ENERGY SECURITY OF POLAND AND COAL SUPPLY: PRICE ANALYSIS

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Overview

This study analyzes the energy security of Poland in terms of coal supply, especially with respect to relations between the domestic versus international coal and gas markets. In particular, we aim to empirically validate the main hypothesis that energy security in the Polish coal market is not equal in each market segment. We investigate this hypothesis by examining whether the Polish electricity and heat markets exhibit different connections with the world energy markets. We use two coal price indexes to represent the domestic coal market for the Polish electricity and heat markets. The first index we use is the PSCMI (Polish Steam Coal Market Index) 1, which refers to Polish coal prices for power use. The other index we use is the PSCMI 2, which represents the analogous prices for heating purposes. In contrast to previous studies, we focus on the coal market, whereas the majority of studies concerning Poland up to this point have covered energy security from the hydrocarbons and natural gas perspectives.

Since Poland has a high self-sufficiency rate for coal, we can learn from our study that if the Polish electricity market is more connected to the international coal market than the gas market, it would be easy for Poland to secure energy in the electricity segment. However, if a domestic coal segment such as the heating market is instead connected to the international gas market, securing energy for this segment without relying on foreign supplies will be more difficult. Therefore, some segments can be managed using the current domestic coal policy, while others might need special treatment to ensure energy security. Thus, the results of this study highlights areas of focus for policy makers who are utilizing coal to secure energy. In this sense, by analyzing energy security in different market segments, our study calls for a market policy tailored to different segments, with separate requirements for different market participants.

Due to the unclear nature of the energy security phenomenon, we have decided to use an idea introduced by an internationally recognized body specializing in energy security, the International Energy Agency (hereinafter: agency or IEA). This agency "defines energy security as the uninterrupted availability of energy sources at an affordable price" (IEA, 2019). IEA breaks the concept into two time horizons: short and long term. The former pertains to the ability to respond promptly to changes in the balance between energy supply and demand, while the latter refers to timely investments that respond to development and environmental challenges (ibidem). The IEA definition includes two aspects of energy security: physical availability of energy and prices. Using the IEA framework, we focus on the price-dimension of energy security in this study. We study how to promote energy security in the Polish coal market divided into different segments.

Methods

To assess the price dimension of energy security in the Polish coal market, we have carried out a cointegration analysis between the coal and natural gas markets. Cointegration tests require the order of the test variables to be consistent. Thus, before performing cointegration tests, the Augmented Dickey-Fuller (ADF), Phillips-Perron (PP), Kwiatkowski–Phillips–Schmidt–Shin (KPSS), and Lee-Strazicich (LS) (2003) stationarity tests were applied on the PSCMI 1, PSCMI 2, coal, and natural gas series. The ADF, PP, and KPSS tests do not consider the effects of structural breaks; thus, we used the LS test, which considers the existence of such effects in the model.

After the order of integration among the test variables is determined by the stationarity tests, we performed the Johansen (1991) and Bierens and Martins (BM) (2010) tests to investigate the nexus between the Polish coal market and the international coal and natural gas markets. To consider the effects of a structural break in the cointegration relationships, we also applied the Gregory-Hansen cointegration test (Gregory and Hansen, 1996). In this cointegration test, a single structural break is included in the model.

For the Polish coal indices, we used the PSCMI 1 and PSCMI 2. The values of these indices (expressed in PLN/t and PLN/GJ) are obtained both from the exchange information platform (GPI) established by the Polish Power Exchange, and published as the Polish Steam Coal Market Index (PSCMI, 2019). The gas price in this study is the monthly Russian natural gas border price in Germany. The unit of this price is US$ per million metric British thermal unit and the data are obtained from the IMF (IMF primary commodity prices). The coal price used in this study is the monthly Australian thermal coal price in US dollars per metric ton. The coal price data is procured from the World Bank. The data used in the study covered the period 2011:1-2019:1.

Results

We found from the Johansen test that both PSCMI 1 and PSCMI 2 are not cointegrated with the natural gas price. On the other hand, the test identified a cointegration relationship between the PSCMI 1 and PSCMI 2 markets. Meanwhile, we found cointegration between the international coal and gas markets and among coal and the two PSCMI markets. The BM test inferred that the cointegration relationship between the international coal and gas markets was time invariant, while those between the coal and the two PSCMI markets had time-varying relationships. This suggested that the cointegration relationships between coal and the PSCMI markets were not stable during our test period.

The GM test indicated that when the effect of a structural break is considered, both the PSCMI 1 and PSCMI 2 markets were cointegrated with the natural gas market. It also revealed that the significance level for rejecting the null hypothesis of no cointegration was higher for the PSCMI 2 than the PSCMI 1. This implied that the PSCMI 2 had a stronger connection to the gas market. Meanwhile, the GM test indicated that while the PSCMI 1 market is cointegrated with the coal market, the PSCMI 2 market did not have a cointegration relationship with the coal market. This suggests that the PSCMI 1 market is more strongly linked to the coal market compared to the PSCMI 2.

Conclusions

Energy security analysis presents a scientific challenge both from the theoretical and empirical points of view. We know that theoretical aspects of energy security require a separate in-depth study, but revealing the overall factors involved with Polish energy security was not our goal. Instead, we have decided to use the IEA concept, defining energy security as an uninterrupted availability of energy sources at an affordable price. Employing this idea, we have described energy security through its price dimension.

To do so, we have used an example of the Polish coal market disaggregated into different segments. The Polish case is interesting for further analysis as this country is both importing and exporting coal. Between 2011 and 2018, Polish hard coal exports decreased and were supplemented with imported coal. At the same time, Poland became a net importer of hard coal (with an exception in the year 2013). Polish coal imports were dominated by steam coal (68-85% in 2011-2018). Prices of coal used in the domestic market were represented by the PSCMI 1 and 2 indices. The former described coal prices in electricity production, while the latter signified prices in the heating sector. Using those indexes, our results of the Gregory-Hansen test revealed that during 2011:1-2019:1, the PSCMI 1 had a relatively stronger market linkage with the international coal market compared to the PSCMI 2. The results also proved that the PSMCI 2 is more linked to the international gas market than that of the coal market. These results shed a new light on the energy security of Poland.

Since our result of the market linkage between PSCMI 1 and international coal markets implies that the Polish electricity sector is more connected to the coal market (and resembles international coal markets) than the natural gas market, it is likely that the Polish electricity sector exhibits energy security, assuming that Polish domestic coal continues to be self-sufficient. On the other hand, we found that the heating sector, despite using insignificant quantities of imported coal, is more connected to the natural gas market. Hence, the energy security in this market might be questioned because Poland relies on other countries for its natural gas supply. By claiming this, our study confirms the result of Kruyt et al (2009) that energy security analysis is highly context dependent.

References

Bierens, H.J., Martins, L.F., 2010. Time-varying cointegration. Economet. Theory 26 (5),1453–1490.

IEA, 2019. Energy security. https://www.iea.org/topics/energysecurity/ (accessed 16 July 2019).

Gregory, A.W., Hansen, B.E., 1996. Residual-based tests for cointegration in models with regime shifts. J. Econometrics 70, 99-126.

Johansen, S., 1991. Estimation and hypothesis testing of cointegration vectors in gaussian vector autoregressive models. Econometrica 59, 1551–1580.

Kruyt, B., Vuuren, D.P., Vries, H.J.M., Groenenberg, H., 2009. Indicators for energy security, Energ. Policy 37, 2166-2181.

PSCMI, 2019. Polish Steam Coal Market Index. https://polskirynekwegla.pl/o-indeksie (accessed 4 April 2019).