THE IMPACT OF OIL PRICE FLUCTUATIONS ON THE UKRAINIAN ECONOMY

by

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Abstract

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It is well known that Ukraine is underendowed in such strategic resources as gas and oil, and taking into account that it specializes in the production of machinery and chemicals, which are highly oil-energy consuming, Ukraine is greatly dependent on the rest of the world. In order to satisfy all internal needs it has to import crude oil from abroad. The goal of this paper is to examine the dependence of Ukraine on the world oil market and to estimate the impact of possible changes in oil prices on main Ukrainian economic indicators, such as output, unemployment, and general price level. Using an approach proposed by Gisser and Goodwin (1983) it can be shown that oil price fluctuations affect Ukrainian GDP and inflation, but have no effect on unemployment at different lags at any statistically significant levels. The results of Error Correction Model indicate that Ukraine will likely face a loss

in nominal GDP equals approximately $215 mln during the first quarter as a response to a 20% increase in the price of oil. This result is close to that obtained by IMF (2000), taking into account that they simulated longer period. Indicators monetary and fiscal policies both have the expected signs and positively affect GDP, but they are not a matter for unemployment. A detailed explanation for this result is also presented. As economic theory suggests, monetary policy has greater effect on the main economic indicators than fiscal policy. The thesis then provides possible explanation of the obtained results and their economic meaning. Finally, it gives the description of possible policy implications and the direction for further studies.

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GLOSSARY

Barrel (bbl). A unit of capacity usually used to measure oil. Contains approximately 159 liters or 35 gallons. Conversion factor from barrels to tons fluctuates from 7 to 9 barrels per ton depending on oil density.

Druzhba (friendship) and **Pridneprovskie Magistral'nye Nefteprovody (pridneprovsk trunk pipelines).** Compose a system of two separated Ukrainian pipelines joining Russia with the Western Europe with total extent of 3850 km and total output capacity of 67.2 mln. tons of oil annually.

Naftogas of Ukraine. National oil and gas state-run company, created in 1998 in order to control the domestic market.

OPEC. Organization of Petroleum Exporting Countries.

INTRODUCTION

The oil shocks over the last few decades have had a profound effect on the growth prospects of both the oil-exporting and oil-importing countries. Taking into consideration the ever-growing needs for oil and gas in order to satisfy production, it is clear that countries that lack these resources are highly dependent on the rest of the world and are more sensitive to economic performance fluctuations.

In the fall of 1973 the whole world economy faced an energy crisis after OPEC countries almost tripled prices for crude oil. Since this organization accounts for about 60 % of world oil trade and about 40 % of world production, the impact of its price increases on the world economy was significant: the majority of oil-importing countries faced declines in economic growth; output and exports in many countries decreased significantly accompanied by rising inflation and unemployment, giving rise to the phenomenon of stagflation. Numerous studies were carried out to investigate possible effects of oil price fluctuations on the main economic indicators of oil-importing countries. Hamilton (1983) was the first to report the econometric correlation of oil shocks with U.S.A. business cycles and GDP growth. Later a strong relationship was found in many countries between oil price shocks and the levels of investment and inflation (Gisser and Goodwin, 1986), employment (Haltiwanger, 1999) as well as the trade balance (IMF, 2000).

It is well known that Ukraine is underendowed in such strategic resources as gas and oil. Taking into account its major export products (metal and chemicals), which are highly energy intensive, Ukraine is greatly dependent on energy sources. Over the period 1991-2001, Ukraine maintained the oil production at approximate 90 thousand barrels per day, which satisfies only 25% of internal needs. Ironically, Ukraine exports some refined products,

while the domestic agricultural sector cannot find the fuel to ensure sowing in spring (the volume of export is not very large). In order to provide the economy with the necessary amount of oil, Ukraine has to import the rest (nearly 75%) from abroad. The share of oil and refined products costs in total import costs is about 40% and contributes approximately $5 bln. annually (about 13% of 2001 nominal GDP)[1]. Oil is mainly imported from Russia and Kazakhstan (however, it should be underlined that Russia can affect the amount of imported oil from Kazakhstan by imposing quotas, because the pipeline belongs to the former). Several years ago, Russia raised the price for export products. Ukraine, which had no alternative source to import from, suffered as a result. On the other hand, Russian prices for oil are strongly affected by OPEC prices. As a result, the Ukrainian economy is tightly connected with world prices for energy resources.

The goal of my thesis is to analyze the impact of possible changes in world oil prices on the main Ukrainian economic indicators, such as GDP, unemployment, and inflation. To understand the importance of the impact of raised prices, let us recall recent military actions in the Persian Gulf, when Iraq's troops occupied Kuwait and seized its oil deposits. The result is well known – the overall price of crude oil rose dramatically accompanied by a crisis at leading stock markets. Taking into consideration that Ukraine's exports are mostly concentrated in metallurgy, machinery and chemicals (about 50%) which are the main consumers of oil, it is obvious that there is a strong connection between prices for fuel resources and overall Ukrainian well-being. Thus, it could be easily predicted that the price increase would cause significant decline in GDP as well as employment

Recent studies, conducted by IMF (2000) investigate the impact of $5 per barrel increase in oil price on the performance of transition countries. They applied a cross-country MULTIMOD simulation model, and found out that

[1] IMF (2001) "*Ukraine: Statistical appendix*"

Ukraine will face a 1.4% decline in GDP ($390mln)[2] due to first round effects. However, this result is under considerable doubt, since in the simulations the 2001 oil price was assumed to be constant at $23 per barrel while the actual price remained highly volatile due to the subsequent OPEC behavior and to recent terrorist attacks in America (with more then $26 per barrel on average before September 11 and about $18 after the attacks). Such dramatic fall in price (30%) was caused by several reasons. First, decline in demand for aircraft fuel by air companies (by 20%)[3] in response to decrease in demand for air flights. Second, by overall slowdown of economic growth in the USA, who is known to be the largest consumer of crude oil in the world (the United States consume 27% of the world consumption). Third, rather warm winter in some American States. It was noted that oil consumption is subject to seasonal patterns (peaks of consumption are observed in 4th quarter with troughs in 2nd quarter[4]. The volume of heating oil consumed by the USA is increasing over the last years, so it seems reasonable that demand for fuel falls as it becomes warmer.

In this paper I use a slightly improved model proposed by Gisser and Goodwin (1986). They estimate St. Louis - type equations of four indicators of macroeconomic performance, namely, real GDP, general price level, rate of unemployment and real investment; while oil prices, money supply, and high-employed budget expenditures serve as exogenous variables. They empirically tested their model for the U.S. economy, and found that a 10% increase in oil price growth rate causes a 1,1% decline in real GDP growth rate as well as a 0,86% decrease in general price level during the first 12 months. For the Ukrainian case these figures are expected to be higher because of great dependence on oil, terms of trade effects (Ukraine does not export crude oil), and due to the absence of appropriate policy response. In the absence of international assistance, the inability to operate in private

[2] In fact, nominal Ukrainian GDP in 2001 amounted UAH 191250 bln and 1.4% constitutes UAH 2677.5 bln or $505 mln if the value in Hryvnas is divided by average exchange rate.

[3] "Troyka-dialog", *monthly report, February 2, 2002*

[4] IMF (2000); "*The impact of higher oil prices on the global economy*"

capital markets is likely to make the impact of oil shocks greater, primarily due to a reduction in domestic demand.

Investigating the impact of oil price fluctuations on the Ukrainian macroeconomy can serve as the key to understanding the formation of macroeconomic parameters which predetermine social and economic development. Moreover, government policies, which can smooth the negative impacts, will be more efficient in the light of the results. Many studies support the idea that monetary policy is the best tool to cope with undesirable effects of higher oil prices. For example, Gisser and Goodwin (1986) suggested in a statistically valid manner that fiscal policy was insignificant in the U.S. over the last 25 years. On the other hand, monetary policy turned out to be significant in the first period and then its effect gradually disappeared over time. The results of many studies are based on the presumption that monetary policy rather than fiscal policy is the powerful tool to smooth fluctuations due to oil shocks.

Chapter 1

LITERATURE REVIEW

Since the aim of my work is to investigate the relationship between oil price fluctuations and such macroeconomic indicators as GDP, unemployment, wages, export and output, in this chapter I attempt a brief overview of the modern economic treatment of this connection and present its results.

1.1. Oil shocks issue in modern economy

Many researchers agree in opinion that no other economic event in post World War II era generated as much attention as the series of oil price shocks, mainly produced by OPEC countries. No studies were necessary to see the clear relationship between oil prices and main economic indicators. Nevertheless, this issue was new and researchers posed such a question as the numerical impact of oil shocks and their correlation with the policy conducted by government in order to predict the best instrument to cope with the negative impacts caused by oil price increases. Since then a large number of studies have reported a correlation between increases in oil prices followed by economic downturns. Examples include Fried and Schultz (1975), Rasche and Tatom (1977,1981), Burbridge and Harrison (1984), Mork (1989), and many others.

Particularly, Hamilton (1983) investigated the impact on the US economy. His evidence suggests that crude oil prices have a strong relationship with the US business cycle and tends to highlight cost-push inflationary effects, while the research of Berndt and Wood (1975,1979) as well as Wilcox's (1983) indicates the complementarity between energy prices and capital in the US economy is rather strong, both before and after 1973. Hence, oil price shocks may have a stronger effect than generally believed. These results were later extended by Mork (1989) and Hooker (1999) who argued that asymmetric

and nonlinear transformations of oil prices restore that relationship, and thus the economy responds asymmetrically and nonlinearly to oil price shocks.

Later Hamilton (2000) reported clear evidence of nonlinearity-oil price increases are much more important than oil price decreases. An alternative interpretation was proposed based on the estimation of a linear functional form using exogenous disruptions in petroleum supplies as an instrument. His study shows that oil shocks play a crucial role in determining macroeconomic behavior because they disrupt spending by consumers and firms.

1.2. Approaches to estimation of impacts of oil shocks

One approach to investigate this relationship was presented in "Crude Oil and the Macroeconomy: Tests of Some Popular Notions", (1986), in which M.Gisser and T. Goodwin tried to summarize results based on the previous research. They formally tested three hypothesis associated with the 1983 energy crisis:

1. That the impact of oil price shocks is largely in the form of cost-push inflation.
2. That crude oil prices affected the macroeconomy very differently before and after 1973.
3. That crude oil prices are determined very differently under the post-1973 institutional regime than under the pre-1973 regime.

In my work I will analyze the possible relationship starting from 1991, so the third hypothesis is not of interest. To check the remaining hypotheses the authors employed a reduced-form approach for US economy. One approach to investigating the first notion is to estimate St. Louis- type equations of four indicators of macroeconomic performance, namely, real GDP, general price level, the rate unemployment and real investment. Each equation takes the form:

$$X_t = \alpha_0 + \sum_{i=0}^{4} m_i M_{i-1} + \sum_{i=0}^{4} f_i F_{i-1} + \sum_{i=0}^{4} o_i PO_{i-1} + \varepsilon_t$$

where $\mathbf{X}_t$ is the indicator of macroeconomic performance, $\mathbf{M_{t-1}}$ is the money supply (M1B), $\mathbf{F_{i-1}}$ is the high employment federal expenditures measure of fiscal policy and $\mathbf{PO_{i-1}}$ is the real price of crude oil. The impact of monetary and fiscal policies on real GDP turned out to be statistically insignificant, while a 1 % change in oil price reduces GDP by 0.11 % with 5 % level of significance. The results for the price deflator are very different. Here monetary policy dominates in size, while 1% change in oil price causes the price increase by only 0.086 %. However, comparing the contribution to $\mathbf{R^2}$, they found out that oil price contributes approximately 55% in both regressions. The same feature was observed in the next regression, where oil price change leads to a 0.69% increase in the unemployment rate and to a 0.32 % decrease in investment in the first-round effect and 0.32% and -0.25% in following years respectively. So, the authors concluded that crude oil prices have had a significant impact on a broad range of macroeconomic indicators, often exceeding that of monetary policy and always exceeding that of fiscal policy.

Although many studies have been devoted to the impact of oil price increases, rather less attention has been paid to the role of monetary policy as a possible remedy. A recent paper by Bernanke, Gertler and Watson (1997) suggests that monetary policy could be used to eliminate any recessionary consequences of an oil price shock. They estimated a VAR model, describing $\mathbf{y}_t$, which contains monthly series for the rate of growth of GDP in real terms $(\gamma_{\mathbf{GDP}}, \mathbf{t})$, the log of the GDP deflator $(\gamma_{\mathbf{DEF}}, \mathbf{t})$, log of commodity price index $(\gamma_{\mathbf{COM}}, \mathbf{t})$, a measure of oil prices $(\gamma_{\mathbf{OIL}}, \mathbf{t})$, the Fed funds rate $(\gamma_{\mathbf{FED}}, \mathbf{t})$, the 3-month treasury bill rate $(\gamma_{\mathbf{TB}}, \mathbf{t})$, and the 10-years Treasury bond rate $(\gamma_{\mathbf{T10}}, \mathbf{t})$ of the form:

$$\mathbf{B_0 y_t = k_0 + B_1 y_{t-1} + B_2 y_{t-2} + B_2 y_{t-2} + \ldots + B_p y_{t-p} + v_t}$$

The matrix $\mathbf{B_0}$ is taken to be the singular triangular and Fed funds rate affects the first four variables by assumption. The model, based on the data set

1965:1-1995:12 was estimated by OLS with the lag length was set to 7. By simulating the equation they determined the effect of 10% increase in the net oil price on each value of $\mathbf{y}_{t+s}$. This change would result in 0.25% slower GDP growth and 0.2% higher prices after two years, while the Fed rates rise 80 points during the first year. The result raises the question whether the slowdown was caused by oil shocks or by the rise in the interest rate. This issue was thoroughly discussed by Lucas (1976) as well. Actually, an increase in money supply has two effects. Since money will become more liquid, the nominal interest rate must fall, while a new cycle of inflation increases the rate. The authors included this feature while using Sims-Zha method to estimate the value of historical shocks. Again, by simulating, they found that a 10% increase in oil price leads to downturn in GDP growth. Repeating the same simulation with policy shocks they determined that Fed funds rate should be rising starting at 4%.

Another point of view on the role of monetary policy as a response to an oil shock was proposed by J. Hamilton (2000). He tested two hypotheses: whether the Fed has the power to implement such a policy and whether the size of effect that Bernanke, Gertler and Watson attributed to oil shock as large as predicted. Using the same technique and methodology (Sims-Zha approach) he came to the conclusion that oil shocks have a bigger effect on the macroeconomy then was predicted earlier. He suggested choosing 12 lags instead of seven as did Bernanke et al. (1997). Hamilton's proposal could be a good answer to Bohi's question (1989) of whether the recessions that followed the big oil shocks were caused not by the oil shock themselves, but rather by the Fed's response.

The next approach which could be useful in analyzing the abovementioned relationship was highlighted by Hunt, Isard and Laxton (2001). They used MULTIMOD (multi-regional macroeconomic model developed by the IMF staff for the primary purpose of analyzing alternative scenarios for the World Economic Outlook) to investigate the macroeconomic effects of oil price shocks, distinguishing between temporary and permanent shocks. This model

is based an annual data and takes the WEO forecast as an exogenous baseline; it was designed to avoid first-order Lucas-critique problems and to shed the light on the main role of monetary policy response. The key equations in MULTIMOD model take the reduced-form structure:

$$\pi_t^{CPI} = \delta_1 \pi_t^M + \delta_2 \pi_t^C + \delta_3 \pi_t^{POIL} + [1- \delta1- \delta2- \delta3] \pi^{CPI}_{t-1} \quad (1)$$

$$\pi_t^C = \Psi \pi^e_{t+1} + [1-\Psi] \pi_{t-1}^C + \gamma[(u_t^*-u_t)/(u_t-\varphi t)] + \alpha[\pi^{CPI}_{t-1} - \pi_{t-1}^C] \quad (2)$$

$$\pi^e_{t+1} = \Omega[\lambda \pi^{CPI}_{t+1} + (1- \lambda) \pi_{t+1}^C] - [1- \Omega][\lambda \pi^{CPI}_{t-1} + (1- \lambda) \pi_{t-1}^C] \quad (3)$$

where π_t^{CPI} is CPI inflation; π_t^M is the rate of the domestic-currency price of manufactured imports; π_t^{POIL} is the rate of inflation of the domestic –currency price of oil; π_t^C is the core inflation; π^e is an expected inflation; u* is the non-accelerating-inflation rate of unemployment (the NAIRU); **u** is the unemployment rate; φ is the minimum absolute lower bound for the unemployment rate. MULTIMOD simulations are used to compare the costs of two possible types of policy errors in responding to a persistent increase in oil prices. The first error results from policymakers assuming that oil price increases will have no inflation effects; the second is that agents are assumed to respond in a more inflationary manner. The results of these simulations are: first, experience during 1980-1990 does not provide a valid basis for dismissing the risk that persistent oil-price increases will pass through into core inflation. Second, delay in responding to a persistent oil-price increase can have large macroeconomic costs if it leads to an erosion of monetary policy credibility. Third, policymakers should interpret the data in a manner that errs in the direction of a more aggressive policy response to oil-price increases (Hunt et.al.2001). This research has found clear correlation between oil prices and aggregate measures of macroeconomic activity, as well as significant correlations between oil prices and macroeconomic data on output, employment, and real wages. In addition, there is a strong evidence of asymmetry in the relationship between oil price changes and corresponding changes in economic activity.

Chapter 2

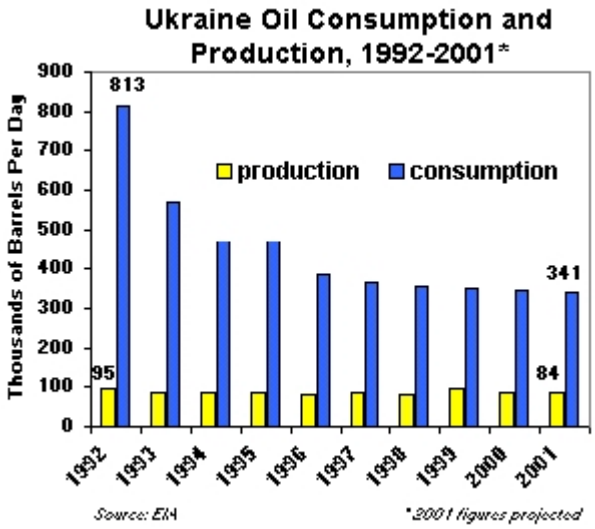
THEORY AND METHODOLOGY

In this chapter I will provide the description of the Ukrainian oil industry, showing the importance of energy resources for the Ukrainian macroeconomy and will show the dependence on Russia as the main supplier of crude oil. In the last section I will run an economic analysis why oil shocks could matter for the economy.

2.1. Description of oil industry in Ukraine

There are three petroleum producing regions in Ukraine (the Carpathian region, Dnipro-Donetsk region and the Black sea and Crimea), but they produce approximately 20-25% of the internal consumption. There are more than 8000 oil and gas fields in Ukraine which are estimated to contain 7-8 billion tons of crude fuel[5].

Figure 2.1. Production and consumption of oil in Ukraine



Average production of oil has been stable over the last few years and amounts 4 million tons per year. In 1975 Ukraine produced about 14 million tons, so we observe a sharp decrease, mainly due to deterioration of equipment and a

decline in industrial consumption which was caused by numerous enterprises closures. In fact, Ukraine's energy sector is now plagued by increasing foreign debt for oil and gas, outdated and inefficient equipment, fuel shortages, barter deals, and non-payment by consumers. Moreover, Ukrainian oil is of low-quality and costs of pumping are high compared to other countries, so it seems reasonable to import rather than to explore new deposits.

Ukrainian oil stocks are not sufficient to ensure all internal needs. In order to provide the economy with the necessary stock, Ukraine has to import it. The share of imported oil, delivered to Ukrainian petroleum refineries in August 2001 was about 90%[6]. Thus, oil markets, which set the price for crude oil in Ukraine should be divided into the domestic one and the rest of the world**.** The lion's share of oil is imported from Russia—about 66% (August, 2001) and approximately 22% is delivered from Kazakhstan[7]. Four out of six refineries in Ukraine are owned by Russian and Kazakhstanian companies; in turn, these are regulated by respective governments.

The process of expansion in oil refining and shrinking in oil production led to significant shifts in crude oil supply to domestic oil refinery plants. While in 2000 Ukraine supplied 35% of crude oil, the crude oil supply in 2001 shrunk by half to 17%. At the same time the shares of Kazakhstan and, particularly, Russia have markedly grown and are likely to grow further. It is important to say that the origin structure of oil supply is not determined by economic factors only.

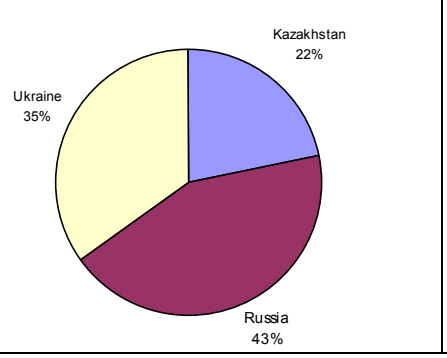
Figure 2.2. Origin of oil supply

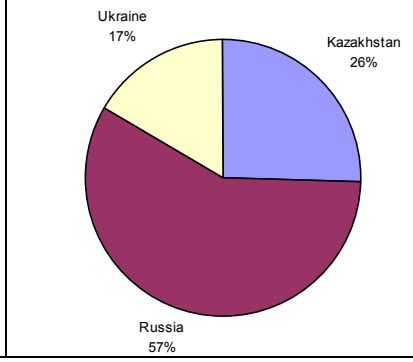
2000 2001(10m)

[5] *Source: US Embassy Kyiv (2000)*

[6] *Business,* September 17, 2001,Vol. 453, pp.28.

[7] *IMF Annual Report,* 2001





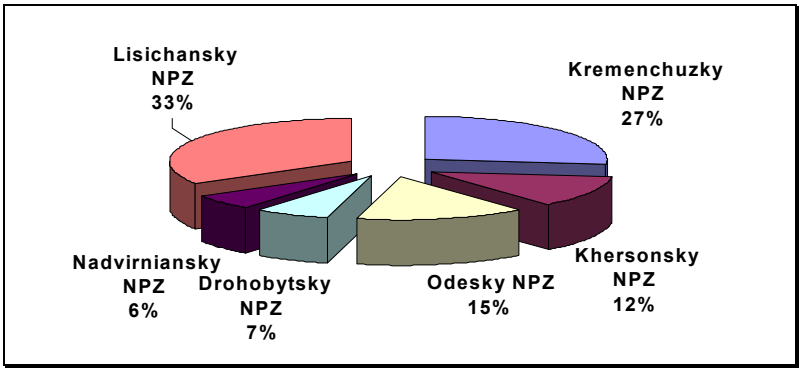
Source: http://oilreview.kiev.ua

Other factors underlying the supply structure as well as other peculiarities in domestic market will be covered in the following section.

There are three oil markets in Ukraine that can influence the internal oil price: the market of oil extraction, the market of oil refining and the market of oil trading. Since the first is fully controlled by the state (approximately 96% of all domestic oil is produced by *Naftogas*, a Ukraine state-run company, a state monopoly which controls almost all of oil production. In the refining industry it resembles an oligopoly well – there are limited number of refineries (six) and there are natural barriers to enter, because existing refineries could potentially produce twice as much as is consumed in Ukraine and the costs of construction of the new refinery are enormous. Moreover, four refineries are owned by foreigners who produce approximately homogeneous products, and currently they are engaged into price competition policies. As a result, prices for refined products have fallen over the last 6 months. Finally, the number of oil traders in Ukraine is large enough, but there are barriers to enter as well (such as price of a license or special requirements). So, I can draw a conclusion about the monopolistic competition in domestic oil trade market. Despite the level of state control, there are a number of successfully operating companies with foreign investment in oil and gas extraction. Mainly, they are small foreign companies which work in joint ventures or under joint agreement with Ukrnafta or with the enterprisers subordinate to the Geology Committee of Ukraine.

The figure below shows the market shares of oil refineries in Ukraine.

Figure 2.3. Market shares of Ukrainian oil refineries in 2001, %



Source: : "Business" # 47, 2001

Three major players, TNK (Tumen Oil Company, Russia, possesses Lisichansky Oil Refinery), Joint Venture UkrtatNafta (possesses Kremenchuzky oil refinery), and LukOil-Ukraine (a subsidiary of LukOil, Russia, possesses Odesky oil refinery) have been pursuing the strategy of price wars to gain their market share. The current market shares are estimated to constitute 33%, 25% and 15%, respectively. Thus, Russia controls over the 2/3 of Ukrainian market. The targets announced are approximately 40%, 30% and 20 % by the aforementioned companies.

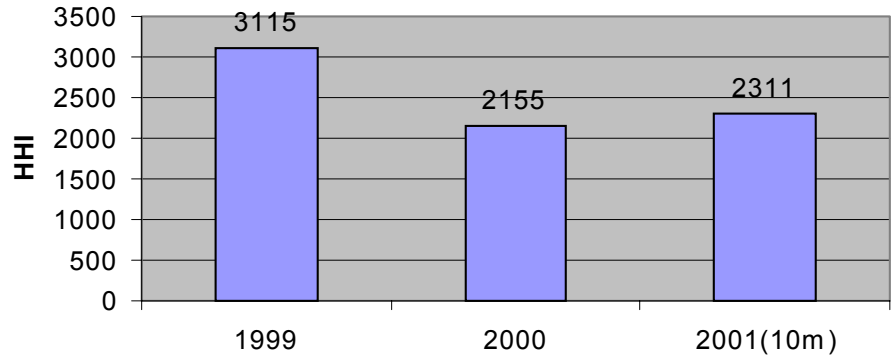
These figures support the conclusion of Bertrand-like oligopolistic competition. According to this model, producers are undercutting their price a bit lower then rival's one to gain market share. ORPs were perusing exactly the same strategy, yielding the significant decrease in wholesale and retail decrease of gasoline and other refined products. For example, average Diesel fuel prices decreased by 36-39% since 12'00, A-76 — by 34-38%, A-92 by 29-33%, A-95 — by 27,3-29,6%[8]. According to reports by market dealers[9], in 4-6 months these ORPs' prices would reach their marginal costs, but still would make profits due to price differential of raw materials in Russia and Ukraine.

[8] *Source: DerzhKomStat, author's calculations*

[9] *http://www.dsnews.com; last accessed on January 14, 2002*

To measure the competitive background in the oil refinery industry I employed Herfindahl-Hirshman Index (HHI). As can be seen in Figure 2.4 over the last three years industry concentration decreased slightly from HHI=3115 in 1999 to HHI=2311 in 2001. This change is attributed to the entry of Russian oil companies in the Ukrainian market and more efficient use of oil refinery plants. In spite of the reduction in concentration, the Ukrainian oil refinery industry is still classified as highly concentrated[10] (HHI>1800) which in turn allows market players to engage in activities designed to push their rivals out of the market (e.g. trade wars) and means that any changes in the industry structure may greatly affect competitive background.

Figure 2.4. Oil Refining Industry Concentration (1999-2001)



Source: http://oilreview.kiev.ua

Over the year 2001 the industry has also remained highly concentrated. At the same time, the volume of oil processed has significantly increased from 5.34 m tons in January to 17.48 m tons in October (more than thee times.)

The present level of consumption of oil in Ukraine is about 30-35M tons a year with the potential growth horizon is about 50M tons annually and the bottom horizon for the amount of oil demanded is 23M. tons. Major categories of consumers that have influence on oil demand:

1.Industrial consumers:

[10] http://www.investopedia.com/terms/h/hhi.asp

-chemical enterprises

-oil-processing companies

-transport companies (auto tracking companies, Ukrzaliznytsya, river and sea shipping companies)

2.Private consumers

-automobile owners.

The causes of decline in demand for oil lie primarily in

- low receivables collection by traders
- low solvency of industrial and private consumers.

Ukraine's exports are mostly concentrated in metallurgy and machinery (about 50%) – industries whish are also the main consumers of imported oil. In order to analyze the impact of oil pricing on Ukrainian total output we should take into account main domestic plants and factories. On the other hand, Russian oil firms such as LUKoil or TNK should be included in analysis as well, because these companies determine oil pricing (in accordance with Russian and Ukrainian Legislation). Oil and gas exports are the main source of income in Kazakhstan, so this industry is supported by the Government there. Their domestic oil companies are supported by state in the form of tax relief and low-interest rate loans. Hence, foreign companies should be treated as actors in the analysis.

Ukraine does not import crude oil from OPEC countries, because of higher prices and enormous transportation costs. Despite that, Ukraine has the opportunity to import oil by sea (Odessa port recently became a free economic zone and has enough capacity to ensure Ukrainian needs). There are also Russian-Ukrainian oil pipelines which reduce the costs of transportation. This system of oil transportation consists of two major pipelines: Druzhba (friendship) and Pridneprovskie Magistral'nye Nefteprovody (Pridneprovsk trunk pipelines). They compose a system of two separated Ukrainian pipelines joining Russia with Western Europe with 3850 km of total pipe length and total output capacity of 67.2 mln. tons of oil annually. Ukraine plays an important role as a transit country for Russian oil

exports to Europe. The southern branch of the 1.2-million-bbl/d Druzhba pipeline from Russia transits Ukraine en route to Slovakia, Hungary, and on to Western Europe. In addition, due to its geographic location and its oil pipeline system, Ukraine has an excellent opportunity to play a major role in bringing increased oil exports from Azerbaijan and Kazakhstan to European oil markets. Rather than seeking to import Caspian Sea oil for domestic consumption, Ukraine is hoping to reap tariffs for Caspian oil transiting its territory as it heads westwards[11].

The chief components of Ukraine's strategy are the $750-million Pivdenny oil terminal and the 500,000-bbl/d Odessa-Brody pipeline. Ukraine is hoping to entice Caspian oil exporters shipping oil via the Black Sea to bypass the crowded Bosporus Straits, already a major chokepoint for tankers, and instead send their oil to European markets via Ukraine. However, Ukraine has not yet found any oil companies to fill the pipeline, and the country's attempts to make itself more attractive to investors--by stepping up oil sector privatization efforts or by proposing an international consortium to manage the pipeline – have seen only limited results thus far.[12]

It also should be taken into account that Russia recently (in the fall of 2001) refused to join OPEC, since experts believe that in five years 75% of Russian oil will be in the hard-extractive category (i.e. costs of pumping will increase) and Russia will not be able to set lower prices at OPEC request, thus making the oil industry a loss-maker. Taking into account that domestic demand for crude oil is inelastic (i.e. oil and gas are necessities for the economy), Ukraine is greatly dependent on Russia who can increase their price up to the point, where Ukraine would switch its partnership in favor of OPEC (taking into account transportation costs). Hence, Russia cannot set the price for crude oil much higher than OPEC's, else Ukraine will import stock from the Persian Gulf.

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[11] *Source: http://www.eia.doe.gov*

[12] *ibid.*

Today Ukraine is facing more difficulties in attracting petroleum investments than its neighbours. It has never been a large producer and is perceived to have small fields which are hard to find and develop. To implement market oriented oil and gas services and attract foreign investments, new legislation was enacted (The Law on Concessions and the Law on Producing Sharing Agreements). Government institutions were reformed, licensing and tax policies were liberalized and a series of oil and gas development projects were offered for implementation. In accordance with different estimates in order to modernize the oil industry in Ukraine during the coming five years, it is necessary to invest in it about $ 30-50 bln. The priority directions of investments are the following:

- Fuels and lubricants;
- Pipeline construction equipment;
- Oil and gas drilling machinery and technologies;
- Equipment for atmospheric-vacuum oil refining;
- Cracking units, distillation units
- Industrial automation, control and monitoring systems for refineries, gas processing and petrochemical plants;
- Desulphurization and quality control facilities;
- Safety systems;
- Fuel storage and dispender system;
- Fuel level monitoring and accounting system.

Unfortunately, Ukraine cannot cope with these investment levels alone, so it needs to attract foreign investments. Now four out of six petroleum refineries in Ukraine belong to Russian and Kazakhstanian oil companies, which are obliged to invest approximately $1.5bln each in the Ukrainian refinery industry in order to maintain the production. Today Canadian, British and Russian companies are exploring new deposits in Crimea and the Dnipro-Donetsk region. In addition, Ukrtransnafta (the domestic oil transportation monopoly) is going to sign a contract with Kazakhstan about the

transportation of Kazakhstanian oil and gas to Europe through Odessa-Brody pipeline. These demonstrate a positive shifts in the process of attracting investments to oil and gas industry over the last few years.

2.2. Government regulation

The following is a brief description of the Ukrainian legislative base, which determines the prices for stock oil and the amount to be imported. In the context of this thesis institutions are rules, enforcement mechanisms, and organizations supporting market transactions, which exist in Ukraine. They help to analyze information, determine property rights and manage competition. These institutions predetermine the development of the Ukrainian economy, since the latter is strongly dependent on imported oil and appropriate laws and decrees will allow rational and successful economic activity.

Naftogas of Ukraine is a national holding company which was created in early 1998 to control and manage all state-owned shares of oil and gas companies. It is the largest company in Ukraine in this sector and its subsidiaries control oil and gas transportation through the pipelines. This company and its branches *Ukrgasvydobuvannya, Ukrnafta and Chornomornaftogas*, produce about 97% of domestic natural gas and 94% of oil. Naftogas owns all oil and gas transportation systems, and most oil and gas storage facilities in Ukraine. In accordance with the Ukrainian legislation, these facilities cannot be privatized, but in the future some part of them are intended to be privatized. Naftogas is a vertically integrated company that performs several functions: oil and gas production and exploration (*Ukrgasvydobuvannya, Ukrnafta* and *Chornomornaftogas*), gas transportation and storage (*Ukrtransgas*), gas trading (Trade House Gas of Ukraine), oil transportation (Druzhba pipeline company), oil refining (*Azmo*l) and liquefied petroleum gas (LPG) transportation (*Ukrspetstransgas*).

On August 15, 2001 the President signed the Law "About oil and Gas" adopted by Verchovna Rada. This document fixes the rules of activity of

Ukrainian oil companies which are not now allowed to set prices for imported crude oil higher than those stipulated by the Government. In addition, it predetermines the activity of the antimonopoly Committee in the fuel sector and sets a price ceiling for refined petroleum which is delivered to factories by domestic refineries. A bit earlier, the Verchovna Rada adopted a set of tariffs and duties for imported and exported crude oil and fuel products. In order to avoid price increases in the domestic market, the procedure for importing was simplified and tariffs were set at an optimal level, while it became too expensive to export During the 1998-1999 session new legislation was enacted - the Law on Concessions and the Law on Production Sharing Agreement that reformed government administrative institutions; licensing and tax policies were liberalized and a number of development projects were offered for implementation.

The main goals that the Ukrainian government is trying to achieve through the industry regulation are:

- ensure a stable supply of petroleum products for domestic producers and consumers;
- ensure socially optimal distribution of oil products;
- ensure a high level of revenues for the budget;

The tools available for regulation the industry can be divided into direct and indirect. The direct tools are:

- tariffs on import of crude oil and oil products;
- tariffs on crude oil and oil products transportation via trunk pipelines;
- licensing of crude oil and oil products transportation via trunk pipelines;
- restriction of enterprises authorized to produce gasoline;
- tariffs on oil extraction (UAH 17.34 per ton);
- international treaties (they may provide exemptions from duties and taxes for Ukrainian or foreign businesses).

An Enactment of Cabinet of Ministry establishes tariffs of USD $0.685 per ton of oil transported through Ukrainian territory.

According to the Law on Licensing of Certain Economic Activities, the transportation of crude oil and oil product via trunk pipelines is subject to licensing. According to effective legislation, the executive body that grants licenses for oil transportation is the National Commission for Energy Regulation and the fee for a license is UAH 340. Licensing can serve as a means of market entry restriction because the criteria for license granting and annulment are too broad and in principle any business entity can be granted or deprived its license at the convenience of the executive body.

Since oil is a strategic resource for most countries and their governments are interested in the development of mutually beneficial relationships, international treaties play an important role in the development of the oil industry. Ukraine has concluded several agreements, mostly with Former Soviet Union countries, that are designed to adjust tariffs or remove barriers in oil transportation. These are:

1. **Agreements with Turkey on the development pipe-line Jeikhan-Samsun**. Ukraine and Turkey agreed to build a pipe-line and oil terminal as a joint-venture. The joint-venture is granted tax and duty exemptions in Turkey and Ukraine as well as other benefits.

2. **Agreement with Kazakhstan on the coordination of activities related to oil refining and petroleum production.** The purpose of the agreement is to coordinate activities in order to avoid mutual losses in petroleum and oil industries. It achieves this goal by adjusting refining and extracting of oil, and, if necessary, mutual oil supply. Oil included in the category of mutual supply is exempted from duties and taxation.

3. **Agreement with Russia on the cooperation in the development of oil and gas industry of Russia.** As a whole, the agreement consists of articles that stipulate the possibility of mutually beneficial participation of Ukraine in the discovery and extraction of oil deposits in Russia. It is mentioned that

resources devoted to this project are free of duties and taxation in both countries.

4. **Agreement with Uzbekistan on the participation in the development of oil and gas industry of Uzbekistan**. The agreement introduces basic principles for the participation of Ukraine in oil extraction in Uzbekistan for refining in Ukraine. In order to perform this task joint ventures will be created and extracted oil is to be distributed according to the shares belonging to the countries.

2.3. The mechanism of affecting the economy through oil shocks

The OPEC boycott in 1970s had a significant impact on OECD countries-its all 24 countries (except Switzerland) experienced a slowdown of economic growth after 1973:4. These countries suffered an increase in their inflation rate at the same time. The fact that all countries were affected simultaneously worsened the situation even more. The years 1973 to 1975, when the first wave of oil price increase occurred, caused steep economic contraction and jump in inflation (reaching 14% in 1974 on average)[13]. Then recession came back, accompanied by increasing inflation, at the time of the second oil price increase in 1979-1981. Employment was a casualty of the adjustment to the oil shock, and unemployment rates approached the levels of World War Two, with the peak of 9% in OECD countries on average. This was significantly higher than in the USA, because of high degree of trade unionization in Europe, which is positively correlated with real wage rigidity. In a result of market clearing, Europe ended up with even greater increase in general price level.

Below the economic explanation of these events is provided, with the discussion of mechanisms how oil shock influences the major indicators of economic performance .

Correlation between oil prices and the macroeconomic performance

[13] From *Organization for economic cooperation and development,* Economic outlook, *December 1989, Table R11-12.*

Although there are a lot of researches which describe the relationship between oil prices and major economic indicators, economists do not hold the unique opinion what is the major reason which could explain the direct and indirect effects. Despite the fact that impact on GDP is empirically supported for many countries, it is difficult to build the correct mechanism which could explain this relationship with other economic indicators. One possible explanation of the great number of economic solutions is that economists do not take into account monetary and fiscal policies conducted by the government. In fact, these policies could serve as a powerful tool to smooth the dependence of the country on the oil price fluctuations. But their effect could differ depending on whether oil shock is anticipated or not.

Oil price increase can affect the macroeconomic behavior through mane reasons.

First, there will be a transfer of income from oil-importing countries to oil-exporting ones. This will reduce the aggregate demand because the demand for oil will likely decline. As the propensity to spend of energy consumers will be larger than the propensity to spend of those who gain income from increased prices, the fall in demand is inevitable. Empirical study conducted by IMF (2000) show that in 2000 the world transfer of income from oil importers to oil suppliers amounted $65 billion or 0,2 % of world GDP. They found a clear distinction in the effect on developing and developed countries: the countries in transition are more affected by higher oil price, transferring their income to oil suppliers at the rate of 0,6% of GDP, while developed countries – only 0,2%.

Second, there will be a rise in the cost of production of goods and services in the oil-importing country. It implies that relative price of energy goods will increase (ceteris paribus), decreasing manufacturer's profits. The direct impact is the likely decrease in the aggregate supply in the short-run under the assumption that wages are relatively inflexible and capital stock is constant.

Third, as Carruth, Hooker and Oswald (1998) pointed out, oil price increase could cause the rise in unemployment. Their reasoning is based on the cost structure of the firm. When the costs of production rise, employers will likely

pay lower wages, assuming that the market is competitive. In the labor supply-demand framework the labor supply decreases since some workers do not agree to work for lower wage. So, structural unemployment rate temporarily increases, but the long-run effect is ambiguous.

Fourth, the impact of oil prices on the inflation also can take place. Higher energy prices can cause the decline in real income of the individuals. They want to offset these losses through the increase in wage, and producers want to restore their profits. In this case oil shock can cause the Central Bank to tighten its policy, which in turn is connected with inflation. The overall effect depends on the consumer's expectations and the bias of the CB's policy.

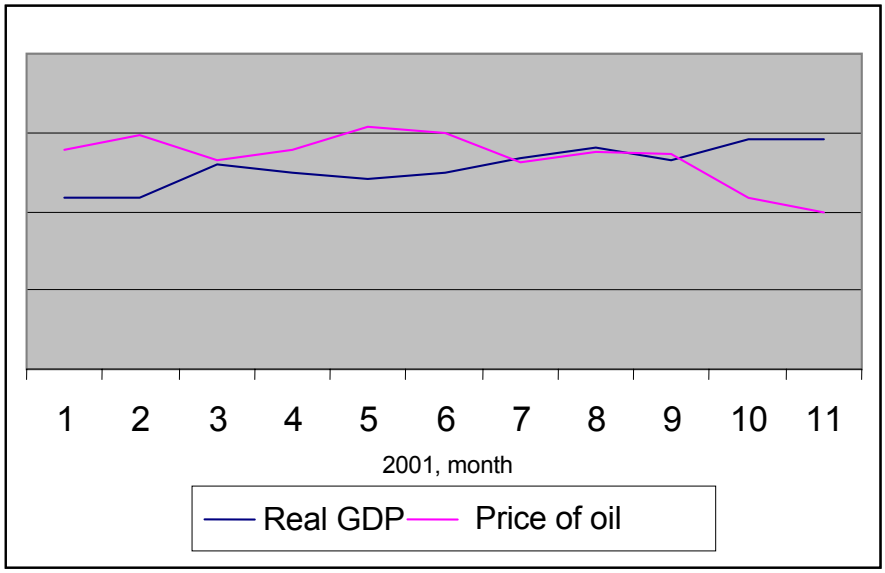
Fifth, the change in relative prices creates incentives to for oil-exporting countries to increase oil extraction and investment. At the same time oil-importers will face lack in recourses and its investments could decrease. This will change depending on the expected duration of price increase.

Finally, there will be direct and indirect effect on the financial market and exchange rate. Through the mechanism described above, oil price increase can affect equity and bond prices and the exchange rate. In the IS-LM framework the possible response of oil chock by government is to increase money supply. Thus LM curve shifts to the right and the new equilibrium interest rate will be lower. Capital goes abroad, depreciating domestic currency and improving trade balance.

Summing up this section, it can be shown that crude oil price increase can cause a decline in GDP and a rise in unemployment. Indirectly it can affect the overall price level and the currency exchange rate. However, these findings depend on whether the shock is anticipated by consumers and the government, and on the duration of expected increase. The effect of oil price decrease can cause the greater effect on the economy. As Hooker (1996) and later Hamilton (2000) found out, in case of permanent energy price decrease the importers will likely face a rapid growth in GDP (ceteris paribus) due to increase in investment jump in order to satisfy the demand for domestic products through the widening of the capital stock.

For the case of Ukraine oil shock should matter, because of its great dependence on the energy. Visual inspection of the series of GDP and prices for oil in Ukraine allows assuming the negative correlation between these two variables[14].

Figure 2.5. Real GDP and the price of oil in Ukraine, 2001



Source: UEPLAC, UICE monthly reports, author's calculations.

However, the sample period for this graph is small enough and we cannot judge about the robust connection between these parameters over time. This plot illustrates the negative correlation only over the last year when Ukrainian real GDP was steadily increasing and the world average prices for oil were decreasing. One striking feature here is that there is immediate response rather than lagged. The model allows to capture this feature, since monthly lags are used rather than quarterly ones.

Correlation between economic indicators and state policies.

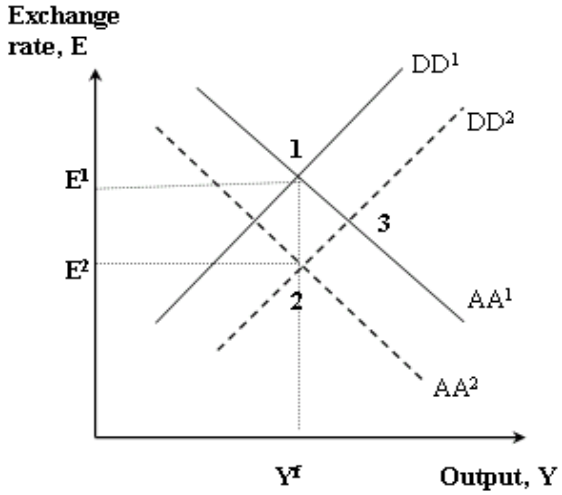
In this section it is explained why fiscal and monetary policies do matter for the Ukrainian macroeconomy and their temporary and permanent effects are observed. The AA-DD framework simultaneously allows to observe the effect of fiscal and monetary expansion on output, unemployment and

[14] All observations of GDP series are multiplied by a constant to make it compatible with oil price series.

inflation. Let us start with the graph, which shows the effect of government expenditures on the parameters of interest.

Assume that the full-employed economy starts at point 1. In the short-run fiscal expenditures has an immediate effect on the output and the exchange rate. The increase in government expansion causes DD curve to move right to DD^2. As a result, new short-run equilibrium will be achieved at point 3, with increased output and real appreciation of the domestic currency, due to the fact that demand for domestic products is permanent. In the long-run agents expect further appreciating of the domestic currency and demand for money increases. Central Bank has to buy foreign reserves, thus decreasing monetary base. As a result, AA curve shifts down and left to AA^2 and the new long-run equilibrium is achieved at point 2. Thus, appreciation "crowds out" demand for domestic products, because they become more expensive relative for imported products. The overall effect is the following: domestic currency appreciated even further, and due to additional appreciation permanent fiscal policy has no effect on output and employment. However, under temporary fiscal expansion the economy will end up at point 3, due to the absence of additional expectations. In this case output increases accompanied by unemployment decrease.

Figure 2.6 The effect of temporary and permanent fiscal expansion

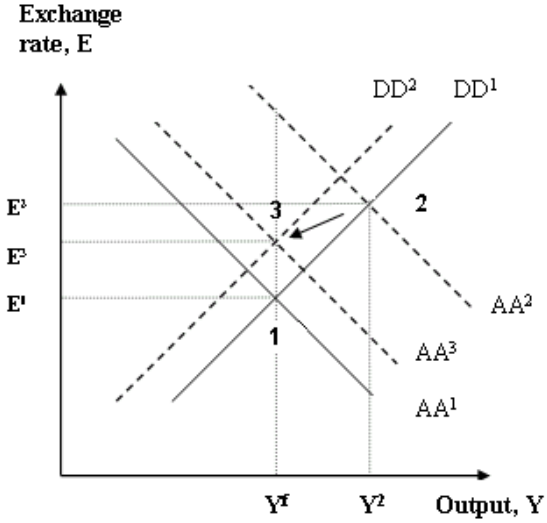


Source: Krugman Paul. R., Obstfield M. (2000); "International Economics: Theory and Policy"; 5th edition, pp. 463.

Summing up this section, we developed the mechanism through which fiscal policy can affect output, exchange rate and unemployment. In next chapter we test the hypothesis whether the government expenditures cause changes in the parameters of interest in AA-DD framework could be applied for the Ukrainian case.

Under the monetary policy the overall effect on the GDP and unemployment is similar. Figure 2 represents the mechanism of affecting the output and exchange rate as a result of permanent and temporary monetary expansion.

Figure 2.7 The effect of temporary and permanent monetary expansion



Source: Krugman Paul. R., Obstfield M. (2000); "International Economics: Theory and Policy"; 5th edition, pp. 462.

Again, let us assume that the full-employed economy starts at point 1 on the graph. Temporary increase in money supply causes AA curve to move upward to AA^3 due to the requirements of asset market equilibrium. Thus, similar to fiscal policy expenditures, in this case output increases and unemployment reduces. The difference is that under monetary expansion domestic currency depreciates. Moreover, the increase in monetary base causes inflation jump.

Under the permanent monetary expansion, the demand for labor increases since more labor is required. In conjunction with steadily increase in the price

level, wages are increased since employees have to work overtime. As a result, producers raise prices for their goods and services.

Domestic goods become more expansive relative to foreign goods, and the trade balance worsens.

In the graph AA first shifts upward to AA^2 and the economy achieves short-run equilibrium at point 2. Due to rise in domestic prices DD curve shifts to the left to DD^2 and real money supply reduces. Finally, AA curve shifts back from AA^2 to AA^3. These two curves intersect at full-employment level due to "overshooting effect".

The overall result is the following: permanent monetary shock has a sharper effect on output and employment relative to temporary one due to exchange rate pessimistic expectations. Then economy returns to its full employment position (point3), because all money prices rise in proportion with the increase in monetary base.

Summary of findings:

Under the temporary fiscal expenditures output increases, domestic currency appreciates, unemployment decreases, no effect on inflation.

Under the permanent increase in government expenditures the economy returns to its initial full employment position because agents expect further appreciation of the domestic currency. Output stays the same as well as unemployment level. No direct effect on inflation.

Under the temporary increase in the monetary base output increases, unemployment rate decreases, since more labor is now required. Domestic currency depreciates. Inflation rate increases.

If the permanent expansion takes place, the impact on the indicators of the interest is stronger: in the short-run output increases even more, inflation rises significantly. Due to further depreciation, trade balance improves, but in the long-run the economy returns to its initial position with slightly depreciated domestic currency. Thus, in the long-run the AA-DD framework predicts the neutrality of the monetary policy.

Since in the regression we use monthly values with the four maximum number of lags rather than quarterly ones we cannot capture long-run affects of both policies. On the other hand, it allows to analyze the short-run impacts on GDP, inflation and unemployment. The model allows to check whether the theory could be applied for the Ukrainian macroeconomy.

Chapter 3

EMPIRICS AND RESULTS

In this chapter I provide the empirical basis for the economic analysis of the possible oil shocks on the main economic indicators described in the previous chapter. According to the theory, oil shocks matter for the economy as well as monetary and fiscal policies. I am interested in the short-run effects of oil price fluctuations on GDP, inflation and unemployment in Ukraine.

3.1. Data description

For this work monthly series are taken. They are: inflation, unemployment rate, GDP, indicator of monetary policy (currency in circulation), fiscal policy (government expenditures) and the price of the crude oil. The data set is mostly provided by the National Bank of Ukraine (NBU), UEPLAC and by the State Committee of Statistics (DerzhKomStat). Series of world oil prices can be found at IFS Survey, while data for Russian oil prices is available at the Ukrainian Interbank Currency Exchange (UICE). The sample for time-series analysis includes 108 monthly observations starting from early the 1993 up to 2001:12. In order to estimate an impact on inflation I used data from 1995:1. Actually, the data for the earlier period are available, but as could be explained in **Appendix 1** one cannot rely on this period since the presence of outliers will yield spurious results. Visual inspection allows to conclude that it is more appropriate to start the analysis from 1995 when the series becomes predictable.

3.2. Methodology

For the estimation of oil price importance I applied a reduced-form approach proposed by Gisser and Goodwin (1986). I estimated three St. Louis-type equations for investigating the changes in Ukrainian real GDP, unemployment level, and inflation rate:

$$\Delta \dot{GDP}_t = \alpha_0 + \Delta\sum_{i=0}^{4} m_i \dot{M}_{t-i} + \Delta\sum_{i=0}^{4} fi\dot{F}_{t-i} + \Delta\sum_{i=0}^{4} o_i \dot{PO}_{t-i} + \lambda_1 \hat{u}_i + \varepsilon_t$$

$$\Delta \dot{Inf}_t = \alpha_0 + \Delta\sum_{i=0}^{4} m_i \dot{M}_{t-i} + \Delta\sum_{i=0}^{4} fi\dot{F}_{t-i} + \Delta\sum_{i=0}^{4} o_i \dot{PO}_{t-i} + \lambda_2 \hat{u}_i + \varepsilon_t$$

$$\Delta \dot{Un}_t = \alpha_0 + \Delta\sum_{i=0}^{4} m_i \dot{M}_{t-i} + \Delta\sum_{i=0}^{4} fi\dot{F}_{t-i} + \Delta\sum_{i=0}^{4} o_i \dot{PO}_{t-i} + \lambda_3 \hat{u}_i + \varepsilon_t$$

where:

GDP- gross domestic product at 1990 constant rubles. Billions of UAH. Seasonally adjusted.

Un- unemployment rate. Calculated as a percentage of Ukrainian labor force. Seasonally adjusted.

Inf - Inflation rate. Calculated as the percentage change in consumer price index to the previous month.

Regressors:

M- money stock (M1). Billions of UAH. Seasonally adjusted.

F- fiscal activity. Budget expenditures. Billions of UAH. Seasonally adjusted.

PO- real price of crude oil. Producer price index. USD/bbl.

$\hat{u}_i$ - error correction term

Similar to many researches in this field, all the series are taken in the growth rates, which allow to avoid the problem of variables incompatibility. The basic ADF test for the obtained series indicates that all series are stationary in first differences (**see Appendix 2**). So, in the model I used differences of the growth rates rather than absolute. At the first stage OLS estimation is performed, which allows to obtain the most precise estimators in case if all conditions are satisfied (are presented later) and then check for autocorrelation, heteroskedasticity and residuals normality. The approach to use growth rates allows to use world average oil prices as a proxy for Russian oil prices (Urals). The problem is that this data is fully confidential and there is no official statistics for the period of interest. However, there is a sample over the last two years obtained from Ukrainian Interbank Currency Exchange. As

the first graph in **Appendix 1** indicates, the series for world prices and Russian prices are highly correlated. Urals on average is cheaper by 1.5-2 dollars per barrel. As for the prices of oil produced in Ukraine, they show no systematic trend and cannot be computed on the basis of the world average prices. This suggests the existence of the price regulation in Ukraine, which significantly affects the producer's prices in Ukraine.

Since I am interested in the hypothesis whether Russian oil prices can affect the Ukrainian economy, I can use average world oil prices in growth rates as a reliable source.

3.2. Analysis of the results

The results of ECM with Newey-West covariance & standard errors are presented below.

Table 3.1. Summary statistics

Regressors	**Dependent variables**		
	GDP	Inflation	Unemployment
Intercept	0.002 (0.01)	0.000 (0.01)	-0.0038 (0.014)
Oil	-0.032 (0.01)*	0.176 (0.05)*	-0.0046 (0.005)
Oil (-1)	-0.074 (0.05)	0.002 (0.06)	0.00179 (0.006)
Oil (-2)	-0.006 (0.00)*	0.001 (0.07)	-0.00435 (0.004)
Oil (-3)	0.002 (0.00)	0.040 (0.05)	0.00591 (0.004)
Oil (-4)	-0.016 (0.005)*	0.032 (0.04)	0.00927 (0.004)**
∑ Oil	-0.126 (0.07)**	0.276 (0.23)	0.007989 (0.007)
Money	-0.170 (0.1)***	-0.388 (0.10)*	0.000021 (0.00)
Money (-1)	-0.020 (0.27)	0.510 (0.09)*	-0.000085 (0.00)**
Money (-2)	0.075 (0.29)	-0.212 (0.09)**	0.000014 (0.00)
Money (-3)	0.137 (0.28)**	0.340 (0.09)*	0.000038 (0.00)
Money (-4)	0.211 (0.19)*	0.311 (0.09)*	0.000005 (0.00)
∑ Money	0.233 (0.11)*	0.561 (0.14)*	-0.000006 (0.00)
Fiscal	-0.018 (0.01)*	0.13 (0.03)*	-0.0000017 (0.005)
Fiscal (-1)	0.009 (0.01)	-0.081 (0.05)	0.0000003 (0.00)
Fiscal (-2)	0.077 (0.04)**	-0.050 (0.07)	0.000029 (0.00)***
Fiscal (-3)	0.022 (0.01)*	-0.056 (0.05)	0.0000016 (0.00)
Fiscal (-4)	0.031 (0.02)	-0.018 (0.03)	0.0000262 (0.00)**
∑ Fiscal	0.121 (0.07)***	-0.069 (0.05)	0.000056 (0.00)
Resid	-0.372 (0.04)*	-0.484 (0.04)*	-0.6808 (0.196)*
R-squared	0.84	0.78	0.53
DW statistics	2.06	2.15	2.05

* significant at 1 % confidence level

** significant at 5 % confidence level
*** significant at 10 % confidence level

The table represents the results of four independently estimated St. Louis – type equations. All series are taken in differences of the growth rates up to 2001:12[15]. The columns contain the impacts of 1% monthly change in growth rates of the regressors on real GDP, inflation and unemployment rate. Standard errors of the coefficients are given in the parentheses.

The method used is error correction mechanism (ECM) with Newey-West standard errors. This technique is possible only under conditions that all series are nonstationary in levels (growth rates in this case) and integrated of the same order . First, simple OLS regression in levels is run and residuals are obtained. This cointegrating regression is run without any lags which shows the existence of long-run relationship between the variables. The necessary condition for cointegration is that the residuals from the abovementioned regression are white-noise, i.e. $u \sim N(0,\delta^2)$. In other words they should be stationary in levels. The Augmented Dickey-Fuller tests for residuals obtained from the preliminary regressions indicate that the null hypothesis of a unit root is rejected for all three regressions. Then the regression with all variables in first differences and computed residuals from cointegrating regression is run. This implies that all variables are cointegrated and there is a long-run relationship between the variables, but it does not necessarily mean that this holds for the short-run. The presence of cointegration between nonstationary variables indicates that their stochastic trends are linked, that is they move in the same direction. The dynamic path of cointegrated variables includes the information about the deviations from the equilibrium that is why VAR model, which does not capture this relationship, will lead to the specification error. By contrast, the ECM corrects the relationship between variables in differences and deviation from equilibrium. In other words, error correction model allows for the short-run deviation of variables from their common movements, but the economic mechanisms always correct these deviations.

[15] Growth rates are calculated by the formula: $(X_t - X_{t-1})/X_{t-1}$ which approximately equals $\ln (X_t/X_{t-1})$ as $\Delta t \rightarrow 0$

The obtained coefficient for the error correction mechanism ("equilibrium error" or "speed of adjustment") should be negative and less than unity, which indicates the model stability. One can treat this coefficient as a mechanism, which ties the short-run behaviour to its long-run value. If it is statistically significant it shows what proportion of the disequilibrium in dependent variables in one period is corrected in the next period.

For example, in the first regression (GDP) the estimated error correction (RESID) is –0.372 (significant at 1% of confidence). This means that 37% of the discrepancy between the actual and the long-run, or equilibrium, value of real GDP is eliminated or corrected each month. The same holds for inflation and unemployment rates (-0.484 and –0.681 respectively).

The error correction model is a nonlinear, although in fact it is intrinsically linear and can be deduced simply from the unrestricted form. That is why all series are taken in growth rates. As Davidson and MacKinnon (1993) showed, OLS estimates will be consistent and the problem of spurious regression disappears. As an alternative to ECM, VAR estimation is possible. However, I choose error correction model due to several reasons. First, VAR is more suitable to make for predictions, which are not the main object of my research. Second, in case the variables are of the same order of integration and cointegrated, the error correction model is the best tool and *must* be employed, while VAR is used when this is not the case.

In short, the construction and application of ECM requires the following steps:

1. First of all, series are checked for stationarity. If they are nor stationary, check the order of integration.
2. All series should be integrated of the same order.
3. This allows to run a cointegration regression and obtain the residuals
4. Residuals should be white-noise.
5. Run regression in differences with obtained residual series.

In my case all variables are stationary in first differences (in first differenced growth rates), so they are integrated of order one I(1). The inspection of the

residuals indicates that they are stationary. So, ECM can be applied in this case.

Summing up this section, it can be concluded that the error correction model (ECM) has the following properties:

- Shows both short-run and long-run aspects of variables dynamics simultaneously;
- Avoids the problem of spurious connection ;
- Does not require preliminary distinction of variables between exogenous and endogenous;
- Satisfies all classical econometric assumptions.

As expected, all oil price coefficients have negative signs, with almost all significant at significant levels. The sum of five monthly coefficients is negative and statistically significant at 5% level. It means that 1 percentage point difference in the growth rates of oil price will cause the 0.126 percentage points decrease in the difference of the real GDP growth rates. Unfortunately, it is relatively hard to transform this figure into levels, so only an approximation calculation could be made. Taking into account that oil shocks cause the peak of their impact in a year (Hamilton, 2000; Hooker, 1996), this decrease in real GDP is significant enough.

It does not necessarily mean that real GDP will fall during its growth period: a better explanation is that GDP will still rise, but at slower rate .The quarterly coefficient can be interpreted and compared with IMF result under the assumption that real GDP growth rate in previous period was zero.

I want to observe the quarterly impact of a 20% increase in the price of oil on real and nominal GDP. For example, in fourth quarter of 2001 the Ukrainian real GDP growth constituted 10.0 %. According to my estimation results, a 20% increase in oil price will likely decrease the quarterly growth rate of GDP by 2,5%. This implies that "potential" growth rate could be 10%+2.5%=12.5% which will increase GDP in the fourth quarter by 0.46 bln of 1992 constant rubles or just 2.26 % of quarterly GDP. This will be approximately UAH 1122 mln in nominal terms, or $211 mln. However, this

figure cannot be compared directly to that obtained by IMF ($505), because I investigated only the first quarter impact, but IMF studied the first round impact which could be rather broad. In my regression I used a larger number of lags and found out that oil was still producing a negative impact on GDP (although insignificant). This indicates that the overall effect on GDP could be larger and the simulated figure could increase substantially. The obtained loss is approximately the same each period in 2001; this is also true for the earlier periods. Hence, I can draw a conclusion that as a result of a 20% increase in the price of oil, Ukrainian GDP will likely face $215 loss on average as a first quarter impact (*ceteris paribus*). Of course, this result is ambiguous, but it gives an approximate interpretation of estimated coefficients.

An interpretation for the monthly coefficients is the following: assume that in January price of oil has increased by 10 % (from 20 to 22 dollars per barrel, for instance); immediately it will cause the real GDP growth to decrease by 0,32%. In March this figure will reach its peak at 0,06% and then the impact of price increase gradually disappears – in May the decline in GDP growth will be 0,16 %.

Meanwhile, monetary policy has the largest impact among all regressors, starting its positive impact from the second lag and then increased next two months. Its coefficients are 0,137 and 0,211 respectively. This trend also holds if the larger number of lags is included. One striking result is that the contemporaneous impact of the monetary policy is negative and statistically significant. That could be explained by its slow effect which means that the current policy decisions of National Bank are not affected by the contemporaneous processes in the economy, but rather are predetermined by the past values of economic variables that seems preferable in the circumstances of Ukraine. However, the sum of five monthly lags is positive and statistically significant (0.233), indicating that the first quarter impact does cause changes in real GDP.

The same explanation could be appropriate for the fiscal policy, which contemporaneously causes a decline in GDP growth rate. Again, fiscal policy

starts working from second lag and the sum of its coefficients is positive, as it should be, and significant at 10% level. Similar to Gisser and Goodwin's findings, all coefficients starting from second lag have expected signs. For the case of the United States, the lagged fiscal policy does not affect real GDP, while for the Ukrainian case it matters, but its effect is not as large as that of monetary policy. It could be explained by the fact that these countries have different markets and macroeconomic policies. In the USA the objectives of the Federal Reserve are well-known and markets are functioning efficiently; in Ukraine people do not anticipate policy changes. I can draw a conclusion that among the regressors real price of oil has immediate impact on changes in real GDP, while fiscal and monetary base start to affect domestic product after some period. Gisser and Goodwin concluded that fiscal policy did not effect US GDP, but this discrepancy could be explained by different regulatory policies in both countries.

Adjusted R-square of the regression is 0.84, so about 84% of changes in GDP growth are explained by lagged regressors. F-statistics is rather high and the null of no joint significance is strongly rejected at 1% of confidence. The correct specification of the regression is also confirmed by low S.E. of the regression (5%) and by omitted variable test, which does not reject the null of no omitted variable (P-value=0.32).

Basic diagnostic statistics (see Appendix 3) indicate the normality of the residuals. Thus, Breusch-Godfrey Serial Correlation LM Test does not rejects the hypothesis of no serial correlation with P-value=0.175. This decision rule is also supported by Durbin-Watson statistics which equals 2.06 and is very close to 2. White Heteroskedasticity test indicates that residuals are homoskedastic (P-value=0.29). The condition that residuals are normally distributed is confirmed by Jarque-Bera test. This can also be seen on CUSUM and CUSUMQ diagnostic figures.

In order to avoid the problems of autocorrelated disturbances and heteroskedasticity, the regression with Newey-West standard errors is applied. This method provides a way to calculate consistent covariance matrices in the presence of both heteroskedasticity and serial correlation. As an alternative,

the regression with robust standard errors was applied, which gave the same coefficients and approximately the same errors as the N-W approach. Under the second method the null of no serial correlation is also supported by Breusch-Godfrey Serial Correlation LM Test

So far, the validity of the results is confirmed by basic tests, so we can rely on it in order to make econometrically valid judgments about the relationship of oil price and basic economic indicators. The assumption of normally distributed disturbances holds for other regressions as well (see Appendices 4-5) for details. This allows to use OLS estimator, which is known to be the most efficient among the others.

The results for inflation are quite different. Here oil prices and monetary policy do cause changes in CPI. Crude oil prices are significant only in the same month, indicating that increase in input price causes a jump in the difference of inflation growth rates. It implies that oil price immediately causes increase in inflation. All oil lagged values have expected positive sign, but not significant, however. The sum of the coefficients indicates that 1% change in oil price growth rates will increase quarterly growth of inflation by more than 0,27%, but it is not significant either.

According to the theory, monetary policy has the largest effect on inflation, reaching its peak in the third lag (0.340). The results show that all monthly coefficients are statistically significant, but some of them have positive sign. Nevertheless, the sum of coefficients is positive and significant which means that monetary policy is positively correlated with inflation in Ukraine. Fiscal policy turns out to be insignificant except its for the contemporaneous value, and as discussed in previous chapter, it is positive.

Again, various tests prove the absence of autocorrelation as well as heteroskedasticity. R-squared of the regression is rather high - 0.78 % which could be treated that Ukrainian inflation is explained by changes in the regressors only by 78 %. This can indicate about the correct model specification, which is also supported by almost zero probability of F-statistics.

For changes in the growth rates of unemployment all the coefficients are actually zero, although significant in all lags. Here oil prices start affecting unemployment only from the fourth lag and this coefficient is positive and significant. Taking into account its small value, no credible conclusions about the correlation between oil prices and unemployment rates could be done. Similar conclusions can be made for both monetary and fiscal policies. Moreover, the power of the regression is the lowest among the others (R^2 =0.53). Again, this could be explained by a weak dependence of unemployment on the regressors for the case of Ukraine.

Chapter 4

DISCUSSION

To answer the question whether oil price fluctuations could influence the Ukrainian macroeconomy, the paper deals with three St.Louis-type equations, where oil prices simultaneously with monetary and fiscal policies influence real GDP, inflation and unemployment. All series were taken in the growth rates in order to smooth the fluctuations and obtain efficient estimates.

The results based on Error Correction Model with Newey-West covariance and standard errors suggest that I cannot reject the null of no effect on the Ukrainian macroeconomy with different significant levels. I employed the estimation using four monthly lags of the regressors and found out that oil prices matter for GDP and inflation, but I failed to find any significant effect on unemployment. All significant coefficients have expected signs.

For the case of real GDP, fiscal policy starts its effect only from second lag. It is argued in the literature that countries in transition in order to avert inflationary consequences should decrease government expenditures. In 2001 Ukraine faced a significant decrease in inflation, ending up with annual rate equal 6.1% (25.8% in 2000). Investigating the government expenditures plot it could be seen that it was still growing, but a slower rate. Monetary policy turned out to affect domestic product starting from third lag and then its effect gradually increases if the larger number of lags is introduced. Oil price fluctuations are significant almost at all lags and show negative trend if the longer period is investigated. The economy will not likely return to its initial position after this period, because general price level will not probably stay the same, so the effect is not temporary. Unfortunately, the investigated period is not long enough to make any credible conclusions about the long-run. If oil price changes relative to the

costs of other inputs are long-term, then the long-run effects will occur in the production function as producers choose different inputs based on their prices. In the short-run, the Ukrainian GDP is affected, but the magnitude of its decrease depends on the policy conducted by authority. The Ukrainian authority is rather flexible in terms of its responses to oil price shocks, if there is a threat of more significant losses than only decrease in tax collections. In order to maintain the production at its current level and to gain as much tax collections as possible from oil importers, it permanently changes the import duties and excise taxes as well as taxation schemes for energy consumers. In conjunction with the policy conducted by Russian government, the overall effect could cause GDP growth increase again. In early August 1997, due to crisis in Russia prices for gasoline in Ukraine immediately jumped twofold and continued to rise because of consumers' pessimistic expectations. Many farmers were not able to gather the harvest because they could not afford diesel fuel at high prices. As a response, Ukrainian government immediately annulled the import duty for diesel fuel from Russia. From the trade-off point of view, this decrease in budget contributions from positive duty is more preferable, than potential losses in agricultural sector. The price of crude oil also depends on the policy conducted by Russian government. For example, it permanently changes export duties in order to maintain contributions to the budget. Up to January 2002, this duty aggregated € 27 per ton. Detailed scale of duties is presented below.

Table 4.1 The scale of Russian export duties for crude oil

Price of oil, $/bbl	Export duty, €/ton
<12.5	0
12.5-15	2
15-17.5	5
17.5-20	9
20-22.5	14
22.5-25	20
25-27.5	27
27.5-30	34
30-32.5	41
>32.5	48

Source: http://oilreview.kiev.ua

On May 2, 2002 Russian government announced that the export duty will be decreased in June to € 8 per ton because of oil overproduction in the country. For Ukraine it means that demand for Russian oil could increase, that in turn could cause increase in GDP (*ceteris paribus*). Next, there are three Russian oil companies which operate in Ukraine and which currently involved in the trade war. After the OPEC request to reduce oil production and export in late 2001, the domestic price for crude oil in Russia fell dramatically reaching a price of $5 per barrel. Four out of six Ukrainian refineries work with Russian oil and belong to Russia which allows to export oil at the price, which is much lower then world one. On the other hand, they sell refined products at competitive prices thus making enormous profits. The major role in price setting plays TNK which owns about 64 thousand filling stations all over Ukraine. One important thing here is that costs of production of one unit of petrol by domestic oil refineries are rather high and Ukraine cannot not compete with Russia. I guess that corruption can take place and in fact price for imported oil is much lower than officially announced. Extra profits (since demand does not fall)[16] allow running dumping policy. The overall scheme is: competing Russian oil companies respond to world increase in oil price and raise price for their products to make more profits. Then, in order to capture the market, they lower the price again, but the economy never returns to its initial condition.

This could also explain the immediate effect of oil prices on inflation. Due to lowering the price of oil, Ukrainian producers do not raise their prices next period; in conjunction with the monetary policy, inflation jump effect could be nullified.

As a result of oil export reduction by OPEC countries and by Russia, the world average price for crude oil in first quarter of 2002 jumped again to $24-26 per barrel. During this period Ukrainian refineries faced a decrease in production and the prices for gasoline slightly increased. Unfortunately,

[7] see figure 2.1

data for inflation and real GDP were not available, so this period is not included into the research. One of the reasons why Ukrainian response to oil price increase was not significant is that in the first quarter the general slowdown in economic activity was observed (this also holds for other countries). Oil price increase could have more significant impact in spring, during the sowing campaign.

There could be several explanations why unemployment is weakly affected. First, it is recognized that official unemployment rates are underestimated and the real rates are much higher. Unfortunately, it is not possible to calculate reliable rates at this stage. However, the results could make sense under the assumption that real and official unemployment series are highly correlated. Since all the values are taken in the growth rates rather than values, the estimates are reliable. Second, weak unionization of Ukrainian labor market does not allow to keep real wages constant through the wage indexation or to support long-term contracts with rigid wages. "Ukrprofspilka"- trade union inherited from the Soviet era cannot achieve all the goals due to variety of reasons. Third, the share of workers employed in other sectors is higher than the share of labor force involved to the energy-consuming sector , so the impact of higher oil prices could be "smoothed" by neutrality of a latter. Fourth reason is wage arrears. The reasoning is based on the assumption that Ukrainians do not quickly respond to the cuts in their real wages. The firm's cost-benefit analysis suggests that the possible response to oil price increase is to reduce expenses either by firing employees or by cutting real wages. It could be achieved by not paying wages in time – inflation will make them less. Wage arrears is a common practice in Ukraine and its total volume has been increased up to the late 2000 (UAH 575 mln in 1995 versus 6325 mln in the second quarter of year 2000)[17]. I guess that the Ukrainian economy is not in its full employment level and workers are afraid to become unemployed if they leave their jobs in a response to wage

[17] UEPLAC *"Ukrainian Economic Trends",* January 2001.

reduction, taking into account the competitiveness of labour market. Today the average vacancy ratio which is calculated as the number of registered job seekers to the number of vacancies is fluctuating at the range of 10-20 persons per vacancy[18]. This implies that labor market is highly competitive and is not very sensitive to wage cuts due to the reasons described above. This idea is also supported by my finding that monetary and fiscal policies do not cause significant changes in short-run unemployment level as well.

There could be several ways how government could cope with oil shocks consequences. *First* is monetary policy which is considered to be the best tool. An increase in the growth rate of money supply has two effects. First, added liquidity should reduce nominal interest rate and cause domestic currency depreciation. The latter is a positive change which can improve trade balance; hence, more oil will be supplied. Second is that it rise in money supply may cause more rapid inflation which increases nominal interest rate. Most economists agree that, for a modest and unanticipated monetary expansion, the liquidity effect would dominate. The National Bank of Ukraine (NBU) should also take into account the inflationary expectations of the consumers while running expansionary monetary policy. On the other hand, increase in the growth rate of money supply may cause some drawbacks. As Hamilton (2001) found out, the potential of monetary policy to avert the contractionary consequences of oil shocks is not as great as suggested by economists. He argues that in some cases the authority should ignore them. Hamilton bases this idea on the Gertler and Watson's (1997) estimation that the biggest effect of an oil shock do not appear until three of four quarters after the shock. If this is the case for Ukraine, the NBU's increase in money supply will only cause additional jump in inflation. This point of view is also supported by Hunt, Isard and Laxton (2001) who state that delay in monetary policy response could be more appropriate in some cases.

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[18] *ibid*

Second, negative consequences of oil price increase could be smoothed by decreasing import tariffs. In this case tariff policy should be oriented to attract as much oil inflow as possible. A best example of such policy was presented above when Government set import duty rate equal zero in a response to oil shock. This move came into effect after some period - average price for gasoline decreased, but did not return to its initial level. Also, temporary tax relief for oil refineries could be a solution. In this case they will be able to supply cheaper refined products.

Finally, in anticipation of oil shock the increase in oil strategic reserves could be helpful. For example, in a response to OPEC's decision to cut production in first quarter of 2002, the U.S. decided to increase its strategic reserves by 10%. Now U.S. oil stock is enough to maintain current consumption level for 30-35 days. Ukraine has two large oil terminals, situated in Odessa and Feodosia (Crimea); their total capacity is enough to ensure the economy with oil for some period.

The government should also conduct sustainable policy in respect of oil products market. It should resign from "seasonal" switching of policies, as it jeopardizes oil market stability and exchange rate.

However, it is difficult to judge about the relationship between oil prices and the macroeconomy on the basis of all assumptions made. There could be some other powerful factors, which could matter. The purpose of the paper is to show the direct impact of oil price fluctuations on the basis of economic analysis under some assumptions, ignoring the hidden factors.

CONCLUSION

So far, I found a clear correlation between oil price fluctuations and such indicators of economic performance as GDP and inflation. One percent increase in the growth rate of real oil price will likely decrease next quarter' GDP growth rate by 0.126 percentage points and its effect is still increasing after. The results are consistent with those obtained by IMF (2000) and have strong predictive power. The impact on unemployment level is not significant which could be explained by weak reactions of Ukrainian workers to the wage reduction. The results also suggest that economic theory could be applied for the case of Ukraine in order to see short-run impact on main economic indicators. A deeper investigation of both the theoretical and empirical aspects of the results could be an interesting topic for further research.

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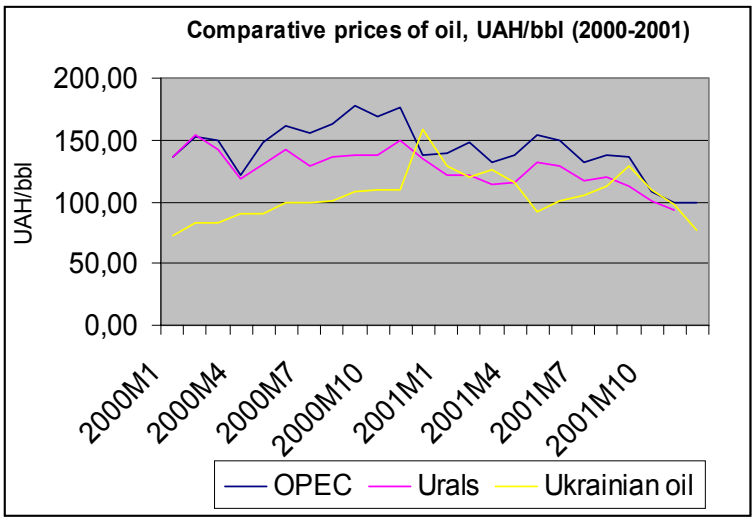
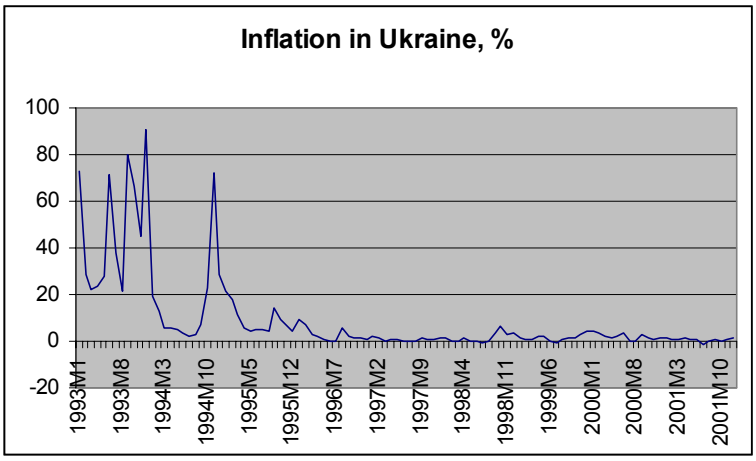


Source: UICE, IFS, NBU, author's calculations



Source: UEPLAC

Augmented Dickey-Fuller Tests for Stationarity

Fiscal, levels			
ADF Test Statistic	-3.109170	1% Critical Value*	-4.0521
		5% Critical Value	-3.4548
		10% Critical Value	-3.1528
Fiscal, first differences			
ADF Test Statistic	**-5.515130**	1% Critical Value*	**-4.0530**
Money, levels			
ADF Test Statistic	-2.514162	1% Critical Value*	-4.0560
		5% Critical Value	-3.4566
		10% Critical Value	-3.1539
Money, first differences			
ADF Test Statistic	**-4.846936**	1% Critical Value*	**-4.0591**
Price of oil, levels			
ADF Test Statistic	-3.146504	1% Critical Value*	-4.0540
		5% Critical Value	-3.4557
		10% Critical Value	-3.1534
Price of oil, first differences			
ADF Test Statistic	**-6.408585**	1% Critical Value*	**-4.0550**
GDP, levels			
ADF Test Statistic	-3.187810	1% Critical Value*	-4.0535
		5% Critical Value	-3.4057
		10% Critical Value	-3.1514
GDP, first differences			
ADF Test Statistic	**-5.163239**	1% Critical Value*	**-4.0560**
Inflation, levels			
ADF Test Statistic	-3.307849	1% Critical Value*	-4.0928
		5% Critical Value	-3.4739
		10% Critical Value	-3.1640
Inflation, first differences			
ADF Test Statistic	**-5.836822**	1% Critical Value*	**-4.0948**
Unemployment, levels			
ADF Test Statistic	-2.601341	1% Critical Value*	-4.0540
		5% Critical Value	-3.4557
		10% Critical Value	-3.1534
Unemployment, first differences			
ADF Test Statistic	**-5.598163**	1% Critical Value*	**-4.0550**

Notes:

- All series are taken in the growth rates
- The number of lags was takes in accordance with LM statistics
- Reject the null hypothesis of the Unit Root if ADF statistics exceeds the MacKinnon critical value which means that is all series are stationary in first differences

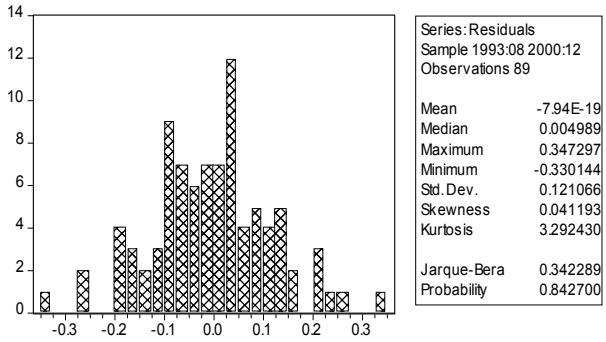
GDP regression. Residuals diagnostic tests

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.104572	Probability	0.375689
Obs*R-squared	16.35798	Probability	**0.175384**

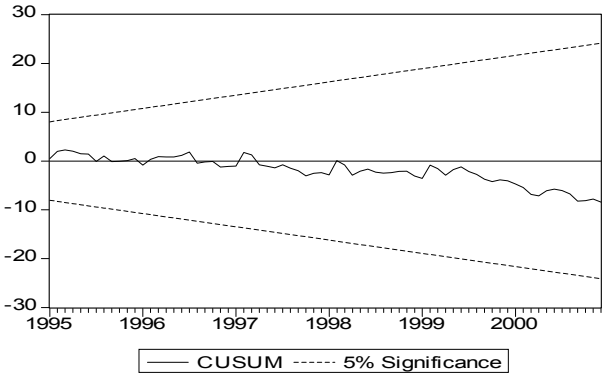
White Heteroskedasticity Test:

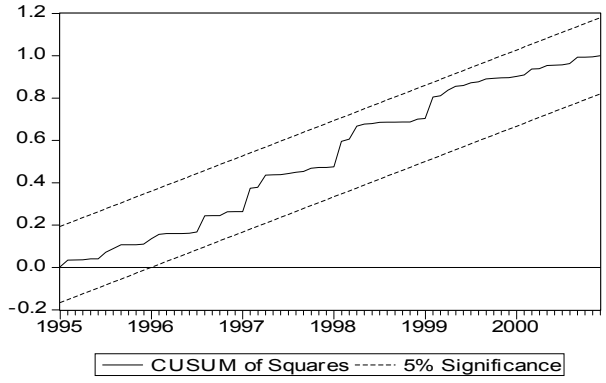
F-statistic	1.181581	Probability	0.287186
Obs*R-squared	35.87168	Probability	**0.291721**



Ramsey RESET Test:

F-statistic	0.796558	Probability	**0.375139**
Log likelihood ratio	0.992943	Probability	0.319024





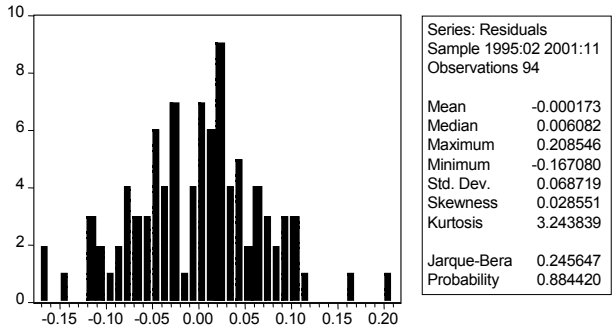
Inflation regression. Residuals diagnostic tests

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.810642	Probability	0.448103
Obs*R-squared	1.958230	Probability	**0.375643**

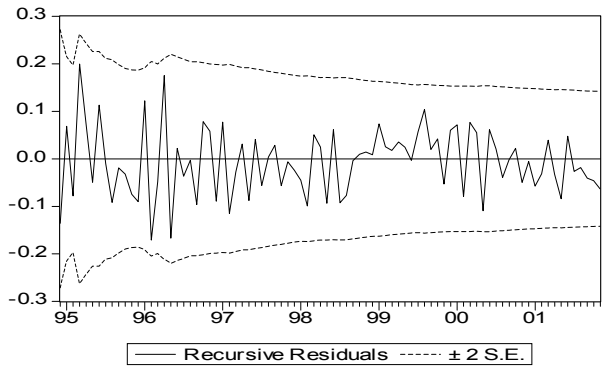
White Heteroskedasticity Test:

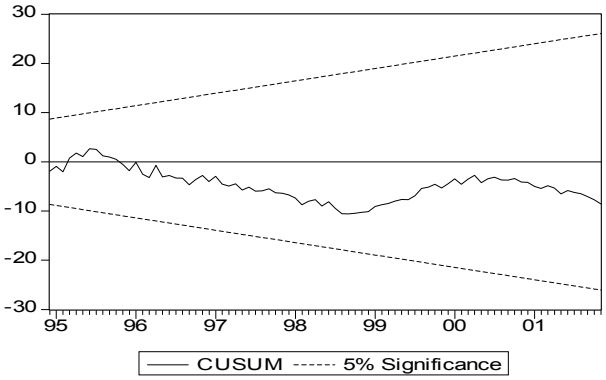
F-statistic	0.903280	Probability	0.611487
Obs*R-squared	28.27187	Probability	**0.556032**



Ramsey RESET Test:

F-statistic	1.384358	Probability	**0.247940**
Log likelihood ratio	6.890807	Probability	0.141772





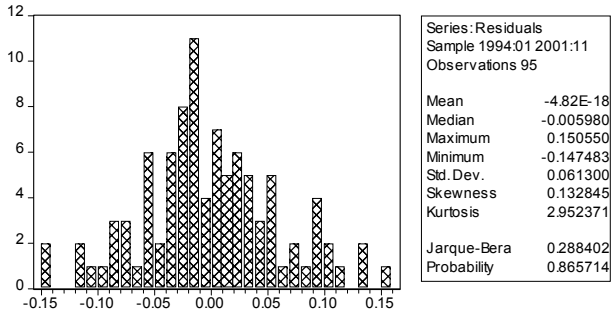
Unemployment regression. Residuals diagnostic tests

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.901050	Probability	0.550569
Obs*R-squared	13.54916	Probability	**0.330419**

White Heteroskedasticity Test:

F-statistic	1.304002	Probability	0.182157
Obs*R-squared	40.36884	Probability	**0.209387**



Ramsey RESET Test:

F-statistic	0.707840	Probability	**0.402801**
Log likelihood ratio	0.880705	Probability	0.348009