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The Relationship between Media Bias and Inflation Expectations in P.R. China

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Abstract

The fact that predictions of inflation can create a self-fulfilling expectations trap creates a powerful incentive to balance output and inflation. Media reports, as a source of public information, contribute to formation of inflation expectations. We investigate how media coverage and possible media bias may affect inflation expectations using the sticky information paradigm and Bayesian learning theory. The findings suggest that the quantity of media reports may or may not affect inflation expectations, depending on media bias and the economic climate. However, media bias explicitly expands the deviation between expected and actual inflation, making media content more important to manage than volume of coverage for controlling inflation expectations.

***Keywords*:** Inflation Expectation, Media Bias, Sticky Information, Bayesian Learning

***JEL*:** E31; D83; D84

1. Introduction

Well-anchored inflation expectations are essential for price stability and economic growth since expectations tend to be self-fulfilling. Managing consumers' inflation expectations has become one of the most important tasks of a country's central monetary authority. However, the trade-offs among the triple objectives of "inflation, employment, and economic growth" give central banks an incentive to accommodate public expectations regarding inflation in order to increase output (Xu, 2009). On the other hand, expectations of inflation may become self-fulfilling, miring the economy in the so-called expectation trap (Armenter and Bodenstein, 2008; Vega and Winkelried, 2005; Xu, 2010). Traditional monetary policies fail to solve the expectation trap problem (Albanesi, Chari, and Christiano, 2003; Christiano and Gust, 2000; Li, Kin and Gao, 2010). Understanding how inflation expectations are formed and seeking an approach outside the traditional monetary policy framework is crucial to manage inflation expectations.

Developed countries frequently adopt indirect measures to manage inflation expectations (Blinder, Ehrmann, Fratzscher, De Haan, and Jansen, 2008). Traditionally, central banks have used the media as an important channel for information disclosure to manage such expectations (Blinder & Krueger, 2004). In fact, the central banks of Canada, England, New Zealand, and Sweden convene regular press conferences to publicly announce target prices and wages. Another commonly used means of indirect communication is public statements from senior government officials during interviews, forums, lectures, or presentations.

A body of research highlights the positive effects of using information disclosure to manage inflation expectations. De Haan, Eijffinger, and Rybiński, (2007) have shown that information disclosure helps lessen the asymmetric flow of information between central banks and the private sector and thereby stabilizes public expectations. Similarly, research at European central banks (Ullrich, 2008) and the P.R. Bank of China (Xiao and Zhou, 2009) supports that information disclosure by the central bank can shape the economy. Eusepi (2005) suggests that announcing measures such as the monetary policy reaction function improves consumers' understanding of the economic situation and stabilizes inflation expectations. He further argues that if information disclosure is low, inflation expectations are likely to fluctuate and the economy may experience volatile macroeconomic cycles. Eusepi (2010) again stresses the importance of the central bank disclosing information for purposes of managing the central economy. In a nonlinear economic scenario the central bank's failure to disclose information causes "learning equilibria," in which the economy alternates between periods of deflation coupled with low output and periods of high economic activity with excessive inflation. According to Bian and Zhang (2012), information disclosure has a more immediate effect on managing inflation expectations compared with traditional monetary policy tools, whereas over the long term interest rate adjustments are more effective than information disclosure. Eusepi goes on to say that full disclosure helps to stabilize expectations around the target inflation rate. In contrast, Van der Cruijsen, Eijffinger, and Hoogduin (2010) argue that full disclosure is not always advantageous. They define an optimal degree of central bank transparency as that which improves the accuracy of inflation expectations.

Although the ideal degree of information disclosure remains a matter of debate, current research provides ample support that central bank information disclosure does play a significant role in guiding inflation expectations. The importance of media reports has been widely cited but how media reports influence inflation expectations has rarely been studied. According to Blinder and Krueger (2004), television and newspapers are the primary sources by which American households gain relevant information on which to form their inflation expectations. Carroll (2003) has documented a positive correlation between accurate inflation expectations and media coverage between 1981 and 2000, suggesting that media reports help American households to understand current inflation rates and predict future changes. Additionally, in describing how inflation expectations are formed, he argues that the media are the most important source of information about inflation and suggests that consumers alter their inflation expectations more frequently in periods when media reports are intensive.

Lamla and Lein (2014) examined the effect of media reports on the frequency and degree of inflation expectations in Germany; they suggest that more frequent media reports improve the accuracy of consumers' inflation expectations. Similarly, Dräger (2014) points out that the public reacts differently to news regarding increasing versus decreasing inflation rates. Past reports exert a positive effect on decreasing inflation on expected inflation but not on increasing inflation scenarios. He argues that the public is swayed more by perceived than actual inflation rates, a conclusion that Benford and Driver (2008) reinforce, adding that media reports are highly influential on perceptions. Interestingly, potentially good news on decreasing inflation seem to be perceived as negative news since they induce an increase in perceived and expected inflation. Zhang, Tong, and Lu (2014) examine the relationships between consumers' expectations and actual inflation in P. R. China using an extended New Keynesian Phillips Curve (NKPC) model. They conclude that media coverage significantly influences consumers' inflation expectations, and that if reports of rising prices increase by 1% the expectation of inflation rises by 0.1–0.2%. The implication is that the media are the most important information source for the public, and that media reports of rising or declining prices tend to lead consumers to expect higher or lower interest rates.

Current studies support that disclosing economic information can manage expectations around inflation, and media reports are a primary means of disseminating such information. However, the media may disseminate inaccurate or biased information for a variety of reasons: to attract viewership/readership (Strömberg, 2004), to serve the interests of major advertisers (Ellman & Germano, 2009), or with state-owned media, to present government propaganda (Houston, Lin, & Ma, 2011). The agenda setting theory proposes that the media are not only senders of information but also processors of information, in that the media may add their own interpretation and bias to the content (Dräger, 2014; McCombs, 2004). For example, Soroka (2006) states that the media are more interested in reporting negative than positive news. Moreover, this media bias has a significant effect on economic growth. At the micro level, Hennig-Thurau, Houston, and Sridhar (2006) and Rinallo and Basuroy (2009) argue that if investors and consumers rely on biased media reports to make investment and consumption decisions, they are likely to suffer economic losses. At the macro level, the audiences will reduce demand for media because of the "market for lemons" problem and eventually lead to social welfare losses (Anderson & McLaren, 2012; Baron, 2006). Furthermore, public beliefs and information structures based on biased media reports will distort the efficient allocation of resources (Ellman and Germano, 2009; Mullainathan and Shleifer, 2005).

Research to date has focused on the quantity rather than the accuracy of media reports, even though the role of media reports in the formation of inflation expectations is a topic of growing interest. Whether volume or accuracy of reports is more important in the formation of inflation expectations is still a matter of debate (Carroll, 2003; Lamla and Lein, 2014). To address this gap in the literature, the present study examines how volume of media reports and media bias each affect inflation expectations by measuring inflation expectations generated from media reports using a Bayesian learning model. Results suggest that both quantity and accuracy of media reports are important in forming inflation expectations. However, media bias has a definite effect on inflation expectation bias, whereas quantity of media coverage has differential effects, depending on the economic climate and the content of reports. Compared to accurate reporting, media bias creates expectations that diverge more from actual inflation rates. Minimizing the discrepancy between expected and actual inflation through objective and accurate media reports helps avoid the trap where expectations of inflation actually trigger an inflationary spiral.

In the remainder of this paper we present our hypotheses within a Bayesian learning and sticky information framework, then introduce our data collection and media bias measures. The empirical results are checked for robustness, then the results are summarized in the conclusion.

2. Model and Hypotheses

This analysis uses Bayesian learning (Lamla and Lein, 2014) and sticky information (Mankiw & Reis, 2002) frameworks to investigate how the quantity and bias of media coverage affect inflation expectations. We also compare the influence of unbiased versus biased media reports on accuracy of inflation expectations. A sticky information approach based on the random adjustment model (Calvo, 1983) and the incomplete information model (Lucas, 1973) measures the effort required for consumers to acquire and apply inflation information. The Sticky Information Phillips Curve (SIPC; Mankiw and Reis, 2002) is considered the most effective analysis for explaining the macroeconomy (Li, Ma and Wang, 2010), as well as for capturing the distribution of inflation expectations. Yet it does not capture individual consumers' expectations.

Assuming that media reports send noisy signals regarding future inflation, and consumers who acquire up-to-date information accurately understand the inflation situation from the messages they receive, there should be a direct correlation between the quantity of media reports and the number of messages consumers receive. We assume that average consumers' a priori beliefs follow a normal distribution of ${\pi_t}^e \sim N(\alpha\pi_t + \beta GAP_t, {\sigma_p}^2)$, where ${\pi_t}^e$ is the inflation expectation for period *t*, π_t is the actual inflation rate for *t*, and GAP_t is the output gap of *t*. Additionally, individuals receive a normal distribution of information $\Phi_{v,t} \sim N(\pi_t + \varphi_{v,t}, {\sigma_\varphi}^2)$ from media report *v*, where $\varphi_{v,t}$ is the bias in *t* generated from the media report *v*. Individuals receive news to update their expectations according to the Bayesian principle. Those who do not receive news retain their existing expectations (Mankiw & Reis, 2002). Given that not all consumers update their expectations each period, future inflation expectations are normally distributed around a mean calculated as follows:

$$E\left({\pi_t}^e \middle| \Phi_{v,t}\right) = \theta_{t-1}[\rho_{t-1}(\alpha\pi_t + \beta GAP_t) + (1-\rho_{t-1})\overline{\Phi_t}\,] + (1-\theta_{t-1})(\alpha\pi_t + \beta GAP_t) \qquad (1)$$

where θ_{t-1} is the percentage of consumers updating their information at *t-1*, $\overline{\Phi_t} = {V_{t-1}}^{-1}\sum_{v=1}^{V_{t-1}} \Phi_{v,t}$, and ρ_t is a weight derived as:

$$\rho_t = \frac{(1/V_t){\sigma_\varphi}^2}{{\sigma_p}^2 + (1/V_t){\sigma_\varphi}^2} \qquad (2)$$

Therefore, $\frac{\partial\rho_t}{\partial V_t} = \frac{-{\sigma_p}^2{\sigma_\varphi}^2}{(V_t{\sigma_p}^2 + {\sigma_\varphi}^2)^2} < 0$, suggesting that the quantity of media reports increases the effect of media coverage on inflation expectations. Furthermore, the more media reports there are, the greater the number of consumers who receive information, indicating that $\frac{\partial \theta_t}{\partial V_t} > 0$. The forecast error is the gap between individuals' inflation forecasts and actual inflation: $EXGAP_t = E\left({\pi_t}^e \middle| \Phi_{v,t}\right) - \pi_t$; we refer to this variable as the "expectations gap." We refer to the absolute forecast error, which measures the accuracy of consumers' expectations, as the "absolute expectations gap": $|EXGAP_t| = \left|E\left({\pi_t}^e \middle| \Phi_{v,t}\right) - \pi_t\right|$. With regard to media bias, two conditions are possible, as follows:

Condition 1: Media reports are unbiased, i.e., $\overline{\Phi_t}$=π_t

$$EXGAP_t = E\left({\pi_t}^e \middle| \Phi_{v,t}\right) - \pi_t = \rho_{t-1}\theta_{t-1}\,\Omega_t + (1-\theta_{t-1})\,\Omega_t \tag{3}$$

$$\frac{\partial(EXGAP_t)}{\partial V_{t-1}} = \left[\frac{\partial \rho_{t-1}}{\partial V_{t-1}}\theta_{t-1} - (1-\rho_{t-1})\frac{\partial \theta_{t-1}}{\partial V_{t-1}}\right]\Omega_t \begin{cases} \leq 0, \Omega_t \geq 0 \\ \geq 0, \Omega_t < 0 \end{cases} \tag{4}$$

$$\frac{\partial|EXGAP_t|}{\partial V_{t-1}} = \frac{\partial|\rho_{t-1}\theta_{t-1}\Omega_t + (1-\theta_{t-1})\Omega_t|}{\partial V_{t-1}} = \frac{\partial(\rho_{t-1}\theta_{t-1} + 1 - \theta_{t-1})|\Omega_t|}{\partial V_{t-1}} \leq 0 \tag{5}$$

where $\Omega_t = \alpha\pi_t + \beta GAP_t - \pi_t$, Eq. (4) and Eq. (5) are the effects of the quantity of media reports on the expectations gap and absolute expectations gap, respectively. Even though $\left[\frac{\partial \rho_{t-1}}{\partial V_{t-1}}\theta_{t-1} - (1-\rho_{t-1})\frac{\partial \theta_{t-1}}{\partial V_{t-1}}\right] < 0$, Ω_t is independent of media reports and has an undetermined sign, reflecting the uncertain effect of the quantity of media reports on inflation, an expectations gap is required. Eq. (5) shows that more media reports promote the accuracy of forecasts by reducing the absolute expectations gap. If the mean value of individuals' expectations exceeds the actual inflation rate (i.e., $\alpha\pi_t + \beta GAP_t - \pi_t \geq 0$), more media reports promote forecast accuracy by reducing the gap between expectations and the actual inflation rate. If the mean expectations value is lower than actual inflation (i.e., $\alpha\pi_t + \beta GAP_t - \pi_t < 0$), more media reports promote forecast accuracy by increasing the expectations gap. Specifically:

Hypothesis 1: If media reports are unbiased, more media reports improve the accuracy of individuals' expectations by drawing expectations closer to actual inflation.

Condition 2: Media reports are biased, i.e., $\overline{\Phi_t} \neq \pi_t$

In this situation, media reports are biased and individuals are persuaded by those reports, i.e., $\overline{\Phi_t} = \pi_t + \varphi_t$ and $\varphi_t \neq 0$, where φ_t denotes an unknown average bias generated from media reports. The expectations gap, absolute expectations gap, and corresponding partial effects of media reports are different from the condition where media reports are unbiased.

$$EXGAP_t = E\left(\pi_t{}^e \middle| \Phi_{v,t}\right) - \pi_t = (\rho_{t-1}\theta_{t-1} - \theta_{t-1})(\Omega_t - \varphi_t) + \Omega_t \quad (6)$$

$$\frac{\partial EXGAP_t}{\partial V_{t-1}} = \left[\frac{\partial \rho_{t-1}}{\partial V_{t-1}}\theta_{t-1} - (1-\rho_{t-1})\frac{\partial \theta_{t-1}}{\partial V_{t-1}}\right](\Omega_t - \varphi_t)\begin{cases} \leq 0, \Omega_t - \varphi_t \geq 0 \\ \geq 0, \Omega_t - \varphi_t \leq 0 \end{cases} \quad (7)$$

$$\frac{\partial |EXGAP_t|}{\partial V_{t-1}} = sgn(EXGAP_t)\frac{\partial EXGAP_t}{\partial V_{t-1}} \begin{cases} \leq 0,\ EXGAP_t(\ \Omega_t - \varphi_t) \geq 0 \\ \geq 0,\ EXGAP_t(\ \Omega_t - \varphi_t) < 0 \end{cases} \quad (8)$$

where $sgn(EXGAP_t) = \begin{cases} 1, EXGAP_t \geq 0 \\ -1, EXGAP_t < 0 \end{cases}$. According to Eq. (7), if people's expectations are high enough—i.e., the gap between expected and actual inflation exceeds the bias of media reports—a greater number of reports will reduce the expectations gap. On the other hand, if people's expectations are already low, more reports will increase the expectations gap. According to Eq. (8), the sign of $\frac{\partial |EXGAP_t|}{\partial V_{t-1}}$ depends on the sign of $EXGAP_t$ and $(\ \Omega_t - \varphi_t)$. If $EXGAP_t(\Omega_t - \varphi_t) \geq 0$, more media reports will improve expectation accuracy and reduce the absolute expectations gap. Otherwise, more media reports will hinder the accuracy of people's expectations. This leads to the following two hypotheses:

Hypothesis 2 If media reports are biased and individuals are persuaded, the content of media reports skews their expectations. The volume of media reports has potentially differential effects on the expectations gap.

Hypothesis 3 If media reports are biased and individuals are persuaded, the volume of reports also has potentially differential effects on the absolute expectations gap.

Media bias is ignored in the cited analysis and literature.

$$\frac{\partial(EXGAP_t)}{\partial\varphi_t} = \theta_{t-1}(1-\rho_{t-1}) \geq 0$$

(9)

$$\frac{\partial|EXGAP_t|}{\partial\varphi_t} = \frac{\partial\sqrt{(EXGAP_t)^2}}{\partial\varphi_t} = sgn(EXGAP_t)\theta_{t-1}(1-\rho_{t-1})\begin{cases}\geq 0, EXGAP_t \geq 0\\ \leq 0, EXGAP_t < 0\end{cases}$$

(10)

$$\frac{\partial|EXGAP_t|}{\partial|\varphi_t|} = \begin{cases}\theta_{t-1}(1-\rho_{t-1}), sgn(EXGAP_t)sgn(\varphi_t) = 1\\ -\theta_{t-1}(1-\rho_{t-1}), sgn(EXGAP_t)sgn(\varphi_t) = -1\end{cases} \quad (11)$$

Eq. (9) indicates media bias broadens the expectations gap, whereas Eq. (10) and Eq. (11) both illustrate that media bias and its absolute value have uncertain effects on the absolute expectations gap:

Hypothesis 4 If media reports are biased and people are persuaded, greater media bias enlarges the expectations gap.

Hypothesis 5 If media reports are biased and people are persuaded, higher media bias impairs the accuracy of their expectations when the expectations gap is positive, but improves accuracy when the expectations gap is negative.

Hypothesis 6 If media reports are biased and people are persuaded, the accuracy of media reports has an ambiguous effect on the accuracy of their expectations. If media reports and people's expectations both overestimate or underestimate actual inflation, more accurate media reports induce more accurate expectations.

The rationale behind these hypotheses is less complicated than it may appear. According to Eq. (1), consumers' expectations are a weighted average of the prior mean expectation and the average message obtained from the media, which is weighted by composites of θ_t and ρ_t, depending on the content of media reports. Therefore, a large number of media reports may produce any of three effects, depending on the economic landscape. For unbiased media reports, more reports draw the average inflation expectations of informed individuals closer to the actual rate and improve the accuracy of their forecasts. Biased media reports may draw the average expectations of informed agents away from the actual inflation rate in either direction. Uninformed individuals retain their existing expectations, which may be skewed in either direction relative to actual inflation. As a consequence, the effect of media reports on inflation expectations is an integrated product of unbiased versus biased reports and out-of-date versus up-to-date inflation expectations.

Applying Eq. (6), we calculate the following empirical equation to test the effects of media coverage on inflation expectations:

$$y_t = \gamma + \Gamma Media_t + \Theta Z_t + \varepsilon_t \tag{12}$$

where $Media_t$ denotes a vector of media variables (the quantity of media reports and media bias), Z_t is a vector of additional controls consisting of actual inflation, lagged inflation, and output gap, and y_t is a vector of dependent variables consisting of the gap between expected and actual inflation and its absolute value.

3. Method

3.1 Inflation expectation

We derived raw coded data on consumers' inflation expectations from the quarterly survey of Chinese Urban Depositors Questionnaire conducted by the P. R. Bank of China. Approximately 23,200 Chinese depositors are surveyed every February, May, August, and November about their price expectations for the coming three months. Given the required survey time, the expectations correspond to March–May, June–August, September–November, and December–February. In this paper we measure actual inflation as the period-over-period growth rate of the consumer price index (CPI) as calculated by the National Bureau of Statistics of P. R. China. Quantified inflation expectations are measured using the international mainstream CP Probability Method, which relatively accurately translates qualitative survey data into quantitative data (Carroll, 2003; Maag, 2010).

3.2 Media report data

Media reports were retrieved from China National Knowledge Infrastructure (CNKI), one of the most authoritative Chinese databases. The CNKI includes more than 700 pieces of public information published by Chinese newspapers. Following the most influential strand in the literature, we screened for reports dealing with inflation using a multi-keyword information retrieval protocol. The keywords entered were "inflation," "deflation," "CPI, Consumer Price Index," "Index of Consumer Prices," and certain synonymous descriptions. The multi-keyword information retrieval method may return unrelated or misclassified reports. To counter such errors, two analysts reviewed the selected reports for topic and content and removed irrelevant ones. The screened reports were classified as predicting rising or falling inflation (RR or FR, respectively), and the ratios of rising and falling reports to overall media reports were labeled as RP and FP, respectively.

- V: Total number of reports
- RR (Rising Reports): Number of reports regarding rising inflation
- FR (Falling Reports): Number of reports regarding falling inflation
- RP (Percentage of rising inflation reports): *RR/V*
- FP (Percentage of falling inflation reports): *FR/V*

The effect of media bias on inflation expectations is analyzed using two different measures of media bias according to the benchmark comparison theory (Gentzkow & Shapiro, 2010; Groseclose & Milyo, 2005). A comparison between the two measurements helps to establish the robustness of our empirical results.

First, we use $\varphi_{1t} = RP_t - \omega_1 FP_t$ to measure media bias, where $\omega_1 > 0$ represents the comparative strength of reports dealing with rising versus falling inflation. A positive ω_1 value indicates that reports of rising versus falling inflation expectations have different saliency for the public (Benford & Driver, 2008; Dräger, 2014). Therefore, media reporting bias is a weighted average of the ratios of rising to falling reports. For inflation-neutral reports, we assume that only noise is transmitted. Media bias (φ_{1t}) may have a positive or negative value. A φ_{1t} value of 0 means media reports are unbiased. The effect of media bias on inflation expectations can be described as $F_{\varphi_{1t}} = \omega_2 \varphi_{1t} = \omega_2 RP_t$-$\omega_1 \omega_2 FP_t$, where ω_2 is an undetermined coefficient. Thus, the effect of media bias on individuals' inflation expectations depends on the comparative strength of rising versus falling reports.

Second, considering that people are likely to perceive reports of increasing inflation as bad news, and vice versa (Benford and Driver, 2008; Dräger, 2014; Zhang et al., 2014), we categorized the inflation expectation generated from each media report. Media reports could potentially deal with rising inflation, falling inflation, or inflation-neutral information (the last exemplified by qualitative survey data of individuals' expectations and perceptions of inflation), with corresponding effects on inflation expectations. Therefore, we use the CP Probability Method to measure media-generated inflation expectations as follows: $MEDIAEX_t^e = -a\frac{FP_t - RP_t}{1 - FP_t - RP_t}$, where $a = \frac{\sum_{t=1}^{T}\pi_t}{\sum_{t=1}^{T}(FP_t + RP_t)/\ (FP_t - RP_t)}$. The bias and absolute bias of media reports correspond to $\varphi_{2t} = MEDIAGAP = MEDIAEX_t^e - \pi_t$ and $|\varphi_{2t}| = |MEDIAGAP| = |MEDIAEX_t^e - \pi_t|$, respectively.

3.3 Descriptive analysis

Prior to 2005 about 10 publications dealt with inflation. Nowadays more than 200 do so, indicating greater attention to this issue. Hence, we use only post- 2005 data in order to eliminate possible errors generated by instability in the early reports. Table 1 presents the summary statistics. The media are more likely to report rising than falling inflation. For each period some reports predict rising, and others, falling inflation, illustrating the inconsistent content of media reports. People reading reports of rising inflation are likely to expect higher inflation rates, and vice versa. Both consumers' and the media's inflation expectations are close to actual inflation rates (0.88, 0.75, and 0.81). The difference between consumers' inflation expectations and actual inflation ($EXGAP_t$) averages 0.05, which is statistically insignificant. Even the maximum bias is not significant, suggesting that consumers' inflation expectations are virtually unbiased. However, the maximum absolute bias (2.87) is significant, indicating that in certain periods consumers' inflation expectations do deviate substantially from actual inflation. Although the measures of media bias ($MEDIAGAP_t$) and its absolute value ($|MEDIAGAP_t|$) are not significant (-0.06 and 1.4, respectively), the maximum values of 4.1 and 4.3 confirm media reports can induce significant distortion in certain periods.

Figure 1 plots the inflation expectations gap ($EXGAP$) against the volume of media reports (V). Although the quantity of media reports generally trends with the inflation expectations gap, the relationship between the two is not fixed. For example, a high volume of media reports may be followed by a high $EXGAP$ period—e.g., 2007Q2 (i.e., second quarter of 2007), 2008Q1, 2008Q2, and 2011Q2—indicating that a large quantity of media reports does not necessarily bring consumers' inflation expectations closer to actual inflation; in other cases heavy media reporting seems to produce more accurate expectations (e.g., 2013Q1).

To capture the relationship between consumers' inflation expectations and media reports, we compared trends in the consumer inflation expectation gap and media bias (Figure 2). Given that the comparative effects of reports regarding rising and falling inflation are unknown, we assign different values to ω_1. As Figure 2 shows, media bias (represented by φ_{1t}) has the same tendency whether $\omega_1 = 1$ or 0.5. Although the media bias value changes slightly, the tendency of φ_{1t} is independent of the value of ω_1 ($0 \leq \omega_1 \leq 1$), implying a robust correlation between media bias and consumers' inflation expectations. Further analysis of φ_{2t} and $EXGAP_t$ suggests an even stronger correlation between the gap in consumers' inflation expectations ($EXGAP_t$) and media bias ($MEDIAGAP_t$), with a stable and close trend between the two measures. The correlation between the absolute values of these measures ($|EXGAP_t|$ and $|MEDIAGAP_t|$) is less stable. As Figure 3, the absolute inflation expectations gap usually follows absolute media bias, but when absolute media bias is high, they may deviate from each other significantly (e.g., 2008Q1–2009Q1 and 2010Q1–2010Q3).

4. Results

Hypothesis 2–6, which assume media bias, are empirically tested in Tables 2 and 3. In Table 2 the different signs for Eqs. (1–3) indicate that a higher volume of biased media reports does not necessarily increase or decrease consumers' inflation expectations, even though some research has claimed volume is significantly correlated with size of the expectations gap. Eqs. (1) and (2) show that whereas reports of rising inflation expand the expectations gap, reports of falling inflation reduce it.

The significantly positive coefficient for volume of media reports in Eq. (3) suggests that a higher quantity of media coverage expands the expectations gap. The results confirm that the effect of the volume of media reports on consumers' expectations gap varies depending on the duplicate effects of rising reports and falling reports. Over the sample period, $\overline{\Omega_t - \varphi_t}$ is less than 0 (mean = −0.592). Therefore, the positive value for volume of media reports confirms Hypothesis 2: if $\Omega_{t+1} - \varphi_{t+1} \leq 0$, more frequent, biased media reports increase the expectations gap. Table 3 shows that the volume of media reports is not significantly correlated with the absolute expectations gap. The coefficients of V, RR, and FR are insignificant in Eqs. (6) to (8), showing that the volume of media reports does not impact the absolute gap in consumers' inflation expectations. This result contradicts Carroll's (2003) findings for the United States, where an increased volume of reports decreases the absolute expectations gap significantly. In contrast, for Germany Lamla and Lein (2014) found no significant correlation between the volume of reports and the absolute expectations gap. In sum, if media reports are biased, the volume of reports does not necessarily improve the accuracy of consumers' inflation expectations.

The effects of media bias on consumers' inflation expectations gap and Hypotheses 4–6 are also shown in Tables 2 and 3. In this paper, ω_1 denotes the relative effect of both rising and falling reports, which is expected to be positive, and ω_2 denotes the effect of positive media bias on the expectations gap, which is also expected to be positive. Eq. (4) in Table 3 reveals $\omega_2 > 0$ and -$\omega_1\omega_2 < 0$, showing that both the coefficients of RP (Rising Percentage) and FP (Falling Percentage) are significant with the signs as expected. The empirical results support the hypothesis that whereas rising reports increase the expectations gap, falling reports decrease it, and media bias enlarges the gap in consumers' inflation expectations. The significance of $MEDIAGAP_t$ in Eq. (5) reinforces the preceding results and Hypothesis 4. Nevertheless, media bias has an unpredictable effect on the accuracy of consumers' expectations. As Eq. (9) in Table 3 shows, the coefficients of RP and FP are insignificant, and media bias φ_2 in Eq. (10) has no significant correlation with the absolute expectations gap. The results show no evidence of a relationship between media bias and the absolute expectations gap.

According to Eq. (11) in Table 3, the accuracy of consumers' expectations ($|EXGAP_t|$) has a significant positive correlation with the accuracy of media reports ($|MEDIAGAP_t|$), with a 1% increase in absolute media bias increasing the absolute expectations gap by 0.42%. Thus, media bias appears to have a stronger effect than volume of media reports in influencing consumers' inflation expectations. Furthermore, all constants in Table 3 are significant, indicating a certain pattern of deviation among Chinese consumers' expectations.

Deepening the analysis, we use a numerical simulation to capture the correlation among the inflation expectations gap, volume of media reports, and media bias. In Figure 4 the expectations gap fluctuates widely when ρ_t and φ_t change. The more that media reports deal with inflation predictions (i.e., ρ_t is smaller), the more significant the effect of media bias on the expectations gap. For example, if ρ_t is close to 1, indicating that the volume of media reports is very small, media bias has little effect on the inflation expectations gap. If ρ_t is close to 0, indicating a high volume of media reports, the inflation expectations gap is significantly affected by media bias. The greater the degree of media bias, the higher the inflation expectations gap, and vice versa. However, on each surface, the change of ρ_t has an ambiguous effect on EXGAP_t, depending on the actual inflation and the output gap. This result suggests that more frequent media reports do not necessarily promote the accuracy of inflation expectations. In fact, when the media tend to report on rising inflation ($\varphi_t > 0$), more frequent media reports induce a larger positive gap between expected and actual inflation. Conversely, when the media tend to report on falling inflation ($\varphi_t < 0$), more media reports induce a larger negative gap between expected and actual inflation rates.

Therefore, reports on rising inflation and falling inflation have different effects on consumers' inflation expectations and the effect of media coverage is unpredictable. Even if media reports are unbiased (i.e., $\varphi = 0$), the effect of more frequent media reports depends on the actual inflation rate and output gap. Thus, a greater number of media reports, whether biased or unbiased, will not necessarily improve the accuracy of consumers' inflation expectations. If the media bias has a high enough positive value (indicating that most reports focus on rising inflation, i.e. $\varphi_t > max\{\Omega_t\}$), more media reports lead consumers to expect higher inflation. If media bias has a sufficiently low negative value to indicate that most reports focus on falling inflation (i.e. $\varphi_t < min\{\Omega_t\}$), a higher volume of media reports leads consumers to expect lower inflation. The numerical simulation results suggest that in the formation of inflation expectations both the volume and accuracy of media reports matter, and media bias has a greater effect than report volume.

We conducted three additional tests to establish the robustness of the empirical results. First, we used two indicators (φ_1 and φ_2) to measure media bias (see Tables 2 and 3). The stability of these values confirms the validity of our results. Second, Generalized Method of Moments (GMM) is employed to estimate Eq. (12). All media variables are instrumented by their own two lags and the main results are not affected. Finally, the potential for endogeneity in the regression analyses was tested using the Geweke causality test to check whether inflation expectations might have influenced media reports. The results, summarized in Table 4, suggest that in the long term the quantity of media reports causes the expectations gap, but the reverse is untrue. Furthermore, there is a significant instantaneous Geweke causality between the quantity of media reports and inflation expectations, indicating that current media reports affect the current inflation expectations gap. Although no long-term statistical causality is found between the expectations gap and the media expectations gap, a statistically significant causality demonstrates that the content of media reports affects consumers' inflation expectations in the immediate term. These results suggest that media reports have a long-term causal effect on the expectations gap rather than the other way around, and that the volume and bias of media reports explain the expectations gap in the short term. The Geweke causality test shows no reverse causation from the release of survey data to media reports. As a consequence, the robustness tests reinforce the empirical results.

5. Conclusions

Information disseminated by the media has a significant effect on consumers' inflation expectations and hence the economy. More than 29% of newspapers, 60% of television stations, and 72% of radio stations in 97 countries and regions are owned and controlled by the national government and have a proven tendency to avoid or defer news that would reflect badly on the government. In these localities, media reports tend to be biased and to distort the statistics used to form inflation predictions. Most previous research has focused on how the quantity of media reports affects consumers' inflation expectations, with few attempts to quantify the correlation between media bias and inflation expectations. To address this gap, we used a theoretical model based on sticky information and partial information to investigate empirically how the quantity and bias of media reports affect inflation expectations.

Assuming that a proportion of consumers adjust their inflation expectations based on media messages, and that the remaining consumers retain their existing expectations, both theoretical and empirical results suggest that both degree of bias and volume of media reports influence consumers' inflation expectations. However, media bias has a more powerful effect than volume of media reports. A large number of media reports may affect inflation expectations in three directions: (1) unbiased reports improve the accuracy of consumers' inflation expectations; (2) biased media reports sway consumers' inflation expectations away from the actual inflation rate in the direction of the report, and (3) the greater the volume of reports, the greater the proportion of consumers who have received that message and thus the greater the effect of media bias compared to quantity of media reports. Therefore, volume of media coverage has a differential effect on consumers' inflation expectations depending on the degree of media bias.

The significant effect of media reports on consumers' inflation expectations has important policy implications for central banks aiming to manage inflation expectations and stabilize inflation. Given that media deregulation and competition help to improve the accuracy of media reports, central banks should seek to promote transparency as well as competition among the mass media in order to anchor inflation expectations. The present analysis highlights the importance of central banks employing a careful communication strategy to minimize the risk of media bias and ensure that consumers are informed accurately and promptly. These measures would enhance the credibility of central banks in their quest to effectively control the cost of anti-inflation because of the self-fulfillment of accurate inflation expectations. As a consequence, the expectation trap is avoided by stabilizing both inflation expectations and output.

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Figure 1

Inflation expectations gap (EXGAP) plotted against volume of media reports (V), 2005–2014

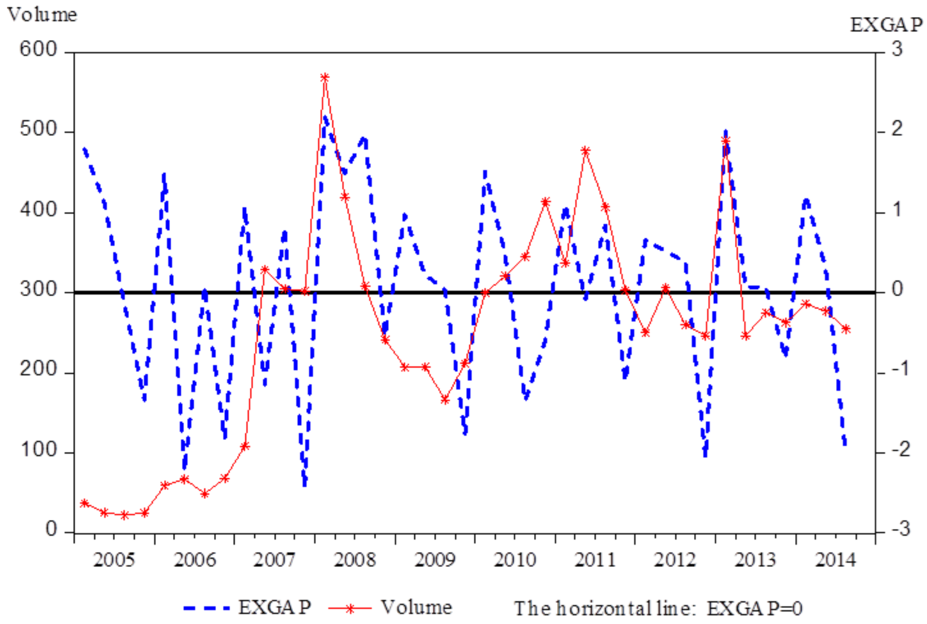

Figure 2

Correlation between inflation expectations gap (EXGAP) and media bias (φ_1 and φ_2) RP(-1)-FP(-1) denotes φ_1 with ω_1=1, RP(-1)-0.5*FP(-1) denotes φ_1 with ω_1=0.5

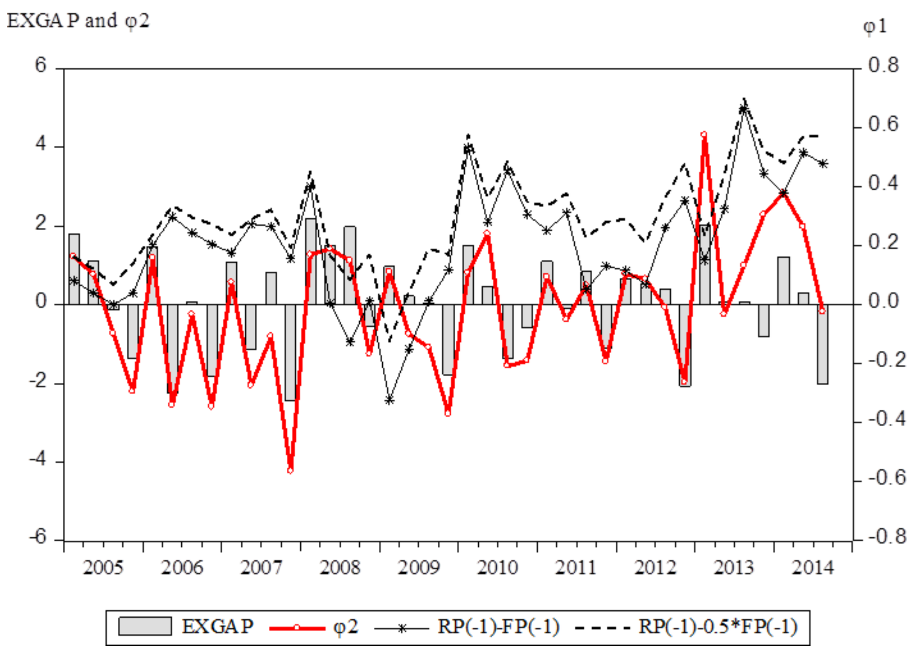

Figure 3

Correlation between absolute values of inflation expectations gap (|EXGAP|) and absolute media bias (|MEDIAGAP|)

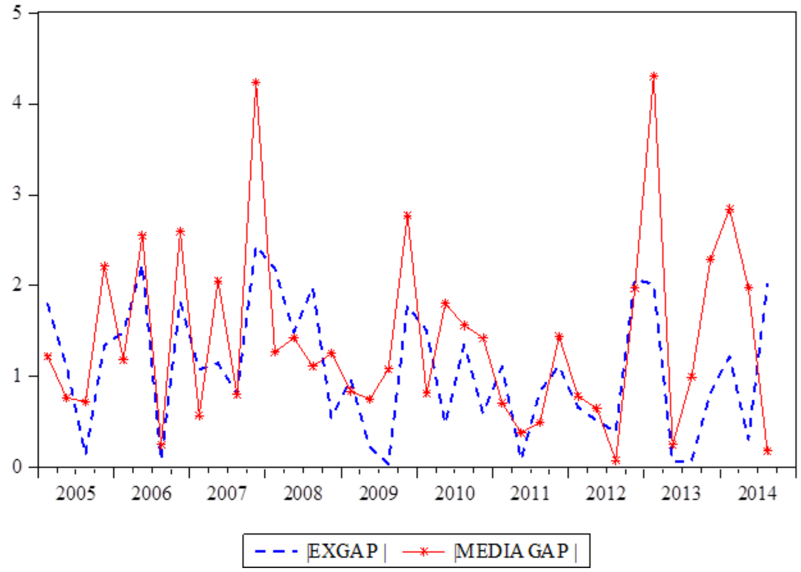

Figure 4

Numerical simulation of the correlation between inflation expectations gap (EXGAP), volume of media reports (ρ), and media bias (φ)

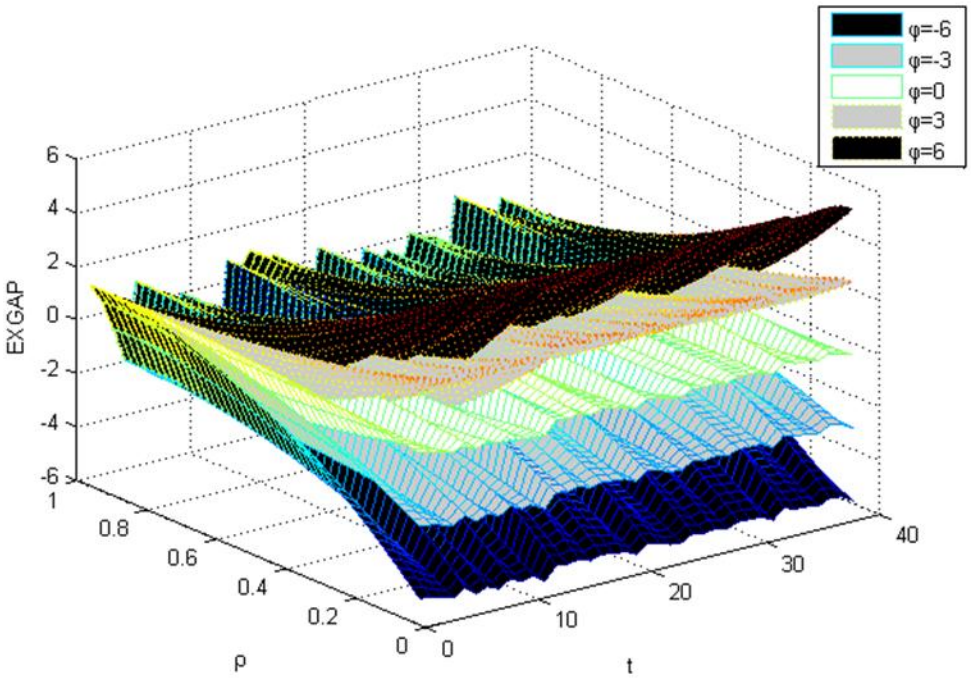

Table 1

Summary Statistics

Variable	Mean	STD	Max	Min
π_t	0.81	1.50	2.43	0.15
π_t^e	0.88	0.50	2.43	0.15
$EXGAP_t$	0.05	1.34	2.19	-1.87
$\lvert EXGAP_t \rvert$	1.12	0.72	2.87	0.01
$MEDIAEX_t$	0.75	1.00	4.10	-0.75
$MEDIAGAP_t$	-0.06	1.74	4.30	-4.23
$\lvert MEDIAGAP_t \rvert$	1.40	1.00	4.30	0.07
V_t	250.87	137.11	569.00	22.00
RR_t	106.59	70.70	286.00	3.00
FR_t	48.03	38.00	144.00	3.00
RP_t	0.39	0.15	0.73	0.08
FP_t	0.19	0.11	0.43	0.03

Notes: π_t = actual inflation; π_t^e = inflation expectation; $EXGAP_t$ = the gap between expected and actual inflation;

$|EXGAP_t|$ = the absolute value of $EXGAP_t$, measuring the accuracy of consumers' expectations; $MEDIAEX_t$ = media-generated inflation expectations; $MEDIAGAP_t$ and $|MEDIAGAP_t|$ denote the difference between $MEDIAEX_t$ and actual inflation, and the absolute value thereof, respectively. V_t, RR_t, and FR_t are the numbers of reports dealing with inflation, rising inflation, and falling inflation, respectively. RP_t and FP_t are the ratios of RR_t and FR_t, respectively.

Table 2

Effects of volume and bias of media reports on inflation expectations gap

	Equation No.				
	(1)	(2)	(3)	(4)	(5)
π_t	-0.830***	-0.846***	-0.746***	-0.830***	-0.723***
π_{t-1}	0.117***	0.067	0.190***	0.095***	0.087*
GAP_t	0.643***	0.741***	0.644***	0.724***	0.680***
RR_{t-1}	0.003***				
FR_{t-1}		-0.005***			
V_{t-1}			0.002***		
RP_{t-1}				0.608***	
FP_{t-1}				-1.644***	
$MEDIAGAP_t$					0.114**
Constants	0.322**	0.949***	0.010	0.708**	0.599***
Observations	38	38	38	38	38
R^2	0.96	0.95	0.96	0.97	0.95

Notes: Dependent variable is $EXGAP_t$

*** p = .01 ** p = .05 * p = .1

Table 3

Effects of volume and bias of media reports on the absolute inflation expectations gap

	Equation No.					
	(6)	(7)	(8)	(9)	(10)	(11)
π_t	0.134*	0.141	0.119	0.119	0.104	0.002
π_{t-1}	0.154*	0.163*	0.159*	0.161**	0.164**	0.116*
GAP_t	-1.292***	-1.316***	-1.334***	-1.341**	-1.344**	-1.680***
RR_{t-1}	0.000					
FR_{t-1}		0.001				
V_{t-1}			0.000			
RP_{t-1}				-0.282		
FP_{t-1}				-0.093		
$MEDIAGAP_t$					-0.015	
ABS $MEDIAGAP_t$						0.415***
Constants	0.806***	0.766***	0.768***	0.972**	0.855***	0.397**
Observations	38	38	38	39	39	39
R^2	0.27	0.27	0.26	0.27	0.27	0.54

Table 4

Geweke causality test for volume of media reports and gap in consumers' inflation expectations

X : $EXGAP$		$F_{X\to Y}$	$F_{Y\to X}$	F_{XY}	$F_{X,Y}$
V	Feedback value	0.121	5.803	71.18	72.29
	Concomitant probability	0.942	0.055	0.000	0.000
	Feedback percentage (%)	0.167	8.027	98.60	100.0
$MEDIAGAP$	Feedback value	0.819	0.125	31.65	32.59
	Concomitant probability	0.664	0.939	0.000	0.000
	Feedback percentage (%)	2.513	0.384	97.12	100.0

Note: $F_{X,Y}$ denotes the causal relation between the two variables X and Y and it is broken out into the causality of X on Y (denoted by $F_{X\to Y}$), the causality of Y on X (denoted by $F_{Y\to X}$), and the instantaneous causality between X and Y (denoted by F_{XY}). The feedback value is the maximum likelihood value for each test under the null hypothesis of $F_{X,Y}$, $F_{X\to Y}$, $F_{Y\to X}$, F_{XY} equal to 0. The concomitant probability is the corresponding *p*-value of the null hypothesis. The feedback percentage is the percentage of the feedback value.

Appendix A: Comparison of SIPC, NKPC, and Hybrid NKPC

Models	SIPC	NKPC	Hybrid NKPC
π_t	0.134***		
	(0.032)		
π_{t-1}	0.086***	-0.003	-0.012
	(0.037)	(0.027)	(0.031)
π_{t-2}			-0.017
			(0.027)
GAP_t	0.492***		
	(0.188)		
GAP_{t-1}		1.687***	1.679***
		(0.641)	(0.651)
Constant	0.636***	0.768***	0.789***
	(0.097)	(0.167)	(0.176)
Observations	52	52	51
R^2	0.62	0.53	0.53

Note: ***, **, and * denote significance at the 1%, 5% and 10% level, respectively. The dependent variable is ${\pi_t}^e$. π_t is the inflation, and GAP_t is the output gap.

Appendix B: GMM estimates of the effects of media reports on inflation expectations gap

	Dependent Variable: $EXGAP_t$				
	(1)	(2)	(3)	(4)	(5)
π_t	-0.798***	-0.885***	-0.773***	-0.872***	-0.541***
π_{t-1}	0.212***	0.018	0.180***	0.063***	0.091**
GAP_t	0.703***	0.728***	0.557***	0.506***	0.695***
RR_{t-1}	0.007***				
FR_{t-1}		-0.014**			
V_{t-1}			0.003***		
RP_{t-1}				1.089***	
FP_{t-1}				-2.476***	
$MEDIAGAP_t$					0.306**
constants	-0.433*	1.339***	-0.257*	0.095	0.332***
observations	34	34	31	31	34
R^2	0.94	0.91	0.96	0.97	0.93

Note: ***, **, and * denote significance at the 1%, 5% and 10% level, respectively.

Appendix C: GMM estimates of the effects of media reports on the absolute inflation expectations gap

	Dependent variable: $\lvert EXGAP \rvert$					
	(6)	(7)	(8)	(9)	(10)	(11)
π_t	0.201**	0.163*	0.205**	1.317	0.101	0.047
π_{t-1}	0.244***	0.196**	0.250***	0.144	0.214***	0.138**
GAP_t	-1.123**	-1.211***	-1.143**	-1.187***	-1.269****	-1.868***
RR_{t-1}	0.001					
FR_{t-1}		0.001				
V_{t-1}			0.001			
RP_{t-1}				-0.633		
FP_{t-1}				-1.465		
$MEDIAGAP_t$					-0.035	
ABS $MEDIAGAP_t$						0.397***
Constant	0.462	0.635**	0.325	1.317	0.738***	0.305**
Observations	37	37	37	38	39	39
R^2	0.24	0.24	0.24	0.23	0.24	0.52

Note: ***, **, and * denote significance at the 1%, 5% and 10% level, respectively.

Appendix A

Comparison of SIPC, NKPC, and Hybrid NKPC

Models	SIPC	NKPC	Hybrid NKPC
π_t	0.134***		
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	(0.037)	(0.027)	(0.031)
π_{t-2}			-0.017
			(0.027)
GAP_t	0.492***		
	(0.188)		
GAP_{t-1}		1.687***	1.679***
		(0.641)	(0.651)
Constant	0.636***	0.768***	0.789***
	(0.097)	(0.167)	(0.176)
Observations	52	52	51
R^2	0.62	0.53	0.53

Note: ***, **, and * denote significance at the 1%, 5% and 10% level, respectively. The dependent variable is ${\pi_t}^e$. π_t is the inflation, and GAP_t is the output gap.

Appendix B

GMM estimates of the effects of media reports on inflation expectations gap

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RR_{t-1}	0.007***				
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V_{t-1}			0.003***		
RP_{t-1}				1.089***	
FP_{t-1}				-2.476***	
$MEDIAGAP_t$					0.306**
constants	-0.433*	1.339***	-0.257*	0.095	0.332***
observations	34	34	31	31	34
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Note: ***, **, and * denote significance at the 1%, 5% and 10% level, respectively.

Appendix C

GMM estimates of the effects of media reports on the absolute inflation expectations gap

	Dependent variable: $\lvert EXGAP \rvert$					
	(6)	(7)	(8)	(9)	(10)	(11)
π_t	0.201**	0.163*	0.205**	1.317	0.101	0.047
π_{t-1}	0.244***	0.196**	0.250***	0.144	0.214***	0.138**
GAP_t	-1.123**	-1.211***	-1.143**	-1.187***	-1.269****	-1.868***
RR_{t-1}	0.001					
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Constant	0.462	0.635**	0.325	1.317	0.738***	0.305**
Observations	37	37	37	38	39	39
R^2	0.24	0.24	0.24	0.23	0.24	0.52

Note: ***, **, and * denote significance at the 1%, 5% and 10% level, respectively.