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МОДЕЛИРОВАНИЕ И АНАЛИЗ ЭКОНОМИЧЕСКОЙ ПОЛИТИКИ В УСЛОВИЯХ ЕВРОПЕЙСКОГО ЭКОНОМИЧЕСКОГО И ВАЛЮТНОГО СОЮЗА

Резюме

Разработана модель, которая базируется на принципах кейнсианской теории, для исследования инструментов и эффектов влияния национальных и бюджетных политик, а также монетарной политики ЕС на экономическую ситуацию в странах, а также их возможность противостоять кризисам. Модель позволяет выделить негативные и позитивные внешние эффекты экономических политик, определить основные цели и формы координации национальных экономических политик. С помощью модели можно определить инструменты стимулирования экономического развития в странах Союза, а также в мире в целом.

Ключевые слова: монетарная политика, бюджетная политика, экономический и валютный союз, экономический кризис, экономический рост.

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MODELLING AND ANALYSES OF ECONOMIC POLICY IN THE CONDITIONS OF EUROPEAN ECONOMIC AND CURRENCY UNION

Summary

The Keynesian model for analysis of instruments and effects of national monetary and fiscal policy as well as monetary policy of the EU on the economic development in the countries and their ability to overcome shocks is developed. The model shows the distinction between negative and positive external effects of economic policies, determine main goals and forms of the national policies coordination systems. The model helps to define instruments for boosting economic growth in the Union, and the world overall.

Keywords: monetary policy, fiscal policy, economic and monetary union, economic shock, economic growth.

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THE SHALE GAS AND OIL REVOLUTION AND ITS INFLUENCE ON THE AMERICAN AND THE GLOBAL ENERGY MARKETS

This research explores the changes in the structure of the American energy market and the global energy market under the influence of the shale gas and oil revolution during the period of 2000 to 2013. Besides, the research also examines the influence of shale gas extraction volume on the structure of US energy resources consumption. The findings show that the growth of shale gas extraction and the increase in the share of shale gas extraction in total volume of natural gas extraction in the USA led to the reduction in natural gas prices and the rise in the share of natural gas consumption in total volume of US energy resources consumption.

Keywords: shale gas, tight oil, energy market, energy resources consumption.

Introduction. Technological innovations in horizontal drilling and hydraulic fracturing have enabled tremendous amounts of oil and natural gas to be extracted profitably from underground shale formations that were long thought to be uneconomical.

Oil markets have recently undergone a significant transformation with the unexpectedly strong rise in the US production of tight (shale) oil. Tight oil refers to unconventional oil trapped in very low-permeability tight formations known as shales, which makes extraction difficult. The combination of horizontal drilling techniques together with hydraulic fracturing and rising oil prices have made the exploration and exploitation of large volumes of tight oil possible.

In the United States, the extraction of tight oil has grown dramatically over the last few years taking the market by surprise. In 2013, the United States is estimated to have produced 3.5 mb/d

of tight oil which is three times higher than the amount it produced in 2010 [3].

Shale gas rose from less than 1% of domestic gas production in the United States in 2000 to over 20% by 2010. Public attention was first drawn to the issue only in 2007 when the 'US Potential Gas Committee' increased its estimates of unproven US gas reserves by 45%, from 32.7 trillion cubic metres (tcm) to 47.4 tcm to allow for shale gas developments [5]. The extraction of shale gas has transformed the US energy landscape. The rapid expansion of shale gas production in the United States has created hundreds of thousands of new jobs directly and in supporting industries. However, domestic shale gas developments have also been the catalyst for far broader economic benefits throughout the country.

Given the above **research background**, this research will study the changes in the structure of the American energy market and the global energy

market under the influence of the shale gas and oil revolution during the period of 2000 to 2013. It will also examine the influence of shale gas extraction volume on the structure of US energy resources consumption. Since there are few researches to study the influence of shale gas extraction volumes in the USA on the structure of global natural gas import, this research will extend the current literature in this area.

The main purpose of the research is to analyze the changes in the structure of the American energy market and the global energy market under the influence of the shale gas and oil revolution. The object of the research is the national energy market of the USA and the global energy market.

In order to achieve the main purpose of the research the following tasks are set:

1. To analyze the structure of energy resources consumption in the USA and to assess the influence of shale gas extraction on natural gas consumption in the USA.

2. To study the correlation between shale gas extraction and US oil market activity.

3. To analyze the structure of the global energy resources consumption and to evaluate the influence of shale gas extraction on US natural gas import and export activity.

4. To assess the influence of tight oil extraction on US oil export.

This research will use **correlation and regression analysis**. As the result of the research several regression models, which will show the influence of the shale gas and oil revolution both on the American energy resources market and the global energy resources market, will be built. According to the literature review, this method has been widely used in previous studies in the energy sector [1; 2; 4; 7; 9].

Boriss Siliverstovs, for example, explored “the dynamics of European, Japanese and North American gas prices and their interrelations...” with the help of econometric analysis and came to a conclusion, that there are “co-movements within the European/Japanese and the North American prices, respectively” [7, p. 614].

Eva Regnier, in her own turn, analyzed energy price volatility and claimed that “oil prices are highly volatile compared with all products manufactured in the United States, but among crude commodities, oil prices are not so unusual, and were in fact less volatile than most crude commodity prices until 1986” [6, p. 421].

By using econometric analysis Miltos Tsoskounoglou came to a conclusion, that “as the world is fast approaching the point where the depletion of ageing oilfields cannot be covered by decreasing new supply coming on stream, crude oil production will start lagging behind demand for oil” [8, p. 3805].

As it is shown above, econometric analysis is one of the most popular and useful methods, which is used to analyze oil and gas markets (see also Asche, Oglend and Osmundsen (2012); Zivot and Andrews (2002); Jacoby, O’Sullivan and Paltsev (2012); Stern and Rogers (2011); Ames et al. (2013); Stephenson, Valle and Riera-Palou (2011)).

Previous works analysis also shows that the shale gas and oil revolution has significant financial benefits both for natural gas and oil consumers and producers. On the other hand, it is mentioned in all the previous studies that there are severe environmental risks of shale oil and gas development.

Research hypotheses and model establishment. As the literature review above shows, the situation

in the global energy market has suffered significant changes lately. The global crisis was followed by sharp fluctuations of hydrocarbons prices, a slowdown in growth of demand and an increase of competition in traditional energy markets. At the same time new technologies produced great influence on the global hydrocarbons trade. However, for example, Cassandra and Lovejoy claim “that there is not a statistically significant relationship between state-level shale gas production and state-level natural gas prices” [1]. As a result, this research adopts the following 4 pairs of null hypotheses and alternative hypotheses in order to assess the influence of shale oil and gas extraction volumes in the USA on the structure of the American and the global energy markets.

Hypothesis # 1.

Null hypothesis: the change in the share of shale gas extraction in total share of natural gas in the USA and the change in natural gas prices do not influence the structure of US energy resources consumption.

Alternative hypothesis: the change in the share of shale gas extraction in total share of natural gas in the USA and the change in natural gas prices influence the structure of US energy resources consumption.

The formula for the testing of the first hypothesis is as follows:

$$ShareNG_cons_t = \alpha + \beta_1 Share_shalenG_t + \beta_2 HH_NGprice_t + \varepsilon_t \quad (1)$$

1. ShareNG_cons – share of Natural Gas Consumption (Excluding Supplemental Gaseous Fuels) in Total Fossil Fuels Consumption (Quadrillion Btu), %;

2. Share_shaleG – share of Dry shale gas production Billion Cubic Feet per year in annual Natural Gas Production (Dry) (Billion Cubic Feet), %;

3. HH_NGprice – Henry Hub Natural Gas Spot Price (Dollars per Million Btu).

4. α – absolute term, which reflects the influence of employed variables or variables, which are not included into observation; β_1, β_2 – undetermined coefficients of the model; t – time change; ε_t – standard error.

Hypothesis # 2.

The bigger volume of liquid hydrocarbons (crude oil and gas condensate), which are extracted together with shale gas, the lower are the costs of shale gas extraction and the higher is the return on investment. Thus, it can be assumed, that if oil price decreases significantly, gas extraction volume in the USA may fall while gas price may rise. As a result of this observation, the following pair of hypotheses can be formulated:

Null hypothesis: the change in oil prices does not influence the share of shale gas extraction in total share of natural gas in the USA.

Alternative hypothesis: the change in oil prices influences the share of shale gas extraction in total share of natural gas in the USA.

In order to check the correctness of the second hypothesis, which suggests the existence of correlation between shale oil price and shale gas extraction volume, we will formulate a regression model of the following type:

$$Share_shaleG = \alpha + \beta_1 oil_SpotPrice_t + \beta_2 Petrol_cons_t + \varepsilon_t \quad (2)$$

1. Share_shaleG – share of Dry shale gas production Billion Cubic Feet per year in annual Natural Gas Production (Dry) (Billion Cubic Feet), %;

2. oil_SpotPrice – Cushing, OK WTI Spot Price FOB (Dollars per Barrel);

3. *Petrol_Cons* – Petroleum Consumption (Excluding Biofuels) (Quadrillion Btu) – as a control variable of oil demand.

4. α – absolute term, which reflects the influence of employed variables or variables, which are not included into observation; β_1, β_2 – undetermined coefficients of the model; t – time change; ε_t – standard error.

Hypothesis # 3.

Null hypothesis: the change in shale gas extraction volumes in the USA does not influence the share of US natural gas import in global import, which means that it does not influence the structure of global natural gas import.

Alternative hypothesis: the change in shale gas extraction volumes in the USA influences the share of US natural gas import in global import, which means that it influences the structure of global natural gas import.

In order to check the correctness of the third hypothesis we will formulate a regression model of the following type:

$$Share_ImNG_US_t = \alpha + \beta_1 \ln Prod_shaleG_US_t + \varepsilon_t. \quad (3)$$

1. *Share_ImNG_US* – share of US Imports of Dry Natural Gas in world import of Dry Natural Gas, %;

2. *lnProd_shaleG_US* – natural logarithm of Dry shale gas production Billion Cubic Feet per year.

3. α – absolute term, which reflects the influence of employed variables or variables, which are not included into observation; β_1, β_2 – undetermined coefficients of the model; t – time change; ε_t – standard error.

Hypothesis # 4.

Null hypothesis: the change in tight oil extraction volumes in the USA does not influence the share of US crude oil (and oil products) export in global oil products export.

Alternative hypothesis: the change in tight oil extraction volumes in the USA influences the share of US crude oil (and oil products) export in global oil products export.

In order to check the correctness of the fourth hypothesis we will formulate a regression model of the following type:

$$Share_ExOil_US_t = \alpha + \beta_1 \ln Prod_to_US_t + \varepsilon_t. \quad (4)$$

1. *Share_ExOil_US* – share of US Total Exports of Refined Petroleum Products, %;

2. *lnProd_to_US* – natural logarithm of tight oil production mill barrel per year.

3. α – absolute term, which reflects the influence of employed variables or variables, which are not included into observation; β_1, β_2 – undetermined coefficients of the model; t – time change; ε_t – standard error.

Conclusion. Taking into account the results of econometric modeling of the influence of shale oil and gas extraction on the structure of the US and the global energy markets together with the general trends in global energy consumption we can make up the following conclusions:

1. The growth of shale gas extraction and the increase in the share of shale gas extraction in total volume of natural gas extraction in the USA led to the reduction in natural gas prices and the rise in the share of natural gas consumption in total volume of US energy resources consumption. Meanwhile, the increase in the share of shale gas extraction in total volume of natural gas in the USA and the reduction in natural gas prices are the main factors which stimulated the rise in natural gas consumption in the USA.

This statement can be supported by the indicator of the coefficient of determination (the coefficient is 95%). Taking into account the fact, that natural gas is widely used by US energy companies, the reduction in gas prices had the following results: American families started paying less money for heating; steel and glass manufacturers also began to save money by reducing energy costs, while petrochemical manufacturers managed to save money by buying cheaper raw materials for producing plastic goods.

2. “The shale revolution” led to a quick rise in the volume of unconventional oil and gas extraction in the USA. At the end of 2014 more than 5 mln barrels of tight oil per day were extracted at seven biggest shale plays in the USA. However, the more liquid hydrocarbons (crude oil and gas condensate) are extracted together with gas, the lower are the costs of shale gas extraction and the higher is the return on investment. The modeling of correlation between the share of shale gas extraction and crude oil prices (West Texas Intermediate Spot Average) enabled us to determine the direct correlation between these indicators. Therefore, we can make up the following conclusion: if oil price decreases significantly, gas extraction volumes in the USA may fall down, and gas price may rise.

The key aspect of the influence of the oil market on the gas market is the question of cancelling the tough restrictions on crude oil export from the USA. An opportunity to export crude oil will lead to an increase in extraction activity in the USA and to a rise in the offer, which, in its turn, will decrease global oil prices even more and will have positive influence on end-users’ ‘wallets’. However, even without this cancellation the oil prices are very low in the US market. In this case, it is much better for the companies to export oil products than crude oil. Moreover, the cancellation of crude oil export restrictions will lead to the situation when the country will become more dependent on import, as a big part of crude oil will go to an external market. US government’s forecast, signaling about oil price fall, will have a great impact on the natural gas market. While drilling companies are closing high-grade deposits from North Dakota to Texas, they also cut down gas extraction at these plays. These actions could prevent further gas prices fall. Moreover, this can have a negative impact on environmental situation, as the technology of hydraulic fracturing will be widely used. The way out of the existing situation could be found in the following actions: the companies hope to reduce costs by 20-30% in 2015 with the help of oil service companies and suppliers; the companies will receive profit by concentration only on the most productive assets; finally, the efficiency can be gained by technology development (for example, one of the most promising technology, which will increase shale oil extraction profitability, is repeated rectification).

3. The situation on the US domestic market had a significant influence on the global market. Due to the increase in shale gas extraction volumes the USA has managed to refuse almost completely to import LNG into the domestic market in recent years.

The research enabled us to determine statistically significant reverse correlation between shale gas extraction volumes and the share of US natural gas import in global natural gas import. The increase in “domestic” gas extraction in the USA naturally led to the fall in import. Natural gas volumes, which the USA does not need any more, are redirected to European and Asian markets. These surplus LNG

volumes have significant pressure on market gas prices. The surplus on an external market, which was formed due to extra LNG volumes, the so-called “gas bubble” made many long term projects unprofitable, for example, Stockman natural gas project (Shtokman.ru, 2015). There is a forecast, that by 2017 the USA will have become net exporter of natural gas, which will be exported mainly to Mexico. Based on the calculation of elasticity coefficient for the regression model, the following conclusion can be made: with all other equal conditions 10% increase in annual shale gas extraction volume will lead to 2% decrease in the share of US natural gas import in global natural gas import annually.

4. As a result of fast development of shale oil extraction, there were several consequences: a rapid reduction in the volumes of imported crude oil into the USA and a rise in the volume of exported oil products from the USA. The share of the USA in global oil export rose by more than twice in the period from 2000 to 2013.

As we can see from the results of the modeling, the most important factor, which contributes to the rise in the share of US oil products export, is tight oil extraction.

The rise in the extraction of light tight oil of good quality led to the situation, where the USA does not need any large-scale delivery of raw materials of the same brand from Europe, Africa and the Middle East. The USA stopped being dependent on energy resources import. As a result, there appeared disbalance on the market: the supply of oil was bigger than demand.

Based on the calculation of elasticity coefficient for the regression model, the following conclusion can be made: with all other equal conditions 10% increase in annual shale oil extraction volume will lead to 3% increase in the share of US oil products export in global export annually.

5. Shale development has affected coal market as well, for example, it has reduced the demand for

coal. As the production of shale gas and tight oil increases, its effects on other energy markets – such as those for coal, for nuclear and renewable energy, and for energy conserving equipment – will also increase. Since 2009 coal, which is not required for US energy power station, has been sent to Europe. As a result, cheap coal from the USA and Columbia started competition with expensive Russian gas in European market.

6. Developing domestic shale gas extraction, the USA will receive substantial benefits, which are much bigger than just satisfying current energy resources demand. The development of shale gas extraction will give a certain impulse for developing the economics and increasing the number of jobs in the country. Due to “the shale gas and oil revolution” a long term downward trend of employment dynamics in the field of oil and gas extraction in the USA was substituted by revival. In general, there was a considerable increase in economic activity in the country. Besides, a substantial rise in investments was noticed at this period. Gas prices, which fell by 25%, became lower than in Europe and Asia. Natural gas, which became cheaper in the USA, stimulated foreign companies to move their production facilities to the USA with the aim of staying competitive in the global market.

In addition, in the near term, shale development causes labor and capital to be used that would otherwise be idle, again raising GDP. In the longer term, however, whether shale resources are available or not, the labor and capital available in the economy will be used at roughly their maximum sustainable rates, so the additional labor and capital used to produce shale resources or energy-intensive goods will mostly be drawn away from the production of other goods and services. As a result, there will be no net change in GDP through that last route, although GDP will continue to be increased by shale development in the other ways just described.

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СЛАНЦЕВА ГАЗОВА ТА НАФТОВА РЕВОЛЮЦІЯ ТА ЇЇ ВПЛИВ НА АМЕРИКАНСЬКИЙ ТА СВІТОВИЙ РИНКИ ЕНЕРГОРЕСУРСІВ

Резюме

Дане дослідження вивчає зміни у структурі американського та світового ринків енергоресурсів під впливом сланцевої газової та нафтової революції в період 2000-2013рр. Крім того, в статті також вивчається вплив обсягу видобутку сланцевого газу на структуру споживання енергоресурсів США. Результати дослідження показали, що зростання частки видобутку сланцевого газу та збільшення частки видобутку сланцевого газу в загальному обсягу видобутку природного газу в США призвело до зменшення вартості природного газу, а також до збільшення частки споживання природного газу у загальному обсягу споживання енергоресурсів США.

Ключові слова: сланцевий газ, сланцева нафта, ринок енергоресурсів, споживання енергоресурсів.

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СЛАНЦЕВАЯ ГАЗОВАЯ И НЕФТЯНАЯ РЕВОЛЮЦИЯ И ЕЕ ВЛИЯНИЕ НА АМЕРИКАНСКИЙ И МИРОВОЙ РЫНКИ ЭНЕРГОРЕСУРСОВ

Резюме

Данное исследование изучает изменения в структуре американского и мирового рынков энергоресурсов под влиянием сланцевой газовой и нефтяной революции в период 2000-2013гг. Кроме того, в работе также исследуется влияние объема добычи сланцевого газа на структуру потребления энергоресурсов США. Результаты исследования показали, что рост добычи сланцевого газа и увеличение доли добычи сланцевого газа в общем объеме добычи природного газа в США привело к снижению цены на природный газ, а также к увеличению доли потребления природного газа в общем объеме потребления энергоресурсов США.

Ключевые слова: сланцевый газ, сланцевая нефть, рынок энергоресурсов, потребление энергоресурсов.

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ОСОБЛИВОСТІ РОЗВИТКУ ПЕНСІЙНИХ СИСТЕМ КРАЇН ЦЕНТРАЛЬНО-СХІДНОЇ ЄВРОПИ

У статті досліджено особливості реформування систем пенсійного забезпечення країн Центрально-Східної Європи. Особливу увагу приділено Угорщині, Польщі, Чехії як лідерам соціально-економічно розвитку в регіоні. Узагальнено результати реформування пенсійних систем країн ЦЄ та зроблені висновки для України.

Ключові слова: пенсійна система, солідарна пенсійна система, накопичувальна пенсійна система, добровільне пенсійне страхування, реформування систем пенсійного забезпечення, країни ЦЄ.

Постановка проблеми в загальному вигляді та її зв'язок із важливими науковими або практичними завданнями. Актуальною проблемою сучасного соціально-економічного розвитку України є недосконалість системи пенсійного забезпечення, про що свідчить значний дефіцит Пенсійного фонду України (ПФУ), низький рівень соціально-економічного добробуту громадян, які мають право на пенсійне забезпечення. Так, за останні чотири роки власні кошти Пенсійного фонду складала лише 67-70%, а 30-33% його виплат забезпечувалося державним бюджетом. Зокрема, в 2014 р. з державного бюджету в Пенсійний фонд України (ПФУ) надійшло 75,8 млрд грн, з яких 56,8 млрд – на дотації на пенсійні виплати, 14,9 млрд – на покриття дефіциту коштів для виплати пенсій, 7,4 млрд – на сплату страхових внесків окремим категоріям застрахованих осіб. При цьому питома вага витрат Державного бюджету на Пенсійний фонд в 2014 р. становила

понад 26%, що є одним із найбільших показників у світі. За прогнозами ця сума в 2016 р. перевищить 100 млрд грн. [1] У цілому це свідчить про неспроможність національної пенсійної системи, де державне пенсійне страхування є практично єдиним джерелом фінансового забезпечення осіб пенсійного віку, виконувати своє призначення.

Отже, важливим є проведення кардинальних реформ, які б створили умови для зростання соціально-економічного добробуту громадян України. В контексті цього актуальним є дослідження досвіду країн Центрально-Східної Європи (ЦЄ), які здійснили трансформації власних пенсійних систем ще в кінці 1990-х – на початку 2000-х рр.

Аналіз останніх досліджень і публікацій. Питанню дослідження розвитку пенсійних систем країн ЦЄ приділяється достатня увага в спеціалізованій літературі. Зокрема, різні аспекти розглядають такі закордонні автори, як В. Антропов, Н. Борисенко, С. Єрошенков, А. Іванов, В. Лін-