Explanatory factors of the inflation news impact on stock returns by sector: The Spanish case

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ABSTRACT

We study the short run response of daily stock prices on the Spanish market to the announcements of inflation news at an industrial level, deepening the potential explanatory factors of this response (risk-free interest rate, risk premium and growth expectations). We observe a positive and significant response of the stock returns in case of “bad news” (total inflation rate higher than expected one) in recession, and also in case of negative inflation surprises (“good news”) in non-economic recession. This behaviour is consistent with the evolution of the company dividend growth expectations, since we observe that the relationship between this theoretical component of the stock price and the unexpected inflation, to a large extent, seems to explain the observed behaviour.

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1. Introduction

This paper deals with the impact of inflation news on stock prices. The paper aims to test in one hand the market condition dependent investor’s discount rate hypothesis due to Veronesi (1999) and on the other hand the company related “flow-through” capacity hypothesis of Estep and Hanson (1980). Thus, we firstly analyse the short run response of the stock returns of each sector to unanticipated component of inflation announcements and, secondly, we study the potential explanatory factors of a differential sectoral response in each scenario.
In the first analysis we consider the direction of the inflation surprises and the state of the economy. In the second analysis, the Dividend Discount Model (DDM) is used as theoretical framework to control for the main components of stock prices: risk-free interest rate, risk premium of stocks and growth expectations of the company profits.

A large body of literature provides evidence for the movement of financial asset prices in response to inflation changes, but conclusions have been widely debated. Meanwhile many international researches have found a significant negative relationship (Bodie, 1976; Fama and Schwert, 1977, or more recently Hu and Willett, 2000; Hagmann and Lenz, 2004; Patra and Poshakwale, 2006), others papers have found no significant relationship (for example, Pearce and Roley, 1988; Joyce and Read, 2002; Payne, 2006; Jareño, 2006, 2008).

Classical explanations of the relationship between unexpected inflation and stock prices proposed in the literature are, for example, the “proxy” hypothesis (Fama, 1981; Geske and Roll, 1983; Kaul, 1987; Zhao, 1999), the nominal contracts hypothesis (Feldstein, 1980; Solnik, 1983; French et al., 1983), the net debtors/creditors hypothesis (Schwert, 1981), the behaviour of the monetary authorities (Fischer, 1993) or the efficient market hypothesis (Basu, 1977).

In any case, we focus our analysis on two alternative explanations. Firstly, the “behavioural finance” hypothesis (Veronesi, 1999), BFH, considers that recent direction of the market or the state of the economy may have a bearing on the extent to which investors respond to new information (Boyd et al., 2005). According to the theoretical equilibrium model of Veronesi (1999), investors discount good (bad) news at a higher rate if it is announced during bad (good) times.

Secondly, the “flow-through capability” hypothesis (Estep and Hanson, 1980), FTH, proposes that the relationship between stock returns and unexpected inflation news depends on the company’s capability of transferring inflation shocks to prices of products and services. This topic is crucial for portfolio managers who are interested in controlling stock returns’ sensitivity to inflation announcements. Asikoglu and Ercan (1992), and recently Jareño (2005) in the Spanish case, evidence that sectors have a different “flow-through capability”. In addition, other papers (Pearce and Roley, 1988; Amihud, 1996; Ewing et al., 2003; Adams et al., 2004; Jareño, 2006, 2008) prove that some features of the companies determine the real effect of the inflation changes on stock returns by sector.

In the Spanish case, Ferrer (2000) and Pérez de Gracia and Cuñado (2001) use cointegration techniques to study the relationship between inflation rates and stock returns in the long term and in aggregated terms. Both of them conclude that this relationship is permanent and its sign is negative. Jareño (2005) analyses the Spanish market and observes that sectors have a different ability to pass inflation shocks on to prices of the products. This capability affects the sensitivity of each sector to inflation changes. Later, Jareño and Navarro (2006) show a negative relationship between the flow-through ability of the companies of each sector and the sensitivity of stock returns to inflation shocks.

Focussing on the time-series event-study methodology, we stress some Spanish and international researches. A large number of recent papers use this approach to analyse the repercussion of some macroeconomic announcements on returns of different market indexes, interest rates or stocks.¹ In general, these papers focus on examining (1) the linearity and asymmetry of the response considering macroeconomic news, (2) the path and speed of that response and (3) the stability of the latter according to the state of the economy or the direction of the news, distinguishing between good and bad news, and even the effects on trading volume.

Related to this subject, in the Spanish case we find some papers have studied several seasonalities about the stock returns, such as January effect (Rubio and Salvador, 1991; Peña, 1995; Meneu and Pardo, 2001), the effect of derivatives market introduction (Corredor and Santamaría, 1996) or effects of rating changes (Abad and Robles, 2006, 2007).

On the other hand, Campbell and Mei (1993) and recently Boyd et al. (2005) study the main explanatory factors which determine the stock prices. Both of them are based on the Dividend Discount Model (DDM) in order to control for the main components of stock prices: risk-free interest rate, risk premium of stocks and growth expectations of the company profits. According to these papers, macroeconomic

announcements affect stock prices, because they contain information about one or more of these primitive factors.

Thus, we mainly make two contributions to the literature. Our analysis by sector is the first contribution, taking into account the flow-through capability of each sector of activity. This ability determines the relationship between unexpected inflation and stock returns. Second, this is the first time in the Spanish market that the possible explanatory factors of the observed behaviour of the stock returns in the DDM framework have been studied.

In our analysis of the inflation news impact on stock returns, we obtain two main results. On one hand, total inflation rates higher than expected one (positive inflation surprises), which can be initially understand as “bad news”, have a positive and statistically significant repercussion during recessions in the Spanish case on stock returns. On the other hand, “good news” (total inflation rates lower than expected one, i.e., negative inflation surprises) have a statistically insignificant effect on stock returns of most of the sectors.

From the analysis of the relationship between inflation announcement and each primary factor in the DDM, we observe that, except risk premium, the rest of the components of stock prices can explain most of the behaviour of stock returns to inflation announcements, above all growth expectations of the company profits. In certain scenarios, completely consistent relationships to those observed in the analysis of stock returns are found. Also, the flow-through capability of companies helps to explain the significant different responses exhibited by sectoral returns to inflation announcements.

The rest of our paper is organized as follows. The next section explains the data and methodology used in this paper. Section 3 describes alternative estimating processes of the unexpected component of inflation rates, and the following section shows a traditional analysis of the response of the abnormal returns by sector to inflation announcements. In the fifth section we analyse this response taking into account the evolution of the three main factors which determine the stock prices. Finally, the last section includes a summary and concluding remarks.

2. Data and methodology

We consider monthly announcements of IPC (Spanish consumer price index) released by INE (Instituto Nacional de Estadística) and the exact date of each announcement, between February 1990 and December 2004. In all we have 179 IPC monthly announcements.\(^2\)

The Spanish consumer price index (IPC) is a weighted average of indexes referred to several groups of consumer goods, according to the Laspeyres formula.\(^3\) In the IPC preparation, prices are taken during the full calendar month (from the first day to the last one) and this information is announced around the middle of the following month. The monetary authorities publish the annual schedule with the exact date of each announcement, but the first available annual schedule corresponds to 1995. The announcements which cover the period from February 1990 through January 1995 have been extracted from “El País” newspaper advertisements.

On the other hand, on May 2004, INE starts to publish the advanced harmonized consumer price index (IPCA) in the first days of the following month. From this period, we consider this announcement assuming that contains the unexpected information.

In order to remove the seasonal component of the IPC series, we use a year-to-year inflation rate. Thus, the monthly inflation rate after seasonal adjustment (\(\pi_t\)) is obtained using the following expression:

\[
\pi_t = \frac{\text{IPC}_t - \text{IPC}_{t-12}}{\text{IPC}_{t-12}}
\]

where IPC\(_t\) is the consumer price index at time \(t\).

During the same sample period, we obtain daily (close-to-close) returns of 115 individual companies traded in the electronic system of the Spanish Stock Exchange, SIBE.\(^4\) We consider all Spanish firms

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\(^2\) We have tried to include “Producer Price Index” (PPI) in our analysis, but dates of announcements are not available in Spain.

\(^3\) More detailed information about the preparation of the price index can be found in www.ine.es.

\(^4\) We adjust stock prices by splits.
which have been quoted during some period in the sample, in order to avoid a possible survival bias of considering only the companies which cover the whole sample. Also, foreign companies quoted in the Spanish Stock Exchange were removed from the sample. We use daily data which allow us to isolate the IPC announcement effects from any other macroeconomic announcements during the month.\(^5\) Finally, we check that, in general, announcements about other macroeconomic magnitudes are not published on the announcement day and during the event window.

Our sample includes 115 Spanish companies and we create daily equally weighted sector-based stock portfolio returns.\(^6\) We use the Madrid Stock Exchange sector definition scheme, but we implement additional subdivisions of two sectors to do resultant sub-sectors more homogeneous. Thus, sector 2 has been split up into “Building sector” (S2B) and “Non-Building sector” (S2WB) and sector 4 into “Media sector” (S4 M) and “Non-Media sector” (S4WM). Table 1 depicts the name of the sectors (S1, S2, . . ., S6), subsectors and the number of companies included in each one. Finally, we calculate a daily equally-weighted total market return as a proxy of the market return (M).

### 3. Estimation of the unexpected inflation component

Some methodologies for measuring the unexpected component of inflation rate can be found in the literature. The most popular approximation (e.g., Schwert, 1981; Joyce and Read, 2002; Fraser et al., 2002; Mestel and Gurgul, 2003) uses simple time series models in order to estimate the expected inflation component, in concrete, ARIMA models or, more specifically, the Box–Jenkins identification–estimation methodology of ARIMA (autoregressive integrated moving average time series models). It is assumed that this component depends on own past of the series. The unexpected component \((\pi^u_t)\) is estimated as the difference between the observed total inflation rate \((\pi_t)\) and the expected component \((\pi^e_t)\).

On the other hand, an alternative methodology uses periodical surveys of forecasts, such as MMS (International Money Market Services) or Thomson Financial, as suitable proxies of the expected inflation rate (Flannery and Protopapadakis, 2002; Andersen et al., 2003; Adams et al., 2004). Unfortunately, similar information is not available in the Spanish case.\(^7\)

Some authors, such as Schwert (1981) and Asikoglu and Ercan (1992), use short-term interest rates as predictors of inflation rate, but according to Alonso-Sánchez et al. (2000) Spanish interest rates do not increase the explanatory capability of the own past of the prices to a great extent.

A branch of literature relies on certain expressions which depend on multiple variables for estimating the inflation rate, such as the growth of the money supply, labour cost, crude oil price or the growth of the industrial production (Hu and Willett, 2000; Boyd et al., 2005; Williams and Adedeji, 2007). Other authors use VAR models (autoregressive vectors) in order to obtain the inflation rate (e.g., Anari and Kolari, 2001; Hagmann and Lenz, 2004), and the simple Kalman filter (Lee, 1992) or the Hodrick–Prescott filter (Kramer, 1998; Pérez de Gracia and Cuñado, 2001; Claar, 2006).

Recently other studies (Sack, 2000; Alonso et al., 2001; Tesseromatis, 2003) use government inflation-indexed bonds. Unfortunately, these bonds are not issued at present by the Spanish Treasury.

Finally, Leiser and Drori (2005) use a naïve model or “myopic expectations” which assumes that the best forecast of inflation rate coincides with the information of the previous month.

Thus, we use the most popular approximation and we estimate the expected inflation rate from ARIMA time series models. In this sense, Joyce and Read (2002) observe similar results using different alternative procedures to proxy the expected inflation rate.

A visual inspection of the inflation rate graph and the classical unit root tests confirms that inflation is not stationary in mean, I(1). The rank-mean analysis evidences that inflation is stationary in variance.\(^8\)

\(^5\) To see advantages of daily data against monthly data, see McQueen and Roley (1993), Flannery and Protopapadakis (2002) and Adams et al. (2004).

\(^6\) We assume that inflation announcements are published before the closing time of the stock exchange market.

\(^7\) Reuters publishes advanced estimations about inflation rate, although the availability of historical data is reduced.

\(^8\) We use augmented Dickey–Fuller, Phillips–Perron and KPSS (Kwiatkowski–Phillips–Schmidt–Shin) tests. In the interest of brevity, we do not report these results and graphs.
Table 1
Number of companies included in this analysis and the sector to which they belong.

<table>
<thead>
<tr>
<th>Sector name</th>
<th>Subsectors</th>
<th>Number of firms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sector 1: oil and energy (S1)</td>
<td>1.1: oil</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>1.2: electricity and gas</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.3: water and others</td>
<td></td>
</tr>
<tr>
<td>Sector 2: basic materials, industry and construction (S2)</td>
<td>Subsector: without building industry (S2-WB)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.1: minerals, metals and transformation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.2: manufacture and assembly of capital assets</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.5: chemistry industry</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.7: aerospace</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>Subsector: building industry (S2-B)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.3: building industry</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.4: building materials</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>2.6: engineering and others</td>
<td></td>
</tr>
<tr>
<td>Sector 3: consumer goods (S3)</td>
<td>3.1: food and drinks</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.2: textile, clothes and footwear</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.3: paper and graphic arts</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.4: car</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.5: pharmaceutical products and biotechnology</td>
<td>26</td>
</tr>
<tr>
<td></td>
<td>3.6: other consumer goods</td>
<td></td>
</tr>
<tr>
<td>Sector 4: consumer services (S4)</td>
<td>Subsector: total without media (S4-WM)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4.1: tourism and hotel and catering business</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4.2: retail trade</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4.4: transport and distribution</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4.5: motorways and car parks</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4.6: other services</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>Subsector: media (S4-M)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4.3: media and advertising</td>
<td>6</td>
</tr>
<tr>
<td>Sector 5: financial and real estate services (S5)</td>
<td>5.1: bank</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5.2: insurance</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5.3: portfolio and holding</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5.4: SICAV</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5.5: real estate agencies and others</td>
<td>24</td>
</tr>
<tr>
<td>Sector 6: technology and telecommunications (S6)</td>
<td>6.1: telecommunications and others</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6.2: electronics and software</td>
<td>8</td>
</tr>
<tr>
<td>Total market</td>
<td></td>
<td>115</td>
</tr>
</tbody>
</table>

Comparing the autocorrelation function (ACF) and the partial autocorrelation function (PACF) with the theoretical patterns of known models, we observe that ARIMA \((1, 1, 0)\) process provides the best possible results, applying Akaike information criterion (AIC).

We predict the month-to-month expected component of inflation rate using the ARIMA \((1, 1, 0)\) process as a benchmark. In contrast to structural models, these models do not require additional information for forecasting, since they use lagged inflation values. This one-step-ahead forecast is repeated for each month in the sample. It is then straightforward to obtain the unexpected component of inflation rate (in first differences) from the following expression:

\[
\Delta \pi_t^u = \Delta \pi_t - \Delta \pi_t^e \quad (2)
\]
Table 2
Monthly descriptive statistics of inflation rates according to non-low and low economic states and positive and negative inflation surprises.

<table>
<thead>
<tr>
<th>Inflation surprises</th>
<th>Negative surprises</th>
<th>Positive surprises</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Median</td>
</tr>
<tr>
<td>Economic states</td>
<td>Non-low</td>
<td>Low</td>
</tr>
<tr>
<td>Mean</td>
<td>−0.00260c</td>
<td>−0.00280c</td>
</tr>
<tr>
<td>Median</td>
<td>−0.002000</td>
<td>−0.003000</td>
</tr>
<tr>
<td>Maximum</td>
<td>−0.001000</td>
<td>−0.001000</td>
</tr>
<tr>
<td>Minimum</td>
<td>−0.010000</td>
<td>−0.007000</td>
</tr>
<tr>
<td>S.D.</td>
<td>0.001843</td>
<td>0.001673</td>
</tr>
<tr>
<td>Skewness</td>
<td>−1.842358</td>
<td>−1.015137</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>7.272314</td>
<td>3.502629</td>
</tr>
<tr>
<td>Observations</td>
<td>53</td>
<td>20</td>
</tr>
</tbody>
</table>

\[ p < 0.01. \]

Table 3
Regression for classifying the “state of the economy”.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>4.316594a (694.1915)</td>
</tr>
<tr>
<td>Trend</td>
<td>0.001827a (30.49692)</td>
</tr>
<tr>
<td>Adj. ( R^2 )</td>
<td>0.839214</td>
</tr>
</tbody>
</table>

Regression model estimated by OLS from monthly data of the industrial production index (IPI) from February 1990 to December 2004:

\[
\text{Ln(IPI}_t\text{)} = \alpha_0 + \alpha_1 \cdot \text{trend}_t + u_t
\]

\[ a \ p < 1\% \; t\text{-statistics in parentheses.} \]

where \( \Delta \pi_t \) is the total inflation rate, \( \Delta \pi_t^e \) is the expected component, and \( \Delta \pi_t^u \) is the unexpected component. All these variables are expressed in first differences.\(^9\)

Table 2 reports sample statistics for low and non-low economic states and positive and negative inflation surprises. The mean monthly inflation rates are statistically significant in the four considered scenarios. These inflation rates tend to be higher in non-low states than in low economic states.

4. Response of the abnormal returns by sector to inflation announcements

In this section, we study the short run response of daily stock prices in the Spanish market to the announcements of inflation news at a sectoral level in the day when the IPC (consumer price index) is announced.

We use an “event window” that contains 5 days: the announcement day \( (t_j) \), 2 days before or “pre-announcement period” \( (t_j - 1 \) and \( t_j - 2) \), and 2 days after the announcement or “post-announcement period” \( (t_j + 1 \) and \( t_j + 2) \) and a “pre-event window” that contains the days between two consecutive event windows \( (t_{j-1} + 3, t_j - 3) \). The pre-event windows are applied to obtain expected returns in order to eliminate possible effects beyond inflation announcements.

The literature uses multiple alternative approximations in order to obtain the expected return, but all of them are based on pricing models such as the market model, Capital Asset Pricing Model (CAPM), Conditional CAPM, the Fama and French three-factor model, etc. However, we prefer not to make the results conditional on the hypotheses of the pricing model, so we estimate the expected return with

\(^9\) A standard unbiasedness test of inflation measures corroborates that this estimate can be considered as an unbiased estimator of ex-post inflation rate.
its unbiased estimator, that is, the average daily return of the sector during the days out of the last four event windows.\footnote{This alternative means including 60 observations approximately (similar number of observations in Mestel and Gurgul, 2003). We assume that this number is enough to guarantee an acceptable accuracy level without important changes in the underlying probability distribution.}

We compute abnormal returns, \( ARS_i(t_j) \), for each event day \( t_j \). The abnormal return of sector \( i \) in the announcement day \( t_j \), \( ARS_i(t_j) \), \( i = 1 \) (sector 1), \ldots, 6 (sector 6), or M (the total market), is the difference between the observed return (ex-post return), \( RS_i(t_j) \), and the expected return of the sector in the absence of an inflation event, \( E[RS_i(t_j)] \). This expected return is computed as the simply sample average during the last four pre-event windows. Thus, the average considers the former 4 months excluding the event-windows, that is, it computes all the working days in the last 4 months period except the 5 days around each one of the previous announcements:

\[
RAS_i(t_j) = RS_i(t_j) - E[RS_i(t_j)]
\]  

### 4.1. Methodology

The literature suggests that the response of stock abnormal returns to unexpected inflation changes depends on two relevant factors: the direction of the inflation surprises and the state of the economy. Thus, in this paper we assume that, in general, sectors of the Spanish economy show responses significantly different to unexpected inflation changes depending on positive inflation surprises (seemingly “bad news” in the literature, i.e., total inflation higher than expected inflation) and negative surprises (apparently “good news”, i.e., a total inflation lower than anticipated inflation), and taking into account the recent direction of the market or the recent state of the economy.

Arguments proposed by the “flow-through” hypothesis (FTH) (Estep and Hanson, 1980) for inflation rate announcements assert that profits of companies with high flow-through capability could be hardly sensitive or even independent to the inflation rate. These companies are able to quickly transfer any inflationist shock to prices of their products and services. In addition, this “flow-through” capability depends on the economic cycle. This company ability is larger in expansion periods than in the rest of states. Thus, positive inflation surprises (inflation rate higher than expected) during expansions should be perceived as “bad news” for all sectors according to the “behavioural finance” hypothesis, but same news could be interpreted as not relevant information or even as “good news” for sectors with high flow-through capability according to the FTH.

#### 4.1.1. Direction of the inflation surprises

Previous studies in other markets document that stock returns do not respond significantly to unexpected inflation movements, but they do not distinguish between positive and negative surprises, showing an insignificant net effect. Andersen et al. (2003) state that the adjustment response pattern of foreign exchange rates after macroeconomic announcements is characterized by a sign effect: “bad news” has greater impact than “good news”.

Thus, in order to check these asymmetric effects, we include two modifiers that are applied to the dummy variables in our analysis. They represent a positive unexpected inflation rate or “bad news” \( D^+_t \) and a negative unexpected inflation rate or “good news” \( D^-_t \), and they take on the following values:

\[
D^+ = \begin{cases} 
1 & \text{if } \pi^+_t > 0 \\
0 & \text{if } \pi^+_t < 0 
\end{cases} \\
D^- = \begin{cases} 
1 & \text{if } \pi^-_t < 0 \\
0 & \text{if } \pi^-_t > 0 
\end{cases}
\]
4.1.2. State of the economy

Authors such as Veronesi (1999) and Docking and Koch (2005), using arguments of the “behavioural finance” hypothesis (BFH), declare that the interpretation of macroeconomic announcements depends on the context in which news is received, that is, the recent direction of the market or the recent state of the economy may influence the investors’ response to new information. In the case of inflation rate news, any increase in this variable should be perceived as “bad news” during expansions, since it could result in fears of an overheating economy. Nevertheless, during recessions, the same increase could be considered as “good news” because economic agents think the economy is growing above expectations. The positive inflation surprise could indicate the end of the depression and higher forecasts of the firms’ cash flows, and an increase of stock prices and returns should thus be expected. The inverse explanation could be applied to negative inflation surprises.

Our study examines a possible different response of abnormal stock returns by sector in the Spanish economy to unexpected inflation changes depending on the direction of the inflation surprises and the state of the economy, that is, we assume that investors’ interpretations of inflation announcements are different in expansion than in recession periods.

McQueen and Roley’s (1993) methodology is widely used in the literature, in order to classify the economic activity by levels: “High” (H), “Medium” (M) and “Low” (L).11 This methodology employs two (upper and lower) bounds around the estimated trend of the industrial production index. An arbitrary constant defines the width of the range around the trend and allows a classification of the economic activity of each period on three different levels.

We first estimate the following regression model (Table 3):

\[
\ln(IPI_t) = \alpha_0 + \alpha_1 \text{\text{trend}}_t + u_t \tag{4}
\]

where IPI\(_t\) is the Spanish Industrial Production Index (after seasonal adjustment) in month \(t\).

Secondly, we choose the constant 0.0285 in order that the log of IPI will be above the upper bound, denoted as high economic activity, 25% of the months. The log of IPI is below the lower bound, indicating low economic activity, about 25% of the time. Medium economic activity is represented by the remaining observations between the bounds.

If \(\ln(IPI)_t \geq \text{upper bound}_t\) → “high” (H).
If upper bound\(_t > \ln(IPI)_t \geq \text{lower bound}_t\) → “medium” (M).
If lower bound\(_t > \ln(IPI)_t\) → “low” (L).

Results of applying this methodology are depicted in Fig. 1. To check the robustness of this analysis, we compare our estimates of the economic states using McQueen and Roley’s (1993) methodology with Gross Domestic Product (GDP) growth rates. We can see in Fig. 2 that the annual growth rate of GDP during our sample period (February 1990–December 2004) is characterized by high levels, except the last part of 1992 and the first part of 1993. There is an obvious parallelism between both series. This simple visual analysis seems to confirm the robustness of this procedure.

In order to control for the state of the economy, we include two modifiers in the dummy variables: \(D_{NL}\) (“Non-Low”) and \(D_L\) (“Low”). Each dummy is equal to one if economic activity in the month \(t\) belongs to the corresponding state (“high” or “medium” in the first one, and “low” in the second one), and zero otherwise.12

4.1.3. Flow-through capability

From results of previous studies of the Spanish stock returns by sectors, we can hypothesize that inflation news impact on stock returns can depend on the flow-through capability of the companies.

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12 Just as in previous research, we combine the medium and high states of the economy to have enough observations. Our sample period is characterized by high growth, except 1993 which is characterized by an economic crisis.
In this sense, Jareño (2005) and Jareño and Navarro (2006) propose an indirect way to estimate the ability of the company to pass an inflation shock on to its output prices and then to its nominal profits. In the latter analysis, sales variable is used, since authors observe that profits one is a very volatile variable and to some extent arbitrary, depending on changing accounting standards and decisions such as depreciations and amortizations or events such as mergers and acquisitions.
These authors analyse the same database of daily equally weighted sector-based stock portfolio returns described in Section 2, and find a significant negative relationship between flow-through capability and sensitivity of stock returns to changes in interest rates or some of its components, e.g. inflation rate. They observe that companies with a high coefficient should have the capacity to reflect inflation rate changes in their product prices and thus “flow through” the effects of inflation to customers (S6, S5, S4M and S1). These firms should be less inflation sensitive than firms with a low flow-through coefficient (such as S2B, S4WM, S3 and S2WB).

4.1.4. Preliminary analysis

Table 4 shows statistics for abnormal returns of different sectors and the whole market for low (L) and non-low (NL) economic states and positive (+) and negative (−) inflation surprises.

The average monthly abnormal stock return is 0.1% for the whole market in the first scenario (−, NL) and 0.47% in the last one (+, L). This average is close to zero in the other two scenarios (+, NL and −, L). When we analyse statistics by sector, almost all sectors show positive mean abnormal returns in the first and last scenarios (−, NL and +, L), meanwhile these values are mainly negative in the second scenario (+, NL). We observe a mix of signs in the third scenario (−, L). Anyway, we only find statistically significant responses in sector 1, scenario (−, NL) and sector 3, scenario (+, L).

Veronesi arguments of the BFH seem to be partially supported by this preliminary analysis. Positive inflation surprises (“bad news”) during recessions seem to be interpreted as “good news” by economic agents since all sectors show high positive mean abnormal returns in this scenario (+, L). Also these positive inflation surprises seem to be considered as “bad news” during expansions (+, NL) since abnormal returns in median terms are negative for most sectors. In any case, observed differences by sector can also be related to the different flow-through capability.

4.2. Estimation of the model

For analysing the abnormal returns response to inflation rate movements, we propose a model which includes the two mentioned factors: the direction of the inflation surprises and the state of the economy:

\[
AR_{i,t} = \alpha_i + \beta_{1i} \cdot D_{NL}^+ \cdot |\pi_{it}^u| + \beta_{12} \cdot D_{NL}^- \cdot |\pi_{it}^u| + \beta_{13} \cdot D_{NL}^- \cdot |\pi_{it}^u| + \beta_{14} \cdot D_{NL}^+ \cdot |\pi_{it}^u| + u_{it}
\]

where \(AR_{i,t}\) is the abnormal return of sector \(i\) on period \(t\), \(|\pi_{it}^u|\) is the unexpected component of inflation rate expressed in absolute values, and finally \(u_{it}\) is the error term of sector \(i\). Superscript + in dummy variables \((D_{NL}^+)\) denotes that inflation rate is higher than expected and superscript − \((D_{NL}^-)\) that inflation rate is lower than expected, that is, positive (“bad news”) or negative (“good news”) unanticipated inflation, respectively. Also, the subscript NL \((D_{NL}^+)\) and L \((D_{NL}^-)\) indicates a non-low and low state of economic activity, respectively. Each dummy variable takes on value 1 when the two conditions take place simultaneously. Thus, the four dummy variables account for all the possible combinations between the two considered factors.

We estimate model 5 for all sectors and for the whole market simultaneously as a system of “Ordinary Least Squares” (OLS) equations. According to Knif et al., 2008, we use Bollerslev and Wooldridge’s (1992) quasi maximum likelihood estimation approach to calculating standard errors. This methodology increases the robustness of estimate results.

Results for this regression are reported in Table 5. We emphasize that the results reveal that quite a lot of parameters are statistically significant, that is, inflation changes incorporate relevant information for the market. Thus, Spanish stock market seems to be efficient during our sample period.

---

13 Lack of data of sector 4-M at the beginning of the sample period forces us to exclude this sector from the SUR estimates.

14 We have also estimated this model for all sectors and for the whole market simultaneously as a system of seemingly unrelated regressions (SUR). According to Zellner (1962) and Tanuwidjaja (2007), this technique accounts for heteroskedasticity and the possible contemporaneous correlation in the error terms across equations. Since the right hand side variables are the same in the nine equations, the SUR estimates using GMM are the same as OLS estimates, only the standard errors differ.
Table 4
Descriptive statistics of monthly stock abnormal returns by sector and the whole market according to non-low (NL) and low (L) economic states and positive (+) and negative (−) inflation surprises.

<table>
<thead>
<tr>
<th>Panel</th>
<th>Economic State</th>
<th>Mean</th>
<th>Median</th>
<th>Maximum</th>
<th>Minimum</th>
<th>S.D.</th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panel A: (−, NL)</td>
<td></td>
<td>0.00321b</td>
<td>0.00111</td>
<td>0.00196</td>
<td>0.00205</td>
<td>−0.001037</td>
<td>0.00036</td>
<td>0.00268</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Median</td>
<td>0.00320</td>
<td>0.00115</td>
<td>0.00145</td>
<td>−0.001023</td>
<td>0.00345</td>
<td>0.000153</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maximum</td>
<td>0.02833</td>
<td>0.03057</td>
<td>0.02483</td>
<td>0.02608</td>
<td>0.05302</td>
<td>0.03702</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Minimum</td>
<td>−0.02179</td>
<td>−0.04026</td>
<td>−0.03125</td>
<td>−0.02588</td>
<td>−0.02946</td>
<td>−0.04389</td>
</tr>
<tr>
<td></td>
<td></td>
<td>S.D.</td>
<td>0.00139</td>
<td>0.01138</td>
<td>0.01161</td>
<td>0.00964</td>
<td>0.01360</td>
<td>0.02069</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Skewness</td>
<td>−0.10508</td>
<td>−0.13638</td>
<td>−0.74246</td>
<td>−0.0384</td>
<td>1.03847</td>
<td>−0.07251</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Observations</td>
<td>53</td>
<td>53</td>
<td>53</td>
<td>53</td>
<td>23</td>
<td>53</td>
</tr>
<tr>
<td>Panel B: (+, NL)</td>
<td></td>
<td>−0.00038</td>
<td>0.00058</td>
<td>0.00052</td>
<td>−0.00051</td>
<td>−0.00075</td>
<td>−0.00035</td>
<td>−0.00017</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Median</td>
<td>−0.00236</td>
<td>0.00081</td>
<td>−0.00108</td>
<td>−0.00147</td>
<td>−0.00254</td>
<td>−0.00998</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maximum</td>
<td>0.03550</td>
<td>0.03485</td>
<td>0.03184</td>
<td>0.04179</td>
<td>0.02643</td>
<td>0.06237</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Minimum</td>
<td>−0.01945</td>
<td>−0.02085</td>
<td>−0.02399</td>
<td>−0.02586</td>
<td>−0.03818</td>
<td>−0.06463</td>
</tr>
<tr>
<td></td>
<td></td>
<td>S.D.</td>
<td>0.01151</td>
<td>0.00953</td>
<td>0.01021</td>
<td>0.00967</td>
<td>0.01173</td>
<td>0.02372</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Skewness</td>
<td>1.21407</td>
<td>0.54279</td>
<td>1.53764</td>
<td>1.33253</td>
<td>0.80041</td>
<td>0.04529</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Kurtosis</td>
<td>4.84634</td>
<td>5.01566</td>
<td>7.64791</td>
<td>9.38993</td>
<td>41.2259</td>
<td>41.5226</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Observations</td>
<td>57</td>
<td>57</td>
<td>57</td>
<td>57</td>
<td>29</td>
<td>57</td>
</tr>
<tr>
<td>Panel C: (−, L)</td>
<td></td>
<td>0.00123</td>
<td>0.00071</td>
<td>0.00184</td>
<td>0.00154</td>
<td>0.00203</td>
<td>NA</td>
<td>0.00032</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Median</td>
<td>0.000106</td>
<td>0.000223</td>
<td>0.00084</td>
<td>0.00242</td>
<td>0.00078</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maximum</td>
<td>0.01056</td>
<td>0.01397</td>
<td>0.01693</td>
<td>0.01550</td>
<td>0.01687</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Minimum</td>
<td>0.016134</td>
<td>0.01833</td>
<td>0.011078</td>
<td>0.01649</td>
<td>0.01876</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>S.D.</td>
<td>0.00881</td>
<td>0.01103</td>
<td>0.00782</td>
<td>0.00902</td>
<td>0.00998</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Skewness</td>
<td>0.06708</td>
<td>0.90177</td>
<td>0.20310</td>
<td>0.36577</td>
<td>0.65579</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Kurtosis</td>
<td>2.28509</td>
<td>3.01518</td>
<td>2.27088</td>
<td>2.63576</td>
<td>3.66029</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Observations</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Panel D: (+, L)</td>
<td></td>
<td>0.00045</td>
<td>0.000145</td>
<td>0.00198</td>
<td>0.000145</td>
<td>0.00007</td>
<td>NA</td>
<td>0.000419</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Median</td>
<td>0.00170</td>
<td>0.00176</td>
<td>0.00032</td>
<td>0.000394</td>
<td>0.000310</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maximum</td>
<td>0.02009</td>
<td>0.02965</td>
<td>0.02778</td>
<td>0.04749</td>
<td>0.02113</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Minimum</td>
<td>0.001789</td>
<td>0.001874</td>
<td>0.002380</td>
<td>0.00785</td>
<td>0.03268</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>S.D.</td>
<td>0.01337</td>
<td>0.01330</td>
<td>0.01564</td>
<td>0.01373</td>
<td>0.01639</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Skewness</td>
<td>0.77435</td>
<td>0.58668</td>
<td>0.13546</td>
<td>1.54558</td>
<td>0.64234</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Kurtosis</td>
<td>2.39793</td>
<td>2.60773</td>
<td>2.27888</td>
<td>5.73166</td>
<td>2.56769</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Observations</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>0</td>
</tr>
</tbody>
</table>

b \textit{p} < 0.05.
Table 5
Response of the stock returns including the state of the economy and the direction of the inflation surprises.

<table>
<thead>
<tr>
<th></th>
<th>S1</th>
<th>S2-WB</th>
<th>S2-B</th>
<th>S3</th>
<th>S4-WM</th>
<th>S5</th>
<th>S6</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>+, NL</td>
<td>0.1822 (0.3381)</td>
<td>0.0660 (0.1071)</td>
<td>0.8861 (1.4818)</td>
<td>0.1214 (0.2397)</td>
<td>0.1643 (0.4471)</td>
<td>1.0431 (1.0428)</td>
<td>0.2265 (0.5277)</td>
<td></td>
</tr>
<tr>
<td>−</td>
<td>−0.3430 (−0.5274)</td>
<td>0.1843 (0.4471)</td>
<td>1.0431 (1.0428)</td>
<td>0.2265 (0.5277)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+, L</td>
<td>3.2416 (2.5881)</td>
<td>2.6600 (1.8588)</td>
<td>3.8256 (3.2486)</td>
<td>0.1268 (0.0839)</td>
<td>3.2937 (3.4380)</td>
<td>4.0920 (1.7903)</td>
<td>2.9993 (3.0860)</td>
<td></td>
</tr>
<tr>
<td>−</td>
<td>−0.8879 (−1.1291)</td>
<td>0.4416 (0.7148)</td>
<td>1.2388 (2.0647)</td>
<td>0.9256 (1.8210)</td>
<td>0.8008 (1.2271)</td>
<td>0.5723 (1.3909)</td>
<td>0.1196 (0.1192)</td>
<td></td>
</tr>
<tr>
<td>Adj. R²</td>
<td>0.0480</td>
<td>0.0018</td>
<td>0.0208</td>
<td>0.0962</td>
<td>0.0474</td>
<td>0.0153</td>
<td>0.0402</td>
<td></td>
</tr>
<tr>
<td>Wald</td>
<td>11.601 (a)</td>
<td>3.3431</td>
<td>2.9543</td>
<td>15.049 (a)</td>
<td>2.2252</td>
<td>11.4608 (a)</td>
<td>6.7694 (b)</td>
<td>9.9037 (c)</td>
</tr>
</tbody>
</table>

In the expressions: \( \text{ARS}_i(t) \) denotes the abnormal sectoral return on the announcement day \( t \), \( \eta_i^u \) the unexpected component of the inflation rate and \( u_t \) represents the error term of sector \( i \), S1, S2-WB, . . ., S6, M each sector and the total market. Dummy variables distinguish between higher (+) and lower (−) inflation than expected and between low (L) and “non-low” (NL) states of the economy. Sample: February 1990–December 2004 (OLS estimation):

\[
\text{ARS}_i(t) = \alpha_i + \beta_{i1} \cdot \text{D}_{iNL} \cdot |\eta_i^u| + \beta_{i2} \cdot \text{D}_{iL} \cdot |\eta_i^u| + \beta_{i3} \cdot \text{D}_{iNL} \cdot |\eta_i^u| + \beta_{i4} \cdot \text{D}_{iL} \cdot |\eta_i^u| + u_t
\]

\( t \)-Statistics in parentheses: \( a \, p < 0.10, b \, p < 0.05, c \, p < 0.01. \)

\( a \) Test of equality between inflation coefficients in different states of the economy.
Secondly, we observe positive significant responses of abnormal returns to the unexpected inflation component for all sectors, except for S4WM, in the case of positive surprises (inflation rate higher than expected) in low states (+, L), and for three sectors in the case of negative surprises in non-low states (−, NL). Despite of the positive response in both scenarios, unexpected inflation changes have a greater impact in this scenario (+, L) than in this one (−, NL), because in the first scenario inflation changes affect quite a lot of sectors and the parameters are higher than them in the second scenario (−, NL).

Finally, no significant reactions are observed in high/medium states of the economy in the case of positive surprises (+, NL), and in the case of negative surprises (inflation rate lower than expected) in low states (−, L).

According to the BFH, a possible economic explanation about the positive significant abnormal returns to positive inflation surprises during recessions (+, L) could be the following. During periods of low activity, positive unanticipated inflation news could be considered as good news because economic agents think the economy is growing above expectations. Nevertheless, these results do not seem to depend on the flow-through capability, as the parameters are positive and significant for all sectors, except for S4WM. In summarize, our results do not support the FTH arguments, although these could be a consequence of the fact that the state of the economy and the direction of the news’ effect domain the flow-through ability effect of each sector.

On the other hand, in the case of negative surprises (inflation rates lower than expected), impact on abnormal returns is positive and significant in four instances (S1, S2B and S3 and M) corresponding to high and medium states of the activity (−, NL). These positive coefficients also support the behavioural finance arguments. According to BFH, any decrease in the unexpected inflation rate should be perceived as “good news” during non-recessive periods, because this announcement can indicate a cooling of the economy, that is, the end of a period characterized by an overheating economy. According to FTH, these positive significant abnormal returns can be explained in sectors with a low flow-through capability (see Jareño and Navarro, 2006), such as S2B (Basic Materials, Industry and Construction) and S3 (Consumer Goods), although this explanation is not applicable to S1 (Oil and Energy).

For analysing the consistency of the previous results, we perform Wald tests with the null hypothesis of equality of coefficients. Results reject the equality of parameters in several industries (except in S2WB, S2B and S4WM) showing significant different responses according to the direction of the news and the state of the economy. This finding evidences that the response of the abnormal returns by sector to unexpected inflation news depends on the sign of the inflation surprises and the economic scenarios.

5. Risk-free interest rate, risk premium of stocks and growth expectations

In this section, we aim to find the justification of this different response of abnormal returns to unexpected inflation changes according to the direction of the news and the state of the economy in the Spanish case observed in the previous analysis. To this end, Boyd et al. (2005) analyse the seemingly odd pattern in stock prices responses to unemployment news from the theoretical paper of Campbell and Mei (1993) which considers the Dividend Discount Model (DDM).

These previous papers suggest that, conceptually, three basic primitive factors determine stock prices: (1) risk-free interest rate, (2) risk premium of stocks and (3) growth expectations of the company profits. Thus, Boyd et al. (2005) analyse if the reaction of abnormal stock returns to unemployment news depends on these primary factors.

According to the Gordon–Shapiro formulation of the DDM:

\[ P = \frac{D(1 + g)}{r + h - g} \] (6)

where \( P \) is the stock or portfolio price, \( D \) is the last dividend paid by the company, \( r \) is the risk-free interest rate, \( g \) is the expected dividend growth rate (constant) and \( h \) is the stock risk premium that investors require to invest in stocks.
The percentage change in the price of the security in response to an inflation rate surprise depends on the response of the three components. The expression is the following one:

$$\frac{dP}{P} / du \approx -\left[ \frac{D}{P} \right] \left[ \frac{dr}{du} + \frac{dh}{du} - \frac{dg}{du} \right]$$

where “u” denotes the unanticipated component in the inflation rate.

According to the methodology used in Boyd et al. (2005), we analyse if the response of the abnormal stock returns to unexpected inflation changes depends on the fact that these surprises convey information about future interest rates. In this sense, we study the bond market response to unexpected inflation changes. Stock and bond prices should respond to the news in the same way. Otherwise, stock price response will depend on the other two primary factors. The following step to analyse the stock price responses to inflation surprises consists of examining the effect of news arrival on the proxy measures for growth expectations and the stock risk premium.15

In our study, starting from the fact that all the significant responses in stock returns by sector in the announcement day are positive, the behaviour of the three explanatory factors during the sample period should be the following: a decrease of the risk-free interest rate and stock risk premium and an increase in the growth expectations of the company profits and dividends. Moreover, all of these significant movements of returns by sector are consistent with a high flow-through capability.

5.1. Response of the risk-free interest rate

The Fisher effect is a much studied subject in financial and monetary economics, but conclusions are controversial. This effect assumes that the majority of nominal interest rate movements are caused by inflation rate fluctuations, the real interest rate remaining constant. Some of this literature focuses on two components of nominal interest rates: real interest rates and expected inflation rates. However, literature frequently distinguishes five components of the nominal interest rates: first, expected real interest rate; second, expected inflation; third, unexpected risk premium of the real interest rates, which shows the uncertainty about future variations of the real interest rates and it depends on the volatility of the bond price; four, unexpected inflation premium; and five, other risk premiums, such as liquidity premium, fiscal/tax bias, coupon bias, etc. Anyway, most of the empirical literature observes that the Fisher effect takes place only partly and just in the long term.

Yields-to-maturity (YTM) of Treasury bonds at 3 months, 1- and 10 years are usually used it as proxies of the risk-free interest rates. These securities are supposed to be default risk-free and to have the highest liquidity. In the Spanish case, daily Treasury bond yield series are not available. Also, the segment of Treasury debt securities for maturities close to 3 months is not liquid enough to extract reliable daily interest rates. For these reasons, we choose an alternative homogeneous way to obtain risk-free interest rates for all maturities. We estimate the daily term structure of interest rates (TSIR) from all the Treasury debt securities traded in each day.16 This approximation of the risk-free interest rates allows us to eliminate possible effects of idiosyncratic aspects of the securities with maturities close to the found one, as spot rates represent, to some extent, a yield average of all the traded securities.

From these TSIR estimates we obtain prices of theoretical securities of Treasury debt of 3 months, 1- and 10-year maturity.17 These estimated prices are used it in order to compute the final YTM.

The model we propose analyses the response of the risk-free interest rate, proxied by the YTM of Treasury bonds, depending on the state of the economy and the direction of the inflation surprises:

$$r_t = \alpha + \beta_1 \cdot D_{NL}^+ \cdot |\pi_t^u| + \beta_2 \cdot D_t^+ \cdot |\pi_t^u| + \beta_3 \cdot D_{NL}^+ \cdot |\pi_t^u| + \beta_4 \cdot D_t^+ \cdot |\pi_t^u| + u_t$$

15 Both variables are directly unobservable.
16 TSIR is estimated by Nelson and Siegel (1987) with residuals in prices weighted by the reciprocal of duration. For a more detailed explanation, see http://www.uclm.es/area/aef/Etti_E.asp.
17 We assume a flat TSIR when we obtain bond prices, so the spot interest rate coincides with the yield-to-maturity and a constant yearly coupon of 7% (approximately the mean coupon of this period for all the traded bonds).
Table 6
Response of the Treasury debt yields depending on the state of the economy and the direction of the inflation surprises.

<table>
<thead>
<tr>
<th></th>
<th>R3M</th>
<th>R1A</th>
<th>R10A</th>
</tr>
</thead>
<tbody>
<tr>
<td>+, NL</td>
<td>−0.0126 (−0.5864)</td>
<td>0.0134 (0.4342)</td>
<td>0.0779 (−0.5049)</td>
</tr>
<tr>
<td>+, L</td>
<td>0.0169 (0.1884)</td>
<td>0.0394 (0.2808)</td>
<td>0.9248 (1.8149)</td>
</tr>
<tr>
<td>−, NL</td>
<td>−0.0255 (−1.0136)</td>
<td>0.0422 (0.6698)</td>
<td>−0.1838 (−0.3449)</td>
</tr>
<tr>
<td>−, L</td>
<td>0.0102 (0.3053)</td>
<td>0.0393 (1.0342)</td>
<td>0.4199 (1.2480)</td>
</tr>
<tr>
<td>Adj. R²</td>
<td>−0.0236</td>
<td>−0.0198</td>
<td>−0.0050</td>
</tr>
<tr>
<td>Wald</td>
<td>2.1587</td>
<td>0.5068</td>
<td>3.3540</td>
</tr>
</tbody>
</table>

Adj. R² in parentheses: **p < 0.10.**

Response of the yields in prices of the Treasury debt ($r_t$) to unexpected inflation news, distinguishing between higher (+) and lower (−) inflation than expected and between low (L) and “non-low” (NL) states of the economy, in the announcement day. R3M, R1A y R10A 3 months, 1- and 10-year yield of the Treasury debt. Sample: January 1993–December 2004 (by OLS and with $t$-statistics corrected by White to take into account the presence of autocorrelation and heteroskedasticity):

$$r_t = \alpha + \beta_1 \cdot D_{NL} \cdot |\pi_t^r| + \beta_2 \cdot D_L \cdot |\pi_t^r| + \beta_3 \cdot D_{NL} \cdot |\pi_t^r| + \beta_4 \cdot D_L \cdot |\pi_t^r| + u_t$$

$t$-Statistics in parentheses: **p < 0.10.**

5.2. Response of the stock risk premium

According to Docking and Koch (2005), the response of the stock returns to some macroeconomics announcements depends on the evolution of the risk premium in each state of the economy. Investors perceive a higher risk in some scenarios and they demand a higher stock risk premium. In the DDM framework, this situation leads to a decrease of the stock prices for this sector.

Literature proposes different alternative measures to approximate the stock risk premium, as this variable is not directly observable. One of these proxies consists of a measure of stock price volatility. It requires assuming that market participants know the future volatility of stocks and they use the variance of stock returns during a certain number of days after the inflation announcement.

Another alternative proxy of the stock risk premium is based on the spread between the YTM of BBB and AAA corporate bonds. Sometimes the YTM of the AAA bonds is replaced with Treasury bond YTM. This spread shows default risk in the bond market (Chen et al., 1986; Bernanke and Blinder, 1992; Ewing et al., 2003).

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18 Notice that the observed behaviour of these YTM can be compared directly with the behaviour of the returns estimated by sector, but indirectly with the behaviour of the risk-free interest rate.

19 The same model has been tested using abnormal Treasury YTM obtained from the same procedure used it in the case of stock returns. Results are quite similar, noticing only that YTM for 3-month maturity have a positive significant response to positive inflation surprises in low states of the economy.
This measure is usually obtained from the fixed income portfolio indexes made up of this kind of bonds. The low trading of the corporate bonds in the Spanish case and the small number of issues rated BBB prevent the existence of daily indexes. In this research, we build a default risk measure which consists of the spread in YTM between corporate and Treasury bonds. From daily trading data of the AIAF (Spanish corporate debt) market, we calculate the average YTM of all straightforward corporate bonds traded in each day. The low liquidity of most of issues entails that the features of traded bonds (coupon, maturity, rating, etc.) can substantially vary from 1 day to the next. In order to refine our data, we use the centered moving average technique (taking three observations) in our daily average YTM. As the average maturity of the considered corporate bonds is around 5 years, we use the YTM of 5-year theoretical Treasury bonds to proxy the default-free interest rate. These YTM are estimated as explained in previous section.

The suggested model to study the behaviour of the stock risk premium to unexpected inflation changes in the announcement day distinguishes between the direction of the news (positive or negative) and the state of the economy. The model is the following:

\[
\Delta h_t = \alpha + \beta_1 \cdot D_{NL}^+ \cdot |\pi_t^u| + \beta_2 \cdot D_L^+ \cdot |\pi_t^u| + \beta_3 \cdot D_{NL}^- \cdot |\pi_t^u| + \beta_4 \cdot D_L^- \cdot |\pi_t^u| + u_t
\]

(9)

where \(h\) is the proxy for the stock risk premium, that is, the default risk premium.

Table 7 shows the results of model (9). There is no evidence of a statistically significant relationship between inflation news and the stock risk premium. The adjusted \(R^2\) is even negative and the Wald test does not reject the null hypothesis of equality of coefficients depending on the scenario. Thus, this second primary factor, which, according to DDM, explains the behaviour of the stock prices, does not contribute to explain the results obtained in previous sections. However, according to some literature, our results could reflect the fact that the stock risk premium is evidently difficult to measure.

5.3. Response of the growth expectations

As in the previous subsection, it is very difficult to obtain a suitable measure of the growth expectations of the company profits and dividends. Boyd et al. (2005) hypothesize that investors are rational, so they observe the data and make good estimates. A rate of an industrial production index should be a proxy for the investor expectations about the growth rate of the company profits and dividends. In our paper, we can not use the Spanish Industrial Production Index (IPI) as it is previously used in the classification of the economic activity in levels. We propose an alternative economic activity index,

<table>
<thead>
<tr>
<th>(\Delta h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>+, NL</td>
</tr>
<tr>
<td>+, L</td>
</tr>
<tr>
<td>−, NL</td>
</tr>
<tr>
<td>−, L</td>
</tr>
<tr>
<td>Adj. (R^2)</td>
</tr>
<tr>
<td>Wald(^a)</td>
</tr>
</tbody>
</table>

Response of the changes in the stock risk premium (\(\Delta h_t\)) to unexpected inflation surprises, distinguishing between higher (+) and lower (−) inflation than expected and between low (L) and “non-low” (NL) states of the economy, in the announcement day. Sample: January 1993–December 2004 (by OLS and with \(t\)-statistics corrected by White to take into account the presence of autocorrelation and heteroskedasticity):

\[
\Delta h_t = \alpha + \beta_1 \cdot D_{NL}^+ \cdot |\pi_t^u| + \beta_2 \cdot D_L^+ \cdot |\pi_t^u| + \beta_3 \cdot D_{NL}^- \cdot |\pi_t^u| + \beta_4 \cdot D_L^- \cdot |\pi_t^u| + u_t
\]

\(t\)-Statistics in parentheses: \(^*\) \(p < 0.10\).

\(^a\) Test of equality between inflation coefficients in different states of the economy.
the “Índice de Actividad Económica” (IAE), monthly elaborated by the Banco Bilbao Vizcaia Argentaria (BBVA).20

We analyse if the relationship between the growth expectations of the company dividends and unexpected inflation changes is significantly different depending on the state of the economy (low and non-low). In that case, it should be reflected in the expectations formation of rational investors. As Boyd et al. (2005) in their study of the impact of the unemployment announcements, we study the relationship between our proxy of the growth expectations in the same month and 1–3 months following the reference month of the inflation surprises. The proposed model is the following:

\[ g_{t} = \alpha + \beta_{1} \cdot D^{+}_{NL} \cdot |\pi_{t}^{u}| + \beta_{2} \cdot D^{-}_{NL} \cdot |\pi_{t}^{u}| + \beta_{3} \cdot D^{+}_{NL} \cdot |\pi_{t}^{d}| + \beta_{4} \cdot D^{-}_{NL} \cdot |\pi_{t}^{d}| + u_{t} \]  

\[ g_{s} = \alpha + \beta_{1} \cdot D^{+}_{NL} \cdot |\pi_{t}^{u}| + \beta_{2} \cdot D^{-}_{NL} \cdot |\pi_{t}^{u}| + \beta_{3} \cdot D^{+}_{NL} \cdot |\pi_{t}^{d}| + \beta_{4} \cdot D^{-}_{NL} \cdot |\pi_{t}^{d}| + u_{t} \]  

where \( g \) is the growth rate of the IAE and \( s \) is the number of leads after announcement dates \( (s = t, t+1, t+2, t+3) \).

According to some authors (e.g., Leibowitz et al., 1989), the g movement depends, to some extent, on the flow-through capability of the companies by sector \( (\lambda) \):

\[ g = g_{0} + \gamma \cdot r + \lambda \cdot \pi \]  

We show the results in Table 8. These results are consistent with results observed in our analysis of the stock responses to unexpected inflation changes. The sign and value of the parameters are quite similar in both analysis (see Table 5), and even they seem to follow a rule of behaviour in their change during the months following the announcement month. Besides, most of the coefficients are statistically significant. More specifically, we find an inverse relationship between the present growth of the IAE and the inflation surprises in “non-low” states of the economy \((+, NL)\) and \((- , NL)\), meanwhile we evidence a direct relationship between those during recessions, \((+, L)\) and \((- , L)\). Similar results are obtained in the case of using lagged growth of the IAE (from 1 to 3 months) as dependent variable.

Thus, these results are consistent with the BFH. In expansion periods, the expectations of the economic agents can incorporate the prediction of an economic growth, slowing down in the following months. In recessions, investors can expect an economic recovery with high expectations as they assume a cyclical behaviour of the economy.

Finally, the Wald test confirms the fact that the response of the growth expectations is significantly different depending on the unexpected inflation surprises and the state of the economy.

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20 BBVA defines the IAE as a synthetic indicator which aggregates about forty activity, expectations, expense, employment, construction and investment series of the Spanish economy. This indicator is standardized (with mean zero and standard deviation one), so positive values are consistent with a higher than average economic activity. Because of that, this is a qualitative indicator that tries to evaluate in which phase is the economic cycle and the proximity of the tendency changes, but this do not quantify the economic level. We acknowledge the data provided by Ana Rubio (BBVA).
From these results and considering the growth expectations of the company profit as a primary component of stock prices, we can conclude that the observed positive abnormal returns in some sectors to negative inflation surprises and high and medium states of the economy (−, NL) is explained by the expectations of the economic agents. An inflation rate lower than expected during “non-low” states is perceived as “good news” as a signal of the economy moves away from an overheating situation. On the other hand, most of the sectors show positive abnormal returns to positive inflation surprises in recessions (+, L). This behaviour can be also explained by the behaviour of the growth expectations, taking into account that coefficients in expansions are much smaller than they are during contractions. Rational investors revise their forecasts more strongly in low than “non-low” states of the economy. Thus, this result is completely consistent with the statistically significant behaviour shown by stock returns in each scenario.

6. Summary and conclusions

The aim of this paper is, firstly, to analyse the short run response of the sectoral stock returns to unanticipated component of inflation announcements and, secondly, to study the potential explanatory factors of a differential sectoral response in each scenario. In the first analysis we consider the direction of the inflation surprises and the state of the economy. In the second analysis, the Dividend Discount Model (DDM) is used as theoretical framework to control for the main components of stock prices: risk-free interest rate, risk premium of stocks and growth expectations of the company profits.

In the first section we obtain two results that partly would be in line with previous literature focussed on other macroeconomic announcements and other markets. On one hand, firstly, positive inflation surprises (inflation rate higher than expected, seemingly “bad news”) have the highest statistically significant impact on stock returns during recessions (+, L) in the Spanish case. Secondly, these positive inflation surprises are really “good news” (positive abnormal returns) in low economic states. Possible reasons can be found in that economic agents think the economy is growing above expectations, associated with a higher inflation absorption capability of the companies.

On the other hand, negative inflation surprises (seemingly “good news”) in “non-low” states of the economy (+, NL) are really “good news” for several sectors, since we observe significant positive abnormal returns. These inflation rates lower than expected lead the economy out of an overheating situation.

In the second section, from the analysis of the relationship between unexpected inflation surprises and each primary factor in the DDM framework (risk-free interest rate, stock risk premium and growth expectations), depending on the direction of the news and the state of the economy, we observe that neither the risk-free interest rate nor the stock risk premium show significant responses to unexpected inflation surprises. Nevertheless, the growth expectations of the company profits and dividends can explain most of the behaviour of stock returns to inflation news. In certain scenarios, completely consistent relationships to those observed in the analysis of stock returns are found. Also, the flow-through capability of companies helps to explain the significant different responses exhibited by sectoral returns to inflation announcements.

In conclusion, we observe relevant differences in the stock return responses to unexpected inflation changes depending on the direction of the news and the state of the economy. Moreover, the magnitude of this response depends on the sector of activity. Finally, most of this pattern can be explained by the response of the growth expectations to inflation surprises.

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