ECONOMIC GROWTH, INFLATION AND OIL SHOCKS: ARE THE 1970s COMING BACK?

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ABSTRACT

The aim of this paper is to analyse the relationship between oil price shocks and the macroeconomic evolution of the G7 countries. By way of the use of the very recent Qu and Perron (2007) methodology, we provide evidence in favour of a non-linear relationship across the 1970-2008 sample. Our results show that the response of output and inflation to oil price shocks becomes weaker from 1970 until the late 1990s. We further observe the impact of oil price shocks on inflation to recover some of its initial importance in the 2000s, whilst we cannot find robust evidence of an influence of oil price shocks on GDP. Nevertheless, the transmission of oil price shocks to the economy is weaker than in the 1970s, which allows us to conclude that oil price shocks have lost some of their explanatory power. Consequently, the causes of the slight rise of inflation in the G7 countries during the 2000s should be looked for in other factors.

Keywords: oil shocks, inflation, business fluctuations
JEL: E31, E32, Q43, C32

1. INTRODUCTION

Since the mid 1960s, oil has been the most important primary energy source all over the world. Almost all economic activities are based on crude oil, which supplies around 40% of the world's total energy needs. The price of a barrel of crude oil is considered to be a point of reference, affecting the other energy markets. Moreover, shocks in crude oil prices do not only affect energy markets. It is widely recognised that they have an effect on the rest of the economy, even being able to influence the inflation rate, affect stock-exchange prices and hinder economic growth.

Due to their possible incidence on the real economy, there is a great deal of empirical research that analyses the effects of energy supply variations on the economy[1]. Much of this literature has focused on the United States, although some authors have recently examined the international impacts of oil shocks, mainly for the G7 countries (see, for example Mork *et. al* (1994), Blanchard and Galí (2008) and Kilian (2008a)).

The previous literature shows that exogenous events in OPEC countries could have caused recessions in industrialized countries through their effect on oil prices during the 1970s, owing mainly to the close statistical relationship between those events and recessions in the United States. By contrast, this conclusion does not seem valid for the 1980s and 1990s, since several authors recently maintain that the impact of oil price shocks on the macroeconomic variables has decreased and almost vanished since the 1980s[2]. The explanations for this change may be found in factors such as the decrease

[1] This relation has been reported by Barsky and Kilian (2002, 2004), Bernanke *et. al* (1997), Blanchard and Galí (2008), Bohi (1989, 1991), Bruno and Sachs (1982), 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), Mork *et. al* (1994), Raymond and Rich (1997) and Shapiro and Watson (1988), amongst others.

[2] See Blanchard and Galí (2008), Kilian (2008a), Kapetanios and Tzavalis (2006) and De Gregorio *et. al* (2007) although the last one only considers the effects of oil on inflation.

of real wage rigidities that smoothes the trade-off between the stabilization of inflation and the stabilization of the output gap; the changes in monetary policy, adopting a commitment to a stable rate of inflation together with credibility gains; the decline of the oil share in the economy since the 1970s and today's higher energy efficiency that might decrease the effects of oil price variations; a reduction in the exchange rate pass-through and, finally, that the current oil price shocks are the result of the strong world demand[3].

This stream of literature, which is clearly related to what is known as "the Great Moderation", provides some evidence in favour of a diminishing of the importance of oil shocks on economies. However, the recent movements in oil prices have cast some doubts on this lack of importance of the shocks and reopened the debate about the influence of oil shocks on economies.

The main objective of this paper is to determine the influence of oil shocks on G7 economies (on inflation and economic growth) between 1970 and 2008, considering the presence of different periods. We apply the recent technique of Qu and Perron (2007) which is devoted to finding structural breaks and allows them to be endogeneously determined by all the model parameters. Systematically assessing the magnitude, the length and the differences and similarities in the response of the G7 economies to exogenous oil price shocks is important for us to understand the historical record. It is also crucial for the design of adequate policy measures to control or smoothen the effects of future energy shocks on an economy.

The paper is organized as follows. After this brief introduction, a literature review is presented in the next section. Section 3 explains the methodology of Qu and

[3] For more detail, see Blanchard and Galí (2008), Nakov and Pescatori (2007), Bernanke *et. al* (1997) and De Gregorio *et. al* (2007).

Perron (2007) and the tools needed to assess the long-term and dynamic impact of oil price shocks on macroeconomic variables. Section 4 contains the main results obtained from our estimates in terms of break points and the effects of exogenous oil shocks on each country's economic growth and CPI inflation rates since 1970. Section 5 reviews the most important conclusions that can be drawn from the paper.

2. G7 ECONOMIES AND OIL SHOCKS: A REVISION OF THE LITERATURE

One of the main aims in business cycle analyses is the characterization and explanation of the frequent fluctuations of real economic activity and their relationship with movements in other macroeconomic variables. A great deal of research has focused on the causes of business cycles and the identification of the shocks responsible for the fluctuations in *output*[4]. Other works have investigated the temporal breaks in business cycles and the usefulness of economic and financial variables to predict the transition in *output* between recession and expansion periods[5]. Changes in oil prices are one of the most commonly identified aggregated shocks. This is the origin of our interest in examining the relationship between oil prices and business cycle fluctuations.

On the theoretical side, some papers, such as Rotemberg and Woodford (1996) or Finn (2000), have tried to construct models to account for the effects of oil price shocks. Kilian (2006) proposes a model for the US that allows the identification of structural shocks underlying the real oil price (oil supply shocks driven by political events in OPEC countries, other oil supply shocks, shocks to the demand for industrial commodities and demand shocks specific to the oil market). More recently, other research covers the relationship between oil prices and the economy through DGSE

[4] For a review of these papers, see Cochrane (1994).
[5] See Boldin (1994).

models. Crucini *et. al* (2008) propose a dynamic factor model to examine the sources of international business cycles as well as the driving forces of these cycles across the G7 countries; Nakov and Pescatori (2007) develop a DSGE model with an oil-producing sector before and after 1984 for the US economy and Blanchard and Galí (2008) build a standard new-Keynesian model with two modifications to introduce oil as an input in production and allow for real wage rigidities, also for the US[6]. Another modelization, proposed by De Gregorio *et. al* (2007), estimates the effect of oil prices on the general price level through a traditional Phillips curve augmented to include oil.

On the empirical side, much of the literature has focused on the US. Hamilton (1983, 1996) argues that most US recessions were preceded by increases in oil prices. Bernanke *et. al* (1997) study the effects of systematic monetary policy on the economy selecting a set of macroeconomic shocks to which policy is likely to respond and focusing primarily on oil price shocks. More recently, Baumeister and Peersman (2008) investigate how the dynamic effects of oil supply shocks on the US economy have changed over time and whether global oil supply shocks can be considered as an important source of economic fluctuation. Kilian (2008b) focuses on the influence of oil production shortfalls on the US GDP and inflation. Additionally, Clements and Krolzig (2002) adopt a different view and consider whether oil prices can account for US business cycle asymmetries.

Another group of papers more closely related to our research focus on the evaluation of the relationship between oil price shocks and inflation and output since the 1970s. For example, Jiménez-Rodríguez and Sánchez (2005) assesses the effects of oil price shocks on the economic activity of the eight main industrialised countries although they do not identify different periods. More recently, Kilian (2008a) studies

[6] Previously, Barsky and Kilian (2002) proposed a dynamic model for the US economy considering three equations: aggregate price-setting, money demand and policy reaction function.

the differences as well as the similarities in the response of the G7 economies to exogenously identified oil supply shocks. Finally, Blanchard and Galí (2008) look for the components of macroeconomic fluctuations that are most associated with exogenous changes in oil prices for the G7 countries (except Canada)[7]. The main finding of these papers is a vanishing effect of oil price shocks in the most important economies since 1980.

All the preceding papers come to the conclusion that oil price shocks affect the international economies. However, the degree of this influence does not seem to be clear and, even more important, neither do the possible changes of the reactions of these economies to oil prices over time. The aim of the following sections is to explore the possible existence of structural breaks in the relationship between oil price shocks and the G7 economies.

3. STRUCTURAL BREAKS IN MULTIVARIATE REGRESSIONS

This section is devoted to presenting the method for detecting the presence of breaks in the relationship between G7 macroeconomic variables and oil shocks. As has been mentioned earlier, this paper uses the Qu and Perron (2007) methodology for this purpose. The information obtained from the application of this method is subsequently employed to estimate the influence of oils shocks on G7 economies. In order to measure this effect, two different tools will be considered: the long-term multipliers, which enable us to check the magnitude and significance of the shocks over the periods

[7] Less directly linked, De Gregorio *et. al* also compute IR analysis and rolling bivariate functions to check the pass-through of oil prices to inflation. Kilian *et. al* (2007) focus on 115 countries, but to explain the effects of demand and supply shocks in the global crude oil market on several measures of the countries' external balance.

considered, and the dynamic multipliers, which allow us to examine the length and the graphic profile of the impacts. In what follows, all these concepts are discussed.

3.1. Detection of structural breaks

The Qu and Perron (2007) methodology has been designed to estimate and test for multiple structural changes that occur at unknown dates in a system of equations. A great advantage of this recent procedure is that changes may occur in the parameters of the conditional mean, the covariance matrix of the errors, or both jointly, and the distribution of the regressors is also allowed to change across regimes. The general model considered by these authors is as follows:

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

There are n equations and T observations, the vector y_t contains the endogenous variables from all the equations, thus $y_t = \left(y_{1t},...y_{nt}\right)$, z_t is the set which includes the regressors from all the equations $z_t = \left(z_{1t},...,z_{qt}\right)^{'}$ and the parameter q is the number of regressors. The selection matrix S is of dimension $n \times q$ with full column rank. This selection matrix involves elements that take the values 0 and 1 and, thus, indicate 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 $\mathrm{T} = \left(T_1,...,T_m\right)$, 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 associated. Furthermore, u_t has mean 0 and covariance matrix $\sum_j$ for $T_{j-1} + 1 \le t \le T_j$.

When using a VAR model, we further have $z_t = \left(y_{t-1},...,y_{t-q}\right)'$, which simply contains the lagged dependent variables and the deterministic terms, and S, which is an identity matrix.

This general framework must be adapted to the present case. In order to analyse the relationship between oil shocks and some macroeconomic variables, the use of a VAR seems to be appropriate. More precisely, this paper poses a bivariate VAR with two endogenous variables (GDP and CPI inflation) and an exogenous variable (OILP)[8]. Hence, the model is composed of the two following equations:

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

and

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

To decide on the number of lags, parameter k, we have computed various criteria: the sequential modified LR test statistic, final prediction error, Akaike information criterion (AIC), Schwarz information criterion (SBIC) and Hannan-Quinn information criterion (HQ). In accordance with the sample size and the significance of the different tests for the full period and for each individual subperiod in each of the seven countries, we have chosen to impose 1 lag. Consequently, z_t is defined as $\left(1, \Delta GDP_{t-1}, CPI_{t-1}, OILP_t, OILP_{t-1}\right)$ and $S = I_{10}$.

Several testing procedures have been considered to determine the number of breaks in the system and jointly test changes in the coefficients and in the covariance matrix. First, we use the $UDmaLR_T(M)$ and $WD\max LR_T(M)$ double maximum tests to

[8] The exogeneity of the oil price variable has been established through a standard Granger causality test.

see if at least one break is present[9]. Then, if the test rejects this hypothesis, we consider a $SEQ_T(l+1|l)$ sequential procedure obtained from a global maximization of the likelihood function and based on a test of l versus $l+1$ changes and which tests for no change versus some unknown number up to some upper bound we impose.

The number of breaks has been selected following critical values derived from response surface regressions. In all the countries but Italy, the tests offer evidence in favour of the presence of 3 breaks. However, in the case of Italy, given the location of the breaks from the global optimization with 2 breaks, there was no more place to insert an additional break that satisfies the minimal length requirement.

3.2. Multipliers

If the k=1 restriction is imposed, the VAR system composed 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

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

From this system, the usual impulse response functions for both GDP and CPI inflation can be directly obtained. Nevertheless, given that it is necessary to estimate the expected response of macroeconomic aggregates to exogenous oil price shocks, long-run multipliers and dynamic multipliers have been computed.

In a general case, and by using lag-polinomials, we obtain our long-run multipliers (LM_i) in the following form:

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

[9] Qu and Perron (2007).

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

Then,

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

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

For the present model, equations (4) and (5) lead the long-run multipliers to be defined as follows:

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

$$\frac{\gamma_{20} + \gamma_{21}}{1 - \delta_{21}} = LM_2 \text{ for CPI inflation} \tag{9}$$

Alternatively, it is possible to use the dynamic multipliers, which can be obtained as described below:

$$\frac{\gamma_{10} + \gamma_{11}}{1 - \beta_{11}} = d_{10} + d_{11}L + d_{12}L^2 + d_{13}L^3 + ... \tag{10}$$

$$\frac{\gamma_{20} + \gamma_{21}}{1 - \delta_{21}} = d_{20} + d_{21}L + d_{22}L^2 + d_{23}L^3 + ... \tag{11}$$

Through some algebra, the next two expressions are obtained:

$$d_{1i} = \beta_{11}^{i-1}\gamma_{11} + \beta_{11}^{i}\gamma_{10} \tag{12}$$

$$d_{2i} = \delta_{21}^{i-1}\gamma_{21} + \delta_{21}^{i}\gamma_{20} \tag{13}$$

It should be noted that,

$$\sum_{i=0}^{\infty} d_{1i} = LM_1 \text{ and } \sum_{i=0}^{\infty} d_{2i} = LM_2$$

In addition, we test the significance of each set of multipliers. For the long-run multipliers (LM_1 and LM_2) we check it through a linear *F* test, with the null hypothesis stated as:

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

or

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

Moreover, confidence intervals at 5% level have also been constructed by using standard bootstrap techniques for both the long run multipliers (LM_1 and LM_2) and the dynamic multipliers (d_{1i} and d_{2i}).

4. RESULTS

To see the evolution of the price of oil since 1970, we use *the Producer Price Index for crude petroleum* and, from the monthly series, we construct a quarterly data set[10]. We should also be aware of the existence of the discussion in the literature related to the use of the real or the nominal oil price. Following the view of Hamilton (2008), this paper uses the nominal oil price because the statistical exogeneity of the right-hand variables is important for interpreting the regression. The oil price is not converted into domestic currency for non-US countries for the same reason.

To estimate the effects of oil price on economic behaviour, we use GDP data to measure production and CPI inflation to identify price evolution. Both are quarterly (measured quarter-to-quarter and expressed in annualized terms) and extracted from the

[10] Several calculations have been performed using the price of West Texas Intermediate crude; nevertheless, the timing of the breaks does not fit the business cycle as well.

OECD's Economic Outlook database[11]. Our data set runs from 1970:I to 2008:IV and, thus, includes recent exogenous oil price shocks (the pronounced increases of 2000 and 2007 which were followed by sharp declines), not considered by some previous studies which may be related to production and inflation. This wider span also allows us to analyse the end of one business cycle and explore the first steps of a new one, characterised by a deep economic world crisis.

The main results obtained from the application of the Qu-Perron methodology are reported in Table 1. First, the timing of the shocks and the different business cycles are presented and, secondly, the impact of the oil price movements (long term and dynamic multipliers) on the variables considered is commented.

4.1 Location of breaks

The results obtained allow the identification of four different periods in the relationship between oil price shocks and the G7 macroeconomic variables. The first interval covers the period between 1970 and the beginning of the 1980s (1980-1983). This period was characterised by the end of the long-lasting oil crisis. Two historical facts help to explain what happened during this period: first, the Arab-Israel war in 1973 which followed the long lasting Arab-Israeli conflict; and, second, the Iran revolution in 1978-79. During this period the economic growth of the seven countries considered was, in general, the highest of the four periods in average, except in the UK and the US, and inflation rates also attained their peak values, reaching two digits figures (Table 2).

The second period starts in the early 80s and ends in the late 80s-early 90s (1987-1992). The final data of the period is characterised by a slight recession that took place in 1989 in the US and a bit later (1992-1993) in the EU. The economic growth rates decreased slowly compared to the first period but the decline of inflation rates was

[11] In the case of the UK, the CPI data have been extracted from the OECD's Main Economic Indicators.

greater. Moreover, there were small oil price peaks, due to the long Iran-Iraq war (1980-88), which followed the Iran revolution, and the Persian Gulf war (1990-91).

The third period runs from around 1990 to a different date for each country between 1995 and 2001[12]. In fact, in the years 2000-01 there was an almost worldwide minor downturn, which, in the US, was lasted a little longer due to the 9/11 terrorist attack but, in spite of this, the US economy reached its maximum mean growth in any of the periods. CPI inflation was lower than in the first two periods and relatively stable. During this period there were no particular events related to oil price peaks and the behaviour of the series is quite flat, characterised, in general, by low crude prices with small rises and drops.

Finally, the last cycle ends in 2008 -when the international economy scenario is characterised by a major downturn in spite of the governments' policy measures to mitigate the adverse consequences of financial turmoil and when inflation rates began to diminish-, concluding a favourable cycle in terms of economic growth. In particular, during the last decade, there have been large movements (increases as well as decreases) in oil prices. At the beginning of 1999, some oil price rises took place and reached their maximum in 2000, coinciding with a time when the growth rate of the economy and world trade were particularly high (in Europe, the depreciation of the Euro had also helped). The civil unrest in Venezuela possibly influenced the oil shocks in 2002-2003, whilst the Iraq war, the Nigerian civil war and hurricane disasters in the Gulf of Mexico also had an effect on oil price movements in 2003. In 2005, the world economy was characterised by high rates of growth and low inflation levels, despite the sharp rise of crude prices as a consequence of the surging demand from the most

[12] In most countries, this period finalises at the beginning of the century, but in Italy it ends in 1995. The reason is that it has only three identified periods which do not exactly coincide with the ones of the other six countries.

dynamic economies (China, India and the US) and the low level of excess oil production. Then, in 2007, there was weak economic growth, inflationary tensions and financial instabilities; the crude oil (as well as raw materials and food) prices continued to rise (due to the strong demand from emerging countries and also due to speculation). In 2008, these prices began to fall[13]. During the whole of this period, movements in oil prices were greater in nominal terms and more persistent than in the first period, although they were below those of the first period in real terms.

The case of Italy is a bit different. The methodology offers evidence in favour of the existence of just two breaks, located in 1983:03 and 1995:04, which gives us three different periods to be studied. The first Italian period ends at a similar date to the one corresponding to the other six countries, while the second Italian period is longer than in the other countries, ending in the mid-90s (this date is similar to the finishing date of the third period in Canada). This also means that the final period is a bit longer, from 1995:04 to the end of 2008. Following Rossi and Toniolo (1996), the end of the first Italian stage can be easily identified: GDP average annual growth was higher until the early 1980s than from them on, the capacity utilization began to fall and the profit margins ended an upward trend in the early 1980s when rising real interest rates led to an unprecedented fall. Furthermore, with respect to prices, after the second oil shock, the commitment to exchange rate stability provided an anchor for inflation but, when an anti-inflationary policy stance was finally adopted, this resulted in slower growth (during 1980-3) than in most industrial countries. These authors characterise the singularity of our second Italian phase (which they call the "splendid eighties") by an increase in the GDP growth rate and private consumption, a fall in inflation, political

[13] In this very recent period, speculation may have affected oil price swings even more than supply and demand changes. Oil is traded in the commodities futures market and it is held by speculative companies that consider it a shelter destiny in order to face the crisis. This futures market may not only have been responsible for the 2007 rises but also for the drastic drop in the price of oil during 2008, when it fell even more precipitously than it rose.

stability and effective government, even though the unemployment was still high. Moreover, monetary policy succeeded in getting price increases back to a single-digit only from 1984-5 on. The third stage for Italy begins earlier than for the other countries. As these authors point out, the reasons may be that the later ending of the post-war than in the rest of Europe and the shift in 1992 of the electorate away from the traditional parties.

4.2. Effects of oil price shocks on macroeconomic variables

Once the different periods have been established, the effect of oil price shocks on the economies is calculated. We show the evidence on the responses of inflation and output to oil shocks -in terms of sign, magnitude and significance-, using long term multipliers (see Table 3). After this valuation, we check the length and profile over time of the responses considering dynamic multipliers.

In the first period (from the early 1970s until 1980/83), the GDP multipliers exhibit negative values for all the seven countries as expected in the economic literature. These multipliers are not very high, although they are significant for three countries (Germany, Japan and the UK). The CPI multipliers are positive for six of the seven countries considered, but significant for the US, Canada, France, the UK and Italy. The result for the UK inflation should be highlighted because the CPI prices seem to overreact to the impact of the oil prices, obtaining a huge multiplier of 1.28[14]. The exception in sign for the CPI multiplier is the case of Japan, where a negative multiplier

[14] This could be related to the strong growth of UK oil production and exports together with the decrease of imports during this period. In fact, the North Sea region began its production in 1975 and UK became a net exporter of oil in 1981, ending in 1984 when the increasing demand for oil made imports increase.

is found, but it is well known that the history of this country does not usually fulfil the standard premises[15].

For the second identified period (1980/83 to 1987/92), we broadly obtain positive GDP multipliers, but the relationship between oil prices and output seems to be weaker than in the preceding period. In fact, these multipliers are only significant and positive, but very small, for Canada and Germany. The results of the CPI inflation multipliers show that all are positive but only in US and Japan are significant and, furthermore, with a very reduced impact when compared to the first period studied.

In the third period (from 1987/92 to 1995/2001), significant GDP multipliers in two countries are identified: Canada and Germany. For the latter country, the impact is positive and very low and, for Canada, while the multiplier is negative, as expected, the value is unusually high (-0.29). In the case of prices, three significant CPI multipliers are found and all of them are positive as expected. These are the cases of Canada, Germany and Italy. The value of the last two multipliers is small. However, in Canada, the value is similar to the one obtained in the first stage of the sample[16].

The evidence for the three periods shows that the estimated response of output and prices becomes weaker (smaller impact and less significant cases over time, with the response even being positive for some countries in the last two periods). Thus, the evidence presented in this paper until this point suggests a vanishing impact of oil price movements on macroeconomic variables[17].

Finally, for the fourth period (1995/2001 until the end of 2008), which includes the most recent economic developments and the sharp movements of oil prices, four

[15] Unexpected results for the Japanese economy are also found in Jiménez-Rodríguez and Sánchez (2005) and Blanchard and Galí (2008).
[16] Indeed, a simple graphical analysis of the Canadian series shows the asynchronous movements of these variables (see Figure 1).
[17] A similar result was obtained by Blanchard and Galí (2008) and Kilian (2008a).

significant GDP multipliers are found, for France, Japan, the UK and Italy. All are positive except in the UK and they all present a negligible value. This result supports the general idea of a decreasing impact of oil prices over time, although they recover some importance to explain the output behaviour in the fourth period. However, the most outstanding results are those related to the CPI multipliers, which are broadly significant and always positive. This result shows that at least some of the recent inflation could be explained, as in the first subsample, by the oil price swings since their impact becomes significant again in this period. The main difference between these results and those obtained for the 1970s is the lower value of the multipliers found in the 2000s. The similarity in the means of oil price changes in the first and the fourth periods[18], with an even stronger variability in the latter (the maximum and the minimum values differ by at least 140 points in the 2000s and by almost 80 in the 1970s), could partially explain this outcome.

In spite of this fact, it is clear that the causes of higher inflation[19] (and even more of GDP) should be looked for in origins other than the oil shocks, due to the very small impact of oil prices on the macroeconomic variables when it is significant.

So far, we have analyzed the magnitude of the macroeconomic effects of oil price shocks and their change over the four periods considered. The estimates of each period point to greater effects of oil price shocks on economic activity and inflation in the first period that slightly reappear in the last period and mainly for inflation. The exceptions are the high magnitude of the effects on Canada's GDP and CPI in the third period, the UK's CPI in the first and the unexpected sign of Japan's CPI in the first. In a second stage, we assess the timing of the responses of the transmission of oil price

[18] See Table 2.
[19] There is a direct mechanism through which the oil component affects the CPI (modifying the cost of the shopping basket) and there are also indirect effects to both CPI and GDP.

shocks on GDP and CPI inflation (see Figure 2) through the examination of dynamic multipliers. We only comment on the figures where significant results were found in terms of long-term multipliers. In general terms, and for both production and inflation, the key impact occurs in the first two quarters after the shock.

For the US economy, the effect of oil price on CPI inflation is slight and positive initially in periods one, two and four (stronger in the first) and begins to vanish after two quarters and completely disappears after three years for the second and the fourth periods, while it lasts more than five years for the first.

In Canada, the smooth and positive impact of oil on GDP in the second period only takes a year to disappear completely whilst the negative and strong effect in the third interval takes a very long time to vanish. Furthermore, the confidence intervals are unusually wide, so the decreasing effects of the impact are very long-lasting. The responses of inflation in the first and third stages show a similar profile, with the peak reached at the second quarter and then disappearing after about three years. In the case of the fourth period, the greatest impact on prices is at the moment of the shock and completely vanishes after only a year.

French GDP responses to oil prices differ in the third and fourth periods. In the third, the move causes a decrease that tends to last a wide range of years with wide confidence bands, while the small positive effect in the fourth completely disappears after eight quarters. The CPI responses are significant in the first and the fourth periods, and both completely vanish after four years but, in the first period, the decreasing profile diminishes smoothly.

For Germany, the dynamic multipliers of oil prices to GDP in periods one and three show contrary initial responses (negative in the first case and slightly positive in the third) but the impact of both disappears after ten quarters.

In Japan, the impact of the oil prices on the GDP is negative in the first period, reaches its peak in quarter two and then almost completely disappears. The dynamic multipliers of CPI inflation show different paths in the first, second and fourth periods. The most similar profiles are found in the first and the fourth periods. The most pronounced impacts are reached after two quarters, but they take many years to completely disappear, both have very big confidence intervals but, in the first case, they even increase over time. In the second period, the CPI response decreases smoothly over time, vanishing after four years.

The dynamic multiplier of oil prices to GDP for the UK is small and only has an initial effect in the first period. In the case of period four, where it is also very slight, it takes many years to completely disappear. The very positive CPI response in the first period reaches its peak in the second quarter and takes a long time to completely vanish. The same case, in terms of timing, occurs in the fourth period, while the effect decreases gradually from the beginning.

Finally, in the Italian economy, the response of CPI inflation is only significant in phases two and three and, in both, it shows a very similar profile, with the highest impact at the time of the shock, which begins to disappear after three years in period three but it takes longer in the second period with broader confidence bands.

Though the timing paths differ substantially across countries and variables, the results for the dynamic multipliers broadly confirm the peculiarity of oil price transmission not only in the 1970s but also in the 2000s.

5. FINAL REMARKS

This paper estimates the impact of oil prices on the economic activity and prices of G7 countries. The use of the recent Qu-Perron methodology allows us to offer evidence of a non-linear relationship between oil price shocks and the G7 economies. More precisely, we identify the existence of four differentiated periods for the sample used, which covers the period 1970-2008. This initial outcome is quite important in the sense that previous literature has found a change in the reaction of the economies to changes in the oil shocks, although neither the existence of these breaks nor their location had previously been verified by way of statistical methods, at least with such powerful tools as the Qu-Perron methodology.

Once the existence of the breaks has been proved, the influence of oil price shocks has been estimated for the different periods considered. Another interesting result that has been obtained is that, whereas the evidence of a temporary reduction in oil price impact on GDP and CPI is consistent across all seven countries until the late 1990s, from then on, the impact on inflation (and, to a lesser extent, on GDP) is less clear-cut. The results suggest that the response of output and prices becomes weaker from 1970 (when it reaches its greatest responses) until the late 1990s. This confirms the results previously obtained in the literature while, in clear contrast to the previous research, in the last period (that mainly covers the 2000s) the impact of oil prices on the macroeconomic variables recovers some of its initial importance. Notwithstanding, the impact is smaller than in the 1970s. Moreover, the examination of dynamic multipliers show that the main impact of oil prices, on both production and inflation, occurs in the first two quarters after the shock, but the timing paths are very different across countries.

The significant effects of oil prices on CPI inflation and GDP coincide with the biggest changes in oil prices in real terms during the 1970s (the first phase of our

sample). These significant effects appear again in the first years of the twenty-first century (the fourth period of our sample) when the peaks and the troughs in the oil prices were very common and persistent but of lower magnitude (in real terms) than in the first period. The size of the impact could be considered almost negligible (although significant) in the last period of our sample, although it allows us to confirm that the recent strong variability of oil prices has transmitted a minimum effect mainly to prices. One explanation could be that the oil price shocks in each phase are simultaneous with large shocks of another nature.

Our results could open a line of future research focused on the identification of the possible causes of this renewed effect of oil prices (at least on inflation) that the previous literature is not able to cover because it explains the progressively vanishing effects of oil prices on the economy instead of the revival of their impact. Nevertheless, we should keep in mind that, on the basis of these results, the origin of higher inflation (and, undoubtedly, of GDP) for the main economies should be looked for in sources other than oil price swings because, when the effect of oil prices is significant, it only explains a small part of the increase in prices.

An adequate and precise characterization of the features studied in this paper (magnitude, length and differences in the response of G7 growth and prices to oil price shocks) is crucial for the implementation of policy measures to control the effects of future oil price shifts.

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APPENDIX

Table 1. Analysis of structural breaks (Qu and Perron methodology)

	Wdmax	Sequential test (l+1/l)		Number of breaks
		l=1	l=2	
US	126.732***	32.634*	46.853***	3
CANADA	89.843***	44.991***	43.294***	3
FRANCE	139.490***	48.133***	35.896**	3
GERMANY	52.133***	49.834***	29.109	3
JAPAN	188.207***	41.043***	27.185	3
UK	242.066***	63.006***	63.448***	3
ITALY	230.464***	55.392***		2

Notes:

(1) M=3 for every country except Italy, for which the sequential test shows there is no place to insert any additional break that satisfies the minimal length requirement. (2) Trimming=0.200. (3) T= 151.000. (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%.

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

	PERIOD 1				PERIOD 2				PERIOD 3				PERIOD 4		
	mean	max. change	min. change	TB I	mean	max. change	min. change	TB II	mean	max. change	min. change	TB III	mean	max. change	min. change
GDP growth															
US	2.87	7.72	-2.71	1983:04	3.52	8.49	-1.00	1991:03	3.59	4.79	1.09	1999:04	2.43	4.85	0.13
CANADA	4.06	8.40	0.66	1981:02	3.16	6.55	-3.71	1988:04	1.60	5.43	-3.37	1996:02	3.14	5.93	-0.51
FRANCE	3.48	5.74	-1.32	1980:02	1.77	3.52	-0.40	1987:04	2.09	4.88	-1.05	1998:01	2.17	4.66	-0.08
GERMANY	2.99	7.08	-2.33	1980:03	2.50	6.78	-1.31	1992:04	1.74	4.71	-1.95	2000:04	1.25	4.14	-0.53
JAPAN	4.43	10.23	-2.07	1981:01	3.86	7.17	0.99	1992:01	0.83	3.65	-2.65	1999:03	1.56	3.96	-1.84
UK	1.70	9.99	-4.11	1982:01	2.75	5.98	-2.17	1991:04	2.91	4.83	-0.47	2000:01	2.48	4.53	-0.75
ITALY	2.98	9.85	-3.68	1983:03					2.39	4.69	-1.46	1995:04	1.29	4.12	-0.86
CPI inflation															
US	7.56	14.42	2.52	1983:04	4.03	6.28	1.35	1991:03	2.57	3.23	1.48	1999:04	2.95	5.27	1.23
CANADA	8.27	12.52	1.32	1981:02	5.84	12.70	3.62	1988:04	2.91	6.44	-0.04	1996:02	2.10	4.48	0.77
FRANCE	9.47	15.01	4.85	1980:02	8.13	14.11	2.10	1987:04	2.34	3.62	0.71	1998:01	1.71	3.30	0.27
GERMANY	5.08	7.48	2.49	1980:03	2.96	7.12	-0.92	1992:04	1.90	4.61	0.26	2000:04	1.77	3.07	0.83
JAPAN	9.07	23.47	3.08	1981:01	2.05	4.71	-0.98	1992:01	0.76	2.24	-0.53	1999:03	-0.17	1.96	-1.40
UK	13.58	26.57	6.18	1982:01	5.42	9.35	2.62	1991:04	2.28	7.00	0.80	2000:01	1.84	4.81	0.61
ITALY	14.53	24.69	4.70	1983:03					6.29	12.74	3.82	1995:04	2.44	5.18	1.39
OIL PRICES															
US	17.45	74.90	-13.80	1983:04	0.64	68.34	-54.09	1991:03	0.09	111.28	-42.86	1999:04	26.88	170.46	-43.26
CANADA	21.39	74.90	-1.28	1981:02	-5.70	54.45	-54.09	1988:04	4.38	68.34	-37.07	1996:02	20.78	170.46	-43.26
FRANCE	18.77	74.90	-1.28	1980:02	2.64	54.45	-54.09	1987:04	1.69	68.34	-37.07	1998:01	24.09	170.46	-43.26
GERMANY	19.40	74.90	-1.28	1980:03	2.27	68.34	-54.09	1992:04	12.33	170.46	-42.86	2000:04	19.85	100.23	-43.26
JAPAN	20.59	74.90	-1.28	1981:01	0.48	68.34	-54.09	1992:01	-2.30	72.43	-42.86	1999:03	29.16	170.46	-43.26
UK	21.48	74.90	-3.68	1982:01	-1.96	68.34	-54.09	1991:04	6.38	170.46	-42.86	2000:01	22.78	100.23	-43.26
ITALY	17.94	74.90	-13.80	1983:03					-1.62	68.34	-54.09	1995:04	20.43	170.46	-43.26

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

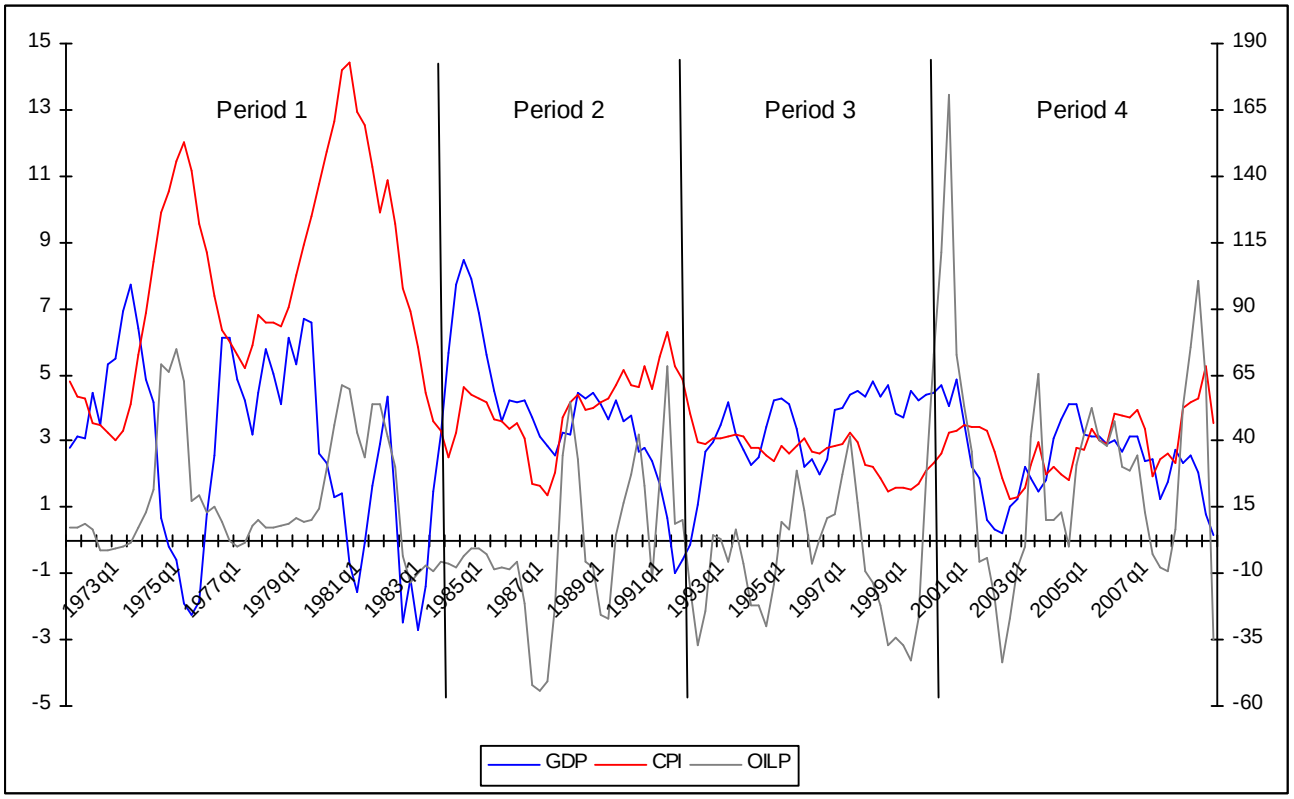
Table 3. Long term multipliers on GDP and CPI inflation (1970:01-2008:04)

	M_{GDP}	M_{CPI}	TB I	M_{GDP}	M_{CPI}	TB II	M_{GDP}	M_{CPI}	TB III	M_{GDP}	M_{CPI}
US	-0.01	0.33***	1983:04	0.07	0.05***	1991:03	0.00	0.02	1999:04	0.02	0.04***
	(-0.11,0.09)	(0.10,0.91)		(-0.04,0.26)	(0.02,0.09)		(-0.02,0.02)	(-0.04,0.09)		(-0.01,0.06)	(0.02, 0.08)
CANADA	-0.03	0.11***	1981:02	0.07***	0.34	1988:04	-0.29***	0.17***	1996:02	0.01	0.02**
	(-0.07,0.01)	(0.06,0.16)		(0.03,0.10)	(-1.90,1.95)		(-0.99,-0.06)	(0.09,0.27)		(-0.05,0.06)	(0.01,0.03)
FRANCE	-0.01	0.21***	1980:02	0.05*	0.04	1987:04	-0.35***	0.00	1998:01	0.02***	0.04**
	(-0.05,0.04)	(0.13,0.37)		(-0.01,0.09)	(-0.13,0.25)		(-1.13,0.62)	(-0.14,0.17)		(0.01,0.03)	(0.01,0.08)
GERMANY	-0.09***	0.01	1980:03	0.05*	0.15*	1992:04	0.02**	0.04*	2000:04	0.03	0.01
	(-0.14,-0.03)	(-0.12,0.13)		(0.00,0.11)	(-0.14,0.49)		(0.01,0.04)	(0.00,0.13)		(-0.04,0.12)	(-0.00,0.02)
JAPAN	-0.09***	-0.62***	1981:01	0.04	0.06***	1992:01	0.03	-0.01	1999:03	0.03*	0.05**
	(-0.15,-0.03)	(-5.82,4.67)		(-0.01,0.08)	(0.02,0.10)		(-0.01,0.08)	(-0.05,0.03)		(0.00,0.06)	(-0.01,0.19)
UK	-0.09***	1.28***	1982:01	-0.01	0.02	1991:04	0.00	0.00	2000:01	-0.05**	0.09***
	(-0.13,-0.04)	(0.09,3.95)		(-0.07,0.03)	(-0.01,0.04)		(-0.01,0.01)	(-0.01,0.01)		(-0.12,-0)	(0.01,0.26)
ITALY	-0.09	0.16	1983:03				-0.05	0.09***	1995:04	0.02*	0.02***
	(-0.25,0.04)	(0.00,0.32)					(-0.16,0.02)	(0.04,0.15)		(0.00,0.05)	(0.01,0.03)

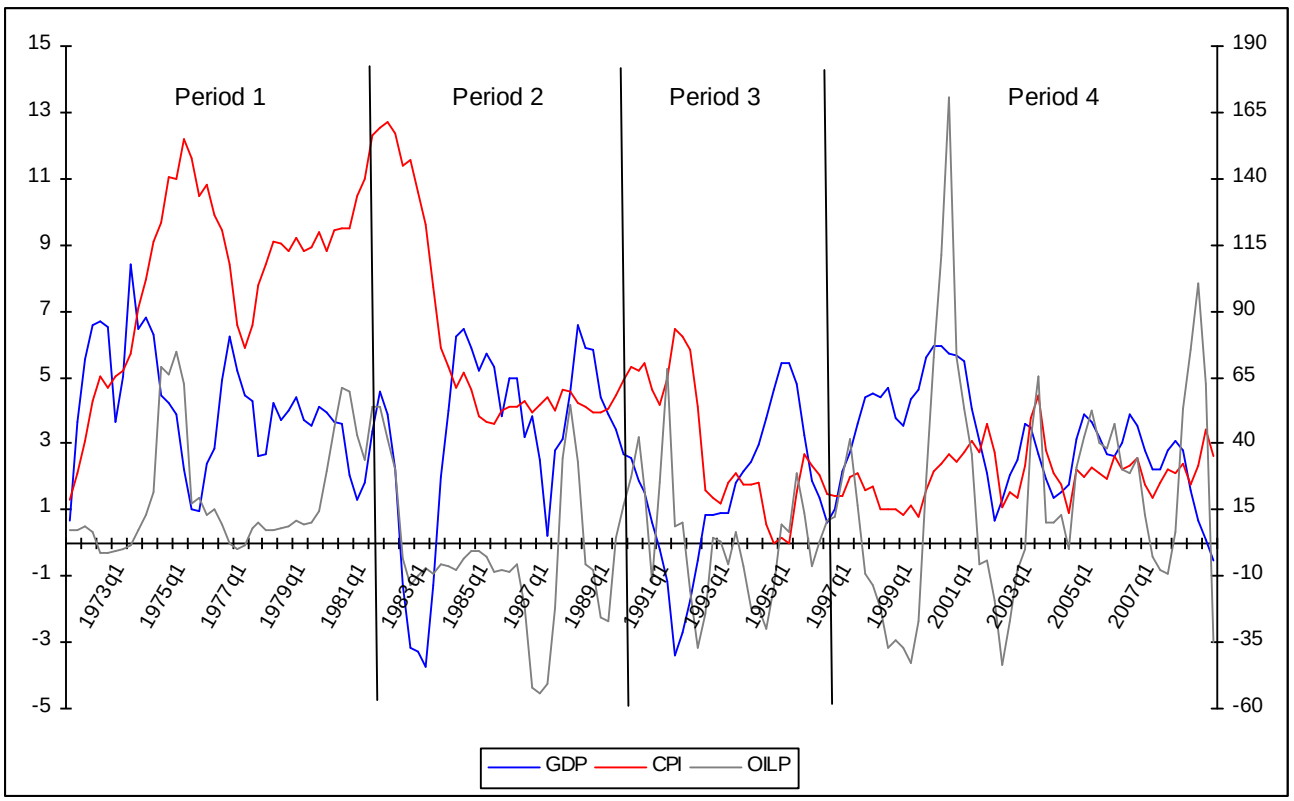
Data obtained from the Economic Outlook, 84 (OECD), UK and Spanish CPI from the MEI (OECD)
TB means time of break.
For a linear F test: * significant at 10%; ** significant at 5%; *** significant at 1%.
In brackets, confidence intervals obtained from a bootstrap technique with the significance level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

Figure 1. Evolution of GDP, CPI inflation and OIL prices (1970:01-2008:04)

US



CANADA



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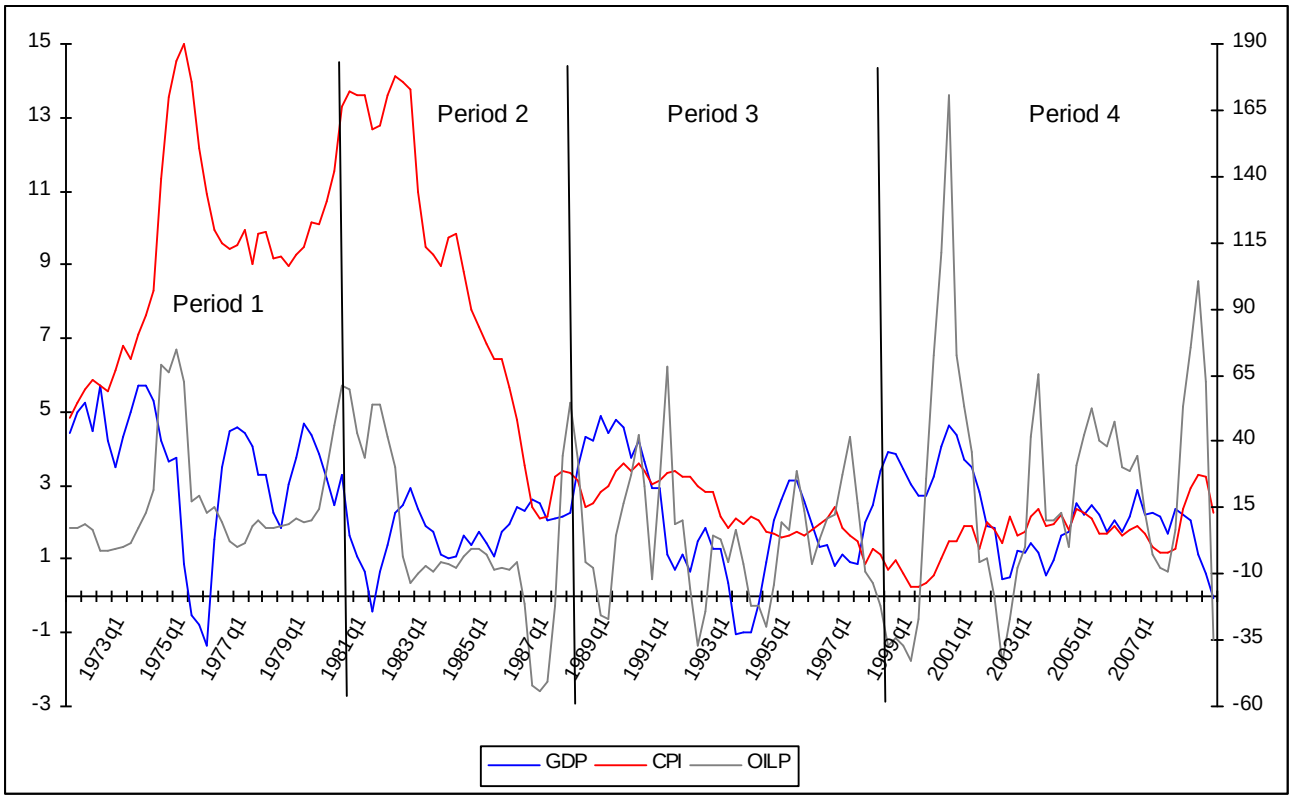

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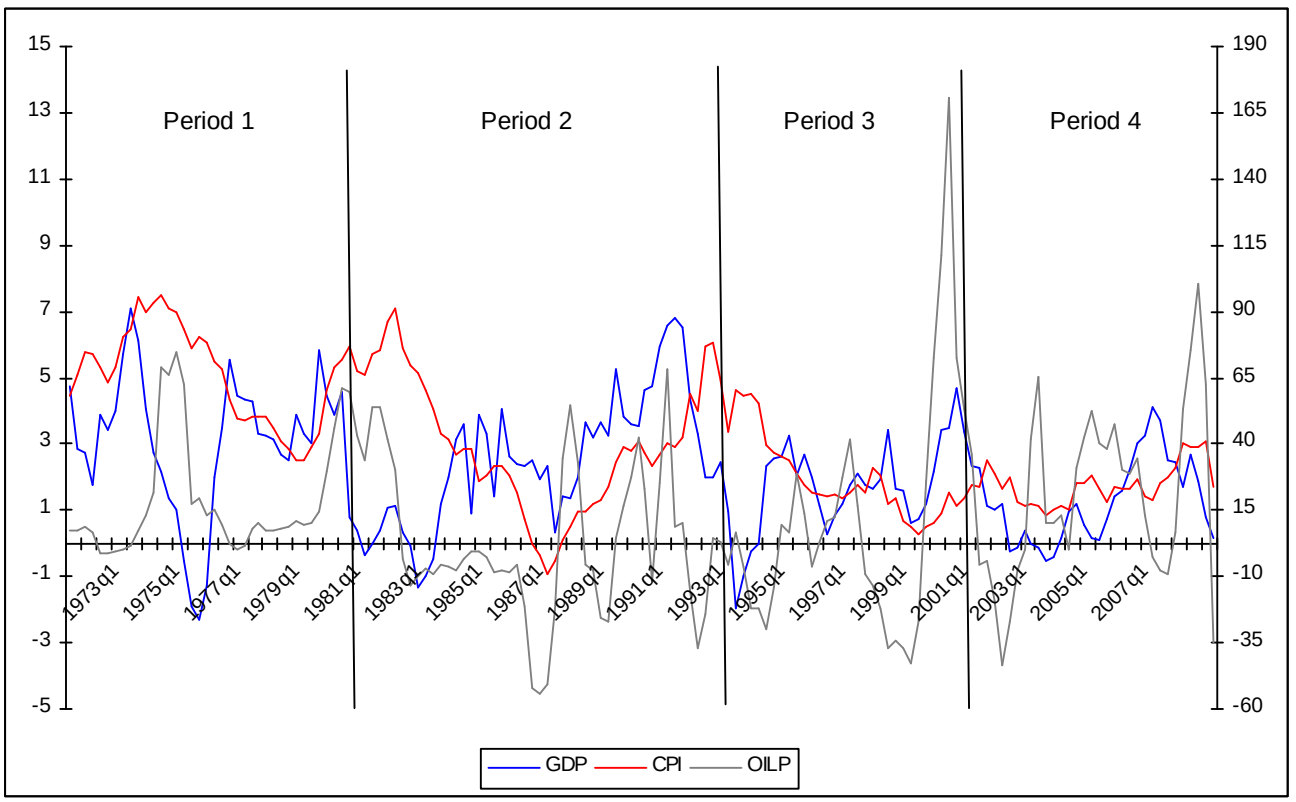

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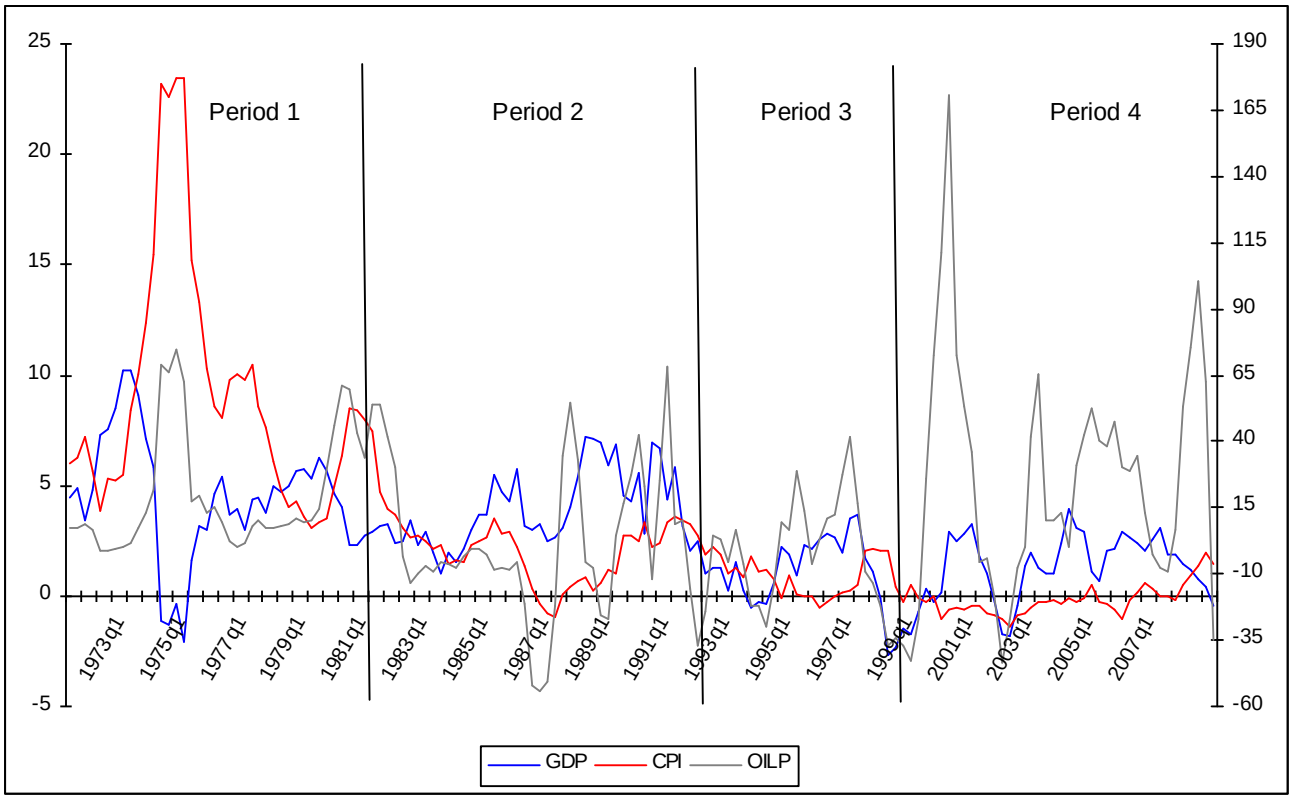
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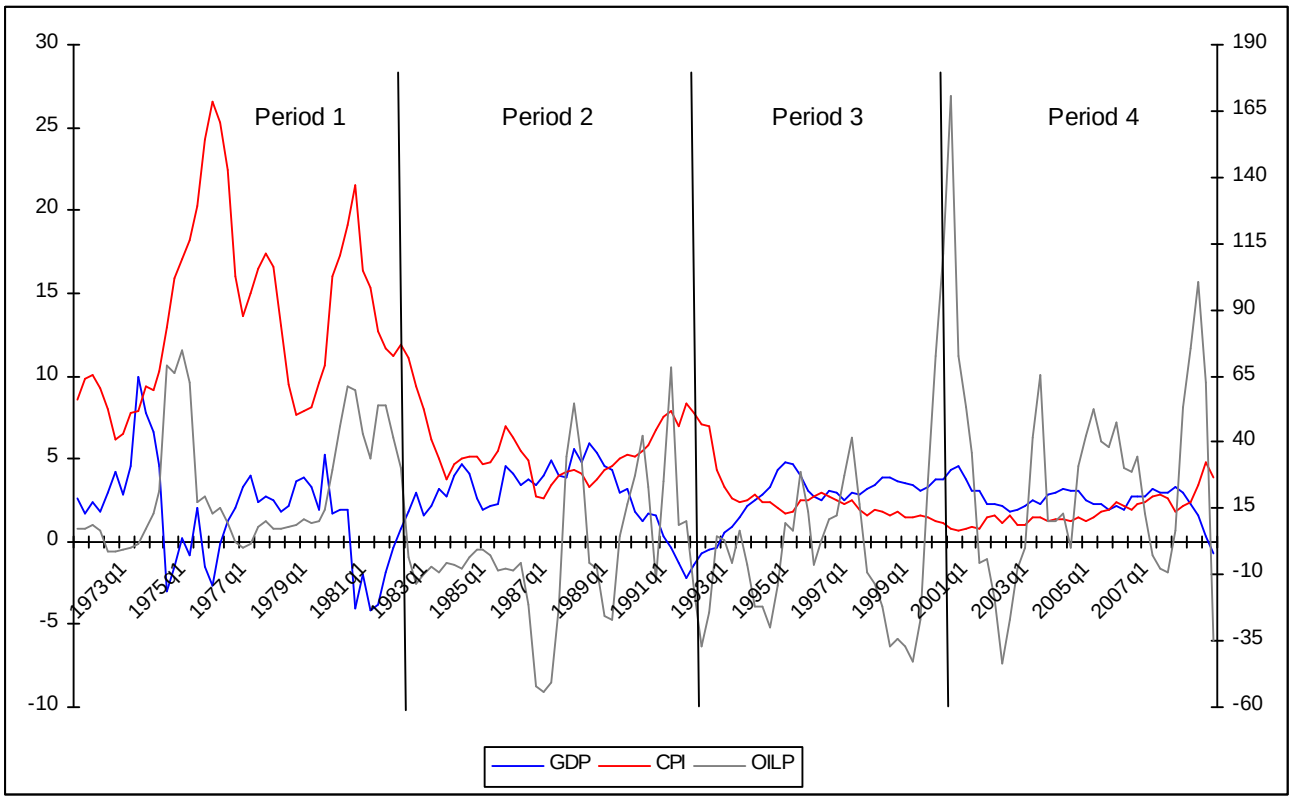
UK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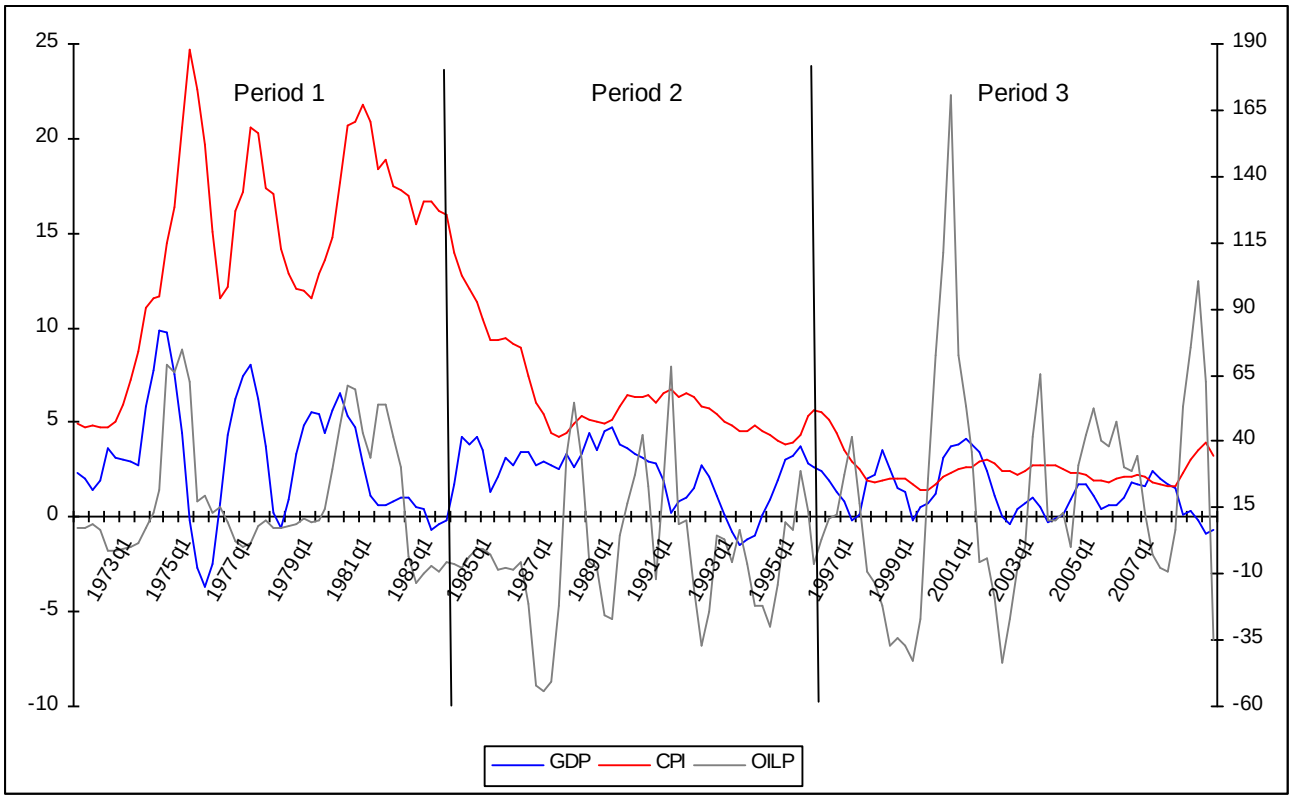
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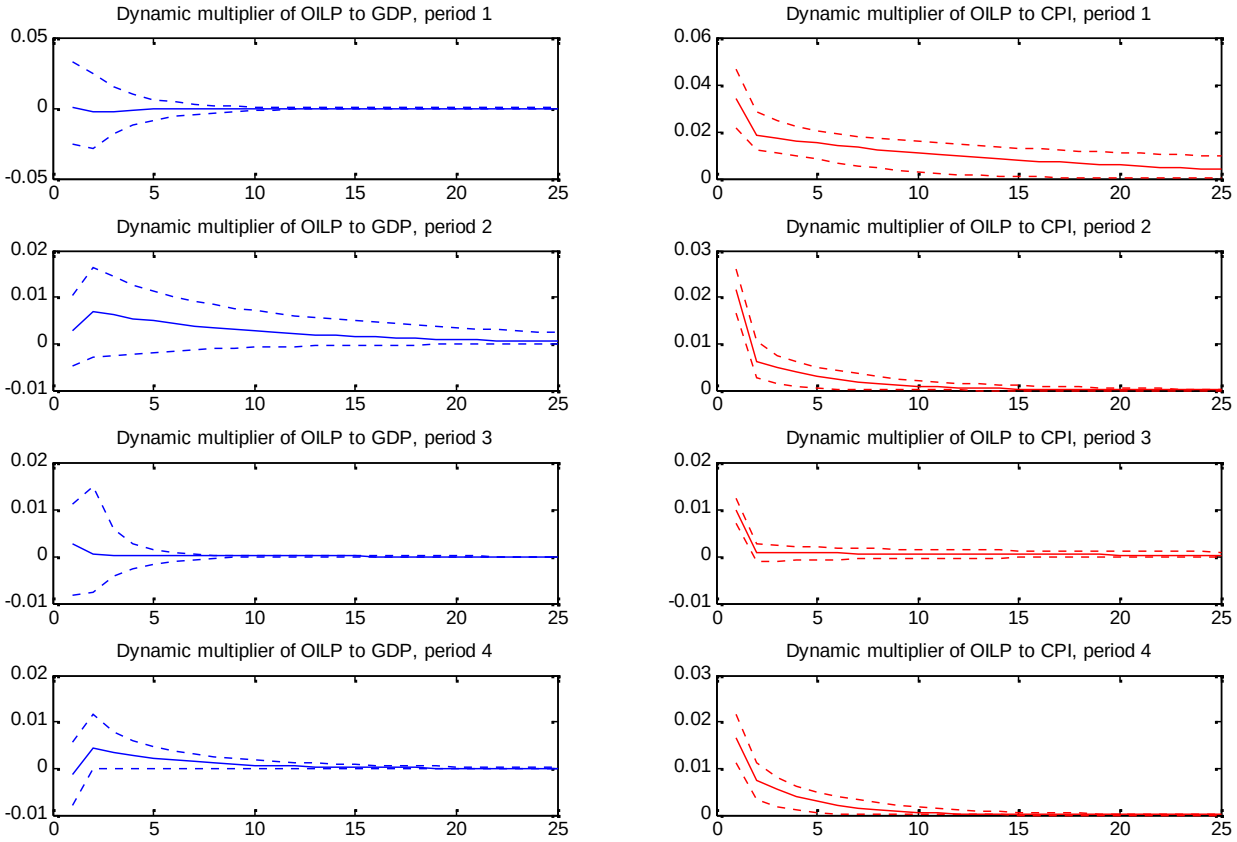
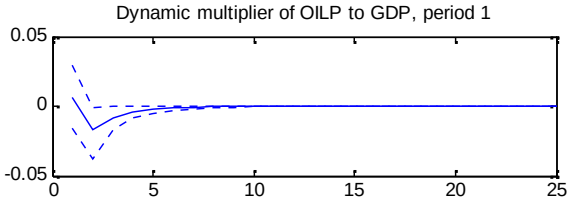
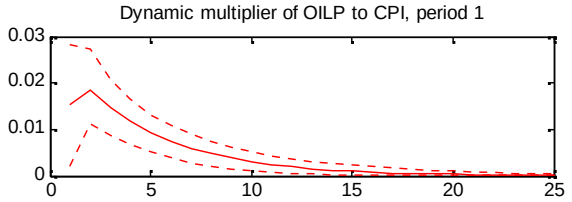
Figure 2. Dynamic multipliers of OIL prices to GDP and to CPI inflation

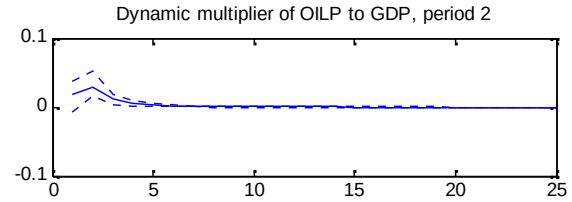
US

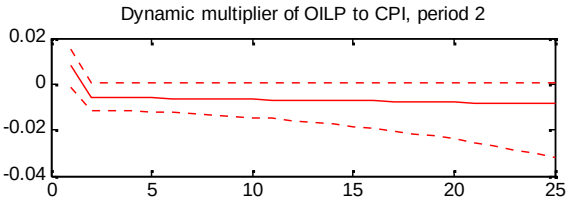


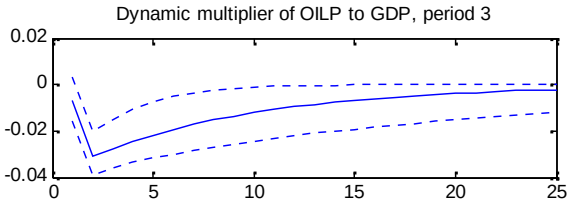
CANADA

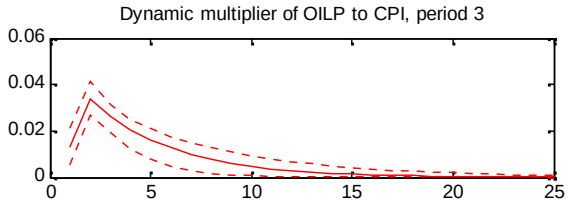


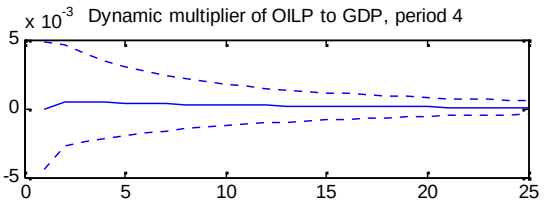


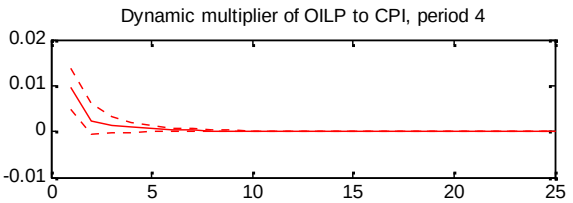




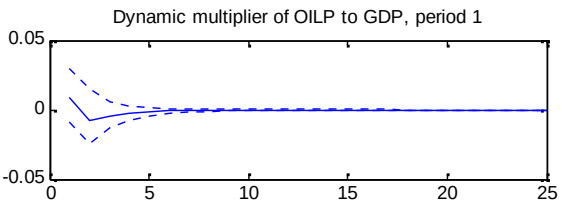


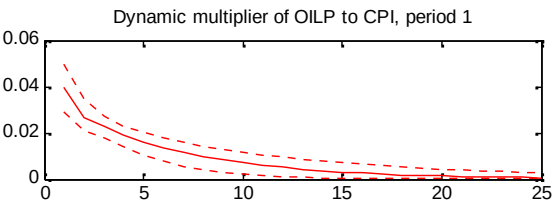


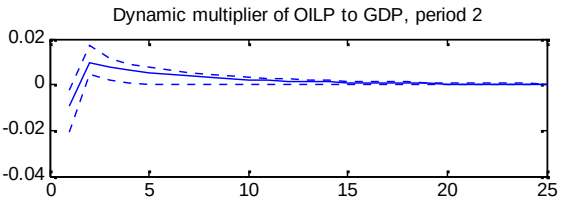


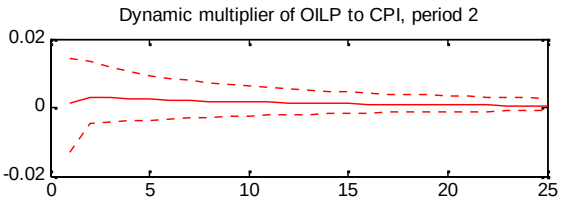


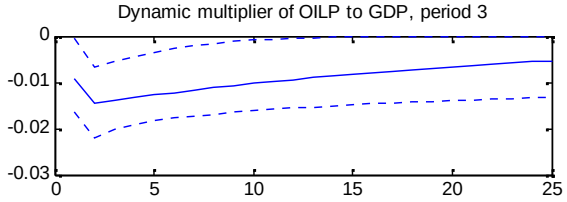
FRANCE

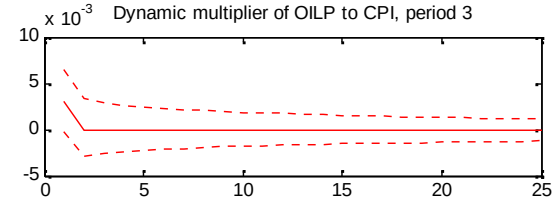


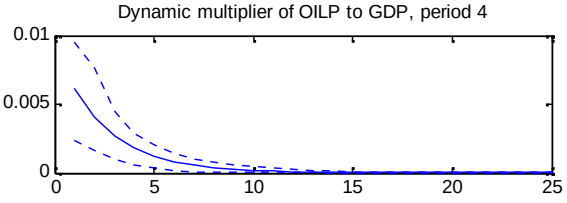


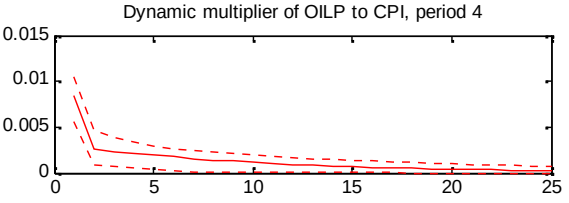




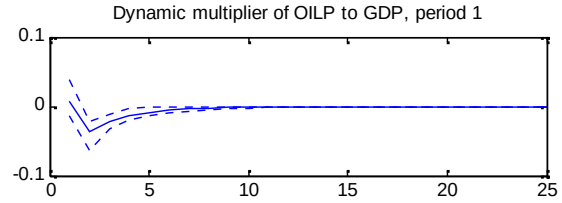


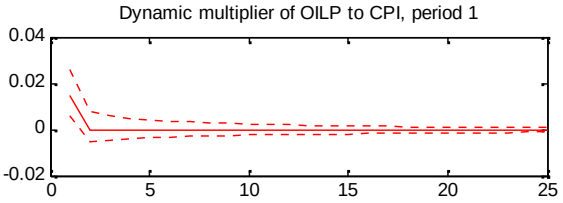


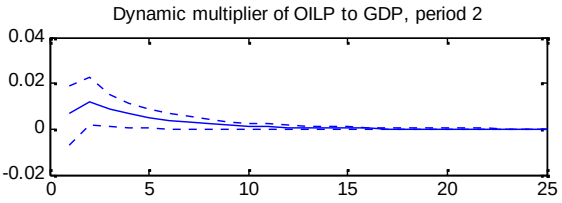


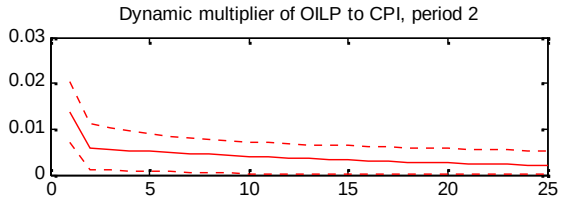


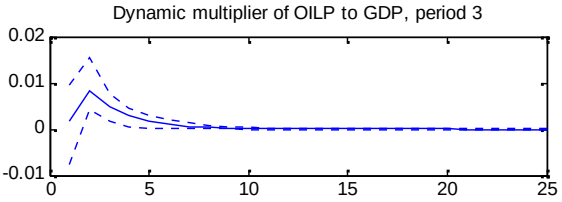
GERMANY

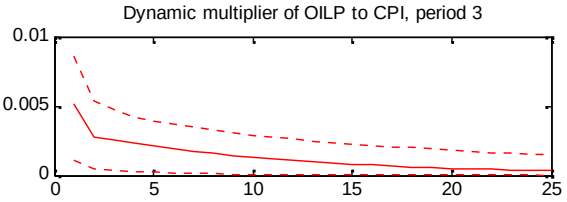


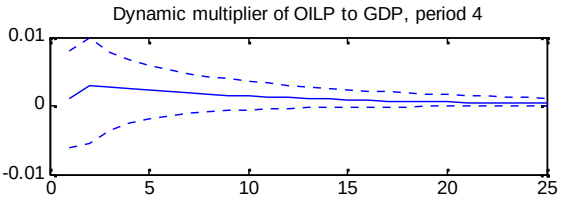


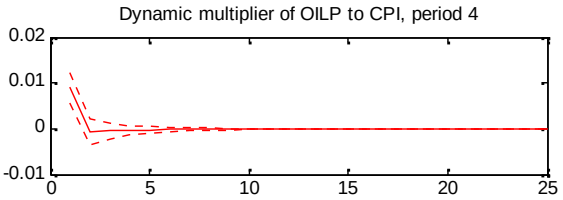




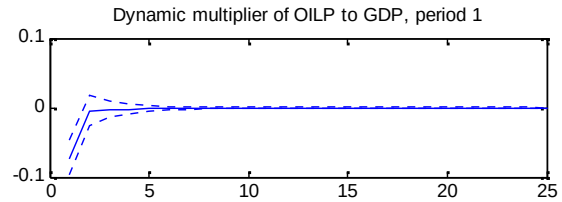


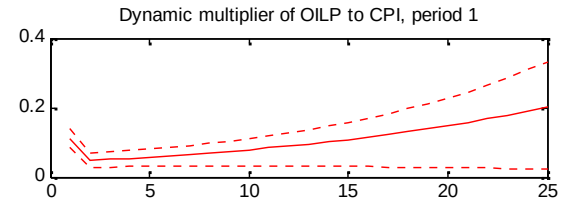


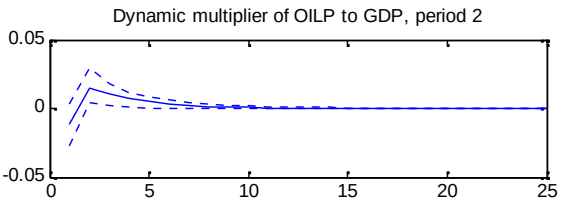


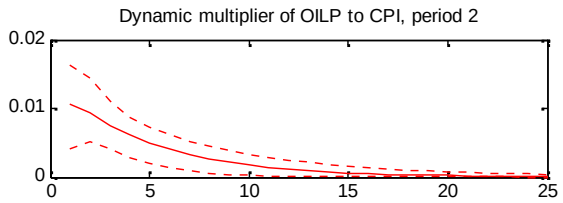


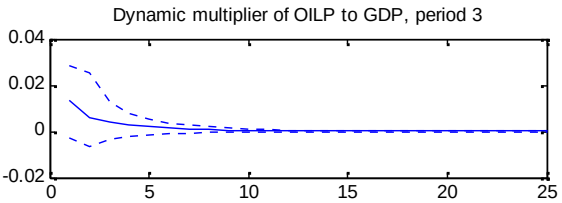
JAPAN

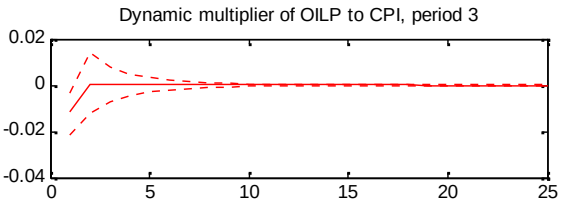


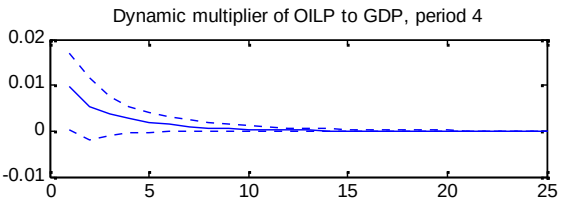


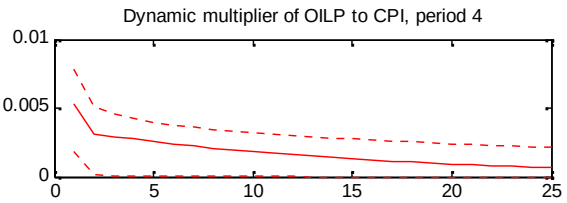




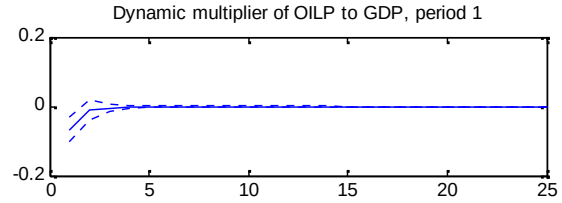


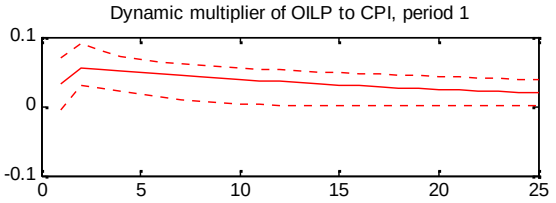


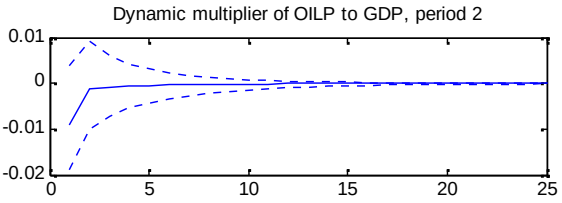


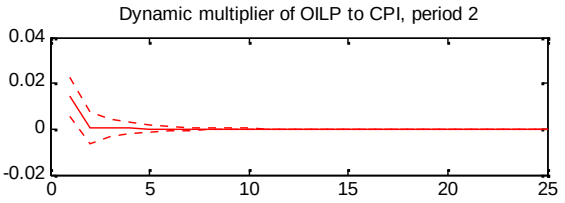


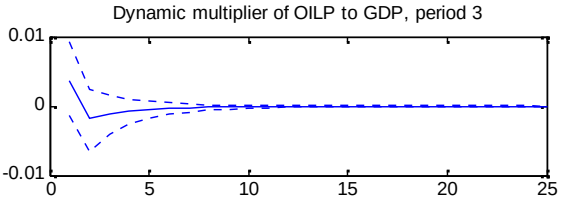
UK

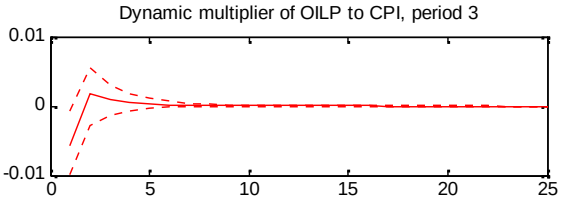

Dynamic multiplier of OILP to GDP, period 1
0.2
0
-0.2
0
5
10
15
20
25

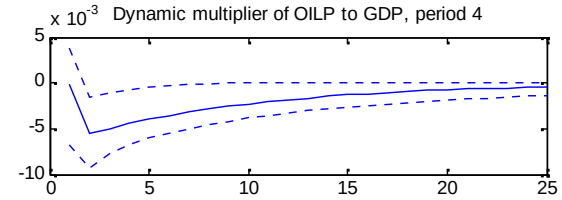

Dynamic multiplier of OILP to CPI, period 1
0.1
0
-0.1
0
5
10
15
20
25

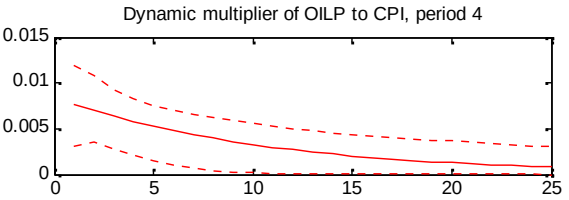

Dynamic multiplier of OILP to GDP, period 2
0.01
0
-0.01
-0.02
0
5
10
15
20
25


Dynamic multiplier of OILP to CPI, period 2
0.04
0.02
0
-0.02
0
5
10
15
20
25

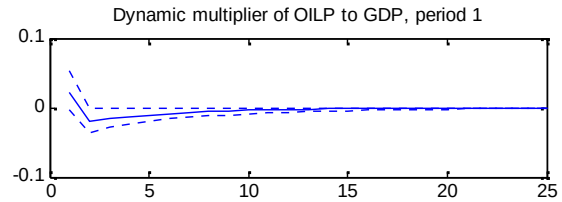

Dynamic multiplier of OILP to GDP, period 3
0.01
0
-0.01
0
5
10
15
20
25

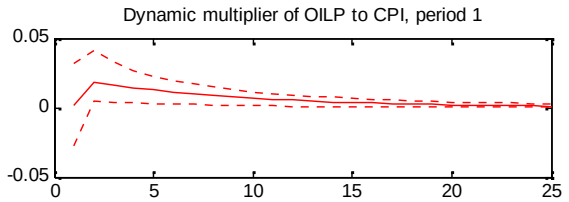

Dynamic multiplier of OILP to CPI, period 3
0.01
0
-0.01
0
5
10
15
20
25

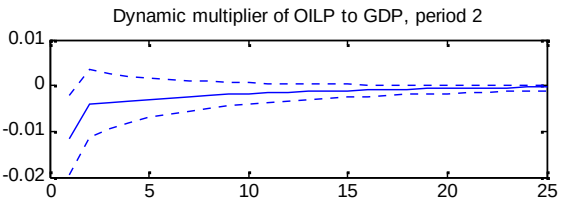

x 10-3
Dynamic multiplier of OILP to GDP, period 4
5
0
-5
-10
0
5
10
15
20
25

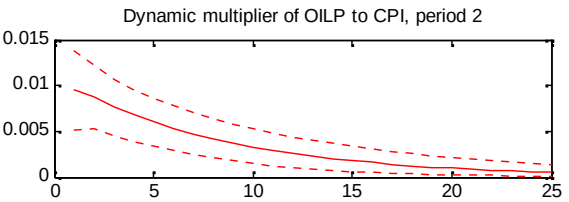

Dynamic multiplier of OILP to CPI, period 4
0.015
0.01
0.005
0
0
5
10
15
20
25

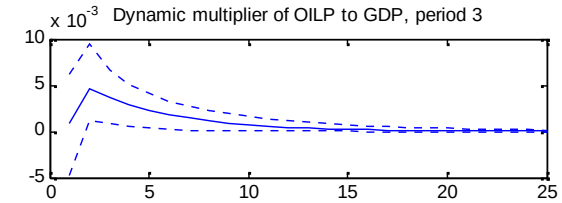
ITALY

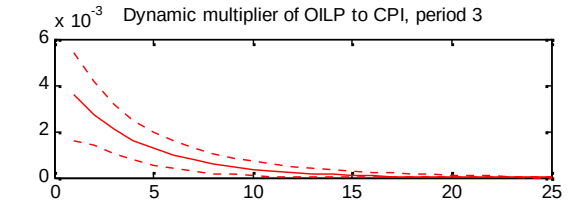

Dynamic multiplier of OILP to GDP, period 1
0.1
0
-0.1
0
5
10
15
20
25


Dynamic multiplier of OILP to CPI, period 1
0.05
0
-0.05
0
5
10
15
20
25


Dynamic multiplier of OILP to GDP, period 2
0.01
0
-0.01
-0.02
0
5
10
15
20
25


Dynamic multiplier of OILP to CPI, period 2
0.015
0.01
0.005
0
0
5
10
15
20
25


x 10-3
Dynamic multiplier of OILP to GDP, period 3
10
5
0
-5
0
5
10
15
20
25


x 10-3
Dynamic multiplier of OILP to CPI, period 3
6
4
2
0
0
5
10
15
20
25