Entrepreneurial Business and Economics Review

OPEN ACCESS

2017, Vol. 5, No. 2

DOI: 10.15678/EBER.2017.050204

Modelling Energy Security and International Competitiveness: The Export Perspective

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ABSTRACT

Objective: The objective of this paper is to investigate the link between energy security and international competitiveness captured by export.

Research Design & Methods: To fulfil the goal, we employed the panel data linear regression model with fixed effects. The study includes 23 countries denoted by one of the world's biggest energy consumption levels between 1995 and 2014.

Findings: The study confirms the existence of the relationship between energy security and export in the defined and examined groups of goods. Energy security influences exports of capital goods most. While the environmental and economic aspects of energy security gain importance in all tested categories of goods, energy imports lose it.

Implications & Recommendations: The research results suggest that the energy security concept is not a coherent phenomenon as the environmental aspect had the greatest influence on international competitiveness. Such a result calls for a broader empirical investigation with a greater sample size divided upon GDP performance.

Contribution & Value Added: The originality of this work lies in studying the link between energy security and international competitiveness from the export perspective. The identified research gap in this area shows a relative lack of theoretical and empirical studies.

Article type:	research paper
Keywords:	international competitiveness; energy security; supply capacity; regression; panel data
JEL codes:	Q37, F14

Received: 21 November 2016 Revised: 3 March 2017 Accepted: 20 March 2017

Suggested citation:

Nyga-Łukaszewska, H., & Chilimoniuk-Przeździecka, E. (2017). Modelling Energy Security and International Competitiveness: The Export Perspective. *Entrepreneurial Business and Economics Review,* 5(2), 71-84, DOI: http://dx.doi.org/10.15678/EBER.2017.050204

INTRODUCTION

Energy has always been a significant production factor, but nowadays its importance is increasing. It is true for both developing and developed countries. However, the role of energy for these groups of countries is different. While continuous economic growth in developing regions surges global energy demand, energy conservation efforts in advanced economies aim at a decrease in energy consumption. Adding to this global strives for climate protection with stringent GHG emission allowances, volatile energy prices and concerns about the security of energy supply, we arrive at the world energy landscape of the 21st century.

Due to the fact that energy security constitutes the scenery foreground since energy consumption centres are located far from energy production centres energy imports and consumption arouses a number of concerns. Initially, these doubts referred to fuel availability and its volatile prices. It reminds oil crises in the 1970's when due to energy shortages and its volatile prices, the world community was driven into the recession path. The mixture of energy concerns changed over time. Because of rising environmental awareness, the world community took efforts aimed at reducing energy consumption. However, it is a difficult task to bring the hunger for energy growth from developing/emerging economies together with the climate protection goals. Reconciling these goals is even harder in the environment of expanding globalisation and trade liberalisation.

In the world of open economies and free trade, countries are strongly focused on gaining and maintaining the ability to compete with their products/services successfully on the international market. Therefore, the goal of the article is an attempt to answer the question whether energy security influences the ability of a country to compete with export in the international market. It is important to understand this relationship because it can enhance our understanding of the energy security phenomenon. It enables us to verify whether energy security is only a goal in itself or it can be a factor determining economic performance more broadly than only GDP. Initially, energy security research focused only on macroeconomic activity depicted by GDP performance (e.g. Leiby, Jones & Curlee, 1997). The identified research gap, considering energy security linked to international competitiveness, strengthens the research need.

The study is based on the panel regression model including 23 countries denoted by one of the world's biggest energy consumption levels between 1995 and 2014. Secondary data were derived from international databases. The paper starts with a theoretical overview of the energy security concept and its linkages with international competitiveness. Such a structure allows us to briefly depict the discussion on the essence of energy security, which is a "blurred" concept (Loeschel, Moslener & Ruebbelke, 2010, p. 1665). Then, we turn to the description of the method used in the paper, which is followed by the discussion on the results. The paper finishes with a conclusion section containing research limitations and suggestions for further studies.

LITERATURE REVIEW AND THEORY DEVELOPMENT

Energy Security

Energy security is one of interdisciplinary concepts. There are a number of research describing energy security stemming from engineering as well as social sciences. The main focus in our case is its economic perception. Therefore, we concentrate on the literature with economic background.

There are a number of works explaining "energy security" and discussing numerous definitions (Winzer, 2012; Ang, Choong & Ng, 2015). Since there is no common understanding what energy security really is, scientists agree that "energy security" or its extension, namely "security of energy supply" is a "blurred concept" whose vagueness does not enable a coherent theoretical analysis (Loeschel *et al.*, 2010, p. 1665). One of the most popular literature strings on energy security refers to external costs. This way of handling the phenomenon dates back to the oil crises. The majority of works in this stream focus on the macroeconomic dimension of energy security, usually visible in the form of the vulnerability of economy to supply disruptions (Barsky & Kilian, 2004; Beccue & Huntington, 2005; Leiby *et al.*, 1997; Arnold & Hunt, 2009; Gupta, 2008; Constantini, Gracceva, Markandya & Vicini, 2007). Some works, if not directly referring to the vulnerability to supply disruptions, use indicators which show this perspective, such as oil or gas vulnerability index (Roupas, Flamos & Psarras, 2011, p. 353). Such perception of the phenomenon has been also adopted by international organisations, such as the World Bank, in assessing the impact of higher natural gas and oil prices for the Ukrainian economy (Davis, Piontkivsky, Pindyyuk & Ostojic, 2005). The central idea in this approach reflects externalities associated with energy security which include (Hunt & Markandaya, 2004, p. 3; Arnold & Hunt, 2009, pp. 1-2):

- monopsony wedge externality – when additional imports of a fuel cause price to rise. The importing country ignores that additional cost and in turn it makes an external cost,
- incomplete rent capture – when a supplier is not able to capture full rent from the consumers through differentiated pricing. That is why any change in the country's fuel mix (like importing more fuels) leads to a change in the level of the supplier's rent and in consequence it constitutes an externality,
- macroeconomic externalities – when the international energy market changes influence macroeconomic performance. That excludes externalities stemming from individual decisions. Examples of global energy market changes include: increased fuel prices or any changes on different markets which spill over the energy market.

The last externality constitutes the most popular method of the empirical investigation of energy security externalities. It results from the methodological reasons, since there are limitations to measuring quantitatively monopsony wedge externality and incomplete rent capture phenomenon (Arnold & Hunt, 2009, p. 2). Moreover, the most popular fuel subjected to the analysis of externalities is crude oil (Barsky & Kilian, 2004; Beccue & Huntington, 2005; Leiby *et al.*, 1997). Here again, it echoes the crude oil market specificity, as there is unlimited access to the global oil prices. However, that is not true for natural gas markets, which are priced regionally. Empirical modelling on the oil market shows an influence of prices on GDP (Arnold & Hunt, 2009; Davis e*t al.*, 2005; Roupas *et al.*, 2011; Leiby *et al.*, 1997; Sauter & Awerbuch, 2003; Huntington, 2004).

The International Energy Agency (IEA) and the European Commission (EC) provide a different understanding of energy security. Both of the institutions focus more on the practical approach to the problem. The IEA and the EC show the multidimensional energy security perspective which includes:

- availability (physical) – which refers to having uninterrupted energy supply at disposal,
- prices – which refer to the affordability of energy to consumers, and
- environmental aspects – which refer to external costs connected with the energy use.

The last dimension is particularly highlighted by the European Commission that sets the European Union at the front of the global climate-energy discussion and action. Prices and supply availability are equally important. The former are often discussed with reference to price volatility, which in 1970s laid foundations for the creation of the IEA. The latter gained on importance at the turn of the twentieth and twenty-first century with various physical energy supply disruptions. The usefulness of such a triangular approach consists in its easy translation into the policy actions. To distinguish between immediate and prospective measures, both institutions stipulate short- and long-term policy actions. Short-term energy security focuses on the ability of the energy system to include supply interruptions. On the other hand, long-term energy security pertains to the adequate level of investments which guarantee energy supply and comply with sustainable development rules (IEA, EC). In our view, the long-term measures offset the market power of energy suppliers and bring balance to the energy market, while the temporary security helps a community resume energy supplies immediately.

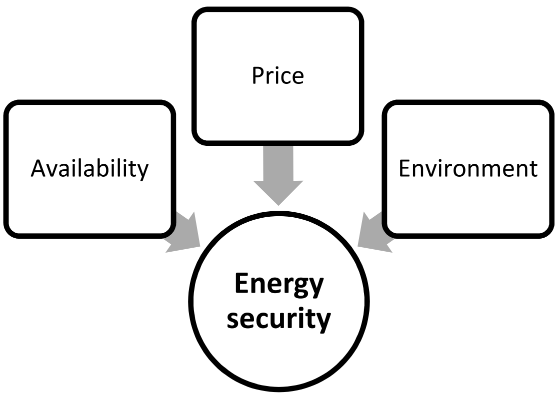

Figure 1. Energy security in the triangular approach
Source: own elaboration based on the IEA and the EC.

Time-dependent energy security perspective is also visible in the selection of measures used to assess the phenomenon. Short-term measures of energy security focus on the risk of supply disruption (like REES Indicator – Risky External Energy Supply, Coq, 2009, pp. 37-38), while long-term measures – on import's diversification (Vivoda, 2009, p. 4616). Just like in the case of the problem of defining energy security, it is also difficult to highlight one method of its measurement. It is an effect of the missing conceptual agreement on what energy security really is. There have been numerous research efforts summarising the existing measuring methods (Sovacool, 2011; Mansson, Johansson & Nilsson, 2014), however, no single methodology has been developed so far. Clearly, scientists focused on research into energy security favour a mixed approach aimed at using different simple or complex measures (Sovacool, 2011). Indicators can be categorised into a few groups (Kisel, Hamburg, Haerm, Leppiman & Ots, 2016):

- technical – including, for example, the ability of the energy system to transport and distribute energy, the availability of energy resources,
- economic – including, for example, prices volatility or dependency on energy imports,
- environmental – including, for example, energy efficiency or intensity and CO_2 emission levels,
- political – including, for example, political stability of an exporter or its relations with importing countries.

We took into account all the above limitations of the energy security definition, and we decided to follow internationally recognised perception of the phenomenon. Therefore, in our work we apply the triangular approach described by the IEA and the EC. We believe that the same importance has to be attached to energy availability, prices and its environmental effects. Firstly, we link energy availability to energy imports as, according to the literature, it poses greater threats to energy security than domestic production. Secondly, we refer to energy prices as a cost for individual customers. And thirdly, we describe the environmental aspect by energy intensity and energy consumption.

Energy Security and International Competitiveness

Energy security and the ability to compete on international markets are often treated as parallel goals in the energy policy (IEA, 2014, p. 5; Keppler, 2009, p. 2). However, there are scientific works indicating a different direction of this relation. According to researchers (Lieber, 1980; Klein, 1988), energy influences the ability to compete at the international level.

The literature review revealed a research gap within the topic of the relationship between energy security and international competitiveness with reference to exports. Energy is usually treated as an input determining industrial costs in these studies (Lieber, 1980). Its negative influence was observed mainly in 1970s as a consequence of oil crises. Western communities, such as France, were concerned about their export competitiveness which had been affected by higher industrial costs (Lieber, 1980). A similar line of reasoning is provided by Klein (1988) who convinces that after the first oil shock in 1970s, the American competitiveness, measured by export unit values, declined (except for the periods when the US dollar depreciated) (Lieber, 1980 p. 311).

There are also scientific investigations and the practical assessment of German competitiveness provided by McKinsey company (McKinsey, 2009). This report follows Lieber's and Klein's argumentation, and proves that energy is a key factor in industries which are strategic for the German economy because of their role in export. The considered group of industries includes not only energy and energy-intensive industries but also transportation and logistics, building technologies and construction, mechanical and plant engineering or IT and IT services (McKinsey, 2009, p. 17). Energy efficiency plays the key role in these industries. Additionally, energy efficient products help to maintain company competitiveness (McKinsey, 2009, p. 13). McKinsey study shows that industries or economy sectors can use energy to create their competitive advantage (McKinsey, 2009, p. 7).

Similarly to McKinsey, Głowacka (1996, p.28) stresses the role of energy efficiency as a demand condition which shapes competitive industries and in consequence national competitive advantage. She refers to the Porter's idea of the competitive advantage of nations by describing Central/Eastern European economies in transition.

Following that logic, we shall consider energy as a determinant shaping the ability of a country to compete successfully in international markets. Zachmann and Cipollone (2013, pp. 139-168) refer to this phenomenon as "energy competitiveness". Energy is included in the analysis of sectoral competitiveness as an input on the supply side. The supply side determinants of sectoral competitiveness include: cost, quality and the availability of sector-specific production factors (Zachmann & Cipollone, 2013, p. 145). Zachmann and Cipollone investigated the impact of electricity prices on the competitiveness of the manufacturing industry in Europe. Their quantitative study was based on data from 27 OECD countries and ranges from 1996 to 2011. According to their findings, energy prices do not determine whether a country becomes a competitive exporter of manufactured products, but they do have an influence on which sectors the country becomes a competitive exporter in (Zachmann & Cipollone, 2013, p. 158).

MATERIAL AND METHODS

The theoretical framework of the investigation of the problem how energy security influences the ability of a country to compete with export on the international market was identified in the standard new trade theory model which formed the basis for the export performance analysis in the UNCTAD report (UNCTAD, 2005). The model refers to differentiated product supplied by producers[1] which operate under increasing returns to scale and manufacture goods derived from the constant elasticity of substitution demand structure.

Moreover, three elements make up exports from country i to country j – product supply capacity, trans-border transport costs and the market capacity of country j. For the purpose of assessing the impact of energy security on the export abilities of countries, solely the supply capacity function was used for further investigations.

The following formula of the regression equation investigates the determinants of supply capacity of country i at time t:

$$\begin{aligned} Y_{it} = \alpha + \beta_1 \ln gdppc_{it} + \beta_2 fdigfcf_{it} + \beta_3 icrg_{it} + \beta_4 udr_{it} + \beta_5 \ln enr\_total_{it} + \\ + \beta_6 \ln enr_{exp}\, c_{it} + \beta_7 \ln enr_{conpc_{it}} + \beta_8 \ln enr_{int_{it}} + \varphi_i + \varepsilon \end{aligned} \tag{1}$$

We used fixed-effects regression model with panel data analysis. We estimated the influence of each exogenous variable on the endogenous (explained) variable in the regression function. While proceeding calculations, we expected the fixed effect in the model due to the fact that each analysed country has its individual characteristics which may or may not influence the predictor variables (the export of goods in the assumed groups), and it should be controlled. In order to confirm the above expectations, we conducted the Hausman test in three regressions (one for each exporting good), and indicated the fixed effect for capital and intermediate goods. In terms of consuming

[1] Exclusively manufacturing was taken into consideration at the regression model.

goods, while Hausman test had not brought the result in the decision of the usage of an appropriate effect, we implemented the solution of the artificial regression approach described by Arellano (1993) and Wooldridge (2002, pp. 290-91), in which a random effects equation is re-estimated by being augmented with additional variables consisting of the original regressors transformed into the deviations-from-mean form. The rejection implies that the fixed effect model is more reasonable or preferred. Under conditional homoskedasticity, this test statistic is asymptotically equivalent to the usual Hausman fixed-vs-random effects test. Unlike the Hausman test, the xtoverid test by Stata extends straightforwardly to heteroskedastic- and cluster-robust versions.

Below we present the Hausman test results of regression functions for:

1. consumption goods:

Number of clusters = 20,
Cross-section time-series model: xtivreg2 fe robust cluster (id),
Sagan Hansen statistic = 0.000,

2. intermediate goods:

Table 1. The Hausman test results of the intermediate goods regression

	Fe (b)	**re (B)**	**Difference (b-B)**	**sqrt(diag(v_b-v_B))**
lngdppc	-0.16795	0.39997	-0.56793	0.07295
fdigfcf	0.00470	0.0042	0.00050	-
icrg	-0.45594	-0.91123	0.45529	-
udr	0.00046	0.00038	0.00008	-
lnenr_total	-0.04813	-0.02152	-0.02662	0.00860
lnenr_expc	1.07215	1.24593	-0.17378	0.03347
lnenr_conpc	0.40275	-1.04080	1.44355	0.26789
lnenr_int	-2.32545	-0.09279	-2.23265	0.39201

b = consistent under Ho and Ha; obtained from xtreg; B = inconsistent under Ha, efficient under Ho; obtained from xtreg; Test: Ho: difference in coefficients not systematic chi2(8) = (b-B)'[(V_b-V_B)^(-1)](b-B) = 54.62; Prob > chi2 = 0.0000 (V_b-V_B is not positive definite).
Source: own calculations.

3. capital goods:

Table 2. The Hausman test results of the capital goods regression

	Fe (b)	**re (B)**	**Difference (b-B)**	**sqrt(diag(v_b-v_B))**
lngdppc	0.1473	0.28499	-0.13769	-
fdigfcf	0.00080	0.0009	- 0.00009	-
icrg	-0.63484	-0.79015	0.15531	-
udr	0.00031	0.00020	0.00011	-
lnenr_total	-0.08797	-0.07552	-0.01245	-
lnenr_expc	0.70878	0.78111	-0.07234	-
lnenr_conpc	1.45621	1.00749	0.44872	0.05805
lnenr_int	-1.71316	-1.10759	-0.60557	0.09571

b = consistent under Ho and Ha; obtained from xtreg; B = inconsistent under Ha, efficient under Ho; obtained from xtreg; Test: Ho: difference in coefficients not systematic chi2(8) = (b-B)'[(V_b-V_B)^(-1)](b-B) = 35.29; Prob>chi2 = 0.0000 (V_b-V_B is not positive definite).
Source: own calculations.

The regression model refers to manufactured goods grouped according to the BEC classification (Broad Economic Categories), which presents end-use categories which are meaningful within the framework of the System of National Accounts (SNA). There are categories approximating the three basic classes of goods in the SNA: capital goods, intermediate goods and consumption goods. The composition of the three basic classes of goods in the SNA in terms of the basic categories of the BEC is as follows:

- capital goods include the following categories: 41 – Capital goods (except transport equipment), 521 – Transport equipment, industrial,
- intermediate goods include the following categories: 111 – Food and beverages, primary, mainly for industry; 121 – Food and beverages, processed, mainly for industry, 21 – Industrial supplies not elsewhere specified, primary; 22 – Industrial supplies not elsewhere specified, processed; 31 – Fuels and lubricants, primary; 322 – Fuels and lubricants, processed (other than motor spirit); 42 – Parts and accessories of capital goods (except transport equipment); 53 – Parts and accessories of transport equipment,
- consumption goods include the following categories: 112 – Food and beverages, primary, mainly for household consumption; 122 – Food and beverages, processed, mainly for household consumption; 522 – Transport equipment, non-industrial; 61 – Consumer goods not elsewhere specified, durable; 62 – Consumer goods not elsewhere specified, semi-durable; 63 – Consumer goods not elsewhere specified, non-durable.

Thus, the following groups of goods were considered in the analysis:

- *lnexp_consump* – export of consumption goods,
- *lnexp_intrm* – export of intermediate goods,
- *lnexp_capital* – export of capital goods.

The dependent variable Y_{it} (where Y is a group of goods: consumption goods, intermediate goods, capital goods) is the export of goods from country i at time t over the period from 1995 to 2014. The export data come from COMTRADE database.

In terms of the explanatory variables, the model includes GDP per capita (*lngdppc*) as standard variable indicating the market size (and consumers' preferences). It enables the estimation of the effect of the market size and common preferences on exports in various groups of goods. It is expected that countries reveal larger volumes of trade as long as they are similar in the economic size. This variable data were obtained from the OECD database and are measured in current PPP (in USD). Foreign direct investment as a percentage of gross fixed capital formation $(fdigfcf)$, as the second independent variable, is assumed to capture the state's technological environment. The data come from the World Bank database. Moreover, institutional quality $(icrg)$ and the labour market (udr) flexibility are used to for portray the economic framework and business environment in a country. The institutional quality is measured by the ICRG index (International Country Risk Guide) which precisely reflects an established framework (and quality) for business conditions in a given country. The mean value of the ICRG index reflects ”Corruption”, ”Law and Order” and ”Bureaucracy Quality” in the scale of values from 0 to 1 – higher values correspond to the better quality of institutions. The second indicator reflects the labour market flexibility, and union density rates – the value of net union membership as a proportion of wage and salary earners in employment.

Apart from the general economic conditions measures, the model takes into account variables specific to this research – four critical variables to control for energy security. In order to make the energy security concept operational for empirical studies, we decided to follow the IEA and the EC logic breaking down the phenomenon into three different aspects. The data availability of these variables is our major concern in this estimation, and therefore it determines the period used in the model – years 1995-2014. The data were sourced from the U.S. Chamber of Commerce Institute for 21st Century Energy (2016 database of the International Energy Security Risk). Indicators are given in the form of indexes with the 1980 base.

The analysis covers 23 economies which have been selected by the U.S. Chamber of Commerce Institute for 21st Century Energy as world leading energy consumers[2]. First of all, we included total energy import exposure (*lnenr_total*) into the model in order to establish the connection with the prime focus of energy security studies, namely supply disruptions (e.g. Leiby *et al.*, 1997). This variable defines the relation of energy import value to total primary energy supply (TPES). The second aspect pertains to energy cost affordability and is expressed by energy expenditures. We use the total real dollar energy expenditures divided by the number of population in each of the analysed countries *(lnenr_expc*). This dimension shows a price or cost effect of energy security calculated *per capita*.

The last element of the function refers to the environmental aspect, which is captured by energy consumption (*lnenr_conpc)* and energy intensity *(lnenr_int*). The energy consumption variable controls the population size. The energy intensity variable is given in million British Thermal Units of the total primary energy supply (TPES) used in the domestic economy for each 1 000 USD of the real GDP of a country.

All energy input data are used in the original form offered by the U.S. Chamber of Commerce Institute for 21st Century Energy (e.g. dividing each variable by the population of the country). Applying such an approach allows to control the scale size effects as it includes population size in energy expenditures and consumption.

The fixed-effects model controls for all countries – (α) and time-invariant (φ_t) differences among the countries (Kohler *et al*., 2009).

Table 3. Regression results

	(1) lnexp_consump		(2) lnexp_intrm		(3) lnexp_capital	
lngdppc	0.286*	(2.34)	-0.168	(-0.95)	0.147	(1.61)
fdigfcf	-0.00435*	(-2.37)	0.00470	(1.63)	0.000804	(0.54)
icrg	-0.915*	(-2.34)	-0.456	(-0.90)	-0.635*	(-2.40)
udr	0.00121	(0.61)	0.000457	(0.25)	0.000308	(0.32)
lnenr_total	-0.0777*	(-2.16)	-0.0481	(-0.74)	-0.0880*	(-2.59)
lnenr_expc	0.640***	(4.61)	1.072***	(7.32)	0.709***	(9.31)
lnenr_conpc	0.134	(0.37)	0.403	(1.10)	1.456***	(7.62)
lnenr_int	-1.036*	(-2.41)	-2.325***	(-4.64)	-1.713***	(-6.56)
constant	24.85***	(9.36)	33.90***	(8.85)	21.12***	(10.60)
N	344		343		343	
R^2	0.6418		0.5911		0.8383	

Note: t-statistics in parentheses; * p<0.05, ** p<0.01, *** p<0.001
Source: own calculations.

[2] Australia, Brazil, Canada, China, Denmark, France, Germany, Indonesia, Italy, Japan, Mexico, the Netherlands, New Zealand, Norway, Poland, Russia, India, Spain, Thailand, Turkey, Ukraine, Great Britain, the United States.

RESULTS

By analysing the results of the estimations, our first impressions lead us to the conclusion that, to some extent expected, the export of goods is mostly driven by other variables than market characteristics or business environment. We indicated that GDP per capita, as well as FDI as % of GFCF, and the quality of institutions are statistically significant solely in terms of the export of consumption goods. However, the results revealed rather weak relationships between the export of consumption goods and GDP per capita or FDI. Nevertheless, the impact of GDP per capita is positive, but FDI affects export slightly negatively. The quality of institutions plays a negative role in the exports of consumption and capital goods. It is even more statistically significant when compared to economic indicators such as GDP per capita and FDI, and it affects export performance much more strongly.

It is noteworthy that previous studies identified a positive impact of an institutional quality on export performance (Rodrik, Subramanian & Trebbi, 2002). Thus, we expected the same results in the model of supply capacity. However, our calculations revealed exactly the opposite results – the better quality of an institution, the lower value of export in the group of consumption and capital goods. The result was statistically insignificant for intermediate goods. To look for an explanation, we went back to the raw data package and it turned out that in our 23-country group, large exporters were ranked low in terms of the quality of institutions (e.g. Russia, China).

In spite of the fact that in the case of capital goods the model fits the best, the evidence for consumption and intermediate goods were also indicated. Our empirical analysis sheds some light on the impact of energy variables on supply capacity. First, surprisingly, the variable referring to energy import exposure stands weak statistical significance in the group of consumption goods and capital goods. The model revealed no statistical significance in assessing the impact of energy import exposure on the export of intermediate goods. Concurrently, we expected this variable to be one of the major export determinant on the basis of the literature review. One of the reasons for that might be the sample composition of a country. In the group we had energy exporters such as: Norway, Russia, Australia, and countries relying heavily on domestic energy production in their energy mix, such as: India, USA or Brazil. For such economies energy import exposure is not an issue. Secondly, we observed a statistically significant, positive impact of energy expenditures on supply capacity in all the considered groups of goods. In fact, a higher level of energy expenditures translates into a greater volume of export – the most important impact was found in the group of intermediate goods. Correspondingly, energy intensity was indicated as statistically significant, however, if energy intensity grows, the supply capacity of the country decreases. It means that the attractiveness of export is greater whenever a country uses energy more efficiently. Our model indicated the strongest negative effect of the above variable within the group of intermediate goods.

Finally, it is worth mentioning that we noticed the significance of energy consumption solely for capital goods, and its revealed impact is positive and rather strong. Nevertheless, there were unidentified effects of this variable in neither consumption nor intermediate goods.

CONCLUSIONS

To sum up, the effect of energy variables on the supply capacity of a country is observed in the three estimated models, but statistical significance of all energy variables was noted only for capital goods. This result confirms the established hypothesis that energy security affects the export of capital goods in the analysed period.

Surprisingly, it turns out that out of all variables depicting energy security, it is not energy availability that plays a crucial role. Environmental and cost aspects of energy security have been found as much more important. This conclusion sheds a new light on energy security, both in terms of the methodological and practical approach. Firstly, the analysis proves that energy security is indeed a complex and multidimensional phenomenon. Therefore, doing any research in this field has to be preceded by an extensive literature review revealing the complexity of energy security. Only then it is possible to include its multidimensional perspective which covers the economic and environmental aspects. Our analysis proves that the following triangular energy security definition brings rich conclusions. Firstly, even though in our investigation energy import exposure did not play any role, we are convinced that different country composition might bring opposite results. Probably, including only net energy importers lacking sustainable indigenous energy production might prove the significance of energy import exposure. This idea confirms that energy security is also a country-specific phenomenon, though any panel-data investigation needs careful interpretation. Secondly, we believe that our analysis shows that energy security experiences changes in the internal structure. It is visible that on average there is a shift from the availability aspect towards the cost-environmental perspective. Such findings deny putting energy import exposure at the forefront of the energy security investigation. The study results confirm that the ability to perform successful export depends rather on aspects which can be easily measured in money terms. While in the case of energy expenditures this link is expected, for energy intensity – it is not that obvious. A decrease in energy intensity translates indirectly into energy savings or an increase in energy efficiency. Looking at energy security from such perspective leads us to the conclusion that this is not a blurred or elusive concept but a down to earth cost-benefit analysis.

Like any study, our empirical investigation has its research limitations. They are conditioned by the analytical approach, the sample content and data availability. Firstly, capturing international competitiveness through export supply capacity is just a proxy of complex determinants shaping the competitive advantage of the nation. Therefore, we stipulate the need for deeper research into export competitiveness in the context of energy security. Secondly, treating large energy users as a homogenous group proved to be a difficult task in terms of the interpretation of the results. It was clearly visible in the variable explaining the quality of an institution and energy import exposure. Therefore, grouping all countries with respect to their net position in energy imports/exports and their stage of development (UNCTAD, 2005; Rodrik *et al.*, 2002) seems to mitigate these problems. Thirdly, the lack of reliable and comprehensive data source on exchange rates did not allow us to include this variable in the regression. However, we are aware of dynamic fluctuations of the exchange rate and its effects on the value of foreign trade transactions, and as a next research step we would enrich the group of macroeconomic variables by an exchange rate dataset. Fourthly, static character of our analysis did not show any possible time-delay effects. Therefore, we recommend including lagged energy variables (e.g.: *t-1* and/or *t-2*), as in our opinion that would facilitate measuring energy security changes and their influence on export within one and/or two years. Allowing for all of the mentioned research limitations requires to establish a comprehensive model of international competitiveness with broader energy security variables.

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Acknowledgements and Financial Disclosure

The article came into being within the project no. KGS/S16/13/2016 entitled 'Selected trends in the world economy' financed by funds allocated to the Collegium of World Economy, Warsaw School of Economics.

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Published by the Centre for Strategic and International Entrepreneurship – Krakow, Poland

Ministry of Science and Higher Education Republic of Poland

The copyediting and proofreading of articles in English is financed in the framework of contract No. 799/P-DUN/2017 by the Ministry of Science and Higher Education of the Republic of Poland committed to activities aimed at science promotion.