Evaluation of political risk factors influencing energy supply disruption

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Abstract. High dependence on imported energy supply makes a country vulnerable to risks of supply disruption. Disruptions can be in the form of government policies, external conflicts, and natural calamities. Several indicators quantifying the probability of supply disruption were proposed in past studies based on a defined set of criteria. However, factors influencing the behavior of energy exports vary per country. In this study, 12 political risk components were investigated and correlated with historical oil-export data to assess the main drivers dictating export behavior. A case study was conducted on Philippine crude oil suppliers from 2001 to 2015, and three countries were elaborated for further discussion. Results showed that oil exports are strongly correlated with internal and external conflicts in Saudi Arabia; internal conflicts in Venezuela; and socioeconomic conditions in Russian Federation. The study recommends utilizing the developed methodology to aid estimation of energy security costs based on various political risk scenarios.

1. Introduction
Energy security is primarily determined by the supply and price of energy. An energy supply is deemed secured if the volume is adequate and the price is kept minimal. The interaction between the two was historically influenced by political, socio-economic, and natural phenomenon. Historical events suggest that factors triggering supply disruptions differ per country. Middle Eastern countries historically enforced oil embargos as a result of geopolitical tension and wars. For countries such as the United States, weather disturbances sometimes play a minor role in supply disruption [1].

Previous studies concerning energy security considered country risk in determining the reliability of an energy exporter in maintaining its current production. Frequently linked to country risk were political risk factors since government policies and relations serve a vital role in importation and exportation of energy supply. Some of the indicators quantifying political risk include the Global Peace Index (GPI) and the International Country Risk Guide (ICRG). The former evaluates the level of peacefulness of a country while the latter uses a more comprehensive methodology consisting of 12 political risk factors.

Based on literature review, only a single study used GPI to calculate the security cost of energy in Korea, where it was found that nuclear energy remains as the most competitive energy source based on cost and reliability [2]. Meanwhile, majority of the studies utilized the ICRG due to its comprehensiveness. The energy security cost of a 10% increase in China’s natural gas imports was quantified with the ICRG score as one of the primary components of the study [3]. It was also used to adjust oil market share and combined with the export potential of a country to evaluate the availability...
of energy supply [4-5]. Lastly, ICRG was previously paired with the Herfindahl-Hirschman index to relate the concentration of energy supply with the probability of supply disruption [6].

While composite ratings were previously utilized in country risk assessment, not all components directly influence the trend of oil export. Preliminary results of the present study found that the composite scores have little to no correlation with the trend of energy production. However, results were opposite when factors were disaggregated. Thus, there is a need to investigate the individual factors to determine the main drivers influencing or reflecting the export behavior.

The novelty of the study is the correlation of individual political risk factors with the historical energy export data using the same dataset for consistency of comparison among countries. The significance of the study lies in the application of these scores in energy security cost modeling, where the scores are used as a proxy for probability of supply disruption, and then multiplied to the economic cost of supply disruption which is derived from an input-output model. Therefore, by considering only the highly-correlated political risk factors, the model can be improved and reflect results close to actual exports.

2. Methodology

Historical political stability performance of oil-exporting countries was based on the 12 risk components identified by the Political Risk Services Group, as summarized in Table 1. The same set of criteria were used for consistency of comparison among countries. A minimum point of zero translates to high risk while higher points correspond to low risk [7]. The maximum points for each subcomponent were also displayed in Table 1.

Table 1. Political risk components.

| Component            | Subcomponent (weight)                                                                 | Points |
|----------------------|--------------------------------------------------------------------------------------|--------|
| Government Stability | Government Unity (4); Legislative Strength (4); Popular Support (4)                  | 12     |
| Socioeconomic Conditions | Unemployment (4); Consumer Confidence (4); Poverty (4)                         | 12     |
| Investment Profile   | Contract Viability/Expropriation (4); Profits Repatriation (4); Payment Delays (4)    | 12     |
| Internal Conflict    | Civil War/Coup Threat (4); Terrorism/Political Violence (4); Civil Disorder (4)      | 12     |
| External Conflict    | War (4); Cross-Border Conflict (4); Foreign Pressures (4)                           | 12     |
| Corruption           | Financial corruption, nepotism, job reservations*                                   | 6      |
| Military in Politics | Distortion of government policy; threat of military take-over*                      | 6      |
| Religious Tensions   | Desire of a single group to separate from the government*                           | 6      |
| Law and Order        | Legal system and its implementation*                                              | 6      |
| Ethnic Tensions      | Tensions arising from difference in culture, nationality, and language divisions*   | 6      |
| Democratic Accountability | Responsiveness of the government to the people; type of governance*              | 6      |
| Bureaucracy Quality  | Interruption in government processes influenced by political pressure and abuse of power* | 4      |
| Total                |                                                                                     | 100    |

*weight not specified

On the other hand, actual crude oil export data, \( E_{act} \), were extracted from the United Nations Commodity Trade Database. However, since the data were expressed in nominal USD values, they had
to be adjusted to constant 2010 values using the GDP deflator, $GDP_d$, of the United States, as depicted by Equation 1.

$$E_{adj} = \left[E_{act}(GDP_d^{-1})\right] \times 100$$

(1)

To express the export values in terms of the number of barrels, the adjusted value, $E_{adj}$, was divided by the average annual OPEC crude oil price, $P_{bbl}$, in USD per barrel (bbl), as shown in Equation 2. Data sources are summarized in Table 2.

$$E_{bbl} = E_{adj}(P_{bbl})^{-1}$$

(2)

The proposed methodology was applied to Saudi Arabia, Russian Federation, and Venezuela – all oil exporters to the Philippines. Each of the 12 political risk components were correlated to the number of crude oil barrels exported per year. Results are discussed in the succeeding section.

Table 2. Data sources.

| Variable | Description | Reference |
|----------|-------------|-----------|
| $E_{act}$ | Actual export value (in USD) | [8-9] |
| $GDP_d$  | GDP deflator | [10] |
| $P_{bbl}$ | Crude oil price per barrel (in USD/bbl) | [11] |

3. Results and Discussion

Political risk components were plotted along with crude oil exports in bbl. Preliminary results suggest a time series delay of one year in the risk factors, as displayed by Figure 1.a. The delay is attributed to the coverage of data reported by the PRS group, wherein the political risk scores published in a particular year (e.g. 2015) reflect the country risk ratings of the previous year (e.g. 2014). Figure 1.b illustrates the adjusted scores consistent with the crude oil export data.

Then, the coefficient of determination $R^2$ between the two time-series was quantified to evaluate their relationship. The $R^2$ value was computed for each risk component, and the factor with the highest value per country were identified (see Figure 2). For Saudi Arabia, results suggest external conflict as highly correlated to oil exports, with an $R^2$ value of 0.7888. A slight decrease in oil production was observed in 2001 due to weakened relations with the United States after the 9/11 attack [12]. However, succeeding administrations were able to redeem the good relationship between the two nations which stabilized Saudi Arabia’s position as the top crude exporter. Moreover, the country was also a victim of the 2008 global recession which severely influenced the decrease in oil production globally [13]. From 2013-2015, a decreasing trend in oil production far from its optimal level was deemed as the country’s effort to maintain its market share [14]. In recent years, Saudi Arabia is considering increasing its production beyond the 12.5 million barrels per day limit to impose its dominance in the oil market [13].

In the case of Russian Federation, socioeconomic conditions were found to correlate the most among set of components with an $R^2$ value of 0.5758. However, literature suggests that changes in socioeconomic conditions were actually indirect effects of trends in global crude oil prices. The rapid increase in crude oil exports from 2001-2003 came to a decline due to increasing crude oil price [15]. The Russian Federation, having an adequate crude oil reserve, initially increased its domestic production, thereby generating jobs and improving socioeconomic conditions. However, the increase in
prices reduced incentives for local companies to increase their production since less volume is needed to maintain revenue levels [16]. After reaching its peak in 2007, the production continued to decrease mainly due to the high cost of oil production which requires a steady high oil price to attract petroleum companies to expand [17].

![Figure 1](image1.png)

**Figure 1.** (a) time series delay of 1 year in external conflict scores; (b) adjusted time series of crude oil export (in bbl) and external conflict rating of Saudi Arabia

Lastly, actual values of crude oil exports for Venezuela were extracted from Trade Map since the United Nations Commodity Trade Database values were incomplete. Thus, higher crude oil export values were computed compared to Saudi Arabia. Results showed that crude oil exports of Venezuela did not correlate very strongly with any of the individual components. The strongest correlation was with internal conflicts, with an R² value of just 0.1397. The low correlation between the two was attributed to the continuous drop of crude oil production despite the improvement of internal conflict conditions between the public and the state in recent years. Historical events support the observed relationship such as the 2002-2003 conflict between the former President Hugo Chávez and his
oppositions when he replaced employees of the state-owned petroleum company Petróleos de Venezuela (PDVSA) [18]. In this period, an estimated peak disruption of 2.6 million barrels per day was reported [19]. The production partially recovered when the government invited international companies to tap the vast crude oil reserves of the country. However, major players later withdrew when the government demanded to increase its control in the company projects. Combined with the damaged infrastructure brought about by the strike, Venezuelan oil production struggled to regain its full capacity, as shown in Figure 2.b.

Figure 2. (a) socioeconomic condition rating vs crude oil export for Russia; (b) internal conflict rating vs crude oil export for Venezuela

4. Conclusion
The correlation between political risk factors and energy supply disruption was assessed using export data and country risk rating from ICRG. The composite country risk scores were disaggregated to individually compute the coefficient of determination $R^2$. Factors with the highest $R^2$ value were verified using historical events leading to supply disruption and price changes. In the case study presented, results suggest that Saudi Arabia was primarily influenced by external conflicts while Russian Federation and Venezuela’s oil export figures mainly correlate with socioeconomic conditions and
internal conflicts, respectively. The study may be extended to future values based on various energy security scenarios. This may include studies concerning the possible effects on oil exporting of rising geopolitical tensions, civil war, oil trade policies, and changes in political leaders. The authors also recommend conducting more rigorous regression and causality tests to verify the results.

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Acknowledgments
The first author gratefully acknowledges the Engineering Research and Development for Technology (ERDT) consortium and the Department of Science and Technology – Science Education Institute (DOST-SEI) for supporting the first author in pursuing his Masters in Mechanical Engineering degree. The authors would also like to acknowledge the De La Salle University Science Foundation, Inc., and the Faculty Development Program for financial assistance in this conference.