ANTICIPATORY STRATEGIES FOR EASTERN EUROPEAN NATURAL GAS SECURITY

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OUTLINE

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II. International Relations/Economic Theory
III. Methodology
IV. Case Studies
V. Conclusions/Recommendations
INTRODUCTION

Dependence of EU28 on Russian Natural Gas
Share (in %) of Russia in national extra-EU28 Imports

Imports from Russia (in %)
- 0-25
- 25-50
- 50-75
- 75-100

Author: Milos Popovic
Source: Eurostat 2016
What strategy is most cost effective for Eastern European countries dependent on Russian natural gas imports to diversify supply?
ANTICIPATORY STRATEGIES, KELANIC (2016)

Coercive Vulnerability
• % of Demand Requirements from Single Source
• Susceptibility to Disruption

Anticipatory Strategies
• Self Sufficiency
• Indirect Control
• Direct Control
ANTICIPATORY STRATEGIES

• The strategies differ depending on countries’ geographic location, the amount of gas imported, domestic natural gas production, access to alternative natural gas supply and alternative sources of energy, and historic political relations with Russia, among other factors.

• The willingness of countries affected by the Ukraine-Russia supply disruptions to pay for infrastructure to reduce vulnerability to future disruptions indicates state preferences and the threat, actual or perceived, to the state by potential supply disruptions.

• This falls within Paul Samuelson’s Theory of Revealed Preferences, where a consumer’s preferences are revealed based upon their purchases.
REVEALED PREFERENCE, SAMUELSON (1938)

Observed Choices in State Infrastructure Spending

State Preferred Energy Security Strategy
EASTERN EUROPEAN ANTICIPATORY STRATEGIES

LNG/Baltic Strategy

- Coastal states can construct LNG import facilities to gain access to increasingly global LNG market, requires trade partner and access to storage

Reverse Flow/Visegrad Group Strategy

- Landlocked states aim to become regional hub or connect to regional hub, by maximizing domestic transport capacity and diversification of supply source
- Reverse flow of existing pipeline infrastructure or building new pipeline capacity extending to non-Russian supply hub
Reverse Flow/Visegrad Group Strategy

<table>
<thead>
<tr>
<th>Country</th>
<th>West-East flow into Country (bcm/yr)</th>
<th>Domestic production (bcm/yr)</th>
<th>Domestic Consumption (bcm/yr)</th>
<th>Excess capacity in event of disruption (bcm/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Czechia</td>
<td>61.2</td>
<td>0.3</td>
<td>7.9</td>
<td>53.6</td>
</tr>
<tr>
<td>Hungary</td>
<td>13.3</td>
<td>1.8</td>
<td>9</td>
<td>6.1</td>
</tr>
<tr>
<td>Poland</td>
<td>15.5</td>
<td>6.1</td>
<td>18.3</td>
<td>3.3</td>
</tr>
<tr>
<td>Slovakia</td>
<td>19.1</td>
<td>0.1</td>
<td>4.6</td>
<td>14.6</td>
</tr>
<tr>
<td>Ukraine</td>
<td>22.2</td>
<td>19.0</td>
<td>41.1</td>
<td>0.1</td>
</tr>
</tbody>
</table>
INTERDEPENDENCE
CASE STUDY METHODOLOGY

• Initial conditions of infrastructure determined using International Energy Agency (IEA) interactive map entitled *Gas Flow Trade in Europe*, the European Network of Transmission System Operators for Gas (ENTSOG) map, the European Commission’s *Projects of Common Interest* interactive map, and the Gas Infrastructure Europe (GIE) LNG Import Terminal Database.

• These maps and the accompanying data were used to determine each country’s natural gas consumption, transmission infrastructure import and export capacity, underground storage capacity, reverse flow capabilities, and the locations of current infrastructure.

• Trade journals, press releases, news articles, and academic publications were consulted to estimate infrastructure capital and operating costs for onshore/offshore pipelines, reverse flow modifications, compressors, LNG import facilities, and storage expansion.
Pricing Assumptions

Coastal Regasification Facility CAPEX
- FSRU 170 kcm Storage Capacity: USD 236-280 M
- Onshore Interface/Infrastructure: USD 30 M
- Construction of Jetty and Piping: USD 80 M

Coastal Regasification Facility OPEX
- Operations & Maintenance: 2.5% of CAPEX/yr
- LNG Surcharge: USD 162 - 216 M/bcm
- Lease Surcharge: USD 189,000/day

Pipeline CAPEX
- Onshore High Estimate East-West Turkmenistan: USD 2274/km-mm
- Onshore Middle Estimate EU Project Average: USD 1229/km-mm
- Onshore Low Estimate Turkmenistan-China: USD 933/km-mm
- Offshore High Estimate Nord Stream: USD 2622/km-mm
- Offshore Low Estimate Langeled: USD 1305/km-mm
- Addition of Bidirectional Compression: USD 2.5 M per facility

Pipeline OPEX
- Compression cost: USD 3.52 M per bcm/yr
- Transit fee: USD 2.19/kcm-100km

Underground Gas Storage CAPEX
- Salt Expansion: USD 236.6 M/bcm
- Salt New Facility: USD 296.6 M/bcm
- Depleted Expansion: USD 173.0 M/bcm
- Depleted New Facility: USD 233.0 M/bcm
- Aquifer Expansion: USD 384.9 M/bcm
- Aquifer New Facility: USD 480.2 M/bcm

Underground Storage OPEX
- Injection/Withdrawal Cost: USD 365/Mcm

Discount Rate: 10%
CASE STUDY: FINLAND

- 2015 Demand: 2.7 bcm
- 100% Supplied by Russia
- 7.4% of Primary Energy
- $0 in Transit Fees
FINLAND: CASE STUDY RESULTS

<table>
<thead>
<tr>
<th>Project</th>
<th>High ($B)</th>
<th>Low ($B)</th>
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<tbody>
<tr>
<td>Helsinki-Hammerfest Pipeline</td>
<td>2.53</td>
<td>1.14</td>
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<tr>
<td>Inkoo LNG 2.5</td>
<td>5.57</td>
<td>4.25</td>
</tr>
<tr>
<td>Inkoo LNG 0.5</td>
<td>1.5</td>
<td>1.19</td>
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<tr>
<td>Balticconnector</td>
<td>0.55</td>
<td>0.4</td>
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<tr>
<td>Inkoo-Denmark Offshore</td>
<td>2.78</td>
<td>1.72</td>
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<tr>
<td>Inkoo 0.5 and Balticconnector</td>
<td>2.05</td>
<td>1.59</td>
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CASE STUDY: BULGARIA

- 2015 Demand: 3.1 bcm
- 100% Supplied by Russia
- 13% of Primary Energy
- $880M in Transit Fees
BULGARIA CASE STUDY: RESULTS

<table>
<thead>
<tr>
<th>Estimated Cost over 30 Year Life</th>
<th>High ($B)</th>
<th>Low ($B)</th>
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</thead>
<tbody>
<tr>
<td>Interconnection Bulgaria-Serbia</td>
<td>0.64</td>
<td>0.5</td>
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<tr>
<td>Black Sea Pipeline Georgia-Bulgaria</td>
<td>2.79</td>
<td>1.73</td>
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<tr>
<td>Interconnection Greece-Bulgaria</td>
<td>2.58</td>
<td>2.49</td>
</tr>
<tr>
<td>Alexandroupolis LNG 2.5 with IGB</td>
<td>6.06</td>
<td>4.52</td>
</tr>
<tr>
<td>Alexandroupolis LNG 0.5 with IGB</td>
<td>3.98</td>
<td>3.58</td>
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CONCLUSIONS/RECOMMENDATIONS

- Anticipatory strategies contingent upon geography, existing infrastructure, and state preferences
- LNG import facilities remain a strategy for coastal states, though redundant LNG capacity unnecessary if already provided regionally
- LNG OPEX surcharge make it a costly long term replacement strategy, though building backup import capacity appears cost effective when combined with pipeline interconnection
- Reversing flow of and connecting to existing pipeline infrastructure reduces capital costs in comparison to new pipeline construction, but involves potential transit fees or loss of transit revenue
- Further interconnection of the internal EU gas market appears to be the most cost effective strategy, though dependent on continued cooperation with neighboring transit states
THANK YOU! QUESTIONS OR COMMENTS?

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