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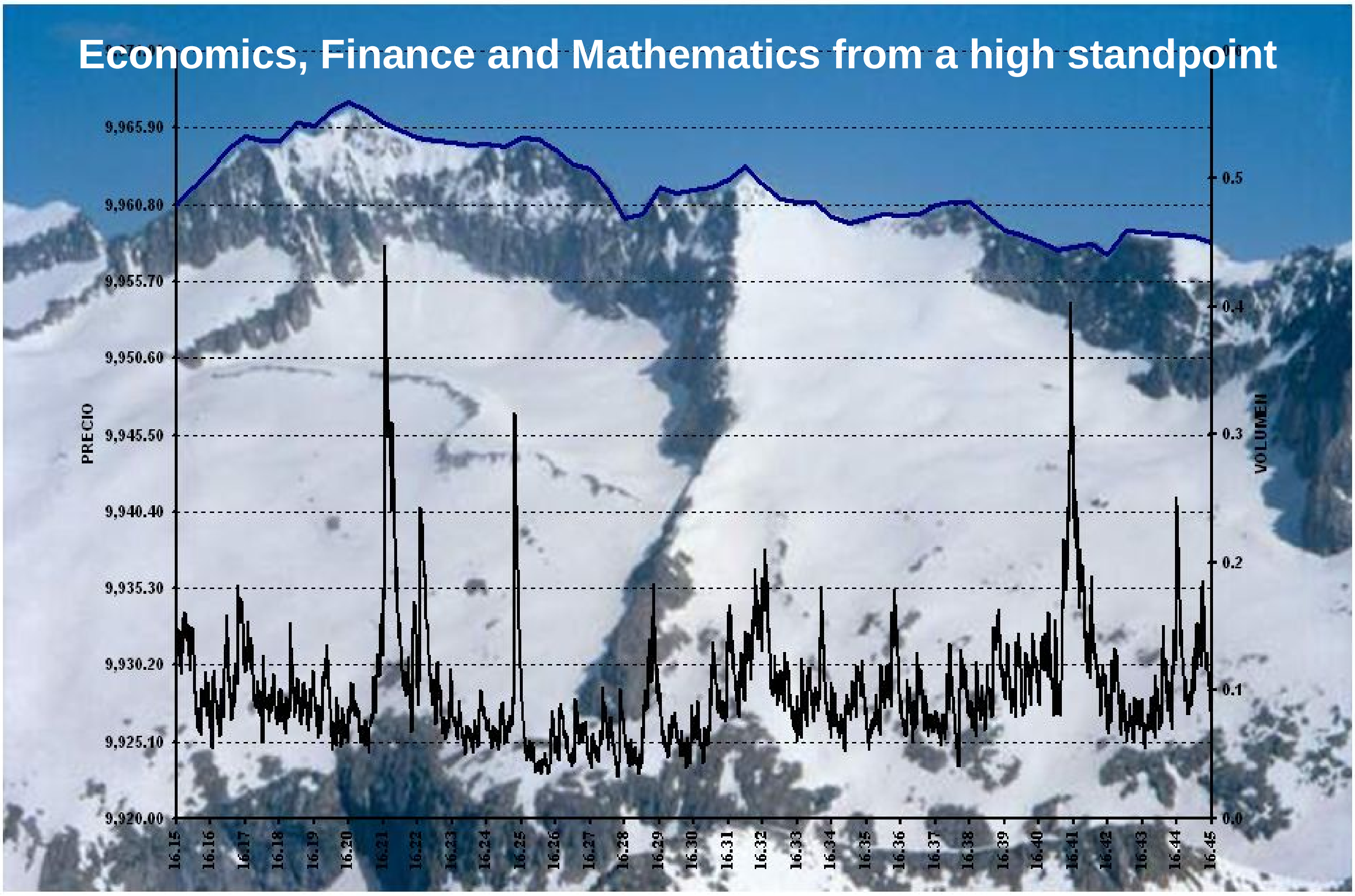

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DT-DAEF 2012/6

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Edita:
Departamento de Análisis Económico y Finanzas de la UCLM
Teléfono: 34 967 599 200. Extensión 2143
http://www.uclm.es/dep/daef/

Depósito Legal: AB-351-2009
ISSN: 1989-4856

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Abstract

This paper analyses the relationship between duration (sensitivity of stocks to interest rate changes) and the flow-through capability (ability of companies to pass inflationist shocks on to prices) of the Spanish companies. If we can corroborate the existence of partial Fisher Effect in the Spanish case, then we can study the mentioned relationship taking into account inflation duration (that is, the sensitivity of stock returns only to expected inflation changes) instead of nominal interest rate duration. Finally, we find a negative relationship between stock duration and flow-through capability.

Keywords: Inflation Expectations; Nominal and Real Interest Rates; Flow-Through capability; Fisher Effect

JEL Classification: E43; F31; G12; G13; G15

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1. Introduction

This paper analyses the relationship between duration (sensitivity of stocks to interest rate changes) and the flow-through capability (ability of companies to pass inflationist shocks on to prices) of the Spanish companies.

This research proposes that if we can affirm the existence of partial Fisher effect in the Spanish case, then we can study the mentioned relationship taking into account inflation duration (that is, the sensitivity of stocks only to expected inflation changes) instead of nominal interest rate duration. Similar to Jareño and Navarro (2010) we analyze this phenomenon in the Spanish Market, but we consider changes in inflation expectations (inflation duration) instead of variations in nominal interest rates.

Whith this objective, the next section revises previous literature and findings about these topics. In section 3 we describe the flow-through capability and show the results of estimates for Spanish companies considering different sectors of activity (Jareño and Navarro, 2010). Section 4 analyzes the concept of inflation duration and applies a model for Spanish stock returns (Jareño, 2006 and 2008) which tests the stock sensitivity to changes in market return, real interest rates and expected inflation rate. In section 5 we propose a model for analyzing the existence of a relationship between inflation duration and flow-through capability in the Spanish Market and, finally, section 6 collects the main conclusions.

2. Theoretical argumentation and justification

According to Díaz and Jareño (2009, 2012), Jareño and Navarro (2010) and Jareño and Tolentino (2012), we can point out that Spain has experienced a persistent inflation rate in 90's and 00's. Thus, inflation rate has become a key factor that should be analysed deeply.

Related whit this subject, Jareño (2005), Jareño and Navarro (2010) and Díaz and Jareño (2012) confirm the importance of the ability of companies to transmit inflation shocks to their products/services prices, that is, the flow-through capability (Estep and Hanson, 1980). Also, higher or lower flow-through capabilities could have consequences on the impact of changes of nominal interest rates on company stock prices. Thus, Asikoglu and Ercan (1992), Díaz and Jareño (2009) and Jareño and Navarro (2010) evidences that the impact of interest rate changes on stock prices is minimal when changes in nominal interest rates are due to changes in the expected inflation and simultaneously firms show a high flow-through capability. This phenomenon is compatible with a negative relationship between inflation duration and the flow-through coefficients, so companies that operate in sectors with high flow-through capability are less sensitive than those firms that operate in low flow-through capability sectors.

Following Jareño (2006), Jareño (2008) and Jareño and Navarro (2010), changes in nominal interest rates may have a different impact on stock prices depending on whether the change is induced by a shift in inflation expectations or caused by changes in real interest rates. This fact points out the importance of the Fisher Effect.

The Fisher Effect states that, if the expected inflation rate rises in a percentage point (π_t^e), the nominal interest rate (i_t) also increases in the same percentage and the real interest rate (r_t^e) remains constant (Fisher, 1930):

$$i_t \approx r_t^e + \pi_t^e \quad [1]$$

According to Jareño and Tolentino (2012), the existence of the *Fisher Effect* has a lot of implications in other kinds of researches related with the flow-through capability, that is, has repercussions on the sensitivity of the stock prices when nominal interest rates change due to variations in the expected inflation rate (Jareño, 2005, and Jareño and Navarro, 2010).

Based on this statement and the Jareño and Tolentino (2012) results, we can affirm the existence of partial Fisher Effect in the Spanish case. So, previous analysis such as Jareño and Navarro (2010) can be replicated using directly inflation changes instead of nominal interest rate changes.

According to Estep and Hanson (1980), Asikoglu and Ercan (1992), Jareño (2005), Díaz and Jareño (2009) and Jareño and Navarro (2010), the flow-through capability is the expected inflation percentage which flows into a firm's expected nominal cash-flows and so into firm profits and dividend growth.

Previous literature affirms that industries with a high level of flow-through capability are less inflation sensitive than industries with a low inflation absorption capability. Also, Asikoglu and Ercan (1992), Díaz and Jareño (2009) and Jareño and Navarro (2010) document a negative relationship between inflation absorption and the sensitivity of the stock prices when nominal interest rates change due to variations in the expected inflation rate. Thus, this flow-through capability seems to have a key role in the estimation of asset duration.

Acording to Leibowitz *et al*. (1989) and Jareño and Navarro (2010), changes in nominal interest rates should have a different impact on stock prices depending on whether the change is caused by variations in inflation expectations or by changes in real interest rates. If we assume the results obtained in Jareño and Tolentino (2012), changes in nominal interest rates could be estimated with changes in inflation expectations.

3. Flow-through capability

In this section, we make use of the results of Jareño and Navarro (2010), taking into account the fact that the flow-through capability is related to the ability of the firm to pass on an inflation shock to its output prices.

Thus, Jareño and Navarro (2010) assume the following model:

$$\frac{\Delta p_t}{p_t} = f(\pi_t, \pi_{t-1}, \ldots) = \alpha_0 + \alpha_1 \pi_t + \alpha_2 \pi_{t-1} + \cdots + u_t \qquad [2]$$

where Δp_t is the output price, and α_i determines the capability of the company to transmit current and past inflation shocks to its output prices, known as the flow-through coefficient (Estep and Hanson, 1980, and Estep *et al.*, 1983).

Supposing that the number of physical output units sold by the firm could be proxied by the number of employees and also assuming a constant productivity, Jareño and Navarro (2010) propose the following model (in first differences):

$$\Delta RT_t = \beta_0 + \beta_1 \Delta RLF_t + \beta_2 \Delta \pi_t + u_t \qquad [3]$$

where RT_t is the relative change in company turnover during t (*Relative Turnover*), RLF_t is the relative change in the number of employees (*Relative Labour Force*), and π_t is the average inflation rate.

In this paper, we focus on estimation of parameter β_2 that shows the flow-through capability of inflation shocks by the companies in each sector (please, see table 1).

Jareño and Navarro (2010) use semi-annual data extracted from public balance reports and profit and loss accounts from the first semester of 1993 to the first semester of 2005. They include variables in differences in order to avoid seasonality problems.

These results confirm that companies with a high value of β_2 should present the capacity to pass inflation rate changes on their product prices. Thus, these firms should show low inflation duration, that is, less inflation-sensitive in comparison with firms characterised by a low flow-through coefficient.

In this paper we follow the sector classification of the Madrid Stock Exchange, that is, Sector 1 (S1): Oil and Energy, Subsector 2 (S2-WB): Basic Materials, Industry and Construction *total without building industry*, Subsector 2 (S2-B): Basic Materials, Industry and Construction Building industry *only building industry*, Sector 3 (S3): Consumer Goods, Subsector 4 (S4-WM): Consumer Services *total without Media*, Subsector 4 (S4-M): Consumer Services *only Media*, Sector 5 (S5): Financial and Real Estate Services and, finally, Sector 6 (S6): Technology and Telecommunications.

Our sample includes 115 Spanish companies and we create daily equally-weighted sector-based stock portfolio returns. We use the Madrid Stock Exchange sector definition scheme, including 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” (S4M) and “Non Media sector” (S4WM).

Table 1. Flow-through capability of each Spanish sector of activity

Estimates of the flow-through ability of the companies listed in the Spanish Stock Exchange obtained from Jareño and Navarro (2010). **S1, S2-WB…, S6** denote each sector

	S1	**S2-WB**	**S2-B**	**S3**	**S4-WM**	**S4-M**	**S5**	**S6**
F-T Capab.	5.6457 [c]	1.9477	-2.0293	0.5848	-0.0641	6.0377	8.1448 [c]	8.4640

[c] p < 1% *t*-statistics in parentheses

According to Jareño and Navarro (2010), a negative value of β_2 shows that increases in the inflation rate are accompanied by a decrease in the growth rate of industry turnover and vice-versa. Also, the lowest values (with negative sign) correspond to the building sector (S2-B), while the highest values (with positive sign) of β_2 are shown by the technological and financial sectors (S6 and S5, respectively).

4. Inflation duration

In this paper, we point up an extension of the Jareño and Navarro (2010) methodology, so we base on new duration models proposed by Jareño (2006 and 2008), in order to include inflation duration estimates. Jareño (2006 and 2008) propose an extension of the Stone (1974) two-factor and the Fama and French (1993) three-factor model, decomposing nominal interest rate changes into variations in the real interest and expected inflation rate.

Previous studies about interest rate sensitivity base on the Stone (1974) two-factor model, which takes into account a nominal interest rate change factor and the traditional market factor (Sweeney and Warga, 1986, Flannery and James, 1984, Chen and Chan, 1989, Kane and Unal, 1990, and Oertmann *et al*., 2000). Nevertheless, Tessaromatis (2003) and Jareño (2006 and 2008) propose a variation of the traditional model, decomposing the nominal interest rate into the real interest and expected inflation rate.

Thus, we base on the following model:

$$r_{jt} = \alpha_j + \beta_{jm} \cdot r^{*}_{mt} + \beta_{jr} \cdot \Delta r^{*}_{t} + \beta_{j\pi} \cdot \Delta E_t(\pi_{t,t+12}) + \varepsilon_{jt} \quad [4]$$

where r_{jt} is the stock *j* return in month *t*, β_{jk} shows the stock sensitivity to factor *k* movements, r^{*}_{mt} is the return on the market portfolio (orthogonalized), Δr_t^{*} represents changes in real interest rates (orthogonalized), $\Delta E_t(\pi_{t,t+12})$ shows shocks in expected inflation rate, and, finally, ε_t is the error term.

This research uses a sample of monthly data of Spanish consumer price index from February 1993 to June 2005. Also, we use daily stock quotations in the Spanish Stock Exchange (SIBE), adjusted by splits. Thus, we obtain stock returns with closing price of the last day of the current month and the previous month. As far as market returns are concerned, we use Spanish stock market index (IGBM).

We use the most popular approximation based on forecast errors of ARIMA processes (time series models) to estimate the expected inflation rate, concluding that ARIMA (1, 1, 0) process provides the best possible results,[3] so we use this process in order to predict the month-to-month inflation rate, assuming shortsightedness exptectations (Leiser and Drori, 2005).[4]

Finally, according to Jareño (2008), we use returns series of the one-year Spanish Treasury debt securities and, finally, we obtain changes in real interest rates, Δr_t, as the difference between variations in nominal interest rates, Δi_t, and year-to year inflation rate, $\Delta E_t(\pi_{t,t+12})$:[5]

$$\Delta i_t = \Delta r_t + \Delta E_t(\pi_{t,t+12}) \quad [5]$$

To avoid the possible existence of multicollinearity between the new explanatory variables, we use an orthogonalization procedure. Following Lynge and Zumwalt (1980), Flannery and James (1984), Sweeney (1998) and Fraser et al. (2002), changes in real interest rates have been regressed on a constant and the series of inflation rates using OLS (ordinary least squares) estimation. Thus, the effect of each factor is isolated and the movement that remains is captured by the residuals.

First of all, we verify the existence of multicollinearity between our variables, so we show the correlation matrix (table 2).

[3] We apply the Akaike information criterion (AIC).

[4] Also, we have conducted an historical unbiasedness test, and we confirm that our proposal is an unbiased estimator of ex – post inflation rate.

[5] Classical unit root tests confirm that inflation and real interest rates are not stationary in mean, I(1). In the interest of brevity, we do not report these results and graphs.

Table 2. Correlations between variables included in our model

r_{mt} is the return on the market portfolio, Δr_t *represents changes in real interest rates* and $\Delta E_t(\pi_{t,t+12})$ *shows shocks in expected inflation rate*

	r_{mt}	Δr_t	$\Delta E_t(\pi_{t,t+12})$
r_{mt}	1.000000	-0.006666	0.008709
Δr_t	-0.006666	1.000000	-0.615668
$\Delta E_t(\pi_{t,t+12})$	0.008709	-0.615668	1.000000

We evidence a high (62%) and negative correlation between real interest and inflation rates, so we confirm we need to orthogonalize these variables.

Then, we orthogonalize the series of real interest rates, using the previous mentioned procedure (table 3).

Table 3. Orthogonalization process

OLS (ordinary least squares) estimation to orthogonalize changes in real interest rates and inflation changes

$\Delta r_t = a + b \cdot \Delta E_t(\pi_{t,t+12}) + \varepsilon_t$

	Intercept	$\Delta E_t(\pi_{t,t+12})$	R^2
Coefficients (t-statistics)	-0.000751 [c] (-3.631756)	-0.804381 [c] (-9.277401)	0.379047

[a] $p < 0.10$, [b] $p < 0.05$, [c] $p < 0.01$

As regards model [4], according to Zellner (1962), we have to use *Seemingly Unrelated Regression* (SUR) methodology, because the equation errors are correlated among sectors. Table 4 collects the main results.[6]

All sectors show a positive and significant sensitivity to variations in the market return. Thus, “Financial and Real Estate Services” (0.6550) is the sector with the lowest sensitivity to changes in the market return, whereas “Consumer Services *only Media*” (1.9243) and “Technology and Telecommunications” (1.3417) are sectors with the highest market sensitivity.

As far as the movements of the real interest rates are concerned, as Tessaromatis (2003) and Jareño (2006 and 2008), we show a negative and

[6] We do not find significant results when we include lagged inflation rates. Results about the existence of the Spanish Fisher Effect in Jareño and Tolentino (2012) corroborate it.

significant sensitivity. The sector that exhibits a high response to changes in real interest rates is sector 6. Contrarily, sectors 4-WM and 5 are the lesser sensitive sectors.

Table 4. Sensitivity of sectorial stock returns to variations in market return, real interest rates and inflation expectations

RS1, RS2-WB …, **RS6** denote returns of sector 1, sector 2 without building industry … and sector 6. r_t^j represents stock returns at time *t* for each sector *j*, β_{jk} shows the stock sensitivity to factor *k* movements, r_{mt} is the return on the market portfolio, *(orthogonalized),* Δr_t^* *represents changes in real interest rates (orthogonalized),* $\Delta E_t(\pi_{t,t+12})$ *shows shocks in expected inflation rate, and, finally,* ε_t *is the error term*. The sample extends from January 1993 to June 2005, and the following regression has been estimated using SUR methodology. *t*-statistics in parentheses [a] $p < 0.10$, [b] $p < 0.05$, [c] $p < 0.01$

$$r_{jt} = \alpha_j + \beta_{jm} \cdot r_{mt}^* + \beta_{jr} \cdot \Delta r_t^* + \beta_{j\pi} \cdot \Delta E_t\left(\pi_{t,t+12}\right) + \varepsilon_{jt}$$

	RS1	**RS2-WB**	**RS2-B**	**RS3**	**RS4-WM**	**RS4-M**	**RS5**	**RS6**
r_{mt}^*	0.7582 [c] (15.433)	0.9053 [c] (12.559)	0.8298 [c] (11.636)	0.7080 [c] (10.830)	0.8360 [c] (13.302)	1.9243 [c] (10.043)	0.6550 [c] (17.454)	1.3417 [c] (13.140)
Δr_t^*	-4.0581 [c] (-3.5267)	-5.0523 [c] (-2.9968)	-6.1571 [c] (-3.6867)	-5.5040 [c] (-3.5974)	-3.3103 [b] (-2.2528)	-3.7178 (-0.5684)	-2.6107 [c] (-2.9735)	-7.4676 [c] (-3.1284)
$\Delta E_t(\pi_{t,t+12})$	-0.9711 (-0.8264)	-5.2452 [c] (-3.0418)	-1.9496 (-1.1430)	-2.1299 (-1.3620)	-2.0640 (-1.3728)	-2.3199 (-0.5291)	-1.8729 [b] (-2.0863)	-5.4709 [b] (-2.2398)
Adj R^2	0.6283	0.5359	0.4998	0.4647	0.5474	0.6114	0.6795	0.5573

Some Spanish companies (in specific sectors) seems not to respond significantly to changes in expected inflation rate factor, so these companies give the impression to have a strong “flow-through capability” (Jareño, 2005, and Jareño and Navarro, 2010). At sectoral level, “Financial and Real Estate Services” sector (-1.8729) presents the lowest significant sensitivity to expected inflation rate movements, and “Basic Materials, Industry and Construction *total without building industry*” sector (-5.2452) and “Technology and Telecommunications” sector (-5.4709) show the highest significant sensitivity.

We evidence that inflation duration is clearly lesser than nominal interest rate duration for all sectors, obtaining the same results that Jareño (2006 and 2008). Thus, we expect the same results that Jareño and Navarro (2010) about the relationship between duration and flow-through capability, but with less significance level.

Also, an intersectoral test of the equality of response does not reject the null hypothesis in case of inflation duration. Nevertheless, stock returns by sectors show significant different responses to real interest rate changes.

5. Relationship between inflation duration and flow-through capability

Previous literature asserts that industries with a high level of flow-through capability are less inflation sensitive than industries with a low inflation absorption capability. Also, Asikoglu and Ercan (1992), Díaz and Jareño (2009) and Jareño and Navarro (2010) document a negative relationship between inflation absorption and the sensitivity of the stock prices when nominal interest rates change due to variations in the expected inflation rate. Thus, this flow-through capability seems to have a key role in the estimation of asset duration.

Jareño and Navarro (2010) find a strong relationship between the sensitivity of stock returns to changes in nominal interest rates and the capability of firms to transmit inflation shocks to the prices of their products and services. This is the first research has confirmed empirically the negative relationship between duration and the flow-through capability. According to Jareño and Navarro (2010), flow-through capability can explain nearly 50 % of the differences found in stock durations for the different economic sectors.

Taking into account results from Jareño and Navarro (2010) and Jareño and Tolentino (2012), we propose an alternative procedure in order to study the mentioned relationship between duration and flow-through capability.

Thus, if we confirm the existence of partial Fisher Effect in the Spanish case (Jareño and Tolentino, 2012), then we can analyze the mentioned relationship taking into account inflation duration (that is, the sensitivity of stocks only to expected inflation changes) instead of nominal interest rate duration.

Thus, figure 1 depicts points that relate industry flow-through capability (section 3) and inflation duration (section 4), showing a negative relationship between them. Sector 6 seems to be an “outlier”, considering the technological bubble suffered in February 2000.

If we delete sector 6 from the analysis, we can test the relationship between stock duration and flow-through capability by running similar regression of Jareño and Navarro (2010):

$$I\hat{D}^j = \alpha_0 + \alpha_1 \cdot F\hat{T}^j + u^j \qquad [6]$$

where $I\hat{D}^j$ is the estimate of sector *j* stock duration, $F\hat{T}^j$ is the flow-through capability of sector *j* and u^j is an error term.

Table 5 collects the results of regression [6] (by OLS and with *t*-statistics corrected by White to take into account the presence of autocorrelation and heteroskedasticity). The R^2 is about 4 % (lower than R^2 from Jareño and Navarro, 2010), so flow-through capability only can explain this percentage of the differences in the inflation duration.

Figure 1. Relationship between flow-through capability (by sector) and expected inflation sensitivity

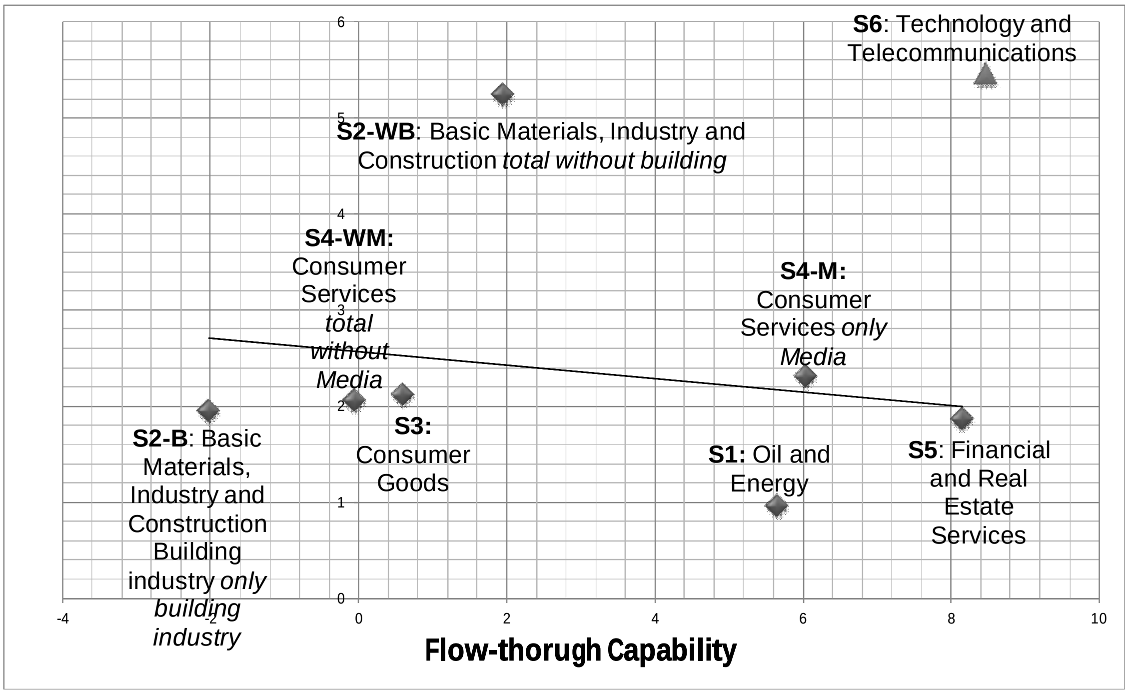

Table 5. Regression between inflation rate sensitivity and sectorial flow-through capability

The following regression has been estimated using OLS techniques with standard errors corrected for autocorrelation and heteroskedasticity using the White procedure. *t*-statistics in parentheses [c] $p < 0.05$ [b] $p < 0.10$ [a] $p < 0.15$

$$I\hat{D}^{j} = \alpha_0 + \alpha_1 \cdot F\hat{T}^{j} + u^{j}$$

$I\hat{D}^{j}$ is the estimate of sector *j* inflation duration, $F\hat{T}^{j}$ is the flow-through capability of sector *j* and u^j is an error term.

Intercept	α_1	R^2	F (*p-valor*)
2.5642 [b] (3.7974)	-0.0690 (-0.8215)	0.0371	0.6792

As Jareño and Navarro (2010), we find a negative relationship between these two variables, but this relationship is not significant. This fact confirms the results get in Jareño and Tolentino (2012), that is, the existence of partial Fisher Effect in the Spanish Economy. Thus, we coincide with previous studies in finding a negative relationship between duration and flow-through ability, but we reformulate the analysis, because we use inflation duration instead of nominal interest rate sensitivity of stock returns by sector.

6. Concluding remarks

Previous literature affirms that industries with a high level of flow-through capability are less inflation sensitive than industries with a low inflation absorption capability. Also, Asikoglu and Ercan (1992) and Jareño and Navarro (2010) document a negative relationship between inflation absorption and the sensitivity of the stock prices when nominal interest rates change due to variations in the expected inflation rate. Thus, this flow-through capability seems to have a key role in the estimation of asset duration.

Whether we confirm the existence of partial Fisher Effect in the Spanish case (Jareño and Tolentino, 2012), then we can analyze the relationship between duration and flow-through capability taking into account inflation duration (that is the sensitivity of stocks only to expected inflation changes), instead of nominal interest rate duration.

So, in order to contribute to the literature, we base on new duration models proposed by Jareño (2006 and 2008), separating variations in nominal interest rates into changes in real interest and expected inflation rates. As regards variations in real interest rates, we find a negative and significant sensitivity. Also, although we find negative inflation duration, nevertheless some sectors show non statistical significance. Finally, we point out that inflation duration is clearly lesser than nominal interest rate duration (Jareño, 2006 and 2008) for all sectors.

Thus, we expect obtaining the same results as Jareño and Navarro (2010) about the relationship between duration and flow-through capability, but with less significance level.

As Jareño and Navarro (2010), we find different values of inflation duration across sectors, so the exposure of stock returns to changes in inflation rates depends on the sector the company belongs to. Also, we evidence different values of flow-through capability across sectors, so these results are consistent with results from these authors.

Moreover, as Jareño and Navarro (2010), we show evidence about negative relationship between inflation duration, i.e., the sensitivity of stock returns to changes in inflation rates, and the flow-through capability, i.e., the ability of firms to transmit inflation shocks to the prices of their products and services.

Nevertheless, this negative relationship is not conclusive, which corroborates the results get in Jareño and Tolentino (2012), that is, due to the existence of a partial Spanish Fisher Effect.

Acknowledgements

We would like to thank Antonio Díaz (Universidad de Castilla-La Mancha, Spain) and Eliseo Navarro (Universidad de Alcalá, Spain) for their comments and suggestions. Finally, we acknowledge the financial support provided by Junta de Comunidades de Castilla-La Mancha grant PEI11-0031-6939, Ministerio de Educación y Ciencia grant ECO2008-05551/ECON and Ministerio de Ciencia e Innovación grant ECO2011-28134, which is partially supported by FEDER funds.

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