The information content of the Euro-area spread. Empirical results using aggregate variables.

Mariam Camarero* **and Javier Ordóñez**

Jaume I University

Cecilio R. Tamarit

University of Valencia

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Abstract

This paper analyzes the inflation change equation for the Euro-area using aggregate data. The results give support to the use of the term structure as an information variable by the European Central Bank.

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Key words: monetary policy, European Monetary Union, cointegration, term structure of interest rates, spread.

*Corresponding author: Department of Economics, Jaume I University. Campus de Riu Sec. E-12080 Castellón (Spain). e-mail: camarero@eco.uji.es. The authors gratefully acknowledge the funancial support from the CICYT and FEDER project SEC2002-03651 and the Bancaja project P1.1B2002-21. The three authors are members of the INTECO research group (GRUPOS03-151). The usual disclaimer applies.

1 Introduction

The European Central Bank (ECB hereafter) relies on two pillars in determining the appropriate level of interest rates: a money growth indicator and an inflation forecast, both at an aggregate level. Within the range of indicators considered as possible drivers of inflation, special attention deserves the use of the yield curve (see Estrella and Mishkin (1997)). However, recently, De Grauwe and Sénégas (2003) have criticized the ECB's strategy claiming that for the implementation of a common monetary policy in the Euro-area it may be better to complement aggregate information with non-aggregated national data. Additionally, Marcellino et al. (2003) found that the predictive power of pooling country-specific forecasts outperforms direct forecasts of aggregate variables. Consequently, this issue has raised doubts as to the convenience of using aggregate information and has opened an empirical debate. In a recent paper, Camarero et al. (2004) pooling individual country information for the term structure have obtained results supporting a homogeneous behavior in the Euro-area. This would give an indirect support to the ECB strategy based on area-wide aggregates.

In this paper we study the role of the term structure as a leading indicator for monetary policy in EMU, and contribute to previous literature in three respects: first, by using the extended area-wide aggregates that have been recently calculated by the ECB, including post-EMU data; second, we estimate a VAR system without imposing ex-ante restrictions; third, we account for possible regime changes.

The remainder of the paper is organized as follows. We first present in Section 2 the theoretical issues. In section 3 we discuss the empirical results and, finally, the conclusions are reported in the fourth section.

2 The term structure as a leading indicator in monetary policy

According to economic theory, the main information content of the term structure should be with respect to future inflation, because the Fisher relation states that nominal interest rates are the sum of real interest and expected inflation rates. If expectations are rational, the term structure spread (as the difference between the yield on a n-period bond and a m-period bond) can be decomposed *à la Mishkin*, in the sum of the expected real rate changes and a term premium. In the empirical literature, this approach has given rise to the test of the so-called *inflation-change equation*:

$$\pi_{t+1}^{k} - \pi_{t+1}^{m} = \alpha_{k,n,m} + \beta_{k,n,m}(R_t^n - R_t^m) + resid_{t+1} \quad (1)$$

where $\pi^k_{t+1} \equiv (1/k) \sum_{i=0}^{k-1} \pi_{t+1+i}$ is the k-period inflation rate from t to $t+k$, R^n and R^m are the interest rates of a bond with a maturity of n and m periods respectively and $resid_{t+1}$ is the regression residual.

In this note we use a system approach to analyze the relationships between these three variables, that are obtained from a process of identification and testing for long and short-term restrictions.

3 Empirical results

The data (long and short term interest rates and the price index) has been obtained from the area-wide database by Fagan et al. (2001) for the period 1970:1-2003:4. The inflation change is computed using the logarithm of the area-wide harmonized consumer price index. The horizon of the forecast is four quarters.

Previous to the cointegration analysis, we have tested for the stationarity of the aggregated variables using the Johansen procedure. This test investigates whether the analyzed variable corresponds to a unit vector in the cointegration space. The results are strongly in favor of rejecting the null hypothesis of stationarity for interest rates (*eur* and *eul*), but not for the inflation change (*dpi*).[1]

Next, we estimate a vector error correction model for the inflation change and the area-wide long and short-run interest rates for the period 1970:1 to 2003:4. The model is specified with two lags and the constant restricted to the cointegration space[2]. From the analysis of the VAR residuals, and in order to maintain the hypothesis of normality, three dummies were introduced and restricted to lie in the cointegration space, named *ds744*, *ds862* and *ds942*, where *dsXXY* stands for a shift dummy which is equal to one from 19XX:Y, and zero elsewhere. An unrestricted impulse dummy is also included in the model. This dummy, called *dds781*, takes the value of one in 1978:1 and zero elsewhere. Misspecification tests (first and fourth order autocorrelation and normality) have been computed and conclude that the model is correctly specified. Additional tests on the individual variables and their role in the system allow us to conclude that none of the variables can be excluded from the cointegration space or be restricted as weakly exogenous.

The cointegration analysis (performed using the Johansen procedure and the programme CATS) is presented in the first panel of Table 1, where an asterisk denotes the Barlett correction for the *Trace* test. Given that three dummy variables are restricted to the cointegration space, the critical value

[1]These results as well as the rest of misspecification tests are available from the authors upon request.

[2]The specification was decided using information criteria.

(*Frac95*) is not appropriate and, following a common practice suggested by Juselius (2004), we add a χ^2 statistic (that is, 4.00) to the critical values for each dummy included in the cointegration relation. In this case, we can accept the existence of two cointegration relations. The choice of $r = 2$ is confirmed by the analysis of the roots of the companion matrix. When r is set to two, the largest root is 0.70. Finally, the choice of $r = 2$ can be also justified in terms of the significance of the second row α coefficients. The choice $r = 1$ would imply a lost of important information about the adjustment behavior of *deur* and, possibly, *ddpi*.

From the identification of the restricted model (see the second panel in table 1), the first cointegration vector corresponds to the inflation change whereas the second cointegration vector is identified imposing the restrictions that the long and short-run interest rates have the same coefficient but with opposite sign, as well as some exclusion restrictions. Therefore, a relationship including the spread and a dummy variable in 1994:2 is stationary. The LR statistic for the joint identification is $\chi^2(6)$=6.20 with a probability value of 0.40. Table 1 also presents the α and $\alpha_\perp$ loading matrices and the short-run parameters for this model. From these results, and looking at the second row of the matrix $\hat{\alpha}$, the short-run interest rate is error correcting to the interest rate spread with an adjustment coefficient of 0.16. In addition, the inflation change is also significant and positively related to the interest rate spread with a coefficient of 2.40. Therefore, a monetary policy contraction would imply a reduction in future inflation. This is an important result, as one of the short-run adjustment mechanisms adopts precisely the form of the inflation change equation.

The common stochastic trend is roughly generated by shocks to the long-run real interest rates, which influences positively the two interest rates. In addition, the interest rates dynamics are driven by their own lag and the inflation change lag. The lower row of Table 1 reports misspecification tests statistics for the restricted model, showing that the residuals are linear, no autocorrelated and normal.

However, the use of pre-EMU data to infer future behavior in the "true" Euro area should be treated with caution, as the creation of the EMU may have led to institutional and behavioral changes. Therefore, the stability and the predictive performance of the VECM is investigated.

Figure 1 reports the recursive Hansen and Johansen (1999) tests for parameter constancy in the cointegration space. From the tests for β, α_1 and α_2 constancy (see panels *(a)*, *(b)* and *(c)*, respectively), the conclusion is that the cointegration space is clearly stable. Finally, figure 2 shows the one-step ahead prediction error for each of the variables of the system. A test value above one implies that the model is not able to predict that observation within the 95% confidence interval. The predictive ability of the model turns out to be generally very good, specially in the case of the short-run interest rate. The exceptions are, in the case of the long-run interest rates, the large shocks of

1994 and 1995, and the beginning of 2001 for the inflation rate.

4 Conclusions

In this paper we have analyzed, using a VAR system approach based on the Johansen methodology, the relationships linking long and short term interest rates and inflation for the Euro-wide aggregates during the period 1970:1-2003:4. The identification of the system shows that the interest rate spread is a stable stationary relation and that an inflation change equation à la Mishkin characterizes the short-run dynamics. This supports both the use of aggregate area-wide data in the implementation of monetary policy by the ECB as well as the role of the term structure as a leading indicator for inflation in EMU.

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Table 1: Empirical results

THE COINTEGRATION RANK

Rank test for cointegration

p-r	r	Eig.Value	Trace	Trace*	Frac95	P-Value	P-Value*
3	0	0.4664	118.061	111.852	35.0704	0.0000	0.0000
2	1	0.2026	36.4088	34.6124	20.1637	0.0001	0.0002
1	2	0.0523	6.9770	6.8314	9.1424	0.1310	0.1394

Roots of the companion matrix

Rank =1	1.0000	1.0000	0.5892	0.2349	−0.0507	−0.0507
Rank =2	1.0000	0.7075	0.7075	0.3790	−0.1084	−0.1084

$\hat{\alpha}$ loadings

	DEUR	DEUL	DDPI
$\hat{\alpha}_1$ (t-ratios)	5.8604	4.7466	−8.851
$\hat{\alpha}_2$ (t-ratios)	4.3125	−0.924	2.4378
$\hat{\alpha}_3$ (t-ratios)	0.9825	2.3582	0.9672

THE RESTRICTED MODEL

Cointegration space (rank=2)

	EUR	EUL	DPI	DS862	DS942	DS744	Cons.
Beta1	0.0000 [NA]	0.0000 [NA]	−1.0000 [NA]	−0.0725 [−1.9878]	0.0000 [NA]	0.1474 [2.7017]	−0.0860 [−1.8423]
Beta2	−1.0000 [NA]	1.0000 [NA]	0.0000 [NA]	0.0000 [NA]	−1.3605 [−4.0645]	0.0000 [NA]	0.0000 [NA]

$\hat{\alpha}$ and $\hat{\alpha}_\perp$ matrices

	EUR	EUL	DPI		EUR	EUL	DPI
$\hat{\alpha}_1$	1.3909 [5.3908]	0.7512 [5.1017]	−0.996 [−8.415]	$\hat{\alpha}_\perp$	1.0000 [5.5523]	0.0308 [0.2419]	0.7965 [3.9027]
$\hat{\alpha}_2$	0.1604 [3.4139]	−0.046 [−1.7239]	2.4024 [2.4024]				

The short-run matrices

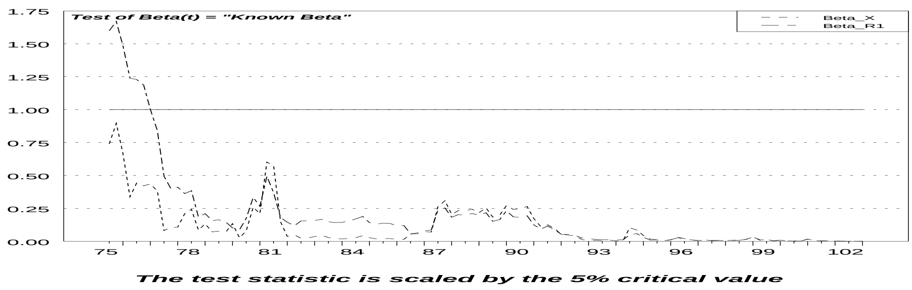
	DEUR(-1)	DEUL(-1)	DDPI(-1)	DDS862	DDS942	DDS744	DDS781
DEUR	0.4343 [5.4665]	–	−1.172 [−6.2584]	–	–	–	–
DEUL	–	0.3929 [5.5277]	−0.4436 [−4.1497]	−1.0620 [−3.6289]	0.7648 [2.6558]	–	1.3678 [4.7662]
DDPI	–	–	–	–	–	−0.9042 [−3.7794]	–

Misspecification tests

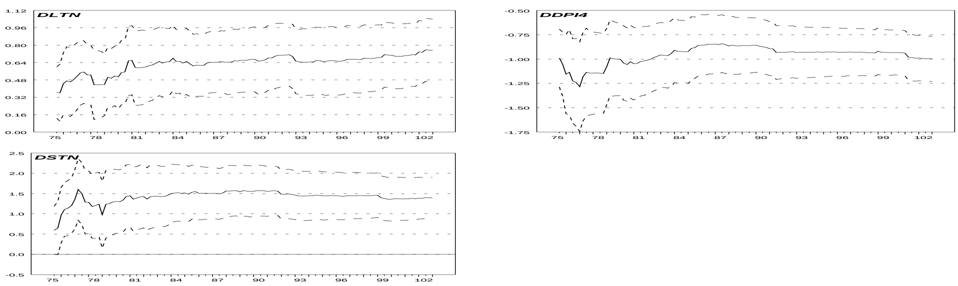
Nor.	AR(1)	AR(4)	NL1	NL2	NL3
0.111	0.149	0.652	0.516	0.744	0.113

(a)The cointegration space is estimated following the Johansen procedure and using the programme CATS by Dennis, Hansen, Johansen and Juselius. An asterisk denotes Barlett correction.
(b) *t-values* in brackets. *Nor* denotes normality test. *AR(1)* and *AR(4)* denotes respectively a test statistic for residual autocorrelation up to order 1 and 4. *NL1* to *NL3* stands for the linearity test by Granger and Teräsvirta (1993) applied respectively to the residuals of the equation for $DEUR$, $DEUL$ and $DDPI$. For *Nor, AR(1), AR(4), NL1, NL2* and *NL3* only the p-values are reported.

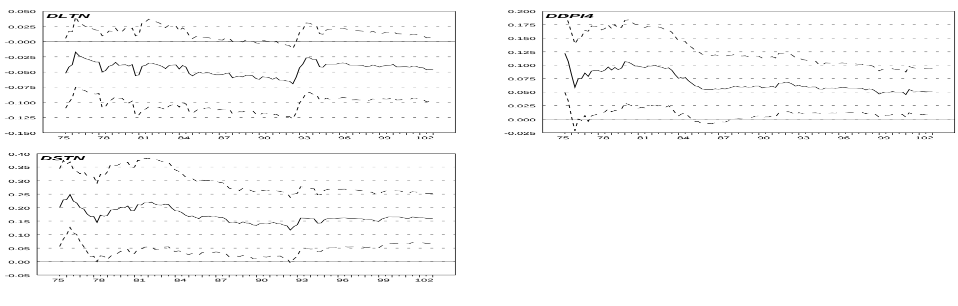
Figure 1: Stability tests



(a) Beta constancy



(b) $\hat{\alpha}_1$ constancy



(c) $\hat{\alpha}_2$ constancy

Figure 2: One-step-ahead prediction errors for the individual variables: prediction period 1994-2003.