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EMU AND MACROECONOMIC SHOCKS: SOME EVIDENCE ON SPANISH REGIONS*

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The Theory of Optimal Currency Areas poses that one of the main costs that EMU may entail for countries and regions belonging in it is the loss of monetary autonomy at the country level, since the scenario brought about by the single currency does not allow for domestic policy adjustments in response to disturbances. The importance of this cost, in turn, is related to the nature of shocks impinging over the different countries and regions that encompass the Eurozone. If the probability that countries and regions suffer the same sort of shock is large, then a common policy designed by the ECB will have beneficial effects on the whole Eurozone. The converse is true, however, if the disturbances that potentially may affect the area have an asymmetric impact.

This paper addresses this issue empirically for the case of the Spanish regions, by means of analysing the shocks that have hit the Spanish regions in the recent past. In particular, we want to identify the kind of shocks suffered by the Spanish regions in the last decades, distinguishing several categories: symmetric versus asymmetric, persistent versus transitory and demand shocks versus supply shocks.

Hence, we examine the behaviour of GAV and prices for 17 Spanish regions over the period 1955-97 by the analysis of a baseline model written in the form of the state-of-spaces, to which the Kalman filter is applied. Main conclusions are as follows: first, and based upon the assumption that common shocks are tantamount to symmetric shocks, it seems that, in most cases, the shocks that have affected the Spanish regions have been mostly symmetric, while asymmetric shocks have been sparser. Second, empirical results suggest that the effects of these shocks have been, generally speaking, persistent rather than transitory. Finally, the estimation indicates that supply shocks have been slightly more frequent that demand shocks.

The policy implications of these results are that the lack of monetary autonomy may not be very onerous. The common monetary policy implemented by the ECB will probably have similar effects on all Spanish regions. Thus, the danger of an increase in regional disparities via this channel does not seem to be very severe.

Keywords: shocks, state space models, Kalman filter, regional disparities.
JEL codes: R11, E5

1. - INTRODUCTION

One of the main issues covered by the recent literature on EMU is the nature and effects of potential shocks impinging on its members. This topic is crucial for the sound implementation and functioning of the ECB monetary policy. In effect, if the probability of asymmetric shocks hitting the various areas was high, the cost of the loss of monetary policy as an adjustment instrument at the country level could be relevant, thus damaging the integration process[1].

An asymmetric shock in the context of a currency union can be defined as a shock affecting a particular country in a different way than others members of the union[2]. According to this characterisation, it is clear that this kind of shocks may entail problems associated to the lack of monetary autonomy at the country level to overcome its negative effects.

However, there are other aspects that are also relevant when assessing the potential impact of a shock: its degree of persistence (Von Hagen and Hammond, 1998), and its origin (demand or supply driven). Obviously, a (negative) persistent shock will be more onerous for a country than a transitory one, since this last type can be coped with provisionally by external debt or public deficits, whereas permanent shocks necessitate more severe adjustments.

In addition, it is plausible to assume that countries may not have the same preferences regarding inflation and unemployment. Thus it is important to ascertain whether the shock is demand or supply driven (Diaz, 1998). A restrictive demand shock will increase unemployment but will not damage inflation. A supply side shock will increase both unemployment and inflation.

There are already an abundant number of studies that have analysed empirically the symmetric or asymmetric nature of shocks[3]. The bulk of this literature has been developed within the framework of EMU, employing different methodologies (for a survey, see Maza, 2001 a).

This paper examines the probability that Spanish regions be affected by asymmetric shocks, together with the issues of their persistence and origin. The methodology pursued is the Kalman filter, once the model has been rewritten in a space of states form. In particular, shocks to production and prices are disentangled in a common and a specific component. The structure of the paper is the following: Section 2 describes the empirical model and shows some basic result that associate common with symmetric shocks and specific with asymmetric shocks. Section 3 and 4 explore the potential asymmetric effects of common disturbances, and the possible symmetric impact of specific shocks. Section 5 concludes.

2. - THE NATURE OF SHOCKS: AN EMPIRICAL ANALYSIS.

2.1. - The model[4]

First, we have to point out a problem concerning the data employed. The series used here are Gross Added Value (GAV) in million of constant pesetas of 1986 and the implicit price indexes. The data basis used (from the Fundación BBVA) provides observations only every two years. To convert them in yearly series we have pursued two techniques: an interpolation and a spline. The results displayed below correspond to the second approach (they do not vary much, however, from those obtained by the first method).

Next, and following Jansson (1997), we have designed a model that analyses the fluctuations experienced by output and prices in the various Spanish regions[5]. Previously the series have been detrended by means of differentiating their logs[6].

We denote by X_{it} the series of output and prices for the region i in period t once the trend has been removed. Next, these series are disentangled in two non-observable components: one that is common for all regions, X_t^C, and another one that is specific, X_{it}^E. Analytically, the measure equation is

$$X_{it} = \gamma_i X_t^C + X_{it}^E$$

The main problem when performing the estimation is that the two components of X_{it} can not be directly observed. However, under certain assumptions (in particular, that they are independent and that their behaviour is known) they can be estimated. Moreover, we allow them to be subject to shocks or, in other words, to be stochastic. Finally, it seems reasonable to assume that the common component captures the symmetric shocks, whereas the region specific component reflects the asymmetric shocks.

Furthermore, we assume that the non observable components follow a first order autorregresive process described by the following transition equations:

$$X_t^C = \alpha X_{t-1}^C + \varepsilon_t^C$$
$$X_{it}^E = \beta_i X_{it-1}^E + \varepsilon_{it}^E$$

Where ε_t^C and ε_{it}^E represent the common (symmetric) and specific (asymmetric) shocks respectively (we shall relax this taxonomy below).

Other assumptions are referred to next. Shocks follow a normal distribution, with average 0 and constant variance. Asymmetric shocks are uncorrelated among themselves ($Cov(\varepsilon_{it}^E, \varepsilon_{jt}^E) = 0$ for all $i \neq j$) and with the symmetric shocks ($Cov(\varepsilon_{it}^E, \varepsilon_t^C) = 0$ for all i).

The next step has been to apply the Kalman filter to compute the optimal estimator of the non-observable components in period t, based upon information available in that period[7]. The estimation of this model allows identifying the type of shock. In addition, we also know that the values of the parameters associated to the lags of the dependent variable provide information on the degree of persistence of a disturbance. Since in this case the process is AR(1), the closer to one is the parameter associated to the first lag, the more persistent the shocks are.

In order to ascertain the importance of symmetric and asymmetric shocks, the variance of the original series has been decomposed as follows:

$$Var(X_{it}) = \gamma_i^2 Var(X_t^C) + Var(X_{it}^E)$$

Where

$$Var(X_t^C) = Var(\varepsilon_t^C) + \alpha Cov(X_t^C, X_{t-1}^C)$$
$$Var(X_{it}^E) = Var(\varepsilon_{it}^E) + \beta_i Cov(X_{it}^E, X_{it-1}^E)$$

By applying this decomposition the percentage of the changes in X_{it} that is explained by symmetric and asymmetric shocks, respectively, can be computed.

We still have to identify demand shocks and supply shocks. The model in itself does not provide an answer to this question, but some information can be ascertained by examining the error terms. In particular, we disentangle the disturbances into demand and supply ones. Therefore, for the level of output we have:

$$\varepsilon_t^C(y) = \alpha^y D_t^C + \beta^y O_t^C$$
$$\varepsilon_{it}^E(y) = \delta_i^y D_{it}^E + \gamma_i^y O_{it}^E$$

and for the price level:

$$\varepsilon_t^C(p) = \alpha^p D_t^C + \beta^p O_t^C$$
$$\varepsilon_{it}^E(p) = \delta_i^p D_{it}^E + \gamma_i^p O_{it}^E$$

Where $D_t^C\ (D_{it}^E)$ represent the symmetric (asymmetric) demand shocks and $O_t^C\ (O_{it}^E)$ represent the symmetric (asymmetric) supply disturbances. Since these shocks are structural, $Cov(Z_t, Y_t) = 0$ for all $Z_t \neq Y_t$, where $Z_t, Y_t = D_t^C, D_{it}^E, O_t^C, O_{it}^E$.

To identify these shocks we assume that the sign of the impact of the demand shocks is the same for output and prices, whereas supply shocks have opposite effects. Thus, we can determine the sign of the parameters and suppose that the impact of either type of shock on output will yield coefficients $\alpha^y, \beta^y > 0; \delta_i^y, \gamma_i^y > 0$; however, as regards supply shocks, their effects on output and prices will be $\alpha^p, \delta_i^p > 0; \beta^p, \gamma_i^p < 0$. With this information is easily seen that since:

$$Cov(\varepsilon_t^C(y), \varepsilon_t^C(p)) = \alpha^y \alpha^p Var(D_t^C) + \beta^y \beta^p Var(O_t^C)$$
$$Cov(\varepsilon_{it}^E(y), \varepsilon_{it}^E(p)) = \delta_i^y \delta_i^p Var(D_{it}^E) + \gamma_i^y \gamma_i^p Var(O_{it}^E)$$

the signs of the correlations between the estimated error terms give information on the importance of supply and demand shocks

2.2. - Main results

Main results are displayed in Table 1. The first column shows how the common component affects fluctuations of output and prices in all regions. Results have been normalised and the sensibility of output fluctuations to the symmetric component of Madrid has been settled to one. In other words, if the coefficient for a particular region is larger than one, that region is more vulnerable to common shocks that Madrid. The same is true for values of the coefficients less than one. Values in parenthesis are the p-values, computed by means of the likelihood ratio test (Harvey, 1990). They can be interpreted, under the null hypothesis, as the probability of a region not been influenced by the common component.

Main results suggest that the changes in the common coefficient affect all regions. The point estimate of the coefficients is close to one, and they are significant in virtually all cases (the only exception is Asturias, with a p-value around 0,4 in the case of output). It seems, therefore, that all regions react in the same way to this kind of shock. This aspect will be further discussed in the next section.

The second and third columns of Table 1 show the degree of persistence of a shock. The closer is the coefficient to one in absolute terms, the more persistent a shock is. If the coefficient is zero, then the shock may be regarded as transitory. Results show, on the one hand, that the impact of symmetric shocks on output and prices are quite persistent. On the other hand, the findings are less homogeneous as far as asymmetric shocks are considered. Anyhow, the effects are more persistent on output than on prices. The probability of these shocks been fully transitory is especially small in the cases of the País Vasco, Canarias and Asturias, whereas Castilla-Leon and Cantabria are in the opposite case. In terms of the price index, Madrid shows the highest level of persistence, followed by Cantabria and Castilla-La Mancha. Again, the converse is true for Aragon and the País Vasco, where the probability is higher that 90%.

Table 2 summarises the percentage of the variations of the level of output and prices by employing the variance decomposition described above. It also presents a ranking of the regions, according to which those regions that have a 1 exhibit the smallest probability of being hit by a specific disturbance. It can be noticed in the table that symmetric shocks are more relevant for most regions, especially concerning the price index. These findings are common to other research in the area (Villaverde, 1999b; Sanchez-Robles and Cuñado, 1999). However, in some regions asymmetric shocks play a prominent role: Asturias (both in output and prices) and Extremadura (output). Regions where asymmetric shocks are less relevant are Comunidad Valenciana, Cataluña and Aragón (output) and Cataluña, Comunidad Valenciana, Madrid, Murcia and Aragón (prices).

Finally, and regarding the last feature of the shocks, we shall consider whether they are demand or supply driven by examining the correlations among the shocks in output and in prices. The main outcomes are displayed in Table 3. The first conclusion is that supply shocks seem to have been relatively more important in Spain. Andalucía exhibits the highest negative correlation (-0,67), followed by the País Vasco, Castilla-León and Madrid. Regions that have been hit by demand shocks are Extremadura and Valencia. Regarding common shocks, the relative importance of demand and supply shocks appears to be the same.

3. - COMMON SHOCKS AND ASYMMETRIC EFFECTS

Up to now, common shocks have been considered tantamount to symmetric shocks. It could be possible, however, that a change in the common component had different impact in each region, especially if the productive structure is dissimilar or the labour market institutions (Blanchard and Wolfers, 1999) are diverse. We shall address this issue in this section.

In particular we will examine if a common shock may behave as an asymmetric disturbance. Accordingly, we repeat the same exercise as in the previous section, but now imposing the same coefficient associated to the common coefficient for all regions. In analytical term, we estimate the following equation:

$$X_{it} = \gamma X_t^C + X_{it}^E$$

The γ coefficient captures the average response of the country to this type of shock. Once this value is obtained, we can approximate the asymmetric effects of a common shock by computing the probability of each region being the same as that of the country. In other words, we have estimated the model under the null hypothesis that the coefficient of each region (γ_i) is the same that the national coefficient (γ). Higher p – values will correspond to more homogeneous behaviour with respect to the national performance, and the probability of common shocks behaving as asymmetric will be lower. According whit this, results with only a coefficient are displayed in Table 4 (to make results comparable with those obtained previously we consider again the coefficient of Madrid equal to 1).

The coefficient that corresponds to output is 1,20. The common component has a decisive influence in the output fluctuations, since it the probability of this coefficient being zero is null. Moreover, results on the persistence of shocks agree with those obtained above. Asymmetric shocks are more transitory in Castilla-León and Aragón, whereas disturbances seem to be more persistent in the País Vasco and La Rioja (the probability of the shocks being transitory is zero).

As far as the price level is concerned, Table 4 shows that the common component plays a relevant role in its evolution (the coefficient is 0,79 and highly significant). The outcomes about the persistence of the disturbances obtained above also carry over to this case. In Madrid and Castilla-La Mancha asymmetric shocks are more persistent, while they seem to be transitory in Cataluña and Aragon.

Now we can approximate the probability of a common shock having different effects on the Spanish regions if we compare the response of each region to that obtained for the country as a whole. Results are displayed in Table 5 and summarised next.

The first column of the Table shows that Asturias seems to have the most dissimilar response regarding the pattern of output, followed by Cataluña, Extremadura, Castilla-León and Valencia. The opposite holds true for the País Vasco, Castilla-La Mancha and Canarias; the probability of the response of these four regions being identical to the national is large.

The second column of Table 5 shows that, in terms of prices, the more different behaviour with respect to national is found in Canarias, Cataluña, Cantabria and Andalucía. The sensitivity of Aragón, Extremadura and Castilla-Leon to the common component is analogous to the national one.

Finally, when we consider both variables at the same time we can not reject the null – at the 5% significance level - of common shocks having symmetric effects in Spanish regions in most cases (the only exception is Canarias –in prices-).

4. - SPECIFIC SHOCKS AND SYMMETRIC EFFECTS

In Section 2 above we disentangled the fluctuations experienced by the Spanish regions in a common and a specific shocks. At that point we identified the latter with the asymmetric disturbances. However, and following Karras (1996) we can inquiry whether it could be the case that specific shocks did not behave in practice as asymmetric. In effect, it could be the case that specific shocks in certain regions were very correlated among them, and therefore alternative adjustment mechanism would not be necessary.

Accordingly, we have computed the correlation coefficient among specific shocks of the 17 Spanish regions – taken on a two by two basis. Values as displayed in Tables 6 (output) and 7 (prices).

As regards output, there are a remarkable number of coefficients that are significantly different from zero. It can not be found, nevertheless, a clear pattern as far as the signs are concerned. Thus, we lack enough evidence to conclude if the specific shocks have asymmetric effects. It can be pointed out though that some regions, like Valencia, seem to suffer disturbances that are not on line with that observed in the rest of the country, (negative signs of the correlation coefficients).

As far as prices are concerned (Table 7) our findings suggest that a larger number of correlation coefficients turn up to be significant. Moreover, negative signs are relatively more abundant. Hence it could be tentatively said that specific shocks seem to be asymmetric. In particular, Castilla La Mancha is the region in which shocks appear to be more asymmetric (the correlation coefficient is negative and significant in eight cases).

5. - CONCLUDING REMARKS

This paper has tried to ascertain whether the probability of Spanish regions experiencing asymmetric shocks is high. Although the Lucas critique is no doubt present when carrying out research on this issue, we have opted to look at the past experience - the period 1955-97 - to try to foresee what the situation will be like in the future.

The basic findings of the paper are summarised as follows:

1. The shocks that have impinged Spanish regions in the aforementioned period have been mostly symmetric. Asymmetric shocks have been sparser, but can be found in the performance of Asturias, Extremadura and the País Vasco.
2. Shocks appear to be persistent, especially for the case of output as compared to prices.
3. Regarding the origin of the shocks, our results suggest that they have predominantly been driven by the supply instead of demand.
4. Common shocks may have asymmetric effects, especially in Asturias, Cataluña and La Rioja.
5. Finally, specific shocks seem to have a more asymmetric impact on prices than on output.

Summing up, it can be tentatively said that the probability of Spanish regions been affected by asymmetric shocks in the future is not very high. Policy implications are clear: the loss of the exchange rate and the monetary policy as adjustment mechanisms at the country level does not appear to be very severe for Spanish regions. However, we can not overlook the fact that these shocks are nevertheless possible, and therefore those measures intended to reform the productive structure at the regional level (an important factor related to the probability of suffering asymmetric shocks) should be welcomed.

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[1] According to the theory of the Optimal Currency Areas, the main alternative adjustment mechanisms are wage flexibility (for an analysis regarding the Spanish case see Villaverde, 1999a; Maza, 2001b and 2002), labor mobility (Maza, 2001a) and fiscal federalism.

[2] There are other alternative definitions but the basic notion is the same. See, for example, Patterson and Amati (1998).

[3] It is important to keep in mind, however, that there is not a direct form to know whether a shock is symmetric or asymmetric. Therefore, research on this area has to use indirect indicators that, in turn, capture at the same time the effect of the shock and the answer to the shock (De Grauwe and Vanhaverbeke , 1993; Bayoumi and Eichengreen , 1993).

[4] Model diagnosis is showed in the appendix.

[5] Chamie *et. al*. (1994) also present a model based in the space of states and the Kalman filter approach.

[6] More specifically, the series employed are $X_{it} = \lfloor \Delta \log(GAV_{it}) - average \rfloor$ and $X_{it} = \lfloor \Delta^2 \log(P_{it} - average \rfloor$ for the GAV and price index P, respectively, where Δ is the lag operator.

[7] The Kalman filter is encompassed by a set of equations that allows a estimator to be recalculated when new information is available. First, the equations are employed to get the optimal prediction of the next observation, taken as given the information available at that moment. Next, when the new information is received and by means of the actualization equations, the predictions are revised. As a result, errors of prediction are generated and employed to construct the likelihood function and the correspondent parameters are estimated.

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APPENDIX: MODEL DIAGNOSIS

In this Appendix we shall cover the statistical properties of the model with more detail as regards normality, serial correlation, homocedasticity and stability of parameters. Table A1 displays the main results. Generally speaking these results suggest that the model is correctly specified.

Table 1
SHOCKS PERSISTENCE

Regions	Sensitivity to the symmetric component γ_i		Persistence of symmetric shocks α		Persistence of asymmetric shocks β_i	
	GAV	**Prices**	**GAV**	**Prices**	**GAV**	**Prices**
Andalucía	1,11 (0)	0,93 (0)	0,76 (0)	0,44 (0,0165)	0,54 (0,0157)	0,31 (0,1680)
Aragón	1,34 (0)	0,79 (0)	0,76 (0)	0,44 (0,0165)	0,55 (0,0956)	0,02 (0,9356)
Asturias	0,72 (0,0039)	0,61 (0,0007)	0,76 (0)	0,44 (0,0165)	0,63 (0,0005)	0,25 (0,2402)
Baleares	1,23 (0)	0,99 (0)	0,76 (0)	0,44 (0,0165)	0,60 (0,0015)	-0,07 (0,7440)
Canarias	1,22 (0)	1,01 (0)	0,76 (0)	0,44 (0,0165)	0,66 (0,0003)	0,10 (0,6415)
Cantabria	1,25 (0)	0,70 (0)	0,76 (0)	0,44 (0,0165)	0,33 (0,1074)	0,35 (0,1084)
Castilla-León	0,91 (0)	0,79 (0)	0,76 (0)	0,44 (0,0165)	0,38 (0,1527)	0,16 (0,4076)
Castilla-La Mancha	1,18 (0)	0,70 (0)	0,76 (0)	0,44 (0,0165)	0,56 (0,0053)	0,30 (0,1278)
Cataluña	1,47 (0)	0,86 (0)	0,76 (0)	0,44 (0,0165)	0,46 (0,0367)	0,08 (0,7347)
C. Valenciana	1,43 (0)	0,78 (0)	0,76 (0)	0,44 (0,0165)	0,82 (0,0601)	0,25 (0,2634)
Extremadura	0,83 (0,0026)	0,79 (0)	0,76 (0)	0,44 (0,0165)	0,53 (0,0067)	-0,14 (0,5443)
Galicia	1,10 (0)	0,74 (0)	0,76 (0)	0,44 (0,0165)	0,68 (0,0018)	-0,15 (0,5648)
Madrid	1,00 (-)	1,00 (-)	0,76 (0)	0,44 (0,0165)	0,70 (0,0010)	0,46 (0,0090)
Murcia	1,04 (0)	0,80 (0)	0,76 (0)	0,44 (0,0165)	0,64 (0,0013)	0,10 (0,5006)
Navarra	1,23 (0)	0,75 (0)	0,76 (0)	0,44 (0,0165)	0,52 (0,0061)	0,11 (0,5188)
País Vasco	1,18 (0)	0,68 (0)	0,76 (0)	0,44 (0,0165)	0,74 (0,0001)	0,02 (0,9184)
Rioja (La)	0,98 (0)	0,84 (0)	0,76 (0)	0,44 (0,0165)	0,66 (0,0008)	0,10 (0,6324)

Notes: p-values in parenthesis. The null hypotheses are:

$H_0 : \gamma_i = 0$

$H_0 : \alpha = 0$

$H_0 : \beta_i = 0$

Source: Fundación BBVA and own elaboration

Table 2
DECOMPOSITION INTO SYMMETRIC AND ASYMMETRIC SHOCKS

Regions	Symmetric component		Asymmetric Component		Ranking	
	GAV	Prices	GAV	Prices	GAV	Prices
Andalucía	84,76	90,23	15,24	9,77	6	8
Aragón	95,38	95,33	4,62	4,67	3	5
Asturias	39,71	49,21	60,29	50,79	17	17
Baleares	79,85	76,20	20,15	23,80	8	16
Canarias	70,07	88,36	29,93	11,64	13	12
Cantabria	75,15	92,62	24,85	7,38	12	6
Castilla-León	77,41	88,90	22,59	11,10	11	9
Castilla-La Mancha	78,39	88,83	21,61	11,17	9	10
Cataluña	95,92	98,19	4,08	1,81	2	1
C. Valenciana	97,13	98,07	2,87	1,93	1	2
Extremadura	47,43	83,53	52,57	16,47	16	14
Galicia	94,28	87,49	5,72	12,51	4	13
Madrid	69,88	97,53	30,12	2,47	14	3
Murcia	77,74	95,47	22,26	4,53	10	4
Navarra	81,99	88,46	18,01	11,54	7	11
País Vasco	59,87	82,03	40,13	17,97	15	15
Rioja (La)	86,84	92,49	13,16	7,51	5	7

Note: figures in percentages. Sources: Fundación BBVA and own elaboration.

Table 3
DEMAND AND SUPPLY SHOCKS

Regions	Correlation coefficient among shocks
Common component	0,08
Andalucía	-0,67*
Aragón	-0,19
Asturias	-0,17
Baleares	0,23
Canarias	-0,09
Cantabria	0,08
Castilla-León	-0,32*
Castilla-La Mancha	-0,15
Cataluña	0,25
C. Valenciana	0,31*
Extremadura	0,44*
Galicia	0,20
Madrid	-0,29*
Murcia	-0,21
Navarra	-0,14
País Vasco	-0,38*
Rioja (La)	-0,22

Note: * : significant at 95%.
Source: Fundación BBVA and own elaboration.

Table 4
RESTRICTED MODEL

Regions	Sensitivity to the symmetric component γ		Persistence of symmetric shocks α		Persistence of asymmetric shocks β_i	
	GAV	**Prices**	**GAV**	**Prices**	**GAV**	**Prices**
Andalucía	1,20 (0)	0,79 (0)	0,77 (0)	0,45 (0,0139)	0,55 (0,0150)	0,23 (0,2968)
Aragón	1,20 (0)	0,79 (0)	0,77 (0)	0,45 (0,0139)	0,28 (0,2228)	0,01 (0,9501)
Asturias	1,20 (0)	0,79 (0)	0,77 (0)	0,45 (0,0139)	0,56 (0,0018)	0,18 (0,3932)
Baleares	1,20 (0)	0,79 (0)	0,77 (0)	0,45 (0,0139)	0,59 (0,0019)	0,07 (0,7280)
Canarias	1,20 (0)	0,79 (0)	0,77 (0)	0,45 (0,0139)	0,66 (0,0002)	0,18 (0,3259)
Cantabria	1,20 (0)	0,79 (0)	0,77 (0)	0,45 (0,0139)	0,35 (0,0709)	0,27 (0,1785)
Castilla-León	1,20 (0)	0,79 (0)	0,77 (0)	0,45 (0,0139)	0,23 (0,2875)	0,17 (0,4016)
Castilla-La Mancha	1,20 (0)	0,79 (0)	0,77 (0)	0,45 (0,0139)	0,56 (0,0037)	0,36 (0,0766)
Cataluña	1,20 (0)	0,79 (0)	0,77 (0)	0,45 (0,0139)	0,61 (0,0027)	-0,01 (0,9597)
C. Valenciana	1,20 (0)	0,79 (0)	0,77 (0)	0,45 (0,0139)	0,59 (0,0047)	0,22 (0,3192)
Extremadura	1,20 (0)	0,79 (0)	0,77 (0)	0,45 (0,0139)	0,54 (0,0057)	-0,14 (0,5238)
Galicia	1,20 (0)	0,79 (0)	0,77 (0)	0,45 (0,0139)	0,64 (0,0040)	-0,24 (0,2478)
Madrid	1,00 (-)	1,00 (-)	0,77 (0)	0,45 (0,0139)	0,69 (0,0008)	0,49 (0,0065)
Murcia	1,20 (0)	0,79 (0)	0,77 (0)	0,45 (0,0139)	0,59 (0,0024)	0,10 (0,5060)
Navarra	1,20 (0)	0,79 (0)	0,77 (0)	0,45 (0,0139)	0,53 (0,0054)	0,08 (0,6071)
País Vasco	1,20 (0)	0,79 (0)	0,77 (0)	0,45 (0,0139)	0,73 (0)	-0,06 (0,7049)
Rioja (La)	1,20 (0)	0,79 (0)	0,77 (0)	0,45 (0,0139)	0,77 (0)	0,08 (0,6954)

Note: p-values in parenthesis. The null hypotheses are:

$H_0 : \gamma = 0$

$H_0 : \alpha = 0$

$H_0 : \beta_i = 0$

Source: Fundación BBVA and own elaboration.

Table 5
COMMON SHOCKS AND ASYMMETRIC EFFECTS

Regions	**GAV**	**Prices**
Andalucía	1,11 (0,7371)	0,93 (0,0878)
Aragón	1,34 (0,5127)	0,79 (0,9741)
Asturias	0,72 (0,1221)	0,61 (0,2505)
Baleares	1,23 (0,8549)	0,99 (0,1391)
Canarias	1,22 (0,9110)	1,01 (0.0185)
Cantabria	1,25 (0,7942)	0,70 (0.0858)
Castilla-León	0,91 (0,2636)	0,79 (0,9604)
Castilla-La Mancha	1,18 (0,9385)	0,70 (0,1081)
Cataluña	1,47 (0,2289)	0,86 (0,0762)
C. Valenciana	1,43 (0,2763)	0,78 (0,8413)
Extremadura	0,83 (0,2486)	0,79 (0,9638)
Galicia	1,10 (0,6390)	0,74 (0,5109)
Madrid	1,00 (-)	1,00 (-)
Murcia	1,04 (0,5128)	0,80 (0,8436)
Navarra	1,23 (0,8161)	0,75 (0,6018)
País Vasco	1,18 (0,9466)	0,68 (0,1628)
Rioja (La)	0,98 (0,3392)	0,84 (0,4307)

Notes: p-values in parenthesis. The null hypotheses are:

$\mathrm{H}_0 : \gamma_i = 1{,}20$

$\mathrm{H}_0 : \gamma_i = 0{,}79$

Source: Fundación BBVA and own elaboration.

Table 6

SPECIFIC SHOCKS AND SYMMETRIC EFFECTS (GAV)

	And	Ara	ast	bal	can	cant	cl	cm	cat	cv	ext	gal	mad	mur	nav	pv	rio
and	1,00																
ara	-0,31*	1,00															
ast	-0,41*	0,39*	1,00														
bal	0,03	0,11	0,29*	1,00													
can	0,00	0,06	0,02	0,20	1,00												
cant	-0,22	0,03	0,17	0,06	-0,23	1,00											
cl	0,22	-0,04	0,14	-0,34*	0,31*	-0,28*	1,00										
cm	0,49*	-0,12	-0,10	-0,38*	0,22	-0,24	0,60*	1,00									
cat	0,17	-0,05	-0,02	0,39*	-0,51*	0,20	-0,42*	-0,50*	1,00								
cv	0,08	-0,17	-0,32*	0,14	-0,19	0,17	-0,31*	0,02	0,21	1,00							
ext	0,43*	0,07	-0,04	-0,20	0,58*	-0,34*	0,62*	0,55*	-0,30*	-0,25	1,00						
gal	0,23	-0,04	-0,09	-0,48*	0,10	-0,02	0,38*	0,59*	-0,53*	0,21	0,17	1,00					
mad	-0,06	-0,10	0,51*	0,10	0,09	0,00	0,40*	-0,01	0,22	-0,41*	0,25	-0,29*	1,00				
mur	0,24	-0,06	0,14	-0,24	0,18	-0,10	0,37*	0,56*	-0,13	-0,27*	0,31*	0,33*	0,17	1,00			
nav	-0,07	0,22	-0,01	-0,04	-0,46*	0,12	-0,20	-0,34*	0,23	-0,08	-0,38*	-0,03	-0,14	-0,35*	1,00		
pv	-0,24	0,09	0,28*	0,06	-0,69*	0,20	-0,14	-0,40*	0,54*	-0,10	-0,50*	-0,30*	0,38*	-0,21	0,65*	1,00	
rio	0,00	0,36*	-0,07	-0,24	0,02	-0,29*	0,01	0,20	-0,18	-0,29*	0,08	0,30*	-0,14	0,13	0,41*	0,08	1,00

Note: * significant at 95%. Source: Fundación BBVA and own elaboration.

Table 7

SPECIFIC SHOCKS AND SYMMETRIC EFFECTS (Prices)

	And	ara	ast	bal	can	cant	cl	cm	cat	cv	ext	gal	mad	mur	nav	pv	rio
and	1,00																
ara	-0,47*	1,00															
ast	0,26	-0,28*	1,00														
bal	0,05	0,37*	-0,43*	1,00													
can	0,18	-0,54*	0,38*	-0,66*	1,00												
cant	-0,15	0,35*	-0,08	0,43*	-0,68*	1,00											
cl	0,55*	-0,41*	0,58*	-0,54*	0,56*	-0,41*	1,00										
cm	0,38*	-0,44*	-0,07	-0,08	0,28*	-0,25	0,57*	1,00									
cat	-0,08	0,62*	-0,28*	0,71*	-0,58*	0,24	-0,54*	-0,59*	1,00								
cv	-0,40*	0,38*	-0,13	-0,16	-0,06	0,08	-0,32*	-0,47*	0,01	1,00							
ext	-0,48*	0,05	-0,46*	-0,16	0,08	-0,25	-0,36*	-0,15	-0,08	0,64*	1,00						
gal	-0,41*	0,84*	-0,59*	0,65*	-0,64*	0,35*	-0,64*	-0,37*	0,72*	0,27*	0,14	1,00					
mad	-0,31*	-0,16	-0,54*	0,01	-0,18	-0,08	-0,52*	-0,28*	0,14	0,05	0,36*	0,12	1,00				
mur	0,59*	-0,64*	0,36*	-0,21	0,67*	-0,59*	0,58*	0,39*	-0,37*	-0,06	-0,02	-0,61*	-0,26*	1,00			
nav	0,00	-0,24	-0,03	-0,05	-0,42*	0,45*	-0,02	0,27*	-0,34*	-0,29*	-0,19	-0,17	0,16	-0,39*	1,00		
pv	-0,27*	0,25	0,08	0,09	-0,56*	0,47*	-0,28*	-0,23	0,15	-0,27*	-0,32*	0,13	0,07	-0,73*	0,62*	1,00	
rio	-0,68*	0,14	-0,32*	-0,14	0,13	-0,05	-0,32*	0,12	-0,27*	0,10	0,36*	0,21	0,17	-0,37*	0,14	0,07	1,00

Note: * significant at 95%. Source: Fundación BBVA and own elaboration.

Table A.1
SPECIFICATION TESTS

Region	Normality		Autocorrelation		Heterocedasticity		Stable parameters	
	GAV	Prices	GAV	Prices	GAV	Prices	GAV	Prices
Andalucía	0,21	5,78	6,22	2,60	1,01	1,88	Yes	Yes
	(0,90)	(0,06)	(0,19)	(0,63)	(0,32)	(0,17)		
Aragón	4,34	2,82	4,39	3,75	1,24	4,50	Yes	Yes
	(0,12)	(0,25)	(0,36)	(0,44)	(0,26)	(0,04)		
Asturias	4,14	0,08	12,11	13,34	0,67	0,26	Yes	Yes
	(0,13)	(0,96)	(0,02)	(0,01)	(0,41)	(0,61)		
Baleares	5,69	7,93	3,08	14,35	0,05	1,72	Yes	Yes
	(0,06)	(0,02)	(0,55)	(0,01)	(0,82)	(0,19)		
Canarias	3,87	2,86	6,39	7,70	0,01	2,94	Yes	Yes
	(0,14)	(0,24)	(0,17)	(0,10)	(0,95)	(0,09)		
Cantabria	3,42	1,31	19,28	3,07	2,22	5,98	Yes	Yes
	(0,18)	(0,52)	(0,00)	(0,55)	(0,14)	(0,02)		
Castilla-León	9,87	0,47	15,03	5,83	3,69	1,86	Yes	Yes
	(0,01)	(0,80)	(0,01)	(0,25)	(0,06)	(0,17)		
Castilla-La Mancha	1,20	1,71	9,23	2,48	1,52	2,81	Yes	Yes
	(0,55)	(0,43)	(0,06)	(0,65)	(0,22)	(0,09)		
Cataluña	3,84	2,43	4,88	4,25	0,79	3,32	Yes	Yes
	(0,15)	(0,30)	(0,30)	(0,37)	(0,38)	(0,07)		
C. Valenciana	1,63	2,45	5,63	2,49	1,83	2,97	Yes	Yes
	(0,44)	(0,29)	(0,23)	(0,65)	(0,18)	(0,09)		
Extremadura	7,22	5,51	6,86	3,41	0,11	0,72	Yes	Yes
	(0,03)	(0,06)	(0,14)	(0,49)	(0,74)	(0,40)		
Galicia	0,16	6,46	10,42	5,36	4,85	0,68	Yes	Yes
	(0,92)	(0,04)	(0,04)	(0,25)	(0,03)	(0,41)		
Madrid	2,61	0,86	17,26	4,88	2,72	2,59	Yes	Yes
	(0,27)	(0,65)	(0,01)	(0,30)	(0,10)	(0,11)		
Murcia	0,41	3,59	7,11	3,27	1,52	2,14	Yes	Yes
	(0,81)	(0,17)	(0,13)	(0,51)	(0,22)	(0,14)		
Navarra	1,08	1,16	4,83	7,26	8,97	1,38	Yes	Yes
	(0,58)	(0,56)	(0,31)	(0,12)	(0,01)	(0,24)		
País Vasco	0,19	2,15	2,97	8,81	2,71	0,70	Yes	Yes
	(0,91)	(0,34)	(0,56)	(0,07)	(0,10)	(0,40)		
Rioja (La)	3,88	1,64	4,34	3,63	3,21	2,60	Yes	Yes
	(0,14)	(0,44)	(0,36)	(0,46)	(0,07)	(0,11)		

Note: p-values in parenthesis. The null hypotheses are:

H_0 : normality

H_0 : no serial correlation

H_0 : homocedasticity.

Test for normality: Doornik y Hansen. Test for serial correlation: Ljung and Box, (autocorrelation up to 5 lags). Test for mocedasticity: ARCH test of Engle. Test for stability of parameters: Brown, Durbin and Evans. Yes means that the null can not be rejected at the 95% level.