Viachaslau Ivantsou

THE REASONS BEHIND ASYMMETRIC RESPONSES OF INFLATION TO AN OIL PRICE SHOCK ACROSS THE EU MEMBERS*[1]

Introduction

Long ago has crude oil become an essential product for the healthy functioning of any industrialized economy. Some people even call it a lynchpin of the most developed countries in the world. It is indispensable for the functioning of the transportation system, it provides one of the most handy sources of energy, it is also used in the production process of plastics and petrochemicals. One may continue this list endlessly, what is known for sure is: if not oil, modern civilization would have looked and functioned in a completely different manner.

1. Major oil consumers and producers

During past 10 years oil consumption patterns experienced several major changes. One of the most important is an increasing demand from developing countries: China, India and Brazil (Figure 1).

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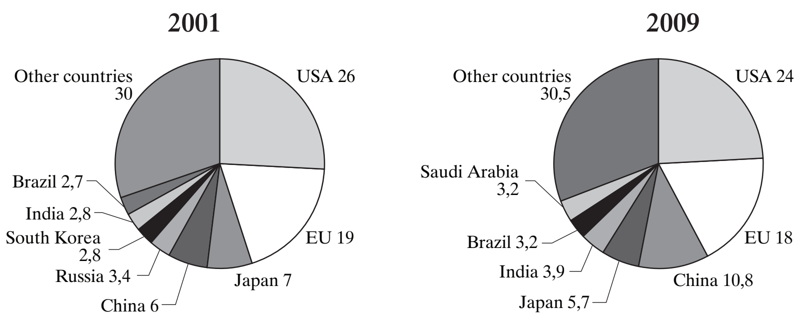
As we see, there is a significant relative 4,8 percentage points rise in demand for oil in China, India and Brazil also started to use more oil. What does this mean for European Union is that in times of relatively unchanging supply, an increased demand would cause a rise in the price of oil, consequently triggering changes in the national economies. However, a boosting demand for oil from developing countries (mostly from China actually) is not the main reason for the changes in the price of oil.

Figure 1

Relative world oil consumption in 2001 and 2009 (%)



Source: NationMaster database, Oil Consumption: Countries Compared.

OPEC countries have historically been the main suppliers of oil to the world economy. In 2010 about 81% of total oil reserves was concentrated within the members of Oil Producing and Exporting Countries:

Figure 2

OPEC proven crude oil reserves (end 2010), thousands of barrels

Venezuela:	296.50; 24%	Iraq:	143.10; 12%	Libya:	47.10; 3,9%
Saudi Arabia:	264.52; 22,2%	Kuwait:	101.5; 8,5%	Nigeria:	37.20; 3,1%
Iran:	151.17; 12,7%	UAE:	97.80; 8,2%	Qatar:	25.38; 2,1%
Total:	1467	*Non-OPEC*:	274	*OPEC*:	1193; 100%

Source: OPEC annual statistical bulletin 2010/2011 edition.

A significant share of world oil reserves and consequently world oil production lies in the middle-east region widely known for its' geopolitical instability. Due to these factors the supply channel is regularly disrupted: Iranian revolution, Iran/Iraq war, Libyan uprising are good examples. They result in a temporary decreased supply of oil; consequently raising the price of crude petroleum and depressing economic activity of the consumers.

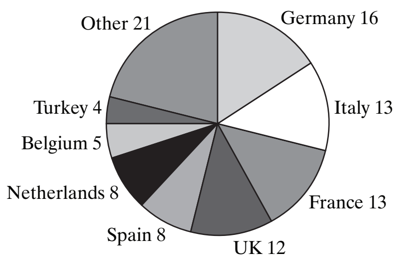
2. Oil consumption in European Union

Two main parameters are to be observed for studying the relative oil consumption in European Union: the first one is a gross inland consumption of oil and the second one is a relative importance of oil for the economies, acquired by dividing the total consumption of oil by a country's GDP at constant prices. The latter one may be viewed as an oil intensity of the economy. The summary is presented below:

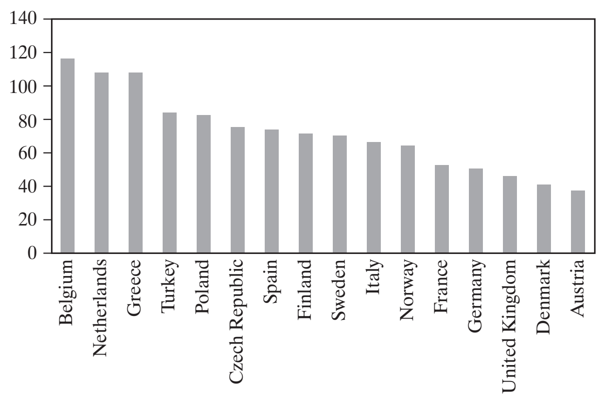
Figure 3

Oil consumption and oil intensity of the economies in European Union

Average for 1996–2008 (%)



Average for 1999–2008
Tons of crude oil per $1 billion of GDP



Source: Eurostat statistical database.

As we see, the nominal oil consumption in a country is not directly related to the oil intensity of the economy. Some countries which use relatively more oil (Germany, France and UK) have lower oil intensities of the economies. On the other side Netherlands, Belgium and Turkey, being among the leaders in oil intensities at the same time use quite a significantly larger amount of oil for their economies. Currently about 67 tons of crude oil are used to produce $1 billion of GDP in EU on average, in a way making petroleum irreplaceable for the union, especially in a shorter perspective.

As mentioned earlier crude oil supply and consequently market prices are extremely volatile. It is obvious that these changes do impact national economies, this has become an axiom in economics somewhat more than 30 years ago. GDP growth and inflation are the two macroeconomic factors, which are affected to the largest extend. Following a sufficient rise in oil prices output will reduce, since the products will become more costly to create. In addition, a significant rise in inflation would be caused as a result of higher prices of factor inputs for production and gasoline for households. There are plenty of studies that examine the pass-through of higher oil prices to inflation (discussed later), one thing they all have in common is that the countries respond noticeably different to the same oil price shock.

Symmetry in responses of the member states to the same external shock is a must for the common monetary policy stance to be appropriate (Patterson, Amati, 1998). Regional divergences have always been a source of serious concern for policymakers. Indeed, if the countries respond differently to the same external shock, designing a single policy response for all of them becomes extremely hard. Some members will need to be ‘sacrificed’ for the sake of the whole union. From that perspective, assessing the reasons behind different responses becomes very important in designing a plan for future action, especially if one wants the whole Economic and Monetary Union of the EU to function properly.

My study strives to find out the causes of regional divergences in responses among EU members following an external macroeconomic shock and in particular, an oil price shock. The work focuses on inflationary differences, since price stability is a top priority for the European Central Bank. One may say that they are most likely to be influenced by a relative importance of the oil for the national economies, implying there is not much that can be done to fix the situation. However, my hypothesis is: the asymmetry is caused by factors completely different from the oil intensities of the economies. Instead, the institutional disparity governing labour markets is to be blamed. Also symmetrical distribution of shocks is one of the optimum currency area criterion (Beck, 2011, 2013; Beck, Janus 2013) and the European Union countries are aspiring to constitute for the European Monetary Union to work properly. The work follows standard structure: in Part II theoretical background is presented followed by methodology description in Part III. In Part IV estimation results are listed and are analyzed in Part V finishing with summary and conclusions.

3. Theory and literature review

3.1. Inflation, supply and demand shocks

Before considering a narrow approach towards oil price hike effects the work introduces a broader explanation of inflation in order to give a clearer picture of the mechanism. Following Alan S. Blinder (Blinder, Rudd, 2013) we can differentiate between 2 types of inflation. The first one is a so-called normal (also referred to as 'baseline' or 'core') inflation. This baseline rate is determined by fundamental macroeconomic forces, mainly the difference between the growth rates of aggregate demand and supply. The second type of inflation is called 'observed' or 'headline' and it tends to converge with core rate over time. There are other ways of measuring inflation; however this one is the most popular, since it allows for studying overall trend in inflation by excluding the most volatile prices. In this work observed inflation is studied. The main difference between headline and core inflation is that the former is calculated from a price index which excludes highly volatile food and energy components. As a result, these two usually show noticeably different levels.

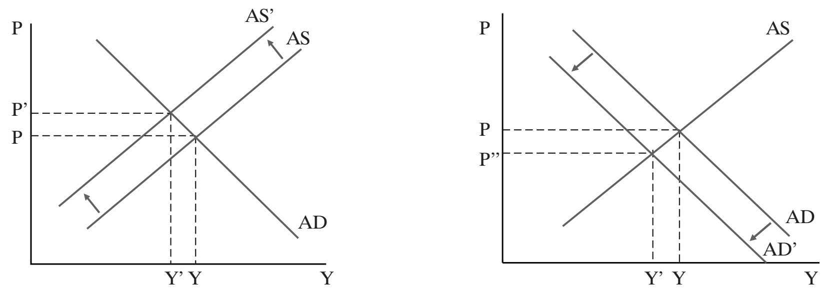
Indeed, actual inflation deviates markedly from the core rate. Rapid increases in food or energy prices (supply shock) can push inflation above its' core rate for a short period of time, the vice-versa process works as well. On the demand side many factors, including monetary and fiscal policy changes, can do the same. Supply shocks have one distinct feature: they influence the ability of firms to produce goods directly, by affecting either the prices or quantities of factor inputs, causing a so-called cost driven inflation. On the other side, demand shocks affect the ability of government, households and firms to purchase the GDP.

The commodity widely perceived to be most vulnerable to negative supply shocks is crude oil, since a great share of world's production is situated in the Middle East region, infamous for its geopolitical instability. It is important to notice, however, that oil price hike effects incorporate details of both aggregate demand and supply shocks. Approaches not taking into account demand effects caused by an oil price rise are not able to fully explain the magnitudes of the recessions triggered by crude oil supply shocks. (Blinder, Rudd, 2008).

We can divide the inflation in two major types, according to its' causes: demand-pulled inflation and cost-pushed inflation. Since an increase in oil price results in both of them, I would like to use the AS-AD model to better illustrate the difference (Blanchard, 2010).

Figure 4

Negative supply (left) and demand (right) shocks in the AS/AD framework



The model starts at the full employment level, that is Y is potential output. As we see, the major difference between these two shocks is that supply shock increases the price level (from P to P'), which then returns to its' initial level when the real wages decline and AS curve shifts right. To the contrary, after the demand shock the price level falls from P to P" and tends to return to its' initial level after the adjustments (due to AS curve shifts or expansionary policies). It can be concluded that following an oil price shock, GDP growth would decrease and inflation would rise in the short-run. Then, when the reduced demand effect takes place, the rise in inflation would be partially offset, however following a further decrease of the output in the economy.

An adverse supply shock carries a painful problem for the government. It causes stagflation: a decrease in the output followed by increased inflation. If policymakers decide to use expansionary policies to fight the reduced output, the economy would be cured but the price level would remain even higher. To the contrary, if the decision to fight inflation is made, the recession becomes even deeper. Policymakers face a very unpleasant tradeoff in this situation.

3.2. Asymmetry

It has become widely accepted among researchers that oil price increases have a negative impact on economic activity. This relationship was investigated by many economists, most of them supported its' existence. In a seminal study, Hamilton (1983) brought interest to this matter, concluding that oil price hikes have preceded most of US recessions prior to 1972, suggesting that crude petroleum was a contributing factor in at least several economic downturns. Currently, a negative impact of oil price rise on the economy is considered to be an axiom in economics. As mentioned earlier, oil price changes usually cause a noticeable deal of asymmetry. Three most important types of it are: positive/negative asymmetry, asymmetry caused by different natures of oil price shock and regional asymmetry.

3.2.1. Positive/negative oil price shock asymmetry

A simple intuition suggests that since an increase in oil prices has a negative impact on the economy, a decrease should boost it. However this proved to be wrong. Mork (1989) investigated the asymmetric effects of the changes in the price of crude petroleum on US economy and concluded that: 'the (GNP) correlation with price decreases is significantly different and perhaps zero.' More recent researches argue that an asymmetry effect between positive and negative price shocks is rather a statistical artifact, resulting from poor estimations and biased models (Edelstein and Kilian 2007, 2009). No consensus on the topic has been reached so far.

3.2.2. Asymmetry caused by the nature of oil price shock

Different nature of oil price shocks constitutes another noticeable asymmetry in responses. Traditional literature differentiates between three major types of distraction. First, an oil supply shock is a shift caused by production distractions because of military conflicts or changes in production quotas, set by oil exporting countries. It results in higher fuel prices, increases the cost of goods and depresses economic activity (Hamilton, 2003). In another words, it leads to stagflation (see paragraph 2.1). Second, it can be demand shock. It is caused by an increased demand for oil and raises both world production and prices of fuel. Continuous growth of oil consumption by India and China might be a good example. Finally, an oil-specific demand shock, which may be caused by a speculative increase in demand for oil or an increase directly connected with uncertainty about future supply. It is not caused by increased global activity and usually results out of precautionary demand for oil because of uncertainty about future availability of petroleum. These shocks are assumed to have a negative impact on the world economy due to increased prices of oil and world production staying unchanged. Gert Peersman in his study (Peersman, Robays, 2009) estimated the relative importance of each type of shock. He concluded that oil price changes account for 38 percent of total consumer price index variability in EU since the establishment of the Central Bank, with 51 percent driven by oil supply shocks, 13 by oil-specific demand shocks and 36 by global activity shocks.

The asymmetry caused by regional differences is another core topic. It constitutes a basis for empirical part of my work and is essential to understand why EU member states' reaction to oil supply shocks is different. A simple logic may suggest that the respond of inflation to oil price hike is mostly dependent on the energy intensity of a chosen economy. However, recent studies prove that for European Union this is not really the case (Peersman, Robays, 2009; Álvarez, 2009).

Before proceeding further in explaining the driving forces behind the regional asymmetry, we need to study how actually the rise in oil price leads to higher inflation. This is usually called 'oil transmission mechanisms' in economics.

3.3. Transmission Mechanisms

For the work to be more comprehensive we should consider a deeper theoretical look on the oil transmission mechanisms. Following Gert Peersman (2009), the final impact of an oil supply shock on inflation can be divided into three supply-channel effects.

1) Direct effects

Consumer price index is calculated as a weighted average of different types of goods which also include fuel. Thus, a direct impact of oil supply shock on CPI is observed, proportional to the increase in prices. Currently energy goods cover about 10 percent of the consumption basket in major EU economies, half of these 10 percent is attributed to liquid fuels, e.g. gasoline and heating fuels (Peersman, Robays, 2009). Consequently, the inflation will rise simply because the price for one of its components will rise. The magnitude of the effect can change under the influence of the substitutability of oil with another energy sources and the sensitivity of the fuel demand to its price (price elasticity of demand). Still, the direct pass-through is not likely to change substantially because of irrelevance of factors mentioned. Indeed, the effective substitutes for oil are not developed yet, as well as the demand for fuel proved to be mostly inelastic since there are simply no alternatives (Hawkins, 2008; Bryce, 2013). These factors are even more significant in the short run.

2) Cost effects

Oil plays a significant role in the production process of many firms. As a factor input, its' increase in price leads to higher costs for producers and consequently higher prices of finished products (see e.g., Kim and Loungani, 1992; Backus and Crucini 1998). As a result, the prices for non-energy goods rise as well. The magnitude of pass-through depends on the degree of competition: firms in a more competitive market are likely to decrease their markups, so the final price stays unchanged. This effect takes much longer time to reveal itself, in contrast to direct effect which has almost immediate impact on CPI.

3) Second-round effects

In order to maintain the purchasing power, decreased by direct and cost effects, employees are likely to demand higher nominal wages in subsequent wage-bargaining rounds as they had previously anticipated lower inflation and the purchasing power of their wages has fallen. In the presence of wage indexation mechanism this happens automatically, since nominal wages are indexed to consumer prices. This results in even higher cost faced by producer, who in turn is likely to increase the prices of finished goods to offset a potential loss in the profit. An important feature of this effect is, that unlike previously mentioned ones, its' impact on inflation is rather persistent, not permanent. Indeed, if the producers respond to higher wages with raising the prices, employees might again ask for raising the remuneration. This may develop a so-called wage-price spiral. Note, that second-round effects depend crucially on the credibility of monetary policy, the role of inflationary expectations (rational or adaptive) and labour market rigidity.

Direct, cost and second-round effects in the WS-PS model context

In order to explain theoretically how actually a rise in the price of oil leads to cost and second-round effects, I will briefly discuss the application of the WS-PS model (Blanchard, 2010) The wage-setting equation I use is as following:

$$W = \underset{+}{P^e} * F(\underset{-}{u}, \underset{+}{z}) \tag{1}$$

where: W is the nominal demanded wage, u and z are unemployment and bargaining power respectively. P^e is expected price level.

The initial PS equation is as following:

$$P = (1 + \mu) * W \tag{2}$$

I will modify it in order to take into account higher oil prices by inserting the price of energy θP, the equation then becomes:

$$P = (1 + \mu) * (W + \theta P) \tag{3}$$

μ – markup over costs, W – nominal labour costs.

Price set by the producers is equal to the sum of labour and energy costs multiplied by the markup. $\mu=0$, in a perfectly competitive market; $\mu>0$ in an imperfectly competitive market. Then by introducing a negative oil supply shock we observe a rise in θP, consequently producers have two choices: either to decrease their markup (so the P stays the same), or to increase the price of their product to get the same profit. We assume that the firms operate in an imperfectly competitive market, meaning that the combination of both strategies would be implied. It results in higher price level in the economy, causing cost-effects.

An increased price level P, together with the direct effect, increase expected price level. As a result, nominal wage demanded by workers in the subsequent wage-bargaining rounds rises. It is then transferred to the PS equation, raising the price level which causes higher expected price level and so on. However, this effect is crucially dependent on the employees' ability to bargain for higher wages that is, on their bargaining power. Consequently, the strength of the second round effects is likely to be determined by the specifics of institutions governing labour market in a particular country.

Expectations formation process also plays an important role. If these are rational and the central bank is credible then, provided they are formed after the announcement of tighter monetary policy to fight inflation caused by the negative oil shock, wages will not rise as the expectations would be forward-looking. Employees will accept a rise consistent with the future lower inflation.

4) Demand effects

Things discussed so far deal with supply channels purely. By increasing costs faced by producers those effects raise the price level and depress economic activity. However, the losses caused by oil supply shocks cannot be fully explained by supply-side considerations (Backus, Crucini, 1998), suggesting that there is something on the demand side happening as well. In his recent study Hamilton (2005) stresses that a key mechanism whereby energy price shocks affect the economy is through a disruption in consumers' and firms' spending on goods and services other than energy. The alternative view that an oil supply shock affects economy mainly through the demand channel (see e.g., Kilian, 2008b) is becoming more and more popular. These researches stress, that the demand effects do mostly influence GDP growth, not inflation. Since they are not directly connected to my study, the review is rather brief.

According to Edelstein and Kilian (2009) there are four complementary mechanisms, through which oil price change affects consumer spending. First, higher oil prices reduce disposable income of households, proportionally to energy's expenditure share in spending. Second, high uncertainty about future fuel supply is likely to lead to the postponement of the investments which are complementary to energy (Bernanke, 1983). Third, even if purchase decisions are reversible, consumers may decide to increase their overall savings (in times of lower consumer confidence) and choose to consume fewer goods and services not necessarily related to energy (Kilian, 2008b). Finally, rising oil prices may boost a demand for energy-efficient goods at the cost of energy-intensive goods, thus triggering a chain of costly reallocation procedures at the expense of the overall output (Davis and Haltiwanger, 2001; Hamilton, 2005).

Bernanke, Gertler and Watson (1997) pointed out the importance of monetary policy for US reaction to oil supply shock, concluding that monetary tightening strengthened recessional effects on GDP and was responsible for early 1980s downturn, rather than the shock itself. With European Central Bank and its stress on price stability, there is a possibility of sacrificing GDP growth in order to hold inflation down to its' normal level. With different countries' responses, a common monetary policy might strengthen primary asymmetry even more, also resulting in monetary contraction in the countries where it is not really needed. Still the matter needs further investigation.

3.4. Regional asymmetry

While there are plenty of studies, examining the magnitude of inflation responses to an oil price hike, the literature, explaining the reasons behind regional asymmetry in EU countries is relatively scarce. Blanchard (2007) applied SVAR model in order to estimate the impact of an oil supply shock on major economies, analyzing the cross-regional as well as cross time differences in results. He outlined three major factors responsible for different reactions among countries: oil share in the production, labour market flexibility and differences in monetary policies across countries. Ciscar, Russ, Parousos, Stroblos (2004), using GEM-E3 model estimated GDP losses caused by oil supply shock for a set of European countries. Oil intensity of the economy was outlined as the most important factor, responsible for regional differences, implying that labour market structure is more important in inflationary concerns. Gert Peersman (2009) investigated the matter of cross-country asymmetry much deeper, stressing second-round effects being the reasons for differences among EU members. In particular, he outlined that labour market flexibility and the presence of wage indexation are responsible for a large share of different responses, apart from oil intensity of the economy.

Now, when we are more familiar with the background, the subject of the study can be assessed more accurately. Further on, my work concentrates on estimating the impact of oil price rise on inflation in selected EU member countries, paying attention to the magnitude of the impact as well as to timing of the effects. Next I examine the results and assess the variables responsible for regional asymmetry between EU members studied.

4. Methodology and Data

4.1. Data frequency

Before starting to describe the used method in more details, I would like to stress major advantages and disadvantages of the chosen data frequency. Taking into account the specifics of the subject studied and the data availability for running a regression model (discussed later) the work focuses on using quarterly data in the econometric part. Using yearly frequency was another option, however it was not considered due to its' low explanatory power for timing of the effects and period length, requiring to take into account several structural breaks resulting from decreasing oil usage by the members and consequently yielding different coefficients for oil impacts on inflation for separate periods (Blanchard, 2007).

Advantages

First, the usage of quarterly data allows for observing the timing of the effects of oil price shock on the inflation. In this study an explicit assumption is made that countries studied may differ on the amount of time that the oil price shock takes to fully reveal itself. This is particularly important when studying second-round effects, being dependent on the labour market characteristics.

Second, given the alternative approaches (e.g. yearly and monthly frequency), using quarterly data is the optimal one, with monthly frequency providing too low period length for observing this kind of effects.

Disadvantages

The major problem of using quarterly approach is that it does not allow for estimating the exact pass-through of oil price rise to inflation, because of its' persistent nature. According to some researches the full impact may take up to two years in order to fully reveal itself (L. J. Alvarez, S. Hurtado, 2009 for example). In the light of the facts mentioned, this study should not be viewed as the one, trying to estimate the exact coefficients. It focuses on comparing the relative strength of the oil price shocks and their timing between countries studied.

4.2. Augmented Phillips Curve

Most of the studies, researching the oil price shock impact on inflation use an augmented Phillips Curve approach, and the thesis sticks to it. In a very general sense this technique is based on the following:

$$\pi_1 = a * \pi_{t-i} + \delta * U_{t-t_1} \tag{4}$$

δ – HCPI inflation (all items included), U – unemployment level.

Inflation (Π) is regressed on its' own past values (proxy for expectations) and unemployment (U). Based on Okun's law (Blanchard, 2010) we replace unemployment by output gap, in order to allow for the inflationary pressures caused by output exceeding or being lower than potential one. This approach proved to have higher explanatory strength (Bolt, Els, 2000). A positive output gap puts an upward pressure on inflation caused by increased production costs especially labour costs, consequently leading to higher prices for goods and services. The vice-versa process works as well. A lagged variable responsible for percentage changes in US dollar price of a barrel of Brent Crude Oil is also included. Taking into account Dubai Fateh price is not considered due to the fact that these two behave almost identically over the whole period studied and including the former one did not yield any significant differences. As a result, it was skipped for simplicity.

I would have used prices in national currencies, however these may interfere with the exchange rate influence on inflation and yield biased results (Kiptui, 2009). So the variable responsible for percentage changes in effective exchange rate was added (for a detailed explanation of exchange rate pass-through see e.g. Takhtamanova, 2008 or Bailliu, Eiji, 2004). Finally, the generalized equation becomes as following (apart from the constant C and outliers):

$$\pi_t = \frac{\alpha(\pi_{t-t_1} + \pi_{t-t_2})}{2} + \frac{\beta(YGAP_{t-t_3} + YGAP_{t-t_4})}{2} + \gamma\Delta OILP_{t-t_1} + \delta\Delta EXCH_{t-t_1} \tag{5}$$

Inflation is being regressed on its' own past values, the output gap in the previous periods, oil price and exchange rate changes. The influence of the inflation and output gap is inserted into the model as a moving average of two lags.

Countries differ significantly on the efficient number and value of the lags (discussed in the next chapters), which is not a surprise given different structures of national economies and labour markets. For several members additional variables were introduced for the oil price changes in the past, allowing for studying the timing of the effects. Possible asymmetric effects between positive and negative oil price shocks are not considered in the model, as no absolute evidence exists, proving the necessity of such procedure.

The estimation was run using Ordinary Least Squares method and the package (Eviews 7.0).

4.3. Data

The regression uses quarterly time series approach, the sample studied ranges from the 1st quarter 1994 till the 4th quarter 2008. The countries researched are: Finland, France, Germany, Ireland, Italy, Netherlands, Norway and United Kingdom.

The data on inflation was obtained from OECD statistics database using Harmonized Index of Consumer Prices (all items included), showing the change from the previous quarter. The Output Gap measure was taken from OECD quarterly output gap revisions database created from Economic Outlook reports. This data is available for only 15 major OECD economies, thus, influencing the final list of members studied. Brent Crude Oil price was acquired from Index Mundi database, representing a change in the quarterly average nominal price in US dollars. The data on effective exchange rate index (41 trading partner included) was taken from the Eurostat statistical database. The quarter-to-quarter change was calculated.

5. Estimation Output

The estimation output is presented in the rest of this chapter, the data is grouped by country studied for higher transparency. A short description of the results follows each table, while a complete analysis is presented in the next chapter. Additional parameters for lagged changes in oil prices are listed in the tables (if relevant). For 5 members Chow-Breakpoint test indicated a need for introducing a structural break, a dummy variable was thus inserted into the regression to take structural changes into account.

5.1. Performing tests

Before discussing actual results, a summary of several statistical tests and quality-assessing parameters of the models is presented.

Figure 5

Statistical tests of the regression (dependent variable: inflation đ)

	R Squared	Adjusted R squared	F-statistic	Durbin--Watson statistic	Jarque--Bera normality test	Heteroscedasticity test (B. P. G)
Finland	0.578308	0.522083	10.28551	1.528606	0.4956	0.4305
France	0.684658	0.624593	11.39861	2.326086	0.6875	0.8562
Germany	0.556703	0.505157	10.80009	2.00558	0.5178	0.7268
Ireland	0.664284	0.610875	12.43759	1.432989	0.5966	0.2847
Italy	0.515638	0.455093	8.516575	1.524938	0.0991	0.8453
Netherlands	0.550569	0.514615	15.31298	1.835769	0.9002	0.6730
Norway	0.674177	0.618322	12.07004	1.645321	0.3539	0.9237
UK	0.701605	0.664306	18.81012	2.302668	0.6600	0.2336

Source: Author's estimations based on data acquired from Eurostat statistical database.

The R-squared value shows the relationship between total sum of squares and explained sum of squares. In another words, it assesses how well the model manages to explain variations in the inflation. As we can see, the value ranges from 50 to 70 per cent, which may be considered as a fully satisfactory number. Taking into account the subject of my study, the R-squared value does not cast any doubt on the applicability of the model.

The F-statistic test is used to verify the overall statistical significance of the model. It tests the hypothesis whether all the parameters included are equal to zero. If the value of the test exceeds the critical value of the distribution, we reject zero-null hypothesis and conclude that the parameters are not equal to zero. The upper critical value for the model is about 2.50 (depending on the number of observations), thus, we can be sure that the model is statistically significant.

The Durbin-Watson test is used to detect the presence of autocorrelation in the prediction errors of the model (residuals). The detailed explanation of the test is quite complicated and is not included in the work. The values provide no serious evidence of autocorrelation, with some countries lying in a so-called 'indecision zone'. For these members the Breusch-Pagan-Godfrey test is used in order to stay on the safe side.

The Jarque-Bera test of normality checks whether the error term follows the normal distribution. We can conclude that all the countries pass the test since the probabilities are much higher than the selected confidence interval (0.05). However, as seen from the table, there is some evidence questioning the applicability of the model for Italy. The probability is very low indicating a possible problem in the distribution of the error term. This issue is discussed in the next part of the work.

Similarly, all the countries pass the Breusch-Pagan-Godfrey test for heteroscedasticity. The test is used to check whether the error terms have a constant variance. Since the calculated probabilities are much higher than 0.05, we conclude that the parameters in the models do have constant variance of the error terms, that is are homoscedastic (as required for the model to pass R-squared and F-statistic tests correctly).

The Chow-Breakpoint test is discussed for each country separately.

5.2. Estimation output

A traditional Eviews outline is used. It includes t-statistics value and consequently – the probabilities of making type 1 error (accepting wrong parameters).

Figure 6

Estimation output for Finland (dependent variable: inflation đ)

	Coefficient	**Std. Error**	**t-Statistic**	**Prob.**
C	0.400395	0.099376	4.029091	0.0002
α	0.469159	0.115594	4.058686	0.0002
β	0.027725	0.007793	3.557624	0.0009
γ	0.011982	0.002581	4.641810	0.0000
$\gamma(1)$	0.004105	0.002259	1.817092	0.0760
$\gamma(2)$	0.010914	0.002473	4.414201	0.0001
δ	0.054098	0.020429	2.648033	0.0112
Structural Break	–0.346437	0.118271	–2.929193	0.0054

Source: Author's estimations based on data acquired from Eurostat statistical database; $\gamma(1)$ and $\gamma(2)$ are second and third lag of a change in oil price.

The regression output proves that changes in oil prices are highly significant for inflation in Finland. The first and third lag of a change in the price of crude petroleum are significant at 99 percent confidence level, while the second one seems to be relatively weak. One may consider this a very unusual happening, a possible explanation is given in the next chapters. Two lags of inflation and output gap were included into the moving average. Chow-breakpoint test indicated a need for introducing a structural break in the second quarter of 2001. The signs of the parameters are as expected, fitting the economic theory.

Figure 7

Estimation output for France (dependent variable: inflation đ)

	Coefficient	Std. Error	t-Statistic	Prob.
C	0.369373	0.112006	3.297802	0.0020
α	0.452962	0.129329	3.502400	0.0011
β	0.113993	0.043240	2.636267	0.0117
γ	0.010210	0.001896	5.386180	0.0000
γ(1)	0.006055	0.001836	3.297209	0.0020
γ(2)	0.008725	0.001865	4.679103	0.0000
δ	0.056949	0.025405	2.241624	0.0303
Structural Break	–0.244653	0.096240	–2.542128	0.0148

Source: Author's estimations based on data acquired from Eurostat statistical database.

For France all coefficients remain significant at 95 percent confidence interval including 3 lags of oil price change. Two lags of both inflation and output gap are included into the moving average. Chow breakpoint test indicated there is a need to introduce a structural break in the fourth quarter of 1999. The signs of the parameters are as expected.

All coefficients remain significant at 95 percent confidence interval for Germany. Two lags of oil price change appeared to be significant for inflation in a certain period and the influence seems relatively weaker than that of France and Finland. In addition, the regression has shown that change of the oil price requires much more time to impact inflation. Two lags of both inflation and output gap were included into the moving average. No structural break has been found.

Figure 8

Estimation output for Germany (dependent variable: inflation đ)

	Coefficient	**Std. Error**	**t-Statistic**	**Prob.**
C	0.240129	0.059971	4.004075	0.0002
α	0.297813	0.126023	2.363172	0.0227
β	0.068186	0.030651	2.224593	0.0315
γ	–	–	–	–
γ(1)	0.008496	0.002110	4.026156	0.0002
γ(2)	0.006913	0.002019	3.424472	0.0014
δ	0.069397	0.023903	2.903341	0.0058
Structural Break	–	–	–	–

Source: Author's estimations based on data acquired from Eurostat statistical database.

Figure 9

Estimation output for Ireland (dependent variable: inflation đ)

	Coefficient	**Std. Error**	**t-Statistic**	**Prob.**
C	0.262789	0.095828	2.742289	0.0088
α	0.539891	0.118504	4.555898	0.0000
β	0.022048	0.010368	2.126654	0.0391
γ	0.010977	0.003492	3.142997	0.0030
γ(1)	0.008548	0.003246	2.633497	0.0116
γ(2)	0.008214	0.003457	2.376375	0.0219
δ	0.064166	0.035884	1.788126	0.0806
Structural Break	–	–	–	–

Source: Author's estimations based on data acquired from Eurostat statistical database.

All coefficients remain significant at 95 percent confidence level for Ireland, including 3 lags of oil price change. Unfortunately, the influence of the exchange rate may be questionable, however, since this is not the subject of my study, I will treat t-Statistic value as satisfactory. Two lags of both inflation and output gap were included into the moving average. No structural break has been found.

Figure 10

Estimation output for Italy (dependent variable: inflation đ)

	Coefficient	Std. Error	t-Statistic	Prob.
C	0.089695	0.103601	0.865771	0.3918
α	0.588808	0.104701	5.623705	0.0000
β	0.037507	0.013001	2.884902	0.0063
γ	0.002559	0.001458	1.755537	0.0868
γ(1)	–	–	–	–
γ(2)	–	–	–	–
δ	0.025992	0.017211	1.510171	0.1389
Structural Break	0.149882	0.066289	2.261048	0.0293

Source: Author's estimations based on data acquired from Eurostat statistical database.

The quality of the model for Italy cannot be considered as appropriate. Two parameters (oil price change and exchange rate change) do not have sufficient t-Statistic value to be viewed as reliable. Different strategies of estimation (changing sample period and lags value) did not yield any significant differences. In addition, the model appeared to be highly unstable with respect to the changes in the period. The change of oil price seems to have highly limited impact with only one lag being relatively significant. Finally the model barely passes heteroscedasticity test. I conclude not to trust the values of the coefficients and will not consider them in the analytical part.

Figure 11

Estimation output for the Netherlands (dependent variable: inflation đ)

	Coefficient	Std. Error	t-Statistic	Prob.
C	0.077591	0.067632	1.147254	0.2564
α	0.729269	0.102424	7.120060	0.0000
β	0.022673	0.008212	2.761068	0.0079
γ	–	–	–	–
γ(1)	0.004038	0.001949	2.071591	0.0432
γ(2)	0.006437	0.001900	3.387985	0.0013
δ	–	–	–	–
Structural Break	–	–	–	–

Source: Author's estimations based on data acquired from Eurostat statistical database.

The behaviour of the model for Netherlands appears to be relatively unstable. The coefficient corresponding for the exchange rate influence is highly sensitive to the period chosen, sometimes even changing its sign. It was excluded from the model, the rest of coefficients did not happen to change because of it. The values of the coefficients responsible for the oil price change proved to be very stable. Their influence is relatively low and is scattered over the several periods. This is studied it in the next chapter. Two lags of both inflation and output gap were included into the moving average. No structural break has been found.

Figure 12

Estimation output for Norway (dependent variable: inflation đ)

	Coefficient	**Std. Error**	**t-Statistic**	**Prob.**
C	0.449436	0.079254	5.670846	0.0000
α	0.229545	0.124145	1.849014	0.0729
β	0.052444	0.018719	2.801714	0.0082
γ	–	–	–	–
$\gamma(1)$	0.016206	0.002368	4.876814	0.0000
$\gamma(2)$	0.008417	0.002508	2.206931	0.0340
δ	0.099965	0.021452	4.659887	0.0000
Structural Break	–0.322371	0.089719	–3.593127	0.0010

Source: Author's estimations based on data acquired from Eurostat statistical database.

Most of the coefficients remain significant at 95% confidence level, including two lags of oil price change. As expected, the influence is getting weaker over time. The value proved to be quite stable, so I've decided to stick to the general equation and keep it. Two lags of inflation and one lag of output gap are included into the moving average. Chow breakpoint test indicated that there is a need to introduce structural break in the first quarter of 2002.

The inflation in UK seems not to be sensitive to external influence. The coefficients responsible for changes in exchange rate and oil price are much weaker than that of the most countries studied. Most of the coefficients remain significant at 99 percent confidence level, apart from third lag of oil price change. It was left in the model since it does not impact other variables. The behaviour of the output gap appeared to be quite unstable, however it was improved by excluding the outliers from the model. Two lags of both output gap and inflation are included into the moving average. Chow breakpoint test indicated that there is a structural break in the first quarter of 2002.

Figure 13

Estimation output for UK (dependent variable: inflation đ)

	Coefficient	Std. Error	t-Statistic	Prob.
C	–0.023551	0.021764	–1.082099	0.2857
α	0.831766	0.104248	7.978713	0.0000
β	0.025411	0.009042	2.810265	0.0076
γ	0.002084	0.000724	2.877403	0.0064
γ(1)	–	–	–	–
γ(2)	0.001140	0.000671	1.700081	0.0980
δ	0.019924	0.006529	3.051566	0.0040
Structural Break	0.079715	0.025725	3.098722	0.0035

Source: Author's estimations based on data acquired from Eurostat statistical database.

For most of the countries influence of the changes in oil prices on inflation appeared to be highly significant at 95 and even 99 percent confidence level. The results also show that for six members (discussed further on) more than one lag of oil price change appears to influence inflation in a certain period, indicating that the impact of oil price rise should take several quarters to reach its' full strength. A detailed analysis of the strength and timing of the effects is presented in the fifth chapter.

6. Output Analysis

As the regression output has shown, an oil price change is highly significant for 6 countries studied. A clear difference between effective number of lags and the overall strength of the effect can be easily observed. While for countries like Norway, Finland and Ireland a change in oil price seems to be responsible for a significant share of total changes in CPI, United Kingdom and Italy seem not to be affected almost at all. In addition, the timescale of the impact also differs substantially. My further analysis focuses on two major sub-topics. First, I study the relation between overall strength of the impact and the oil intensity of the economy. In another words the more oil a particular country uses to produce GDP, the higher should be inflations reaction to an increase in the price of crude petroleum. Second, the differences in the timing and the strengths of the effects should depend on the labour market flexibility level of a country. Indeed, since the second-round effect is caused by wages, adjusting to an external shock, more rigid labour markets will tend to observe an increase in the nominal wages. This will lead to higher labour costs which will then be transferred to higher prices for products not related to oil. The chapter proceeds as following: first, I examine the relation of the overall strength of the impact with an oil intensity of the economy. Second, a dependence between timing, second-round effects' strength and the degree of labour market flexibility of a country is studied. Finally, I create a generalized equation summing the findings.

6.1. The Strength of the Impact and Oil intensity

As simple logic may suggest, the inflation vulnerability to external oil price shock should depend on a relative importance of this factor input for the general economy. Indeed, the more oil a country uses to produce its' GDP, the larger should be the extent to which it would be affected by a change in the price of crude petroleum. These process may be addressed to as cost effect, described in the second chapter. Since a company which uses oil to produce its' product will face increased costs as a result of negative oil supply shock, the price for the product will rise to compensate the effect. Of course, this process may have substantially different results, depending on the degree of competition and structure of a particular industry. Firms facing a more competitive environment are likely to hold their prices closer to the original levels, since a sufficient increase will discourage potential customers. Also, if there is a possibility of switching to another input, for instance bio-fuels, the effect would be offset. Unfortunately, a detailed analysis of this matter lies beyond the topic of my work.

In order to assess the relation between inflation vulnerability to oil price shock and oil intensity of the economy I check, whether the countries, affected most, do depend on the petroleum more than the rest of the members studied. To do this I first calculate a relative importance of the oil for each economy by dividing gross domestic product by gross inland consumption of oil (in tons) in the same year. The results are presented in the first row in the table as an average between 1995 and 2007 (sorted by oil intensity from most to least). The second row is an estimated gross effect on inflation of a 10 percent increase in the price of oil, acquired by summing all the lags significant at 90% confidence level.

Figure 14

Relative usage of oil by members studied

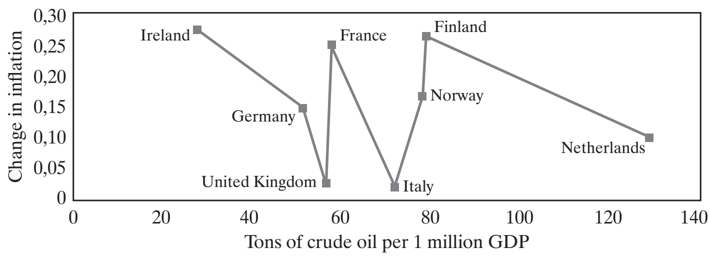
	Nether-lands	Fin-land	Norway	Italy	France	United King-dom	Ger-many	Ire-land
Intensity	128,77	78,73	78,36	72,26	57,92	56,56	51,56	28,39
Gross eff.	0,104	0,269	0,24	0,026	0,249	0,03	0,153	0,276

Source: Eurostat statistical database and Author's estimations based on Eurostat statistical database.

The results are in no way proving the hypothesis. The Netherlands, being the country with the most oil-intensive economy is among the members affected to the lowest extent. Ireland does not fit the picture at all, with highest gross impact and lowest oil intensity. The other countries seem not to suite the relation as well. A number of different indicators for energy intensity of the economies was used including real energy intensity (Christie, 2009), still they did not yield an acceptable relation. Surprisingly, the oil intensity and the inflations vulnerability to an oil price shock do not seem to be correlated at all. A graph is presented to illustrate this in a more transparent way:

Figure 15

Oil intensity and the strength of the impact



Source: Eurostat statistical database.

Now we can see that the correlation between factors mentioned seems not to exist at all. If it would, then the line should have been an upward sloping, with inflation response increasing with oil intensity. This suggests that the reason behind asymmetrical responses is not related to the relative usage of crude oil by countries. This also means that either the cost effects strength does not depend on the oil intensity of the industry or the strength of this effect is largely overestimated. In the latter case the members would still differ according to the relative usage of oil by economies. However, the difference would be insignificant as the cost effects are too small, compared to the other effects. This leads us to the following conclusion: the asymmetrical responses are driven not by cost effects, and consequently oil intensities of the economies, but instead the direct and second-round effects are responsible for the asymmetry. Demand effects mostly cause stagnation because of decreased disposable income and costly reallocation procedures, so the impact on inflation is rather poor. As discussed earlier, second-round effects should depend on the degree of flexibility of national labour markets, this is to be discussed in the second part of this chapter, while here an analysis of direct effects is presented.

6.2. Direct Effect

Let me shortly recall the explanation of a direct effect. The European method to measure the inflation is based on the changes in Harmonized Index of Consumer Prices (HICP). One of the components the index is composed of is liquid fuels, the relative importance of which is presented in the table below:

Figure 16

Fuel weight in HCPI

	Netherlands	**Finland**	**Norway**	**Italy**	**France**	**UK**	**Germany**	**Ireland**
HCPI (%)	3,8	5,4	4,5	3,6	4,9	3,5	4,8	5,0
Gross effect	0,104	0,269	0,246	0,026	0,249	0,03	0,153	0,276

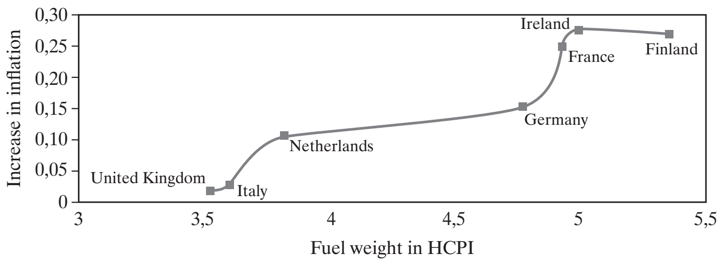
Source: Eurostat statistical database and Author's estimations based on Eurostat statistical database.

The data is taken from the Eurostat statistical database and represents an average from 1998 till 2008. Again, to make it more transparent I present a graph, similar to the previous one, with an impact of a 10 percent increase of oil price on inflation and the weight of fuels in HCPI for a particular country. Norway is excluded from the graph, as it shows significantly different labour market regulations, which tend to play a relatively more important role than in the other countries studied. This case is discussed in the next part of the chapter.

Summary is presented below:

Figure 17

Inflation response and fuel weight in HCPI



Source: Eurostat statistical database and author's estimations based on Eurostat statistical database.

The correlation impresses. While using an oil intensity of the economy as an explanatory variable gives us a totally misleading picture, introducing fuel weight in HCPI provides substantially different results. The line behaves almost perfectly, all points contribute to the general picture, except Ireland, which despite the relatively lower weight of fuel in its' HCPI structure, faces higher increase in inflation than Finland. However, the overall picture still impresses. In order to make the results even more convenient, I run a simple panel regression (excluding Norway), changes in inflation being a dependent variable and fuel weight in HCPI being the explanatory: $\Delta\pi = c(1) + c(2) * FUELW$ (6), the results are presented in Figure 18.

Figure 18

Correlation between gross impact and fuel weight in HCPI

	Coefficient	Std. error	t-Statistic	Prob.
C(1)	–0.464253	0.087873	–5.283224	0.0032
C(2)	0.140195	0.019596	7.154254	0.0008

Source: Author's estimation based on data acquired from Eurostat statistical database.

Obviously the model passes all the tests, the discussion of which is not presented here. The R-squared value is 90 percent. The output suggests that if one more percent of the total basket value is spent on fuels, than the inflations reaction to a 10 percent increase in the price of oil would rise by 14 percentage points.

As it appears, different responses to the same oil price shock are most likely to be caused by the method, the country structures its' consumer price index. By definition, the structure of HCPI for a particular country represents the structure of spending, an average household faces in a certain period. This means that the more a regular man spends on fuels in a country, the harder this country would be affected by an oil price shock.

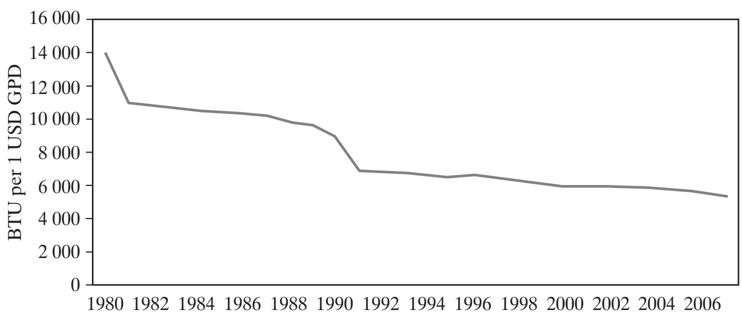
Of course, the direct effect is not the only driving force behind regional asymmetry. Although the cost effects seem to be relatively low, second-round effects can still influence the situation. Consider the following logic: prices for goods do not rise because firms face higher factor input costs, but more likely, because employees ask for higher wages as a consequence of lower disposable income caused by higher gasoline prices (at least the rise is more noticeable). If it is so, than the influence of cost effects is highly limited, if not irrelevant.

Although the direct effect efficiently fits the overall picture, the cost effect, being the most intuitive one, for some reasons does not have a sufficient significance for my subject. Before proceeding on to the labour market flexibility discussion I want to try and shortly explain the reasons for such a phenomenon. I see three possible explanations for weak cost effects.

The first reason is the general trend towards reducing the energy intensity of the major economies in European Union. Let's take a closer look at the following graph:

Figure 19

Energy intensity dynamics, 1980–2006



Source: The Titi Tudorancea Bulletin, Energy Intensity – Total Primary Energy Consumption per Dollar of GDP.

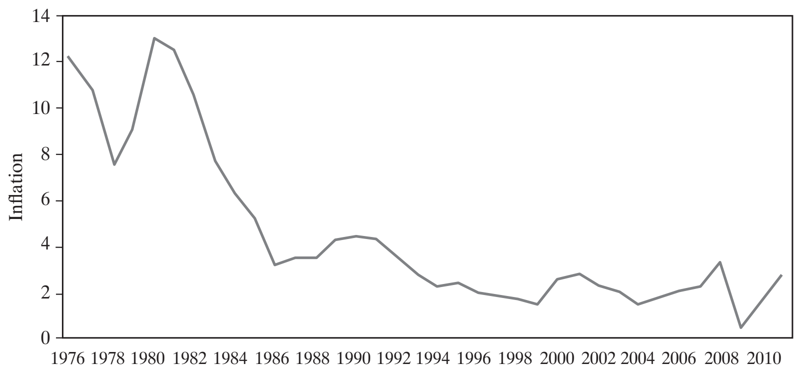
It represents total primary energy consumption (British Thermal Unit) per dollar of Gross Domestic Product in EU. As we can see, the energy intensity in Europe has fallen on average more than 50% between 1980 and

1994, implying a dramatic decrease in the significance of cost effects to the general price level. In our sample studied, the overall significance of the oil appears to be much less for the general economy than it used to be. Consequently, this means that although the cost effects still do exist in the modern economy, their relevance is expected to be about 50 percent lower than in 1980s. Firms, on average probably will simply not consider a change of a factor of such a small importance. In addition, an ongoing process of globalization and increased competition puts an additional pressure on producers in a more competitive environment. Those companies will most likely decrease their profit margins in the periods of increased price of oil than give their opponents a chance to capture additional market share.

Second, there is a clear tendency of a decreasing inflation across all countries studied. Again, let's take a look at the graph:

Figure 20

Inflation dynamics 1976–2010



Source: OECD statistical database.

It represents an average percentage change of CPI calculated from the members studied. It is easily seen that in the sample period, inflation is significantly less than it used to be several years ago. What does this mean for the price-setting process of firms? The logic is pretty straightforward, if a firm constantly exists in a highly inflationary environment, it will tend to adjust its' prices more frequently in order to have the same real income. Expected inflation in periods of high inflation is also higher, putting a significant pressure on the future prices for goods. However, an environment with lower inflation and consequently lower expected inflation does not have that intense effect. Indeed, changing prices for products is costly for firms (as it might trigger a continuous process of reallocations and modifications), and if the cost is comparatively higher than a decrease in real earnings, raising the prices is not a wise decision (at least in the same period). In addition, the prices tend to be sticky in the short run. This also makes price-adjustment process to occur less frequently, especially if the external shock has little impact (Hall, 2007). Finally, combining with the previous factor it can be stated that in times of lower general inflation level and oil, being less significant for the production process, firms will tend to pay less attention to the changes in the prices of crude petroleum. This might dramatically decrease the significance of cost effect.

Third, the methodology and data frequency chosen simply may not be able to fully trace the cost effect. The process of changing prices might take months or even years under the influence of dozens of different factors. In this framework, regression analysis is not able to adequately assess the importance of cost effects on such a continuous process. Using macroeconomic modeling should be more efficient for this purpose, however the usage of such an advanced technique lies beyond the framework of the current work. Still, cost effects are responsible for about 10 to 20 percents (depending on the type of model chosen) of a total impact of oil price change (see, for example Alvarez, 2009), meaning that their importance is relatively low.

6.3. Second-round effects

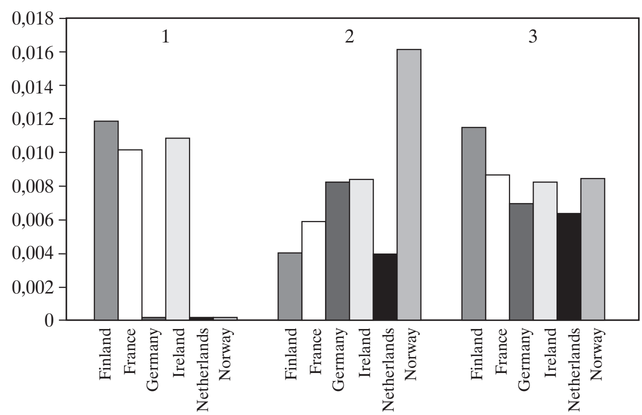
The relevance of cost effects and consequently oil intensities of the economies for cross-regional differences is highly limited. The answer to the question why some countries observe stronger inflationary effects after oil price hike than the others should be instead found in the weight of fuel in HCPI of a particular country. However, this does not explain all cases of asymmetry. As it appears, the countries show significantly different dynamics of the process. For instance, in Germany and Ireland the impact tends to decrease over time, indicating that the second-round effects are weak. In Finland and Norway, on contrary, second and third lag of a change in oil price show the same strength as the first one, suggesting that those countries observe relatively higher second-round effects.

Before proceeding further I would like to briefly remind the reader how actually the second-round effect occurs. The basic process is rather simple: since the real wages of the workers decrease as the result of direct and possibly cost effects, employees will tend to ask for higher wages in the subsequent wage-bargaining rounds. Producers will then face higher costs, and will respond by raising prices for their products, decreasing profit margins or a combination of both, depending on the level of competition in the industry. Again, the prices would rise and real wages would fall, triggering higher inflationary expectations and higher nominal wage demanded in the next wage-bargaining rounds. Eventually, a wage-price spiral may develop (further upward shifts of the AS curve due to shifts in expectations). This will increase the overall strength of the oil price shock impact on inflation and make it more scattered over the time.

However, the relevance of this effect is crucially dependent on the employees' ability to ask for higher wages, in another words – their bargaining power. If the workers are able to bargain for higher wages relatively easier in a particular country, second-round effect would tend to be stronger. Before proceeding with analyzing labour market flexibility I present a diagram, showing relative importance of each lag of oil price change for all the members except United Kingdom and Italy, due to the fact that oil price increase is almost insignificant for them.

Figure 21

Oil price changes lag values



Source: Author's estimation based on data acquired from Eurostat statistical database.

As noted earlier, Norway was excluded from HCPI structure analysis due to the fact that it might depend relatively more on effects, other than direct one. As we can see from the chart, the influence is transferred by second and third lag, the first one being not important. This suggests that second-round effects play a significant role in this country. Finland also shows a bit unusual behaviour: first and third lags are almost equal, while the second one is relatively lower. This also suggests a strong presence of second-round effects. The rest of the countries seem to behave quite well, with a slight tendency of a decreasing influence over the time. The Netherlands might also be considered as an unusually behaving country, however the gross effect is limited and thus I cannot conclude for sure whether it will be able to trigger higher inflationary expectations or not.

In order to analyze the reasons behind an unusual dynamics of Norway and Finland I would like to take a closer look at several labour market characteristics. Unfortunately a detailed analyses of second-round effects and labour markets lies beyond the scope of this paper, thus the research is rather brief and only tries to assess the major principles, governing those effects. For a more precise and detailed overview an accurate decomposition of the reaction of nominal wages to oil price shock is needed, so it can clearly define the countries with strong second-round effect and differentiate it from the direct one.

In my analysis of the labour market 2 indicators are used, the first one is a level of strictness of Employment Protection Legislation (EPL) indicator published by OECD commission. It assesses how problematic and costly firing is for the employer, 6 being the most strict environment. The second indicator is a so-called labour union density, which shows the relation between the number of union members and total number of employees. In another words it assesses the level of unionization of a labour market. Both indices represent an average for the period 1995–2007, calculated for each country separately. I assume that these indicators, if combined, can adequately assess the level of bargaining power that workers have in a certain country. Here, I do not study the degree of automatic wage indexation in a country and its' relevance for second-round effects since this mechanism is only applied in Spain (out of the sample studied). The rest of the countries do not have this type of mechanism, or its' coverage is relatively weak (Caju, Gautier, Momferatou, Ward-Warmedinger, 2008). The summary of relevant factors is presented in the following table:

Figure 22

Labour market indicators

	Finland	France	Germany	Ireland	Netherlands	Norway
EPL	2,06	3,02	2,35	1	2,3	2,63
Unionization (%)	75	8	24	38	23	55

Source: OECD Indicators of Employment protection.

Let's take a closer look at the data. If we consider an EPL indicator, France and Norway are the countries with the most strict labour protection legislation while Finland and Norway have the highest unionization levels across members studied. As intuition suggests, those three countries should have relatively stronger second-round effects then the rest of the members. Recall the chart I've presented. There is a connection between irregular behaviour of a country's inflation and bargaining power of employees within it. Consider Norway for example: if we combine the two indicators, we may conclude that it has the most beneficial environment for the wage bargaining process. My estimation shows that the impact is significantly higher than that of countries with the same fuel weight in HCPI. Since I've concluded that the cost effects are comparatively weak and demand effects mostly influence the GDP growth level, the analysis suggests that Norway experiences significant second-round effect. The other two countries with relatively higher bargaining power are France and Finland. They both show quite an unusual dynamics, with first and third lags being almost equal. This also strengthens a possible correlation.

However, the relation is far from being perfect. Take a closer look at Ireland: the wage bargaining process here is far less suitable for employees than in the rest of the countries. This should result in a noticeable decrease of a shock's influence over the time, as nominal wages will not rise. However, the results show only a slight tendency of a decreasing influence. What can be concluded from the analysis is that the relation does exist for sure. Second-round effects and unusual dynamics tend to be related to the labour market flexibility of a country. Unfortunately, the investigation is not complete, no absolute evidence has been found that might explain completely this relation. A more advanced method should be used, so that the reaction of nominal wages is decomposed as a function of oil price shock, providing a much more accurate data to work with. Still, this matter needs further investigation and might be a topic for future studies.

6.4. Presenting The Results: Generalized Equation

In order to provide a more complete understanding of my work I build a generalized equation, which strives to sum all my findings. It presents the overall impact's strength as a function of direct, cost and second-round effects. It does not take into account specialized cross-country differences, only explaining the general dependencies.

Let's start with a gross effect as being the sum of direct, cost and second-round effect:

$$X = X_1 + X_2 + X_3 \tag{7}$$

X – gross effect, X_1 – direct effect, X_2 – cost effect, X_3 – second-round effects.

The direct effect is linearly correlated with the fuel weight in HCPI of a particular country, β, and an change in the price of oil:

$$X_1 = C_1 + \alpha_1 * (\Delta P * \beta) \tag{8}$$

C – constant, P – oil price, α – multiplier factor.

The cost effect is linearly correlated with the oil intensity of the economy, δ. Although my results do not show that this effect is significant, the theory strongly proves its' existence. Thus, it is included for completeness:

$$X_2 = C_2 + \alpha_2 * (\Delta P * \delta) \tag{9}$$

Note, that both the constant and multiplier factor are much lower than in (2).

To allow for second-round effects, I express them as a sum of initial effects (direct and cost), multiplied by a function of labour market flexibility, since the level of bargaining power will determine the strength of a transfer of direct and cost effects to an increase in nominal wages and consequently to second-round effects:

$$\begin{aligned} X_3 &= [X_1 + X_2] * f(b.p.) = \\ &= [(C_1 + \alpha_1 * (\Delta P * \beta)) + (C_2 + \alpha_2 * (\Delta P * \delta))] * f(b.p.) \end{aligned} \tag{10}$$

The function responsible for bargaining power ($f(b.p.)$) is likely to be a non--linear function and include several different factors, indicating labour market flexibility level.

Finally, integrating (2), (3) and (4) into (1) gives us:

$$\begin{gathered} X = X_1 + X_2 + X_3 \\ X = C_1 + \alpha_1 * (\Delta P * \beta) + C_2 + \alpha_2 * (\Delta P * \delta) + [(C_1 + \alpha_1 * (\Delta P * \beta)) + \\ + (C_2 + \alpha_2 * (\Delta P * \delta))] * f(b.p.) \end{gathered} \tag{11}$$

Simplifying (5) and presenting the sum of the constants as C finally gives us:

$$X = C + \alpha_1 * (\Delta P * \beta) + \alpha_2 * (\Delta P * \delta) + [C + \alpha_1 * (\Delta P * \beta) + \\ + \alpha * (\Delta P * \delta)] * f(b.p.) \tag{12}$$

Holding other things constant and in the framework of a single monetary policy in, a country's strength of inflation reaction to an oil price shock is:
1) Positively linearly related with the fuel weight in HCPI.
2) Positively linearly related with the oil intensity of the economy.
3) Positively non-linearly related with the level of labour market flexibility.

My study concludes that for the countries in European Union to determine the strength of the impact the most important parameters are: fuel weight in HCPI (α_1) and the degree of labour market flexibility ($f(b.p.)$), however the latter one's mechanism of influence still needs further investigation.

Conclusions

Currently, the asymmetric reactions of EU members to the same external macroeconomic shocks represent a serious concern for policy makers. For a common monetary policy to be efficient a similar reaction to the shocks across the members is a prerequisite. Monetary contraction which is imposed in EMU to offset the positive effect of oil price rise on inflation is inadequate. In countries such as Norway and Finland the tightening level might be too small, not being able to accommodate inflation properly. However, with ECB stress on price stability this is unlikely to happen. What is more bothering is that the contraction level might be excessively high for countries experiencing milder effects. It causes even more asymmetry and also depresses the GDP growth, reduces demand and puts a recessionary pressure on the economy. It is likely that different behaviour of economies would also follow other types of macroeconomic shocks, causing serious difficulties in applying a common monetary policy. This problem should not be underestimated, especially taking into account current unstable situation in European Union. The only way of coping with this is taking a course to decrease the asymmetry between member states as far as it is reasonably possible. While the asymmetry caused by direct effects is almost impossible to deal with (imagine ECB forcing households across countries to spend exactly the same amounts on gasoline), second-round effects can actually be delivered to the same level. What is needed, is to reduce the institutional divergences in labour markets across European Union. This will significantly decrease the differences between second-round effects across EU members. Taking into account the latter EMU enlargement makes this even more important, since several members possess quite a high level of automatic wage indexation (e.g. Cyprus, Malta and Slovenia), leading to an increased asymmetry. Currently the EU policymakers have much more important issues to deal with, for instance public debt accumulation. Still, a long-term aim to converge institutional frameworks of labour markets needs to be established, so the whole union is able to function properly.

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The Reasons Behind Asymmetric Responses of Inflation to an Oil Price Shock Across the EU members

Summary

In this article, I have analysed the impact of an oil price shock on major EU economies and explained the reasons responsible for asymmetric responses of inflation across members studied. The results of the study have much in common with other similar research, however several findings still need to be cited. First, oil intensity of the economy is not the main determinant of the impact's strength across the EU members. It is due to the fact that companies observed a substantial decrease in the relative oil usage in the production process during past 30 years. This, together with low inflationary environment and increased level of competition makes the adjustment of product prices to the increased price of oil negligible and sometimes too costly. Second, the direct effect and consequently weight of fuel in HCPI is responsible for a significant share of cross-country differences. My study finds a strong relation between the strength of the impact and HCPI's structure, suggesting that the pass-through is crucially dependent upon the households' relative spending on fuels. Third, second-round effects cause another noticeable share of differences across the EU members. Their strength is strongly correlated with the level of bargaining power employees have, supporting the initial hypothesis. In addition, the degree to which the effect of oil price shock is scattered over time is also affected by labour market flexibility level. Finally, the pass-through coefficients are relatively small, supporting Blanchard's (2007) findings, which state that the effects of oil price change on inflation have become relatively mild, compared to the 1960–1970s period.

Przyczyny asymetrycznych reakcji inflacji po szokach naftowych między członkami Unii Europejskiej

Streszczenie

W artykule przeanalizowano wpływ wzrostu ceny ropy naftowej na największe gospodarki UE i wyjaśniono przyczyny asymetrycznego oddziaływania inflacji w badanych krajach. Wyniki pracy są spójne z innymi badaniami na ten temat, jednak niektóre kwestie muszą być przedstawione

oddzielnie. Po pierwsze, ropochłonność gospodarki nie jest głównym czynnikiem decydującym o sile oddziaływania zmiany ceny na inflację. Wynika to z faktu, że firmy obserwowały znaczne zmniejszenie zużycia ropy naftowej w trakcie procesu produkcyjnego w ostatnich 30 latach. To, wraz z obniżeniem ogólnego poziomu inflacji i wzrostem poziomu konkurencji, sprawia, że dostosowanie ceny produktów do wzrostu ceny ropy staje się znikome, a czasem zbyt kosztowne. Po drugie, bezpośredni efekt, a w konsekwencji względna masa paliwa w HCPI, są odpowiedzialne za znaczną część różnic w całym kraju. Moje badanie wykazuje silny związek pomiędzy siłą oddziaływania i strukturą HCPI, co sugeruje, że współczynnik regresji przy zmiennej γ jest w znacznym stopniu uzależniony od względnej ilości wydatków gospodarstw domowych na paliwo. Po trzecie, efekty podnoszenia płac z powodu wzrostu cen są odpowiedzialne za kolejną znaczącą część asymetrii między członkami UE. Ich siła jest skorelowana z poziomem siły przetargowej pracowników, co potwierdza początkową hipotezę. Ponadto, na stopień, w którym efekt wzrostu cen ropy naftowej jest rozłożony w czasie, wpływa także poziom elastyczności rynku pracy. Na koniec, współczynnik regresji przy zmiennej γ jest stosunkowo mały, co potwierdza wyniki Blanchard'a (2007), które sugerują, że oddziaływanie zmiany ceny ropy na inflację drastycznie zmniejszyło się w porównaniu z okresem 1960–1970.

Причины ассиметричных показателей инфляции как результата шоковых цен на нефть в странах-участницах ЕС

Резюме

В статье представлен анализ влияния роста цен нефти на экономику крупнейших стран ЕС и содержится попытка выяснения причин ассиметричного воздействия инфляции в исследуемых странах. Результаты исследования соотносятся с другими исследованиями, посвящёнными данной тематике, однако некоторые вопросы должны быть представлены обособленно. Во-первых, нефтеемкость экономики не является основным фактором, определяющим степень влияния изменения цен на инфляцию. Причиной служит тот факт, что компании наблюдали значительное уменьшение расхода нефти в ходе производственного процесса в течение последних 30-ти лет. Это, наряду с понижением общего уровня инфляции и повышением уровня конкуренции, приводит к тому, что процесс приспособления цен товаров к возросшей

цене нефти становится ничтожным, а порой слишком дорогостоящим. Во-вторых, прямой эффект, а в итоге относительная масса топлива в HCPI (Гармонизированный индекс потребительских цен), отвечает за значительную часть различий между исследуемыми странами. Данное исследование даёт возможность обнаружить сильную связь между степенью влияния и структурой HCPI, что наводит на мысль о том, что коэффициент влияния изменения цены на нефть в значительной степени зависит от относительного количества затрат индивидуальных хозяйственных потребителей на топливо. В-третьих, результаты повышения заработных плат вследствие роста цен отвечают за очередной значительный элемент асимметрии между странами-участницами ЕС. Их уровень коррелирует с уровнем переговорной силы работников работников, что является подтверждением первоначальной гипотезы. Кроме того, на уровень, в котором результат роста цен на нефть распределён во временном отношении, влияет также степень эластичности рынка занятости. И, наконец, коэффициенты влияния изменения цены на нефть относительно малы, подтверждением чего являются результаты Blanchard'a (Бланшара) (2007), которые наводят на мысль о том, что влияние изменений цен на нефть на инфляцию резко уменьшилось по сравнению с периодом 1960–1970 гг.