An Assessment of Gazprom's Proposed Commitments Concerning Central and Eastern European Gas Markets Using a Global Gas Market Simulation Model[1]

Dr Chi Kong Chyong[2], EPRG, University of Cambridge

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[1] This research comment is part of an ongoing research into the economics of natural gas markets that the author is undertaking at the University of Cambridge. The comment has been submitted to the European Commission, Directorate-General for Competition, Antitrust Registry, 1049 Bruxelles/Brussel regarding Case AT.39816 — Upstream gas supplies in central and eastern Europe

[2] EPRG Research Associate and Director of the Energy Policy Forum, University of Cambridge.

1. Background

1. In April 2015, the European Commission Directorate-General for Competition (DG COMP) began a formal investigation into Gazprom's suspected violations of EU antitrust rules by issuing its statement of objections[3]. In the statement, the Commission was concerned that Gazprom was impeding competition in the gas supply markets of Central and Eastern European Member States (MS) – Bulgaria, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland and Slovakia – by implementing abusive strategies, in particular:
    a. by imposing *territorial restrictions* in its sales agreement with its clients in the above countries;
    b. by pursuing *unfair pricing policy* in five MS - Bulgaria, Estonia, Latvia, Lithuania and Poland (from now on five MS); and
    c. by *obtaining unrelated commitments* from its contractual counterparties concerning gas transport infrastructure (in Poland – Yamal-Europe gas pipeline and in Bulgaria – South Stream gas pipeline).
2. On the 13th of March 2017, DG COMP published Gazprom's proposed commitments[4] to address the Commission's competition concerns as regards gas markets in Central and Eastern Europe. In particular, Gazprom has proposed:
    a. in relation to Point 1a above, to remove all clauses that would hinder re-sale of its gas to other customers once and for all, and to facilitate cross-border gas trade in Central and Eastern European gas markets by allowing Gazprom's customers in those countries to change delivery points;
    b. in relation to Point 1b above, (i) to introduce competitive gas price benchmarks[5] into price review clauses contained in its long-term gas sales contracts with customers from Bulgaria, Estonia, Latvia, Lithuania and Poland, and (ii) to increase the frequency and speed of price revisions; and finally
    c. in relation to Point 1c above, Gazprom committed to not claim damages from Bulgaria regarding the cancellation of the South Stream pipeline.
3. In the press release[6], the Commissioner in charge of competition policy, Margrethe Vestager, stated that: *'We believe that Gazprom's commitments will enable the free flow of*

[3] http://europa.eu/rapid/press-release_IP-15-4828_en.htm
[4] http://ec.europa.eu/competition/antitrust/cases/g2/gazprom_commitments.pdf
[5] Average weighted import border prices in Germany, France and Italy and/or the development of the prices at the relevant generally accepted liquid hubs in Continental Europe (see page 8, Gazprom's commitments: http://ec.europa.eu/competition/antitrust/cases/g2/gazprom_commitments.pdf)
[6] http://europa.eu/rapid/press-release_IP-17-555_en.htm

gas in Central and Eastern Europe at competitive prices. They address our competition concerns and provide a forward looking solution in line with EU rules. In fact, they help to better integrate gas markets in the region. This matters to millions of Europeans that rely on gas to heat their homes and fuel their businesses. We now want to hear the views of customers and other stakeholders and will carefully consider them before taking any decision'.

4. Thus, the Commission has invited all interested parties to comment on these commitments[7]. Hence, this is the objective of this research. In particular, we are interested in:
    a. If, and, under what circumstances the possibility of changing delivery points (from now on 'swap deals') of Russian gas within the markets of Central and Eastern Europe would improve the welfare and market efficiency of the five MS;
    b. Defining the product and geographic market definition of the proposed swap deals. The former (product definition) deals with the question of an alternative means of constraining the potential market power of Gazprom in the five MS and hence a competitive assessment of the swap deals that Gazprom proposed vis-à-vis gas diversification infrastructure in the five MS. The latter (geographic definition) deals with the question of the possible impact of swap deals on the wholesale prices of other markets and how geographically 'wide' those impacts would be. This is important, as any changes to the service charges for swap deals could move market prices beyond those markets directly affected by swap deals.
5. To pursue these two objectives, and in order to quantify and measure the potential impact of these commitments, we use a global gas market simulation model – a large-scale computational model that simulates gas market operations based on economic fundamentals. The model allows us to run numerous *'controlled'* experiments or *'what-if'* type of analyses. These various *'what-if'* analyses that we conducted using the global gas market model are quite similar to the withholding analysis[8] or SSNIP test conducted as part of competition and merger investigations (Joskow and Kahn, 2002[9]; Patton et al., 2002[10]; CMA, 2015[11]). One should note that

[7] http://ec.europa.eu/competition/antitrust/cases/g2/gazprom_commitments.pdf

[8] The withholding analysis is a flipside of the SSNIP (Small but Significant and Non-transitory Increase in the Price) test which seeks to define the smallest relevant market for which a firm hypothetical monopolist could profitably impose a hypothetical small (typically in the range of 5-10%), permanent price increase (see European Commission's notice on the definition of the relevant market for the purposes of Community competition law. Published in the Official Journal: OJ C 372 on 9/12/1997.)

[9] Joskow, P. and E. Kahn, (2002), "A Quantitative Analysis of Pricing Behavior in California's Wholesale Electricity Market During Summer 2000," The Energy Journal, Vol. 23, No. 4

the usage of market simulation models for energy market competition assessments have been used before – see e.g. Chauve and Godfried (2007[12]), Wolak (2011[13]). A brief and non-technical description of the model and important input data and assumptions can be found in Annex 1 and Annex 2.

2. The Analytical Framework

6. The structure of this analysis is as follows. First, using the gas market model, we establish a competitive benchmark where all gas supplies into Europe and other market regions are priced according to their short-run marginal costs (Scenario A in Table 1). Then, we conduct a *withholding analysis* to test if Gazprom's hypothetically monopolistic behaviour in the five MS (Scenario B1) would increase its profit relative to its profit under the established competitive benchmark case (compare Scenario B1 with Scenario A). Next, we examine if the proposed remedies – Gazprom's swap deals – would limit and constrain its market power in those five MS. We do so by comparing the expected prices of the five MS for Scenarios B2, B1 and A. Finally, we conduct various sensitivities analyses, particularly focusing on the impact of swap deals on gas diversification infrastructure in the five MS and the benefits of facilitating interconnection agreements between some of these MS as an alternative solution to the perceived problem of the market power of dominant suppliers in the Central and Eastern European markets.
7. The entire analysis is focused on the time period 2020 until mid-2021[14] using daily resolution, that is, reported results from the model that roughly correspond to day-ahead wholesale markets in years 2020-2021. The reason for focusing on the years

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[10] Patton, D., Sinclair, R., and LeeVanSchaick, P. (2002). "Competitive Assessment of the Energy Market in New England", a report prepared by Potomac Economics, Independent Market Advisor to ISO New England. Available at: http://www.ferc.gov/CalendarFiles/20030912171352-A-3_2b_NE_CompetitiveAssessment.pdf

[11] Competition & Markets Authority (CMA) (2015). "Energy market investigation. Updated issues statement", consultative document issued during the course of the investigation. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/404867/Updated_Issues_Statement.pdf

[12] Chauve, Philippe, and Godfried, Martin (2007). 'Modelling competitive electricity markets: are consumers paying for lack of competition?'. Competition policy newsletter 2007-2, Opinions and Comments. Available at: http://ec.europa.eu/competition/publications/cpn/2007_2_18.pdf . In this publication the authors described a simulation model (quite similar to the one used in this research) that was used as part of DG COMP's inquiry into competition in gas and electricity markets in 2005.

[13] A Price Effects Analysis of the Proposed Exelon and Constellation Merger, by Frank A. Wolak, revised October 11 , 2011. Available at: http://webapp.psc.state.md.us/Intranet/maillog/content.cfm?filepath=C:%5CCasenum%5CAdmin%20Filings%5C110000-159999%5C134689%5CErrataWolakEx.FW-2.pdf

[14] We want to include at least 1.5 year in order to analyse two winter periods and one full gas and storage year. The model could be used to simulate market developments in any year chosen by the analysts.

2020-2021 is that a number of important gas infrastructures in Europe will likely be available by that time period (such as Gas Interconnection Poland–Lithuania, possible expansion of capacities of Świnoujście and Klaipėda LNG terminals, TAP and IGB interconnectors etc.) which may be impacted by the proposed swap deals.

8. Furthermore, it is expected that in that period international LNG export capacities (from the US and Australia, in particular) will ramp up dramatically and hence may constrain any hypothetical market power exerted by Gazprom resulting from its dominant position in the supply markets of those five MS. In addition, if the commitments are adopted, it will likely take time for all existing and new contracts between Gazprom and buyers from these five MS to adopt changes including those related to pricing mechanisms. This may include further negotiations as well as time for market participants to 'test' the ideas of swap deals, therefore a complete and full implementation of the commitments will be close to the 2020 time period anyway. It would also be easy to carry out a similar study for other periods either before and/or after the 2020.

Table 1: Main scenarios analysed

Competitive benchmark – Scenario A	Hypothetical Monopolistic Behaviour	
	Scenario B1: without swap deals	**Scenario B2:** with swap deals
	Scenario B1.1: as in B1 plus GR-BG & BG-RO Interconnection agreements	

9. **Definition of competitive benchmark (Scenario A):** Under the competitive benchmark scenario, we assume that all gas suppliers are price-takers and they sell gas to Europe at short-run marginal costs. Figure 1 provides a stylistic example of supply and demand curves and competitive price benchmark. The upward curve is the competitive benchmark aggregate willingness-to-supply curve, which is the aggregation of short-run marginal costs of all supplies to a European gas market. On Figure 1, the aggregate gas demand curve is shown to have at least two 'tranches': (i) a very inelastic tranche representing demand-responsive sectors such as the electricity market (e.g. power plants consuming gas), and (ii) the second 'tranche' which is the vertical section of the demand curve which is the 'non-responsive' gas demand sector (residential customers and SMEs). The model is constrained to compute prices for the 'demand-responsive' tranche only as day-ahead wholesale gas prices are largely determined by gas-to-gas as well as inter-fuel (e.g. coal-gas switching in the electricity sector) competition. Moreover, day-

ahead gas prices do exhibit spikes due to weather-driven events and this is incorporated in the model as long as total demand under extremely cold conditions would cause a local gas grid or gas infrastructure further upstream to be capacity constrained (either physically and/or contractually).

10. Thus, the intersection of the competitive benchmark aggregate willingness-to-supply curve with the actual demand responsive section of the aggregate gas demand curve is the market price that would result if no supplier had the ability to exercise unilateral market power (Figure 1: '$P_{competitive}$'). Note that this competitive benchmark price is also equal to the marginal cost of the highest cost supplier in that particular market.

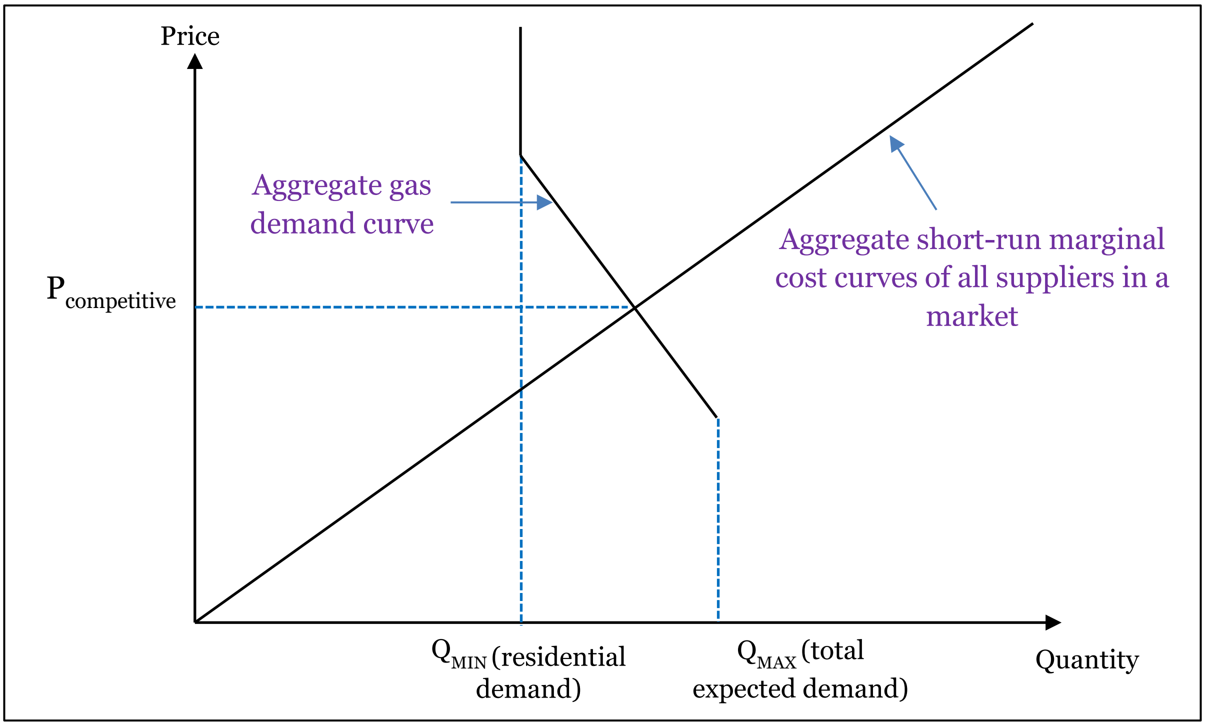


Figure 1: Stylised example of competitive price setting in a single zone market

11. It is important to note that in subsequent analyses, we compare wholesale prices of the five MS under a hypothetical monopolistic behaviour (Scenario B1) (and various other sensitivities) with two sets of competitive benchmark prices reported by the model: (i) an average of wholesale day-ahead prices of North Western European markets[15], and (ii) competitive wholesale prices in the five MS. The former is 'netback' from liquid, an established wholesale market in Europe, which is often referred to and compared with in the European gas industry and recent price arbitration while the latter is the 'net forward' or 'cost plus' method, reflecting the marginal cost of supplying gas to the five MS.

[15] These are: Belgium, France, the Netherlands, Germany and Italy.

12. The monopolistic behaviour in the five MS could result in potential mark up over short run marginal cost (SRMC) which in theory could be larger (and sometimes significantly larger) than the mark up over the NWE prices. The reason being that the five MS markets are closer to the source of gas – Russia – than most of the NWE markets, hence, marginal costs of supplying the two regions from the same source should reflect different transport costs.

3. Withholding analysis

13. To carry out this analysis, it was assumed that Gazprom can act strategically by withholding supplies[16] to the five MS in order to obtain higher prices and hence revenue. In commodity markets, the standard way to model imperfect competition among market participants is the Cournot non-cooperative game (see Annex 1 for more details).
14. Thus, we have obtained an estimate of Gazprom's simulated profits under the competitive benchmark case (Scenario A) and under a hypothetical 'market power' case (Scenario B1) – they show that Gazprom can profitably withhold its supplies to raise potential wholesale prices in the five MS. Gazprom's profit under market power assumption (Scenario B1) is ca. 2.86% larger than its profit under the competitive benchmark.
15. Further, the simulated wholesale day-ahead gas prices in Bulgaria, Estonia and Poland are on average higher than the average competitive prices of North Western European markets. In particular, a hypothetical monopolist could profitably raise prices in Bulgaria, on average[17], by 85% relative to average NWE prices under the competitive benchmark case (Scenario A); in Estonia – by 9% and in Poland – by 2%. It is important also to note that the majority of relatively high prices under the market power scenario happen during the winter period (see Figure A1 and A2 in Annex 3) – in Bulgaria, prices are, on average, 83% higher in Jan-Mar compared to NWE prices; in Estonia – 12% higher; in Lithuania – 5% higher; in Latvia – 1% higher, and in Poland – 9% higher.
16. Of the five MS, Poland, Lithuania and Latvia have prices which could be close to the NWE competitive benchmark. In particular, for these countries, there are around 40% of days (i.e. 218 days in a sample of 546 days) when wholesale prices are marginally higher (not more than 20%) than competitive prices (see Figure A1, Annex 3). That is, Gazprom's monopoly power in those markets is constrained by supplies coming from LNG, which are assumed to be competitively priced. This is a

[16] Withhold supplies down to the minimum annual contract quantity under long-term supply contracts between Gazprom and buyers from these five MS.
[17] over 546 simulated day-ahead prices

valid assumption as long as global markets are oversupplied, which is the expected situation in 2020-2021.

17. It should be noted that comparing the realised prices under the monopoly case (Scenario B1) with potential competitive prices in these five MS reveals a substantially larger mark-up (relative mark ups over average NWE prices) – 10-75% above potential competitive prices, with up to 112% mark up in some days for Bulgaria (see Figure A3 and A4, Annex 3).
18. Overall, the mark-up above competitive prices in these five MS depends on their ability to import non-Gazprom gas at competitive costs.

4. Impact of proposed swap operations on Gazprom's dominant position in Central and Eastern European gas markets

19. Under the proposed commitments, buyers from Central and Eastern Europe could swap their delivery locations – (i) from original delivery point in Slovakia (Velke Kapusany) to the new delivery point in Bulgaria (Negru Voda) or to Lithuania (Kotlovka), (ii) from the original point in Hungary (Beregovo) to Bulgaria, and (iii) from the original point in Poland (Kondratki) to Lithuania – for a fee paid to Gazprom.[18]
20. In a nutshell, Gazprom's proposal to offer buyers from Central and Eastern Europe possibilities to change the delivery points of its contracted gas with Gazprom means that Gazprom can facilitate the integration of markets not directly linked by gas transport infrastructure. This means that, as per Gazprom's proposed commitments, it can deliver gas destined, for example, to SPP, a wholesaler and one of the main importers of Russian gas to the Slovak gas market, a possibility to divert part (or all) of its contracted volume to another market – Bulgaria and/or Lithuania – for a fee, which is to be paid by SPP to Gazprom for these diversions.
21. The reason that we are simply referring to this possibility of changing the delivery points of Russian gas as 'swap deals' is that, taking the example of Slovak's SPP, if SPP finds it profitable to deliver some (or all) of its contracted gas with Gazprom away from Velke Kapusany (the original delivery point of Russian gas into the Slovak gas market) to allegedly captive markets of the Baltic States (e.g. Lithuania) or to Bulgaria, then SPP would have to procure alternative gas to deliver to its own market in Slovakia; SPP can do so by procuring gas in liquid hubs, e.g. TTF, NCG, CEGH etc. Alternatively, if SPP has interruptible contracts with its clients further downstream, then it could simply call them in.

[18] These proposed fees and other details can be found here http://ec.europa.eu/competition/antitrust/cases/g2/gazprom_commitments.pdf

22. Thus, these swap deals would help to 'equalise' Russian gas contract prices in Central and Eastern European markets (for a fee to be paid to Gazprom, and in theory, the differences in prices between these MS would then equal these service charges). This is because by allowing the changing of delivery points, Gazprom allows competition between the different contracts it has with client in these markets. Hence, by design and in theory, the possibilities of changing delivery points address DG COMP's concern of *unfair pricing policy* by Gazprom. That is, the proposal removes any price discrimination that Gazprom could have enjoyed by charging the same gas with different prices, according to customers' willingness to pay in those five MS.
23. The results from the modelling of the monopolistic behaviour scenario with these swap deals (Scenario B2) suggest that the proposal can substantially mitigate the potential market power arising from Gazprom's dominant position in these five MS. In particular, comparing wholesale day-ahead prices with competitive benchmark prices reveals that for Bulgaria and Poland, prices are close to NWE prices whereas prices in the other three Baltic markets are on average lower than the average NWE prices (see Figure A5 and A6, Annex 3).
24. Comparing prices under the Scenario B2 with potential competitive prices in the five MS shows similar results – the proposed swap deals can substantially mitigate Gazprom's hypothetical exercise of market power in those five MS. In particular, the prices in Bulgaria are on average 5% lower than the competitive prices, for Estonia – 22% higher, for Lithuania – 5% lower, for Latvia – 13% higher and for Poland – 11% higher (see Figure A7, Annex 3).
25. It is worth noting that although the proposed swap deals could dramatically constrain Gazprom's market power in the five MS, hypothetically, Gazprom could still raise prices in Estonia (by 40% relative to competitive price benchmark) and Latvia (by 24%) during the summer and the first half of the winter period (see Figure A8, Annex 3).
26. While the impact of swap deals on market prices in the five MS is clear, one should note that the swap deals will also impact prices in other markets, particularly markets west of Slovakia, Hungary and Poland. As noted, the primary reason for this is that once Russian gas to Slovakia and Hungary is re-directed to other markets in the Baltics and Bulgaria, more gas should flow from the west to Slovakia and Hungary as a substitute for the volumes of Russian gas being redirected away. Thus, regarding the question of how wide these impacts are on prices in terms of geographic coverage, it is evident that in 40% of the sample period (ca. 200 days) the swap deals cause average prices in NWE to rise by as much as 10-11% relative

to the same prices in the competitive benchmark case (Scenario A) (see Figure A9 and A10).

27. In summary, the proposed swap deals and corresponding service fees may improve market efficiency and constrain Gazprom's potential market power in the five MS. Although the proposed swap deals do not involve Poland as an importing side (Poland, Slovakia and Hungary are exporting countries under the proposed swaps) these swaps marginally improve (by lowering) prices in Poland as well. The reason for this is that Lithuania becomes a regional hub for Russian gas under the swap deals scenario and thus relatively cheap gas from Russia is being delivered back to Poland as well as to the other two Baltic markets (for details see Section 5.1 below).

5. Impact of swap deals on gas diversification policies and infrastructure

28. In terms of actual volumes of swap deals, Figure A14 (Annex 3) reports daily swap volumes between different locations under scenario B2. The first thing to note is that the majority of swaps are from Slovakia to Lithuania (averaging ca. 9 mmcm/day or 3.3 bcm/year) and from Slovakia to Bulgaria (averaging 1 mmcm/day). Marginal swap volumes to Lithuania and Bulgaria also come from Hungary and on some days from Poland to Lithuania (see Figure A11 and Table A1, Annex 3).
29. The proposed swap deals will turn Lithuania into a hub for Russian gas imports – daily swaps received exceeds total daily consumption in Lithuania by as much as ca. 30% (Table A1, Annex 3). This gas is then transited mainly to Poland through GILP as well as being used to phase out Klaipeda LNG.
30. The swap deals improve *'contractual'* diversification in the sense that Gazprom's market share, and, in particular, its contract volume with importers from Lithuania, Poland and Bulgaria, would be reduced in favour of re-directed contract gas volumes between Gazprom and the buyers from Slovak and Hungarian markets.
31. In particular, Gazprom's market share in Lithuania is reduced to around 63% while swap volumes increase the market share at the expense of LNG at Klaipeda to around 36% of daily consumption (Figure A12) while the rest is LNG volumes (ca. 1%). That said, physical gas coming from Russia is close to 99% (63% from Gazprom and 36% from swap deals) of average daily consumption.
32. Similarly, for Poland, Gazprom's gas in the Polish market is roughly constant at 33%, but the swap volumes from Slovakia/Lithuania take up around 4% of daily consumption (Figure A11). However, on some days, the combined share of Gazprom's gas and the swap volumes reaches 49% of daily consumption – that is, physical gas coming from Russia could be as high as 49%, which is 12% higher than the market share of Russian gas without swap deals (ca. 37%).

33. Based on the analyses of network flows in Latvia and Estonia produced by the model, the entire gas consumption is still coming from Russia (physically). The swap deals shift the patterns of network and storage utilization slightly in Latvia. In particular, storage facility in Latvia becomes slightly less critical since the increased inflow of Russian gas through Kotlovka means that seasonal flexibility is being increasingly met by direct supplies coming through Belarus/Russia (Figure A18). Furthermore, with the swap deals, the Estonian gas supply is being supplied more directly from Russia (Varska) during winter days and less through Lithuania (Karski) because of the reduced need to use Latvian gas storage for supplies to Estonia.
34. As for Bulgaria, the dependence on Russian physical gas is still the same – 100% of daily consumption. As noted, the swap deals improve *'contractual'* diversification with sellers from Slovakia and Hungary taking up as much as 29% of market share (Figure A13). Again, this is Russian gas being re-directed from Slovakia and Hungary.
35. Legitimate questions arise from these facts. First, since Gazprom has long-term gas contracts with buyers from the five MS, would the company be willing to cancel or substantially reduce minimum take-or-pay volumes to allow swap volumes to take up market share in Poland, Lithuania and Bulgaria? If not, then, what are the mechanisms that would allow the proposed swaps to take place and hence constrain Gazprom's potential market power?
36. To summarise, in terms of import dependency, and in particular, Russian gas import dependency in Lithuania, Poland and Bulgaria, the swap deals seem to increase the market position of Russian gas. The swap deals may increase the diversity of contracted gas and increase the number of market players further downstream but they do not improve physical security and diversity of supply. They could improve the economics of gas trading and potentially liquidity in Central and Eastern European gas markets, but not energy security.

5.1. Impact on Gas Interconnector Poland-Lithuania (GIPL)

37. The majority of investments in gas infrastructure (planned or realised) in the five MS are meant to diversify their gas supply portfolios as well as give them an economic advantage in negotiations with dominant gas suppliers over terms of gas imports and trade.[19]
38. It is expected that GIPL, an important gas pipeline that will connect the Baltic markets with the rest of Europe through Poland, will be in operation by 2020. Our

[19] Lithuania's Klaipeda LNG terminal is a well-cited example of the role of an alternative source of gas in negotiations over terms of trade with Gazprom.

analysis of competitive benchmark case (Scenario A) reconfirms the importance of this interconnector as a strategic asset whose value increases if Gazprom decides to exercise market power in Poland and the Baltic markets (Scenario B1). In this situation, flows through GIPL help to arbitrage away any price differentials arising from potential price discrimination by Gazprom (Table A2). Nevertheless, the utilization of this interconnector is rather low due to both Poland and Lithuania having direct access to global LNG and hence there is already an indirect link between these two markets through global LNG markets.

39. The impact of swap deals on GILP (Scenario B2) is that it increase flows from Lithuania to Poland and GIPL is used at full capacity in that direction while there is no flow of gas from Poland to Lithuania through GIPL (Figure A15 and A16). While it may have been planned that GIPL would be predominantly used in the opposite direction – from Poland to Lithuania – results from the modelling work suggest that this is not the case when swap deals flood Lithuania and use GIPL to ship Russian gas to Poland.

5.2. Impact on LNG terminals in Poland and Lithuania

40. Similar to the case of GIPL, LNG terminals in Poland and Lithuania are understood to be of strategic importance to the two countries and the region as a whole. Under the scenario of Gazprom's potential market with swap deals (Scenario B2), it was found that the utilisation of the Klaipeda LNG is significantly reduced compared to utilisation under the competitive benchmark case (Scenario A) or when swap deals are not permitted (Scenario B1) (Table A3). In particular, total LNG imports in Lithuania drop to ca. 0.21 bcm over the analysed period compared to 1.87 bcm in the monopolistic behaviour case (Scenario B1). The Polish Świnoujście LNG terminal seems to be less affected by the proposed swap deals. Figure A17 reports changes in LNG flows into Europe caused by the swap deals.

41. Thus, swap deals price LNG out of Lithuania by flooding relatively cheaper Russian gas into the region. One important implication of this competition is that the swap deals may limit the possible inter-regional trading of non-Russian gas (LNG) between the Baltic states and between them and Poland. These swap deals could potentially keep non-Russian gas out of Latvia and Estonia because if the swap deals and corresponding gas volumes are priced competitively (as is the case), then, as the results have shown, they can substantially limit LNG in the region. This is reflected in the positive price impact of the swap deals (as discussed above in Section 4) by limiting Gazprom's dominant position in the region. However, as also

noted above (Section 5), they do not improve gas diversification efforts in the Baltic region since swap deals are physical gas coming from Russia through Belarus.

5.3. Impact on the Greece-Bulgaria interconnector (IGB)

42. Although there could be potential delays in implementing this interconnector for various reasons[20], to analyse the impact of swaps on operations on IGB, it was assumed that IGB and the Southern Gas Corridor would be completed by 2020. The modelling results show that if IGB is implemented and the gas from Shad Deniz II is priced at the short-run marginal cost, then IGB could significantly limit Gazprom's potential market power in Bulgaria. Figure A19 reports relative prices under potential monopolistic behaviour by Gazprom (Scenario B1) when IGB is in operation relative to competitive benchmarks. One can see that IGB does indeed considerably limit potential price increase because of the dominant position of Gazprom (see the discussion in Section 3 for the price impact of this dominant position on Bulgaria's prices without IGB).
43. The important assumption that could change the above conclusions is the one concerning Bulgaria's ability to procure gas from Azerbaijan at the short-run marginal cost. Based on various industry reports, it is believed that Azeri gas imported to Europe is priced against NWE competitive benchmarks. If so, the total cost of Azeri gas for Bulgaria could be at least twice as high as the total short-run marginal cost.[21] This may have a negative impact on IGB's ability to constrain Gazprom's market power. Indeed, if we assume that the cost of Azeri gas for Bulgaria through IGB roughly corresponds to the simulated prices of NWE[22], then the simulated prices under Gazprom's monopolistic behaviour are high relative to competitive benchmarks (Figure A20). On some days, prices are as high as in cases without IGB (Figure A1, top left panel).
44. Similar to the role of other strategic gas infrastructure of the Baltic states, the IGB and access to non-Russian gas in the Caspian region are important for Bulgaria to limit any potential abuse of Gazprom's dominant position. Crucially, IGB's ability to limit Gazprom's market power in Bulgaria is a function of the prices that Bulgaria will receive for Azeri gas. Thus, if Azeri gas were to be priced at SRMC for Bulgaria, the introduction of swap agreements would not affect the utilisation of IGB. However, should Azeri gas be priced at NWE competitive benchmarks, then swap deals would completely take over IGB/Azerbaijan's market share in Bulgaria

[20] including delays in implementing the Southern Gas Corridor project
[21] The other way to think about this potentially higher cost of Azeri gas is that even though the commodity price could be procured at SRMC the transit fees from Azerbaijan to Bulgaria could be changed by the respective parties to capture additional rents.
[22] Ca. $4-4.5/mmbtu

(Table A4). Thus, the Bulgarian-Azeri gas contract might turn out to be *'out of the money'*.

6. Impact of inter-TSO interconnection agreements on Gazprom's dominant position in the Central and Eastern European markets

45. Based on the published version of Gazprom's proposed commitments, it is understood that Gazprom will facilitate the conclusion of interconnection agreements, particularly between Greece and Bulgaria. This is one of the quickest, cheapest, and most effective ways of constraining Gazprom's market power in captive markets, such as Bulgaria. The reason is that if interconnection agreements are signed, then virtual backhaul and swap operations could be used to limit excessive pricing by Gazprom in Bulgaria. This is similar to the swap deals proposed by Gazprom, as extensively discussed above. For example, importers of Russian gas in Greece that have long-term contracts with Gazprom could offer that gas to Bulgaria with favourable pricing terms while instructing the Bulgarian TSO to ship that gas to clients in Bulgaria. Then, sellers from Greece could buy gas from global LNG to replace Russian gas in Greece. This amounts to supplying LNG to Bulgaria for an extra fee negotiated between Greek and Bulgarian counterparts.
46. We argue that this inter-TSO interconnection agreement and the possibility of implementing backhaul and swap operations could potentially limit Gazprom's market power in captive markets. Indeed, modelling results show that allowing swap operations between Greece and Bulgaria dramatically limits Gazprom's market power even without its proposed swap deals (changing delivery points between Slovakia/Hungary and Bulgaria) (see Figure A21).
47. It is indeed even more pro-competitive than Gazprom's swap proposals because such backhaul and swap deals between Greece and Bulgaria allow direct competition between different sources of gas – LNG, reverse flow from Italy (once TAP is in operation), or the export of Azeri gas to Greece.
48. Thus, a relatively simple 'soft' measure may improve the competitive landscape of the Bulgarian gas market without the requirement to wait for 'hardware' (interconnectors) to be built.

7. Conclusions

49. We have provided an extensive analytical work to examine the impact of Gazprom's proposed commitments to improve the gas market conditions in Central and Eastern European markets. The results of this research show that:
50. In principle, Gazprom's proposed commitments and, in particular, possibilities for buyers of its gas from Central Europe (Slovakia, Poland, and Hungary) to change

delivery points to new locations (Lithuania and Bulgaria) may substantially limit Gazprom's potential market power in these markets. They allow price convergence of Russian gas in the region and offer a rather efficient way to connect these markets to more liquid markets in North Western Europe.

51. The option of having these swap deals and hence potential market entry by other suppliers into the Baltic markets and Bulgaria may (positively) affect price negotiations and arbitration (if needed) between existing buyers in the Baltics and in Bulgaria with Gazprom. The option presents an opportunity to trigger price review clauses because markets further downstream are now fundamentally changed, the legacy contracts may be *'out of the money'*, and arbitration may result in price reviews in favour of more competitive prices for Bulgaria and the Baltic states. However, arbitration is expensive and time consuming, and asymmetry exists in favour of Gazprom, which is large compared to small importers in the Baltics and Bulgaria.
52. For these positive effects stemming from these possible swap deals to take place, there may be a need to request gas release programmes further downstream in the Baltic and Bulgarian markets because if gas users are tied to some long-term purchase agreements with existing importers, then new suppliers from Central Europe that would be willing to change delivery points and enter these captive markets would not be able to do so.
53. One should acknowledge that this *'virtual'* link between these markets and other more competitive markets rely on Gazprom and its service charges. One must determine further sensitivities regarding different levels of service charges and how they may change the results presented here. It is also not clear from the proposed commitments what factors affect those service charges – are they dependent on how the upstream transmission system in Russia works? Are they dependent on transit fees to be paid by Gazprom to other parties along the way to Slovakia, Bulgaria, and Lithuania? Understanding the methodology of calculating these service charges would be helpful in this respect.
54. Regarding companies from Slovakia, Poland, and Hungary that could now enter the gas markets of the Baltic states and Bulgaria, legitimate questions arise. First, since Gazprom has long-term gas contracts with buyers from these five MS, would the company be willing to cancel or substantially reduce minimum take-or-pay volumes to allow swap volumes to take up market share in Poland, Lithuania, and Bulgaria? If not, then, what are the mechanisms that would allow the proposed swaps to take place and hence constrain Gazprom's potential market power?
55. Although the ability to change delivery points may have a positive impact on market efficiency, it also poses a number of policy challenges, namely, gas

diversification and energy security for the five MS. The swap operations seem to increase the market share of Russian gas in Lithuania and Poland, while the other markets see no improvement in diversification. However, swap deals may in fact decrease Gazprom's market share at expenses of its other buyers entering the markets of the Baltic states and Bulgaria. This is *'contractual'* diversification rather than physical because swap volumes are still Russian gas.

56. Further, the swap deals could (negatively) impact the utilisation of strategic gas infrastructure assets such as the Poland-Lithuania gas interconnector (GILP), the Klaipeda and Świnoujście LNG terminal, the Greece-Bulgaria interconnector, and more generally, Bulgaria's gas contract with Azerbaijan.
57. Finally, the swap deal may have *'unintended'* consequences in terms of *disintegrating* the Baltic markets and Bulgaria from the rest of the markets in Europe. In particular, it was shown that Klaipeda LNG terminal usage is roughly nil when swap deals are allowed. This means an increasing cost of using the gas system in the Baltics and Bulgaria (IGB faces a fate similar to that of Klaipeda LNG) because of the adopted regulatory model in Europe whereby all gas assets are *socialised*. The cost of cross-border trading between these small markets and the rest of Europe would then be hampered by these additional costs.
58. Thus, the only positive factor among the proposed commitments is the certainty of the competitive prices of Russian gas, which will be priced against NWE competitive benchmarks, and the *socialised cost of gas systems* (which would then include all strategic assets deployed against Gazprom's monopoly power). It is a vicious circle in the sense that these projects were publically financed for security reasons and would be used should Gazprom exercise its market power in these countries. Now that Gazprom has proposed changes to its contractual and sales practice to ensure competitive markets and prices in these five MS, these assets, if built, will not be utilised, and the costs should be allocated to all users of their gas systems.
59. In light of declining gas demand relative to the size of the gas systems and the different competitive landscape across European markets[23], the results reveal fundamental challenges for the current regulatory model in Europe to complete the project of a *single market for gas.* DG COMP should launch a comprehensive study on the impact and the suitability of the current regulatory regime in supporting and further facilitating competition in and across European gas markets.

[23] The NWE market region is large, liquid, and competitive, whereas the 'energy' islands of the Baltic states and South East European markets are small and isolated.

Annex 1: Modelling framework

In the natural gas market modelling literature, a framework that is often used to model imperfect competition among market participants is the Cournot non-cooperative game. In this game, a Nash equilibrium is a set of actions (e.g. quantity of gas sales) such that no market participant (player) has an incentive to unilaterally deviate from its own actions, given opponents' actions. In a gas market model, an agent's objective is to maximize its profit given a set of constraints (such as production or transmission capacities constraints). Under certain conditions, such as a concavity of objective functions (for maximization problems) and convexity of feasible regions, the Karush-Kuhn-Tucker (KKT) conditions are both necessary and sufficient conditions for optimality of the maximization problem. Therefore, the essence of modelling the gas market system is to find an equilibrium that simultaneously satisfies each market participant's KKT conditions for profit maximization and market clearing conditions (supply equals demand) in the model. Due to the necessity and sufficiency of KKTs for global optimality when the players' problems are convex, this solution is a Nash equilibrium of the market game embodied in the model. To illustrate the underlying mathematical structure of the model here, consider a simple problem that a gas producer might face:

$$\max_{q \geq 0} \pi = qp(q) - C(q) \quad (1)$$

subject to

$$q \leq Q \ \ (\lambda) \quad (2)$$

where q is a sales variable, p(q) is an affine inverse demand function, C(q) is a production cost function such that C′(q)>0, C′′(q)>0, and Q is the producer's production capacity. Then, the KKT conditions for (1) are

$$0 \leq q \perp p + \frac{\partial p}{\partial s} q + \lambda - C'(q) \leq 0 \quad (3)$$

$$0 \leq \lambda \perp (q - Q) \leq 0 \quad (4)$$

The symbol ⊥ denotes orthogonality, which in the case of (3) is a more compact way of expressing the following complementarity relationship:

$$0 \leq q, p + \frac{\partial p}{\partial s} q + \lambda - C'(q) \leq 0, q\left(p + \frac{\partial p}{\partial s} q + \lambda - C'(q)\right) = 0$$

Note that the term $\frac{\partial p}{\partial s} q$ in (3) is Cournot mark-up, which is determined by the model based on input data such as price elasticity of demand, supplies from competitive sources etc. The set of conditions (3-4) is a set of complementarity conditions, or a complementarity problem. If there are also equality conditions, the problem is known as a mixed complementarity problem (MCP). Gathering these conditions for all optimization problems combined with all market clearing conditions (such as supply equals demand) in the gas market system forms a market equilibrium problem in the form of an MCP. Applications of the MCP to energy market modelling are numerous and these problems can be efficiently solved with commercial solvers such as PATH. An alternative formulation of the above mathematical programme is to instead define a nonlinear programming problem (NLP) whose KKT conditions are (3)-(4). If there is such a NLP and the problem is convex such that any local optimum is also a global optimum, then any solution to this NLP is also a Nash equilibrium.

Annex 2: Main Data Inputs and Assumptions for Modelling

In order to conduct a market definition analysis, a natural gas market simulation model was used. The model examines and analyses the interaction of supply and demand on a daily basis at global scale. On the supply side, the model includes all the main gas producing countries, such as Russia, Norway, Qatar, Australia, Algeria and other producing regions such as North America, Central and South America, Middle East, Central Asia and so on. The model therefore covers all existing gas producers in the world. On the demand side, the model covers all existing consuming countries and regions, such as GB, Continental European markets, Russia and other countries of the Former Soviet Union, China, India, North America, Middle East and so on.

To match demand with supply, the model also covers the entire gas value chain from production regions down to the transmission level. Therefore, it captures various gas infrastructure assets such as pipelines, LNG facilities and gas storage facilities. It is an economic and optimization model and therefore does not include some real-world characteristics of gas infrastructure (such as pressure drop in gas pipelines, management of linepack, gas quality limits etc.). In this model, two main parameters characterise gas infrastructure assets and differentiate between them – physical capacities and the unit cost for utilizing those assets.

Given the inputted cost structure and capacities for these infrastructure assets, the objective of the model is to find a least cost solution to meet global demand taking into account various physical constraints, such as gas production capacities, transmission network capacities, LNG liquefaction and send-out capacities, storage injection, withdrawal and maximum working volume capacities as well as minimum and maximum daily demand profiles and contractual obligations (e.g. annual contract quantity and minimum take-or-pay).

The outputs from the model are projections of supply, demand, equilibrium prices[24], pipeline and LNG flows, storage injection and withdrawal at daily resolution. In other

[24] The notion of *'equilibrium'* prices simply means that prices are determined at the intersection of

words, the model approximates the operations of day-ahead gas markets. With such a level of detail in terms of geographical scope as well as daily resolution, the model allows us to conduct market definitions and competition assessments of gas transportation assets and commercial deals fairly accurately. The model consider all existing crossborder interconnection points in Europe as well as disaggregating European demand regions into individual markets according to their national borders (EU28). This resulted in around 1,320 pipeline connections (or 'arcs') in total. The physical capacities of these interconnection points were taken from ENTSO-G's 2015 capacity map[25] whereas their entry and exit charges were taken from ACER's most recent market monitoring report.

Key assumptions

Since the model was run for future years (2020 and 2021), expected gas demand and infrastructure capacities were taken from IEA WEO2016 and ENTSO-G's 2015 Ten Year Network Development Plan. In particular, new cross-border capacities and LNG regasification capacities in the EU were added in the model based on their final investment decision (FID) status - those projects which took FID as outlined in ENTSO-G's 2015 TYNDP report were added into the model with start time and capacities as reported by these projects. All existing storage sites are aggregated to regional/country level. New storage capacities are also taken into account according to their FID status (as reported in ENTSOG's 2015 TYNDP).

The model also takes into account all LNG projects that took FID before 2016, such as those from Australia or USA. Where information about future infrastructure capacities are not publicly available, such as the majority of non-EU gas infrastructure (pipelines, LNG and storage facilities), we rely on capacities taken from another long-term gas capacity expansion model with annual time resolution to 2035[26]. The capacity expansion model is a partial equilibrium model that only takes into account the interaction of demand and supply for natural gas and hence such issues as inter-fuel competition (e.g. coal-gas-oil switching) and income effect (e.g. GDP growth and total energy demand) and how they

demand with supply

[25] Capacity map version May 2015, available at: http://www.entsog.eu/maps/transmission-capacitymap (accessed March 2016)

[26] A detailed description of an earlier version of the long-term gas market model without investment decisions can be found in Chyong, C.K. and B.F. Hobbs (2014). Strategic Eurasian Natural Gas Market Model for Energy Security and Policy Analysis: Formulation and Application to South Stream. Energy Economics, Vol. 44, pp. 198–211. Available at: http://dx.doi.org/10.1016/j.eneco.2014.04.006. The investment decision component of the current version of the long-term capacity expansion model has a theoretical foundation similar to that found, e.g., in Zwart, G. and Mulder, M. (2006). NATGAS: A Model of the European Natural Gas Market. CPB Memorandum. CPB Netherlands Bureau for
Economic Policy Analysis; or in Egging, R., Holz, F., Gabriel, S.A. (2010). The World Gas Model: a multi-period mixed complementarity model for the global natural gas market. Energy 35 (2010), 4016–4029.

may alter demand for natural gas is not explicitly modelled (in the manner the general equilibrium models would do[27]).

Thus, to overcome this shortcoming the capacity expansion model was calibrated to run based largely on IEA WEO15 '450/CPS' scenarios to account for high-level energy policies and general equilibrium effects (i.e. inter-fuel competition, income effect etc.). Marginal supply cost curves are derived from a combination of the in-house database of known gas infrastructure projects that were gathered from publicly available information for the last ten years as well as proprietary information obtained from gas industry stakeholders.

All other assumptions related to physical capacities of existing infrastructure assets were obtained from IEA WEO2015, IEA Natural Gas Information 2015, or from the official sources of owners of those infrastructure assets.

It is important also to note that the entry and exit charges that were used for the European network (taken from ACER) in the model are annual tariffs, hence flow patterns from the model should be treated as annual contracted flows adjusted for daily fluctuations in supply and demand conditions, whereas in reality there are different transportation products (e.g. daily, monthly) with corresponding tariff structures which may (or may not) result in additional flows for some entry and exit points in Europe. Furthermore, when running the model for future years it is implicitly assumed that the relative cost structure of gas networks in Europe, and hence their tariffs for entry and exit points, stay at the current level.

Also, it is worth mentioning that the European pipeline network in the model does not take into account the differences between high- and low-calorific gas and therefore some of the physical constraints resulting from such differences are not captured in the network flow. However, it is understood that conversion facilities between high and low-calorific gas are in place at the majority of the interconnection points of the two systems (e.g. in the Netherlands) so these differences may have a limited impact on the flows from the model.

Finally, daily gas demand profiles are the average of daily gas demand in the last 5 years and hence the impact of weather on gas demand in 2020-2021 is assumed to be an average impact witnessed in the last 5 years. The model was run for one and a half years or 546 days starting from 1 January 2020. Since the model determines storage injection and withdrawal profiles based on the cost structure of the assets in the model, together with supply and demand conditions, at the beginning of each model run it was assumed that all

[27] The drawback of using general equilibrium models for analyses of gas pipeline competition issues is that these models are aggregated at a high level, representing entire regions and not necessarily representing the gas network in sufficient detail.

storages are half-full, reflecting that 1 January is roughly the mid-point through the winter season.

Annex 3: Detailed results from the model

A3.1. Results from comparing Scenario B1 with average NWE prices under the competitive benchmark case (Scenario A)

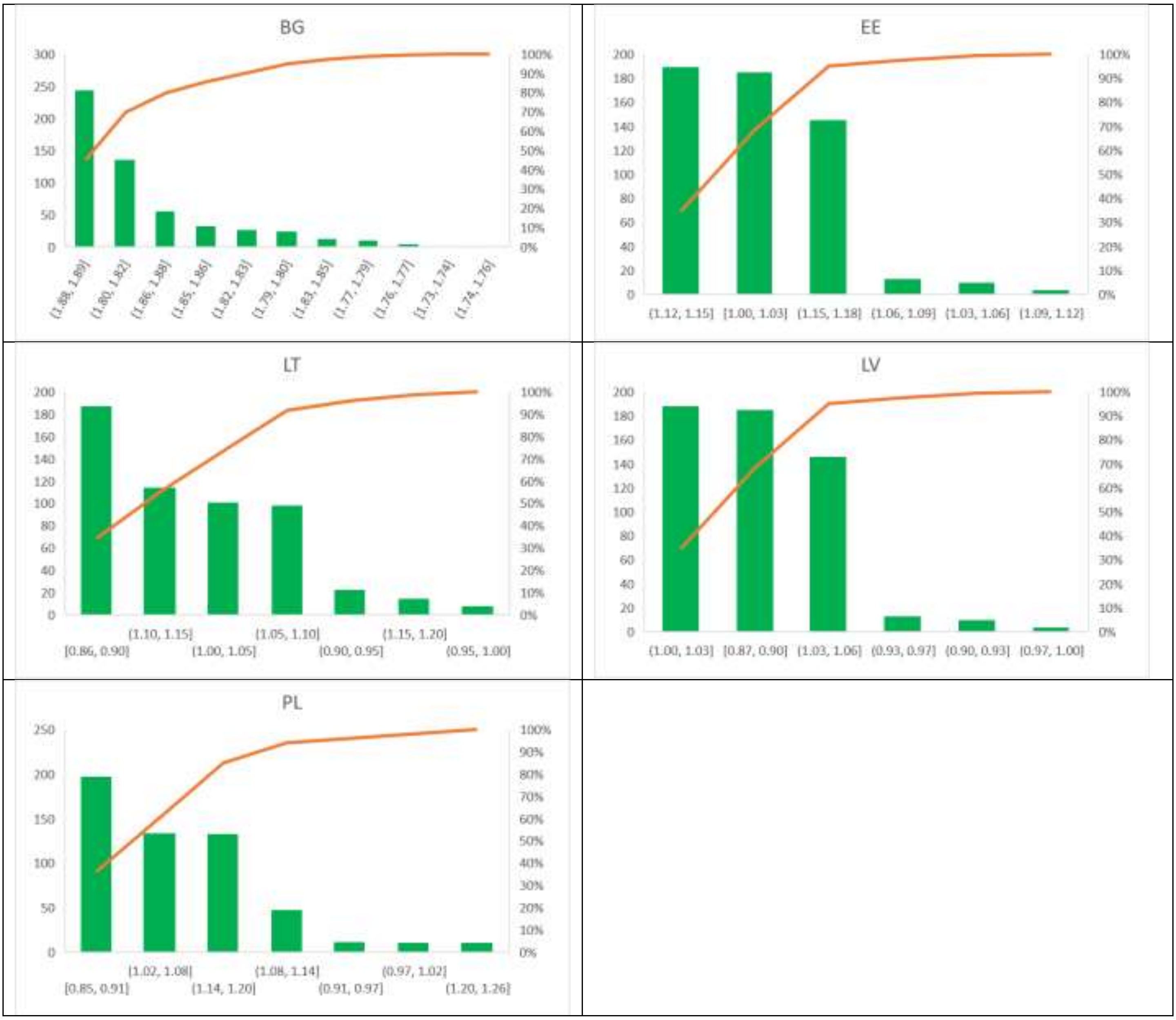


Figure A1: Distribution of simulated prices under market power case (Scenario B1) relative to average prices of North Western European (NWE) markets under the competitive benchmark case (Scenario A)

Note: X-axis shows the relative price index under market power compared to day-ahead average NWE prices under competitive benchmark (competitive benchmark = 1). Y-axis shows the total number of days that prices under market power are higher (>1) or lower (<1) than under the competitive benchmark case. For example, in Bulgaria, there are almost 250 days in the simulated

2020-2021 period when prices under market power exceed competitive NWE prices by as much as 88-89% (the highest bin on the top left chart).

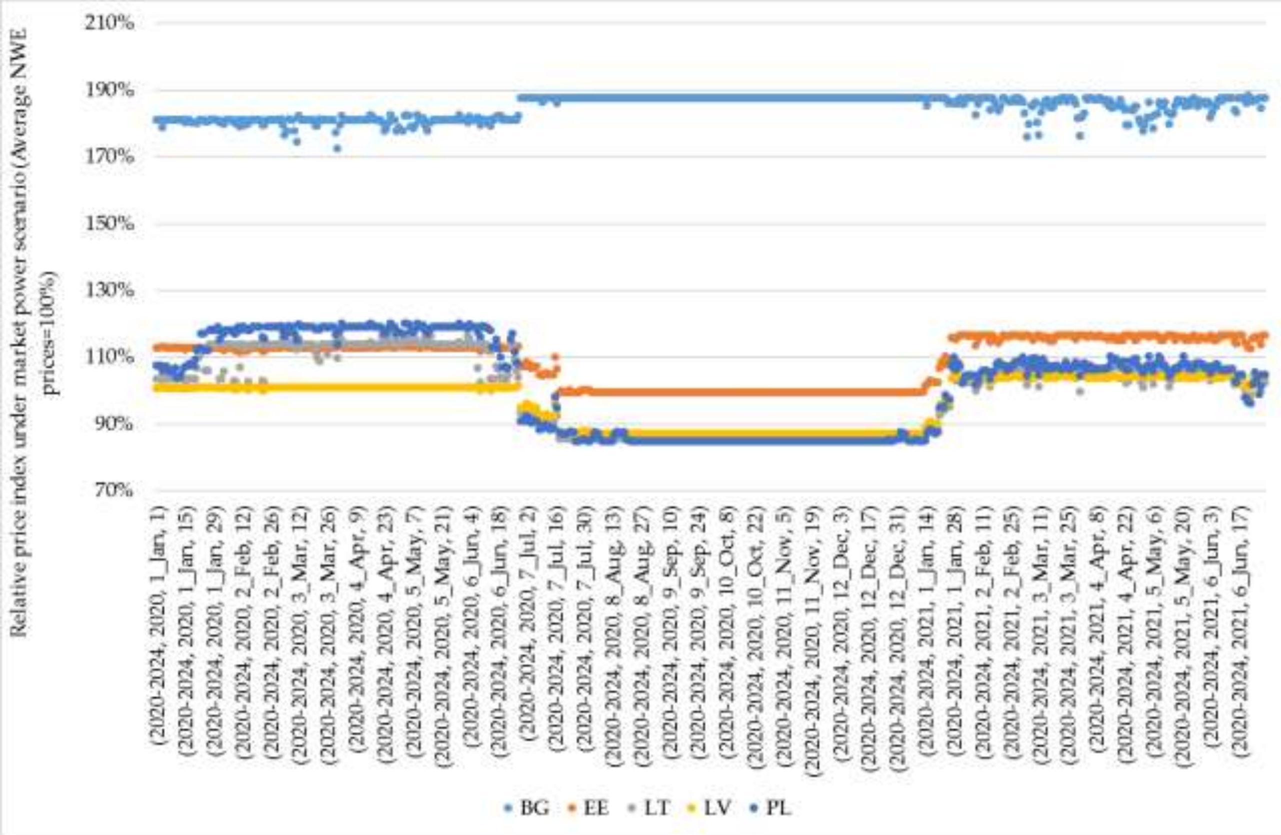
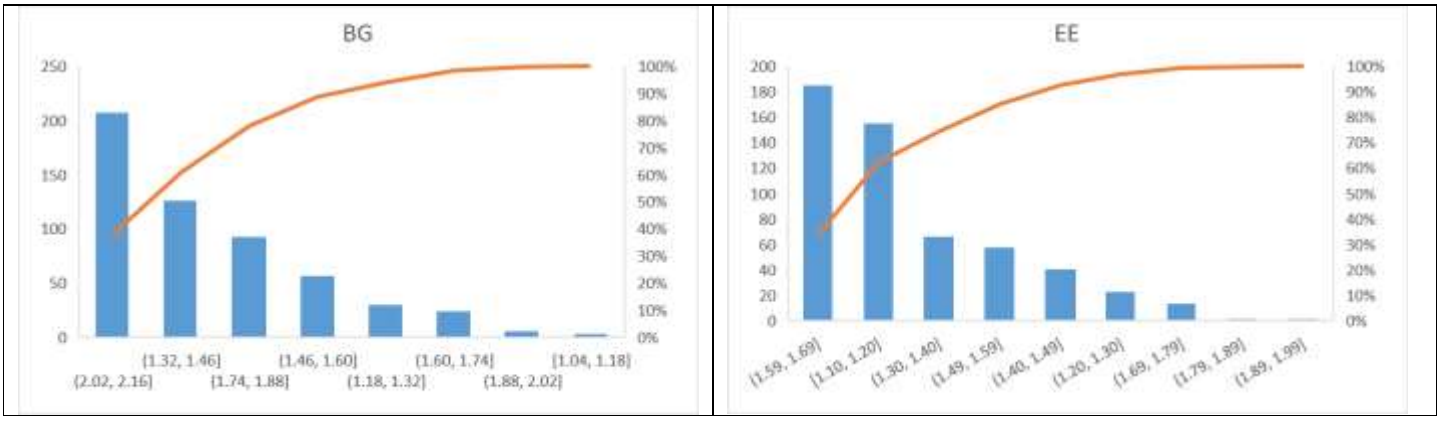


Figure A2: Relative price index under market power case (Scenario B1) (average NWE prices under the competitive benchmark = 100%).

A3.2. Results from comparing Scenario B1 with competitive prices in the five MS (Scenario A)



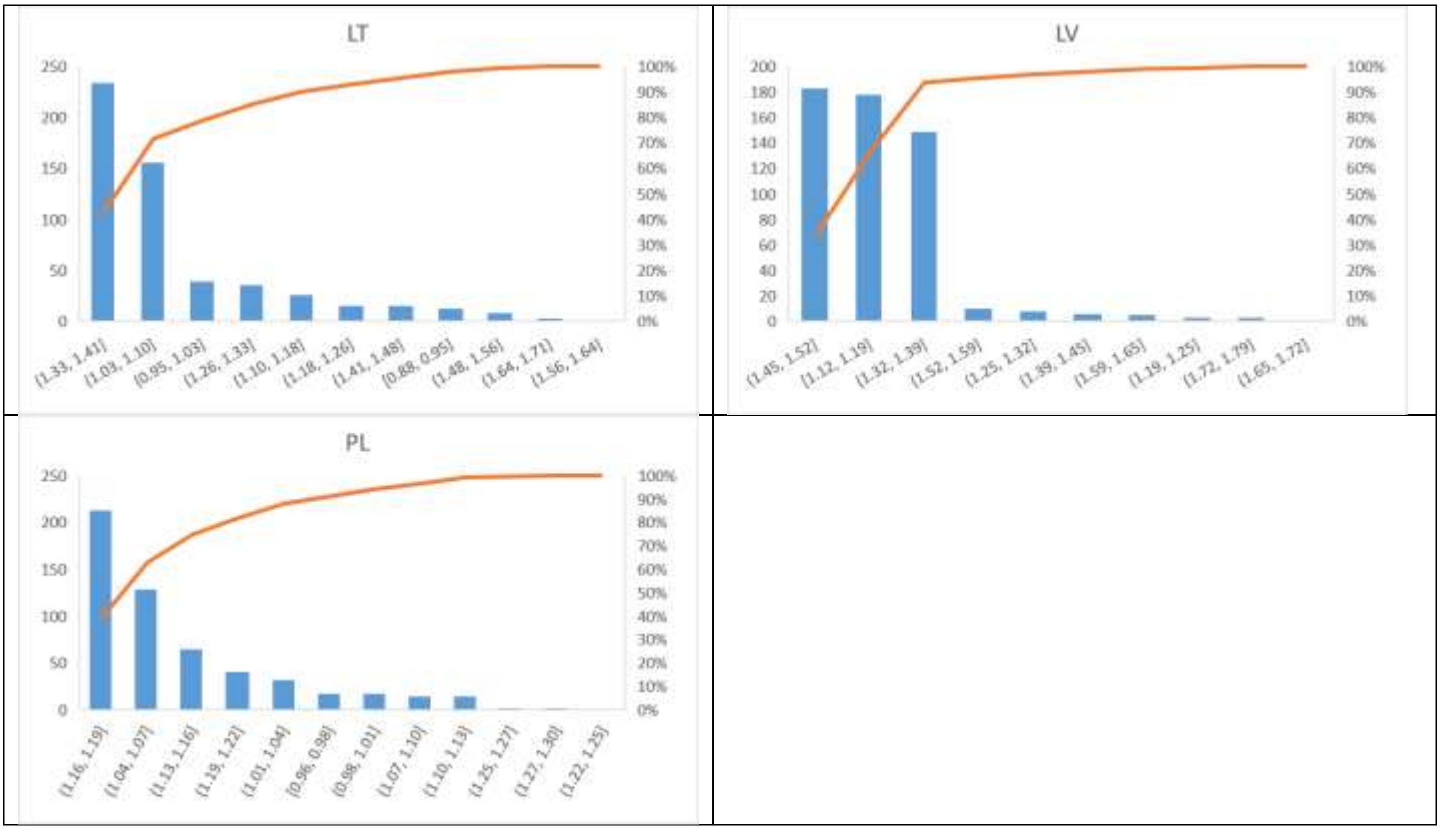


Figure A3: Distribution of simulated prices under market power case (Scenario B1) relative to potential competitive prices in the five MS (Scenario A)

Note: X-axis shows the relative price index under market power compared to day-ahead average NWE prices under competitive benchmark (competitive benchmark = 1). Y-axis shows the total number of days that prices under market power are higher (>1) or lower (<1) than under the competitive benchmark case. For example, in Bulgaria, there are almost 250 days in the simulated 2020-2021 period when prices under market power exceed competitive prices in Bulgaria by as much as 102-116% (the highest bin on the top left chart).

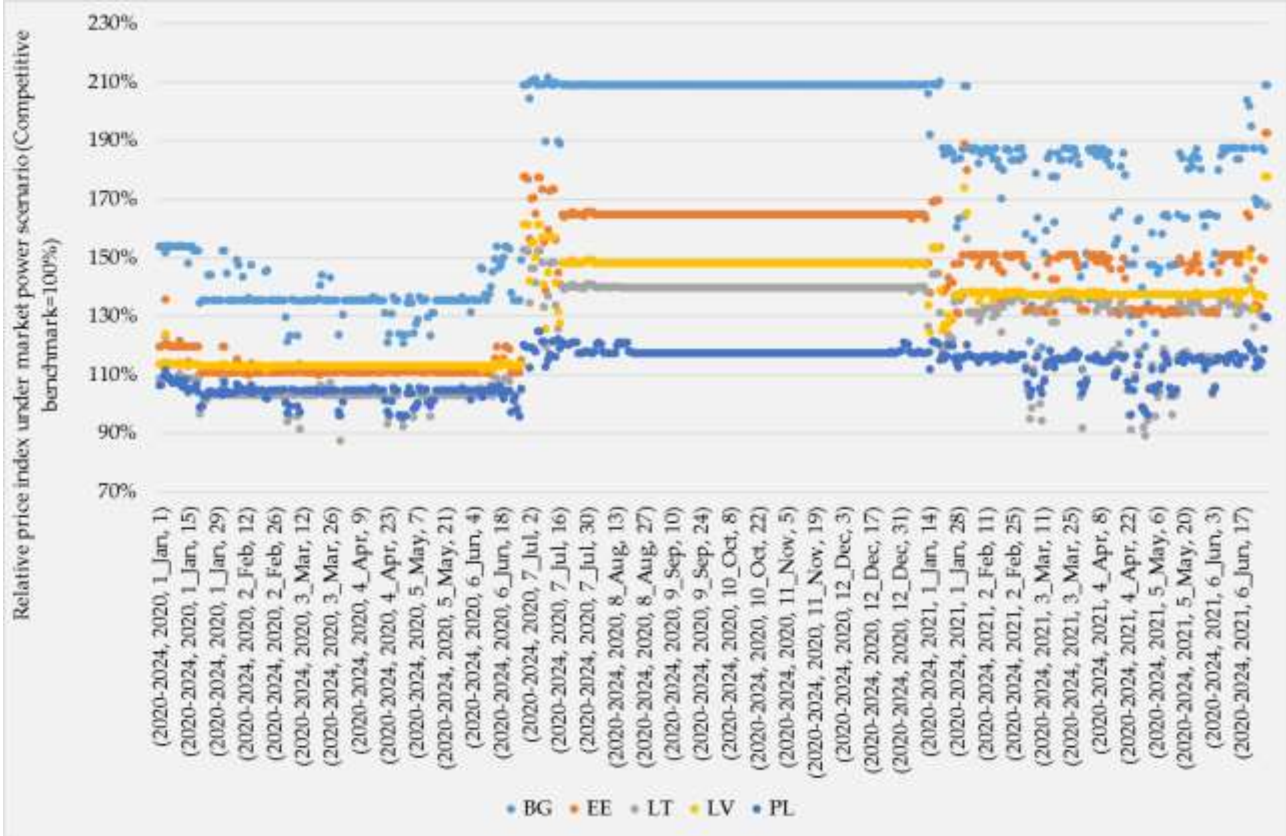


Figure A4: Relative price index under market power case (Scenario B1) (competitive price = 100%).

A3.3. Results from comparing Scenario B2 with average NWE prices under the competitive benchmark case (Scenario A)

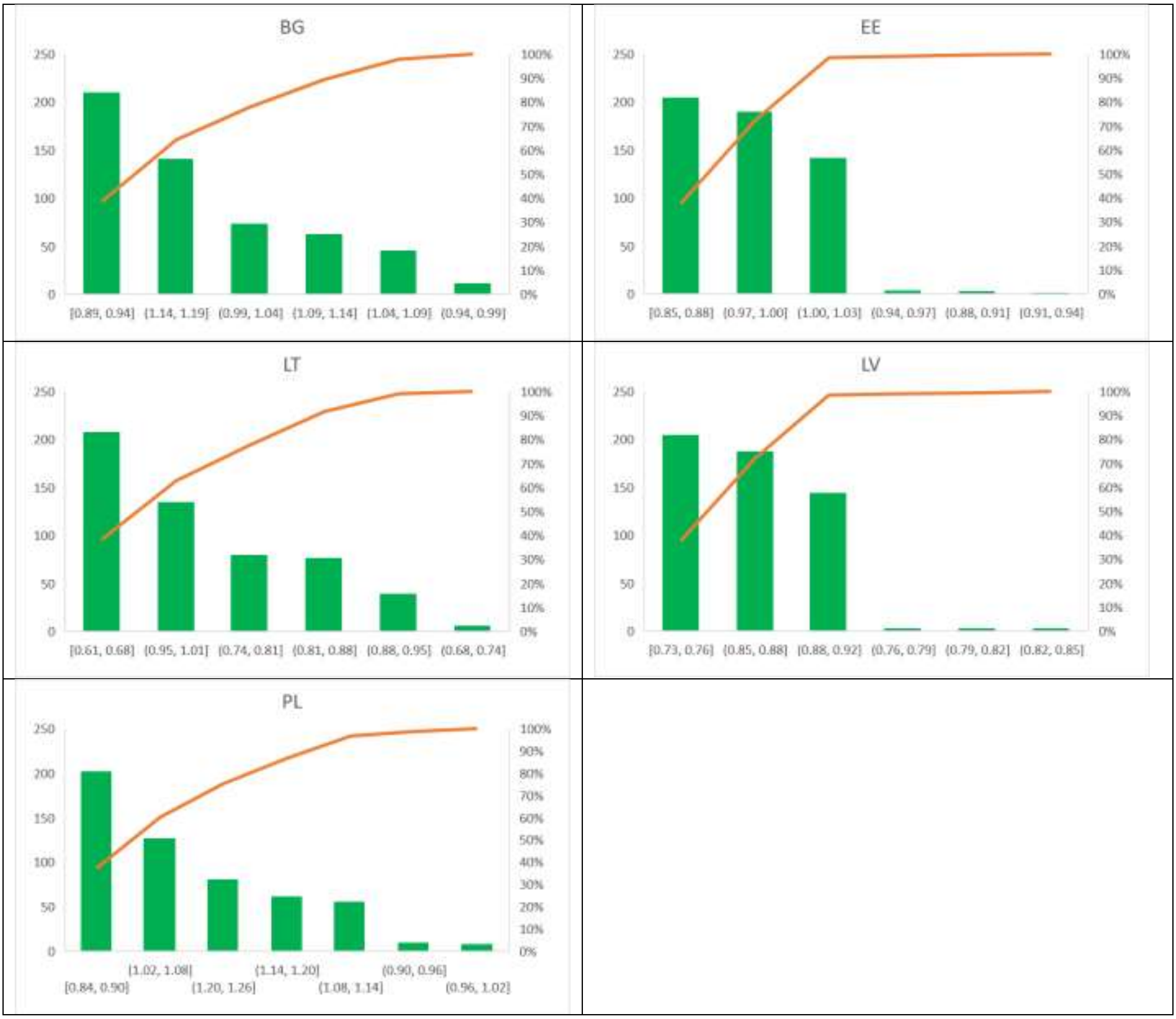


Figure A5: Distribution of simulated prices under market power <u>with</u> swap deals case (Scenario B2) relative to the NWE competitive benchmark case (Scenario A)

Note: X-axis shows relative price index under market power compared to prices under competitive benchmark (competitive benchmark = 1). Y-axis shows the total number of days that prices under market power are higher (>1) or lower (<1) than under the competitive benchmark case.

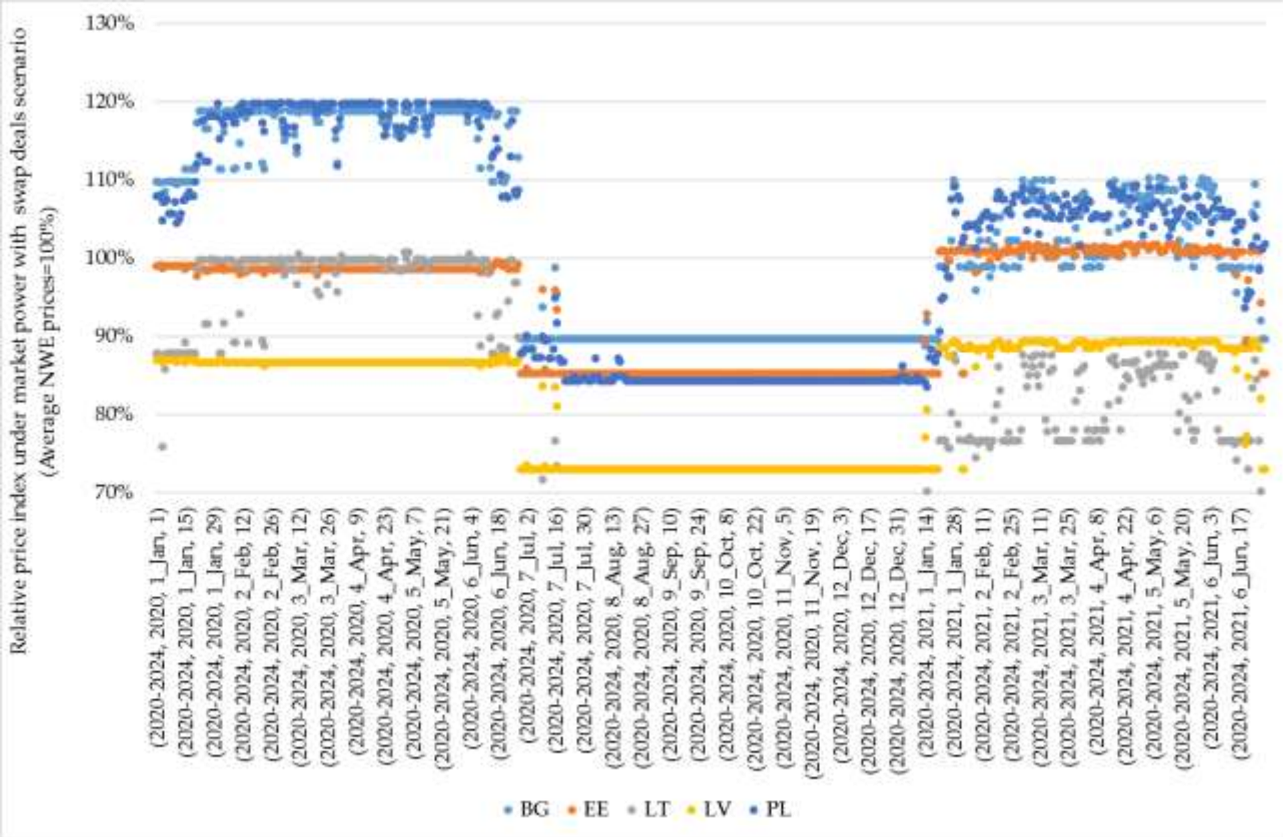
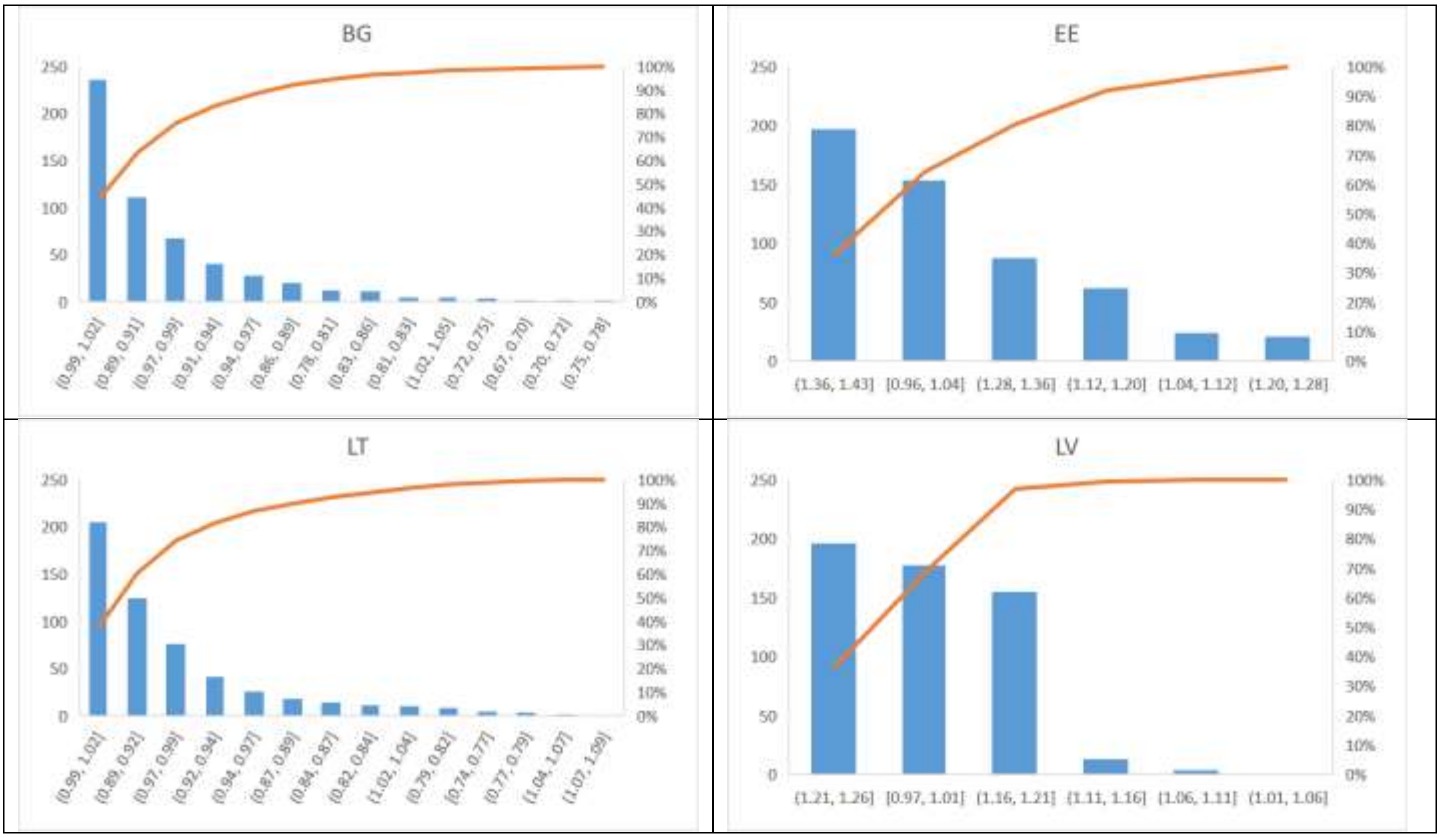


Figure A6: Relative price index under market power with swap deals case (Scenario B2) (NWE competitive benchmark = 100%).

A3.4. Results from comparing prices under Scenario B2 with potential competitive prices in the five MS (Scenario A)



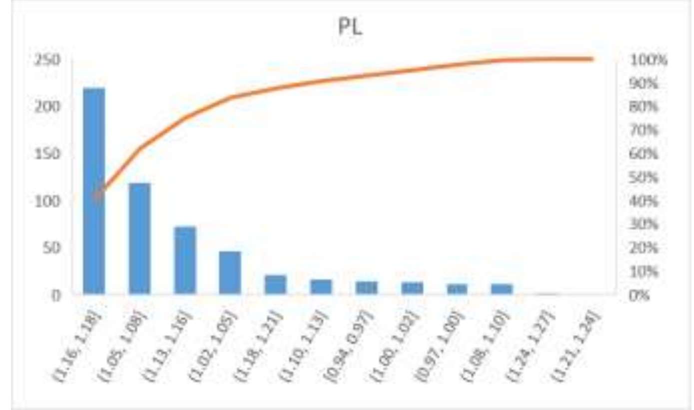


Figure A7: Distribution of simulated prices under market power <u>with</u> swap deals case (Scenario B2) relative to potential competitive prices in the five MS (Scenario A)

Note: X-axis shows the relative price index under market power compared to day-ahead average NWE prices under competitive benchmark (competitive benchmark = 1). Y-axis shows the total number of days that prices under market power are higher (>1) or lower (<1) than under the competitive benchmark case.

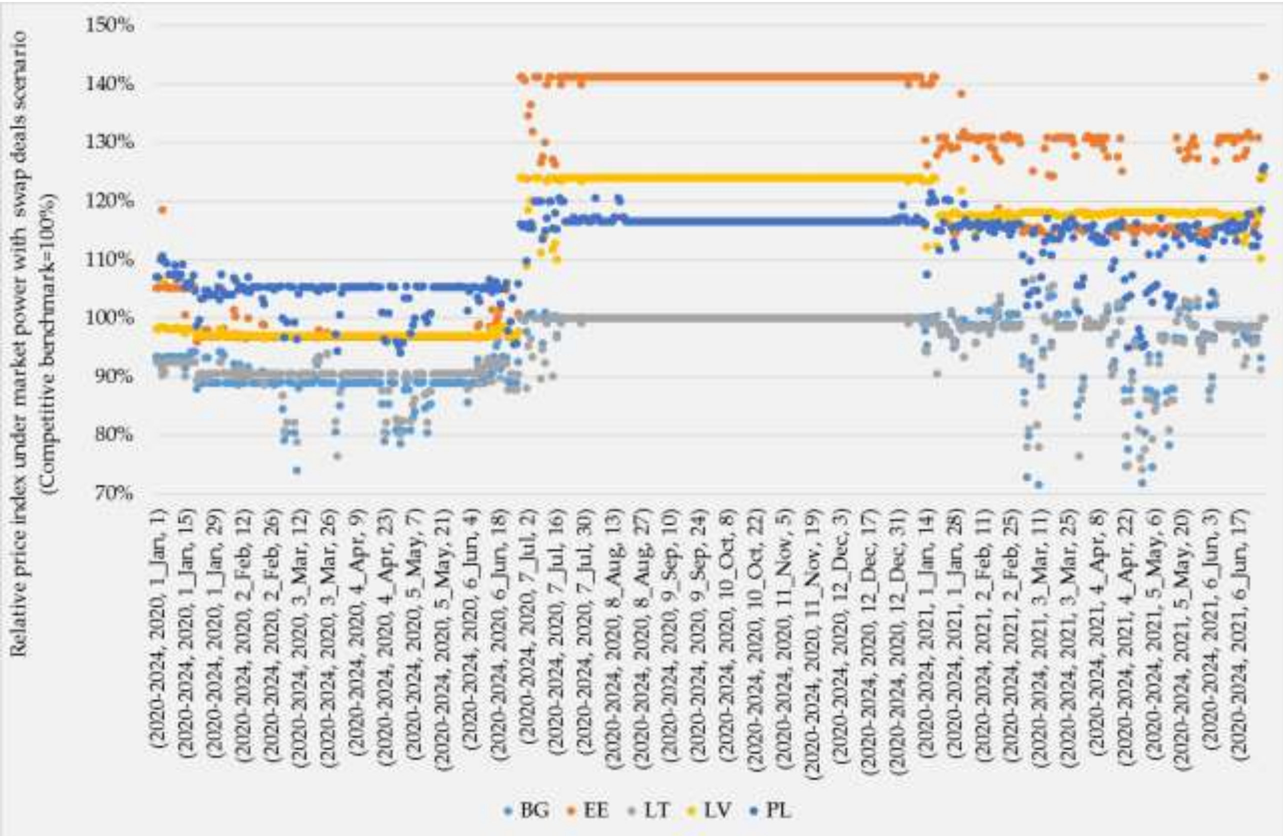


Figure A8: Relative price index under market power <u>with</u> swap deals case (Scenario B2) (competitive price benchmark = 100%).

A3.5. Detailed results of the assessment of the impact of swap deals on North Western European market prices

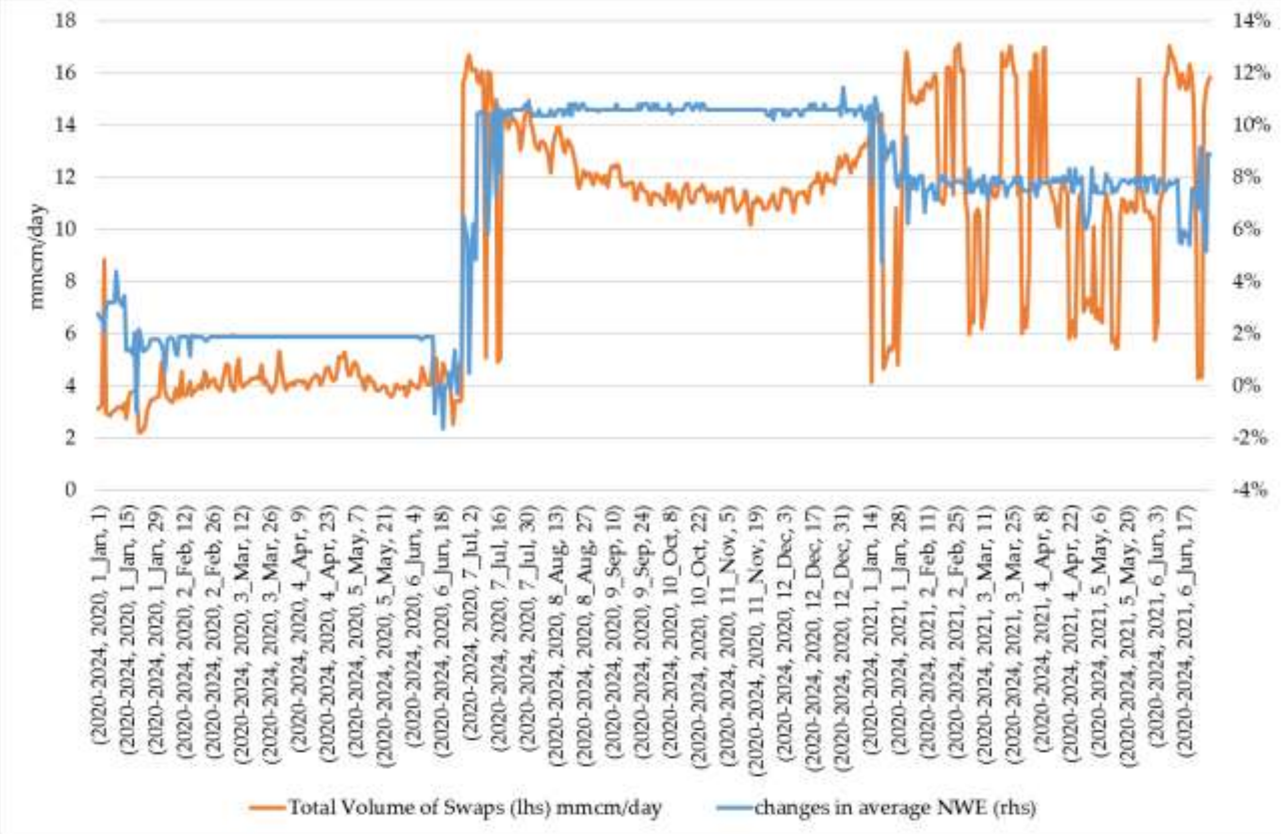


Figure A9: Changes in average NWE day-ahead prices relative to competitive benchmark case without swap deals (Scenario A).

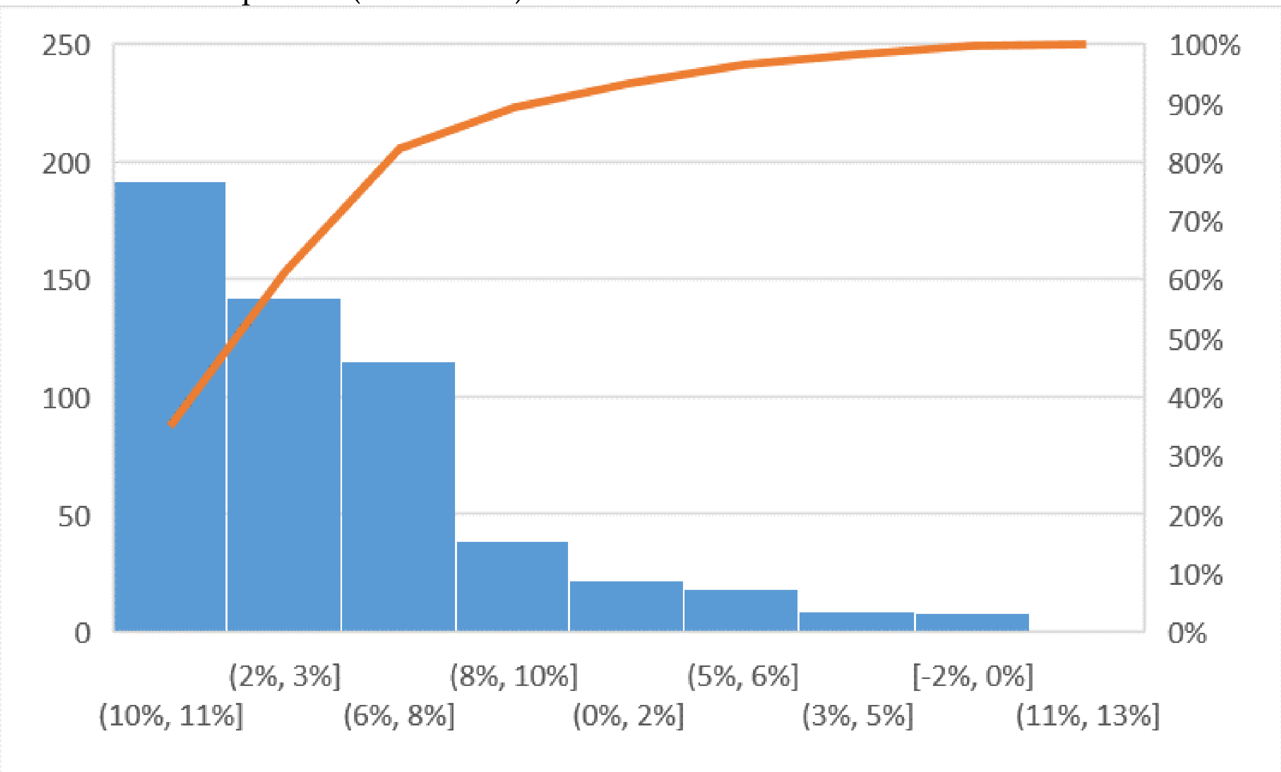


Figure A10: Magnitude and distribution of changes in average NWE day-ahead prices relative to competitive benchmark case without swap deals (Scenario A).

A3.6. Detailed results of the assessment of the impact of swap deals on import dependency of the five MS

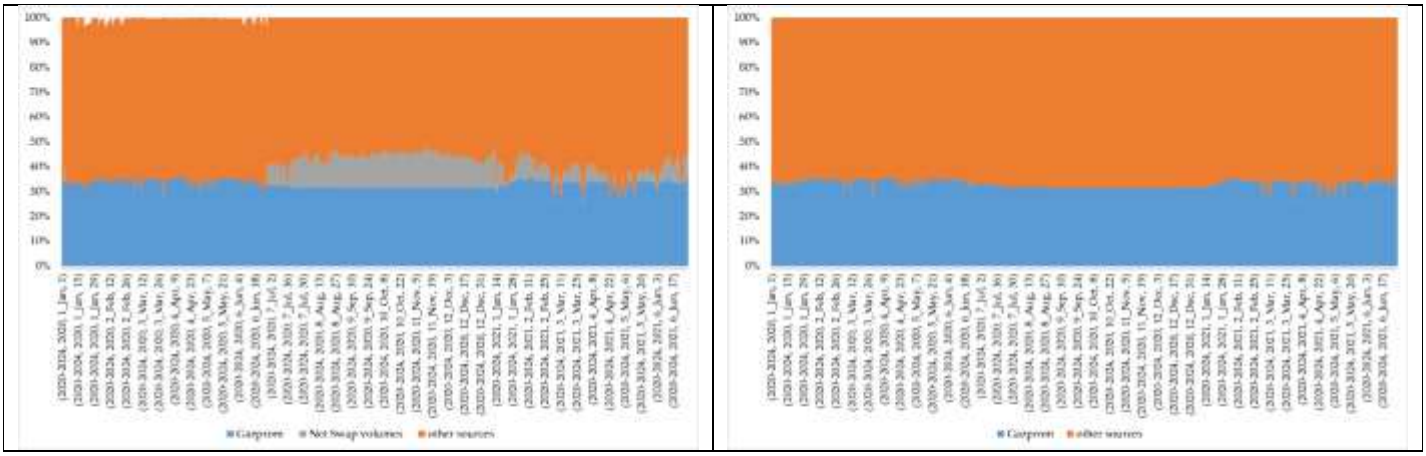


Figure A11: Sources of gas in Poland (left panel – with swap deals, Scenario B2; right panel – without swap deals, Scenario B1)

Note: Note that net swap volumes is swap volume into Poland (from Lithuania) less swap volume out of Poland (to Lithuania).

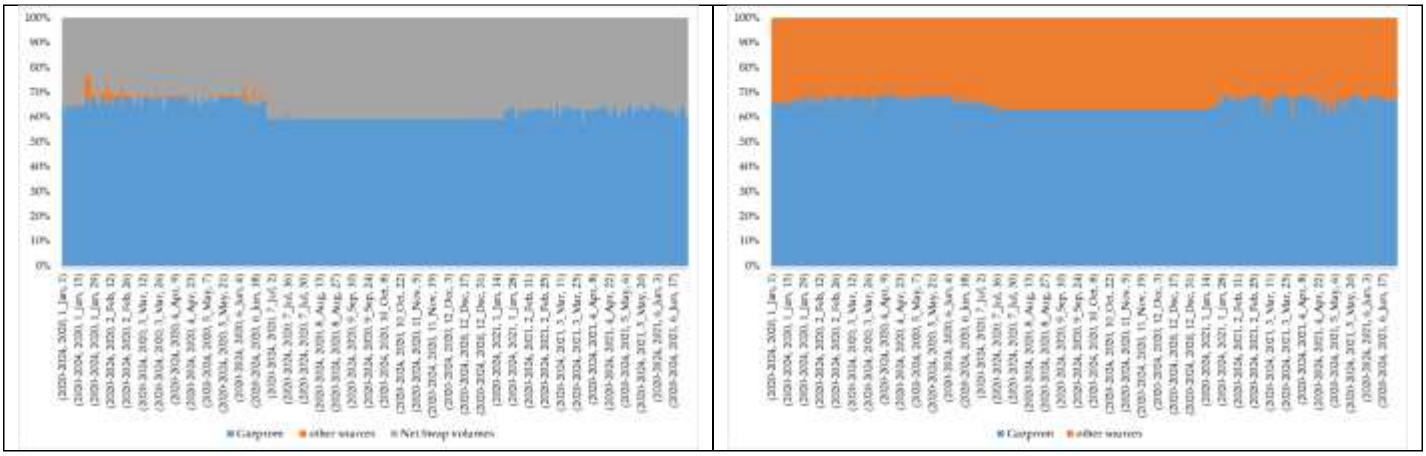


Figure A12: Sources of gas in Lithuania (left panel – with swap deals, Scenario B2; right panel – without swap deals, Scenario B1)

Note: Note that net swap volumes is swap volume into Lithuania less swap volume out of Lithuania.

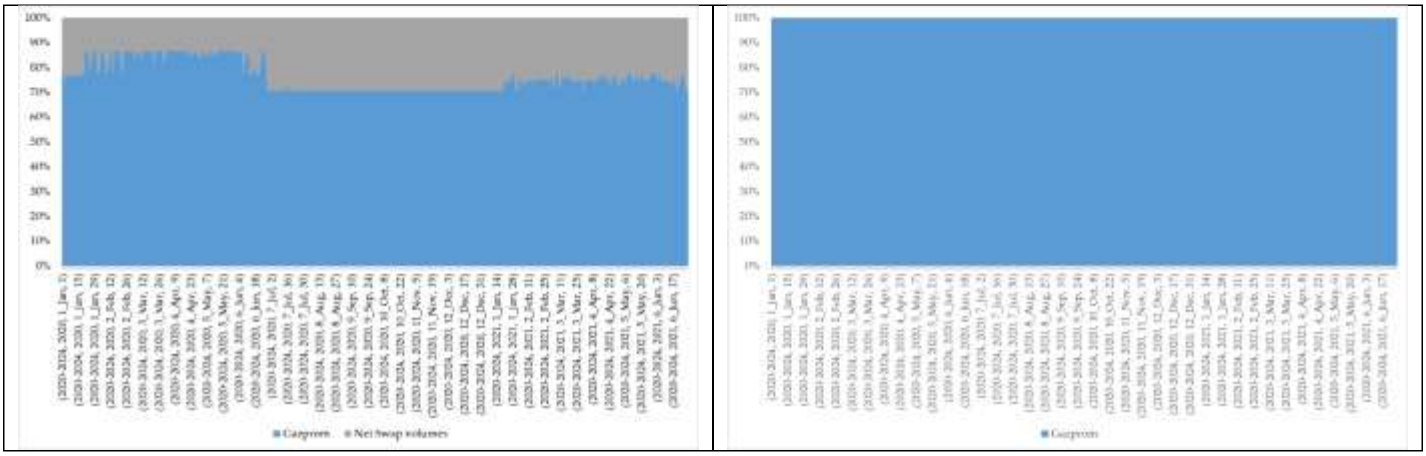


Figure A13: Sources of gas in Bulgaria (left panel – with swap deals, Scenario B2; right panel – without swap deals, Scenario B1)

A3.7. Detailed results for the assessment of the impact of swap deals on infrastructure utilization and network flows

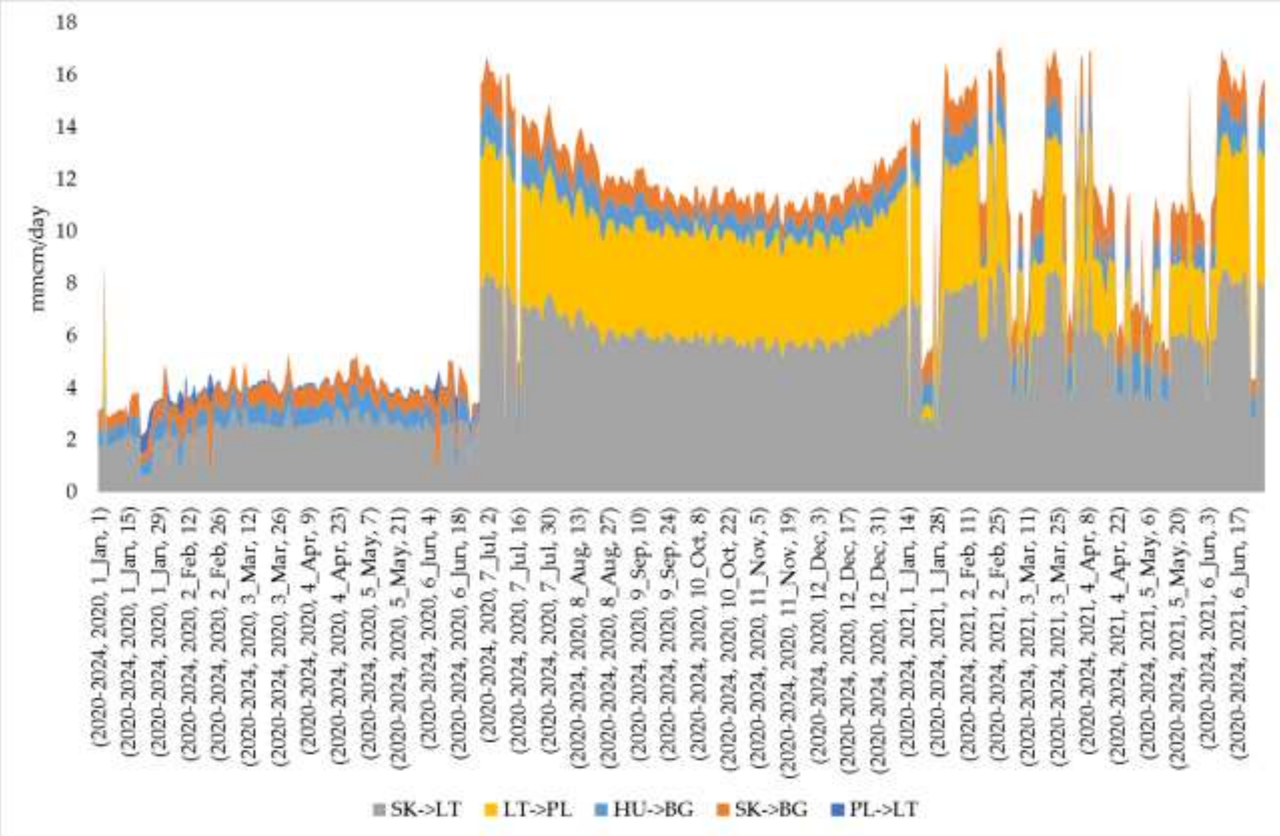


Figure A14: Physical volume of swaps between different locations in Central and Eastern European markets (results under Scenario B2)

Table A1: Average daily gas consumption and swap volumes received in Bulgaria, Lithuania and Poland (Scenario B2)

	BG	LT	PL
Average daily consumption, mmcm/day [1]	8.45	7.12	54.86
Average daily swap volume received, mmcm/day [2]	3.50	9.17	2.443
Share of swap volume in total daily consumption, [3]=[2]/[1]	41%	129%	4%

Table A2: Total flows (bcm) through GIPL (Jan-2020 until Jun-2021) under various scenarios

	Competitive benchmark (Scenario A)	Market power (Scenario B1)	Market Power (Scenario B2)
PL->LT	0.02	0.03	0.00
LT->PL	0.56	0.72	1.50

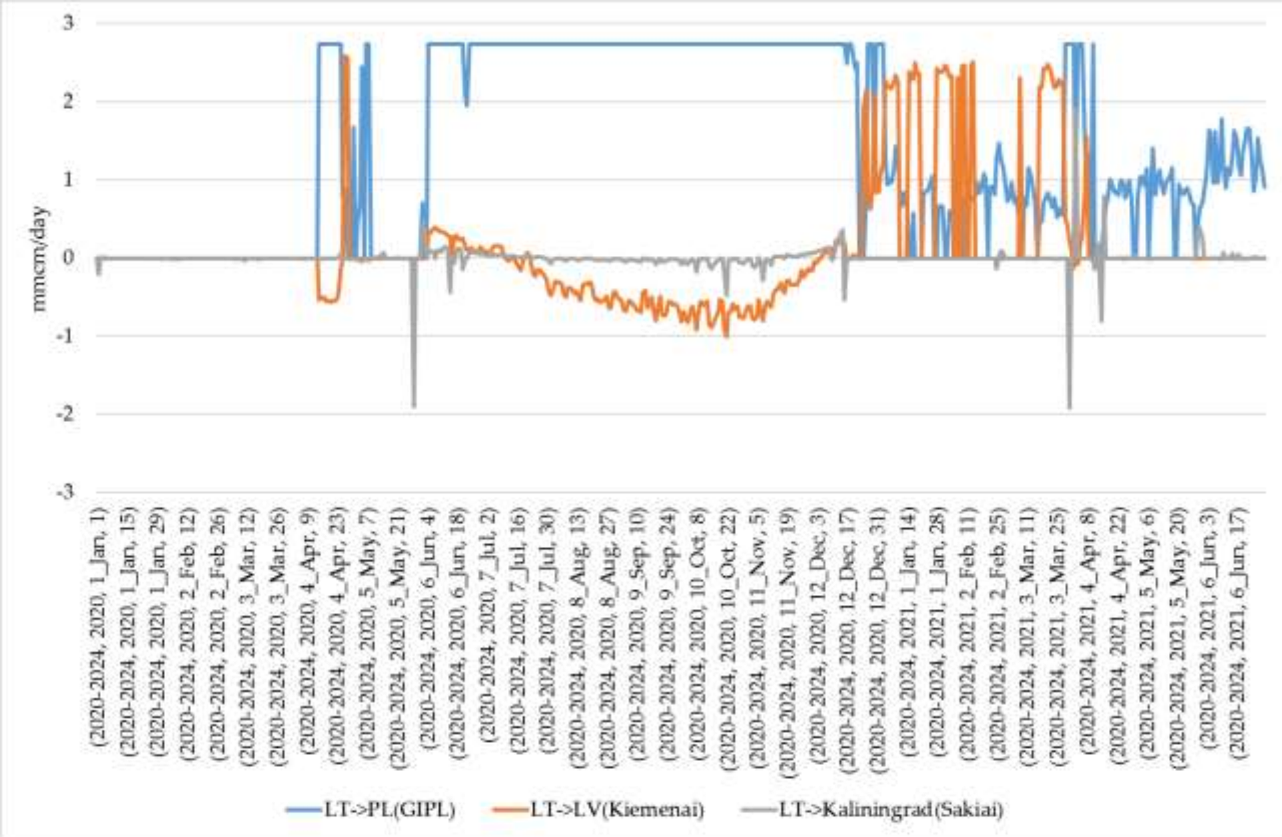


Figure A15: Changes in flows out of Lithuania

Note: '+' means that flows are higher under Scenario B2 than under Scenario B1

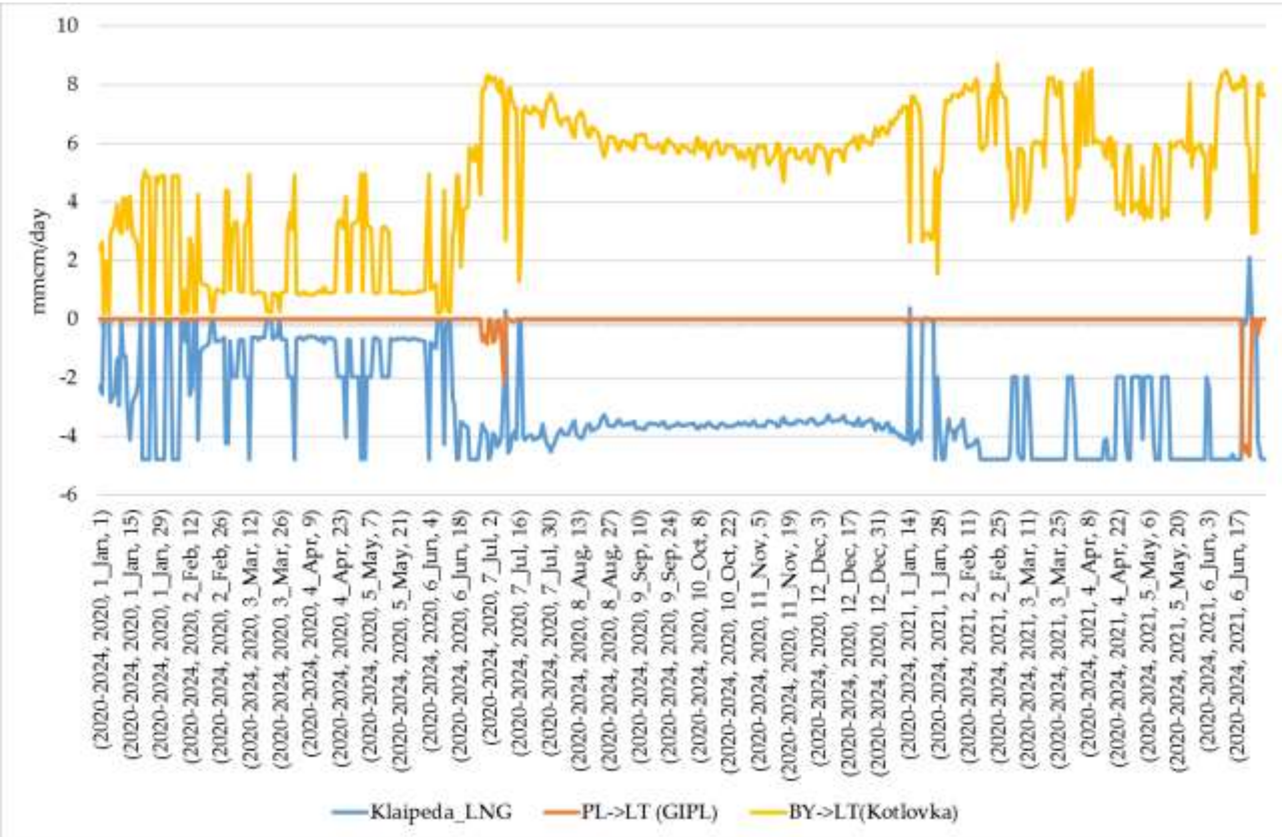


Figure A16: Changes in flows out of Lithuania

Note: '+' means that flows are higher under Scenario B2 than under Scenario B1

Table A3: LNG send out rates and total imports (from Jan-2020 until Jun-2021) by Lithuania and Poland by various scenarios.

	Competitive benchmark (Case A)		**Monopolistic behavior (Case B1)**		**Monopolistic behavior (Case B2)**	
	Klaipeda	Świnoujście	Klaipeda	Świnoujście	Klaipeda	Świnoujście
Average daily send out rate, mmcm/day	3.97	5.09	3.57	18.07	2.52	17.36
Total imports (Jan-2020 until Jun-2021), bcm	0.41	1.02	1.87	9.67	0.21	9.29

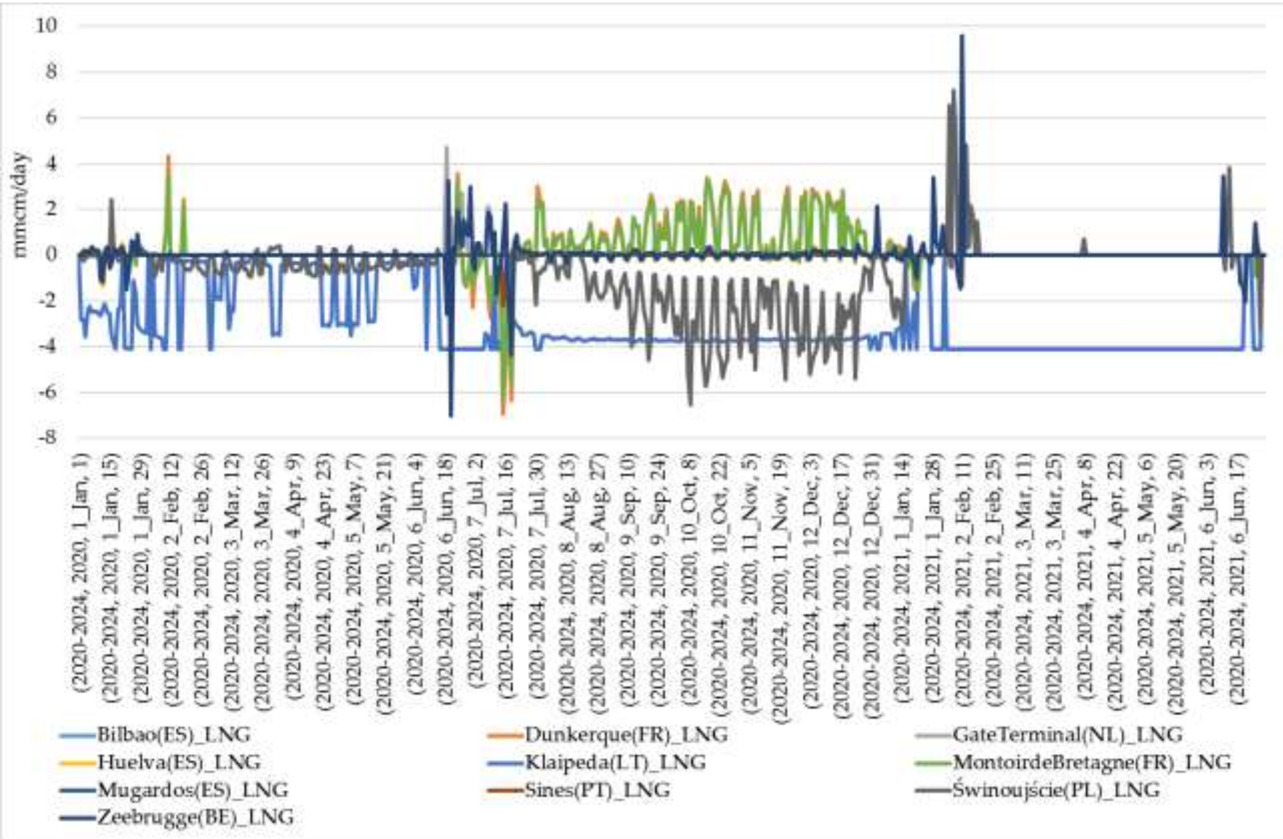


Figure A17: Changes in LNG flows

Note: '+' means that flows are higher under Case B2 than under Case B1 (positive impact of swap deals on LNG inflows into Europe), while '–' means that flows are lower under Scenario B2 than under Scenario 1 (negative impact of swap deals on LNG inflows into Europe). For example, swap deals compete directly with LNG at Klaipeda terminal in Lithuania – Russian gas flowing into Lithuania through swap deals phases out LNG from Klaipeda completely.

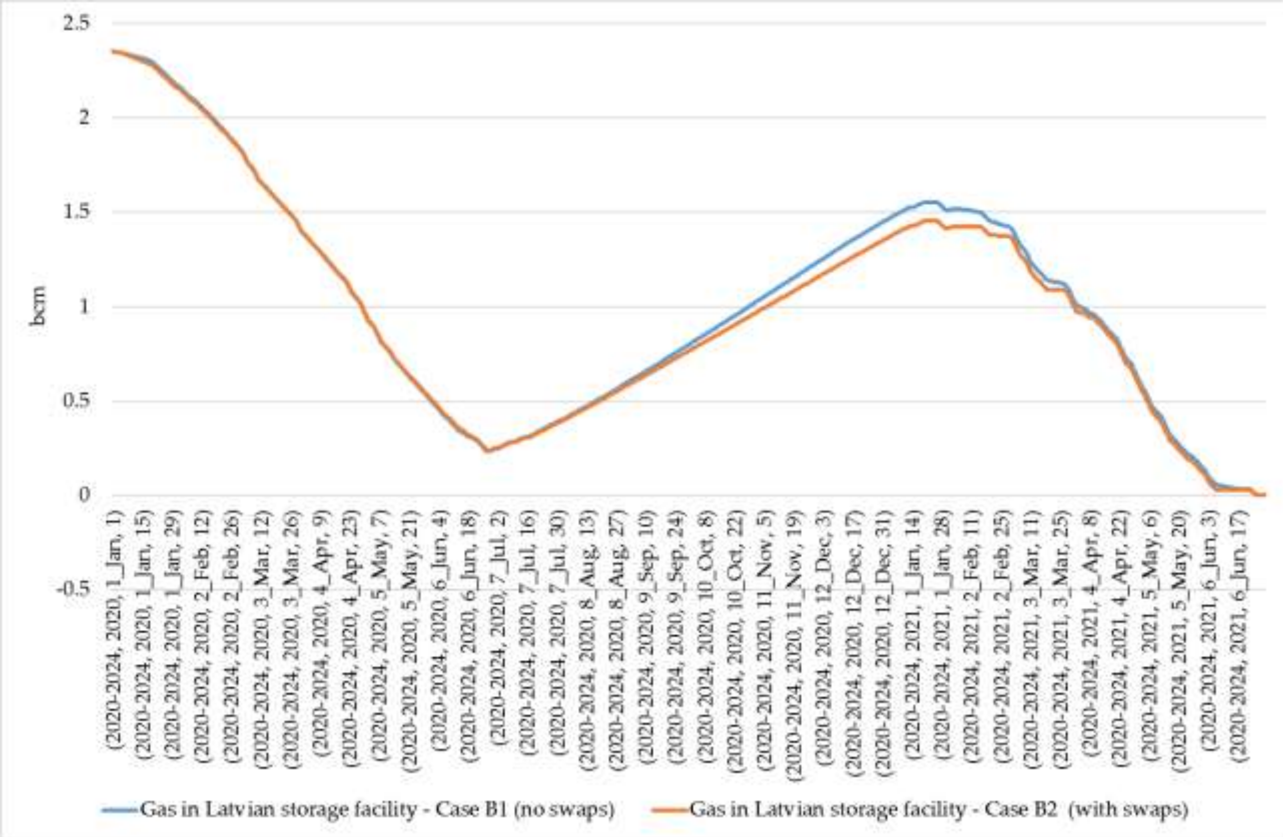


Figure A18: Gas volume in Latvian storage facility under various scenarios

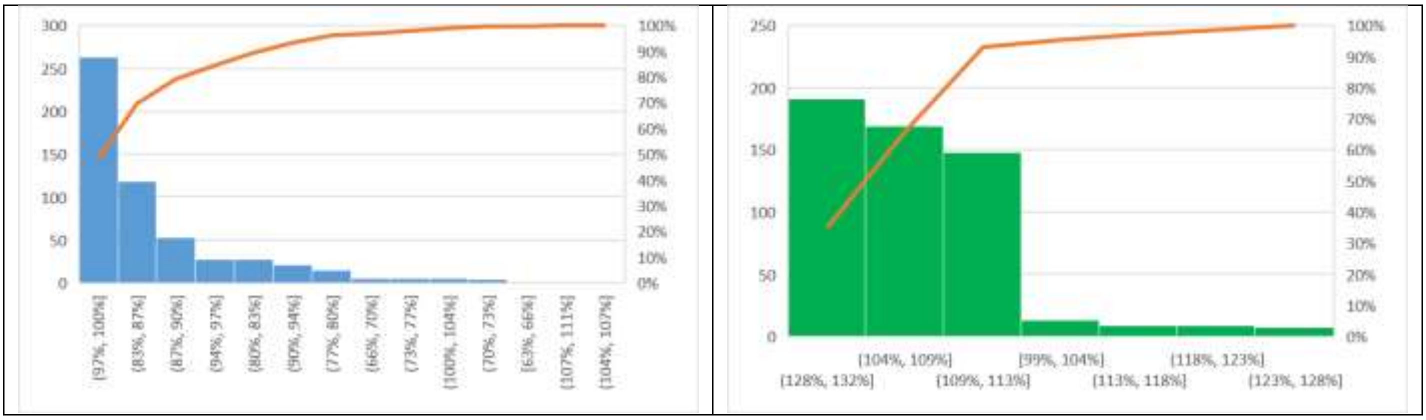


Figure A19: Distribution of simulated prices in the market power case (Scenario B1) relative to potential competitive benchmark prices in BG (left panel) and relative to competitive benchmark prices of NWE (right panel)

Note: includes the IGB pipeline, and Azeri gas for Bulgaria is assumed at SRMC

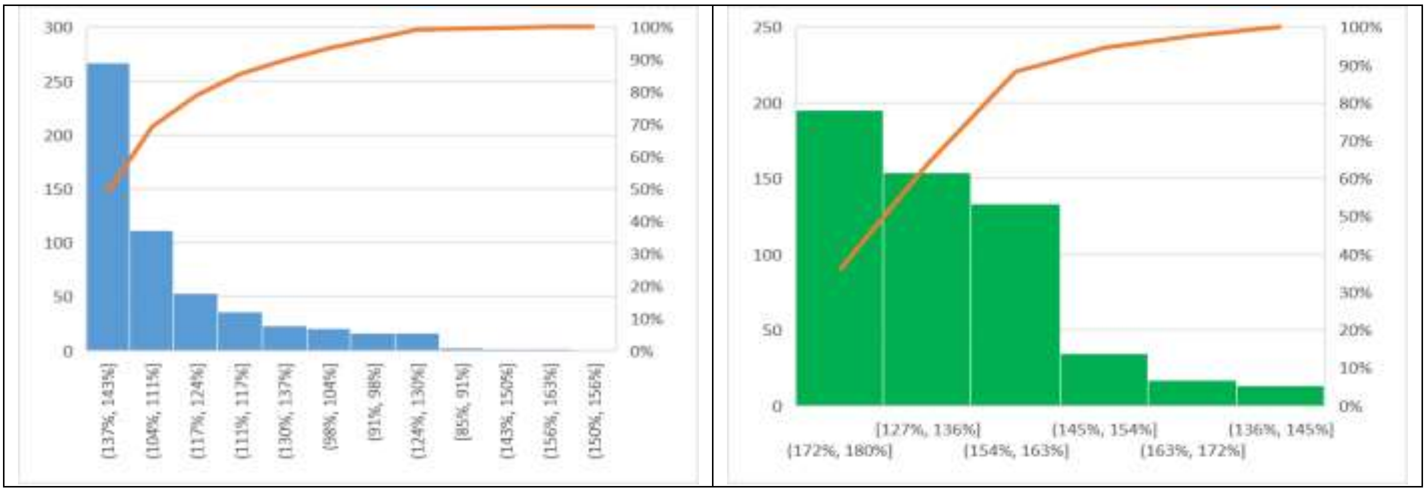


Figure A20: Distribution of simulated prices in the market power case (Scenario B1) relative to potential competitive benchmark prices in BG (left panel) and relative to competitive benchmark prices of NWE (right panel)

Note: includes the IGB pipeline, and Azeri gas for Bulgaria is assumed at competitive average NWE prices

Table A4: Total imports of gas through IGB under various scenarios

	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Total imports through IGB (Jan 2020–Jun 2021), bcm	0.99	0.53	1.01	0.00
Average daily import rates, mmcm/day	1.83	2.18	1.86	0.00

Notes: Scenario 1 – monopolistic behaviour without swaps (Scenario *B1) with the IGB pipeline and Azeri gas for Bulgaria priced at SRMC; Scenario 2 – same as Scenario 1, but Azeri gas is priced at NWE competitive benchmarks; Scenario 3 – same as Scenario 1, but with proposed swap deals; Scenario 4 – same as Scenario 3, but Azeri gas is priced at NWE competitive benchmarks.*

A3.8. Detailed results for the assessment of the impact of inter-TSO agreements on Gazprom's monopoly power in Bulgaria

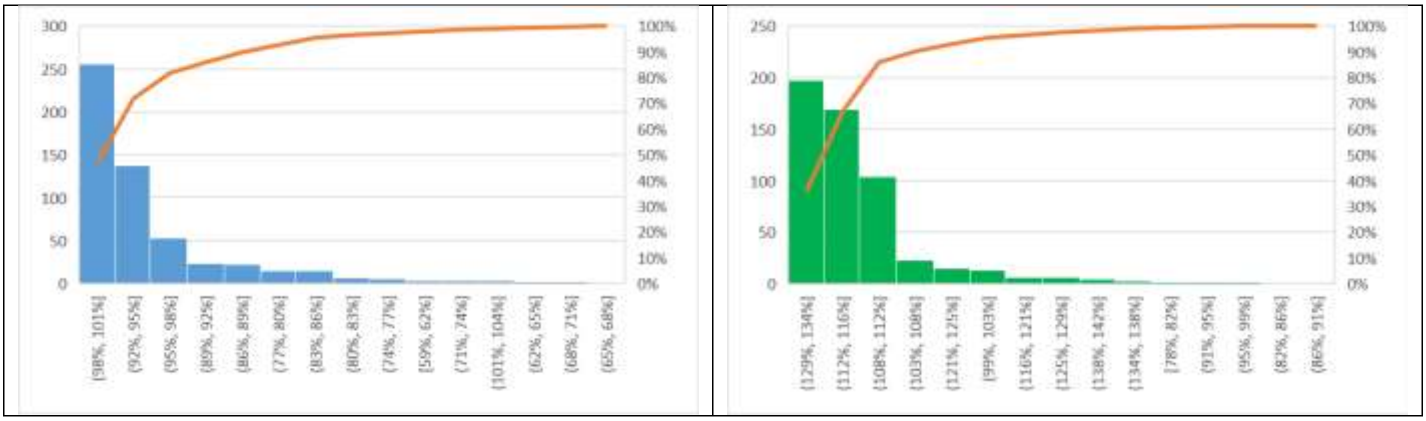


Figure A21: Distribution of simulated prices in the market power case (Scenario B1) relative to potential competitive benchmark prices in BG (left panel) and relative to competitive benchmark prices of NWE (right panel)

Note: includes assumed interconnection agreements between Greece and Bulgaria allowing the parties to do swaps and backhaul operations