older respondents do. This finding is in line with the findings of Malmendier and Nagel (2015): using several decades of microdata, they found clear evidence that long-term inflation expectations vary across individuals depending on their personal experience of inflation.

In this paper, we find that, at least in the case of Switzerland, both views – the one that stresses the importance of long-term factors and the one that focuses on short-term dynamics and individual characteristics – are relevant for understanding the behaviour of the long-term inflation expectations of firms. To this end, we use the Swiss National Bank (SNB) regional network survey, which is conducted on a quarterly basis among various companies from different industries and areas of the economy in Switzerland. The survey is based on the form of deep and detailed conversations with CEOs/CFOs. Our analysis spans Q3 2014 to Q4 2017.

With respect to the first view, the interaction of monetary policy with long-term inflation expectations, we proceed as follows. We test whether providing external guidance in the form of communicating information regarding past average inflation and the objective and performance of the central bank influences long-term inflation expectations and the uncertainty surrounding these expectations. To do so, we set up an experiment in the following manner. We randomly split the sample of interview partners into two equally large groups. Before answering the questions regarding long-term inflation expectations, half of the sample received an explicit reminder (which we call *guidance*) regarding what the Swiss National Bank's objective is, about its performance and about long-term average inflation. The second half of the sample did not receive any information (*no guidance*). We find that: a) guidance can influence the long-term inflation expectations of firms to a certain extent; and b) guidance does, surprisingly, not have an impact on the uncertainty surrounding these forecasts. However, c) the degree of uncertainty is positively correlated with the level of long-term inflation expectations, and respondents who are more uncertain place greater weight on the signals that they receive through guidance.

To address the second view, which focuses more on short-term dynamics and individual characteristics that help to explain long-term inflation expectations, we analyse whether other attributes covered in the SNB regional network survey possibly help to explain the

firms' long-term inflation expectations. We find that: d) short-term inflation expectations; and e) individual factors related to prices, such as the firms' assessments of expected purchase prices, show a significant relationship with their long-term inflation expectations. We find in addition, that: f) a large, unanticipated shock – in our case, a large shock to the exchange rate – moves long-term inflation expectations.

Recently, interest in the behaviour of firms' inflation expectations has emerged. Since firms set prices and wages, both of which influence inflation, central banks have a natural interest in understanding the nature of firms' inflation expectations. However, as noted by Coibion et al. (2018), information about firms' expectations is limited compared to information retrieved from surveys of households, from professional forecasters and from financial market participants. Therefore, these inflation expectations have been studied more frequently. Our research and findings relate in particular to the following papers in which firms were analysed. Coibion et al. (2018) shed light on the behaviour of firms in New Zealand by implementing a quantitative survey conducted in four waves. With regard to inflation expectations, they focused on short-term inflation expectations covering a horizon of 12 months. Among many other things, they documented that errors in beliefs about recent inflation are biased towards the upside. They also found a positive correlation between uncertainty and inflation forecasts. When providing information about recent macroeconomic variables, as well as the forecasts of professional forecasters and the inflation target of the central bank, they found that firms adjusted their inflation forecasts consistently with models of Bayesian learning in response to new information. Additionally, firms with higher levels of uncertainty revised their expectations by more, i.e., placing greater weight on the signals that they receive. The authors also reported a time dimension (cyclicality) in how information is processed. As mentioned above, our paper focuses on long-term inflation expectations and has a cross-sectional time series rather than a panel structure. Although our survey and the experiment are established quite differently, our findings are in line with the aforementioned results of Coibion et al. (2018). Kumar et al. (2015) used the same database as Coibion et al. (2018) and complemented their findings by checking for anchoring of the firms' inflation expectations in New Zealand and the influence of monetary policy on inflation expectations. To answer these questions, they concentrated on one wave of the survey, namely, that conducted in Q3 2014. They

found that managers commonly report large revisions in their forecasts. In addition, those who report high short-term inflation forecasts also tend to expect higher long-term inflation. We also find this positive correlation in our study over a period of time.[1]

The remainder of the paper is structured in the following way. Section 2 describes the survey and the data at hand in greater detail. It also provides a short overview of the inflation environment in Switzerland. Section 3 discusses the setup of our experiment. Section 4 presents visually some results regarding the impact of guidance on long-term inflation expectations and uncertainty. In Section 5, we estimate a model of the possible explanatory variables of long-term inflation expectations and discuss the results. Section 6 analyses how much weight the firms, on average, place on the signals that they receive through guidance. Section 7 concludes the study.

2 The SNB regional network survey and the inflation environment

2.1 The SNB regional network survey

Our investigation is based on unique data collected through the SNB regional network survey, which has been conducted since Q1 2010 on a quarterly basis over a time period of six to seven weeks in the respective quarter. The survey is intended to gather information about the state of the economy and business perspectives. The main survey results are summarised in a publicly available report, the 'Business cycle signals'.[2] The survey is unique along several dimensions. First, all of the interviews are conducted in person by the SNB's regional representatives on the company's premises. This procedure guarantees the identity of the respondent. The typical interview partner is the company's CEO or CFO. Second, sufficient time is allocated to ensure that the exact question content is clear and that no misunderstandings arise. A standard interview lasts roughly ninety minutes, crucially improving the quality and reliability of the answers. Third, the same questions are asked across all industries considered, which allows for an aggregation of the data and

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[1]While Bryan et al. (2015) also covered time series of firms' inflation expectations, they tested what these expectations look like, whether they are accurate and whether they matter, and they did not explore how firms form expectations.

[2]The reports can be found at the following link: `https://www.snb.ch/en/iabout/snb/regional/id/regional_pub`.

the formation of a view of developments at the national level.

Interviews are conducted using a standardised questionnaire, which is completed by the SNB representative and not by the interview partner. It is composed of a number of closed questions that request either a numeric answer or a qualitative answer ranging on a scale from 1 to 5, as well as by open questions in which partners can freely comment on issues such as factors driving demand, monetary policy or risks to the outlook. Appendix A.1 provides the questions contained in the standardised questionnaire. For the purposes of this project, i.e., testing for the impact of guidance on long-term inflation expectations, the standard structure of the survey has been complemented over a period of three and a half years by a number of additional questions on inflation expectations. Section 3 discusses these questions in detail.

The survey sample is typically composed of 240 companies per quarter and 208 in the third quarter of the year. Companies are chosen to reflect the country's economic structure in terms of employment and value added across industries and regions. Only the public sector and agriculture are excluded from the survey. The company sample is fully renewed each quarter. As a consequence, interview partners change each quarter. In a typical quarter, 25% to 40% of companies participate in the survey for the very first time. Based on a given number of interviews to be conducted per sector, companies are partly selected through a random drawing by the Federal Statistical Office and partly chosen by the SNB regional representative. Major players obviously must be visited on a regular basis. To avoid overburdening of the interview partners, however, no company is generally revisited before a break period of at least six quarters has elapsed. Our investigation relies on answers collected between Q3 2014 and Q4 2017, i.e., fourteen rounds of surveys amounting to 3123 interviews.

2.2 The inflation environment in Switzerland and the primary objective of the SNB

Before moving on to our experimental design, we briefly discuss the inflation environment in Switzerland and the SNB's primary objective. Figure 1 shows the development of Swiss headline inflation over the last five decades. Since the beginning of the 1970s, Swiss CPI inflation has trended downwards. Since the beginning of the financial crisis, under

the influence of a negative output gap, declining international energy prices, as well as various large exchange-rate appreciation waves, Swiss inflation drifted further downwards, undergoing periods in negative territory. Since January 2017, CPI inflation has moved back into positive territory.

Regarding the monetary policy framework in Switzerland, the SNB's primary goal is to ensure price stability in the medium to long term. The SNB explicitly formalised this goal in 2000 by defining price stability as a CPI rate less than 2% per year and non-negative. With these facts in mind, let us continue with the setup of our experiment.
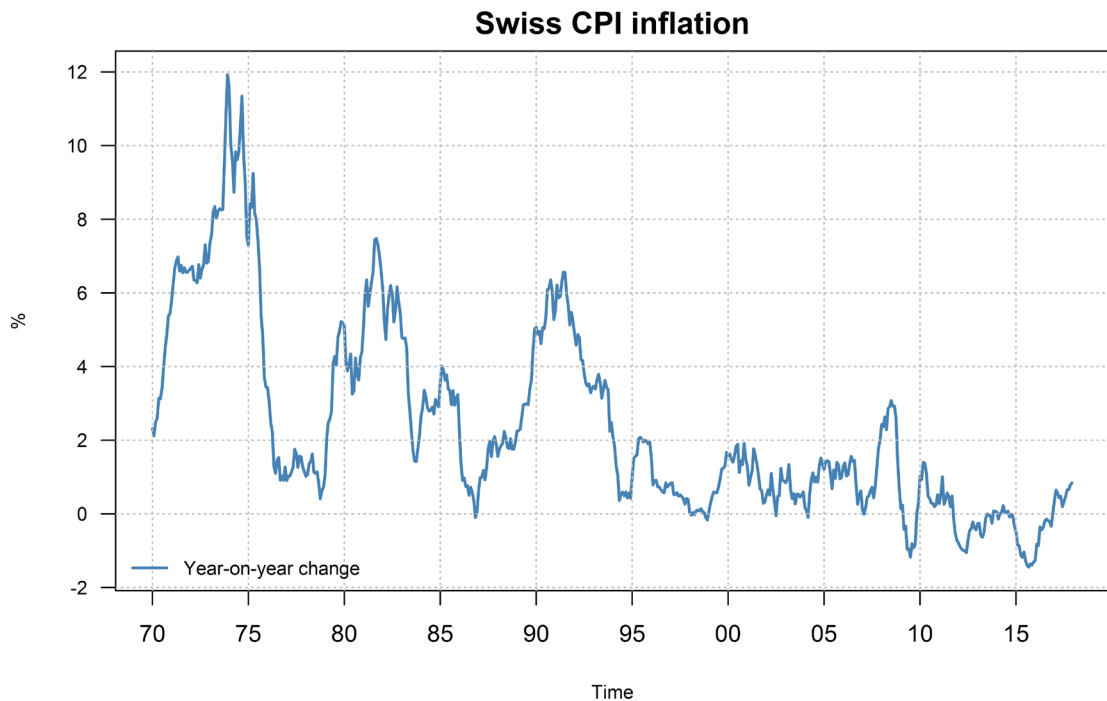

Figure 1: Swiss CPI year-on-year inflation since 1970.

3   Setup of our experiment

In the context of the first view mentioned in the introduction, namely, the interaction of monetary policy and long-term inflation expectations, we test whether providing information regarding past average inflation and the objective and performance of the central bank influences long-term inflation expectations and the uncertainty surrounding these expectations.

To this end, we set up the following experiment. Between Q3 2014 and Q4 2017, we

randomly split the sample of interview partners into two equally large groups in each quarter. Before answering the questions on long-term inflation expectations, half of the sample received an explicit reminder (which we call *guidance*) about what the central bank's objective is, about its performance and about long-term average inflation in Switzerland. This information should serve the guided group as an external reference point. Over time, we varied the information that the guided group received about long-term average inflation. From Q3 2014 until Q1 2016, we communicated in the introductory statement that past average inflation was approximately 1%[3] and, from Q2 2016 until Q4 2017, that it was just less than 2%[4].

The second half of the sample did not receive any information before answering the questions (no guidance). To assess the unguided group's potential internal long-term reference point, between Q2 2015 and Q4 2017, the unguided respondents were asked about their perceived past average inflation over the previous 20 years or so.

To analyse whether guidance reduces the uncertainty surrounding inflation expectations, we asked both groups how certain they were about their indicated inflation expectations.

The following paragraph lists the set of questions that each group received in detail.

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[3]One percent is the long-term average of Swiss CPI year-on-year inflation between the beginning of 1991 and the end of 2017. In addition, 1% is in the middle of the SNB's range defining price stability.

[4]Two percent is the long-term average of Swiss CPI year-on-year inflation between the beginning of 1974 and the end of 2017 and the upper limit of the SNB's definition of price stability.

Questions to the guided group:

Guidance in the form of an introductory statement: The SNB's primary goal is to ensure price stability. This is a goal that it has pursued with a great deal of success to date. From a long-term perspective, the average annual rate of inflation, as measured by the consumer price index (CPI), ...

[**from Q3 2014 until Q1 2016 we stated:**] ... has been around 1%.

[**from Q2 2016 until Q4 2017 we stated:**] ... has been just under 2%.

Question 1: Within what range do you expect annual inflation to be in 3-5 years' time, as measured by the consumer price index (CPI)?

- From: ...% to ...% ● No opinion

Question 2: In your opinion, what is the likelihood of annual inflation – as measured by the consumer price index (CPI) – being outside the indicated range in 3-5 years' time? Please state a likelihood between 0% and 100%.

- Likelihood: ...% ● No opinion

Questions to the unguided group:

Note: No guidance, i.e., no introductory statement

Question 1: Within what range do you expect annual inflation to be in 3-5 years' time, as measured by the consumer price index (CPI)?

- From: ...% to ...% ● No opinion

Question 2: In your opinion, what is the likelihood of annual inflation – as measured by the consumer price index (CPI) – being outside the indicated range in 3-5 years' time? Please state a likelihood between 0% and 100%.

- Likelihood: ...% ● No opinion

Question 3: In your opinion, what has been the average rate of annual inflation – as measured by the CPI – over the last 20 years or so?

- From: ...% to ...% ● No opinion

In Appendix A.2, Table A.1 describes in detail the number of observations per question asked and across industries. The table covers both the standard questions and those introduced for the experiment.

As mentioned above, firms are generally revisited at the earliest after a minimum break period of six quarters, indicating that, over time, the share of repeaters increases in our sample. Repeaters were treated in the following manner. Those who were guided the first time were also guided the second time along. Those who were unguided in the first interview were guided the second time. Could these repeaters bias our results? The data at hand do not allow us to formally assess this aspect. However, it seems reasonable to assume that the bias, if it exists at all, is limited in our sample. First, a minimum break period of six quarters is a long time span. By the time that the respondents are interviewed again, they might not remember in detail the questions and the answers that they gave the last time that they were interviewed. Second, since our investigation is based on seven quarters with guidance of 1% and seven quarters with guidance of 2%, even if the interview partner received guidance for a second time, the information varied.

4 Visual inspection of results

Before we formulate the model for estimation, we first present visually some of the results to the above-described questions.

4.1 Impact of guidance on long-term inflation expectations

Figure 2 provides a first hint of the impact of guidance on long-term inflation expectations. It reports the mean of the midpoint answers to question 1 with and without guidance and to question 3 (perceived past average inflation over the last 20 years or so), together with the external information provided in the introductory statement of 1%, respectively 2%. We observe a clear pattern: the mean of the midpoint answers on inflation expectations in 3 to 5 years of the guided group is first less than and then greater than the mean of the midpoint answers of the unguided group. The guided group's answers switch from less than to greater than the unguided group's answers with the change in information provided in our introductory statement, i.e., when we switch from 1% to 2%.
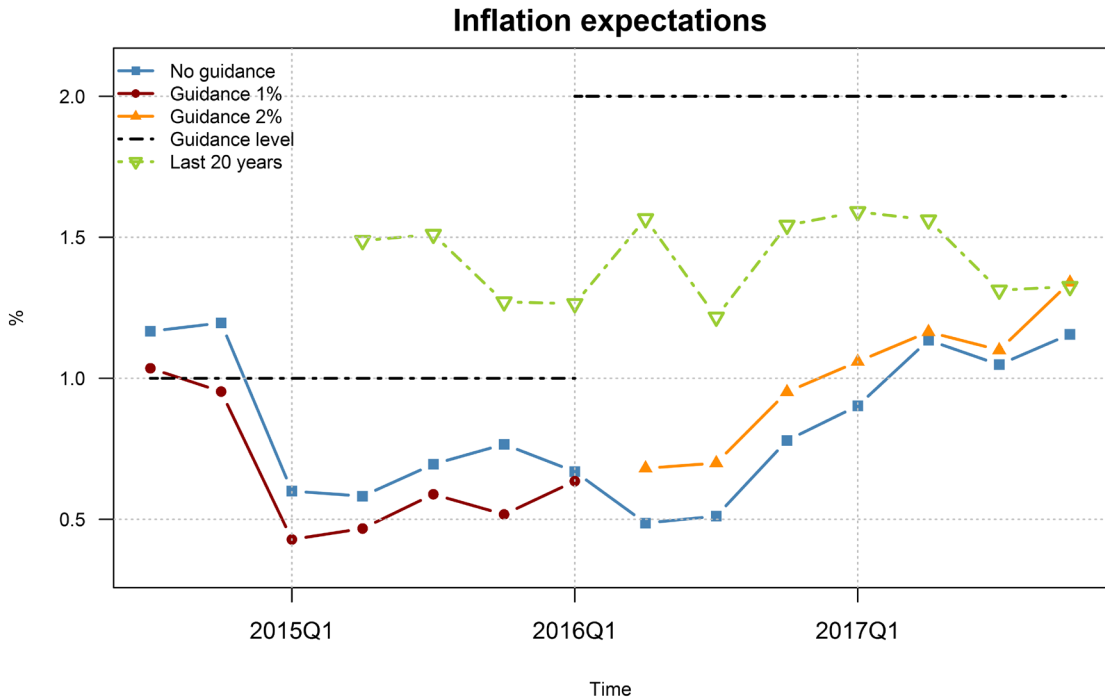
Figure 2: Impact of guidance on long-term inflation expectations.

To interpret this pattern, the results for long-term perceived past average inflation are useful. We gauged the unguided group's internal prior on long-term perceived average inflation with question 3, which is also shown in Figure 2. Because we split the groups in our experiment randomly, we can assume that the unguided group's long-term internal prior mirrors the guided group's one.

We observe that this internal prior on long-term average inflation lies between the external information provided to the guided group of 1%, respectively, and 2%. Interestingly, long-term perceived average inflation (on average, 1.4% in our sample) deviates significantly from realised inflation. Realised inflation in Switzerland was, on average, much lower than perceived by the unguided group – approximately 0.5% over the last 20 years (Q4 1997 - Q4 2017). The upward bias in perception has been previously documented in the literature (see e.g. Kumar et al., 2015).

How does the gap between the internal prior and external information translate into adjustments of the inflation expectations of the guided group? Apparently, the guided group considers the difference between the internal prior and the external information and adjusts its inflation expectations, not by the exact amount of the gap but in a de-amplified

fashion. This observation is in line with the literature: Cavallo et al. (2014) found that households confronted with information about past inflation that differs from their priors assign a certain weight (less than 100%) to this information to update their actual beliefs about inflation. The adjustment to the new information can be described as a linear function of the distance between the new information and the prior belief.[5] Coibion et al. (2018) found that firms receiving a signal about, e.g., recent macroeconomic variables, forecasts of professional forecasters and/or the inflation target of the central bank adjust their inflation expectations consistently with models of Bayesian learning in response to the new information. Our results seem to be in line with these findings, and they also complement Detmeister et al. (2016) who showed that the perception of long-term average inflation and long-term inflation expectations are closely related.

4.2 Impact of guidance on uncertainty

Does guidance have an impact on the uncertainty surrounding the expectations and/or on the interval width of the answers regarding inflation expectations? Figure 3 shows the mean of the assigned likelihood of being outside the indicated range (question 2) of the guided and unguided groups. Figure 4 presents the average interval width of the guided and unguided groups in each quarter. In neither figure do we observe a clear pattern between the guided and unguided groups. When performing t-tests, we do not find any statistical evidence that guidance influences the uncertainty surrounding the forecasts or the interval width.[6]

Intuitively, one would expect that guidance reduces the uncertainty and/or narrows the range of answers given. Cavallo et al. (2017) showed that households receiving a signal tend to be more confident in their inflation expectations. Surprisingly, firms in Switzerland do not seem to share this pattern. However, we will see later that uncertainty is positively correlated with inflation expectations; i.e., the more uncertain an interview partner is, the higher his or her inflation forecast is (refer to Section 5). Furthermore, those who are more uncertain place greater weight on the signals that they receive through guidance (refer to Section 6).

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[5]See also Cavallo et al. (2017).
[6]For the t-tests, we split the sample into the periods with 1% and 2% guidance.
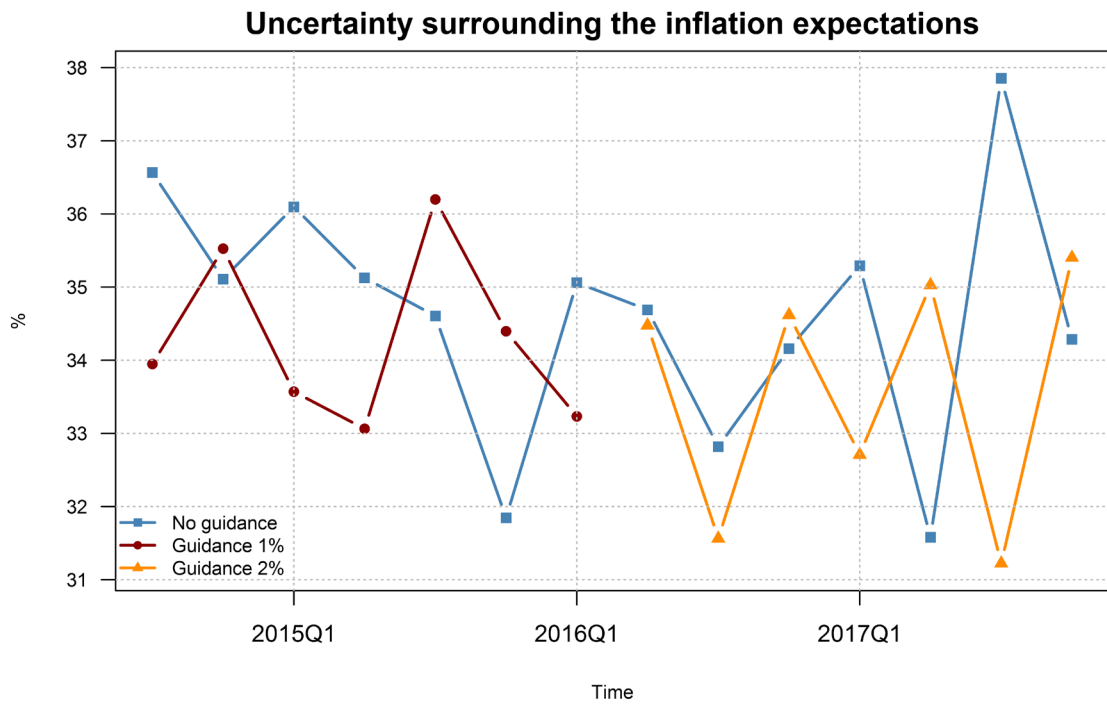
Figure 3: Likelihood of being outside the indicated range of long-term inflation expectations for the guided and unguided groups on average.
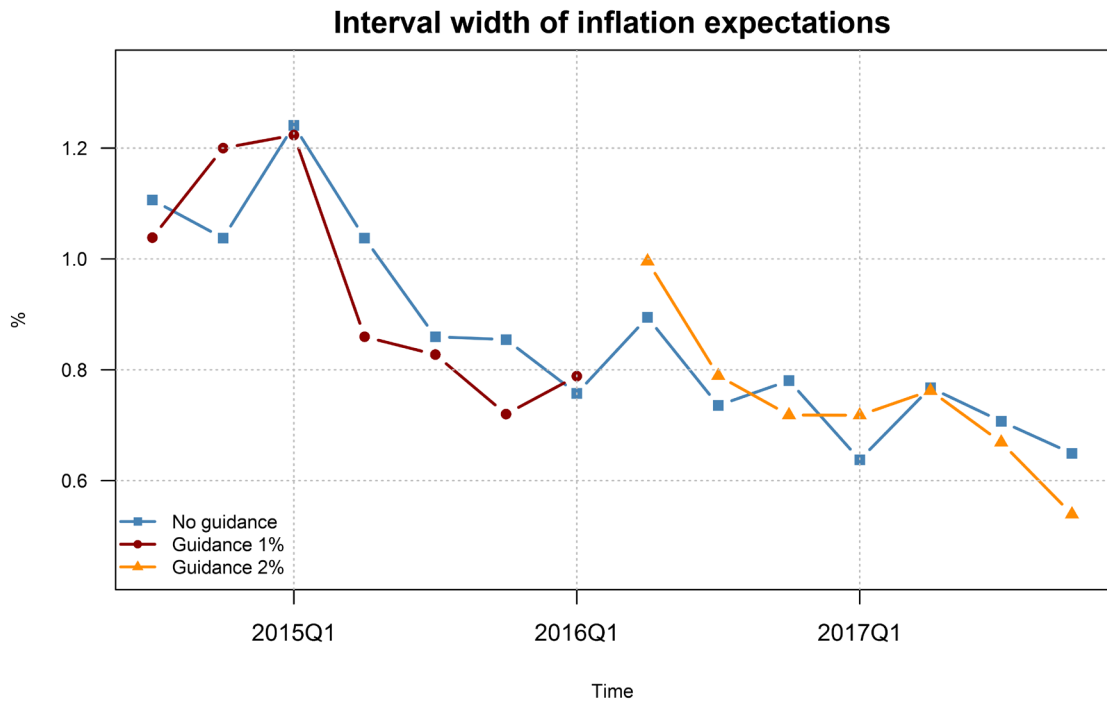

Figure 4: Average interval width of long-term inflation expectations for the guided and unguided groups.

In summary, with both introductory statements (guidance of 1% and 2%) we observe

an impact of guidance. Firms seem to have an internal reference point, e.g., long-term perceived past average inflation. With our guidance, we provide external information that implicitly references this prior. The gap between the prior and the external information translates into an adjustment of inflation expectations but only in a de-amplified manner. Importantly, we also observe that we cannot pin long-term inflation expectations exactly to the external information that we provide, nor are expectations exactly positioned at the internal long-term prior. There must be additional factors that help to explain firms' long-term inflation expectations.

In light of recent discussions about raising the inflation target with the underlying assumption that expectations would follow in the desired fashion, our results so far suggest that managing these expectations is not as straightforward as it might sound. In the following section, we test empirically for the variables that help to explain long-term inflation expectations.

5   Explanatory variables of long-term inflation expectations

As we discussed, visual inspection suggests that guidance has an impact on long-term inflation expectations. Furthermore, long-term inflation expectations do not correspond exactly either to the internal prior on long-term average inflation or to the external information that we provide through guidance. As mentioned in the introduction, one view of inflation expectations stresses the importance of the monetary policy framework, long-term performance and the credibility of the central bank. The second view focuses on the influence of short-term dynamics and individual characteristics for long-term inflation expectations.

To account for these two views, our model takes the following form:

$$
\begin{aligned}
\pi_{it}^{long\text{-}term} = {} & \beta_0 + \sum_{t=1}^{T} z_{it}\beta_t + \sum_{j=1}^{2} w_{ijt}\gamma_j + \delta\pi_{it}^{short\text{-}term} + \sum_{j=1}^{p} x_{ijt}\zeta_j \\
& + \sum_{t=1}^{T}\sum_{j=1}^{2}(z_{it} \times w_{ijt})\eta_{jt} + \sum_{t=1}^{T}(z_{it} \times \pi_{it}^{short\text{-}term})\theta_t + \sum_{t=1}^{T}\sum_{j=1}^{p}(z_{it} \times x_{ijt})\kappa_{jt} \quad (1) \\
& + \sum_{j=1}^{p}(x_{ijt} \times \pi_{it}^{short\text{-}term})\lambda_p + \sum_{l=1}^{p}\sum_{j=1}^{p}(x_{ilt} \times x_{ijt})\xi_{jl} + \epsilon_{it},
\end{aligned}
$$

where $\pi_{it}^{long\text{-}term}$ is the individual long-term inflation expectation of firm i at time t. β_0 is a constant, and w_{i1} and w_{i2} are dummy variables for 1% and 2% guidance, respectively. To account for short-term dynamics, we include the answers on short-term inflation expectations $\pi_{it}^{short\text{-}term}$. We also include firm-level characteristics x_{ijt} of firm i at time t. The element of time might also be important: During our experiment, the firms were affected by a large, unanticipated exchange rate shock. The SNB introduced an exchange rate floor of CHF 1.20 per EUR on 6 September 2011. It announced that it would discontinue the minimum exchange rate of CHF 1.20 per EUR on 15 January 2015, leading to an appreciation of the Swiss franc to CHF 1.04 per EUR by the end of January 2015. The decision to discontinue the minimum exchange rate fell between the SNB regional network survey of Q4 2014 and Q1 2015. The impact of this large shock on long-term inflation expectations shows up clearly in Figure 2: the unguided group revised its long-term expectations from 1.2% on average to 0.6% on average and the guided group from 1.0% to 0.4% in Q1 2015. We therefore also account for time z_{it} in equation (1). Table 1 lists and defines all of the dummy variables, together with the number of observations.

Table 1: Description of the dummy variables used in the model.

Dummy variables[1]	Dummy value of 1	Number of observations	Dummy value of 0	Number of observations	NA[4]
z_1	Q4 2014	226	Q3 2014 $\iff z_1 = z_2 = \ldots = z_T = 0$	175	-
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	
z_T	Q4 2017	237	Q3 2014 $\iff z_1 = z_2 = \ldots = z_T = 0$	175	-
w_1	Guidance 1%	736	No guidance	768	-
w_2	Guidance 2%	831	No guidance	788	-
x_1	Firms with more than 140 employees	1550	All other firms	1573	-
x_2	Firms with more than 5% export share	1498	All other firms	1625	-
x_3	Firms with more than 30% uncertainty about long-term infl. exp.	1314	All other firms	1403	406
x_4	Firms with a higher or the same level of real turnover (compared with the same period last year)	2215	All other firms[2]	908	-
x_5	Firms with a higher or the same level of real turnover (compared with the previous quarter)	2472	All other firms[2]	651	-
x_6	Firms with overutilisation or normal utilisation of capacity	2040	All other firms[2]	1083	-
x_7	Firms with higher or normal profit margins	1591	All other firms[2]	1532	-
x_8	Firms with low or almost correct staff levels	2556	All other firms[2]	567	-
x_9	Firms with more difficult or usual recruitment	2360	All other firms[3]	588	175
x_{10}	Firms that expect higher or unchanged real turnover	2661	All other firms[2]	462	-
x_{11}	Firms that expect increasing or the same utilisation of capacity	2737	All other firms[2]	386	-
x_{12}	Firms that expect higher or unchanged employment	2504	All other firms[2]	619	-
x_{13}	Firms that expect increasing or unchanged purchase prices	2157	All other firms[2]	837	129
x_{14}	Firms that expect increasing or unchanged sales prices	2137	All other firms[2]	973	13
x_{15}	Firms that expect increasing or unchanged equipment investment	2345	All other firms[2]	767	11
x_{16}	Firms that expect increasing or unchanged construction investment	1931	All other firms[2]	500	692
x_{17}	Midlands Region	402	Geneva Region $\iff x_6 = x_7 \ldots = x_{12} = 0$	405	-
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$
x_{23}	Zurich Region	309	Geneva Region $\iff x_6 = x_7 \ldots = x_{12} = 0$	405	-

[1] For simplicity, the subject index i and the time index t are not shown.
[2] The response categories "=" ("normal" or "unchanged"), "+" and "++" ("higher" or "increasing"), as well as the response categories "−" and "−−" ("tighter" or "reducing"), for the variables x_j are combined (see Appendix A.1).
[3] The response categories "=" ("as usual"), "+" and "++" ("slightly more difficult" or "considerably more difficult"), as well as the response categories "−" and "−−" ("slightly easier" or "considerably easier"), for the variable recruitment x_9 are combined (see Appendix A.1).
[4] NA stands for not applicable, indicating the respondent refused or was not able to provide an answer to the corresponding question.

In equation (1), we also allow for interaction terms: guidance with time ($z_{it} \times w_{ijt}$), short-term inflation expectation with time ($z_{it} \times \pi_{it}^{short\text{-}term}$), firm-level characteristics with time ($z_{it} \times x_{ijt}$), short-term inflation with firm-level characteristics ($x_{ijt} \times \pi_{it}^{short\text{-}term}$) and firm-level characteristics with each other ($x_{ilt} \times x_{ijt}$).

Our estimation is based on the backward-stepwise selection approach.[7] Under this selection, one starts by fitting a model with all of the potential variables of interest.[8] To reduce complexity, we first do not include interaction terms in the model. In each

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[7] As a robustness check, we also perform the forward-stepwise selection approach, which sequentially adds to the model the variable that most improves the fit. In addition to the forward-stepwise selection, we also apply the hybrid stepwise-selection strategy that considers both forward and backward moves in each step and selects the "better' of the two.

[8] We excluded the dummy variable x_{16} because of the small number of observations available.

step, the fitting is based on the Akaike Information Criterion (AIC); i.e., in each step, the variable that minimises the AIC score of the resulting model is dropped from the model. We continue by successively re-fitting reduced models and by applying the same rule until the AIC score is minimised. Furthermore, we only include variables that can be interpreted. We then allow for interaction terms. We inspect the 2-way interaction terms of the remaining variables in the resulting model, again by applying backward selection. Thereafter, we select variables and interaction terms that can be interpreted. Finally, we also apply an F-test to compare nested models and select the more parsimonious model.

Table 2 summarises the results. We find that guidance, short-term inflation expectations and time enter significantly. Kumar et al. (2015) also showed a positive correlation between short-term and long-term inflation expectations. Coibion et al. (2018) documented a time dimension (cyclicality) of inflation expectations. The unanticipated exchange rate shock occurred in Q1 2015, and time enters significantly, as well as the interaction term of time and short-term inflation expectations.

Of the many individual characteristics for which we tested, only purchase prices enter significantly. However, sales prices seem to share a similar pattern: Figures A.1 and A.2 in Appendix A.3 show inflation expectations grouped by expected purchase and sales prices. The figures show that sales prices follow a similar pattern as purchase prices but in a less pronounced manner. They, therefore, do not enter significantly into our estimations. Other characteristics, such as firm size, export orientation, region, etc., do not enter significantly either.

Uncertainty does play a role. It enters positively, in line with Coibion et al. (2018). The higher that the uncertainty is, the higher that the long-term inflation expectations are. Figure A.3 in the Appendix shows this effect clearly. It plots long-term inflation expectations grouped by uncertainty.

Overall, our results suggest that both views, the one that emphasises the importance of the monetary policy framework, long-term performance and credibility of the central bank and the one that focuses on the influence of short-term dynamics and individual characteristics for long-term inflation expectations, play roles in the formation of inflation expectations of firms in Switzerland.

Table 2: Linear regression model of long-term inflation expectations based on variables including interaction terms.

	Estimate	Standard error	t-value	p-value
Intercept	0.776	0.097	7.98	< 0.001
Q4 2014	0.043	0.113	0.39	0.699
Q1 2015	-0.284	0.123	-2.30	0.021
Q2 2015	-0.311	0.113	-2.74	0.006
Q3 2015	-0.217	0.116	-1.88	0.060
Q4 2015	-0.210	0.112	-1.88	0.060
Q1 2016	-0.151	0.109	-1.39	0.165
Q2 2016	-0.432	0.115	-3.74	< 0.001
Q3 2016	-0.374	0.116	-3.22	0.001
Q4 2016	-0.236	0.112	-2.11	0.034
Q1 2017	-0.212	0.113	-1.86	0.062
Q2 2017	-0.119	0.116	-1.03	0.301
Q3 2017	-0.340	0.121	-2.80	0.005
Q4 2017	-0.213	0.132	-1.61	0.106
Guidance 1%	-0.130	0.055	-2.36	0.018
Guidance 2%	0.135	0.051	2.64	0.008
Inflation expectations$^{(short-term)}$	0.403	0.079	5.05	< 0.001
Uncertainty of inflation exp.$^{(long-term)}$ >= 30%	0.190	0.038	4.91	< 0.001
Expect increasing or unchanged purchase prices	0.174	0.044	3.90	< 0.001
Q4 2014×Inflation exp.$^{(short-term)}$	-0.113	0.151	-0.75	0.452
Q1 2015×Inflation exp.$^{(short-term)}$	-0.334	0.089	-3.76	< 0.001
Q2 2015×Inflation exp.$^{(short-term)}$	-0.274	0.092	-2.96	0.003
Q3 2015×Inflation exp.$^{(short-term)}$	-0.136	0.102	-1.33	0.183
Q4 2015×Inflation exp.$^{(short-term)}$	-0.015	0.115	-0.13	0.895
Q1 2016×Inflation exp.$^{(short-term)}$	-0.033	0.098	-0.34	0.731
Q2 2016×Inflation exp.$^{(short-term)}$	0.002	0.125	0.02	0.981
Q3 2016×Inflation exp.$^{(short-term)}$	0.198	0.111	1.77	0.076
Q4 2016×Inflation exp.$^{(short-term)}$	0.235	0.133	1.77	0.077
Q1 2017×Inflation exp.$^{(short-term)}$	0.119	0.130	0.92	0.359
Q2 2017×Inflation exp.$^{(short-term)}$	0.185	0.119	1.54	0.122
Q3 2017×Inflation exp.$^{(short-term)}$	0.204	0.120	1.71	0.088
Q4 2017×Inflation exp.$^{(short-term)}$	0.076	0.127	0.60	0.550

Residual standard error: 0.950 on 2544 degrees of freedom
Multiple R-squared: 0.199, Adjusted R-squared: 0.189
F-statistic: 20.38 on 31 and 2544 degrees of freedom, p-value: < 0.001

The fitting is based on the backward-stepwise selection, which selects the model using the Akaike Information Criterion (AIC). We also use the F-test to compare nested models and select the more parsimonious model.

6 How much weight do firms place on the signals that they receive through guidance?

We infer that guidance plays a role in long-term inflation expectations. This section explores the weight that firms, on average, place on the signals that they receive through guidance. We can treat the unguided group as a control group, assuming that, a priori, i.e.,

without guidance, both groups should have the same beliefs. The guided group, however, receives a signal (guidance with 1% and 2%) and adjusts its beliefs by placing some weight on the signal. We refer to this weight as the Kalman gain (KG). Furthermore, the weight $(1 - KG)$ is placed on the group's prior beliefs, mirrored by the unguided group's inflation expectations. Thus, we set

$$\mathbb{E}\left(\pi_{it}^{Guidance}\right) = (1 - KG)\,\mathbb{E}\left(\pi_{it}^{No\ guidance}\right) + KG\,w_t^* + \epsilon_t, \tag{2}$$

where w_t^* denotes the corresponding signal of guidance of 1%, and 2% at time t. Furthermore, let

$$w_t^* = \begin{cases} 1\% & \text{if } t \in \{Q3\ 2014 \dots Q1\ 2016\}, \\ 2\% & \text{if } t \in \{Q2\ 2016 \dots Q4\ 2017\}. \end{cases} \tag{3}$$

The expectation $\mathbb{E}\left(\pi_{it}^{\bullet}\right)$ is the mean long-term inflation expectation $\bar{\pi}_t^{\bullet}$ at time t of the respective group, and KG represents the weight that the firms place on the signal. First, we calculate the weight KG for the whole sample. Furthermore, we want to know whether those who are more uncertain about their inflation forecasts place greater weight on the signals that they receive through guidance. We, therefore, split the sample with respect to the level of uncertainty as defined in Table 1, i.e., x_3, where x_3 represents firms with more than 30% uncertainty about long-term inflation expectations.

Table 3 summarises the results.

Table 3: Kalman gain (KG) for different samples

Sample group	$(1 - KG)$	KG
Whole sample	0.90	0.10
Uncertain sample	0.85	0.15
Certain sample	0.96	0.04

The uncertain (certain) sample stands for those showing a level of uncertainty with respect to their long-term inflation forecasts of greater than (equal or less than) 30%.

Indeed, we observe that firms place some weight on the new information that they receive in the form of guidance. Those who are more uncertain about their forecasts place greater weight on the signal than those who are more certain about their forecasts. This

result is in line with Coibion et al. (2018), who showed that firms with a higher degree of uncertainty revised their forecasts by more than firms that were more confident about their initial forecasts.

7 Conclusions

In the wake of the financial crisis and the zero-lower-bound problem, it has been widely discussed whether central banks should raise their inflation targets (and with them inflation expectations). These arguments assume that long-term inflation expectations would follow an increase in the communicated target in the desired manner. Our findings, however, suggest that managing these long-term inflation expectations is not as easy as it might sound. As we showed, the central bank can influence long-term inflation expectations by providing external information in the form of guidance; however, the impact is limited. Guidance could influence expectations only to a certain extent, and we could not pin expectations exactly to the signal provided. In addition, guidance per se did not decrease the uncertainty surrounding expectations. However, we found that those who are more uncertain place greater weight on the signals that they receive. It seems that other forces are at play too, such as short-term dynamics, which are somewhat related to prices and large shocks, in our case a shock to the exchange rate.

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A Appendix

A.1 Standard survey questions

Question about the number of staff: What is the number of staff (full-time equivalents) in your company?

Question about export share: What is the percentage of turnover exported (share of turnover ex Switzerland)?

Question about real turnover (year-on-year change): How has real turnover in the current month or quarter been until now, compared with the same period last year? Real turnover is:

- Substantially higher than in the previous year ("++")
- Slightly higher than in the previous year ("+")
- At the same level as in the previous year ("=")
- Slightly lower than in the previous year ("−")
- Substantially lower than in the previous year ("−−")

Question about real turnover (change from previous period): Disregarding specific seasonal factors, how has real turnover in the current quarter been by comparison with the previous quarter? Real turnover is:

- Substantially higher than in the previous quarter ("++")
- Slightly higher than in the previous quarter ("+")
- At the same level as in the previous quarter ("=")
- Slightly lower than in the previous quarter ("−")
- Substantially lower than in the previous quarter ("−−")

Question about capacity utilisation: Disregarding specific seasonal factors, how do you assess the current utilisation of technical capacity and infrastructure?

- Substantial overutilisation ("++")
- Slight overutilisation ("+")
- Optimal/normal utilisation or nearly optimal/normal utilisation ("=")
- Slight underutilisation ("−")
- Substantial underutilisation ("−−")

Question about profit margins: What is your assessment of your current margins?

- Considerably higher than usual ("++")
- Somewhat higher than usual ("+")
- At about the normal level ("=")
- Somewhat tighter than usual ("−")
- Considerably tighter than usual ("−−")

Question about staff level: Is your current staff level adequate?

- No, it is much too low ("++")

- No, it is somewhat low ("+")
- Our staff level is almost exactly right for our needs ("=")
- No, it is somewhat high ("−")
- No, it is much too high ("−−")

Question about recruitment: Have you hired staff recently? If so, how would you describe the recruitment of new staff at present?

- Considerably more difficult than usual ("++")
- Slightly more difficult than usual ("+")
- As time-consuming as usual ("=")
- Slightly easier than usual ("−")
- Considerably easier than usual ("−−")
- Not applicable

Question about turnover expectation: Compared to the current situation and disregarding specific seasonal factors, how will real turnover develop over the next two months?

- Substantially higher ("++")
- Slightly higher ("+")
- Unchanged ("=")
- Slightly lower ("−")
- Substantially lower ("−−")

Question about capacity utilisation expectation: Disregarding specific seasonal factors, what changes in technical capacity and infrastructure utilisation do you expect to occur over the next two months?

- Substantial increase ("++")
- Slight increase ("+")
- No change ("=")
- Slight decrease ("−")
- Substantial decrease ("−−")

Question about employment expectation: Compared to the current situation, and disregarding specific seasonal factors, how will staff numbers develop over the coming two months?

- They will be substantially higher ("++")
- They will be slightly higher ("+")
- They will remain unchanged ("=")
- They will be slightly lower ("−")
- They will be substantially lower ("−−")

Question about purchase price expectations: How do you expect your purchase prices to change over the coming six months?

- Substantial increase in the price level ("++")
- Slight increase in the price level ("+")
- Unchanged price level ("=")
- Slight fall in the price level ("−")
- Substantial fall in the price level ("−−")
- Not applicable

Question about sales prices expectation: How will your sales prices change over the coming six months?

- We will increase our prices significantly ("++")
- We will increase our prices slightly ("+")
- Our prices will remain unchanged ("=")
- We will reduce our prices slightly ("−")
- We will reduce our prices significantly ("−−")
- Not applicable

Question about equipment investment expectation: How will your real expenditure on equipment investment in the next twelve months compare with the past twelve months?

- It will increase substantially ("++")
- It will increase slightly ("+")
- It will remain unchanged ("=")
- It will decrease slightly ("−")
- It will decrease substantially ("−−")
- Not applicable

Question about construction investment expectations: How will your real expenditures on construction investment in the next twelve months compare with the past twelve months?

- It will increase substantially ("++")
- It will increase slightly ("+")
- It will remain unchanged ("=")
- It will decrease slightly ("−")
- It will decrease substantially ("−−")
- Not applicable

Question about short-term inflation expectations: Where do you expect inflation – as measured by the CPI – to be in the next six to twelve months?

- From: ...% to ...% • No opinion

Question about long-term inflation expectations: Where do you expect inflation – as measured by the CPI – to be in 3-5 years?

- From: ...% to ...% • No opinion

A.2 Description of the data

Table A.1: Description of the number of observations in the survey pooled from Q3 2014 until Q4 2017.

Variable[1]	Total		Manufacturing		Construction		Services	
	N	NA[5]	N	NA[5]	N	NA[5]	N	NA[5]
Sectors/Industries	3123	-	1145	-	245	-	1733	-
Turnover, year-on-year change	3123	-	1145	-	245	-	1733	-
Turnover, change from previous period	3123	-	1145	-	245	-	1733	-
Capacity utilisation, current situation	3123	-	1145	-	245	-	1733	-
Profit margins, assessment of current margins	3123	-	1145	-	245	-	1733	-
Staff level, assessment	3123	-	1145	-	245	-	1733	-
Recruitment, assessment	2948	175	1051	94	235	10	1662	71
Expected turnover, over the next six months	3123	-	1145	-	245	-	1733	-
Expected capacity utilisation, over the next six months	3123	-	1145	-	245	-	1733	-
Expected employment, over the next six months	3123	-	1145	-	245	-	1733	-
Expected purchase prices, over the next six months	2994	129	1140	5	245	-	1609	124
Expected sale prices, over the next six months	3110	13	1143	2	245	-	1722	11
Expected equipment investment, real expenditure in the next 12 months	3112	11	1142	3	244	1	1726	7
Expected construction investment, real expenditures in the next 12 months	2431	692	1027	118	203	42	1201	532
Expected inflation,[2] in the next 6-12 months	2995	128	1094	51	232	13	1669	64
Expected inflation,[2] in 3-5 years	2875	248	1046	99	221	24	1608	125
Uncertainty concerning exp. inflation,[3] being in 3-5 years, outside the indicated range	2717	406	977	168	209	36	1531	202
Average rate of annual inflation,[4] over the previous 20 years	1100	1397	432	539	82	103	586	755

[1] Most of the questions in the survey provide ordered category responses from 1 to 5.
[2] The question requests a quantitative response.
[3] The question requests a likelihood between 0% and 100%.
[4] Pooled from Q2 2015 until Q4 2017, since the question was only introduced in Q2 2015
[5] NA stands for not applicable, which means that the respondent refused or was not able to provide an answer to the corresponding question.

A.3 Visual inspection of purchase, sales prices and uncertainty

Inflation expectations by purchase prices
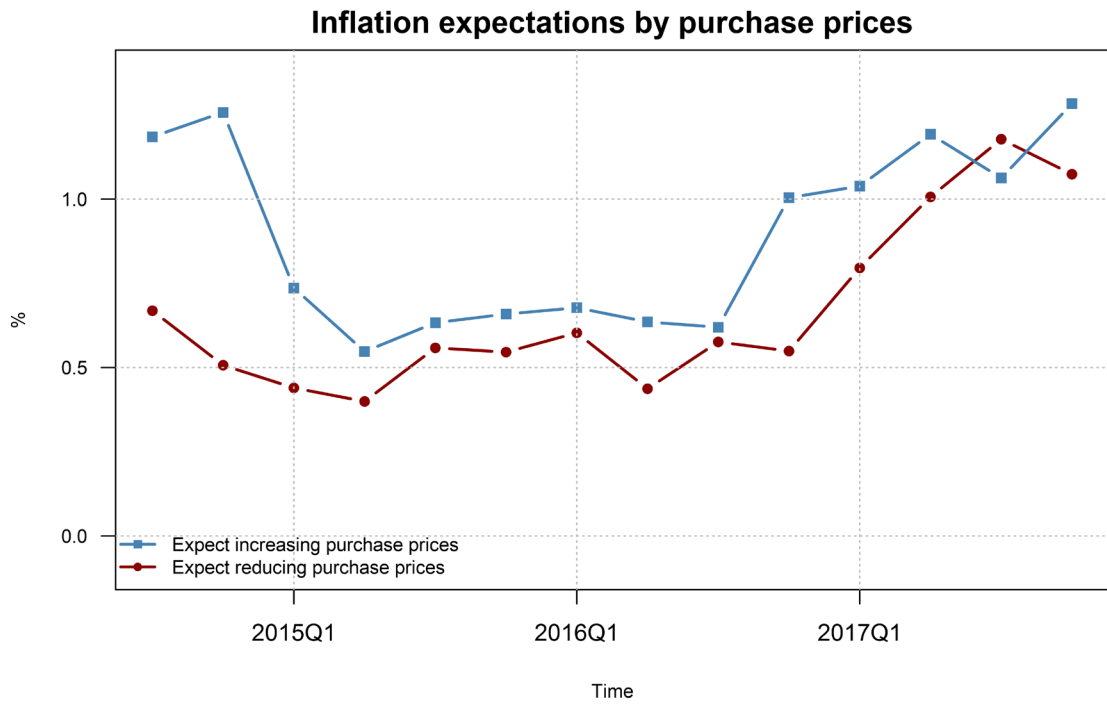
Figure A.1: Long-term inflation expectations by expected purchase prices.

Inflation expectations by sales prices
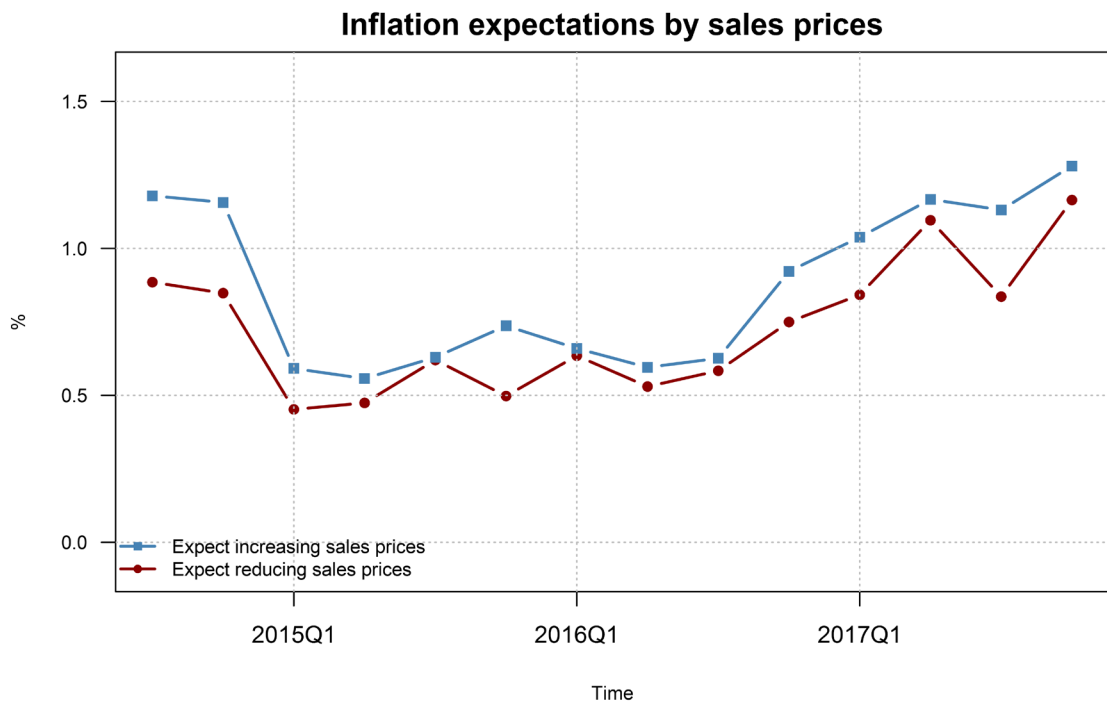
Figure A.2: Long-term inflation expectations by expected sales prices.
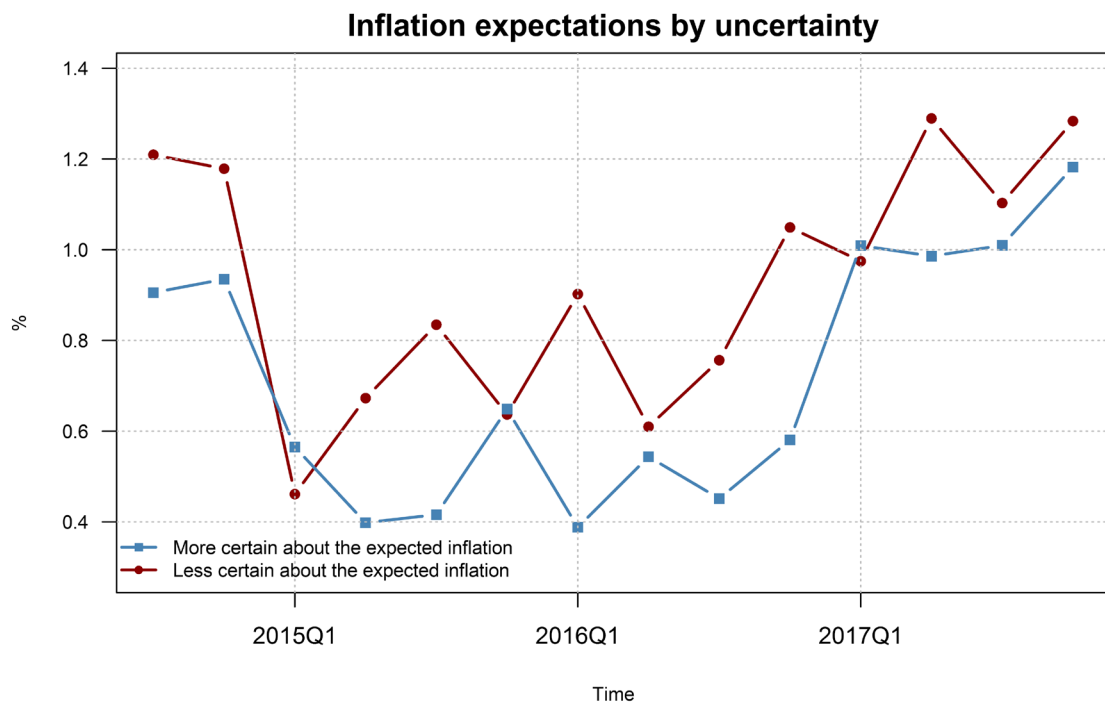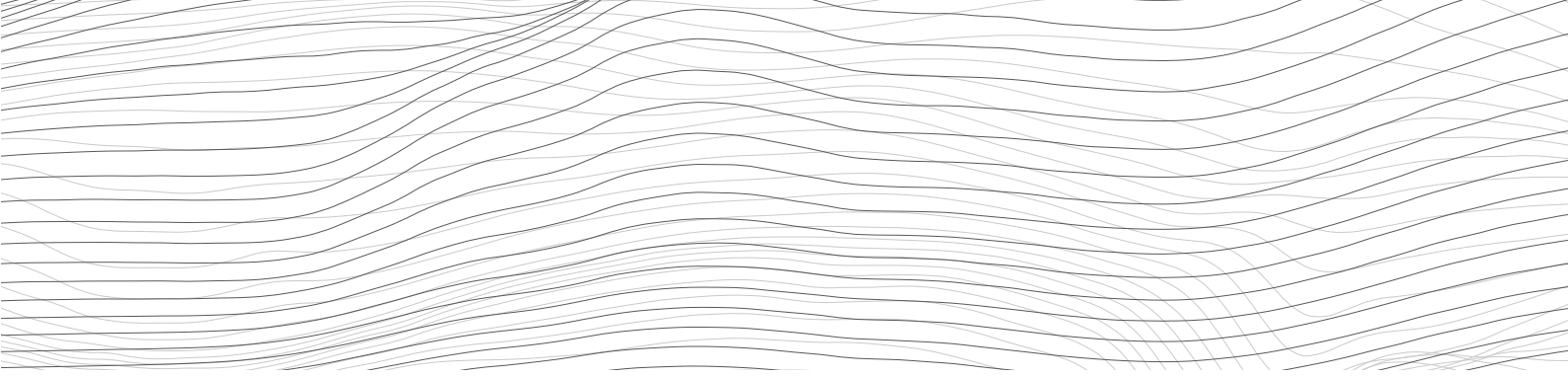
Figure A.3: Long-term inflation expectations by uncertainty.

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