8. ECONOMIC ACTIVITY AND NATURAL GAS AS A POTENTIAL DESTABILIZER OF THE SLOVENIAN ECONOMY

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Abstract

This article empirically investigates whether natural gas has the potential of destabilizing the Slovenian economy. The results confirmed the indirect relation that the increase in gas prices decelerates the dynamics of aggregate domestic consumption, which further decelerates activities in individual industries. An empirical analysis has proven that the natural gas does have the potential of forecasting the production trends in individual industries within the Slovenian economy. By using the dynamics of natural gas price movements (and other explanatory variables), we can forecast the dynamics of movements in the production of textiles, leather, fur and clothes, rubber and plastic-based products, metals, furniture, as well as in the processing industry, recycling, electricity, natural gas, steam and hot water supplies in Slovenia.

The obtained results suggest that natural gas price shocks can influence economic activity beyond those explained by direct input cost effects and via the indirect effect of possibly delaying the purchase of goods.

Keywords: natural gas prices, production by industries, energy supply, aggregate domestic consumption.

JEL Classification: C2, E0, E3, Q4.

Introduction

Despite numerous efforts towards a more efficient use of energy, the energy needs are soaring. Economic growth in developing countries, especially in China and India, constitute an additional energy price pressure. Price trends do not exclude any energy source, because they are dictated – in addition to increasing needs – by the relatively

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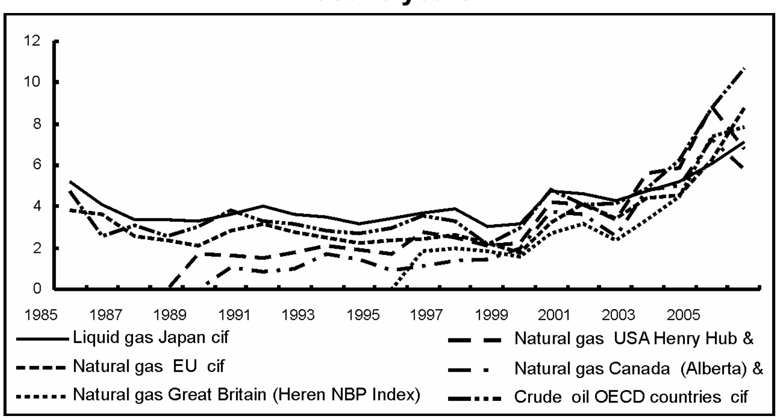
expensive existing and new alternative technological solutions. Thus, further price increases in energy can be expected in the world markets. Energy prices are important for production, business cycle, cost structure, financial markets, export revenues and real exchange rate dynamics. Hayo and Kutan (2005) found that the oil price has a positive impact on stock returns.[1] Meanwhile, Kutan and Wyzan (2005) found that natural reserves are expected to yield significant export revenues and real exchange rate dynamics.

The fastest growing source of primary energy is natural gas. It has been estimated that by 2025 the consumption of natural gas will increase by 67%. For a number of years, the prices have been higher than in the '90s, and will continue to increase in the upcoming years (Energy security 2008).

One MMBtu (MMBtu – one million BTUs, British thermal unit; 1000 cubic feet of natural gas is comparable to 1MBtu, which is occasionally expressed as MMBtu, which is approximately equivalent to 1 GJ) of natural gas gives us six times less thermal energy than a barrel of oil. The price of both energy resources are related in the long-run, because in the past the ratio of the price of crude oil to that of natural gas was around 10:1 (Hartley *et al*., 2007). The movement in prices of natural gas in comparison with crude oil and liquefied gas on important world markets during the last twenty years is shown in Figure 1.

Figure 1

Movement of natural gas prices on important world markets during the last 20 years



CIF = cost insurance freight

Source: Statistical Review of World Energy (2008).

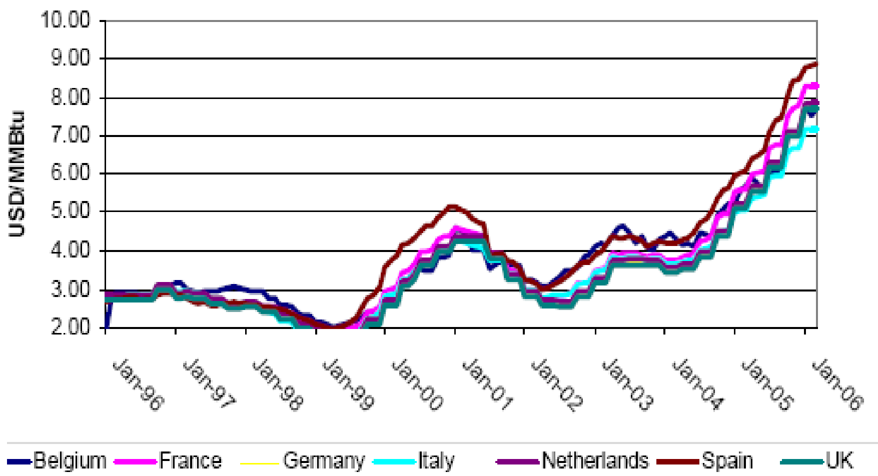
An increase in a global crude oil price will ultimately result in a higher residual fuel oil price and, hence, a higher natural gas price (Hartley *et al*., 2007). The import prices of natural gas in some European countries during the period between 1996 and 2006

[1] Fernandez (2007) confirmed the effect of political conflicts in the Middle East on stock markets worldwide.

are given in Figure 2. The prices of natural gas in the EU have increased more than twofold over the last twenty years, and amounted to, on average, 8.77 US dollars in 2006 per 1 GJ. Between 2004 and 2006, the imported price was the highest in Spain and France, and lowest in the United Kingdom and Italy, where the import price for 1 MMBtu of natural gas was, on average, almost 1.7 US dollars lower than in Spain. In 2007, the cheapest natural gas was found in Lithuania, Latvia, Estonia and Bulgaria; the most expensive natural gas was in Germany, the United Kingdom and in Hungary (Statistical Review of World Energy 2008).

Figure 2

Average import prices of natural gas in European countries between 1996 and 2008



Source: Reinaud (2007).

This article is divided into four parts: part one as introduction, part two discusses the EU's guidelines and the role of the common European natural gas market; part three discusses the gas consumption in Slovenia. In part four, we empirically examine the intensity of the impact of natural gas on the Slovenian economy and individual industries, as well as examine the cause/effect relationships between the price and quantity of natural gas, different industries, aggregate domestic consumption, production, employment and inflation. In this way, we will answer the question of whether natural gas is an energy product that has significant potential for destabilizing the Slovenian economy. We tested two hypotheses, a direct effect of natural gas on production by industries and an indirect effect through aggregate domestic consumption on industry production.

The Role of the Common European Natural Gas Market

The development of a common European energy market will ensure the security of supply and lower prices, which subsequently demands the development of connections, improved network infrastructure and the consistent implementation of the Community Competition Law (Brečevič 2003, Serletis and Shahmoradi, 2005). It is not possible to establish a competitive and common European market without additional physical capacities, which would involve greater energy "participation" among economies and improved interconnections in the European natural gas network, together with a decreased need for spare capacity and, eventually, also lower costs (Mulder and Zwart, 2006).[2]

The European gas market is undergoing substantial changes due to increasing imports from countries outside of the EU and, in part, because of the liberalization process as well. Completion of the internal gas market and changes in the market structure are expected to generate an outcome that will meet fundamental energy policy requirements with regard to: prices, security of supply and protection of the environment. The formation of partnerships among the Caspian and Mediterranean countries, as well as among countries in North Africa and the Middle East, has improved the supply of natural gas in Europe. The new strategy set up by Europe and Africa includes the interconnection of energy systems, which could – when taking into account a suitable natural gas transmission network - diversify natural gas supplies in Europe (Sagen *et al*., 2006).

European gas consumption has been increasing considerably over the last years and the share of natural gas in the total EU energy consumption is rising as well. The reasons behind this are related to the environmental attractiveness of gas compared with alternatives like coal, nuclear energy and the low construction costs of gas-fired power plants. With regard to increased gas consumption in households, in the energy sector and in the industry as a whole, and also due to the required formation of a common natural gas market, the following positive effects, arising from investments in natural gas infrastructure, can be expected in the national economy:

- lowering expenses for the transmission of natural gas,
- improved efficiency of the internal natural gas market, price reductions, higher standards of service and increased competitiveness,
- reduction of losses during the transmission and distribution of natural gas,
- increased involvement of the national economy in the energy infrastructure of EU member countries,
- increased storage capacities and reduced dependence on natural gas exporters,
- increased income from network charges.

The adoption of the European Directive concerning common rules for the internal market in natural gas (2003/55/ES), the Directive concerning measures to safeguard the security of the natural gas supply (2004/67/ES), the Directive concerning the production and distribution of energy (2001/77/EC in 2003/54/EC) determine the

[2] Natural gas network capacity should enable the transmission of natural gas for thermo-energy objects, for industrial customers and households, as well as facilitate spare capacity for natural gas transmission.

guidelines for the development of a natural gas network in New EU Member and Associated Countries.

The Energy Agency of the Republic of Slovenia determines the general conditions for natural gas supplies from the network. Beginning in July 2004, regulations setting rules for access conditions to natural gas networks came into force in the EU states (1228/2003), which aimed at available network capacities and requires the use of market methods in granting free cross-border transfer capacities. The Council of the European Union in its Council Regulation No. 1223/2004 granted provisions to Slovenia for the transitional period regarding free cross-border capacity, which made it possible for Slovenia to use non-market methods in allocating free capacity until July 2007 (insofar as such capacity did not exceed half of the total available interconnection capacity). The EU Regulation of 2005, which sets rules for the access to natural gas networks, is aimed at ensuring non-discriminatory network access conditions for gas transmission networks taking into account the differences between national and regional markets (Morgan, 2006).

The EU Member States should assign national regulators, to determine at the EU level, the tools for the cross-border flow of natural gas, including non-discriminatory network access, tariffs, capacity allocation together with a certain schedule for the market supply. Compliance with the directives should ensure the economical and efficient use of natural gas, investments aimed at improving natural gas storage, the solidarity scheme in cases of interruption of natural gas power supply, improve natural gas infrastructure, and should encourage investments in energy infrastructure with due regard to environmental protections (Jaffe and Victor 2005). Investments in energy infrastructure are also necessary because of the European guidelines, which necessitate the creation of stocks (e.g. a 90-day stock of petroleum and petroleum products, natural gas and liquefied petroleum gas).

Natural Gas Consumption in Slovenia

When considering the fact that half of the energy demand in the EU countries is satisfied through imports, and that natural gas consumed in the EU comes mainly from three countries (Russia, Algeria and Norway), import dependence on natural gas gives this energy product the potential to influence the movement of macroeconomic variables and production by industries. If the current trends persist, the dependence on imports will rise to as high as 80%. It can safely be expected that the price and availability of natural gas is likely to have a growing influence on the national economy in the future. The liberalization of the gas market is expected to ensure the security of gas supply (Festić, Križanič and Repina, 2008).

The price of petrol, natural gas and electricity has almost doubled over the last couple of years. At the same time, the price of natural gas is below the European average in Slovenia, where gas prices for industrial customers are approximately 13% below the European average and lower than the gas prices for households.

With regard to increasing demand for fossil fuels, congestion of supply chains and increased import dependency it can be expected that the price of natural gas is unlikely to fall. This fact can also encourage energy innovativeness and efficiency, increase efforts aimed at the competitiveness of renewable energy sources, and the importance of renewable energy sources and their potential for influencing natural gas and oil processes (Wiser *et al*., 2005).

The indicators in Table 1 show the dynamics of natural gas consumption growth in individual industries with regard to the dynamics of final natural gas consumption movements. Cumulatively, the dynamics of natural gas consumption growth in the energy sector exceeded the dynamics of final natural gas consumption growth by 32% in the period between 1997 and 2000. After 2000, the growth of final natural gas consumption exceeded the growth of natural gas consumption in the energy sector, namely by 17.5% in 2001, by 24% in 2003, by 1.6% in 2004 and by 22.2% in 2005. The dynamics of natural gas consumption growth in manufacturing and civil engineering lagged behind the dynamics of final consumption until 2002 by between 2.5% and 10.2%. The dynamics of natural gas consumption in households exceeded the dynamics of final consumption by 1.6% to 14.9% in the period between 2000 and 2005, whereas the cumulative dynamics of movements for the period between 1997 and 2000 showed a 19.6% higher growth of natural gas consumption in households with regard to final natural gas consumption growth. The dynamics of non-energy consumption lagged by 6.5% to 11% behind the dynamics of final consumption, or accelerated by 10% to 14%.

Table 1

Natural gas consumption indicators in Slovenia

(mio Sm3)	1997/2000	2000/01	2001/02	2002/03	2003/04	2004/05
Import/consumption	1.0072	1.0011	0.9998	1.0015	0.9999	1.0010
Energy sector /final consumption	1.3258	0.8251	1.0376	0.7593	0.9842	0.7778
Manufacturing and civil engineering/final consumption	0.8979	0.8973	0.9749	1.0558	1.0083	1.0296
Households/final consumption	1.1962	1.0161	1.1468	1.1497	1.0399	1.0505
Other consumers/final consumption	0.2054	4.1016	1.1858	0.4799	1.1343	0.4433
Non-energy consumption/final consumption	-	0.9359	0.8893	1.1465	0.8864	1.1082

* Quotient of year-on-year indexes of growth rates for selected indicators.

* Sm3: standard cubic meter at 15 °C and 1.01325 bar.

* Manufacturing and civil engineering include manufacturing activities without the production of coke, petroleum products, nuclear fuel and civil engineering according to the standard classification of activities.

* Final energy consumption is energy consumption, which is consumed in transportation, industrial, commercial, agriculture, public and household sectors; with the exception of deliveries to the energy conversion sector and to the energy industry itself.

* Other consumers refer to sectors, which are not explicitly stated in the indicators.

Source: Own calculations on the basis of SURS, Energy balance (2007).

The key question of this analysis is the question of whether available natural gas prices and available quantities have the potential of influencing the production in different industries in Slovenia and if changes in the growth of production in the Slovenian economy can be influenced by natural gas prices and quantity fluctuations (Kliesen, 2006). The theoretical basis for this analysis is that smaller quantities of available energy products and higher prices lower the dynamism of production, increase the general price level, reduce employment and have a negative influence on net exports. Since oil is more often used as an energy product, the influence of its price and available quantities on the stated dependent variables has been empirically confirmed (Hamilton, 1983, Jones, Leiby and Paik, 2004, Guo and Klisen, 2005). Empirical studies on the influence of natural gas on the stated dependent variables are rather rare, due to the fact that natural gas as an energy product has not been so widely used. Some studies confirmed the influence of natural gas prices on regional economic activities (Leone, 1982, Considine and Mount, 1983), on the redistribution of income between households and natural gas suppliers (Stockfisch 1982) and on inflation (Ott and Tatom, 1982). Conclusions derived from the above studies regarding the influence of higher natural gas prices on inflation, on the reduction of real income in households and the reduction of (regional) economic activity are not significant. Studies confirmed that a 20% natural gas price growth had approximately the same effect as a 10% petrol price growth on the growth of real GDP (Kliesen, 2006). On the other hand, the growth of natural gas prices only lowered the consumption of lower budget households if it was unanticipated (Cullen *et al*., 2005).

In the following chapter, we test two hypotheses: a direct effect of natural gas on production by industries and an indirect effect through aggregate domestic consumption on industry production.

The Influence of Price and Available Natural Gas Quantities in the Slovenian Economy

Data. When collecting the necessary data, we relied on the internal data base of the EIPF (2007) and OECD (2007).[3] The model has been assessed on the basis of quarterly data within the stated period, from the third quarter of 1992 to the first quarter of 2007. The models include key segments of the entire Slovenian economy, as well as production in individual industries. Movements in total (industrial) production, production in different industries, price movements (the consumer price index, the producer price index of durables and the producer price index of whole industrial products), movements in employment and exports (of goods and services), the Tolar-Euro exchange rate, the aggregate domestic consumption (as total domestic consumption of households, investment and national consumption), domestic consumption (of households), gross wages in the tradable sector, stocks of goods, the prices of metal, the petroleum product prices corrected by excise duties, the price of oil,[4] the price of natural gas[5] and natural gas consumption (as gross natural gas consumption in Slovenia) were utilized.

[3] The Economic Institute of the Law School, Ljubljana.

[4] Brent, in USD per barrel. The prices of oil were converted in Euros.

Moffatt and Salies (2003) demonstrated that logarithmic approximation is accurate if the rates of change among variables are reasonably small. The time series are transformed into differences in logarithms as an approximation for growth rates measured in percentage changes in the original time series. The difference in logarithms (dlog) is practically equivalent to percentage change. After deriving the transformed time series, the stationarity of all the selected time series has been obtained at a 1% significance level (Dickey and Fuller, 1979), although the unit root test revealed that at least one time series for each country seems to already be a candidate for stationarity in the original form.

Because the analysis including the dummies did not significantly change the results, we decided to employ only annual growth rates as quarterly data - year-on-year basis for the time series of total industrial production, production by industries, real export of goods and services, standardized unemployment rates, stocks of goods, the aggregate domestic consumption, consumption of households and the prices of consumer and industrial products.

Methodology. In order to assess the effects of potential natural gas prices and quantity dynamics on the Slovenian economy, the method of least squares and impulse response methodology was employed. The equations were assessed by the difference of logarithms for chosen variables by taking into account the optimal time delay and best Akaike criterion. The ARMA technique incorporates residuals from previous observations into the regression model for current observation. If the correlogram shows that a serial correlation dies off after a small number of lags/increasing number of lags, the series will obey a low-order moving average process/autoregressive process (MA/AR) (Ruey and Tiao, 1984). After achieving good results in the Breusch-Godfrey/ARCH test, the hypothesis H_0 about the non-existence of serial autocorrelation of residuals was accepted. According to the Chow forecast test and Ramsey-Reset test, which were used for proving the stability of the estimated functions, we have accepted the hypothesis regarding structural stability (Thursby, 1982).

The VAR models include a considerable number of variables and it is necessary to test each of them for exogeneity. Testing for exogeneity follows the methodology proposed by Greene (2003). Greene (2003, 582) made clear that tests for exogeneity can be based on the concept of Granger causality applied to individual equations and examined by the Wald test in order to test the significance of a particular explanatory variable. The reaction of a variable to an impulse generated by another variable is assumed to reveal the causal relationship between them (Engle and Granger 1978) and the relative importance of each random innovation in affecting the variables in the models (Jones *et al.*, 2003).

How macroeconomic shocks - in the sense of natural gas prices dynamics – affect industry production was analyzed by impulse responses (Sims and Zha, 1999). Analyzing the residuals' covariance matrix facilitates the assessment of the robustness of the impulse analysis towards the re-ordering of variables. Since there are correlations between some residuals, it is necessary to examine the sensitivity of

[5] The price of imported natural gas through gas pipelines (in EUR/MBTu), wholesale price, weighted average for EU-25.

the responses to the re-ordering of the variables. Therefore, recursive identification is used, which separates the residuals into orthogonal shocks using the Cholesky factorization of the covariance matrix of residuals (Canova 2003). Recursive identification subsequently attributes all the contemporaneous correlations of the residuals and all of the effects of any common components on the variable that is ordered first in the VAR system. Each impulse or shock equals one standard deviation of the time series for the respective variable and causes other time series to respond (Pesaran and Shin, 1998).

We analyzed the potential influence of natural gas price and quantities of individual sectors, as well as on the entire Slovenian economy. Regression activities in individual industries (shown in the Appendix on online version of the article) were analyzed on the basis of the model as seen from the following equation:[6]

$$Dlog(X_t\text{-}sector)= \sum_{t=1}^{i} [b_1 \cdot Dlog(P\_gas_t)]+ \sum_{t=1}^{i} [b_2 \cdot Dlog(Q\_gas_t)]+$$
$$+ \sum_{t=1}^{i} [b_3 \cdot Dlog(X_{t-i}\text{-}sector)]+ \sum_{t=1}^{i} [b_4 \cdot Dlog(sp1_t)]+ \sum_{t=1}^{i} [b_5 \cdot Dlog(efob\_eu_t)]+ \quad (1)$$
$$+ \sum_{t=1}^{i} [b_6 \cdot Dlog(zal_{t-i}/qb1_t)]+\varepsilon$$

The price movements were explained by the price movements of petroleum products corrected by excise duties, natural gas prices, metals, gross wages in the tradable sector, the movements of relationships between stocks and industrial production, and the movements of relationships between stocks and aggregate domestic consumption (equation 3). In order to assess the influence on the whole economy (industrial production, inflation, employment, export of goods, aggregate domestic consumption) the following equations were used:[7]

$$Dlog(qb1_t)= \sum_{t=1}^{i} [b_1 \cdot Dlog(P\_gas_t)]+ \sum_{t=1}^{i} [b_2 Dlog(Q\_gas_t)]+$$
$$\sum_{t=1}^{i} [b_3 \cdot Dlog(sp1_{t-i})]+ \sum_{t=1}^{i} [b_4 \cdot Dlog(efob\_eu_{t-i})]+ \sum_{t=1}^{i} [b_5 \cdot Dlog(es\_eu_{t-i})]+ \varepsilon \quad (2)$$

[6] Where: Dlog represents the difference in logarithm as an approximation for growth rate; b_m is the coefficients of regression equations; X_t is the output of the chosen sector; P_is the gas_t prices of gas imported through gas pipelines; Q_gas_t is the amount of natural gas used in Slovenia; X_{t-n} is the output for the chosen sector during past quarters; $sp1_t$ is the aggregate domestic consumption; $efob\_eu_t$ is the export of goods; zal_t is the stocks of goods and $qb1_t$ equals total industrial production. The maximum time shift is 10 quarters.

[7] Where Dlog represents the difference in logarithm; b_m is the coefficient of regression equations; $qb1_t$ is industrial production; $sp1_t$ is aggregate domestic consumption; $cbs1_t$ is the domestic consumption of households; zap_t is employment; $sp1_{t-n}/zal_{t-n}$ is the relation between aggregate domestic consumption and stocks of goods; $sp1_{t-n}/qb1_{t-n}$ is the relation between aggregate domestic consumption and industrial production; $zal_{t-n}/sp1_{t-n}$ is the relation between stocks and aggregate domestic consumption; $efob\_eu_t$ is the export of goods; es_eu_t is the export of services; eur_t is the Tolar-Euro exchange rate; $tgor_t$ is the price of petroleum products corrected with excise duties; $metals_t$ is the price of metals; bpl_t_t is gross wages in the tradable sector; $price\_stst_t$ is the consumer price index; pc_spt_t is the producer's price index of durables and pcs_t is the producer's price index of all industrial products. Maximum time shift is 11 quarters.

$$\begin{aligned} Dlog(price\_stst_t) = & \sum_{t=1}^{i} [b_1 \cdot Dlog(P\_gas_t)] + \sum_{t=1}^{i} [b_2 \cdot Dlog(bpl\_t_t)] + \\ & + \sum_{t=1}^{i} [b_3 \cdot Dlog(zal_{t-i}/sp1_{t-i}/)] + \sum_{t=1}^{i} [b_4 \cdot Dlog(sp1_{t-i}/qb1_{ti})] + \\ & + \sum_{t=1}^{i} [b_5 \cdot Dlog(tgor_t)] + \sum_{t=1}^{i} [b_6 \cdot Dlog(metals_t)] + \sum_{i=1}^{n} [b_7 \cdot Dlog(pc\_spt_t)] + \varepsilon \end{aligned} \tag{3}$$

$$\begin{aligned} Dlog(zap_t) = & \sum_{t=1}^{i} [b_1 \cdot Dlog(P\_gas_t)] + \sum_{t=1}^{i} [b_2 \cdot Dlog(Q\_gas_t)] + \\ & + \sum_{t=1}^{i} [b_3 \cdot Dlog(sp1_{t-i}/zal_{t-i})] + \sum_{t=1}^{i} [b_4 \cdot Dlog(sp1_{t-i}/qb1_{t-i})] + \sum_{t=1}^{i} [b_5 \cdot Dlog(efob\_eu_{t-i})] + \varepsilon \end{aligned} \tag{4}$$

$$\begin{aligned} Dlog(efob\_eu_t) = & \sum_{t=1}^{i} [b_1 \cdot Dlog(P\_gas_t)] + \sum_{t=1}^{i} [b_2 \cdot Dlog(Q\_gas_t)] + \\ & + \sum_{t=1}^{i} [b_3 \cdot Dlog(sp1_{t-i}/zal_{t-i})] + \sum_{t=1}^{i} [b_4 \cdot Dlog(sp1_{t-i}/qb1_{t-i})] + \\ & + \sum_{t=1}^{i} [b_5 \cdot Dlog(eur_t)] + \sum_{t=1}^{i} [b_6 \cdot Dlog(cbs1_{t-i})] + \varepsilon \end{aligned} \tag{5}$$

$$\begin{aligned} Dlog(sp1_t) = & \sum_{t=1}^{i} [b_1 \cdot Dlog(P\_gas_t)] + \sum_{t=1}^{i} [b_2 \cdot Dlog(efob\_eu_{t-i})] + \\ & + \sum_{t=1}^{i} [b_3 \cdot Dlog(sp1_{t-i}/zal_{t-i})] + \sum_{t=1}^{i} [b_4 \cdot Dlog(zal_t/qb1_{t-i})] + \sum_{t=1}^{i} [b_5 \cdot Dlog(pcs_t)] + \varepsilon \end{aligned} \tag{6}$$

Results. The results confirm cyclical movements (Serletis and Kemp, 1998) and the influence of the price and quantity of natural gas on some activities in Slovenia. The importance of natural gas for economic activity is increasing (see, Krichene, 2002, Michot, 2004). With regard to the results, it can be said that a larger amount of natural gas has a positive effect on: the production of textiles, leather, fur and clothes (with a low coefficient of 0.5), on the processing industry (with a higher elasticity coefficient, 1.9), on the production of metals (4.3 elasticity), on the processing of wood (7.5), on electrical machinery (2.9), and on the manufacture of furniture and other processing activities (total coefficients 8.8). Higher natural gas consumption triggers elasticity in the dynamics of the electricity supply, the natural gas supply, the steam supply and the hot water supply (2.4 elasticity coefficient), as well as on the whole of industrial production (with 0.06 elasticity).

The results show that the potential influence of natural gas prices on production in certain industries, namely, the price of natural gas, has a potential influence on the dynamics of the movement of the whole industrial production at a 5% significance level with an elasticity of coefficient -0.11 and at a time shift of two quarters (see Kliesen, 2006); as well as on the dynamics of aggregate domestic consumption at a 5% significance level with an elasticity coefficient of -0.99 and at a time shift of four quarters, with the response of exports being statistically insignificant. Long-term higher natural gas prices have an immediate and long-term impact on consumer spending on energy goods and services (Henry and Stokes, 2006). The price of natural gas could be used for forecasting movements in the production of textile, leather, fur and clothes (with an elasticity coefficient of -3.2), the production of paper and cardboard (-1.3), intermediate consumption products (-0.09), leather and footwear

(-1.2) and for the production of products from rubber and plastics (total coefficient -0.9). The dynamics of movements in recycling could be forecasted by means of natural gas price movements, because the total coefficient is negative (-2.7) at a 5% significance level. With the dynamics of natural gas price movements, the dynamics of movements in the production of metals could be forecasted, with the total coefficient at -0.15. Electricity, natural gas, steam and hot water supply negatively elastically respond (coefficient -5.7) to a 1% increase in natural gas prices.

The collected results also show an influence of natural gas prices on inflation.[8] From the equation, it can be seen that an increase in the price of natural gas by one percentage point contributes to an increase in living costs by 0.021 percentage points, whereas the growth of oil prices and petroleum products (without excise duties) is higher and amounts to 0.04 percentage points in Slovenia. Natural gas prices can ignite inflation and cause recession (Krichene and Askari, 2007). An increase in natural gas prices decelerates aggregate domestic consumption in Slovenia (with the coefficient -0.99), which then further decelerates total industrial production (with the coefficient 0.37) and the production by industries (with a coefficient of 0.14 in recycling and the chemical industry, a coefficient of 0.53 in the furniture industry, a coefficient of 0.08 among electrical machinery equipment, a coefficient of 0.04 in the metal industry, a coefficient of 0.03 in the textile industry, a coefficient of 0.09 in the processing industry, a coefficient of 0.15 for plastics and a coefficient of 0.02 in the production of paper, pulp and cardboard). The developing countries and transition economies take explicit account of the direct impact of higher (oil and) natural gas prices and the secondary impact on electricity prices, other than through the general rate of inflation. Higher gas prices would undoubtedly drive up the prices of other fuels, magnifying the overall macroeconomic impact. Rising gas use worldwide will increase this impact (IEA, 2004).

Positive employment effects arise from an extension of the available quantities of natural gas in Slovenia (for other countries see KPMG, 2005).[9] Higher natural gas prices are contributing to stubbornly high levels of unemployment and exacerbating budget-deficit problems in many OECD and other energy-importing countries (IEA, 2004). The results of the study by Baclajanschi *et al*. (2007) suggest that natural gas prices changes could dampen economic growth while putting additional strains on the current account deficit. But the significant impact of natural gas on exports was not proven for the case of Slovenia.

We confirmed that by using the dynamics of natural gas price movements (and other explanatory variables) we could forecast the dynamics of movement in the production of textiles, leather, fur and clothes, products from rubber and plastic materials, metals, furniture and goods from the processing industry, recycling, electricity, natural gas, steam and hot water supplies. The model indicates that for industries that have a large

[8] Bole and Rebec (2007) proved that the increase of natural gas prices contribute to an increase of industrial product prices with a coefficient of 0.031 in the time period of four quarters.

[9] If labour supply or tradable sector productivity increases in emerging Asian economies, which are an important factor driving energy price increases, then industrial countries receive some positive terms-of-trade effects coming through non-energy tradable goods that offset some of the negative implications of permanently higher real energy prices (Babee and Hunt, 2007).

cost share of natural gas, natural gas price shocks mainly reduce supply (see Lee and Ni, 2002). The assessed equations are a relatively good indicator, on the basis of which we could reach conclusions about the influence of natural gas prices and quantities on the dynamics of production in different industries in Slovenia. It can also be concluded from the results that there is an indirect impact of natural gas prices through the dynamics of aggregate domestic consumption on production by industries. The consequent influence of the dynamics of aggregate domestic consumption impacts on the activities in individual industries (with coefficients on an interval from 0.004 to 0.044).

Furthermore, we performed the VAR model as an impulse-response analysis (Table 2) confirming the indirect impact of gas prices on individual industries through aggregate domestic consumption in Slovenia (see Kilian, 2007).[10]

Table 2

Impulse response analysis (aggregate domestic consumption and output of individual industry, VAR)11

Response of DLOG(SP1):				
Period	DLOG(P_GAS)	DLOG(Q_GAS)	DLOG(SP1)	DLOG(X17)
4	-0.008689	0.006977	-0.008792	0.008732
5	-0.002389	0.002662	0.034324	-0.003249
Response of DLOG(X17):				
Period	DLOG(P_GAS)	DLOG(Q_GAS)	DLOG(SP1)	DLOG(X17)
1	-0.014387	-0.008431	-0.023146	0.056123
3	-0.007144	-0.003043	0.024202	0.009231
Response of DLOG(SP1):				
Period	DLOG(P_GAS)	DLOG(Q_GAS)	DLOG(SP1)	DLOG(X19)
2	-0.002681	-0.005871	-0.016462	-0.006936
4	-0.008076	0.010948	-0.008593	-0.009860
Response of DLOG(X19):				
Period	DLOG(P_GAS)	DLOG(Q_GAS)	DLOG(SP1)	DLOG(X19)
1	-0.024918	0.007336	-0.030517	0.087386
7	-0.003389	0.033734	0.017158	0.028184
Response of DLOG(SP1):				
Period	DLOG(P_GAS)	DLOG(Q_GAS)	DLOG(SP1)	DLOG(X21)
2	-0.003906	-0.005116	-0.018949	-0.007198
4	-0.007417	0.005735	0.001784	-0.007910
Response of DLOG(X21):				
Period	DLOG(P_GAS)	DLOG(Q_GAS)	DLOG(SP1)	DLOG(X21)
1	-0.001763	0.000152	-0.026045	0.033586
3	-0.019448	0.004099	-0.017941	0.013176
Response of DLOG(SP1):				
Period	DLOG(P_GAS)	DLOG(Q_GAS)	DLOG(SP1)	DLOG(X24)

[10] The price of natural gas influences the dynamics of aggregate consumption growth, with the Granger tests being causally significant for a time lag of 2-6 quarters. The dynamics of aggregate domestic consumption further influences activities in different industries.

[11] We extracted only the relevant impulse-response relations from the whole system of equations.

2	-0.004675	-0.010640	-0.015650	-0.018028
4	-0.007830	0.012306	-0.004099	-0.012691
Response of DLOG(X24):				
Period	DLOG(P_GAS)	DLOG(Q_GAS)	DLOG(SP1)	DLOG(X24)
2	0.000553	-0.009185	-0.034015	0.007654
3	-0.006139	0.013128	0.004166	0.033696
Response of DLOG(SP1):				
Period	DLOG(P_GAS)	DLOG(Q_GAS)	DLOG(SP1)	DLOG(X27)
2	-0.009283	-0.003054	-0.013593	0.017503
6	-0.005674	-0.000643	-0.008766	0.012989
Response of DLOG(X27):				
Period	DLOG(P_GAS)	DLOG(Q_GAS)	DLOG(SP1)	DLOG(X27)
1	0.011292	0.004527	0.022505	0.032469
2	0.007095	0.003848	-0.000620	0.003228
Response of DLOG(SP1):				
Period	DLOG(P_GAS)	DLOG(Q_GAS)	DLOG(SP1)	DLOG(X37)
2	-0.016663	0.011222	-0.010656	0.014976
6	-0.021495	0.013818	-0.002621	0.012528
Response of DLOG(X37):				
Period	DLOG(P_GAS)	DLOG(Q_GAS)	DLOG(SP1)	DLOG(X37)
2	-0.006831	0.009007	0.029030	0.000962
4	-0.018205	0.052442	0.014945	0.022650
Response of DLOG(SP1):				
Period	DLOG(P_GAS)	DLOG(Q_GAS)	DLOG(SP1)	DLOG(X31)
2	-0.014733	0.016211	-4.07E-05	0.006309
5	-0.016985	0.014573	0.035198	-0.008827
Response of DLOG(X31):				
Period	DLOG(P_GAS)	DLOG(Q_GAS)	DLOG(SP1)	DLOG(X31)
3	-0.001117	0.007645	-0.020006	0.003562
4	0.001269	0.018428	-0.034726	0.012784
Response of DLOG(SP1):				
Period	DLOG(P_GAS)	DLOG(Q_GAS)	DLOG(SP1)	DLOG(X40)
1	-0.001391	0.013143	0.053609	0.000000
5	-0.002544	-0.009412	0.043956	-0.007256
Response of DLOG(X40):				
Period	DLOG(P_GAS)	DLOG(Q_GAS)	DLOG(SP1)	DLOG(X40)
3	-0.016979	-0.008393	0.004827	-0.051879
4	-0.011365	0.010665	-0.071034	-0.020122
Response of DLOG(SP1):				
Period	DLOG(P_GAS)	DLOG(Q_GAS)	DLOG(SP1)	DLOG(X20)
2	-0.007515	-0.010974	-0.007583	-0.019759
8	-0.009876	0.014549	0.006797	-0.012090
Response of DLOG(X20):				
Period	DLOG(P_GAS)	DLOG(Q_GAS)	DLOG(SP1)	DLOG(X20)
3	0.010459	-0.011659	-0.018427	0.026175
5	0.009122	-0.003529	-0.011528	0.025565
Response of DLOG(SP1):				
Period	DLOG(P_GAS)	DLOG(Q_GAS)	DLOG(SP1)	DLOG(X36)
3	-0.004382	-0.014664	-0.009063	0.005294

5	-3.33E-05	0.011262	0.020010	0.002992
Response of DLOG(X36):				
Period	DLOG(P_GAS)	DLOG(Q_GAS)	DLOG(SP1)	DLOG(X36)
1	0.008553	0.011143	-0.006292	0.048553
3	0.003982	-0.005851	-0.014153	0.013612
Response of DLOG(SP1):				
Period	DLOG(P_GAS)	DLOG(Q_GAS)	DLOG(SP1)	DLOG(QA)
2	-0.004395	-0.000940	-0.001921	-0.015124
6	0.005970	0.009875	-0.002398	-0.010727
Response of DLOG(QA):				
Period	DLOG(P_GAS)	DLOG(Q_GAS)	DLOG(SP1)	DLOG(QA)
3	-0.003723	0.001062	-0.002526	0.013331
7	-0.001714	0.002079	-0.003372	0.013197
Response of DLOG(SP1):				
Period	DLOG(P_GAS)	DLOG(Q_GAS)	DLOG(SP1)	DLOG(QD)
3	-0.006382	-0.008004	-0.007782	0.001052
7	-0.004903	-0.011223	-0.003498	-0.002842
Response of DLOG(QD):				
Period	DLOG(P_GAS)	DLOG(Q_GAS)	DLOG(SP1)	DLOG(QD)
3	0.000897	0.000376	-0.001139	0.008226
6	0.008344	0.007483	-0.010084	-0.001083
Response of DLOG(SP1):				
Period	DLOG(P_GAS)	DLOG(Q_GAS)	DLOG(SP1)	DLOG(DB)
4	-0.006755	0.011396	0.003982	0.011434
10	-0.000176	0.006675	-0.010986	0.013609
Response of DLOG(DB):				
Period	DLOG(P_GAS)	DLOG(Q_GAS)	DLOG(SP1)	DLOG(DB)
2	0.008568	0.002074	0.024180	0.018820
7	0.006408	0.013340	0.011528	0.005353
Response of DLOG(SP1):				
Period	DLOG(P_GAS)	DLOG(Q_GAS)	DLOG(SP1)	DLOG(DH)
4	-0.012145	0.012468	0.003524	-0.018275
8	-0.012618	0.015558	0.001603	-0.014850
Response of DLOG(DH):				
Period	DLOG(P_GAS)	DLOG(Q_GAS)	DLOG(SP1)	DLOG(DH)
3	-0.006198	-0.001654	-0.012769	0.013633
7	0.007386	0.003302	-0.012861	0.014374
Stand. Errors: Analytic, Cholesky Order.: DLOG(P_GAS) DLOG(Q_GAS) DLOG(SP1) DLOG(Xxx)				

Source: EIPF data base, OECD and own calculations (November 2007).

The results show the influence of natural gas prices and quantity on aggregate domestic consumption in Slovenia and the influence of aggregate domestic consumption on the dynamics of individual industries, with the higher natural gas price decelerating the dynamics of aggregate domestic consumption (see Cullen *et al*., 2005).[12] Changing energy prices may create uncertainty about the future path of energy prices, causing consumers to postpone the purchasing of goods and increasing precautionary savings in response to higher energy prices (Kilian, 2007). In the following activities in Slovenia, namely: the production of textiles, leather, fur and clothes, the production of pulp, paper and cardboard, recycling, electricity, natural gas, steam and hot water supplies and intermediary consumption products, the deceleration of economic activity in individual industries was confirmed if the price of natural gas was rising (deceleration was weak, with coefficients ranging between -0.003 and -0.021 and with a time lag between one and seven quarters). The production of textiles, leather and textile products decelerated if the dynamics of aggregate domestic consumption in Slovenia decelerated (in a time lag of one quarter), the production of pulp, paper and cardboard indirectly decelerated if aggregate domestic consumption decelerated and when the price of natural gas increased (with a time lag between one and three quarters). The production of chemicals, chemical products and artificial fibers decelerated if the dynamics of aggregate domestic consumption growth decelerated (with a time lag between two and three quarters), with the deceleration of metal production being weaker than the aforementioned activities (with a coefficient of -0.0006 in a time lag of two quarters). The intensity of deceleration in recycling is insubstantial (for a time lag between two and four quarters, and with a change of coefficient amounting to -0.015). As expected, electricity, natural gas, steam and hot water supplies decelerate in a time lag of four quarters if the dynamics of aggregate consumption decreased. With a reduction in purchasing power and an increased probability of being unemployed comes the postponement of large expenses, such as those for nonessential products or major purchases like furniture etc. (see Kilian, 2007). The processing industry, the dynamics of production, intermediate consumption products, furniture, wood processing, rubber and plastic materials, the production of chemicals, chemical materials and artificial fibers also decelerate (with a time lag between one and seven quarters), with the weak deceleration found in the production intermediate consumption products (with the average coefficient value of -0.003) if the dynamics of aggregate consumption growth decelerated.[13]

The magnitude of the effect of natural gas price shock on production in individual industries indirectly through aggregate domestic consumption, derived from the impulse-response function of natural gas price shocks in the individual industries' production of a VAR, is between -0.0002 and -0.025 as an elasticity, spread over three to eight quarters. With regard to the coefficient values, it can be said that the intensity of reactions in individual industries to the impulses of natural gas price accelerations has been proved. This is also the case for the indirect intensity of responses in individual industries to the higher natural gas prices because of a deceleration of aggregate domestic consumption in the national economy.

[12] We do not state the results of the whole response-impulse function. They present only the relevant impulse-response relation of the whole system of functions.

[13] Al-Gudhea et al. (2007) distinguish between small and large shocks in this context. And show that asymmetry is more pronounced in small shocks, which may be due to consumer search costs.

Conclusion

The empirical analysis demonstrated the potential of natural gas price movements (and other explanatory variables) to forecast movements in production for some industries in the Slovenian economy. Natural gas price movements can help us forecast the movements in the production of electricity, natural gas, steam, hot water supplies, the production of metals, textiles, leather, footwear, leather and fur products, clothes, the production of pulp, paper, cardboard and products from paper and cardboard, the production of products from rubber and plastic materials, the processing industry and the production of furniture, the production of intermediary consumption products and recycling.

The indirect influence of the dynamics of natural gas price movements on individual economic activities through the decrease in the dynamics of aggregate domestic consumption, which decelerates the dynamics of production movements in individual industries, was proven. The dynamics of gas prices decelerates the dynamics of aggregate domestic consumption, which further decelerates the activities in individual industries with deceleration coefficient values ranging from -0.003 to -0.021 with a time lag between one and seven quarters.

The obtained results suggest that natural gas price shocks influence economic activity beyond that explained by direct input cost effects and via the indirect effect of possibly delaying purchasing of goods. From the results it can also be stated that natural gas has the potential to destabilize the Slovenian economy.

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List of Abbreviations

bpl_t: the gross wages in tradable sector

cbs1: the domestic consumption of households

db: the production of textile, leather, fur and clothes

dh: the production of products from rubber and plastics

efob_eu: the export of goods

es_eu: the export of services

eur: the Tolar-Euro exchange rate

metals: the price of metal

P_gas: the price of natural gas (=cene_plina in the pictures in the Appendix – impulse-response)

pc_spt: the producer price index of durables

pcs: the producer price index of all industrial products

price_stst: the consumer prices index

Q_gas: natural gas consumption in Slovenia (=poraba_plinslo in the pictures in the Appendix – impulse-response)

qa: the production of intermediate consumption products

qb1: total industrial production

qd: the processing industry

sp1: the aggregate domestic consumption (as total domestic consumption of households, investment and national consumption)

sp1/qb1: the relationship between aggregate domestic consumption and total industrial production

sp1/zal: the relationship between aggregate domestic consumption and stocks of goods

tgor: the petroleum products prices corrected by excise duties

x17: the production of textiles

x19: the production of textiles, leather, footwear and leather products, except clothes

x20: the wood processing, the production of products from wood, cork, straw and wicker, except furniture

x21: the production of pulp, paper and cardboard and products from paper and cardboard

x24: the production of chemicals, chemical products, artificial fibers

x27: the production of metal

x31: the production of electrical machinery and equipment

x36: the production of furniture and other processing industry

x37: recycling

x40: the production of electricity, natural gas, steam and hot water supply

X_{t-n}: output of a chosen sector in past quarters

zal: the stocks of goods

zal/sp1: the relationship between stocks of goods and aggregate domestic consumption

zap: employment