Industry Effects of Monetary Policy in Spain

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(Received May 2006: in revised form December 2006)

RODRÍGUEZ-FUENTES C. J. and Padrón-Marrero D. Industry effects of monetary policy in Spain, Regional Studies. The aim of this paper is to analyse the presence of sectoral asymmetries in monetary policy transmission in Spain in the period before the introduction of the single monetary policy in Europe (1988–98). Monetary policy shocks are identified through both a standard vector auto-regression model (VAR-shock) and the specification of a reaction function (RF-shock) for the monetary authority in Spain. The responses of the different industrial branches with regard to the estimated monetary shocks are then analysed at national accounting sector and subsector levels. The results confirm the presence of significant differences in the sectoral responses with respect to national monetary shocks in Spain. In addition, the sectoral asymmetries found in the present study show a strong correlation with regard to the regional asymmetries found in a previous study.

Monetary policy Industry effects Monetary shocks Spain

RODRÍGUEZ-FUENTES C. J. et Padrón-Marrero D. Les effets de la politique monétaire sur le secteur industriel en Espagne, Regional Studies. Cet article cherche à analyser la présence des asymétries sectorielles dans la transmission de la politique monétaire en Espagne pendant la période qui a précédé l'établissement du système monétaire européen (de 1988 à 1998). On identifie les chocs de la politique monétaire à la fois par moyen d'un modèle d'auto-régression vectorielle type (choc-VAR) et de la spécification d'une fonction de réaction (RF-choc) pour les instances monétaires espagnoles. Dans le cadre des comptes de la nation et sur le plan sectoriel, il s'ensuit une analyse des réponses des divers secteurs industriels quant aux chocs monétaires approximatifs. Les résultats confirment d'importantes différences des réponses sectorielles quant aux chocs monétaires nationaux en Espagne. En outre, les asymétries sectorielles qui se présentent, sont en corrélation étroites avec les asymétries régionales qui se présentaient dans une étude antérieure.

Politique monétaire Effets industriels Chocs monétaires Espagne


Währungspolitik Branchenspezifische Auswirkungen Währungsschocks Spanien

RODRÍGUEZ-FUENTES C. J. y Padrón-Marrero D. Los efectos de la política monetaria sobre la industria en España, Regional Studies. El objetivo de este artículo es analizar la presencia de las asimetrías sectoriales en la transmisión de la política monetaria en España durante el periodo antes de la introducción en Europa de la política monetaria única (1988–98). Identificamos los choques de la política monetaria a través de un modelo estándar vector de autorregresión (choque VAR) y la especificación de una función
de reacción (choque RF) para la autoridad monetaria en España. Analizamos luego las respuestas de las diferentes ramas industriales con respecto a los choques monetarios estimados en el sector de contabilidad nacional y los niveles de subsectores. Nuestros resultados confirmar la presencia de diferencias significativas en las respuestas sectoriales con respecto a los choques monetarios nacionales en España. Asimismo las asimetrías sectoriales de nuestro estudio muestran una fuerte correlación con las asimetrías regionales de un estudio previo.

Política monetaria  Efectos en la industria  Choques monetarios  España

JEL classifications: E52, L60

INTRODUCTION

The study of the transmission mechanism of monetary policy has traditionally focused on the aggregate level of the economy, specifically on the impact of monetary policy decisions on production and price levels. Nevertheless, the last decade has seen an increasing amount of research that concentrates on the study of asymmetries which can arise in the transmission of national monetary shocks, either in specific regions which make up the national economy (regional asymmetries), or among their respective productive sectors (sectoral asymmetries). Undoubtedly, a significant portion of this literature is motivated by the loss of monetary sovereignty which some European Union (EU) countries have experienced as a result of their conversion into regions within the euro zone. These countries have all irreversibly lost their prior ‘national monetary identities’ and as such have begun to be concerned about the regional repercussions of the European Central Bank’s monetary policy (Rodríguez Fuente, 2005, pp. 5–7).

The growing interest in the study of sectoral asymmetries in the transmission of monetary policy has also been stimulated by the forecast that the establishment of a single currency in the EU would convert sectoral shocks in truly regional shocks (Krugman and Venables, 1996), which in turn would lead to regional tensions in the process of European integration. This forecast has also been reinforced by some empirical evidence in studies that emphasize the importance of the differences in the regional productive structure in the explanation of the different regional responses with regard to national monetary policy shocks (e.g. Carlino and DeFina, 1996, 1998a, b, 1999; Guiso et al., 1999; Arnold, 2001).

The present paper analyses sectoral asymmetries in the transmission of national monetary shocks in Spain and also explores the possible relationships among estimated sector shocks with the estimated regional shocks from an earlier paper (Rodríguez Fuente et al., 2004).

The paper is divided into an introduction, four main sections, and conclusions. The body of the paper begins with a brief review of the empirical literature concerning sectoral asymmetries in monetary policy transmission. The responses of the different branches that make up the industrial sector in Spain are then studied in the next two sections. The third section introduces the estimates of monetary policy shocks in Spain for the period 1988–98. It is well known that the estimation of monetary shocks is a critical step in any study that attempts to analyse the effects of monetary policy, and that the observed correlations between interest rates, output and prices can be due to an inverse causation process. Consequently, the exogenous component (monetary shocks) must be isolated from its endogenous response. A vector autoregressive (VAR) model is used to identify these shocks. Most of the empirical literature employs the VAR model when studying the monetary transmission mechanism. However, the present study does not end with just the VAR model. In addition, a reaction function for the Bank of Spain is estimated in order to compare the robustness of the results obtained from the VAR model. This new approach can be used, in the authors’ opinion, as a complement to the traditional VAR literature. The fourth section studies the response of industrial production (by sector and subsector) with regard to the estimated monetary policy shocks from the previous section. The results confirm the presence of important differences in the sectoral responses with respect to national monetary shocks in Spain and are consistent with the available empirical evidence of other countries. In addition, the sectoral asymmetries presented in this section show some similarities with the regional asymmetries found in previous work (Rodríguez Fuente et al., 2004) since the classification of the Spanish regions according to their implicit sectoral sensitiveness reflect a strong correlation with the ordering which is obtained by using their sensitivity when taking into account national monetary shocks (regional asymmetries).

SECTORALASYMMETRIES IN THE TRANSMISSION OF MONETARY POLICY: AN OVERVIEW OF THE EMPIRICAL LITERATURE

A review of the literature on the sectoral effects of monetary policy based on empirical evidence leads to three important conclusions. Firstly, the choice of the VAR model as the econometric technique to identify monetary shocks. Secondly, that the strategy followed to value the measure of heterogeneity in the sectoral response consists in estimating a VAR model for each of the
sectors studied. This strategy leads to an estimation of as many reaction functions as sectors that are considered in the study and, consequently, obtaining a series of different monetary shocks\(^1\) for each of the studied sectors (which hinders the validity of intersectoral comparisons). The third conclusion is that most studies tend to incorporate among the endogenous variables both national and sectoral variables (production and price levels). In this case it is more common that national aggregates are placed ahead of the monetary policy variable, while sectoral variables appear after that variable (GANLEY and SALMON, 1997; DEDOLA and LIPPI, 2000, 2005). This consideration and the use of recursive identification methods (the Cholesky decomposition method) lead to the inclusion of the implicit assumption that monetary shocks do not have a contemporaneous impact on national aggregates but do have an instantaneous effect on sectoral variables, which could be interpreted as an inconsistency in the model.\(^4\)

This analysis is found in the work of GANLEY and SALMON (1997), which studies the responses of different production sectors with respect to monetary policy shocks in the UK. This study estimates 24 VAR models (one for each of the sectors under study) that incorporate, as endogenous variables, short-term interest rate, the real gross national product (GNP) of the UK and its implicit deflator, and, lastly, the production index of each sector. The Cholesky decomposition method is used with the variables ordered according to their previously mentioned description. Results from the study indicate that monetary policy measures implemented by the Bank of England have had varying impacts according to sectors. Examples can be found in the construction sector and, to a lesser extent, in manufacturing, where both sectors are subject to stronger and more rapid responses to national monetary shocks. In addition, the authors confirm large variability in the response to each of the branches that make up the manufacturing sector. For instance, there are cases where some branches offer a very weak response (industries linked to nondurables consumer expenditures, as producers of food, drink and tobacco, textiles and footwear), while other industries (industries supplying construction, as glass, tiles, concrete and bricks, and wood products; or industries linked to durables consumer expenditures, as vehicle manufacture) react in a very clear manner.

Results obtained by HAYO and UHLENBROCK (1999/2000) also suggest the presence of important sectoral differences in their responses to national monetary shocks in West Germany. Their findings show that approximately half of the analysed branches show a different response than the average one for the sector.

DEDOLA and LIPPI (2000, 2005) focus on the responses of industrial production in five countries belonging to the Organization for Economic Cooperation and Development (OECD). They studied the production sector response of 21 industrial branches in Germany, France, the USA, Italy, and the UK by using a common specification in the estimated VAR models. The results from these papers indicate that the differences among sectoral responses with respect to monetary shocks are much greater than those found in other countries. The authors also investigated if the observed sector heterogeneity in the response to national monetary shocks was due to industry-specific factors or country-specific factors. They concluded that sectoral responses were similar among all the different countries studied. Their results also show that the impact of monetary shocks is greater in production industries including durable goods, which place greater demands on working capital and smaller borrowing capacity (DEDOLA and LIPPI, 2005, p. 1565).

As noted above, most of the empirical studies that analyse sectoral effects of monetary policy tend to employ a VAR model to estimate each sector’s response. This decision also assumes that national variables are not instantaneously affected by monetary shocks whereas the sectoral variables are affected, which could be interpreted as an inconsistency in the model. Various alternatives have been proposed to address this inconsistency. One is seen in the work of RADDATZ and RIGOBON (2003), which suggests estimating a single national VAR model where national production is substituted by the production levels in each sector under consideration. These authors also introduce a non-recursive identification method that allows them to sort the obstacle, namely that monetary shocks do not have a contemporaneous effect on national variables but do have an instantaneous effect on sectoral variables. Even so, the results obtained by Raddatz and Rigobon also suggest the presence of important sectoral asymmetries in the responses from different industrial branches in the US economy with respect to national monetary policy, where durable goods and property investment are the two sectors that show the strongest response. Nevertheless, the approach of Raddatz and Rigobon is not free of problems. For instance, the complete identification of all structural parameters of the model requires several assumptions. In addition, the large number of estimated parameters creates an important reduction in the degrees of freedom, which is a sensitive issue when working with short time series.

PEERSMAN and SMETS (2002) propose a two-step strategy to value sectoral asymmetries in monetary policy transmission in the euro zone. The first stage is carried out by extracting monetary shocks from the estimates derived from a VAR model for the national economy. The estimated national monetary shocks from the first stage are then used in the second stage to explain the behaviour of the sectoral production based upon its past behaviour and estimated national monetary shocks from the prior stage. These estimated national monetary shocks will be equal for each of the studied sectors since they have been extracted from the national VAR model.
The present paper begins by incorporating the strategy used by Peersman and Smets, but it will also estimate national monetary shocks by using the specification of a reaction function for the Bank of Spain.

**IDENTIFICATION OF MONETARY SHOCKS: VECTOR AUTOREGRESSIVE (VAR) MODELS AND REACTION FUNCTIONS**

Following the current orthodox empirical literature on monetary policy (CRISTIANO *et al.*, 1999), the present authors have identified the exogenous monetary shocks by means of a VAR model and a reaction function of the central bank. This second approach is, in the authors’ opinion, a novel contribution in the context of the empirical literature regarding sectoral asymmetries in the transmission of monetary policy. Details of the specification of the VAR model as well as the reaction function follow.

**Vector autoregressive (VAR) model**

The general equation of the VAR model that has been chosen to identify the monetary policy shocks Spain is of the form:

\[
\begin{bmatrix}
X_t \\
Y_t
\end{bmatrix} = \begin{bmatrix}
A(L) & B(L) \\
C(L) & D(L)
\end{bmatrix} \begin{bmatrix}
X_{t-1} \\
Y_{t-1}
\end{bmatrix} + \begin{bmatrix}
a & b \\
c & d
\end{bmatrix} \begin{bmatrix}
e^X_t \\
e^Y_t
\end{bmatrix}
\]

(1)

where \(Y_t\) is the vector containing the endogenous variables of the system, all of which refer to the set representing the national economy. This set is made up of these variables in the following order: national industrial production index (IPI); the consumer price index (CPI); the German inter-bank interest rate \(i_{\text{AL}}\); the M3 monetary aggregate; the interest rate for three-month non-transferable deposits \(i_{\text{ESP}}\); and the real effective exchange rate for the peseta (REER): 6

\[
Y_t = [\text{IPI}_t, \text{CPI}_t, i_{\text{AL}}, \text{M3}, i_{\text{ESP}}, \text{REER}]
\]

(2)

An exogenous variable vector has also been introduced that includes a constant (const), a tendency (trend), and a world commodity price index (WCPI) to control possible external shocks:

\[
X_t = [\text{const, trend, WCPI}_t]
\]

(3)

The VAR model has been estimated in levels, which allows one to control the possible existence of cointegration. Almost all variables are expressed in logarithmic form, the exception being interest rates. Data have been taken from the *Monthly Statistical Bulletin* of the Bank of Spain; and the sample covers the period from January 1988 to December 1998. 7 The lag structure used in the model is two months; and the monetary policy shock that has been identified is a result of the Cholesky decomposition method, with the variables defined and ordered according to the above comments.8

Fig. 1 depicts the impulse–response function of the most important variables, namely production and prices. It indicates that prices remain unaltered after an unexpected monetary policy shock, which could be justified by the high levels of price (and nominal wages) rigidity that have been traditionally seen in the Spanish economy. The case of production, however, is consistent with other studies where monetary policy reaches its maximum impact on production on the seventh month after the unexpected monetary shock took place.

**Reaction function**

The VAR methodology has played an important role in the empirical analysis concerning the impact of monetary policy actions on economy. Even so it has been questioned not only in its method for retrieving
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Table 1. Results from estimating the reaction function for the Bank of Spain

<table>
<thead>
<tr>
<th>k = 3</th>
<th>k = 6</th>
<th>k = 12</th>
<th>k = 6</th>
<th>k = 12</th>
<th>k = 6</th>
<th>k = 3</th>
<th>k = 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>p = 3</td>
<td>p = 6</td>
<td>p = 12</td>
<td>p = 3</td>
<td>p = 6</td>
<td>Z = i₅</td>
<td>Z = i₆</td>
<td></td>
</tr>
<tr>
<td>ρ</td>
<td>0.905**</td>
<td>0.949**</td>
<td>0.973**</td>
<td>0.924**</td>
<td>1.006**</td>
<td>1.002**</td>
<td>0.898**</td>
</tr>
<tr>
<td>α</td>
<td>-0.485</td>
<td>-2.015</td>
<td>-0.249</td>
<td>-1.943*</td>
<td>33.049</td>
<td>81.290</td>
<td>-0.414</td>
</tr>
<tr>
<td>β</td>
<td>2.054**</td>
<td>2.556**</td>
<td>1.532**</td>
<td>2.252**</td>
<td>-0.700</td>
<td>-4.583</td>
<td>1.895**</td>
</tr>
<tr>
<td>γ</td>
<td>0.223**</td>
<td>0.088</td>
<td>-0.337*</td>
<td>0.423**</td>
<td>-2.662</td>
<td>-3.986</td>
<td>0.208**</td>
</tr>
<tr>
<td>λ</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.122</td>
<td>0.561**</td>
</tr>
</tbody>
</table>

Notes: Estimates were carried out using Eviews.

The proposed reaction function is a simple combination of a Taylor Rule–type reaction function (Taylor, 1993) and a first-order partial autoregression rule. The Taylor Rule reaction function incorporates the forward-looking behaviour assumption for the monetary authority (under the assumption of rational expectations). The autoregression rule captures monetary shocks, but also with the problems associated with capturing the forward-looking behaviour which modern monetary policy theory attributes to central banks (Clarida et al., 1999; Svensson, 1999). Under this scenario, the monetary authority considers the expected evolution of the relevant economic aggregates in the near future while making decisions in the present. This approach has grown in favour among a number of authors when evaluating the actions of central banks, and can be adapted to its inclusion in the specification of a reaction function for the monetary authority.

For this reason it was also decided to estimate a reaction function for the Bank of Spain where the unexpected monetary shock is identified with the unexplained observed interest rates by deriving rates based on the estimated reaction function.

The reaction function that was estimated has the following form:

\[ i_t = \rho i_{t-1} + (1 + \theta) [\beta \pi_{t+k} + \gamma \pi_{t+k} + \lambda Z_I] \]

\[ + \epsilon_t \]  

(4)

where \( \pi \) is the inter-annual inflation rate; \( x \) is the output-gap; and \( Z \) is a set of variables which can affect interest rate decisions, independently of its explanatory power on inflationary trends and the output-gap, which include the exchange rate and a foreign interest rate. The model specification includes the peseta/mark nominal exchange rate and the German three-month interest rate.

The proposed reaction function is a simple combination of a Taylor Rule–type reaction function (Taylor, 1993) and a first-order partial autoregression rule. The Taylor Rule reaction function incorporates the forward-looking behaviour assumption for the monetary authority (under the assumption of rational expectations). The autoregression rule captures demonstrated tendencies by central banks to smooth interest rate changes.

The resultant reaction function was estimated by the generalized method of moments (GMM) by taking advantage of the following set of orthogonal conditions:

\[ E[\epsilon_t / \Omega_t] = E[i_t - \rho i_{t-1} - (1 - \theta) \alpha + \beta \pi_{t+k} + \gamma \pi_{t+k} + \lambda Z_I] / \Omega_t \]

\[ = 0 \]  

(5)

Possible problems of heteroskedasticity and autocorrelation led the authors to use the Newey and West method when calculating standard errors. The Hansen \( J \)-statistic was also calculated to control possible over identification. Table 1 shows that the best results were obtained by the forecast horizon \( k = 6 \cap p = 3 \). In addition, it was decided to omit the peseta/mark nominal exchange rate since changes in the variable were not statistically significant in any of the tested specifications.

Fig. 2 compares the accumulated monetary shocks obtained from VAR models with those derived from the reaction function. The resultant time profiles indicate that both series are quite similar, leading to an interpretation of favourable evidence regarding the robustness of the results. Also worth mentioning is the presence of a strong relationship between the shown path from the accumulated shocks and the short-term interest rate. Consequently, in the periods where the short-term interest rate increases, contracting shocks are seen, as in the opposite case for falling rates. Nevertheless, from 1996 to 1997 this relationship seems to stray from this trend. If this is the case, these actions could be interpreted as deliberate actions by the Bank of Spain to tighten monetary policy and thus exercise...
stricter control on the inflation rate and satisfy the Maastricht criteria.

SECTORAL ASYMMETRIES IN THE TRANSMISSION OF MONETARY SHOCKS

Following Peersman and Smets (2002), the industry effects of monetary policy shock in Spain are studied herein by using the following expression which relates the trends from the production activity from each industrial branch with its past behaviour and the estimated accumulated monetary shock from the prior section:

\[ \text{ipi}_{i,t} = \alpha_i + \sum_{j=1}^{12} \beta_j \cdot \text{ipi}_{i,t-j} + \gamma_i \cdot \text{shock}_{t-1} + \eta_{i,t} \quad (6) \]

where \( \text{ipi}_{i,t} \) is monthly growth rate of the industrial production index (IPI) of branch \( i \); \( \text{shock}_{t-1} \) is the accumulated monetary policy shock estimated previously (VAR- and RF-shock); and \( \eta_{i,t} \) is an error term. Given the possibility of instantaneous correlation between the different Spanish industrial branches, expression (6) has been estimated using the Seemingly Unrelated Regressions (SUR) method.

The lack of statistical significance from the obtained results at the section level of industrial activity could be attributed to the presence of distinct behaviour among the activity branches (subsections) which make up the different industrial sections. Therefore, the paper will now analyse the sectoral responses at the subsection level, with the results shown in Table 3.

Table 2 summarizes the estimated values from the response of the different industrial sections in Spain with respect to a monetary shock (\( \gamma_i \)). Table 2 indicates that the production response with respect to an unexpected monetary shock is generally negative. Another aspect which deserves attention is the presence of clear similarities among the obtained results for both VAR- and RF-shocks. These results suggest that the contraction in production is greater among mining industries (section C), while section E (electricity, gas and water supply) is found at the opposite extreme. However, the low statistical significance of the estimates for this disaggregated level (sections) should be highlighted since only the estimated response for the mining industries from the RF-shock were seen to be statistically significant.

Table 2. Response from different industrial branches with respect to a monetary shock (\( \gamma_i \))

<table>
<thead>
<tr>
<th>Section</th>
<th>RF-shock Coefficient</th>
<th>t-statistic</th>
<th>VAR-shock Coefficient</th>
<th>t-statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>-1.260707</td>
<td>-2.648278</td>
<td>C</td>
<td>-0.665141</td>
</tr>
<tr>
<td>D</td>
<td>-0.490532</td>
<td>-1.509285</td>
<td>D</td>
<td>-0.229419</td>
</tr>
<tr>
<td>E</td>
<td>-0.025145</td>
<td>-0.103596</td>
<td>E</td>
<td>0.221215</td>
</tr>
</tbody>
</table>

Note: C (mining and quarrying), D (manufacturing), and E (electricity, gas and water supply).
Industry Effects of Monetary Policy in Spain

Table 3. Response by industrial subsections with respect to monetary shock ($\gamma$)

<table>
<thead>
<tr>
<th>Subsection</th>
<th>Coefficient</th>
<th>t-statistic</th>
<th>Subsection</th>
<th>Coefficient</th>
<th>t-statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>DA</td>
<td>0.107995</td>
<td>0.367364</td>
<td>EA</td>
<td>0.245455</td>
<td>0.968357</td>
</tr>
<tr>
<td>DC</td>
<td>-0.032593</td>
<td>-0.082099</td>
<td>DN</td>
<td>0.208370</td>
<td>0.460732</td>
</tr>
<tr>
<td>EA</td>
<td>-0.051506</td>
<td>-0.213997</td>
<td>DF</td>
<td>0.070817</td>
<td>0.185372</td>
</tr>
<tr>
<td>DE</td>
<td>-0.081628</td>
<td>-0.342259</td>
<td>DE</td>
<td>-0.033691</td>
<td>-0.139498</td>
</tr>
<tr>
<td>DF</td>
<td>-0.224908</td>
<td>-0.668028</td>
<td>DA</td>
<td>-0.090756</td>
<td>-0.293388</td>
</tr>
<tr>
<td>DG</td>
<td>-0.292967</td>
<td>-0.733748</td>
<td>DC</td>
<td>-0.095969</td>
<td>-0.228702</td>
</tr>
<tr>
<td>DI</td>
<td>0.412020</td>
<td>1.659474</td>
<td>DH</td>
<td>0.276524</td>
<td>0.644695</td>
</tr>
<tr>
<td>DN</td>
<td>-0.537933</td>
<td>-1.236804</td>
<td>DI</td>
<td>-0.314554</td>
<td>-1.586139</td>
</tr>
<tr>
<td>DL</td>
<td>-0.823875</td>
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<td>DJ</td>
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</tr>
<tr>
<td>DD</td>
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<td>-0.435383</td>
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<tr>
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<td>-0.896411</td>
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<tr>
<td>DH</td>
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<td>DG</td>
<td>-0.535510</td>
<td>-1.533995</td>
</tr>
<tr>
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<td>-2.990396</td>
<td>DB</td>
<td>-0.551075</td>
<td>-1.706137</td>
</tr>
<tr>
<td>CB</td>
<td>-1.126873</td>
<td>-1.988770</td>
<td>DD</td>
<td>-0.630545</td>
<td>-1.298233</td>
</tr>
<tr>
<td>CA</td>
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<td>-3.520476</td>
<td>CA</td>
<td>-0.715491</td>
<td>-1.580320</td>
</tr>
<tr>
<td>DK</td>
<td>-1.925580</td>
<td>-3.067467</td>
<td>CB</td>
<td>-0.819522</td>
<td>-1.629274</td>
</tr>
<tr>
<td>DM</td>
<td>-2.002185</td>
<td>-2.523202</td>
<td>DK</td>
<td>-1.111361</td>
<td>-2.136371</td>
</tr>
</tbody>
</table>

Wald test

\[ \chi^2 (\text{probability}) \]

<table>
<thead>
<tr>
<th></th>
<th>\chi^2 (probability)</th>
<th></th>
<th>\chi^2 (probability)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total sample</td>
<td>34.60183 (0.0045)</td>
<td>Total sample</td>
<td>20.32358 (0.0016)</td>
</tr>
<tr>
<td>7+ and 5–</td>
<td>29.93248 (0.0016)</td>
<td>7+ and 5–</td>
<td>17.41318 (0.0062)</td>
</tr>
<tr>
<td>3+ and 3–</td>
<td>24.76408 (0.0002)</td>
<td>3+ and 3–</td>
<td>12.56997 (0.0278)</td>
</tr>
</tbody>
</table>

Note: CA, mining and quarrying of energy producing materials; CB, mining and quarrying except of energy-producing materials; DA, manufacture of food products, beverages and tobacco; DB, manufacture of textiles and textile products; DC, manufacture of leather and leather products; DD, manufacture of wood and wood products; DE, manufacture of pulp, paper and paper products; publishing and printing; DF, manufacture of coke, refined petroleum products and nuclear fuel; DG, manufacture of chemicals, chemical products and man-made fibres; DH, manufacture of rubber and plastic products; DI, manufacture of other non-metallic mineral products; DJ, manufacture of basic metals and fabricated metal products; DK, manufacture of machinery and equipment not elsewhere classified (n.e.c.); DL, manufacture of electrical and optical equipment; DM, manufacture of transport equipment; DN, manufacturing n.e.c.; EA, electricity, gas and water supply.

The results also indicate once again that estimated parameters from the RF-shock are greater (in absolute value) than those obtained from using the VAR-shock, in addition to having greater statistical significance. Although there is a greater level of disaggregation in these estimates, the comparison between the obtained sectoral responses from both VAR- and RF-shocks allow one to offer some conclusions. First, that subsection EA (electricity, gas and water supply) on once again is seen as one of the branches least sensitive to monetary shocks, as in the case at the section level. Other branches also appear, such as the manufacture of food products, beverages and tobacco (subsection DA), as well as the manufacture of leather and leather products (subsection DC), the paper industry (subsection DE), and the manufacture of coke, refined petroleum products and nuclear fuels (subsection DF). Another observation is that the greater sensitivity to national monetary shocks would take place in machinery and mechanical equipment (subsection DK), the mining and quarrying of energy producing material (subsection CA), and the mining and quarrying of other minerals (subsection CB).

Some important differences need to be mentioned when comparing the results from the obtained estimates from the reaction function (RF-shock) and the VAR model (VAR-shock). The first difference concerns the DM (manufacture of transport equipment) and DJ (manufacture of basic metals and fabricated metal products) subsections. While high sensitivity is observed with respect to estimated monetary shocks based on the reaction function (RF-shock) of these subsections, the VAR-shock produces much lower sensitivity. A second difference occurs in the different manufacturing industries (subsection DN), where slight sensitivity with respect to estimated monetary shocks based on the VAR model are noted (VAR-shock). Nevertheless, the estimated response for the reaction function (RF-shock) ranks this section in an intermediate position among all sectors.

The presence of sectoral asymmetries in the transmission of monetary policy has obvious direct implications at the regional level. Indeed, given that Spanish regions show important differences in industrial specialization, the presence of different sectoral responses with respect to monetary policy impulses in...
Spain could convert the sectoral shocks into regional ones. With the purpose of studying the link between sectoral asymmetries and regional asymmetries in Spain, an index of regional sensitivity (ISR-1) was calculated that, hypothetically, would reflect the sensitivity of each Spanish region with respect to the monetary shocks based on the industrial specialization profile. The comparison between this index, which reflects the regional sensitivity due to the region’s industry mix, and the regional response with respect to national monetary policy shocks, which was estimated by the authors in earlier work, indicates the presence of a high degree of correlation between regional and sectoral asymmetries in Spain (Fig. 3), which is consistent with the traditional literature regarding the interest rate transmission mechanism. Nevertheless, this correlation is far from being perfect, so it seems reasonable that other factors different to the sectoral mix, such as those related to the financial structure and behaviour (Rodríguez Fuentes et al., 2004, pp. 260–262), might also have played a relevant role in the explanation of regional asymmetries in the transmission of monetary shocks in Spain.

CONCLUSIONS

This paper has studied sectoral asymmetries in the transmission of monetary policy shocks in Spain in the period immediately before the establishment of the single monetary policy (1988–98). The identification of monetary shocks was carried out through an estimate of a VAR model and the specification of a reaction function for the Bank of Spain. The monetary shocks obtained were then employed to study the degree of sensitivity of the different activities that make up the industrial sector in Spain. The results are consistent with those available for other countries (Ganley and Salmon, 1997; Dedola and Lippi, 2000, 2005; Hayo and Uhlenbrock, 1999/2000; Peersman and Smets, 2002; Raddatz and Rigobon, 2003), namely the presence of important differences in sectoral responses with respect to national monetary shocks in Spain. In addition, the sectoral asymmetries found in the present study show a strong correlation with the regional asymmetries found in a previous study (Rodríguez Fuentes et al., 2004). In particular, the resultant classification from ordering Spanish regions according to the sensitivity of different industrial branches which make up their respective industrial gross domestic product reveals a high correlation with the ordering that is obtained by using sensitivity with respect to national monetary shocks (regional asymmetries). It can be concluded from the results that at least during the period 1988–98 differences in industrial specialization are an important explanatory factor for the regional asymmetries in the transmission mechanism of monetary policy in Spain. However, aside from the fact that the correlation among sectoral and regional shocks is less than one, it could also be concluded that the explanation of the regional differences with respect to national monetary shocks requires the inclusion of different factors not found in regional productive specialization. Such factors would include those related with the dimension and financial structure of the regional business and financial sectors, as well as the levels of competition (both internal and external) which are present in each sector.

APPENDIX

Table A1. Sectoral and regional asymmetries of monetary policy in Spain

<table>
<thead>
<tr>
<th>Region</th>
<th>ISR-1</th>
<th>ISR-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Andalucia</td>
<td>0.58</td>
<td>0.22</td>
</tr>
<tr>
<td>Aragon</td>
<td>0.99</td>
<td>0.60</td>
</tr>
<tr>
<td>Asturias</td>
<td>0.83</td>
<td>0.52</td>
</tr>
<tr>
<td>Baleares</td>
<td>0.39</td>
<td>0.12</td>
</tr>
<tr>
<td>Canarias</td>
<td>0.39</td>
<td>0.28</td>
</tr>
<tr>
<td>Cantabria</td>
<td>0.70</td>
<td>0.56</td>
</tr>
<tr>
<td>Castilla-Leon</td>
<td>0.74</td>
<td>0.77</td>
</tr>
<tr>
<td>Castilla-Mancha</td>
<td>0.67</td>
<td>0.06</td>
</tr>
<tr>
<td>Cataluña</td>
<td>0.70</td>
<td>0.60</td>
</tr>
<tr>
<td>Extremadura</td>
<td>0.34</td>
<td>0.17</td>
</tr>
<tr>
<td>Galicia</td>
<td>0.76</td>
<td>0.48</td>
</tr>
<tr>
<td>Madrid</td>
<td>0.62</td>
<td>0.38</td>
</tr>
<tr>
<td>Murcia</td>
<td>0.63</td>
<td>0.26</td>
</tr>
<tr>
<td>Navarra</td>
<td>1.00</td>
<td>0.68</td>
</tr>
<tr>
<td>País Vasco</td>
<td>0.95</td>
<td>0.77</td>
</tr>
<tr>
<td>Rioja</td>
<td>0.66</td>
<td>1.00</td>
</tr>
<tr>
<td>Valencia</td>
<td>0.69</td>
<td>0.60</td>
</tr>
</tbody>
</table>

Correlation coefficient: 0.394

Notes: ISR-1: this index is the result of multiplying, for each region, the estimated sensitivity from the RF-shock (Table 3) for each of the industrial subsections by its respective participation in the regional industrial gross domestic product in 1998. The values shown are the result of diving each region’s response by the maximum value.

ISR-2: the index reflects the response of the regional industrial production to unexpected monetary policy from a reaction function for the Bank of Spain (for further details, see Rodríguez Fuentes et al., 2004, p. 260). Values are the result of diving each region’s response by the maximum regional response.
NOTES

1. Nevertheless, this hypothesis has been questioned by other authors, who point out that the shape of a monetary union also reinforces bilateral trade among its members. This effect would result in higher levels of correlation in their respective cycles and a lower probability of experiencing asymmetric shocks (Frankel and Rose, 1998).

2. The authors have not been able to include the services in their analysis due to a lack of statistics in Spain in this regard.

3. This result is unconvincing since Central Bank decisions will always cause a single (and common) monetary shock, which undoubtedly might produce different effects on certain sectors; but it is the response that might differ across sectors not the shock itself.

4. Nevertheless, Dedola and Lippi (2005, p. 1551) point out that the estimated parameter associated with the instantaneous response of the production sector monetary shock is not far from zero, and such an inconsistency would not be relevant in their model.

5. It is important to note that the present study is only considering the unanticipated monetary policy, that is, the monetary policy ‘surprises’ or exogenous shocks, which is common practice in the current empirical literature on sectoral effects of monetary policy (Ganley and Salmon, 1997; Hayo and Uhlenbrock, 1999/2000; Peersman and Smets, 2002; Dedola and Lippi, 2005). However, the present authors are aware that the monetary policy decisions also have a systematic component which is at least as important as the ‘monetary surprises’ (McCallum, 2001, p. 38), but its identification usually requires the estimation of structural models which are highly demanding in terms of data (not available to the authors).

6. The reasoning behind the inclusion of the German interest rate is to acknowledge Spain’s membership in the European Monetary System (EMS) and the ‘anchoring’ role performed by the German economy within the EMS. The authors also considered the insertion of the M3 due to the importance attributed by the Bank of Spain to monetary aggregates (in its monetary strategy) during most of the period under study (Bank of Spain, 1997, pp. 89–119).

7. The reasoning for using this period is to avoid the period of monetary instability present during the 1970s and early 1980s where monetary policy of the Bank of Spain focused on the strict control of monetary aggregates. Starting with the mid-1980s the growing financial opening of the Spanish economy, with its membership in the EMS, and especially the liberalization process of the Spanish financial system created important changes in the strategy followed by the Bank of Spain, resulting in the growing importance of interest rates in the execution of monetary policy. The year 1988 was chosen as the beginning date for this second period, thus avoiding the important variability experienced in interest rates during 1987 (for further details, see Bank of Spain, 1997, esp. pp. 89–119).

8. By acting this way, the authors assumed that unexpected monetary policy actions do not have an instantaneous impact on output (IPI) and prices (CPI).

9. Data restrictions limit the estimates for the industrial activity branches to the period 1991–98.

10. This parameter was calculated as the result of multiplying, for each region, the estimated sensitivity from the RF-shock (Table 3) for each of the industrial subsections by its respective participation in the regional industrial gross domestic product in 1998.

11. The values of both parameters are shown Appendix Table A1.

REFERENCES


