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EU Gas Import Tariff Under Duopoly: A Contribution to the Energy Sanctions Debate on Russia

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Summary:

The Russo-Ukrainian war has triggered a debate about the adequate sanctioning policy options available to Germany and the European Union, respectively: Ideally, sanctions should impose considerable economic costs on Russia and contribute to a reduction of the Russian government's ability and willingness to continue its military aggression against Ukraine. Two options are discussed, namely an embargo on Russian exports of fossil fuels and an import tariff. If European policymakers want to consider the option of a gas import tariff on Russian exports, the pros and cons of such a policy option clearly have to take the following into consideration: Firstly, the impact on Russia – in particular the effects on Russia's budget revenue - and Gazprom as the largely state-owned dominant gas exporter. Secondly, the analysis has to focus on the effects on consumers of imported natural gas in the European Union. Proponents of an import tariff allude to optimal tariff theory and argue that such a policy would shift the burden primarily towards the exporters of fossil fuels, because of tariff revenues accruing to EU households. To understand the price and quantity effects of an EU gas import embargo vis-à-vis Russia, an adequate theoretical framework is required: While one might consider a monopoly framework – with Gazprom as the only supplier in the EU – there are good arguments that a duopoly (or oligopoly) market structure analysis is more useful to derive the key effects of an EU import tariff since such an approach allows to take into account windfall gains for competitors, the consideration of cost differentials between suppliers and the possibility of changes in market leadership. We consider the effect of revenue maximizing tariffs for both the case in which Gazprom retains and loses its market leadership position. The tariff maximizing tariff would significantly reduce the market share of Gazprom and Gazprom would only partially increase gas prices, namely by 50% of the tariff if leadership is maintained and by 25% if leadership is lost. However competitors would also increase their price mark ups, with a stronger increase if competitors become market leaders. The increase of price mark ups and the decline of the market share of Gazprom make it more difficult to raise sufficient tariff revenues from Gazprom in order to compensate EU consumers, compared to the monopoly case.

Zusammenfassung:

Der russisch-ukrainische Krieg hat eine Debatte über die angemessenen sanktionspolitischen Möglichkeiten Deutschlands bzw. der Europäischen Union ausgelöst: Idealerweise sollten Sanktionen Russland erhebliche wirtschaftliche Kosten auferlegen und dazu beitragen, die Fähigkeit und Bereitschaft der russischen Regierung zur Fortsetzung ihrer militärischen Aggression gegen die Ukraine zu verringern. Es werden zwei Optionen diskutiert, nämlich ein Embargo auf russische Exporte fossiler Brennstoffe und ein Importzoll. Wenn die europäischen Entscheidungsträger die Option eines Gasimportzolls auf russische Exporte in Betracht ziehen wollen, müssen bei der Abwägung der Vor- und Nachteile einer solchen politischen Option die folgenden Punkte berücksichtigt werden: Erstens die Auswirkungen auf Russland – insbesondere die Auswirkungen auf die russischen Haushaltseinnahmen - und auf Gazprom als den weitgehend in Staatsbesitz befindlichen dominierenden Gasexporteur. Zweitens muss sich die Analyse auf die Auswirkungen auf die Verbraucher von importiertem Erdgas in der Europäischen Union konzentrieren. Die Befürworter eines Importzolls berufen sich auf die Theorie der optimalen Zölle und argumentieren, dass eine solche Politik die Last in erster Linie auf die Exporteure fossiler Brennstoffe verlagern würde, da die Zolleinnahmen den EU-Haushalten zufließen. Um die Preis- und Mengeneffekte eines EU-Gasimportembargos gegenüber Russland zu verstehen, ist ein angemessener theoretischer Rahmen erforderlich: Während man einen Monopolrahmen – mit Gazprom als einzigem Anbieter in der EU – in Betracht ziehen könnte, gibt es gute Argumente dafür, dass eine Duopol- (oder Oligopol-) Marktstrukturanalyse nützlicher ist, um die wichtigsten Auswirkungen eines EU-Importzolls abzuleiten, da ein solcher Ansatz die Berücksichtigung von Mitnahmeeffekten für Wettbewerber, die Berücksichtigung von Kostenunterschieden zwischen Anbietern und die Möglichkeit von Veränderungen der Marktführerschaft erlaubt. Wir betrachten die Auswirkungen von ertragsmaximierenden Zöllen sowohl für den Fall, dass Gazprom seine Marktführerschaft behält, als auch für den Fall, dass es sie verliert. Der tarifmaximierende Tarif würde den Marktanteil von Gazprom erheblich verringern, und Gazprom würde die Gaspreise nur teilweise erhöhen, nämlich um 50 % des Tarifs, wenn die Marktführerschaft erhalten bleibt, und um 25 %, wenn die Marktführerschaft verloren geht. Allerdings würden auch die Wettbewerber ihre Preisaufschläge erhöhen, und zwar noch stärker, wenn die Wettbewerber Marktführer werden. Der Anstieg der Preisaufschläge und der Rückgang des Marktanteils von Gazprom machen es im Vergleich zum Monopolfall schwieriger, ausreichende Tarifeinnahmen von Gazprom zu erzielen, um die Verbraucher in der EU zu entschädigen.

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1. Introduction

The Ukraine-Russia war has triggered a debate about adequate sanctioning policy options of Germany and the EU, respectively: Ideally, sanctions should impose considerable economic costs on Russia and contribute to a reduction of the Russian government's ability and willingness to continue its military aggression against the Ukraine. Among the influential studies on the topic of an energy import embargo of Germany vis-à-vis Russia was Bachmann et al. (2022); using a different modeling approach, namely the NiGEM model the research institute IMK (Behringer, 2022) also look into the question of a German energy import embargo. The special issue of the effects of a natural gas import embargo of Germany vis-à-vis Russia was analyzed by an interdisciplinary group of researchers (Leopoldina, 2022). two economist from the Bachmann group teamed up with two French economist (Baqaee et al., 2022) to analyze the macroeconomic impact of a French and EU energy import embargo vis-à-vis Russia, respectively. The output losses were rather modest for the EU countries considered. As regards the economic effect of a German energy import embargo vis-à-vis Russia some economists apparently expect a strong negative output effect for Russia for which the IMF (2022) in its World Economic Outlook has made a forecast of an output decline by 11 percent just in 2022 – without any energy import embargo from the EU and the United Kingdom.

On April 27th, 2022, Russia announced that it would stop delivering gas to Poland and Bulgaria with the official reasoning provided by the Russian government being that both of the aforementioned countries had not paid for Russian gas deliveries in Rubles as stipulated by President Putin a month previously: Settlement terms were changed unilaterally such that gas would have to be paid for in Rubles, while the relevant contracts in almost all cases indicated that payment should be in US Dollars or Euros. The forward gas price increased by about 15 percent on that day, and it is plausible that the price increase for natural gas – and for LNG deliveries in the short term – would be much higher if the EU would indeed impose an EU-wide gas embargo or if Russia would stop gas deliveries to all EU countries. In the short term, Poland expects to face serious challenges with regard to gas supply as gas storage facilities in Poland indicate a filling ratio of about 70 percent in late April 2022 on the one hand, on the other hand, Poland expects additional gas transportation and delivery, respectively, from Norway by October at the latest (whether this new pipeline link between Norway and Poland will actually be fully operational by that time remains to be seen). Meanwhile, Bulgaria is about to complete a new pipeline link with Greece which will allow Bulgaria to switch to higher gas imports from Azerbaijan during the second half of 2022.

Gazprom's stoppage of deliveries to Poland and Bulgaria thus creates short-term transition problems for the two countries; in the very short-term, Poland expects to import additional gas from Germany. To the extent that Russia's government does not undertaking specific measures aimed at blocking additional gas deliveries from Norway and Azerbaijan, respectively, gas markets in the EU should not face much additional disturbance; however, price volatility could increase and this – following the basic logic of portfolio theory - will usually translate into an upward shift of the marginal cost curve in downstream sectors using natural gas; some industrial users and private households might want to switch to LNG, the price for which exceeded that of natural gas for private households by about 18 percent in summer 2021 and March 2022 (Wocher/Rosenberger, 2022; the price differential might point to a similar marginal cost

differential). Inflationary pressure in EU countries thus might further increase in the medium term and the European Central Bank may thus be expected to closely monitor both gas markets and oil markets.

If EU policymakers want to consider the option of a gas import tariff on Russian exports the pros and cons of such a policy option clearly have to take into consideration on the one hand the impact on Russia – in particular effects on Russia's budget revenue - and Gazprom which is a largely state-owned dominant gas exporter and Russia's leading producer of natural gas. If politicians in Germany or the EU27 would not consider an outright energy import embargo – such an embargo is possible for individual EU countries – but instead would want to impose an import tariff there are three questions:

- How will the market price develop and related to this: how big is the change in the equilibrium output – in particular in a setting where Gazprom (GP) may be classified as a monopoly supplier in the EU market: This situation has been analyzed by Gros (2022) who has assumed a linear demand function for gas in the EU. In this setting one can show that under profit maximization the EU countries' governments will be able to compensate the consumers' welfare loss from the tariff-related price increase in the EU gas market.

- How will the market equilibrium change if the quasi-real world setting is not a Gazprom monopoly but rather a duopoly where initially - before the EU's imposition of an import tariff (which has to be the same for all EU countries and thus is qualitatively different from a national embargo setting for Russian gas) – Gazprom is in a Stackelberg leader position in the gas sector in the EU so that other firms/the other firm in the market acts as a strategic follower to Gazprom; and with the import tariff imposed Gazprom remains in the Stackelberg leader position. In this setting one has to raise the question whether or not it is possible that governments in EU countries could use the tariff revenue to compensate the tariff-related welfare loss of consumers in the EU, since in this case the followers would increase their mark ups. We find that for a revenue maximizing increase of tariffs the market share would fall so much that tariff revenues would be insufficient to fully compensate EU consumers for the increase of gas prices by Gazprom and its competitors.

- How will the market equilibrium change if imposing of an EU import tariff brings about a change of the Stackelberg leader position; e.g. in the form that a big LNG firm is the new Stackelberg leader dominating the gas market in the EU – all this in a setting where LNG marginal production cost exceed that of gas supplied by the natural gas pipeline network in Europe, including Russia (the network is largely owned by Gazprom). Again, is it possible for EU countries' governments to use the tariff revenue to fully compensate the consumers for their welfare loss related to the higher tariff-ridden market price? We will show that in this scenario Gazprom would shift the tariff onto prices to a smaller but higher cost of LNG competitors would have a stronger impact on the gas price. Thus also in this case a full compensation of EU households from the tariff increase would not be possible.

The policy option of using an import tariff on Russian oil and gas exports was at first suggested by Hausmann (2022) in a short contribution to Project Syndicate; a basic idea of such an import

tariff was to force Gazprom to reduce its offer price for gas – net of the import tariff – so that the profit of Gazprom and hence corporate tax revenues from Gazprom accruing to Russia's government budget would reduce. A central role in the analysis of the Russian gas supply in the EU is for Gazprom which is a very large company which is quoted on the stock market and effectively owned by the Russian government. Gazprom is Russia's gas export firm whose management apparently is well connected to the Russian President and the Russian government, respectively. From the perspective of the Russian government exporting gas effectively is part of the foreign policy of Russia – often with international price differentiation which amount for certain countries for an economic advantage.

It will be emphasized here that Gazprom might be considered as a profit-maximizing company; but one should not be really certain about this since Gazprom is a "political company" which has a crucial role for Russia's international power position. As regards the special competition between gas delivered by pipelines and LNG suppliers one may point out that strategic investment of gas exporters using pipelines seem to be relevant in reality: By some overinvestment in pipeline capacity the gas exporters using pipelines can try to fend off market entry of new LNG suppliers (or prevent the increase of international sales by existing LNG companies). It is noteworthy that the Russian government has a considerable understanding of LNG markets which contribute to international gas market integration; Russia's share in world natural gas reserves in 2020 was 19.9 percent, followed by the Iran with 17.1 percent, Qatar with 13.1 percent, Turkmenistan with 7.2 percent and the US with 6.7 percent (BP, 2021).

The subsequent analysis is structured as follows: Section 2 takes a look at the international gas market and the gas supply-side, respectively; namely immediately prior to the start of the military tensions between the Ukraine and Russia in 2021 and the war in the Ukraine in 2022. Section 3 presents the Stackelberg duopoly model for the EU natural gas market and presents key conclusions, including findings for a situation with an import tariff where Gazprom remains in the initial Stackelberg leader position; and in addition the focus is on a situation in which the introduction of the EU import tariff goes along with a new leader situation in the EU gas market – Gazprom no longer is the Stackelberg leader company. The final section presents key conclusions and some ideas for future research.

2. Market Shares of Major Natural Gas Suppliers and the Role of the Supply by Gazprom for the EU Market and the Russian Budget

As regards the economic significance of oil and gas for Russia, the energy sector is a major pillar of Russia's output and also a crucial source of government revenue. Over the course of the second decade of the 21st century, the oil and gas sector has accounted for about 40 percent of Russia's central government revenues, where the structural breakdown for the ratio of the oil pillar to the natural gas pillar was about 4:1. Oil and gas firms active in fossilized natural resources exploitation have to pay special fees to the government plus the standard corporate taxes; with the exception of Gazprom which enjoys benefits in the form of a lower effective corporate tax rate (for details see Yermakov/Kirova, 2017). If the EU would impose a gas import embargo vis-à-vis Russia, one would face at least four major effects:

- A rise of the gas price in the EU, partly as a consequence of a rising anticipated future gas prices.
- A decline of real gross domestic product in Russia in 2022/23, beyond the forecasted output contraction as described in the IMF World Economic Outlook in spring 2022 (IMF, 2022).
- A considerable increase of LNG sold in EU countries in 2022/23 and a much higher share of LNG in the energy mix in the European Union in the medium term – with new LNG terminals becoming operational in several EU countries and with new connecting gas pipelines in particular between Spain and France as well as Spain/France and Italy. The European Commission (2022) has emphasized that there is spare capacity in LNG terminals in several EU countries in early 2022 (e.g., in Spain), but the political focus was also on challenges of an expansion of intra-EU gas pipeline networks which, however, is time-consuming.

As regards market shares in the EU gas market – based on physical quantities delivered – the biggest supplier was Russia with a market share of 38.7 percent; followed by Norway and Algeria with 18.6 and 7.2 percent, respectively. The next three positions in the subsequent Tab. 1 are taken by the Netherlands, Qatar and the United States with market shares of 5.7 percent, 4.1 percent and 3.9 percent, respectively. In the list of top 10 supplier countries. one finds the UK, Nigeria, Germany and Libya which accounted for market shares of 3.8 percent, 2.9 percent, 2.4 percent and 1.1 percent, respectively. Of all the top gas supplier countries, Russia's political influence is strong only in Libya. In the US, shale gas producers are the marginal producers in the national gas market and rising relative gas prices typically lead to higher fracking gas production with a rather short delay.

As regards Germany's situation, the main three supplier countries were Russia, Norway and the Netherlands with market shares in 2020 of 65.2 percent, 20.5 percent and 12.7 percent, respectively (see Tab. 2). It is quite apparent that Germany faced the situation of a dominant supplier - Gazprom - in 2020 and this position would have even been reinforced – a somewhat

strange and risky situation – if the North Stream 2 gas pipeline would have started operation in 2022 as was envisaged still in 2021.

Table 1: EU27 Imports of Natural Gas by Partner Country (Top 15) in 2020

	Partner Country	Imports in mio. m^3	Share of total imports
	TOTAL	***400,589.36***	***100.00%***
1	Russia	155,019.77	38.70%
2	Norway	74,562.74	18.61%
3	Algeria	28,997.23	7.24%
( )	*Not specified*	*27,431.30*	*6.85%*
4	Netherlands	22,941.34	5.73%
5	Qatar	16,385.18	4.09%
6	USA	15,682.14	3.91%
7	United Kingdom	15,155.55	3.78%
8	Nigeria	11,460.99	2.86%
9	Germany	9,439.35	2.36%
10	Libya	4,460.00	1.11%
11	Trinidad and Tobago	3,112.85	0.78%
12	France	2,802.49	0.70%
13	Hungary	2,623.58	0.65%
14	Denmark	1,871.38	0.47%
15	Equatorial Guinea	1,129.67	0.28%
Sum			**98.12%**

Note: 'Share of total imports' is calculated as a simple share of the total imports value as indicated by the data set.
Source: Own representation; data from Eurostat (2022), online data code: NRG_TI_GAS.

Table 2: German Natural Gas Imports by Partner Country in 2020

	Partner Country	Imports in mio. m^3	Share of total imports
	TOTAL	***80,439.02***	***100.00%***
1	Russia	52,463.57	65.22%
2	Norway	16,484.58	20.49%
3	Netherlands	10,211.68	12.69%
( )	*Not specified*	*1,279.19*	*1.59%*
Sum			**100.00%**

Note: 'Share of total imports' is calculated as a simple share of the total imports value as indicated by the data set.
Source: Own representation; data from Eurostat (2022), online data code: NRG_TI_GAS.

On the user side of gas, the structural breakdown in Germany – according to data from Statista - was 36 percent for industry in 2020, 31 percent private households and 14 percent for power generation. As regards gas market regulations in Germany, the law stipulates that in a situation of a major shortage of natural gas, then industry would face the first physical cuts in supply

while private households would be the last group of natural gas customers who would have to deal with cuts in the supply of gas. In France and Italy similar regulations hold.

If the export of Russian gas to the EU would fall strongly in the medium term, global LNG markets will become more important than they were in 2020/21, prior to the Russian-Ukrainian war. The dominant supplier country of LNG in the world economy in 2020 was Australia with a market share of 33.8 percent, followed by the US and Malaysia with 16.7 and 8.8 percent, respectively (see Tab. 3). Russia ranked in position 4 with a share of 8.7 percent, followed by Nigeria, Oman and Indonesia, Papua New Guinea, Trinidad and Tobago, Brunei Darussalam and Algeria. The latter – with a market share of 2.7 percent – is an important supplier to France and the EU, respectively. To the extent that Russian LNG ships would be banned by the EU, and thus could not deliver gas to ports in the European Union, the market share of other leading LNG exporters in the EU would increase.

Table 3: Top 15 Exporting Countries of Natural Liquefied Gas in 2020 (exported value in thousand US$)

	Country	Exported value in 2020 (thousand US$)	Share of World
	World	*77,923,928*	*100.00%*
1	Australia	26,312,442	33.77%
2	United States of America	13,045,788	16.74%
3	Malaysia	6,865,068	8.81%
4	Russian Federation	6,745,828	8.66%
5	Nigeria	3,748,842	4.81%
6	Oman	3,677,245	4.72%
7	Indonesia	3,609,514	4.63%
8	Papua New Guinea	3,310,233	4.25%
9	Trinidad and Tobago	2,341,485	3.00%
10	Brunei Darussalam	2,161,184	2.77%
11	Algeria	2,099,697	2.69%
12	Angola	1,016,229	1.30%
13	Peru	520,027	0.67%
14	Equatorial Guinea	505,253	0.65%
15	Norway	466,569	0.60%
Total			**98.08%**

Note: Product Code 271111 – Natural gas, liquefied.
Source: Own calculations (IV); data are ITC calculations based on UN Comtrade and ITC statistics (2022).

As regards the prospects of competition between Russia and the US – the latter with its LNG gas exports – Corbeau/Yermakov (2016) have raised the question as the extent to which duopoly competition it the gas market is to be expected. With respect to the rising role of LNG in transatlantic markets and in Asian markets, Varahrami/Saeed Haghighat (2018) have identified several key factors reinforcing the position of LNG relative to pipeline-delivered gas.

3. Stackelberg Duopoly as an Approach to the EU Gas Market

In the following, it is assumed that there are two suppliers *i*=(1,2) and supplier 1 is, initially, the Stackelberg leader. Here, one can consider Gazprom as being the Stackelberg leader and all other (LNG) suppliers as the followers. The Stackelberg model has the monopoly case as a special case (namely, when the followers supply zero quantity). Due to the cost differentials between pipeline and LNG gas, the two suppliers differ in terms of marginal cost

$$C1 \leq C2 \tag{1}$$

Demand for gas of suppliers 1 and 2 (denoted by *Q1* and *Q2* respectively) is linear and a negative function of the gas price *P*

$$P = a - b(Q1 + Q2) \tag{2}$$

The supply problem of the two duopolists is solved sequentially. In the first stage, the follower determines its supply as a function of the supply of the leader. In a second stage, the market leader maximizes profits, taking into account the reaction of the follower.

Stage 1: Supplier 2 maximizes profits, by taking the supply of the dominant producer as given

$$Max\Pi 2 = \Big(\big(a - b(Q1 + Q2)\big) * Q2 - C2 * Q2\Big) \tag{3}$$

$$\frac{\partial \Pi 2}{\partial Q2} = a - bQ1 - C2 - 2bQ2 = 0 \tag{4}$$

Optimization yields a reaction function for *Q2* of supplier 2 (as a function of *Q1*)

$$Q2 = \frac{a - bQ1 - C2}{2b} \tag{5}$$

It is assumed that Q2>0, otherwise this would be a monopoly situation.

Stage 2: Supplier 1 maximizes profits by taking into account the reaction of the follower to its supply decision

$$Max\Pi 1 = \Big(\big(a - b(Q1 + Q2)\big) * Q1 - C1 * Q1\Big) \tag{6}$$

Supplier 1 takes into account the reaction function of supplier 2, thus we can reformulate the maximization problem as follows

$$Max\Pi 1 = \left(\left(a - b\left(Q1 + \frac{a - bQ1 - C2}{2b}\right)\right) * Q1 - C1 * Q1\right) \tag{7}$$

The first order condition

$$\frac{\partial \Pi 1}{\partial Q1} = (a - C1) - \left(\frac{a - C2}{2}\right) - bQ1 = 0 \quad (8)$$

yields the following supply equation

$$Q1 = \frac{1}{2b}a + \frac{1}{2b}C2 - \frac{1}{b}C1 \quad (9)$$

The quantity of the leader depends positively on the cost of the follower and negatively on its own cost. One can now determine the quantity of the follower, given its reaction function

$$Q2 = \frac{1}{4b}a - \frac{3}{4b}C2 + \frac{1}{2b}C1 \quad (10)$$

The quantity of the follower depends positively on the cost of the leader and negatively on its own cost. Substituting *Q1* and *Q2* into the demand function gives an expression for the price of gas in terms of the respective cost of the two producers. Despite different costs, there is a uniform price charged for a homogeneous good. This implies that supplier 1 charges a higher mark-up compared to supplier 2

$$P = \frac{1}{4}a + \frac{1}{4}C2 + \frac{1}{2}C1 \quad (11)$$

The cost of supplier 1 is more relevant for the market price than the cost of supplier 2. For the price to exceed marginal cost (C2), the term “a” of the demand function must be sufficiently large.

In the next section, a number of possible reactions of suppliers 1 and 2 are considered in the case that EU governments would impose a tariff on supplier 1. The goal is to understand the conditions under which a tariff is not welfare improving for domestic households, i.e., that generates revenues which are insufficiently large to allow to compensate domestic consumers of gas for the price increase induced by said tariff. Various tariff strategies can be considered. First one could consider a marginal tariff increase, however, this strategy would hardly affect the market position of Gazprom and would not be the consistent with the aim of imposing maximum cost on Gazprom. Second one could impose a tariff which is high enough such that the market share of Gazprom goes to zero. However this would yield zero tariff revenues from Gazprom and would only result in an increase of the gas price (by competitors). The most consistent strategy, given the political goals appears to be a revenue maximising tariff, since this strategy inflicts the highest cost on Gazprom. This is the strategy we consider here. As shown subsequently, this leads to sizeable tariffs which would reduce the market share of Gazprom significantly.

EU governments impose a tariff on Gazprom

The tariff considered here takes the form of a unit/quantity tax and increases cost per unit for supplier 1 from *C1* to *C1+t1*. No assumption is made on whether the tariff on Gazprom affects its market leadership position but both possibilities are considered.

The aim is to calculate the economic effects which are as closely as possible calibrated to the actual market shares of Gazprom. Assuming that the market leader has a cost advantage ($C1 \leq C2$), the duopoly model restricts the market share of the leader to be above 66 percent. This restricts the cost advantage which can be assumed in order to stay as close to the actual pre-war market share as possible. Therefore, the cost advantage of Gazprom is fixed at 10 percent in the following calculations.

Case 1: Gazprom remains market leader in the EU

The new market price is denoted as P^*. The formula remains unchanged except for the presence of *t1* in the unit cost term of supplier 1

$$P^* = \frac{1}{4}a + \frac{1}{4}C2 + \frac{1}{2}(C1 + t1) \qquad (11')$$

Thus, *t1* increases the market price by 50 percent of the tariff rate, which is similar to the monopoly case. There is, however, a difference compared to the monopoly case. In the duopoly case, firms in group 2, i.e., follower firms, also increase the price of gas even though they do not have to pay the tariff. That is, while in the monopoly case the mark-up declines (the monopolist increases price less than the tariff), in the duopoly case supplier 1 reduces the mark-up while supplier 2 increases the mark-up. This makes the sign of the welfare effect more ambiguous. The quantity sold by supplier 1 is reduced by $\frac{1}{b}$*t1

$$Q1^* = \frac{1}{2b}a + \frac{1}{2b}C2 - \frac{1}{b}(C1 + t1) \qquad (9')$$

The budgetary problem is the following: The tariff increases the price for all suppliers, but government only receives revenues from supplier 1 (which also loses market share).

The price for consumers increases by ½*t1, tariff revenues are given by

$$TREV = t1Q1^* = t1 * (\frac{1}{2b}a + \frac{1}{2b}C2 - \frac{1}{b}(C1 + t1)) \qquad (12)$$

This allows governments to subsidize households per unit of consumed gas by

$$\frac{TREV}{Q^*} = t1\frac{Q1^*}{Q1^* + Q2^*} \qquad (13)$$

Comparing the price increase due to the tariff of ½ to the subsidy per unit of consumed gas suggests that households can only be fully compensated if the market share of Gazprom stays

above 50 percent. This generates a trade-off between the revenue-maximizing tariff and the size of the subsidy. The higher the revenue-maximizing tariff rate, the lower the share of Gazprom in total gas consumption will be and this may ultimately fall below 50 percent.

The revenue-maximizing tariff is

$$\frac{\partial TREV}{\partial t1} = \left(\frac{1}{2b}a + \frac{1}{2b}C2 - \frac{1}{b}C1\right) - \frac{2}{b}t1 = 0 \qquad (14)$$

$$t1opt = \left(\frac{1}{4}a + \frac{1}{4}C2 - \frac{1}{2}C1\right) \qquad (15)$$

The following table compares the effects of a revenue-maximizing tariff with a price elasticity smaller and larger than 1, respectively.

Table 4: Price and revenue (per unit of gas) - optimal Gazprom tariff

	dRevenue/Q	dPrice	T1opt
ELAST = 1.25	0.17	0.2	0.4
ELAST = 0.8	0.27	0.32	0.625

Note: C2=1.1*C1
Source: Own representation.

The model suggests a substantial tariff on gas imports from Gazprom (40 percent vs 62.5 percent). The revenue-maximizing tariff would, however, reduce the market share of Gazprom below 50 percent, thereby yielding tariff revenues which would be insufficient to fully compensate domestic households. Thus, a tariff strategy consistent with the full compensation of domestic households would have to restrict the tariff such that the market share of Gazprom does not decline below 50 percent.

Case 2: Gazprom does not remain market leader but LNG producers become market leader

The policy including the tariff on Gazprom could alter the market structure and make LNG suppliers the dominant suppliers. This is the considered in the following, namely with supplier 2 as the new Stackelberg leader. With the new price leadership, the price level in the EU increases from

$$P = \frac{1}{4}a + \frac{1}{4}C2 + \frac{1}{2}C1 \qquad (11)$$

to

$$P^* = \frac{1}{4}a + \frac{1}{2}C2 + \frac{1}{4}(C1 + t1) \qquad (11')$$

The price increase in the case of changing market leadership is given by

$$P^* - P = \frac{1}{2}C2 + \frac{1}{4}(C1 + t1) - \frac{1}{4}C2 - \frac{1}{2}C1 = \frac{1}{4}(C2 - C1) + \frac{1}{4}t1 \qquad (16)$$

There are two reasons for a price increase. Firstly, due to the tariff, i.e., the tax increase leads to a gas price increase (but now the coefficient defining the extent of the shift of taxes onto prices is reduced from ½ to ¼) and, secondly, the higher marginal cost of the LNG producers dominates the price for gas in the EU.

The output of Gazprom is now given by the formula of the follower (Note(!) *Q1* is now output of follower)

$$Q1^* = \frac{a}{4b} - \frac{3}{4b}(C1 + t1) + \frac{1}{2b}C2 \quad (17)$$

while output as leader was

$$Q1^* = \frac{a}{2b} - \frac{1}{b}(C1 + t1) + \frac{1}{2b}C2 \quad (18)$$

The fact that Gazprom has become the follower in the gas market, reduces its ability to shift the burden of the tariff onto prices. Comparing (17) and (18) one can see that the output of the follower responds less to the increase of the tariff but there is an independent decline of the market share due to the change in the leadership position, as shown by the constant in eq. (17) and (18).

Compared to case 1, the smaller price and quantity response to the tariff improves welfare, but the fact that the high cost LNG producers are now dominating the market is increasing the price. This leaves some ambiguity and makes the results sensitive to the size of the cost effect.

Tariff revenues are now given by

$$TREV = t1Q1^* = t1 * \left(\frac{a}{4b} - \frac{3}{4b}(C1 + t1) + \frac{1}{2b}C2\right) \quad (19)$$

Revenue per unit of gas consumed remains crucially determined by the output share of Gazprom

$$\frac{TREV}{Q^*} = t1\frac{Q1^*}{Q1^* + Q2^*} \quad (20)$$

The revenue-maximizing tariff

$$\frac{\partial TREV}{\partial t1} = \left(\frac{1}{4b}a - \frac{3}{4b}C2 + \frac{1}{2b}C1\right) - \frac{6}{4b}t1 = 0 \quad (21)$$

$$t1opt = \left(\frac{1}{6}a - \frac{1}{2}C1 + \frac{1}{3}C2\right) \quad (22)$$

Table 5: Price and revenue (per unit of gas), optimal Gazprom tariff

	dRevenue/Q	dPrice	T1opt
ELAST = 1.25	0.054	0.084	0.28
ELAST = 0.8	0.078	0.11	0.42

Note: C2=1.2*C1
Source: Own representation

In the case that Gazprom would lose its market leadership position (which is likely, since it faces higher costs), it becomes less likely that tariff revenues would be sufficient to fully compensate domestic households, since in this case the market share of Gazprom falls by more than in the previous case.

4. Conclusions and Further Research Perspectives

In a recent paper, Gros (2022) applied the theory of optimal tariffs for the analysis of the impact of sanctions on gas imports from Russia. He concludes that tariffs on Russian gas imports would reduce revenues for Gazprom and they would be welfare enhancing for the EU, since Gazprom would only partially adjust prices in response to the tax increase and governments could generate sufficient tariff revenues to compensate EU citizens for that price increase. This analysis is based on the assumption that Gazprom is a monopoly supplier of gas.

Given that Gazprom is not the only supplier of gas to the EU, although it does hold a sizeable market share in a number of EU countries, suggests that a duopoly model is perhaps more appropriate for characterizing the gas market than a pure monopoly model. Another well-known feature is the cost advantage of pipeline gas over LNG. Herein, both elements are considered and it is found that under these conditions it is less likely to achieve welfare gains from imposing an import tariff on Gazprom. The reasons are straightforward. In a duopoly model, the increase in production costs for one supplier increases the market price for gas, i.e., it increases the mark-up of suppliers not affected by the tariff, while tariff revenues are only collected from one supplier. Compared to the monopoly model, the tax base is smaller and Gazprom would lose significant market share. A policy of subjecting Gazprom to an import tariff could also result in Gazprom losing its leader role in the EU gas market. If that would indeed happen, there would be an additional positive price effect, namely the higher marginal cost of LNG producers would play a larger role for gas prices. In that case, welfare improvements for EU households would be even harder to achieve.

There are other considerations which have thus far not been considered, namely that Gazprom is unlikely to be a pure profit maximizing firm but may instead have other, perhaps strategic, objectives such as the goal of retaining a certain market share for example (at least in the period before the war). This could have kept prices artificially low before the war and provides greater room for manoeuvre to increase prices. Moreover, if we regard the role of Gazprom as being dependent on Russian government policy, the price response to a tax increase could be different from that of a purely profit maximizing firm. If the goal of Russia is to minimize welfare gains for the EU, Gazprom could for example increase the price more than would be optimal under profit maximization in order to signal to EU consumers that a price increase is due to the tax increase of EU governments. A high EU import tariff on Russian gas could also trigger the counter-reaction to stop exporting Russian gas to Europe altogether which would bring about difficult challenges for some EU countries, including Germany. There would be indeed an additional problem for the Ukraine which would most likely no longer receive natural gas from Russia – except for the Donbas region and neighboring regions which are under full military control of Russia. Hence, the EU would be expected to deliver a large quantity of natural gas to Ukraine; at the same time, the rules of the European Union would require that there is intra-

EU solidarity in the provision of natural gas. EU countries (mainly EU accession countries in Eastern Europe) facing particularly severe gas supply shortages would expect to get natural gas deliveries from, e.g., Germany, the Netherlands, Italy and other EU countries.

Finally, the analysis in this paper considers only cost differentials between pipeline and LNG gas as determinants for the gas price. As is well known from the theory of exhaustible resources, prices also include a scarcity rent. In the case that a tax on one supplier would reduce the world supply of gas, this may have additional effect on the gas price.

References

Bachmann, R. et al. (2022), What if? The Economic Effects for Germany of a Stop of Energy Imports from Russia (study in German), ECONtribute Policy Brief No. 028, online: https://www.econtribute.de/RePEc/ajk/ajkpbs/ECONtribute_PB_028_2022.pdf (last accessed 30.03.2022).

Baqaee, D. et al. (2022), The Economic Consequences of a Stop of Energy Imports from Russia, Paris: CAE.

Behringer, J., et al. (2022), Ukraine war hampers recovery after pandemic. Prognose der wirtschaftlichen Entwicklung 2022/23, IMK Report No. 174, March 2022, Düsseldorf: IMK, online: https://www.imk-boeckler.de/fpdf/HBS-008284/p_imk_report_174_2022.pdf (last accessed 04.04.2022).

BP (2021), Statistical Review of World Energy, London.

Corbeau, A.S.; Yermakov, V. (2016), Will There Be a Price War Between Russian Pipeline Gas and US LNG in Europe?, King Abdullah Petroleum Studies and Research Center (KAPSARC Publications), July 2016, https://www.kapsarc.org/wp-content/uploads/2016/07/KS-1643-DP037A-Will-There-be-a-Price-War-Between-Russian-Pipeline-Gas-and-US-LNG-in-Europe.pdf (last accessed 02.05.22).

European Commission (2022), In focus: Reducing the EU's dependence on imported fossil fuels, European Commission, 20th April 2022, Brussels https://ec.europa.eu/info/news/focus-reducing-eus-dependence-imported-fossil-fuels-2022-apr-20_en (last accessed 25.04.22).

Gros, D. (2002), Optimal Tariff Versus Optimal Sanction, The case of European gas imports from Russia, CEPS Policy Insights, No. 2022-12, Brussels https://www.ceps.eu/ceps-publications/optimal-tariff-versus-optimal-sanction/ (last accessed 02.05.22).

Hausmann, R. (2002), The Case for a Punitive Tax on Russian Oil, Project Syndicate, dated Feb. 26th, 2022 https://www.project-syndicate.org/commentary/case-for-punitive-tax-on-russian-oil-by-ricardo-hausmann-2022-02 (last accessed 13.04.22).

IMF (2022), World Economic Outlook. War Sets Back the Global Recovery, April 2022, https://www.imf.org/en/Publications/WEO/Issues/2022/04/19/world-economic-outlook-april-2022 (last accessed 03.05.22).

Leopoldina/National Academy of Sciences (2022), How Russian natural gas can be replaced in German and European energy supply, Ad Hoc Statement, 08.03.2022, Halle, online: https://www.leopoldina.org/publikationen/detailansicht/publication/wie-sich-russisches-erdgas-in-der-deutschen-und-europaeischen-energieversorgung-ersetzen-laesst-2022/ (last accessed 30.03.2022).

Varahrami, V.; Saeed Haghighat, M. (2018), The assessment of liquefied natural gas (LNG) demand reversibility in selected OECD countries, *Energy Reports*, Volume 4, November 2018, 370-375 https://doi.org/10.1016/j.egyr.2018.05.006 .

Wocher, M.; Rosenberger, J. (2022), Renovierung nötig: Das doppelte Energieproblem in deutschen Wohnungen [PJJW trans: Renovations required: The double energy problem in German properites], Handelsblatt, 27th April 2022, https://www.handelsblatt.com/infografiken/grafik/infografik-renovierung-noetig-das-doppelte-energieproblem-in-deutschen-wohnungen/28279092.html (last accessed 29.04.22)

Yermakov, V.; Kirova, D. (2017), Gas and Taxes: The Impact of Russia's Tinkering with Upstream Gas Taxes on State Revenues and Decline Rates of Legacy Gas Fields, Energy Insight 20, The Oxford Institute for Energy Studies, October 2017, https://www.jstor.org/stable/resrep33915 .

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