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Inflation Perceptions and Expectations in Sweden - Are Media Reports the 'Missing Link'?

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Abstract

Using quantitative survey data from the Swedish Consumer Tendency Survey as well as a unique data set on media reports about inflation, we analyze the formation process of inflation perceptions and expectations as well as interrelations between the variables. Throughout the analysis, the role of media reports about inflation is emphasized and results for the low inflation period January 1998 to December 2007 are compared to those including the high inflation year 2008. Rejecting rationality, we find that perceptions, but not expectations, are affected asymmetrically by news, where media effects are generally stronger in times of high and volatile inflation. For the low inflation sample period, inflation expectations are more affected by shocks to perceptions than *vice versa*, but Granger causality runs from expectations to perceptions. Including more volatile inflation, we find more feed-back between the variables and a strong media effect especially on perceptions.

Keywords: Inflation expectations, inflation perceptions, media reports.

JEL classification: C32, E31, E37.

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1 Introduction

Ever since the rational expectations revolution in macroeconomics, policy makers have emphasized the importance of inflation expectations for monetary policy making. As a consequence, a large literature on the formation of inflation expectations has emerged and many economies have introduced implicit or explicit inflation targets in an attempt to anchor expectations around the target. Analyzing survey data of inflation expectations in Sweden and the US, Bryan and Palmqvist (2005) find indeed that the introduction of the inflation target in Sweden introduced a new focal point for expectations around the target, while a similar focal point does not exist for the US. Nevertheless, a number of studies reject rationality of inflation expectations, where forecasts fail either the condition of unbiasedness or of efficiency, or both.[1]

The analysis of inflation perceptions has received less attention in the literature, but more recently the large gap between actual and perceived inflation rates occurring in most Euro countries after the cash changeover has triggered a large literature.[2] Regarding the formation of inflation perceptions in general, Jonung and Laidler (1988) as well as Lein and Maag (2008) reject rationality of inflation perceptions for a panel of European countries. Similarly, Dräger et al. (2009) find evidence of loss aversion with respect to rising inflation and higher availability of price changes in frequently bought goods both before and after the Euro introduction. This finding implies that certain behavioral mechanisms might influence the formation of inflation perceptions, hence also questioning the concept of rationality.

While most theoretical models assume that agents form expectations based on observed actual inflation rates, the empirical observation of po-

[1] Studies that reject rationality of expectations include, *inter alia*, Batchelor and Dua (1987), Thomas (1999), Forsells and Kenny (2002), Mankiw et al. (2004), Dias et al. (2008) and Souleles (2004), where the latter uses micro survey data instead of aggregates.

[2] Explanations of the jump in perceptions range from price intransparencies (Dziuda and Mastrobuoni, 2005), difficulties in applying the conversion rates (Ehrmann, 2006), a perceptual crisis (Eife, 2006, Eife and Coombs, 2007, Fullone et al., 2007 and Blinder and Krueger, 2004), macroeconomic illiteracy (Del Giovane et al., 2008, Cestari et al., 2007), a media bias (Lamla and Lein, 2008) to behavioural biases such as expectancy confirmation (Traut-Mattausch et al., 2004) and loss aversion (Brachinger, 2006, 2008).

tentially large deviations between actual and perceived inflation rates raises the question of the relationship between expected and perceived inflation. The role they play in their respective formation process then becomes an important issue for policy makers and theoretical economists alike.

However, surprisingly little research has taken place regarding the nature of the relationship between expectations and perceptions on inflation. An early contribution, Jonung (1981) reports a significantly positive correlation coefficient between perceived and expected inflation of about 0.5, using an older version of the Swedish Consumer Tendency Survey. A similar result is also reported by van der Klaauw et al. (2008) for the US.

With regard to the direction of causality, a number of studies suggest that households often form inflation expectations based on their perception of past inflation. Analyzing qualitative responses of the 2008m2 issue of the Bank of England/GfK NOP Inflation Attitudes Survey, Benford and Driver (2008) report that almost 50% of respondents stated that inflation perceptions both over the past six months and over the past year and longer were 'very important' when forming expectations. More recently, Maag (2010) finds in a Gaussian mixture model using micro data from the Swedish Consumer Tendency Survey that about 51% of households form static inflation expectations on the basis of perceived inflation, while only 19% form forward-looking expectations based on actual inflation. Further evidence of inflation perceptions feeding into expectations is presented by Blanchflower and Kelly (2008) who report that groups with biased perceptions also form biased expectations.

However, there exists also empirical evidence of causality running from inflation expectations to perceptions: Traut-Mattausch et al. (2004) conduct experiments with restaurant menus denoted in Euro and in D-Mark and find that in all studies price trend perceptions are significantly biased towards price increases. This bias is not due to memory biases or inaccurate recall, but persists even when the original prices in the past are provided. The authors therefore attribute their finding to selective outcome correction resulting in the so-called 'expectancy confirmation hypothesis': Agents that expect prices to rise, will also perceive the price increases since calculation errors are more thoroughly corrected when they disconfirm the initial expectations than otherwise. This finding thus points to a possible direction of causality from expectations to perceptions. Evidence in line with expectancy confirmation in the context of inflation is also provided by Fluch and Stix (2005), Koskimäki (2005) and Hofmann et al. (2007).

These empirical results are integrated into a conceptual framework in Ranyard et al. (2008), specifying the relationship between individuals and their socio-economic environment. The authors hypothesize that inflation perceptions are influenced by the direct experience of price changes and also by social amplification via the media or word of mouth. Via agents' spending behavior, inflation perceptions then feed back into actual and expected inflation rates. Inflation expectations, on the other hand, are based on inflation perceptions and economic forecasts and may also be influenced by social amplification. Finally, expectations feed back into actual inflation through saving, spending and investment decisions.

In line with the importance of social amplification on the Ranyard et al. (2008) model, in his epidemiology model Carroll (2001, 2003) proposes the media to be the most important source of information about inflation developments, linking the intensity of news reporting to the share of agents using the most recent information set in a sticky-information setting à la Mankiw and Reis (2002, 2003, 2006, 2007). The empirical importance of media reports both as a transmission mechanism of information and as a possible cause for a bias in expectations and perceptions is also highlighted by Lamla and Lein (2008, 2010). Especially with regard to inflation expectations, the authors find using German survey data that the 'tone' of an article may bias expectations, as they react more strongly to negative news. Similarly, Soroka (2006) reports that the media themselves report negative news more extensively than positive news, resulting in asymmetric news coverage. Furthermore, media reports may influence the dispersion of inflation perceptions and expectations across households, as shown by Maag and Lamla (2009) and Badarinza and Buchmann (2009).

This paper adds to the literature by conducting an empirical analysis of the framework proposed in Ranyard et al. (2008). Thus, we aim at analyzing in detail the interrelation of inflation expectations and inflation perceptions by evaluating both their formation process and by investigating the direction of causality and feedback-effects between the variables, accounting for actual inflation. Throughout the analysis, special emphasis is given to the role of social amplification via media reports on inflation. Furthermore, we compare results for the case of a low-inflation regime, as seen in Sweden from January 1998 to December 2007, to those from extending the sample period to include high and volatile inflation caused by a price hike in energy and food prices in 2008. The study is conducted using monthly quantitative survey data of households' inflation expectations and perceptions from the Swedish Consumer Tendency Survey and a unique data set on media reports about inflation from the media research institute Mediatenor.

Results from both long-run single-equation and SVEC estimations suggest that in the stable inflation regime inflation expectations are formed on the basis of perceived, rather than actual, inflation, while perceptions are affected by lagged inflation and only to a lesser extent by expectations. Media reports about inflation generally seem to have only small effects. Granger causality runs from inflation expectations to perceptions both in the short and in the long run, suggesting that past expectations are predictive for perceptions. By contrast, once high and volatile inflation in 2008 is included into the sample period, we see more interaction between inflation perceptions and expectations, while actual inflation becomes less important. Furthermore, the media are found to exert a much stronger influence especially on inflation perceptions, where we find asymmetric media effects related to negative news. Granger causality tests also find reverse causation between inflation perceptions and expectations, as well as short-run causality from the media to perceived inflation.

The remainder of the paper is structured as follows: Data descriptions and initial test results for unit roots and cointegration are given in section 2. Section 3 presents results of rationality tests for inflation expectations and perceptions, as well as regressions evaluating the formation process and the role of media reports. The nature of interrelations between inflation expectations and perceptions is analyzed in Section 4, estimating SVEC models and testing for Granger causality. Finally, section 5 concludes.

2 Data Description and Unit Root Tests

2.1 Inflation Expectations and Perceptions

Data for monthly inflation perceptions and expectations is obtained from the Swedish Consumer Tendency Survey for the time-span January 1996 to March 2010. The survey has been conducted on a monthly basis since 1993, originally by Statistics Sweden, between 2002 and 2008 by GfK and since October 2009 by CMA Research AB. Responses from 1993 to 2001 have been processed by the National Institute of Economic Research, the responsible statistics agency, in order to ensure comparability with later surveys. During the first two weeks of each month, a random sample of about 1,500 indiviuals is interviewed via telephone, where the target population is the Swedish public aged 16 to 84.[3]

The Swedish Consumer Tendency survey coincides with the Joint Harmonized Consumer Survey conducted by the European Commission.[4] However, in addition to questions Q5 and Q6 asking for a qualitative measure of inflation perceptions and expectations, respectively, the Swedish survey additionally asks respondents for a quantitative evaluation of perceived and expected inflation. The questions asking for quantitative inflation perceptions and expectations read as follows:

5a-b. "Compared with 12 months ago, how much higher in percent do you think that prices are now? (Average)"

6a-b. "Compared with today, how much in percent do you think that prices will go up (i.e. the rate of inflation 12 months from now)?"

[3]For further information on the Swedish Consumer Tendency Survey and the full questionnaire, see www.konj.se. The survey is also discussed in detail in Palmqvist and Strömberg (2005).

[4]See European Commission (2008).

The quantitative questions are located in the questionnaire directly after the qualitative questions asking about "prices in general", so that the framing of the questions with regard to CPI inflation seems well identified. We use average responses to questions 5a-b. and 6a-b. as our measure of inflation perceptions (π^p) and inflation expectations (π^e), respectively.[5]

2.2 Media Data

The data on media reports about inflation is taken from a unique data set for Sweden assembled by the media research institute Mediatenor.[6] For the time-span of January 1998 to December 2008, all articles related to inflation that were published in the Swedish newspaper 'Svenska Dagbladet' were coded according to a codebook in line with the standards of media content analysis. The codebook comprises all details regarding the coding of the content of articles and allows for an objective and reproducible evaluation of the media content. Aspects of each article coded include, *inter alia*, placement in the newspaper, news source, country covered, tone of the article and aspect of inflation covered. Robustness of the data is achieved by continuous training of coding specialists as well as inter-coder reliability and sample quality tests, where articles are encoded by several analysts to ensure a high level of coding accuracy. For reasons of resource restrictions, not all media contents in Sweden could be coded. Therefore, the Dagbladet as the biggest newspaper in the country was chosen to represent the defining medium that other media sources rely on for information.

In addition to the total number of articles ($vol\_articles$) related to inflation in a given month, the data set comprises several more detailed variables:

- $vol^{\pi\ increase}$ – the number of articles dealing with increasing inflation.
- $vol^{\pi\ decrease}$ – the number of articles dealing with decreasing inflation.

[5] The Swedish Consumer Tendency survey does not provide the median of answers across respondents. Rather, mean responses corrected for extreme values of inflation perceptions and expectations are available. We checked for robustness of all our results with respect to the corrected measures. Since we found no significant changes in the results, we use the encompassing mean of all survey answers in the paper.

[6] See www.mediatenor.com.

- $vol^{\pi\ highlevel}$ – the number of articles dealing with high inflation.
- $vol^{\pi\ lowlevel}$ – the number of articles dealing with low inflation.
- $vol^{positive}$ – the number of articles written in a positive tone.
- $vol^{neutral}$ – the numer of articles written in a neutral tone.
- $vol^{negative}$ – the number of articles written in a negative tone.
- $vol^{housing}$ – the number of articles dealing with price changes in housing.
- vol^{food} – the number of articles dealing with price changes in food.
- vol^{energy} – the number of articles dealing with price changes in energy.

From these media variables, we constructed the following aggregates to be used as explanatory variables:

- $vol\_tone = vol_t^{\pi\ increase} + vol_t^{\pi\ decrease} + vol_t^{\pi\ highlevel} + vol_t^{\pi\ lowlevel}$
- $vol\_tone^{subj} = vol^{positive} + vol^{negative}$
- $vol\_energyfood = vol^{energy} + vol^{food}$

While the variable vol_tone contains all articles whose objective topic could induce households to interpret the article as good or bad news regarding inflation, the variable vol_tone^{subj} includes articles that subjectively suggest by the tone they are written in that the content of the article is either good or bad news. Thus, whereas the former variable could cause a bias if households are particularly averse to high or low inflation, the latter variable seems more likely to directly induce a bias by the implications of its subjective tone. However, vol_tone^{subj} should to some extent be intepreted cautiously as it contains the variables most likely prone to error by the coder. Finally, $vol\_energyfood$ summarizes articles on price changes that seem likely to have a particulary strong effect on inflation expectations and perceptions: Both price changes in food and in energy usually cause wide public discussions. While price changes in food items might particularly affect inflation perceptions due to the availability effect, price changes in energy could serve as a business cycle indicator for inflation expectations. Note that the media variables are not mutually exclusive since one article may belong to several media categories.

< Figure 1 here >

Figure 1 depicts quantitative inflation perceptions and expectations from the Swedish Consumer Tendency Survey together with actual HICP inflation and the total volume of articles about inflation from our Mediatenor data set. It seems that over the sample period perceptions and expectations generally moved closely together and also in line with actual inflation. Nevertheless, from 2003 onwards perceptions and expectations were consistently higher than actual inflation, with perceptions being closer to actual inflation than expectations from 2006m1 - 2007m11. When food and energy prices pushed up inflation from December 2007 onwards, a rapid increase in both perceptions and expectations occurred.[7] The spike was particularly strong for perceptions and did not match actual inflation rates. The volume of articles on inflation shows a similar pattern: We see a strong increase in media coverage on inflation in 2008, while beforehand the number of articles was relatively stable. The strong media coverage about inflation in 2008 continued as actual inflation rates fell dramatically when the financial crisis took hold. A few spikes in the number of articles mark periods of increasing or declining inflation rate, where the outlier at the end of 1999 could be due to a strong increase of oil prices during that period.

< Figure 2 here >

[7]While the spike in inflation, perceptions and expectations at the end of the sample period is an obvious outlier, a recursive Chow test also finds a structural break at the end of 2003, when perceptions and expectations started to remain higher than actual inflation. Hence, we checked for robustness of our results when splitting the sample in 2003m12 instead of estimating models including or excluding the spike in 2008. However, we found that results did not differ dramatically and indeed seem to be driven by events in the last year of the sample. For ease of exposition, we therefore compare results for the recursive samples 1998m1 - 2007m12 and 1998m1 - 2008m12 throughout.

Plotting perceptions and expectations together with the number of articles with a subjective positive or negative tone summarized in the variable vol_tone^{subj}, it seems that inflation perceptions, and to a slightly lesser extent also expectations, are positively correlated with articles written in a negative tone and negatively correlated with articles that have a positive tone. Overall, news about inflation seem to be predominantly depicted as negative, rather than positive, news. Nevertheless, the period of low perceptions and expectations at the beginning of the sample, as well as the sharp drop after the spike before the financial crisis, are both accompanied by a higher number of articles with a positive tone regarding inflation.

2.3 Macro Data

In addition to the data on expectations, perceptions and media reports, we use a number of control variables in our analysis. Actual monthly inflation rates (π) are constructed from the harmonized consumer price index for Sweden, from which we calculate year-on-year inflation rates. The timing of the inflation series thus coincides with the rate of inflation asked for in the Consumer Tendency Survey.

Additional macroeconomic and monetary aggregates are an indicator of industrial production ($prod^{industry}$), the harmonized monthly unemployment rate (U), long-term interest rates defined as the 10-year yield on government bonds (i^{long}), short-term interest rates defined as 3-months treasury bills (i^{short}) and the growth rate of money supply M2 ($m2$). All variables are obtained from the OECD Main Economic Indicators Database and are available for the sample period February 1998 to January 2010.

2.4 Unit Roots and Cointegration

Before proceeding to the econometric analysis, we test all variables for unit roots in order to avoid spurious results. Table A.1 in the appendix summarizes results of unit root tests for actual, expected and perceived inflation, as well as for the volume of media articles.[8] Apart from the standard augmented Dickey-Fuller (ADF) test for a unit root developed by Dickey and Fuller (1979), we also conducted a GLS-detrended version of the Dickey-Fuller test (DF GLS) proposed in Elliott et al. (1996) and the Phillips and Perron (1988) (PP) test for a unit root. Additionally, Table A.1 reports values of the Kwiatkowski et al. (1992) (KPSS) test that tests for the null hypothesis of stationarity as opposed to the null of a unit root. All tests were conducted with a constant, but excluding a linear trend. Approximate p-values for the ADF and PP test statistics are from MacKinnon (1994).

The ADF test of Dickey and Fuller (1979) tests for the null hypothesis of a unit root by estimating the regression

$$\Delta y_t = \alpha y_{t-1} + x_t'\delta + \beta_1 \Delta y_{t-2} + ... + \beta_p \Delta y_{t-p} + \epsilon_t, \tag{1}$$

where x_t denotes a vector of exogenous variables that may include a constant and a linear time-trend. The null hypothesis of a unit root is then tested as $H_0 : \alpha = 0$ against the alternative $H_1 : \alpha < 0$. The DF GLS test from Elliott et al. (1996) estimates the ADF test statistic in 1 using data that have been detrended by substracting $x_t'\hat{\delta}$, where $\hat{\delta}$ is the coefficient of a GLS estimation of Δy_t on Δx_t. Phillips and Perron (1988) use the standard Dickey-Fuller test regression excluding additional lagged differences of y_t and control for autocorrelation by using Newey-West standard errors when calculating the test statistic. The Kwiatkowski et al. (1992) KPSS test analyzes the reversed null of (trend) stationarity by regressing the variable in question on a constant (and a time trend) and testing for stationarity of the partial sums of the residuals, which under the null should be integrated of order one.

From Table A.1 we see that all tests reject the null hypothesis of a unit root in the media variable *vol_articles* (i.e. cannot reject the null of stationarity), where the same result of stationarity applies to all other media

[8]The remaining media variables were also tested for unit roots, but results were in line with those for *vol_articles*. With respect to macro and money aggregates, we found a unit root in $prod^{industry}$, U, i^{long} and i^{short} and therefore use differences of these variables in all regressions. Results for the unit root tests are not reported here due to space limitations, but can be obtained from the author upon request.

variables. With respect to actual, perceived and expected inflation, results are less clear-cut: In the case of actual inflation π, both the ADF and the DF GLS test cannot reject the null of a unit root, while the PP test rejects at the 10% level and the KPSS test cannot reject the null of stationarity at the 5% level. For perceived inflation π^p, all unit root tests fail to reject the null of a unit root, while the KPSS test rejects the null of stationarity at the 5% level. By contrast, both the ADF and the PP test suggest inflation expectations π^e to be stationary, as the null hypothesis is rejected at the 5% level. However, the DF GLS test cannot reject at this significance level and also the KPSS test rejects the null of stationarity at the 5% level. Thus, there is some evidence of non-stationarity for actual, perceived and expected inflation during the time span analyzed here.

Hence, we proceed to estimate Johansen (1991, 1995) tests of cointegration between the variables. The tests are conducted in the framework of a vector error correction model (VECM) of the form

$$\Delta y_t = \Pi y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-i} + B x_t + \epsilon_t, \tag{2}$$

where y_t is a k-vector of nonstationary endogenous variables, x_t is a vector of exogenous variables and Π, Γ_i and B are coefficient matrices. Granger's representation theorem then states that if the coefficient matrix Π has reduced rank $r < k$, then there exist r cointegration relations between the variables in y_t such that $\Pi = \alpha\beta'$ and each column in β represents a cointegrating vector.

Table A.2 in the appendix presents both trace statistics and maximum eigenvalue statistics of the Johansen (1991, 1995) cointegration tests for bivariate cointegration between the pairs (π^e, π^p), (π, π^e) and (π, π^p) as well as tests for trivariate cointegration between (π, π^e, π^p). All tests for bivariate cointegration reject the null hypothesis of no cointegration (rank 0) at the 1% level, but show much smaller test statistics when testing for the null of 1 cointegration relationship (rank 1). Although the test statistic is still above the 5% critical value, the tests nevertheless indicate the existence of a cointegration relationship between the variables. Similarly, when testing for cointegration in the trivariate VECM including actual, perceived and expected inflation, we find evidence of two cointegrating relations between the variables. We thus conclude that while there is some evidence of non-stationarity regarding actual, perceived and expected inflation, it seems that all three variables are cointegrated. This result is in line with findings in Lein and Maag (2008) and Dräger et al. (2009) who find evidence of panel-cointegration between actual and perceived inflation for European samples. For the empirical analysis, estimations are hence done either in levels, specifying long-run relationships, or in the framework of error correction models.

3 The Formation Process of Inflation Perceptions and Expectations

In this section, we analyze the formation process of inflation perceptions and expectations. First, we evaluate the concept of rationality by testing for accuracy, a bias and efficiency in perceived and expected inflation. Second, results of single-equation models describing long-term relations between perceptions and expectations and the role of media reports on inflation are presented.

3.1 Rationality Tests

In line with the literature, we test for rationality of inflation perceptions and expectations by evaluating three different aspects of rationality, namely accuracy, unbiasedness and efficiency: First, both perceptions and expectations should be as accurate as possible with respect to actual present and future values of inflation, respectively. We analyze accuracy by reporting mean absolute errors (MAE) and root mean squared errors (RMSE), which are normalized by average inflation over the sample period. In comparison with the MAE, the RMSE emphasizes the effect of large forecast errors.[9]

[9]Batchelor and Dua (1987), Thomas (1999) and Forsells and Kenny (2002) test for accuracy of inflation expectations in the UK, the US and the Euro area, respectively. Lein and Maag (2008) analyze MAE and RMSE of inflation perceptions for a sample of

Next, we test for a bias with respect to inflation perceptions and expectations, respectively. Under the null hypothesis of no bias, today's inflation perceptions as well as inflation expectations one year ago should be an unbiased predictor of today's actual inflation rate. Hence, we estimate the regressions

$$\pi_t = \alpha + \beta\pi_t^p + \epsilon_t \tag{3}$$

$$\pi_t = \alpha + \beta\pi_{t-12}^e + \epsilon_t \tag{4}$$

and test for the joint null hypothesis $H_0 : (\alpha, \beta) = (0, 1)$. In order to account for the cointegration between π and π^p or π^e, respectively, we estimate (3) and (4) in a vector error correction model (VECM) and test for H_0 regarding the cointegration relations contained in the cointegrating vector. The test is conducted with a Wald test estimated using the Johansen Maximum Likelihood estimator. Furthermore, we present results of Wilcoxon (1945) signed-rank tests for the null hypothesis if $H_0 : \pi_t = \pi_t^p$ and $H_0 : \pi_t = \pi_{t-12}^e$, respectively.[10] With the advantage of being unaffected by non-normal distributions, this non-parametric test procedure tests for the equality of matched pairs of observations by assuming that both distributions are the same. After forming differences between the variables, they are ranked according to their absolute value and then signed with the sign of the original difference. The test statistic is given either by the sum of positive or negative signed ranks, depending on which is smallest.[11]

Finally, we complete the rationality tests by evaluating whether perceptions and expectations efficiently incorporate available information. Differentiating between the concepts of weak-form and strong-form efficiency, we first test if perception or expectation errors are persistent or significantly cor-

European countries including Sweden.

[10] Dufour (1981) presents a similar non-parametric test for serial dependence.

[11] Most studies cited above that analyze the rationality of inflation perceptions and expectations test for a bias in a regression set-up as in equations (3) and (4). However, only Dias et al. (2008) account for the non-stationarity and cointegration of inflation expectations and actual inflation.

related with lagged inflation rates. Second, strong-form efficiency is tested by regressing errors on a larger set of macroeconomic and monetary aggregates. All variables are lagged by 13 months in order to exclude the possibility of overlapping errors within the 12-month horizon of forecasts/backcasts and to allow for one publication lag: In the case of forward-looking expectations 12 months ahead, a random forecast error in a particular month would also be included in the subsequent 11 forecasts, since only then actual inflation rates are revealed. By contrast, since perceptions are backcasts of inflation over the past 12 months, any error could in principle be corrected as actual inflation rates become available each month. However, this imposes a rather strict concept of rationality on inflation perceptions, therefore, we relax the test by only including variables with a lag of 13 months.[12]

To avoid spurious results, we use first differences of all variables that were found to be non-stationary.[13] Estimation results are presented with Newey-West standard errors that are robust to serial correlation and heteroscedasticity in the residuals. We present results of the rationality tests for the whole sample period 1998m1 - 2008m12, since test results for the low-inflation period 1998m1 - 2007m12 did not differ significantly.[14]

< Table 1 here >

Table 1 presents results of the three rationality tests for inflation perceptions in Sweden. Both the normalized MAE (0.40) and RMSE (0.52) are relatively high, considering that inflation perceptions are based on actual inflation and should thus be less prone to inaccuracy than inflation expectations. Lein and Maag (2008) report similar results using Swedish data for the time span of 1993 - 2007. With respect to a bias in perceptions, both

[12]Weak-form or strong-form efficiency with respect to inflation expectations is also tested by Batchelor and Dua (1987) for the UK, by Thomas (1999), Mankiw et al. (2004) and Souleles (2004) for the UK as well as by Forsells and Kenny (2002) and Dias et al. (2008) for European economies. Jonung and Laidler (1988) as well as Lein and Maag (2008) test for strong-form efficiency of inflation perceptions.

[13]For unit root tests on actual, perceived and expected inflation as well as $vol\_articles$, see table A.1 in the appendix. Test results of unit root tests on the remaining variables are available from the author upon request.

[14]Results are available from the author upon request.

the Wald test from a VECM estimation and the non-parametric Wilcoxon signed-rank test reject the null hypothesis of no bias in inflation perceptions at the 1% level. In line with the results regarding accuracy, it thus seems that inflation perceptions in Sweden do not relate one-to-one to actual inflation. Finally, we find evidence of both weak- and strong-form inefficiency: While perception errors are not significantly correlated with errors 13 months ago, changes in actual inflation in t-13 significantly reduce perception errors. This finding remains robust when we include a larger set of explanatory variables. Additionally, we find that past information about changes in long-term interest rate significantly reduces perception errors.

< Table 2 here >

Results of the rationality tests for inflation expectations in Sweden are given in Table 2. Regarding the accuracy of inflation forecasts, both the MAE (0.48) and RMSE (0.60) are larger than those found with respect to perceptions. This is not surprising, since inflation expectations are formed with respect to an uncertain future, while perceptions relate to actual values of inflation. Nevertheless, these values indicate that also inflation expectations are to some degree formed inaccurately. Testing for a bias in inflation expectations, both the Wald test in a VECM setting and the Wilcoxon signed-rank test reject the null of no bias at the 1% level. However, in contrast to our results for inflation perceptions, we find little evidence of inefficiency of expectations. Only changes in short-term interest rates 13 months ago yield a weakly significant coefficient, albeit with a positive coefficient.

3.2 Inflation Perceptions and Expectations and the Role of Media Reports

After having rejected rationality, we turn to analyzing the formation process of perceptions and expectations in more detail. Specifically, we analyze correlations between the variables and actual inflation as well as the role of media reports on inflation, where we distinguish between different aspects of media reports on inflation. We estimate all regressions in levels, so that results may be regarded as long-term relationships and should be super-consistent due to cointegration between the inflation variables. A lagged endogenous variable is included in all models in order to account for the persistence of the variables.

Since the survey interviews are conducted in the first two weeks of each month, official statistics for that month's inflation rate might not yet be available and media articles of that month could be published also after the interviews. In order to avoid any bias due to publication lag, we thus lag actual inflation and all media variables by one month.

Furthermore, endogeneity tests suggest an endogeneity problem with respect to inflation perceptions and expectations, respectively. The test shown in Tables 3 to 6 analyzes the null that a specified endogenous regressor can be treated as exogenous. It is constructed as the difference of the Hansen-Sargent statistics from two models, where the regressor is treated as endogenous or as exogenous, respectively, and has a $\chi^2(1)$ distribution. In response to the results, we estimate all models using the general method of moments (GMM) estimator and instrumenting for inflation expectations and perceptions, respectively, with their first and twelfth lags. Generally, the underidentification test showing the Kleibergen and Paap (2006) LM statistic for the null that excluded instruments are not correlated with the endogenous regressor can be rejected or misses significance only marginally, while the Hansen (1982) J statistic cannot reject the null hypothesis that all instruments are valid in the sense that they are uncorrelated with the error term. Standard errors reported are robust to heteroscedasticity and autocorrelation. For models containing only past inflation as explanatory variable, we employ the OLS estimator with Newey-West standard errors. All results are compared for estimation periods covering the low-inflation period 1998m1 - 2007m12 to those for an extended sample period including the high-inflation year 2008.

< Table 3 here >

< Table 4 here >

Tables 3 and 4 show estimation results of single-equation models explaining inflation perceptions in Sweden. For the estimation period 1998m1 - 2007m12, results suggest that inflation perceptions are based largely on lagged actual inflation, while (instrumented) inflation expecations and media reports play no significant role. However, when extending the sample to include the high-inflation period in 2008, we find that both expected and lagged actual inflation rates significantly and positively affect perceived inflation, suggesting some form of expectancy confirmation behavior as in Traut-Mattausch et al. (2004).

Regarding the effect of media reports about inflation on perceptions in the extended sample 1998m1 - 2008m12, we find that the volume of articles on inflation significantly raises inflation perceptions, albeit with a small coefficient. However, when distinguishing between the effects of media reports on rising, falling, high and low inflation, we find that only 'bad news' reporting either increasing or a high level of inflation significantly raise inflation perceptions, while coefficients on articles about falling or low inflation remain insignificant. This result could be related to households' loss aversion with respect to above-average inflation as analyzed in Dräger et al. (2009), which might lead to an asymmetric perception of media news that can bias perceptions.[15] Similarly, articles with a negative tone have a significantly positive coefficient, while the coefficient on articles with a positive tone is not significant, albeit negatively signed. However, neutral articles are also found to significantly reduce inflation perceptions. Finally, articles related to price changes of food items significantly increase inflation perceptions. This result could be indicative of the higher availability of price changes in frequently bought goods: As hypothesized in Brachinger (2006, 2008), agents will perceive price changes more strongly, the more often they buy a particular product. Hence, media reports on food-related inflation might trigger the availability effect, thus producing a further media-related bias to perceptions.[16] Overall, it thus seems that when accounting for periods of high and

[15] Note that coefficients on $vol^{\pi\ increase}_{t-1}$ and $vol^{\pi\ decrease}_{t-1}$, as well as on $vol^{\pi\ highlevel}_{t-1}$ and $vol^{\pi\ lowlevel}_{t-1}$, are not statistically different from each other. However, only the former are significantly different from zero, while the latter have no significant impact on perceptions.

[16] Empirical evidence of the availability effect on inflation perceptions is given in Döhring

volatile inflation, perceived inflation rates are influenced significantly, and possibly biased, by the media.

< Table 5 here >

< Table 6 here >

Estimation results for the formation process of inflation expectations are given in Tables 5 and 6. Regarding the stable inflation regime until 2007, we find that inflation expectations are significantly correlated with their respective perceptions of inflation, while lagged actual rates play no role. The result that inflation expectations are largely based on perceptions is in line with findings in Jonung (1981), van der Klaauw et al. (2008) and Maag (2010). However, once we include the period of high inflation rates in 2008, estimation results show that lagged actual inflation rates in most models significantly affect expectations, while perceptions remain insignificant.[17]

Regarding the role of media reports for inflation expectations, we find some media effects already in the low-inflation regime: Inflation expectations increase with the number of articles on increasing inflation and on housing prices. While the number of articles on low inflation has a significantly dampening effect on expectations, the effect of articles about decreasing inflation is wrongly signed with a positive coefficient. Extending the sample period until 2008m12, in addition to the effects of articles about increasing or low level inflation, we find a similar effect of news with a positive or negative tone. Overall, it thus seems that inflation expectations in Sweden are not affected asymmetrically by media reports, in contrast to inflation perceptions.[18] Finally, including the high inflation year 2008, media reports on energy price changes seem to trigger a reduction in inflation expectations, while articles about food prices have a positive impact on expectations. Note that news about longer lasting housing price changes affected forward-looking inflation

and Mordonu (2007), Lein and Maag (2008) and Dräger et al. (2009).

[17]Note that the decrease in centred R^2 from model (1) to models (3), (4), (6) and (7) is due to changes in the significance of the constant, which is not reported here.

[18]This result is in contrast to findings in Lamla and Lein (2008), who find that German inflation expectations reacted more strongly to negative news.

expectations in the low-inflation regime, while short-run volatility in food and energy prices only has an impact when including the high-inflation period.

4 Interrelations between Inflation Perceptions and Expectations

After the analysis of the formation process of inflation perceptions and expectations in the previous section, we turn to evaluating the nature of their interrelation. We analyze the cointegration relation as well as impulse-response functions and forecast error variance decompositions in a structural vector error correction (SVEC) model and present tests for long- and short-run Granger causality.

4.1 SVEC Estimations

Accounting for the cointegration between actual, perceived and expected inflation, we analyze interrelations of π, π^p, π^e and $vol\_articles$ by evaluating impulse-response functions and forecast error variance decompositions (FEVD) from an SVEC model. The model is estimated in a two-stage procedure, where the cointegration vector, assuming two cointegration relations, is estimated with the simple two step estimator (S2S) in the first stage and the remaining coefficients of the SVEC model are estimated with OLS in the second stage. In line with the information criteria, all models are estimated with 2 lags and including a constant and seasonal dummies.[19]

The SVEC model thus takes on the following form:

$$\Delta y_t = \alpha\beta' y_{t-1} + \Gamma_1 \Delta y_{t-1} + \Gamma_2 \Delta y_{t-2} + C_0 D_t + u_t, \tag{5}$$

where $y_t = \begin{pmatrix} \pi_t & \pi_t^p & \pi_t^e & vol\_articles_t \end{pmatrix}'$ is the vector of endogenous variables, D_t includes the constant and seasonal dummies and u_t is the vector

[19]The VECM models satisfy stability conditions and we find no evidence of autocorrelation or heteroscedasticity in the residuals. Test results are available from the author upon request.

of reduced-form residuals. The cointegration relations between the variables are estimated in the matrix β, where the first column excludes actual inflation π_t and the second column excludes perceived inflation π_t^p. The first coefficient of each cointegration relation is normalized to 1. α contains the loading coefficients and Γ_1, Γ_2 and C_0 are coefficient matrices.

< Table 7 here >

The coefficients governing the cointegration relation between actual, perceived and expected inflation, as well as media reports about inflation, are shown in Table 7 for the two sample periods. As expected, we find cointegration between inflation perceptions and expectations, as well as between actual and expected inflation, in both models: Coefficients of the cointegration relation between perceived and expected inflation in β_1 suggest a onte-to-one cointegration relation between the variables, as the coefficient of π_{t-1}^e is found highly significant and close to -1. In fact, a Wald test using the Johansen ML estimator cannot reject the restriction $\beta(3,1) = -1$ in the model for the sample period 1998m1 - 2007m12, so that we restrict the coefficient in order to increase efficiency of the estimation. Regarding the second cointegration relation between actual and expected inflation, both models find highly significant coefficients of π_{t-1}^e, while the coefficient of π_{t-1} is again normalized to 1. As expected, the volume of articles on inflation does not feature significantly in either cointegration relation for the stable inflation period, but a Wald test rejects restricting the coefficients to zero. However, it is interesting to note that a significant, albeit small, coefficient of $vol\_articles_{t-1}$ is found in cointegration relation between π^p and π^e when extending the sample to include the high inflation year 2008.

Analyzing the loading coefficients contained in α, we use a sequential elimination of regressors (SER) procedure based on the Akaike information criterion to restrict those loading coefficients to zero that lead to the largest reduction in the information criterion. Regarding the cointegration relation between perceived and expected inflation, we find that only π_{t-1}^p yields a significant loading coefficient in the shorter sample period, suggesting that actual and expected inflation and the media were weakly exogenous. However, extending the sample period, we find a weakly significant negative loading coefficent also for π^e_{t-1} and a large positive coefficient for $vol\_articles_{t-1}$. It thus seems that including the spike in actual, perceived and expected inflation in 2008 leads both π^p and π^e to adjust to the long-run cointegration equilibrium, while the media have a divergent effect. Nevertheless, the SVEC model remains stable.[20] Finally, loading coefficients for the second cointegration relation between actual and perceived inflation remain similar between both models, with only actual inflation adjusting to the long-run equilibrium.

In order to identify impulse-response functions and FEVD, we impose restrictions on the contemporary relations between the endogenous variables with a Cholesky-decomposition of the following form:

$$\begin{pmatrix} u_t^{\pi} \\ u_t^{\pi^p} \\ u_t^{\pi^e} \\ u_t^{vol\_articles} \end{pmatrix} = \begin{pmatrix} b_{11} & 0 & 0 & 0 \\ b_{21} & b_{22} & 0 & 0 \\ b_{31} & b_{32} & b_{33} & 0 \\ b_{41} & b_{42} & b_{43} & b_{44} \end{pmatrix} \begin{pmatrix} \varepsilon_t^{\pi} \\ \varepsilon_t^{\pi^p} \\ \varepsilon_t^{\pi^e} \\ \varepsilon_t^{vol\_articles} \end{pmatrix} \tag{6}$$

where u_t denotes the vector of reduced-form residuals and ε_t the vector of structural shocks. The identification is chosen based on theoretical and empirical observations: We argue that actual inflation is unlikely to be affected by perceived and expected inflation rates (or the media) in the same month due to the generally observed stickiness of prices incorporated into most modern macroeconomic models, see Calvo (1983). Also, since several authors find empirical evidence that inflation expectations are largely formed on the basis of perceived inflation (see, e.g., Benford and Driver, 2008 and Maag, 2010), we allow for a contemporaneous effect of perceptions on expectations, but not *vice versa*. Finally, in order to account for a possible publication-lag, we only allow lagged effects of media reports on actual, perceived and expected inflation.

[20]The finding of changes in the cointegration relation between inflation perceptions and expectations between the two sample periods could be captured in a model with threshold cointegration as suggested by Hansen and Seo (2002). However, since the break is at the end of the sample period, it would be difficult to identify without further datapoints and we would have to make a decision whether to restrict α or β. We leave this question for future research.

$<$ *Figure 3 here* $>$

$<$ *Figure 4 here* $>$

Figures 3 and 4 show impulse-response functions of π, π^p, π^e and $vol\_articles$ over 30 months for the two sample periods, where 95% confidence intervals were generated with 1000 bootstrap-replications using Hall's percentile interval. Calculating impulse-response functions for the stable inflation regime, as expected a one-standard-deviation increase of actual inflation causes both inflation perceptions and expectations to rise, while the media are not affected.[21] Similarly, a shock on perceived inflation causes a persistent increase of actual and expected inflation, while impulse-responses of actual and perceived inflation after a shock to expectations build up more slowly. Regarding $vol\_articles$, we find no significant effect of an unexpected rise in media reports on inflation expectations, but a small, weakly significant, negative effect on actual and perceived inflation.

By contrast, we see more interaction between perceptions, expectations and the media once the high inflation year 2008 is included in the sample period: Impulse-response functions suggest stronger effects of shocks to expectations on both perceived and actual inflation, as impulse-responses build up more quickly. Notably, the effect of shocks on actual inflation is reduced in the extended sample period, as impulse-responses of perceptions and expectations become insignificant after a few months. Finally, the stronger effect of media reports when accounting for higher inflation in 2008 also features in the impulse-response functions, where especially π^p (and π) increase significantly after a media shock, with only a small effect on π^e.

$<$ *Table 8 here* $>$

Finally, forecast error variance decompositions are presented in Table 8 for both sample periods. Due to the identification of the model, the forecast

[21] Note that a permanent effect of temporary shocks on the level variables is not surprising, since actual, perceived and expected inflation rates are non-stationary. Hence, while the SVEC model is estimated in first differences, shocks may lead to permanent level shifts of the non-stationary variables, as first differences return to zero when the shock dies out. By contrast, shocks on the stationary media variable have no significant long-run effects.

error variance of inflation is unaffected by other variables in the very short run, but in the longer run both perceived and expected inflation account for about 25% and 19%, respectively. While perceived inflation also remains largely exogenous in the short run, at a longer horizon especially inflation expectations account for almost 30% of its forecast error variance, while actual inflation explains about 23% and the media only have a small effect. Expected inflation is also affected more strongly by perceived, rather than actual, inflation, as almost 35% of its forecast error variance is due to π^p already in the short run. Finally, the media appear largely exogenous in the earlier sample period.

Including high inflation in 2008, in line with impulse-responses we find an increased role of expected inflation and the media for both actual and perceived inflation: While expectations become very important for actual inflation, explaining up to 42% of its forecast error variance in the longer run, both expectations and the media become dominant for perceptions, each explaining almost 30% of its forecast error variance. As the strong effect of perceptions on expectations remains valid also in the extended model, results suggest more interaction between perceived and expected inflation in the extended sample. By contrast, the impact of actual inflation is reduced, however, inflation itself becomes more sensitive to perceptions, expectations and the media. Finally, we find some feedback also between the media and inflation perceptions, as the strong effect of media reports on perceptions is mirrored to some extent by perceptions explaining up to 13% of forecast error variance in $vol\_articles$.

4.2 Granger Causality

After evaluating the dynamics between actual, perceived and expected inflation as well as the media in the SVEC estimations, we also test for Granger causality between the variables.

Causality tests are conducted in a vector error correction (VECM) framework, which allows to test for both long- and short-run causality between the variables, as in Mosconi and Giannini (1992) and Kirchgässner and Wolters

(2007).[22] Assuming two endogenous variables y_t^1 and y_t^2, the model takes the following form:

$$\begin{pmatrix} \Delta y_t^1 \\ \Delta y_t^2 \end{pmatrix} = \begin{pmatrix} \gamma_1 \\ \gamma_2 \end{pmatrix} \begin{pmatrix} ecm_{t-1} \end{pmatrix} + \sum_{i=1}^{p} \begin{pmatrix} a_i^{11} & a_i^{12} \\ a_i^{21} & a_i^{22} \end{pmatrix} \begin{pmatrix} \Delta y_{t-i}^1 \\ \Delta y_{t-i}^2 \end{pmatrix} + CD_t + \begin{pmatrix} \varepsilon_t^1 \\ \varepsilon_t^2 \end{pmatrix}, \quad (7)$$

where ecm denotes the long-run cointegration relation, D_t contains deterministic variables and ε_t is the vector of $i.i.d.$ error terms. As in Granger (1969), a variable is then said to be Granger-causal for another variable if it contains useful information for predicting that latter variable. In the VECM framework, y_t^2 will be Granger-causal for y_t^1 in the long-run if a Wald test rejects the null hypothesis $H_0 : \gamma_1 = 0$, but not $H_0 : a_1^{12} = ... = a_p^{12} = 0$. Conversely, we find Granger causality in the short-run, if the Wald test rejects $H_0 : a_1^{12} = ... = a_p^{12} = 0$, but not $H_0 : \gamma_1 = 0$. Instantaneous causality between perceived and expected inflation is present if the null hypothesis $H_0 : Cov(\varepsilon_t^1, \varepsilon_t^2) = 0$ can be rejected.

We conducted tests for pairwise Granger causality between perceived and expected inflation, and also tests for block-exogeneity in a larger VECM model including actual, perceived and expected inflation, as well as media reports about inflation. Again, all VECM models were estimated with 2 lags.[23]

< Table 9 here >

Pairwise tests for Granger-causality between perceived and expected inflation, as well as tests for instantaneous causality, are summarized in Table 9 for the two sample periods.

[22] A more general version of Granger causality tests in models with integrated variables conducts the tests in a VAR framework adjusted with one extra lag, see Toda and Yamamoto (1995). While these general tests yield similar results, we present results from the more efficient tests differentiating between long- and short-run causality.

[23] All estimated VECM models satisfy stability criteria and test results find no significant evidence of autocorrelation or heteroscedasticity in the residuals. Test results are available from the author upon request.

Results imply that Granger-causality in the period 1998m1 - 2007m12 runs from inflation expectations to inflation perceptions, both in the short and in the long run. This suggests that in the period of relatively stable inflation rates in Sweden from January 1998 to December 2007 lagged expected inflation provided significant information for predicting perceived inflation, while the reverse was not the case. Nevertheless, the finding of instantaneous causality between perceptions and expectations in all models also indicates some feedback between the variables in the current period.

However, when we extend the sample to include the high inflation year 2008, the pattern of one-way causality from expectations to perceptions breaks down. Rather, we find evidence of reverse causality between perceived and expected inflation in the long run. Furthermore, test results suggest short-run causality from perceptions to expectations. It thus seems that events in 2008 caused inflation perceptions to change before expectations in the short run, while both variables are significantly affected by their long-run cointegration relationship.

$<$ *Table 10 here* $>$

$<$ *Table 11 here* $>$

Test results for long-run and short-run Granger causality in a larger VECM including π, π^p and π^e as well as different media variables are presented in Tables 10 and 11.[24] Since all endogenous variables are included in the long-run cointegration relation, tests for long-run Granger causality in Table 10 only allow to test for block-exogeneity. However, when testing for short-run Granger causality in Table 11, we can distinguish between effects of each variable.

Overall, test results for long-run block-exogeneity for the period 1998m1 - 2007m12 confirm Granger-causality running from inflation expectations to the other endogenous variables, as all tests cannot reject the null of no Granger causality from π, π^p and *media* to π^e. With respect to the remaining three variables, we find reverse long-run Granger causality. Extending

[24] Note that the extended VECM was estimated with cointegration rank two to account for two cointegration relations between actual, perceived and expected inflation.

the sample period to include the high inflation year 2008, results find reverse long-run causality between perceived and expected inflation also when accounting for actual inflation and the media, as all models reject the null of no causality towards π^p and π^e at the 1% level. By contrast, results regarding long-run Granger causality towards actual inflation and the media are less conclusive and differ across models.

Analyzing tests for short-run Granger causality finally allows to test for the impact of all four endogenous variables separately.[25] Regarding the shorter sample period, we do not find much evidence of short-run Granger causality between the variables, except for some weakly significant effects of the media on actual inflation, and of perceived and expected inflation on the media. By contrast, once the sample period is extended, test results find reverse causality between perceived and expected inflation also in the short run. While perceived inflation becomes predictive for actual inflation rates in the short run, actual inflation is found to affect expectations in addition to perceived inflation, albeit only at the 10% level. In line with results from the SVEC estimations, we additionally find short-run Granger causality from the media to inflation perceptions in the extended sample. This implies that media reports on inflation become useful for predicting perceptions in the short run when accounting for the more turbulent period of high and volatile inflation in 2008.[26]

5 Conclusion

Using quantitative survey data for Sweden, we evaluate the formation process of inflation perceptions and expectations as well as interrelations between the

[25]For reasons of space limitation, we present only test results of the model with $vol\_articles$. Results from VECMs with vol_tone, vol_tone_subj and $vol\_foodenergy$ did not differ significantly and are available upon request.

[26]This result is in line with findings in Lamla and Lein (2010) who estimate a LSTAR2 model for perceptions and the media in Germany and find that articles on inflation had a more pronounced effect on inflation perceptions during the time of the Euro cash changeover. As the new currency led to increased uncertainty regarding inflation, it seems that media effects became more powerful, where the authors suggest that the effect was driven by the tone of articles.

variables. In line with the conceptual framework presented in Ranyard et al. (2008), we hypothesize that the media might act as transmission mechanism between perceptions and expectations and, thus, include a number of media variables from a unique data set for Sweden.

After rejecting rationality of both inflation perceptions and expectations, we evaluate their formation process and the role of media reports about inflation. For the low-inflation regime 1998m1 - 2007m12, we find that in the long run, inflation perceptions are formed on the basis of lagged actual inflation, while expectations are affected by present perceived, not lagged actual, inflation. This result is in line with findings in Maag (2010), who reports that Swedish households base their inflation expectations largely on perceived, rather than actual, inflation rates. While the media seem to have no significant effect on perceptions in the low-inflation regime, we find some media effects on inflation expectations. Extending the sample period to include the high inflation year 2008, we find more media effects on both expectations and perceptions. Especially inflation perceptions seem to react asymmetrically to negative news, which could be due to loss aversion of households with respect to above-average inflation rates as suggested by Brachinger (2006, 2008) and Dräger et al. (2009).

Turning to the analysis of interrelations between actual, perceived and expected inflation, as well as the media, results from an SVEC model imply that in a stable inflation regime, shocks to actual inflation have persistent effects on both perceptions and expectations. While we find a strong effect of a shock to perceptions on expected inflation, the reverse effect builds up more slowly. Overall, media shocks only have a small effects. However, when including high inflation in 2008, interaction between perceptions and expectations is found to be stronger, and we find a strong role of media reports working predominantly through a pronounced positive effect on inflation perceptions. While actual inflation becomes more sensitive to changes in perceptions, expectations or the media, its own effect is reduced.

Regarding the direction of causality, pairwise Granger-causality tests suggest causality to run from expectations to perceptions in the short and the long run during the low-inflation period. By contrast, once high and volatile inflation in 2008 is included in the sample period, Granger-causality tests find reverse long-run causality between perceptions and expectations and additional short-run causality from perceptions to expectations. These results are confirmed when testing for long-run block-exogeneity in a larger model including actual inflation and the media. Moreover, in the extended sample we also find short-run causality from the media to perceptions.

Overall, results for Sweden suggest that in normal times inflation perceptions are less affected by shocks to expectations than the reverse, but past expectations are significant for predicting perceptions both in the long and in the short run. Inflation expectations, on the other hand, are strongly influenced by current perceptions, both in the single-equation and in the SVEC estimations. Interestingly, dynamic SVEC estimations suggest that actual inflation, while important, explains less of the forecast error variance of perceptions and expectations than the variables between themselves. Once inflation becomes higher and more volatile, we find more interaction between inflation perceptions and expectations, as perceptions are increasingly affected by current expectations and become themselves predictive for future expectations in the short run.

Whereas in the low-inflation regime media effects are relatively restricted, they become more important for perceptions and expectations in the extended sample, where especially inflation perceptions increase significantly in response to a rise in media reports on inflation. Furthermore, Granger causality tests find media reports to be predictive for perceptions in the short run. Thus, taking into account the results regarding the cointegration vector in the extended SVEC, we might conclude that media reports indeed become a 'missing link' between perceived and expected inflation when including periods of high and volatile inflation. However, since single-equation results also suggest that perceptions react asymmetrically to media news, their strong impact in the extended sample might have distorting effects on the cointegration relation. For further research it thus remains to be evaluated, whether the dynamics between perceptions and expectations will return to the low-inflation regime once inflation rates have stabilized, or whether they remain altered.

References

Badarinza, C. and M. Buchmann (2009, September). Inflation Perceptions and Expectations in the Euro Area - The Role of News. *ECB Working Paper 1088*.

Batchelor, R. A. and P. Dua (1987). The accuracy and rationality of UK inflation expectations: some quantitative evidence. *Applied Economics 19*(6), 819–828.

Benford, J. and R. Driver (2008). Public attitudes to inflation and interest rates. *Bank of England Quarterly Bulletin 48*(2), 148–156.

Blanchflower, D. G. and R. Kelly (2008, April). Macroeconomic Literacy, Numeracy and the Implications for Monetary Policy. *Manuscript*.

Blinder, A. S. and A. B. Krueger (2004, September). What Does the Public Know About Economic Policy, and How Does It Know It? *NBER Working Paper 10787*.

Brachinger, H. W. (2006, July). Euro or "Teuro"?: The Euro-Induced Perceived Inflation in Germany. *University of Fribourg Switzerland Department of Quantitative Economics Working Paper 5*.

Brachinger, H. W. (2008, August). A New Index of Perceived Inflation: Assumptions, Method, and Application to Germany. *Journal of Economic Psychology 29*(4), 433–457.

Bryan, M. and S. Palmqvist (2005, April). Testing Near-Rationality Using Detailed Survey Data. *Federal Reserve Bank of Cleveland Working Paper Series 05-02*.

Calvo, G. (1983, September). Staggered Prices in a Utility-Maximizing Framework. *Journal of Monetary Economics 12*(3), 383–398.

Carroll, C. D. (2001, December). The Epidemiology of Macroeconomic Expectations. *NBER Working Paper 8695*.

Carroll, C. D. (2003, February). Macroeconomic Expectations of Households and Professional Forecasters. *Quarterly Journal of Economics 118*(1), 269–298.

Cestari, V., P. Del Giovane, and C. Rossi-Arnaud (2007, February). Memory for Prices and the Euro Cash Changeover: An Analysis for Cinema Prices in Italy. *Banca d'Italia Eurosistema Temi di discussione del Servicio Studi 619*.

Del Giovane, P., S. Fabiani, and R. Sabbatini (2008, January). What's Behind "Inflation Perceptions"? – A Survey-Based Analysis of Italian Consumers. *Banca d'Italia Eurosistema Working Paper 655*.

Dias, F., C. Duarte, and A. Rua (2008). Inflation Expectations in the Euro Area: Are Consumers Rational? *Banko de Portugal Working Papers* (23).

Dickey, D. A. and W. A. Fuller (1979, June). Distribution of the Estimators for Autoregressive Time Series With a Unit Root. *Journal of the American Statistical Association 74*(366), 427–431.

Döhring, B. and A. Mordonu (2007, July). What Drives Inflation Perceptions? A Dynamic Panel Data Analysis. *European Economy Economic Papers 284*.

Dräger, L., J.-O. Menz, and U. Fritsche (2009). Prospect Theory and Inflation Perceptions - An Empirical Assessment. *DEP Discussion Papers Macroeconomics and Finance Series* (3/2009), 1–80.

Dufour, J. (1981). Rank Tests for Serial Dependence. *Journal of Time Series Analysis 2*(3), 117–128.

Dziuda, W. and G. Mastrobuoni (2005, May). The Euro Changeover and Its Effects on Price Transparency, and Inflation. Mission Euro, Mission Accomplished! *Working Paper*.

Ehrmann, M. (2006, February). Rational Inattention, Inflation Developments and Perceptions after the Euro Cash Changeover. *ECB Working Paper Series 588*.

Eife, T. A. (2006, July). Currency Changeovers as Natural Experiments. *Inaugural Dissertation Ludwig-Maximilians-Universitaet Muenchen*.

Eife, T. A. and W. T. Coombs (2007, November). Coping with People's Inflation Perceptions During a Currency Changeover. *University of Heidelberg - Department of Economics - Discussion Paper Series 458*.

Elliott, G., T. Rothenberg, and J. Stock (1996). Efficient Tests for an Autoregressive Unit Root. *Econometrica 64*(4), 813–836.

European Commission (2008). The Joint Harmonised EU Programme of Business and Consumer Surveys.

Fluch, M. and H. Stix (2005, November). Perceived Inflation in Austria – Extent, Explanations, Effects. *Österreichische Nationalbank Monetary Policy and the Economy Q3/05*(3), 22–47.

Forsells, M. and G. Kenny (2002, August). The Rationality of Consumer's Inflation Expectations: Survey-Based Evidence for the Euro Area. *ECB Working Paper 163*.

Fullone, F., M. Gamba, E. Giovannini, and M. Malgarini (2007, May). What Do Citizens Know about Statistics? The Results of an OECD/ ISAE Survey on Italian Consumers. *Manuscript*.

Granger, C. W. J. (1969). Investigating Causal Relations by Econometric Methods and Cross-Spectral Methods. *Econometrica 37*(3), 424–438.

Hansen, B. E. and B. Seo (2002, October). Testing for Two-Regime Threshold Cointegration in Vector Error-Correction Models. *Journal of Econometrics 110*(2), 293–318.

Hansen, L. (1982). Large Sample Properties of Generalized Method of Moments Estimators. *Econometrica 50*(4), 1029–1054.

Hofmann, E., E. Kirchler, and B. Kamleitner (2007, December). Consumer Adaptation Strategies: From Austrian Shilling to the Euro. *Journal of Consumer Policy 30*(4), 367–381.

Johansen, S. (1991). Estimation and Hypothesis Testing of Cointegration Vectors in Gaussian Vector Autoregressive Models. *Econometrica 59*(6), 1551–1580.

Johansen, S. (1995). *Likelihood-based Inference in Cointegrated Vector Autoregressive Models*. Oxford University Press.

Jonung, L. (1981, December). Perceived and Expected Rates of Inflation in Sweden. *American Economic Review 71*(5), 961–968.

Jonung, L. and D. Laidler (1988, December). Are Perceptions of Inflation Rational? Some Evidence for Sweden. *American Economic Review 78*(5), 1080–1087.

Kirchgässner, G. and J. Wolters (2007, October). *Introduction to Modern Time Series Analysis*. Berlin: Springer-Verlag.

Kleibergen, F. and R. Paap (2006). Generalized Reduced Rank Tests Using the Singular Value Decomposition. *Journal of Econometrics 133*(1), 97–126.

Koskimäki, T. (2005). How the Finnish Consumer Price Index Survived the Euro change-over. *OECD Seminar on Consumer Price Indices, Paris 21-22 June 2005*.

Kwiatkowski, D., P. C. B. Phillips, P. Schmidt, and Y. Shin (1992, October - December). Testing the Null Hypothesis of Stationarity Against the Alternative of a Unit Root: How Sure are we that Economic Time Series have a Unit Root? *Journal of Econometrics 54*(1-3), 159–178.

Lamla, M. and S. Lein (2010). The Euro Cash Changeover, Inflation Perceptions and the Media. *KOF Swiss Economic Institute Working Paper 254*.

Lamla, M. J. and S. M. Lein (2008, June). The Role of Media for Consumers' Inflation Expectation Formation. *KOF Swiss Economic Institute Working Paper 201*.

Lein, S. M. and T. Maag (2008, September). The Formation of Inflation Perceptions - Some Empirical Facts for European Countries. *KOF Swiss Economic Institute Working Paper 204*.

Maag, T. (2010). How Do Households Form Inflation Expectations? – Evidence From a Mixture Model of Survey Heterogeneity. *mimeo, ETH Zurich*.

Maag, T. and M. J. Lamla (2009). The Role of Media for Inflation Forecast Disagreement of Households and Professional Forecasters. *KOF Swiss Economic Institute Working Paper 223*.

MacKinnon, J. G. (1994). Approximate Asymptotic Distribution Functions for Unit-Root and Cointegration Tests. *Journal of Business & Economic Statistics 12*(2), 167–176.

Mankiw, N. G. and R. Reis (2002, November). Sticky Information versus Sticky Prices: A Proposal to Replace the New Keynesian Phillips Curve. *Quarterly Journal of Economics 117*(4), 1295–1328.

Mankiw, N. G. and R. Reis (2003, September). What Measure of Inflation Should A Central Bank Target? *Journal of the European Economic Association 1*(5), 1058–1086.

Mankiw, N. G. and R. Reis (2006, May). Pervasive Stickiness. *American Economic Review 96*(2), 164–169.

Mankiw, N. G. and R. Reis (2007). Sticky Information in General Equilibrium. *Journal of the European Economic Association 5*(2-3), 603–613.

Mankiw, N. G., R. Reis, and J. Wolfers (2004). Disagreement about Inflation Expectations. In *NBER Macroeconomics Annual 2003*, Volume 18, pp. 209–248. National Bureau of Economics Research.

Mosconi, R. and C. Giannini (1992). Non-Causality in Cointegrated Systems: Representation, Estimation And Testing. *Oxford Bulletin of Economics and Statistics 54*(3), 399–417.

Palmqvist, S. and L. Strömberg (2005, March). Households' Inflation Opinions - A Tale of Two Surveys. *Sveriges Riksbank Economic Review 2004:4*, 23–42.

Phillips, P. C. B. and P. Perron (1988, June). Testing for a Unit Root in Time Series Regression. *Biometrika 75*(2), 335–346.

Ranyard, R., F. Del Missier, N. Bonini, D. Duxbury, and B. Summers (2008). Perceptions and expectations of price changes and inflation: A review and conceptual framework. *Journal of Economic Psychology 29*(4), 378–400.

Soroka, S. N. (2006, May). Good News and Bad News: Asymmetric Responses to Economic Information. *Journal of Politics 68*(2), 372–385.

Souleles, N. S. (2004, February). Expectations, Heterogenous Forecast Errors, and Consumption: Micro Evidence from the Michigan Consumer Sentiment Surveys. *Journal of Money, Credit, and Banking 36*(1), 40–72.

Thomas, L. (1999, Autumn). Survey Measures of Expected U. S. Inflation. *Journal of Economic Perspectives 13*(4), 125–144.

Toda, H. Y. and T. Yamamoto (1995). Statistical inference in vector autoregressions with possibly integrated processes. *Journal of Econometrics 66*(1-2), 225 – 250.

Traut-Mattausch, E., S. Schulz-Hardt, T. Greitemeyer, and D. Frey (2004, November-December). Expectancy Confirmation in Spite of Disconfirming Evidence: The Case of Price Increases Due to the Introduction of the Euro. *European Journal of Social Psychology 34*(6), 739–760.

van der Klaauw, W., W. Bruine de Bruin, G. Topa, S. Potter, and M. Bryan (2008, December). Rethinking the Measurement of Household Inflation Expectations: Preliminary Findings. *Federal Reserve Bank of New York Staff Report 359.*

Wilcoxon, F. (1945). Individual comparisons by ranking methods. *Biometrics Bulletin 1*(6), 80–83.

6 Appendix

6.1 Tables

Table 1: Testing Rationality of Inflation Perceptions

Accuracy:		MAE	RMSE
		0.4027	0.5213
Bias: $\pi_t = \alpha + \beta\pi_t^p$	F-stat./z-stat.	prob.	
H_0:$(\alpha, \beta) = (0, 1)$	16.0533	0.000	VECM, 12 Lags
H_0: $\pi_t = \pi_t^p$	-6.521	0.000	Wilcoxon signed-rank test
Efficiency: π^p_error	(1)	(2)	(3)
$\pi^p\_error_{t-13}$	-.1856		
	(.1535)		
$d(\pi)_{t-13}$		-.5188***	-.4636***
		(.1333)	(.1613)
$d(\pi^p)_{t-13}$			.0775
			(.1804)
$d(\pi^e)_{t-13}$			-.0587
			(.1396)
$d(prod^{industry})_{t-13}$			.0214
			(.0214)
$d(U)_{t-13}$			.0565
			(.0866)
$d(i^{long})_{t-13}$			-.7189**
			(.3233)
$d(i^{short})_{t-13}$			.5745
			(.6363)
$m2_{t-13}$			-3.9044
			(5.0107)
$vol\_articles_{t-13}$			.0101
			(.0089)
ADF test resid.	-3.606	-3.977	-4.169
1% critical value	-2.598	-2.598	-2.598

Note: Newey-West standard errors in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% level, respectively.
Sample period: 1998m1-2008m12.

Table 2: Testing Rationality of Inflation Expectations

Accuracy:		MAE	RMSE
		0.4844	0.6005
Bias: $\pi_t = \alpha + \beta\pi^e_{t-12}$	F-stat./z-stat.	prob.	
H_0:$(\alpha, \beta) = (0, 1)$	34.6822	0.000	VECM, 12 Lags
H_0: $\pi_t = \pi^e_{t-12}$	-3.983	0.000	Wilcoxon signed-rank test
Efficiency: π^e_error	(1)	(2)	(3)
$\pi^e\_error_{t-13}$	.1319		
	(.1755)		
$d(\pi)_{t-13}$		-.1505	-.0795
		(.2116)	(.2545)
$d(\pi^e)_{t-13}$			-.0827
			(.1690)
$d(\pi^p)_{t-13}$			.0384
			(.1718)
$d(prod^{industry})_{t-13}$			-.0417
			(.0454)
$d(U)_{t-13}$			-.0399
			(.1394)
$d(i^{long})_{t-13}$			-.3351
			(.5435)
$d(i^{short})_{t-13}$			1.8473*
			(.9533)
$m2_{t-13}$			5.3637
			(6.1947)
$vol\_articles_{t-13}$			.0218
			(.0187)
ADF test resid.	-2.881	-2.985	-3.330
1% critical value	-2.599	-2.598	-2.598

Note: Newey-West standard errors in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% level, respectively.
Sample period: 1998m1-2008m12.

Table 3: Inflation Perceptions and the Media

π_t^p	(1)	(2)[1]	(3)	(4)	(5)	(6)	(7)
π_{t-1}^p	.8764***	.8429***	.7919***	.7675***	.7579***	.7632***	.7801***
	(.0889)	(.0567)	(.0718)	(.0732)	(.0691)	(.0693)	(.0743)
π_t^e	.0612		.0695	.0696	.0561	.0689	.0428
(instrumented)	(.1114)		(.0930)	(.0938)	(.0941)	(.0927)	(.0959)
π_{t-1}		.0919**	.1004**	.1185***	.1166***	.1153***	.1287***
		(.0455)	(.0415)	(.0375)	(.0360)	(.0377)	(.0397)
$vol\_articles_{t-1}$				-.0032			
				(.0048)			
$vol_{t-1}^{\pi\ increase}$					-.0064		
					(.0115)		
$vol_{t-1}^{\pi\ decrease}$					.0004		
					(.0474)		
$vol_{t-1}^{\pi\ highlevel}$					.0084		
					(.0144)		
$vol_{t-1}^{\pi\ lowlevel}$					-.0216		
					(.0157)		
$vol_{t-1}^{positive}$						-.0009	
						(.0194)	
$vol_{t-1}^{neutral}$						-.0078	
						(.0120)	
$vol_{t-1}^{negative}$						-.0018	
						(.0120)	
$vol_{t-1}^{housing}$							.0406
							(.0388)
vol_{t-1}^{food}							-.0152
							(.0344)
vol_{t-1}^{energy}							-.0022
							(.0104)
centered R^2	0.840	-	0.848	0.850	0.849	0.851	0.846
Endog. test π^e	4.403**	-	6.820***	6.666***	7.925***	7.583***	6.642***
Kleibergen/Paap LM	4.045	-	6.269**	6.199**	7.108**	6.902**	7.611**
Hansen J stat.	0.805	-	1.253	0.933	0.773	0.785	1.238

Note: GMM with robust standard errors in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% level, respectively. Sample period: 1998m1 - 2007m12. [1]OLS with Newey-West standard errors.

Table 4: Inflation Perceptions and the Media including the High Inflation Year 2008

π_t^p	(1)	(2)[1]	(3)	(4)	(5)	(6)	(7)
π_{t-1}^p	.8917***	.8784***	.8177***	.7756***	.7585***	.7664***	.7607***
	(.0338)	(.0473)	(.0477)	(.0496)	(.0456)	(.0483)	(.0330)
π_t^e	.1226*		.1311*	.1468**	.1367**	.0967	.1442**
(instrumented)	(.0744)		(.0751)	(.0714)	(.0569)	(.0624)	(.0617)
π_{t-1}		.1314**	.1162***	.1411***	.1389***	.1410***	.1304***
		(.0539)	(.0424)	(.0429)	(.0450)	(.0397)	(.0376)
$vol\_articles_{t-1}$				.0072*			
				(.0040)			
$vol_{t-1}^{\pi\ increase}$					.0239*		
					(.0134)		
$vol_{t-1}^{\pi\ decrease}$					.0100		
					(.0369)		
$vol_{t-1}^{\pi\ highlevel}$					.0239*		
					(.0141)		
$vol_{t-1}^{\pi\ lowlevel}$					-.0112		
					(.0114)		
$vol_{t-1}^{positive}$						-.0132	
						(.0146)	
$vol_{t-1}^{neutral}$						-.0247**	
						(.0125)	
$vol_{t-1}^{negative}$						.0295***	
						(.0109)	
$vol_{t-1}^{housing}$							.0353
							(.0264)
vol_{t-1}^{food}							.0756**
							(.0362)
vol_{t-1}^{energy}							-.0145
							(.0119)
centered R^2	0.930	-	0.935	0.938	0.940	0.937	0.942
Endog. test π^e	5.201**	-	5.561**	5.268**	4.655**	5.396**	5.175**
Kleibergen/Paap LM	3.843	-	4.214	4.067	4.360	3.993	4.463*
Hansen J stat.	0.287	-	0.001	0.126	1.235	0.008	0.124

Note: GMM with robust standard errors in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% level, respectively. Sample period: 1998m1 - 2008m12. [1]OLS with Newey-West standard errors.

Table 5: Inflation Expectations and the Media

π_t^e	(1)	(2)[1]	(3)	(4)	(5)	(6)	(7)
π_{t-1}^e	.7348***	.8301***	.7317***	.7319***	.7007***	.7127***	.6314***
	(.1147)	(.0763)	(.1155)	(.1163)	(.0882)	(.1046)	(.0737)
π_t^p	.1814**		.1948*	.1778*	.1511**	.1712*	.2333***
(instrumented)	(.0909)		(.1009)	(.0989)	(.0711)	(.0955)	(.0776)
π_{t-1}		.0533	-.0102	.0063	-.0117	.0086	.0057
		(.0398)	(.0323)	(.0275)	(.0328)	(.0311)	(.0366)
$vol\_articles_{t-1}$				.0005			
				(.0036)			
$vol_{t-1}^{\pi\ increase}$					.0338***		
					(.0097)		
$vol_{t-1}^{\pi\ decrease}$					.0970**		
					(.0479)		
$vol_{t-1}^{\pi\ highlevel}$					.0074		
					(.0136)		
$vol_{t-1}^{\pi\ lowlevel}$					-.0521***		
					(.0203)		
$vol_{t-1}^{positive}$						-.0232	
						(.0168)	
$vol_{t-1}^{neutral}$						.0040	
						(.0188)	
$vol_{t-1}^{negative}$						.0034	
						(.0117)	
$vol_{t-1}^{housing}$							.1142**
							(.0488)
vol_{t-1}^{food}							.0136
							(.0291)
vol_{t-1}^{energy}							.0121
							(.0103)
centered R^2	0.788	-	0.791	0.786	0.800	0.787	0.815
Endog. test π^e	4.527**	-	4.704**	4.551**	6.830***	6.219**	5.843**
Kleibergen/Paap LM	5.297*	-	5.612*	4.857*	6.112**	6.107**	6.986**
Hansen J stat.	1.547	-	1.452	1.391	2.011	0.997	2.765*

Note: GMM with robust standard errors in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% level, respectively. Sample period: 1998m1 - 2007m12. [1]OLS with Newey-West standard errors.

Table 6: Inflation Expectations and the Media including the High Inflation Year 2008

π_t^e	(1)	(2)[1]	(3)	(4)	(5)	(6)	(7)
π_{t-1}^e	.9397***	.8359***	.9511***	.9443***	.8546***	.8460***	.9550***
	(.1126)	(.0648)	(.1156)	(.1208)	(.1088)	(.1083)	(.1414)
π_t^p	-.0346		-.1057	-.1219	-.1122	-.0955	-.1819
(instrumented)	(.0841)		(.1119)	(.1304)	(.1340)	(.1326)	(.1515)
π_{t-1}		.0586	.0996*	.1224**	.0822	.1091*	.1212**
		(.0379)	(.0561)	(.0599)	(.0594)	(.0560)	(.0565)
$vol\_articles_{t-1}$				.0021			
				(.0039)			
$vol_{t-1}^{\pi\ increase}$					.0561**		
					(.0220)		
$vol_{t-1}^{\pi\ decrease}$					.0275		
					(.0331)		
$vol_{t-1}^{\pi\ highlevel}$					.0087		
					(.0160)		
$vol_{t-1}^{\pi\ lowlevel}$					-.0552***		
					(.0198)		
$vol_{t-1}^{positive}$						-.0407***	
						(.0158)	
$vol_{t-1}^{neutral}$						-.0279	
						(.0237)	
$vol_{t-1}^{negative}$						.0288*	
						(.0153)	
$vol_{t-1}^{housing}$							.0735
							(.0635)
vol_{t-1}^{food}							.1287*
							(.0754)
vol_{t-1}^{energy}							-.0399**
							(.0193)
centered R^2	0.776	-	0.758	0.755	0.782	0.775	0.760
Endog. test π^e	4.421**	-	3.684*	3.637*	2.525	3.961**	1.490
Kleibergen/Paap LM	3.112	-	4.102	4.537*	4.708*	4.308	4.322
Hansen J stat.	0.518	-	0.857	0.796	2.779*	0.223	3.924**

Note: GMM with robust standard errors in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% level, respectively. Sample period: 1998m1 - 2008m12. [1]OLS with Newey-West standard errors.

Table 7: Cointegration Relation in the SVEC

1998m1-2007m12	α_1	α_2	β_1	β_2
π	0.119	-0.173***	-	1.000
	(0.109)	(0.057)		(0.000)
π^p	-0.220***	0.087**	1.000	-
	(0.068)	(0.036)	(0.000)	
π^e	-	-	-1.000***	-0.766***
			(0.000)	(0.242)
$vol\_articles$	-	-	0.018	0.011
			(0.050)	(0.087)
Wald test on	Test-stat.	H_0		
β-restrictions	2.166	$\beta(3,1) = -1$		
	(0.141)			
1998m1-2008m12	α_1	α_2	β_1	β_2
π	-	-0.185***	-	1.000
		(0.049)		(0.000)
π^p	-0.270***	0.093***	1.000	-
	(0.058)	(0.035)	(0.000)	
π^e	-0.104*	-	-1.046***	-0.680***
	(0.063)		(0.142)	(0.245)
$vol\_articles$	2.101**	-	-0.087***	-0.016
	(1.002)		(0.023)	(0.040)

Note: Standard errors and p-values for the Wald test in parentheses.
*,** and *** denote rejection of H_0 at the 10%, 5% and 1% level, respectively.

Table 8: Forecast Error Variance Decomposition

		1998m1 - 2007m12			1998m1 - 2008m12		
	Forecast horizon	1 month	25 months	50 months	1 month	25 months	50 months
π	% due to π	100	68	50	100	34	21
	% due to π^p	0	20	25	0	20	24
	% due to π^e	0	7	19	0	33	42
	% due to $vol\_articles$	0	5	6	0	13	13
π^p	% due to π	5	30	23	5	12	8
	% due to π^p	95	47	40	95	36	34
	% due to π^e	0	15	28	0	25	29
	% due to $vol\_articles$	0	8	9	0	27	29
π^e	% due to π	10	17	15	8	5	3
	% due to π^p	34	38	36	37	28	27
	% due to π^e	56	43	48	55	58	60
	% due to $vol\_articles$	0	2	1	0	9	10
$vol\_articles$	% due to π	1	2	2	0	5	7
	% due to π^p	0	0	0	4	12	13
	% due to π^e	2	3	2	0	5	7
	% due to $vol\_articles$	97	95	96	96	78	73

Note: Forecast error variance decompositions for the 1998m1 - 2007m12 sample are from the restricted model.

Table 9: Pairwise Granger Causality between π^e and π^p

1998m1 - 2007m12	$\pi^e \rightarrow \pi^p$	$\pi^p \rightarrow \pi^e$	$\pi^p \leftrightarrow \pi^e$
Long-run	3.33*	0.06	34.472***
	(0.068)	(0.806)	(0.000)
Short-run	4.60*	4.44	
	(0.100)	(0.109)	
1998m1 - 2008m12	$\pi^e \rightarrow \pi^p$	$\pi^p \rightarrow \pi^e$	$\pi^p \leftrightarrow \pi^e$
Long-run	5.08**	15.31***	39.584***
	(0.024)	(0.000)	(0.000)
Short-run	2.99	16.62***	
	(0.224)	(0.000)	

Note: χ^2 statistics with p-values in parentheses. *,** and *** denote rejection of H_0 at the 10%, 5% and 1% level, respectively.

Table 10: Long-Run Granger Causality in the Extended SVEC

1998m1 - 2007m12	1) $vol\_articles$	2) vol_tone	3) vol_tone_subj	4) $vol\_foodenergy$
$\pi^p, \pi^e, media \rightarrow \pi$	6.69**	5.26*	6.81**	6.54**
	(0.035)	(0.072)	(0.033)	(0.038)
$\pi^e, \pi, media \rightarrow \pi^p$	5.84*	6.61**	5.79*	6.45**
	(0.054)	(0.037)	(0.055)	(0.040)
$\pi^p, \pi, media \rightarrow \pi^e$	0.59	1.09	0.36	0.61
	(0.745)	(0.579)	(0.835)	(0.736)
$\pi^p, \pi^e, \pi \rightarrow media$	27.59***	25.37***	21.11***	30.35***
	(0.000)	(0.000)	(0.000)	(0.000)
1998m1 - 2008m12	**1) $vol\_articles$**	**2) vol_tone**	**3) vol_tone_subj**	**4) $vol\_foodenergy$**
$\pi^p, \pi^e, media \rightarrow \pi$	6.69**	2.48	6.05**	1.19
	(0.035)	(0.289)	(0.049)	(0.550)
$\pi^e, \pi, media \rightarrow \pi^p$	14.03***	21.71***	16.37***	12.46***
	(0.001)	(0.000)	(0.000)	(0.002)
$\pi^p, \pi, media \rightarrow \pi^e$	12.57***	13.87***	13.17***	17.63***
	(0.002)	(0.001)	(0.001)	(0.000)
$\pi^p, \pi^e, \pi \rightarrow media$	5.93*	7.22**	3.96	10.08***
	(0.052)	(0.027)	(0.138)	(0.007)

Note: χ^2 statistics with p-values in parentheses.
*,** and *** denote rejection of H_0 at the 10%, 5% and 1% level, respectively.

Table 11: Short-Run Granger Causality in the Extended SVEC

π	1998m1 - 2007m12	1998m1 - 2008m12
$\pi^p \to \pi$	0.37	7.11**
	(0.830)	(0.029)
$\pi^e \to \pi$	0.82	1.57
	(0.662)	(0.457)
$vol\_articles \to \pi$	4.84*	3.14
	(0.089)	(0.208)
π^p	1998m1 - 2007m12	1998m1 - 2008m12
$\pi^e \to \pi^p$	3.84	6.05**
	(0.146)	(0.049)
$\pi \to \pi^p$	0.27	3.81
	(0.873)	(0.149)
$vol\_articles \to \pi^p$	0.86	6.48**
	(0.651)	(0.039)
π^e	1998m1 - 2007m12	1998m1 - 2008m12
$\pi^p \to \pi^e$	4.44	12.22***
	(0.109)	(0.002)
$\pi \to \pi^e$	2.01	4.89*
	(0.365)	(0.087)
$vol\_articles \to \pi^e$	0.90	1.91
	(0.638)	(0.385)
$vol\_articles$	1998m1 - 2007m12	1998m1 - 2008m12
$\pi^p \to vol\_articles$	5.06*	3.33
	(0.080)	(0.189)
$\pi^e \to vol\_articles$	5.41*	3.37
	(0.067)	(0.186)
$\pi \to vol\_articles$	0.90	2.09
	(0.639)	(0.352)

Note: χ^2 statistics with p-values in parentheses.
*,** and *** denote rejection of H_0 at the 10%, 5% and 1% level, respectively.

Table A.1: Unit Root Tests

		π	π^e	π^p	$vol\_articles$
ADF test	Test stat.	-2.476	-3.321	-1.984	-7.399
	Approx. p-value	0.121	0.014	0.294	0.000
	Lags	1	1	1	1
DF GLS test	Test stat.	-1.576	-1.962	-1.970	-2.617
	5% crit. value	-1.972	-2.020	-2.041	-2.596
	Lags	12	6	3	2
PP test	Test stat.	-2.750	-3.151	-2.003	-7.815
	Approx. p-value	0.066	0.023	0.285	0.000
	Lags	1	1	1	1
KPSS test	Test stat.	.246	.674	.723	.257
	5% crit. value	0.463	0.463	0.463	0.463
	Lags	12	12	12	12

Note: Approximate p-values are from MacKinnon (1994).

Table A.2: Johansen Cointegration Tests

		π^e, π^p	π, π^e	π, π^p	π, π^e, π^p
trace stat.	rank 0	27.255***	23.955***	23.148***	44.930***
	rank 1	5.436**	6.600**	4.245**	22.805***
	rank 2	-	-	-	6.162**
max. eigenvalue stat.	rank 0	21.819***	17.355***	18.903***	22.125***
	rank 1	5.436**	6.600**	4.245**	16.643***
	rank 2	-	-	-	6.162**

Note: *** and ** denote rejection of H0 at the 1% and 5% level, respectively.

6.2 Figures

Figure 1: Actual, Perceived and Expected Inflation and Articles on Inflation

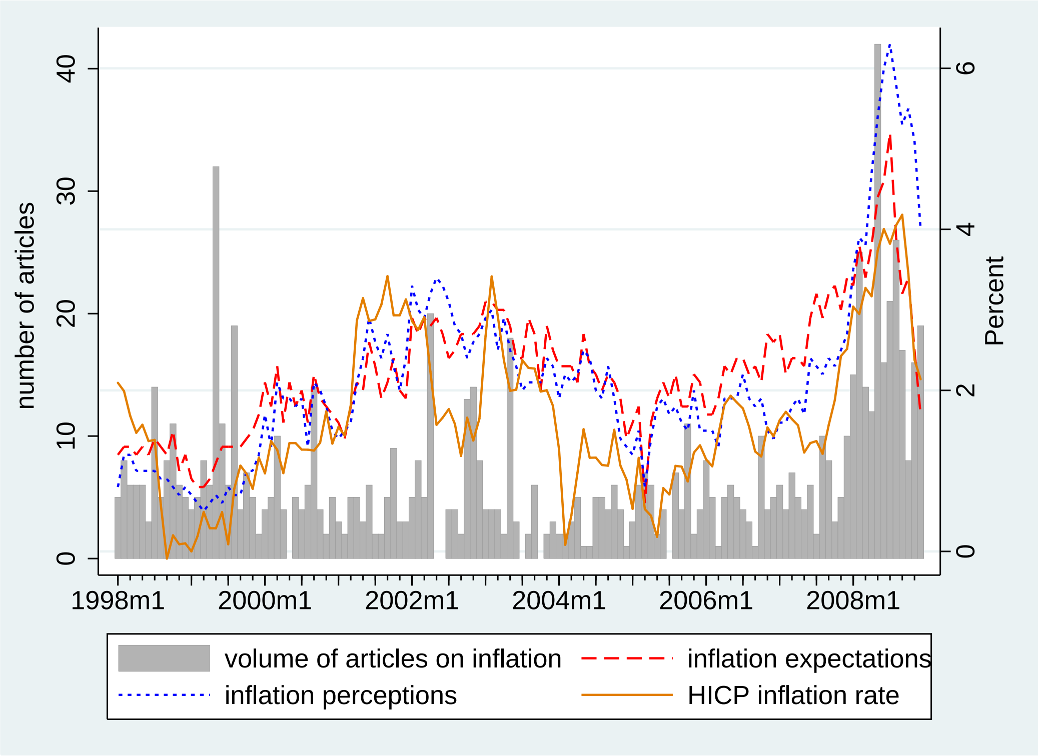

Figure 2: Perceived and Expected Inflation with Positive and Negative News

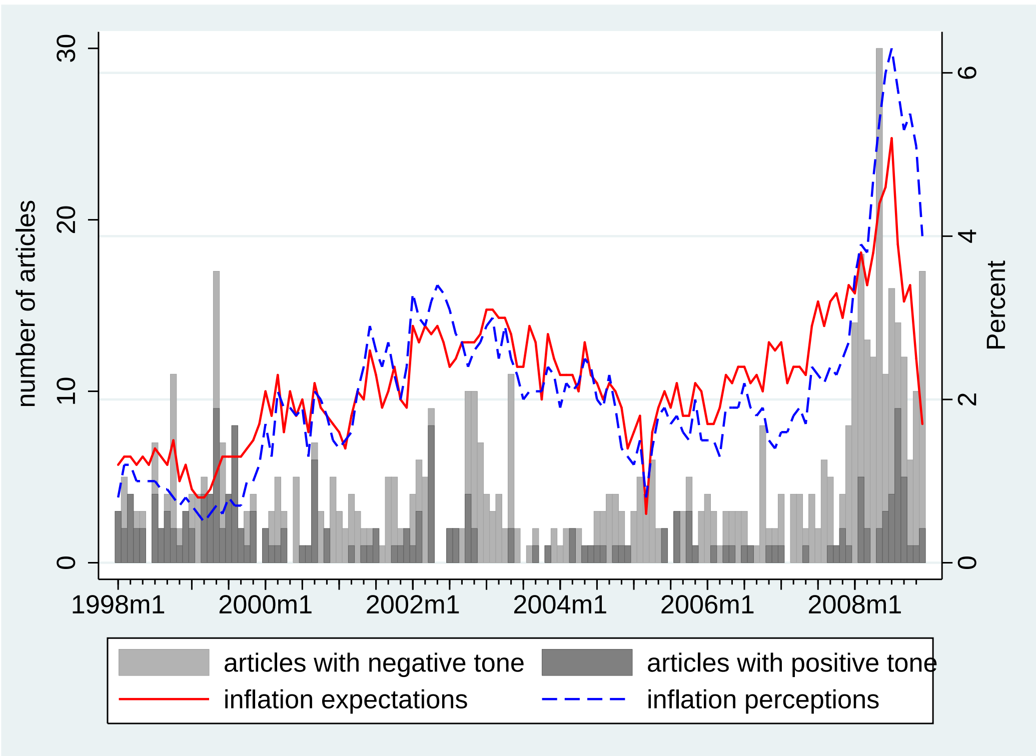

Figure 3: SVEC with π, π^p, π^e and $vol\_articles$, 1998m1 - 2007m12

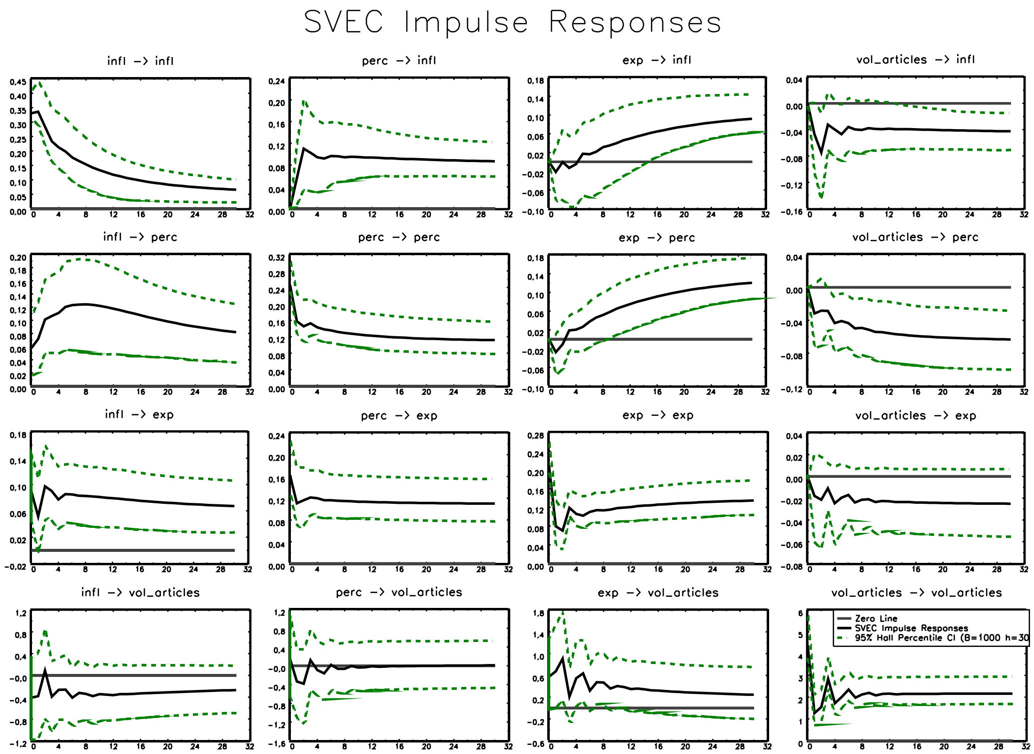

Figure 4: SVEC Including the High Inflation Year 2008