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# THE IMPACT OF OIL SHOCKS ON THE SPANISH ECONOMY

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**Abstract**

This paper analyses the impact of oil price shocks on both the GDP growth and on inflation in the Spanish economy and its seventeen NUTS-2 regions. The Qu and Perron (2007) and the Bai and Perron (1998, 2003a and 2003b) methods identify different periods across the sample. Evidence in favour of a diminishing effect of oil price shocks on the output and inflation is found from the 1970s until the mid 1990s. The influence of oil shocks recovers some of its initial importance for the GDP in the last part of the 1990s and, especially, for the inflation, in the 2000s (five years when considering regions). The most outstanding result is that oil price movements could explain at least some of the inflation in the latter period, the main difference between these outcomes and those obtained for the 1970s being the lower value of the impact found in the last part of the sample.

*Key words*: oil shocks, inflation, business fluctuations, Spain.

*JEL classification*: E31, E32, Q43, C32.

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## 1. INTRODUCTION

Oil is the most important primary energy source all over the world. During the 1970s, shocks in oil prices derailed the economy and so, it was recognised and established as conventional wisdom that they do not only affect energy markets but they are also a cause of fluctuations on the rest of the economy.

Due to their relevance as a source of macroeconomic fluctuations, there is a great deal of literature that analyses the impact of oil price shocks on the economy[1]. The previous literature shows that oil price shocks during the 1970s could have caused recessions in industrialised countries, but from 1980s onwards, their effect on macroeconomic variables has diminished and almost vanished. In fact, there is a growing body of research affirming that more recent oil price shocks show a limited impact on economic activity and prices, related to what is known as “the Great Moderation”. Blanchard and Galí (2008) look for the components of macroeconomic variations that are most related with exogenous changes in oil prices for the G7 countries except Canada. Kilian (2008) studies the differences and similarities in the response of the G7 economies to exogenous oil supply shocks using impulse response analysis and counterfactual simulations. Kapetanios and Tzavalis (2009) develop a parametric model to examine if the apparent instability of the oil-macroeconomy relationship can be attributed to large oil price shocks. Nakov and Pescatori (2007) propose a DSGE model with an oil-producing sector to assess the extent to which macroeconomic moderation in US can be accounted for by changes in oil shocks and the oil share in GDP. Jiménez-Rodríguez and Sánchez (2005) studies the impacts of oil price shocks on the economic activity of the eight main industrialised countries through a multivariate VAR analysis using linear and non-linear models. Kilian *et al.* (2007) explain the effects of demand and supply shocks in the global oil market on several measures of 115 countries’ external balance. De Gregorio *et al.* (2007) compute IR analysis and rolling bivariate functions to check the pass-through of oil prices only on to inflation in a sample of 34 countries. The common outcome from all these papers is that they find that the effect of oil price shocks on the most important economies apparently becomes less important after 1980.

The reasons for this change may be found in many factors now listed. Firstly, the changes in the conduct of monetary policy, with the adoption of a commitment to a stable rate of inflation together with greater independence and subsequently credibility gains. Secondly, the decrease of real wage rigidities that smoothes the trade-off between prices and output gap stabilization. Thirdly, the reduction of the oil share in the economy and the higher energy efficiency. Fourthly, the decrease of the weight of the industrial sector (where there is a great dealof firms that use crude oil intensive technologies) in favour of the services sector over the

[1] See Barsky and Kilian (2002, 2004), Bernanke *et al.* (1997), Bohi (1989, 1991), Davis and Haltiwanger (2001), Hamilton (1983, 1996, 2003, 2005), Hamilton and Herrera (2004), Hooker (1996, 2002), Lee and Ni (2002), Lee *et al.* (1995), Mork (1989), Raymond and Rich (1997) and Shapiro and Watson (1988), amongst others. Much of this literature is focused on the United States, even though some papers recently examine the effects of oil shocks on the G7 countries (for example Mork *et al.* (1994), Blanchard and Galí (2008) and Kilian (2008)).

recent decades. Fifthly, a decline in the exchange rate pass-through and, last but not least, the fact that the current oil price shocks may be a result of a growing world demand[2].

Despite these explanations, strong movements in oil prices seen in the noughties seem to bring the lack of importance of the oil shocks into question and reopen the debate about their influence on macroeconomic variables.

The Spanish economy has been excluded in most of the preceding papers. Only the authors that consider a great number of countries, such as Kilian *et al.* (2007) and De Gregorio *et al.* (2007) do include Spain. However they do not pay any attention to the special features of Spain that could be of importance in the influence and evolution of oil shocks' impact on the economy, for instance, examining key sectoral regional differences. However, two recent papers explore this theme. Hernández Martínez (2009) analyses the negative effects of oil prices increases on the Spanish GDP and inflation from 1984 to 2008, through a VECM. Álvarez *et al.* (2009) studies the effect of oil price movements only on CPI inflation for Spain as a whole and the Euro area, finding evidence of a slight inflationary impact of oil price changes but restricted approximately to the last decade. None of them consider regional differences and their span is shorter than ours.

According to the International Energy Agency (IEA), the oil dependency in Spain is stronger than in many other industrialised economies. Thus, in 2006 the share was 58,1% (12 pp above the European OECD countries), which nevertheless means a reduction of almost 20 pp with respect to the beginning of the 1970s, something worth pointing out. Furthermore, oil price shocks have differential effects on the different sectors of the economy, the industrial being the one most affected by these changes, due to the fact that it is the main consumer of crude oil by products, followed by the transport sector.

So why consider Spain´s different regions? It can be spatially disaggregated into 17 NUTS-2 regions with noticeable different weights of their industrial sector apparent in each one. This statement together with the greater importance of the country's use of oil prompted the study of the influence of oil price shocks on the Spanish economy and its regions. As far as we know, this more disaggregated geographical level has not been considered in the research pieces that focus on the relationship oil prices-macro economy up till now.

Accordingly, the main aim of this paper is to establish the effect of oil price shocks on macroeconomic variables for Spain and its 17 NUTS-2 regions for the longest available period (1970-2008 for the Spanish economy and 1980-2008 for the regions). Allowing for the presence of different periods, for Spain we use recent methodological advances in finding structural breaks such as Qu and Perron (2007) procedure which allows for the breaks to be endogenously determined by all the model parameters while for its regions, we apply the methodology of Bai and Perron (1998, 2003a, 2003b) that test for the presence of structural breaks in the relationship between oil prices and each of the two macroeconomic variables considered (GDP and CPI inflation). We will systematically assess the magnitude, the length

[2] More detailed explanations can be found in Blanchard and Galí (2008), Nakov and Pescatori (2007), Bernanke *et al.* (1997) and De Gregorio *et al.* (2007).

and the differences and similarities in the response of the economies to exogenous oil price shocks through the use of long-term multipliers. This analysis would not only help us to understand the historical facts but also to develop adequate policies (more orientated to specific regions or sectors) in order to control the economic impact of future oil price shocks.

The fact that our set of data runs from 1970s to 2008 and, consequently, includes recent oil price movements and the end of an expansionary business cycle, allows us to analyse a wider span than in previous studies and in more depth, which gives an additional feature to the paper.

After this introduction, the paper is organised as follows. Section 2 focuses on the Spanish economy as a whole, it introduces Qu and Perron procedure and the methodology used to assess the long-term impact of oil price shocks on the GDP growth and the inflation, together with the results obtained from the application of these tools. Section 3 is devoted to the regional disaggregation, presenting Bai and Perron method, an outlook of the industrial activity and the main results found for the regions. From the estimations of the two different methodologies similar break points are obtained for the country and its regions. There also appears a reduction of oil price shocks effects from 1980 onwards that subsequently reappears in the last decade mainly on prices. Finally, Section 4 presents the main conclusions.

## 2. THE SPANISH ECONOMY

In this section we analyse the evolution of the Spanish economy and the relationship between the two main macroeconomic variables (GDP and CPI inflation) and the oil price shocks. As a first step, we use the Qu and Perron (2007) methodology to determine the presence of breaks in the sample considered. The periods obtained from the application of this methodology are later used to estimate the influence of oil shocks on the Spanish economy. Finally, and in order to measure this effect, we compute long-term multipliers; this tool allows us to identify the magnitude of the shock and its significance for each period.

### 2.1. Detection of structural breaks in multivariate regressions

The Qu and Perron (2007) (QP henceforth) approach provides a valid technique to find the breaks throughout periods, as it allows multiple structural changes that occur at unknown dates in a system of equations. The added value of this procedure is that changes can occur in the regression coefficients and / or the covariance matrix of the errors and the distribution of the regressors has not to remain stable across regimes. The method of estimation is quasi-maximum likelihood based on Normal errors.

There are $n$ equations and $T$ observations, the vector $y_t$ includes the endogenous variables from the system, so $y_t = (y_{1t},...y_{nt})$, the parameter q is the number of regressors and $z_t$ is the set which includes the regressors from all the equations $z_t = (z_{1t},...,z_{qt})'$. The selection matrix $S$ is of dimension $nq \times p$ with full column rank, it involves elements that take the values 0 and 1 indicating which regressors appear in each equation. The total number of structural changes in the system is $m$ and the break dates are denoted by the $m$ vector $\mathrm{T} = (T_1, ..., T_m)$, taking into account that $T_0 = 1$ and $T_{m+1} = T$. A subscript $j$ indexes a regime ($j = 1, ..., m+1$), a subscript $t$ indexes the temporal observation ($t = 1,...T$), and a subscript $i$ indexes the equation ($i = 1,...n$) to which a scalar dependent variable $y_{it}$ is related.

The model proposed is of the form:

$$y_t = (I \otimes z_t^{'}) S\beta_j + u_t \quad (1)$$

with $u_t$ having mean 0 and covariance matrix $\sum_j$ for $T_{j-1} + 1 \leq t \leq T_j$. For a standard VAR model, we have $z_t = (y_{t-1}, ..., y_{t-q})^{'}$ and an identity matrix $S$.

In the present case, once tested the exogeneity of the oil price variable through a Granger causality test, we use a bivariate VAR with two endogenous variables (GDP and inflation) and an exogenous variable (OILP)[3]. Then, the model can be expressed as:

$$\Delta GDP_t = \alpha_1 + \sum_{i=1}^{k} \beta_{1i} \Delta GDP_{t-i} + \sum_{i=1}^{k} \delta_{1i} \Delta CPI_{t-i} + \sum_{i=0}^{k} \gamma_{1i} \Delta OILP_{t-i} + u_1 \quad (2)$$

and

$$\Delta CPI_t = \alpha_2 + \sum_{i=1}^{k} \beta_{2i} \Delta GDP_{t-i} + \sum_{i=1}^{k} \delta_{2i} \Delta CPI_{t-i} + \sum_{i=0}^{k} \gamma_{2i} \Delta OILP_{t-i} + u_2 \quad (3)$$

We have chosen to impose 1 lag according to the sequential modified LR test statistic, final prediction error, Akaike information criterion (AIC), Schwarz information criterion (SBIC) and Hannan-Quinn information criterion (HQ). Hence, $z_t$ is defined as $(1, \Delta GDP_{t-1}, CPI_{t-1}, OILP_t, OILP_{t-1})$ and $S = I_{10}$. Imposing k=1, the VAR system of equations (2) and (3) transforms into the following two equations:

$$\Delta GDP_t = \alpha_1 + \beta_{11} \Delta GDP_{t-1} + \delta_{11} \Delta CPI_{t-1} + \gamma_{10} \Delta OILP_t + \gamma_{11} \Delta OILP_{t-1} + u_1 \quad (4)$$

and

$$\Delta CPI_t = \alpha_2 + \beta_{21} \Delta GDP_{t-1} + \delta_{21} \Delta CPI_{t-1} + \gamma_{20} \Delta OILP_t + \gamma_{21} \Delta OILP_{t-1} + u_2 \quad (5)$$

To determine the number of breaks in the system, we first use the $UDmaLR_T(M)$ and $WD\max LR_T(M)$ statistics to test whether at least one break is present[4]. When the test rejects it, the test $SEQ_T(l+1 \mid l)$ is sequentially applied for $l = 1,2...$, until the test fails to reject the null hypothesis of no additional structural break. Following critical values derived from response surface regressions, the tests offer evidence in favour of the presence of three breaks in the system of equations. However, we have considered four breaks instead of three because although the QP methodology suggests the last option it also admits an additional break that satisfies the minimal length requirement. The cycle dating obtained has two main advantages

[3] The Ng and Perron (2001) test and the KPSS test of stationarity of Kwiatkowski *et al.* (1992) show that the series are I(1). Consequently, we have used growth rates in order to achieve stationarity.
[4] Qu and Perron (2007).

for our analysis: firstly, it improves the cycle dating and, secondly, if we only consider three breaks in the last period an explosive root appears in the GDP variable that disappears when admitting four (Table 1).

**Table 1. Analysis of structural breaks (QP methodology). Spain.**

| | WDmax | Sequential test (l+1/l) | | | Number of breaks |
|---|---|---|---|---|---|
| | | l=1 | l=2 | l=3 | |
| SPAIN | 150.313*** | 88.213*** | 73.651*** | 0.000 | 4 |

Notes:

(1) M=4. (2) Trimming=0.200. (3) T= 150.000. (4) The covariance matrix of the errors is allowed to change. Normality is assumed when testing changes in the covariance matrix. (5) The number of coefficients (beta) in each regime is 10. (6) The error is serially uncorrelated. (7) The distribution of the regressors is allowed to change. (8) No pre-whitening when constructing confidence intervals.

* significant at 10%; ** significant at 5%; *** significant at 1%.

### 2.2. Long-term multipliers

From equations (4) and (5), the usual impulse response functions for both GDP and CPI inflation can be directly drawn. However, we want to quantify the expected response of the two macroeconomic variables to exogenous oil price shocks, so we have alternatively constructed long-run multipliers.

We obtain our long-run multipliers ($LM_i$) from the lag-polynomials expression of the VAR. For a general case:

$$A(L)Y_t = \alpha + B(L)X_t + u_t \quad (6)$$

where $A(L) = 1 - \beta_1 L - \beta_2 L^2 - ...$ and $B(L) = \gamma_0 + \gamma_1 L + \gamma_2 L^2 + ...$

So,

$$Y_t = A(L)^{-1}\alpha + A(L)^{-1}B(L)X_t + u_t \quad (7)$$

and $A(L)^{-1}B(L)$ is defined as the long-run multiplier.

For our model, we define our long-run multipliers from equations (4) and (5):

$$A(L)^{-1}B(L) \Rightarrow \qquad \frac{\gamma_{10} + \gamma_{11}}{1 - \beta_{11}} = LM_1 \text{ for } \Delta GDP \quad (8)$$

$$\frac{\gamma_{20} + \gamma_{21}}{1 - \delta_{21}} = LM_2 \text{ for } \Delta CPI \text{ inflation} \quad (9)$$

Confidence intervals at 5% level for these multipliers have been constructed by standard bootstrap methods. Additionally, the significance is tested by drawing a linear *F* test, with the null hypothesis stated as:

$$H_0 : \gamma_{10} + \gamma_{11} = 0 \text{ for } \Delta GDP$$

or

$$H_0 : \gamma_{20} + \gamma_{21} = 0 \text{ for } \Delta CPI \text{ inflation}$$

### 2.3. Location of breaks and effects of oil price shocks over the economic evolution

Even though there is a discussion in the literature about the use of the real or the nominal oil price, due to the fact that the statistical exogeneity of the right-hand variables influences the interpretation of the results, we have chosen to use the nominal price as in Hamilton (2008). Our measure of oil price is the monthly *Producer Price Index for crude petroleum* from the US Bureau of Labor Statistics, transformed in a quarterly data set since 1970:I until 2008:IV.

To compute the impact of oil price changes on the Spanish economic evolution two variables from the OECD's database have been used: the GDP to measure production and the Consumer Price Index (CPI) to proxy price behaviour[5]. Both are measured quarter-to-quarter and expressed in annualized terms. The data set covers from 1970:I to 2008:IV

**Table 2. Descriptive Statistics (1970:01-2008:04). Spain.**

| | | GDP growth | CPI inflation | OIL PRICES |
|---|---|---|---|---|
| PERIOD 1 | mean | 4.52 | 15.19 | 15.73 |
| (1970:01-1978:02) | max. change | 8.65 | 27.24 | 74.90 |
| | min. change | -0.08 | 7.20 | -1.28 |
| | st. deviation | 2.74 | 5.92 | 21.77 |
| PERIOD 2 | mean | 1.18 | 13.49 | 13.28 |
| (1978:03-1985:04) | max. change | 3.24 | 18.06 | 61.20 |
| | min. change | -0.50 | 7.84 | -13.80 |
| | st. deviation | 0.92 | 2.61 | 24.76 |
| PERIOD 3 | mean | 3.33 | 6.20 | -0.06 |
| (1986:01-1993:02) | max. change | 7.88 | 9.47 | 68.34 |
| | min. change | -2.80 | 4.06 | -54.09 |
| | st. deviation | 2.46 | 1.36 | 30.63 |
| PERIOD 4 | mean | 3.43 | 3.31 | 13.13 |
| (1993:03-2000:04) | max. change | 5.82 | 5.12 | 170.46 |
| | min. change | -0.40 | 1.50 | -42.86 |
| | st. deviation | 1.44 | 1.20 | 47.38 |
| PERIOD 5 | mean | 3.15 | 3.31 | 19.85 |
| (2001:01-2008:04) | max. change | 4.01 | 4.91 | 100.23 |
| | min. change | 0.00 | 2.19 | -43.26 |
| | st. deviation | 0.88 | 0.72 | 33.42 |

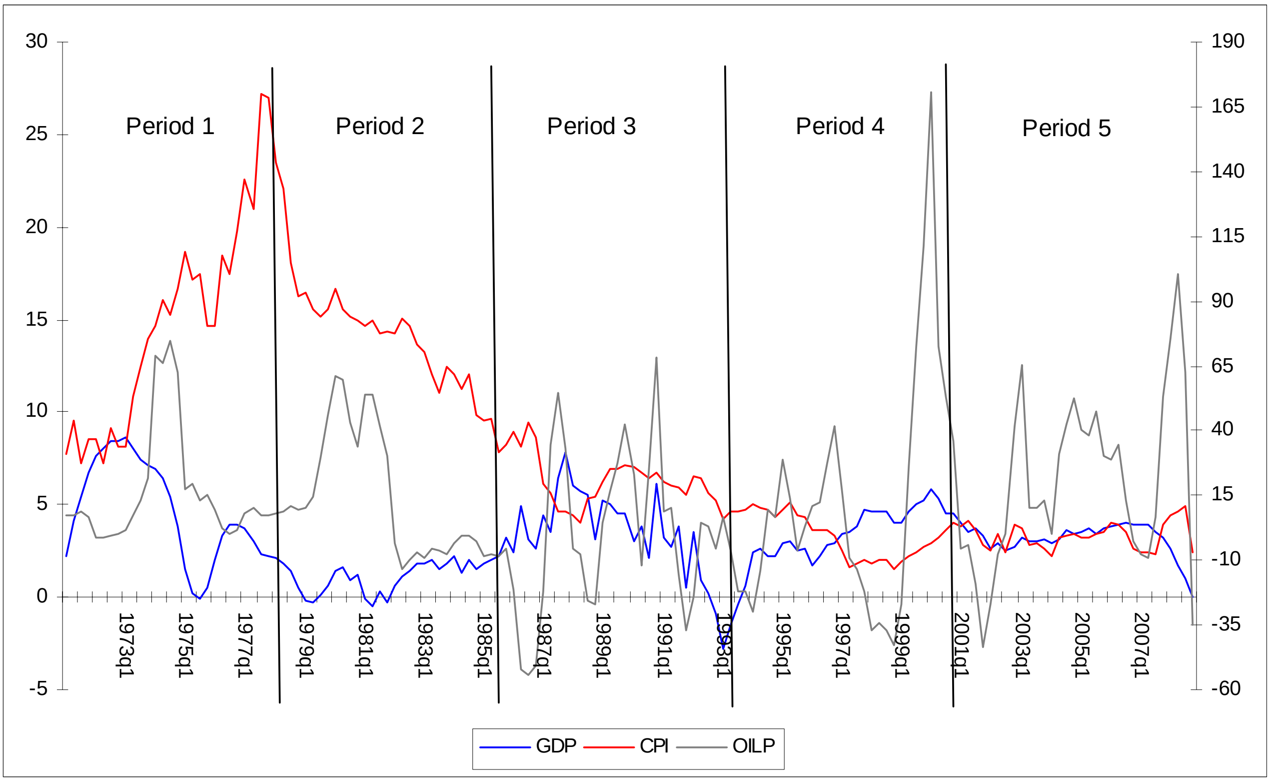
*GDP obtained from the Economic Outlook, 84 (OECD), CPI from the MEI (OECD).

The analysis of structural breaks is reported in Table 1. A statistical description of the variables is considered and their graphical analysis over the period appears in Table 2 and

[5] We compute the rate of growth of the variables. This means that, in the case of the CPI, what we are considering is inflation.

Figure 1. In the next paragraphs, the different intervals obtained from the timing of the shocks and the effect of the oil price movements on production and prices (through the use of long term multipliers) are presented and reported in Table 3. In addition, a recursive estimation of the long-run multipliers for OILP to both endogenous variables (GDP and CPI inflation) has been carried out. The results, displayed in Figure 2, offer a more detailed picture of their evolution.

**Figure 1. Evolution of GDP, CPI inflation and OIL prices (1970:I-2008:IV). Spain.**



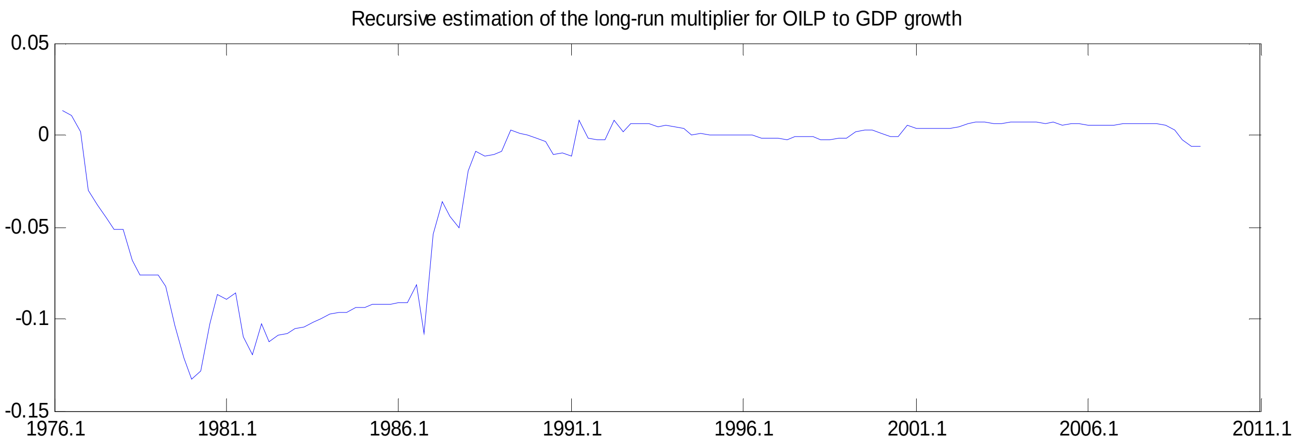

Five different periods have been endogenously determined by all the model parameters[6]. The first one runs from 1970 to the second quarter of 1978. During this period the GDP grew at 4.52 in mean and was the highest of the five periods considered (Table 2). The inflation rate also reached its peak values of the whole sample. Both variables presented a sharp variability. Related to oil prices, the Yom Kippur war in 1973 started the oil crisis of the 1970s decade and the sharp oil price spikes characterised those years. This crisis coincided in Spain with the political instability that followed the end of Franco's dictatorship. The political transition made it difficult to implement vigorous economic measures and, so, compensatory policies were put into place[7].

Spain was one of the main oil-importing countries and to consume a little more oil, meant the cost rose a lot, diminishing the income, affecting a firms' viability and thus hindering

[6] See Serrano Sanz (2009) for a review of the Spanish economic evolution since the 1970s.
[7] These policies meant that there was no translation of international oil price increases to the inflation, that is, to consumers.

economic growth. The government increased interventionism and price controls were imposed. This scenario clearly explains that the GDP multiplier exhibits a negative and significant value, although not very high; while the CPI multiplier is positive but not significant (Table 3). The recursive estimations of the long run multipliers for both variables confirm these results (Figure 2).

**Figure 2. Recursive estimation of the long-term multipliers for OILP to GDP growth and CPI inflation**



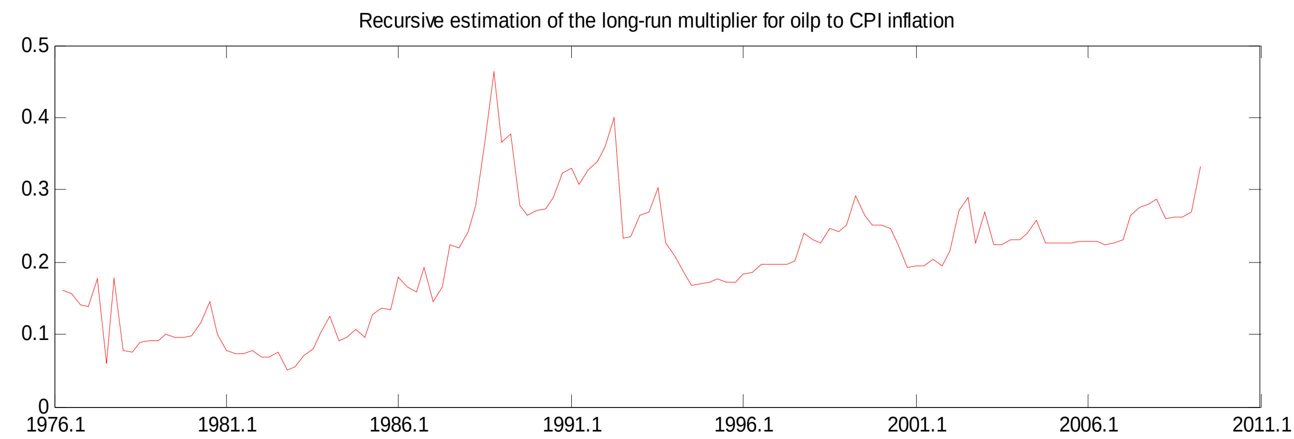



**Table 3. Long term multipliers on GDP and CPI inflation (1970:01-2008:04). Spain.**

| $M_{GDP}$ | $M_{CPI}$ | TB I | $M_{GDP}$ | $M_{CPI}$ | TB II | $M_{GDP}$ | $M_{CPI}$ | TB III |
|---|---|---|---|---|---|---|---|---|
| -0.08*** | 0.09 | 1978:02 | -0.01 | 0.03 | 1985:04 | 0.06 | -0.02 | 1993:02 |
| (-0.16,-0.02) | (-0.76,1.03) | | (-0.03,0.01) | (-0.05,0.10) | | (-0.03,0.17) | (-0,06,0,01) | |

| $M_{GDP}$ | $M_{CPI}$ | TB IV | $M_{GDP}$ | $M_{CPI}$ |
|---|---|---|---|---|
| 0.01** | 0.03 | 2000:04 | -0.01 | 0.02** |
| (0.00,0.02) | (-0.01,0.05) | | (-0.06,0.04) | (0.01,0.04) |

GDP data obtained from the Economic Outlook, 84 (OECD) and CPI inflation from the MEI (OECD)
TB means time of break.
For a linear F test: * significant at 10%; ** significant at 5%; *** significant at 1%.
In brackets, confidence intervals obtained from a bootstrap technique with the significance level at 5%.

The second period starts in 1978:III and ends in 1985:IV. The inflation rates continued reaching two digit figures and the economic growth was the lowest of the five periods considered, just 1.18 in mean. To fight structural imbalances, the Moncloa's Pacts were the first measures of the reinstated democracy; these agreements tightened monetary policy, controlled the external deficit and tried to hold prices down. The economy began a slight recovery. Nevertheless, the Iranian revolution (1979) brought about a sharp increase in oil prices, which was followed by small peaks in the following years explained by the long Iran-Iraq war. Furthermore, dollar appreciation until 1984 made Spain's energy bill even more expensive. The oil price behaviour together with a feeble economy, still not recovered from the previous imbalances, account for the low GDP and high inflation, but the oil prices did not show a significant effect on either production or inflation as the long run multipliers prove[8]. The PSOE political party won the 1982 elections with an absolute majority, allowing the implementation of a major macroeconomic adjustment and so the years from 1982 to 1985 set the basis for the subsequent recovery, ending our second period.

The third period covers between 1986:I to 1993:II. The signing of the adhesion treaty to the EEC that came into force in 1986 signals the starting date. A new phase initiated: the economic activity began to grow above 2% once again and the mean GDP over the period was 3.33; furthermore, the inflation rate fell and was 6.2 on average. There were tiny oil price movements due to the last years of Iran-Iraq war (1980-88) and the first Gulf war (1990-91). Nevertheless the mean of this variable over the period was a small decline. This evolution of oil prices meant that neither the GDP multiplier nor the inflation one attained significant values[9]. Although during this period the Spanish economy achieved strong rates of economic growth, relevant imbalances remained: current account and budget deficits and some price disequilibria, which becoming a member of the European Monetary System in 1989 did not solve[10]. In 1992, amongst some political and economic crisis in Europe, the imbalances weighed more, the Monetary System collapsed and the Spanish currency ("peseta") needed three consecutive devaluations. The crisis reappeared in 1993, the finishing date of the period under study.

The interval from 1993:III to 2000:IV forms our fourth period. The economic downturn was severe but brief and in 1994 the government acquired the commitment of setting the Spanish economy on a stable economic growth path in order to meet the Maastrich criteria to enter the Euro later. So as to do this, the Bank of Spain, through a new autonomy rule, was charged with price stability as its main objective, consequently the CPI inflation decreased in the period, being only 3.31 in mean. Soon after 1994, the Spanish economy found itself in a path of stable and balanced growth, in fact achieving the second highest GDP growth in mean of the

[8] The recursive estimation of the long-term multipliers confirms this result as they were quite flat during that second period. Moreover, the effect of oil prices on the GDP becomes stable in the second half of the period.

[9] In fact, the recursive estimation of the long term GDP multipliers goes from a negative value to a positive one at the end of the period. The evolution of the recursive CPI multiplier is divided in two phases: first there is a price control while secondly inflationary tensions appear. These, together with the small decline in the mean of the oil price variable, means that in the whole period the effect is not significant.

[10] More specifically these imbalances were partially corrected up to 1989 and reappeared again from then on to the end of the period.

five periods considered (3.43). There were no particular events related to oil price peaks and the behaviour of the series is characterised in general by small rises and falls, except the sharp rise at the beginning of 2000, when the maximum change of the whole sample is reached. Some of these movements were transferred to the GDP multiplier and, the combination of economic growth and positive oil price data in mean with also positive peaks, are reflected in a significant and positive value but with a much reduced impact. In contrast, the CPI multiplier is not significant. The last half of the period was characterised by tight rigid macroeconomic policies to meet the Maastricht criteria, which allowed Spain to join the Euro economy in 1999. Nevertheless, at the beginning of the new century there was an almost worldwide short and minor downturn, brought on by the technological bubble burst.

Finally, the fifth period ends in 2008, concluding a favourable cycle in terms of economic growth. In particular, the mean GDP growth was 3.15, with a minimum non-negative growth and the CPI prices were in mean the same as in the previous period but with the minimum change never reaching below 2.2. Nonetheless, there have been large movements in oil prices in this period. The strikes in Venezuela influenced oil shocks in 2002-2003, while the Iraq war and the following unrest, the Nigerian civil war and the hurricane in the Gulf of Mexico all explain oil price movements in 2003. In 2005, there was a burst of crude prices as a consequence of the surging demand from China, India and other formerly underdeveloped countries like Brazil and also in the US, together with a low level of excess oil production due to the OPEC measures. Two years later, oil prices once more rose again as a consequence of the strong demand from emerging countries and also due to speculation, but in 2008, these prices began to fall[11]. It is noteworthy that during this period, oil prices were below those of the first period in real terms but more persistent. In this context, oil prices had a positive small and significant effect to the CPI inflation but not to the GDP[12].

It is known that in the past energy pricing there existed an important component of economic policy (taxation or prices regulation). This last significant effect of oil prices on the CPI inflation could be partially related to the issue that during the five periods considered the final oil prices in Spain went through different regulatory regimes. Prices were administratively fixed until 1990 and up to 1998 this system was modified with a ceiling price regulation. From then on the market was liberalised. Furthermore, the privatization of the main Spanish oil firm (Repsol) in 1997 could have had an influence in explaining the effect on CPI prices in the fifth period. Before its privatization, the company could have followed a particular strategy of maintaining

[11] It is true that speculation may have affected oil price movements even more than supply and demand circumstances. The popularity of oil futures could have contributed to increase oil prices in 2007 and their strong fall during 2008. Speculators trade oil future contracts to make a profit on the difference between the buy and sell price. The fact that the dollar was sliding in value (2001-2008) could have encouraged investors.

[12] The recursive estimation of the long-term multiplier to CPI inflation shows a growing trend during this period, what would confirm this outcome.

profits, as well as including some of the government's among its objectives, such as the control of inflation[13] (see Contín-Pilart *et al.* (2009) Perdiguero (2010) for more details).

To sum up, after 1970s decade, the evidence shows that the estimated response of oil price shocks to macroeconomic variables steadily declined. Blanchard and Galí (2008) and Kilian (2008) obtained a similar result for the G7 countries. However, and in clear contrast to the previous literature, in the last part of the 1990s for the GDP and, specially, in the 2000s for the CPI, the influence of oil shocks recovers some of its initial importance[14]. Thus, the most outstanding result is that the oil price movements could explain at least some of the recent inflation. The main difference between these outcomes and those obtained for the 1970s is the lower value of the multipliers found in the last two periods. The similarity in the mean of oil price changes between the first and fourth and fifth periods, with an even stronger variability in the two latter (the maximum and the minimum values differ more in the last ones), could, to some extent, explain this result (Table 2)[15]. Nevertheless, the causes of inflation should be looked for in other variables outside the oil shocks, due to the very small effect of oil prices when the multipliers are significant.

The oil price movements meant again some effect on the macroeconomic behaviour of Spain. So, it looks clear that oil price is a variable to be considered in the design of the country's economic policy framework in order to implement adequate economic measures.

## 3. REGIONAL DISAGGREGATION

The effect of an oil price shock on the evolution of the Spanish economy as a whole has been studied in the previous section. Nevertheless, this analysis may be distorted by the degree of aggregation selected. As already stated, Spain is divided into seventeen NUTS-2 regions, with differences in their business cycles and also in the weight of each of the main sectors. The significance of their industrial sector and, to a lesser extent, the tertiary and the agricultural ones, could be relevant to suppose a different behaviour of the region's economic evolution when facing an oil price shock.

Accordingly, it looks clear that a more disaggregated analysis could shed some additional light to understand the effect of an oil price shock on the macroeconomic variables. For that reason, in the present section, the impact of an oil price shock on the evolution of each of the seventeen Spanish regions is measured. Firstly, in order to understand the possible different behaviour of the regions, a descriptive view of the spatial distribution of industrial activity is presented. To determine the presence of breaks the Bai and Perron (1998, 2003a,

[13] Nevertheless, Contín-Pilart *et al.* (2009) suggest that the collaboration of the government and the major operator trying to maintain overall price stability apparently continued once the price regulations had been abolished.

[14] Nevertheless, this smaller impact could have an explanation in what Kilian (2008c) indicates. He carries out an exercise for the US and he points that the economy tends to be resilient and seemingly unaffected by an increase in oil prices since 2002 because much of this increase was fuelled by a booming world economy and in the short term, the expansionary effects of an aggregate demand shock for industrial commodities help to offset the adverse consequences of higher oil prices

[15] This result is similar to the one obtained by Gómez-Loscos *et al.* (2009) for the G7 countries, although these authors find that the impact of oil shocks over production and inflation becomes significant only after 2000.

2003b) method is used. The lack of availability of long enough series (and their limited periodicity in the case of GDP) prevents the application of QP procedure for a system of equations. The methodological alternative used poses each endogenous macroeconomic variable in an individual equation together with our exogenous variable. The results obtained from the application of this methodology are then employed to compute the impact of an oil shock on the regions' economy through the use of long-run multipliers.

### 3.1. An overview of the industrial activity in the Spanish regions

A sharp rise in energy costs has differential effects on different sectors of the economy and consequently some firms do worse, mainly those belonging to the industrial sector that use oil intensive technologies but not always so[16]. Thus, such firms that use oil intensive technologies are specially affected by an oil price shock, since the cost of producing goods and services that use petroleum products as an input brings about noticeable marginal cost variations.

Likewise, Hamilton (2008) notes that energy price shocks may be transmitted through adjustments in firms' investing expenditures. In fact, he signals two main channels. The first is the one mentioned before, that is, an increase in the oil price raises the marginal cost of production, depending on the cost share of energy. The second is with reduced demand on the firms' output, so consumer expenditure falls due to rising energy prices. Furthermore, households devote some of their spending to refined oil products, such as fuels or heating oil, producing an effect on the consumer price index and, indirectly, on the per capita GDP.

Changes in oil prices may also create uncertainty about future energy prices, causing firms to postpone or even cancel investment decisions (see Bernanke, 1983). Furthermore, the changes in oil prices could have an effect on the revision of inflation expectations or wages setting.

There is a relevant degree of heterogeneity between sectors in the Spanish regions as a simple look at the data will show[17]. In the twenty-eight years covered by our study (1980-2008), the services and construction sectors have increased their weight over the total production at the expense of industrial, agricultural and energetic sectors. In 2008, almost 70% of Spanish total GDP comes from the tertiary sector, 14.3% is industrial, 11.4% is generated by construction and the 2.6% and 2.7% remaining belong to the agriculture and energy sectors.

The most industrialised regions (with an industrial weight clearly above the Spanish average) are NAV, LAR, PVAS, CAT, CANT, ARA and AST; there are two groups with an industrial average around the Spanish one: CVAL, GAL, CYL and CLM (a little higher) and MUR and MAD (slightly below). Finally, the less industrialised regions are AND, EXT, BAL and CAN.

[16] According to the IEA data, crude oil is entirely consumed by the industrial sector, while petroleum products (derivatives) are also used in the transport sector and other ones.

[17] The seventeen Spanish Autonomous Communities correspond to NUTS-2 regions in the EUROSTAT nomenclature. We maintain the Spanish names and the regions are denoted by Andalucia (AND), Aragón (ARA), Asturias (AST), Baleares (BAL), Canarias (CAN), Cantabria (CANT), Castilla y León (CYL), Castilla-La Mancha (CLM), Cataluña (CAT), Comunidad Valenciana (CVAL), Extremadura (EXT), Galicia (GAL), Madrid (MAD), Murcia (MUR), Navarra (NAV), País Vasco (PVAS) and La Rioja (LAR).

This particular industrial ranking has remained with no important changes in the whole period considered.

### 3.2. Detection of breaks in bivariate regressions

When working with regional series the availability of data diminishes significantly. To calculate the impacts of oil price shocks on the economic evolution, on the one hand, GDP data to proxy production is used: the longest available series, at least in annualized terms, runs from 1980 to 2008 and our source is the *IVIE*[18]. On the other hand, to measure price behaviour we use the Consumer Price Index (CPI) from the Instituto Nacional de Estadística (Spanish Statistical Institute), the data is monthly, but a quarterly series is constructed, and the working sample begins in 1979:I and ends in 2008:IV. Finally, the *Producer Price Index for crude petroleum* is transformed into quarterly or annual terms depending on the endogenous variable.

We uphold stationarity for the variables through the unit root tests of Dickey and Fuller (1981), Phillips-Perron (1988) and Ng and Perron (2001), as well as the KPSS test of stationarity of Kwiatkowski *et al.* (1992) and we can confirm that all the series are I(1). So, we calculate the growth rates of the series and test again, obtaining I(0) series in all the cases.

To test for the presence of structural breaks in the causal relationship between macroeconomic variables (GDP growth or inflation) and oil prices, the Bai and Perron (1998, 2003a, 2003b) methodology is applied (BP henceforth). These contributions detect the most appropriate number of breaks in bivariate regressions, consistently determining the number of break points over all possible partitions as well as their locations. Based on the minimisation of the sum of the squared residuals over all the possible combinations of time breaks, this method offers T-consistent estimators of the time of the break and it is not necessarily very time-consuming (if we use the algorithm discussed in BP (1998) the obtaining of the estimators is $\mathrm{O}(T^2)$ for any $m \geq 2$).

They estimate the following model where up to $m$ breaks ($m+1$ regimes) may appear:

$$y_t = x_t\beta + z_t\delta_j + u_t \qquad (10)$$

with $y_t$ being the dependent variable; $x_t$ $(p \times 1)$ and $z_t$ $(q \times 1)$ representing vectors of independent variables of which the first is univariate and the second can change. $\beta$ and $\delta_j$ (*j=1, ..., m+1*) are the corresponding vectors of coefficients and $T_i$, ..., $T_m$ are the break points treated endogenously in the model.

These authors design several testing procedures to determine the number of breaks. The *supF_{T}(k)* tests the null hypothesis of no breaks against the alternative of *k* breaks while the *supF_{T}(l+1/l)* test considers the existence of *l* breaks, with $l = 0,1,\ldots n$ against the alternative of *l+1* changes. The *UDmax* and *WDmax* double-maximum tests check the null of no structural breaks against the presence of an unknown number of breaks. Therefore, when these

[18] The *IVIE (Instituto Valenciano de Investigaciones Económicas)* has linked the two different series of GDP with base years 1986 (1980-1996) and 2000 (1995-2008), that are available in the *Instituto Nacional de Estadística (Spanish Statistical Institute)*.

last two tests rejects the null, they suggest continuing with a sequential application of the *supF_{T}(l+1/l)*.

This general outline must be modified to the present case. In particular, two different equations are estimated, for any of the two endogenous variables (GDP and CPI inflation), in the following form[19]:

$$\Delta y_t = a_i + b_i \Delta OILP_t + u_t \qquad (11)$$

A maximum number of 5 breaks has been considered which, in accordance with the sample size, supposes a trimming parameter of 0.15 and no pre-whitening has been applied to the series.

Finally, long-term multipliers as in section 3.3 are also computed.

### 3.3. Location of breaks and effects of oil price shocks on regional GDP and inflation.

The results of this exercise are summarized in Tables 4, 5 and 6. The estimates of the timing of the breaks and the posterior estimates of the impact of the oil price movements on the GDP growth and on inflation for each of the periods obtained are commented in the following paragraphs. The results are extremely conditioned by the scarcity of regional data, and are even more scarce for the GDP variable than for the price one.

**Table 4. Analysis of structural breaks (BP methodology). Spain and its regions.**

| | GDP | | | CPI | | |
|---|---|---|---|---|---|---|
| | UDmax | WDmax | Number of breaks | UDmax | WDmax | Number of breaks |
| SP | 192.49 | 377.41 | 2 | 345.79 | 454.68 | 2 |
| AND | 107.32 | 210.41 | 1 | 464.81 | 837.61 | 2 |
| ARA | 165.94 | 165.94 | 1 | 292.84 | 398.02 | 2 |
| AST | 23.47 | 33.02 | 1 | 263.16 | 309.58 | 2 |
| BAL | 83.45 | 133.13 | 0 | 278.25 | 460.74 | 2 |
| CAN | 12.96 | 15.95 | 0 | 263.07 | 281.98 | 3 |
| CANT | 184.77 | 362.27 | 0 | 133.97 | 157.86 | 2 |
| CYL | 1244.85 | 2440.76 | 1 | 498.52 | 867.18 | 2 |
| CLM | 61.84 | 61.84 | 2 | 721.22 | 1150.54 | 2 |
| CAT | 92.45 | 126.84 | 2 | 267.38 | 477.97 | 2 |
| CVAL | 35.68 | 56.93 | 0 | 158.06 | 236.41 | 2 |
| EXT | 21.07 | 37.33 | 1 | 470.15 | 715.58 | 3 |
| GAL | 258.77 | 507.37 | 1 | 455.56 | 693.31 | 3 |
| MAD | 36.40 | 58.06 | 0 | 145.20 | 205.79 | 2 |
| MUR | 84.50 | 115.93 | 0 | 247.73 | 325.21 | 3 |
| NAV | 45.59 | 89.40 | 0 | 578.12 | 680.11 | 3 |
| PVAS | 15.32 | 24.45 | 0 | 442.95 | 868.49 | 4 |
| LAR | 288.69 | 366.10 | 0 | 219.85 | 300.09 | 3 |

[19] The Andrews (1991) method is used to construct a covariance matrix robust to serial correlation. Alternately, several calculations have been performed for an ADL model in the form $\Delta y_t = \alpha + \beta_1 \Delta y_{t-1} + \gamma_0 \Delta OILP_t + \gamma_1 \Delta OILP_{t-1} + u_t$ and the long-run multipliers have been derived. Nonetheless, there are hardly any variations in the results.

Although the number of breaks for the GDP equation in the different regions ranges between 0 and 2, the BP methodology allows us to clearly identify one or two periods that fit the QP results quite well, in spite of the shorter sample and the less periodicity in regional data (Table 5). Hence, for nine regions no breaks are identified (BAL, CAN, CANT, CVAL, MAD, MUR, NAV, PVAS and LAR). When there are breaks, the first one is found between 1984 and 1986 in seven regions (AND, ARA, CYL, CLM, CAT, EXT and GAL) and in Spain as a whole. So, this period clearly coincides with period 2 of the previous methodology. In two regions (CLM and CAT), and in Spain, another break is identified around 1990, situating the ending of period 3 of QP procedure a bit earlier. In the case of AST the only break detected is in 1999, almost coinciding with the final date of preceding period 4. To sum up, in general terms and given the availability of data, this cycle dating fits rather well with regard to the previous section.

The long run multipliers do not show a clear standard, except the apparent and progressive loss of importance of oil price shocks on the GDP. For the regions with only one break, the GDP multiplier is negative and significant in four cases (ARA, AST, CYL and EXT) and in Spain while in CLM -that has an additional break- it is also negative and significant. Furthermore for GAL it is positive and significant. These results could be capturing the movements in oil shocks of the last year of the 1970s decade. Additionally, ARA, AST and CYL are regions characterised by the relative high importance of the industrial sector, thus the oil price movements could have affected them more. After 1984/85 only two positive and significant multipliers are found in CYL (which has no more breaks) and CLM (which has another break in 1989). The unexpected results for CLM and also GAL could be partially explained as they belong to a cluster of regions traditionally poorer and less developed than the rest of Spain (together with EXT and AND) and the common negative values of GDP during those years could be conditioning the results [20]. Finally, two positive and significant multipliers appear in the regions with no breaks (NAV and LAR). This could have an explanation in the fact that they are, by tradition, heavily industrialised regions throughout the twenty-eight years considered and part of their development might be related to oil price behaviour. Although this result is not expected, the size of the multiplier is small (as in the case of CYL) and it is true that in the whole period the positive negative sign is not so easy to identify[21].

For the equation of inflation the number of breaks runs from two to four but the dating of the first two breaks is similar in all the regions, fitting the previous methodology quite well (Table 6). The first period ends between 1984:III and 1986:IV, while the second period runs until a date between 1991:I and 1996:I. From then on, the results are more heterogeneous but they also adjust to the QP periodicity. Firstly, in three regions (PVAS, LAR and MUR) whose period 2 ends in 1991 or 1992, at least one more break is identified; in 1995:IV for the first two and in 1996:IV for MUR. In the case of PVAS, another break appears in 2002:III. Secondly, in four regions (CAN, EXT, GAL and NAV) there is a third additional break between 2000:III and 2003:I.

[20] See Gadea *et al.* (2006) for a classification of Spanish regional clusters.
[21] The economic dynamism of these two regions could influence this sign. Gómez-Loscos *et al.* (2009) also found positive and significant values of GDP multipliers for some of the G7 countries in the noughties (2000-2008) but with a really small size.

**Table 5. BP procedure and long-term multipliers for the GDP. Spain and regions.**

| | ao | bo | TB I | a1 | b1 | TB II | a3 | b3 |
|---|---|---|---|---|---|---|---|---|
| SP | 1.55 | -0.04 | 1986 | 5.00 | -0.02 | 1990 | 2.79 | 0.01 |
| | (0.008) | (0.078) | | (0.000) | (0.690) | | (0.000) | (0.224) |
| AND | 1.56 | -0.07 | 1984 | 3.38 | 0.01 | | | |
| | (0.0104) | (0.102) | | (0.000) | (0.290) | | | |
| ARA | 3.48 | -0.13 | 1984 | 2.90 | 0.02 | | | |
| | (0.001) | (0.003) | | (0.000) | (0.179) | | | |
| AST | 2.02 | -0.03 | 1999 | 2.84 | 0.01 | | | |
| | (0.000) | (0.049) | | (0.001) | (0.700) | | | |
| BAL | 3.63 | 0.01 | no breaks | | | | | |
| | (0.000) | (0.6853) | | | | | | |
| CAN | 3.26 | -0.02 | no breaks | | | | | |
| | (0.000) | (0.3528) | | | | | | |
| CANT | 2.46 | 0.02 | no breaks | | | | | |
| | (0.000) | (0.3043) | | | | | | |
| CYL | 2.60 | -0.18 | 1985 | 2.36 | 0.02 | | | |
| | (0.00) | (0.000) | | (0.000) | (0.045) | | | |
| CLM | 0.76 | -0.09 | 1984 | 6.54 | 0.10 | 1989 | 2.37 | 0.02 |
| | (0.500) | (0.065) | | (0.000) | (0.016) | | (0.000) | (0.333) |
| CAT | 0.57 | -0.03 | 1985 | 5.22 | 0.03 | 1990 | 2.82 | 0.01 |
| | (0.369) | (0.316) | | (0.000) | (0.234) | | (0.000) | (0.341) |
| CVAL | 2.87 | 0.02 | no breaks | | | | | |
| | (0.000) | (0.2730) | | | | | | |
| EXT | 4.71 | -0.14 | 1985 | 3.01 | 0.03 | | | |
| | (0.004) | (0.055) | | (0.000) | (0.336) | | | |
| GAL | 0.48 | 0.04 | 1986 | 2.64 | 0.00 | | | |
| | (0.427) | (0.067) | | (0.000) | (0.746) | | | |
| MAD | 3.58 | -0.01 | no breaks | | | | | |
| | (0.000) | (0.5288) | | | | | | |
| MUR | 2.92 | 0.02 | no breaks | | | | | |
| | (0.000) | (0.2024) | | | | | | |
| NAV | 2.59 | 0.04 | no breaks | | | | | |
| | (0.000) | (0.0286) | | | | | | |
| PVAS | 2.11 | 0.02 | no breaks | | | | | |
| | (0.000) | (0.2322) | | | | | | |
| LAR | 3.05 | 0.05 | no breaks | | | | | |
| | (0.000) | (0.0494) | | | | | | |

Notes:
Output from the estimation of the model selected by the sequential method at significance level 5%.
P-value in brackets.
In AST and EXT the model has been selected at significance level 10%.

**Table 6. BP procedure and long-term multipliers for the CPI inflation. Spain and regions.**

| | ao | bo | TB I | a1 | b1 | TB II | a3 | b3 | TB III | a3 | b3 | TB IV | a4 | b4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SP | 12.26 | 0.07 | 1986:IV | 5.46 | 0.01 | 1995:IV | 2.89 | 0.01 | | | | | | |
| | (0.000) | (0.000) | | (0.000) | (0.246) | | (0.000) | (0.017) | | | | | | |
| AND | 12.36 | 0.06 | 1986:IV | 5.28 | 0.01 | 1995:IV | 2.73 | 0.01 | | | | | | |
| | (0.000) | (0.000) | | (0.000) | (0.154) | | (0.000) | (0.033) | | | | | | |
| ARA | 11.90 | 0.06 | 1986:IV | 5.40 | 0.01 | 1995:III | 2.90 | 0.01 | | | | | | |
| | (0.000) | (0.000) | | (0.000) | (0.316) | | (0.000) | (0.006) | | | | | | |
| AST | 12.31 | 0.09 | 1986:IV | 5.51 | 0.01 | 1995:IV | 2.90 | 0.01 | | | | | | |
| | (0.000) | (0.000) | | (0.000) | (0.401) | | (0.000) | (0.068) | | | | | | |
| BAL | 12.16 | 0.06 | 1986:IV | 5.08 | 0.01 | 1995:IV | 2.99 | 0.01 | | | | | | |
| | (0.000) | (0.000) | | (0.000) | (0.338) | | (0.000) | (0.112) | | | | | | |
| CAN | 12.14 | 0.12 | 1986:IV | 5.23 | 0.02 | 1995:IV | 2.64 | 0.00 | 2003:I | 2.06 | 0.03 | | | |
| | (0.000) | (0.000) | | (0.000) | (0.041) | | (0.000) | (0.846) | | (0.000) | (0.011) | | | |
| CANT | 12.00 | 0.07 | 1986:IV | 4.97 | 0.00 | 1995:IV | 2.80 | 0.01 | | | | | | |
| | (0.000) | (0.000) | | (0.000) | (0.737) | | (0.000) | (0.056) | | | | | | |
| CYL | 12.04 | 0.07 | 1986:IV | 5.18 | 0.01 | 1995:IV | 2.78 | 0.01 | | | | | | |
| | (0.000) | (0.000) | | (0.000) | (0.385) | | (0.000) | (0.006) | | | | | | |
| CLM | 12.17 | 0.09 | 1986:IV | 5.20 | 0.01 | 1995:IV | 2.76 | 0.01 | | | | | | |
| | (0.000) | (0.000) | | (0.000) | (0.446) | | (0.000) | (0.004) | | | | | | |
| CAT | 12.31 | 0.05 | 1986:IV | 6.11 | 0.02 | 1994:IV | 3.27 | 0.01 | | | | | | |
| | (0.000) | (0.000) | | (0.000) | (0.036) | | (0.000) | (0.007) | | | | | | |
| CVAL | 12.43 | 0.07 | 1986:IV | 6.00 | 0.00 | 1992:IV | 3.19 | 0.01 | | | | | | |
| | (0.000) | (0.000) | | (0.000) | (0.912) | | (0.000) | (0.257) | | | | | | |
| EXT | 12.38 | 0.07 | 1986:IV | 5.04 | 0.00 | 1996:IV | 2.36 | 0.00 | 2002:III | 2.29 | 0.02 | | | |
| | (0.000) | (0.000) | | (0.000) | (0.995) | | (0.000) | (0.748) | | (0.000) | (0.007) | | | |
| GAL | 12.12 | 0.05 | 1986:IV | 5.56 | 0.01 | 1995:IV | 2.41 | 0.01 | 2000:III | 3.06 | 0.02 | | | |
| | (0.000) | (0.000) | | (0.000) | (0.494) | | (0.000) | (0.216) | | (0.000) | (0.048) | | | |
| MAD | 12.26 | 0.08 | 1986:IV | 5.66 | 0.00 | 1994:III | 2.92 | 0.01 | | | | | | |
| | (0.000) | (0.000) | | (0.000) | (0.793) | | (0.000) | (0.079) | | | | | | |
| MUR | 13.90 | 0.02 | 1984:III | 6.78 | 0.00 | 1992:II | 4.35 | 0.00 | 1996:IV | 3.13 | 0.01 | | | |
| | (0.000) | (0.047) | | (0.000) | (0.761) | | (0.000) | (0.896) | | (0.000) | (0.046) | | | |
| NAV | 11.89 | 0.07 | 1986:IV | 5.71 | 0.01 | 1996:I | 3.08 | 0.00 | 2002:III | 2.51 | 0.02 | | | |
| | (0.000) | (0.000) | | (0.000) | (0.255) | | (0.000) | (0.272) | | (0.000) | (0.001) | | | |
| PVAS | 12.47 | 0.04 | 1986:IV | 5.90 | 0.01 | 1991:II | 4.98 | 0.00 | 1995:IV | 3.12 | 0.00 | 2002:III | 2.71 | 0.02 |
| | (0.000) | (0.000) | | (0.000) | (0.433) | | (0.000) | (0.864) | | (0.000) | (0.509) | | (0.000) | (0.005) |
| LAR | 13.19 | 0.03 | 1985:II | 6.63 | 0.00 | 1991:I | 5.21 | 0.01 | 1995:IV | 3.24 | 0.01 | | | |
| | (0.000) | (0.003) | | (0.000) | (0.611) | | (0.000) | (0.759) | | (0.000) | (0.016) | | | |

Notes:
Output from the estimation of the model selected by the sequential method at significance level 5%.
P-value in brackets.

The long-term multipliers define a clear pattern characterised by three features. Firstly, when there is a significant impact of oil price shocks on inflation it is always positive, as supposed in the literature. Secondly, the oil price impact on CPI loses importance from more or less 1985 on, except in two regions; and thirdly, commencing in approximately 1995 it recovers some of its initial importance, that's to say, it is significant in less cases and the impact is smaller[22]. Specifically, in Spain and all its regions the impact is positive and is significant for the first period identified. In the second period only two positive and significant multipliers appear in CAN (which due to its particular condition as an island, the oil prices could have a deeper effect, through their effect on flight costs) and in CAT (probably more demanding of crude due to it being a highly industrialised region). In the third period (beginning in the first half of 1990s), nine positive and significant multipliers are found, but with a smaller impact than in the first period. These are the cases of AND, ARA, AST, CANT, CYL, CLM, CAT, MAD and Spain itself. Furthermore, in seven more regions, the ones that have more than two breaks, a significant positive impact also appears in their last periods and with a lesser magnitude than in the first one (CAN, EXT, GAL, MUR, NAV, PVAS and LAR). So, the only Spanish region that does not reflect the oil price influence in CPI inflation in recent years is CVAL, characterised by a scarce relevance of the industrial sector in its economy.

In the last part of the sample (from approximately 1995), the magnitude of the impact in almost all the regions is very similar to the one of Spain (0.01), except for three cases, where it is a bit higher: CAN –maybe explained by the deeper effects of an oil price shock due to its particular condition as an island-, EXT and GAL –two of the less efficient regions in economic terms- and PVAS and LAR –with an important industrial weight.

## 4. CONCLUSIONS

Spain continues to be strongly dependent on oil nowadays compared to other European countries. Although the results of a growing number of papers show that the impact of oil price shocks on macroeconomic variables in the main developed countries has decreased since the 1970s, we find evidence of a renewed impact in the last decade both on GDP and, more clearly, on inflation for Spain and its regions.

The use of the QP and the BP procedures allow us to determine the existence of a non-linear relationship between oil price shocks and the macroeconomic variables. Consequently, the impact of an oil price shock is not constant, there exists different periods and in some of those periods the oil prices even do not show any importance on the two macroeconomic variables considered. This lack of importance could be due to the combination of the stimulating effect and the adverse effect of strong global demand for industrial commodities and it could also have been sometimes explained by the softening effect of other factors such as the currency exchange rate The breaks obtained for Spain as a whole and for the NUTS-2 regions fit the historical economic record quite well. The influence of oil shocks has been estimated

[22] The renewed effect of oil prices on inflation could be related to the end of the possible influence of the government in setting fuel prices to control inflation through different regulations until 1998, as pointed out in Section 3.2.3.

though the use of long-term multipliers for the different periods identified and for each geographical unit and it is summed up in the following paragraphs.

Firstly, in Spain after the 1970s decade, as in documental evidence, the estimated response of oil price shocks to macroeconomic fluctuations decreases. However, in clear contrast to the previous literature, which maintains that the effects of oil price shocks have waned since the 1980s, in the last part of the 1990s for the GDP and, specially, in the 2000s for the inflation, the influence of oil shocks recovers some of its initial importance, albeit the impact is smaller than in the 1970s.

Secondly, in the Spanish regions the effect of oil price shocks on production and inflation losses importance progressively. However, for the latest variable, commencing in approximately 1995, the influence recovers some relevance as occurs in Spain, but here beginning about five years earlier.

Finally, the most outstanding result of our paper is that the oil price fluctuations could explain at least some of the recent inflation. We say “some” because the main difference between these outcomes and those obtained for the 1970s is the lower value of the multipliers found in the last decade.

The level of disaggregation appears to have some importance for the understanding of the economic behaviour when facing an oil shock, at least in the GDP of the most industrialised regions. However, once the geographical patterns are taken into account, a new line of research could make an in-depth study of the decomposition of the total Consumer Price Index into different items, which could help to better identify the transmission mechanisms of variation in oil prices and to evaluate the recent fluctuations. The combination of the geographical and sectoral disaggregation is important to face new oil price shocks with an adequate design of economic policies that consider the differential geographical behaviour of some regions and also the impact of particular items on the evolution of prices.

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