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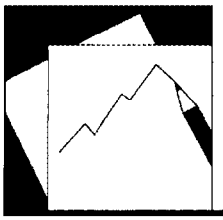

IMF Working Paper

Imperfect Competition and the Design of VAT Regimes: The Case of Energy Trade Between Russia and Ukraine

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Imperfect Competition and the Design of VAT Regimes: The Case of Energy Trade Between Russia and Ukraine [1]

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Abstract

Under imperfect competition, Russia and Ukraine may choose to deviate from optimal tax considerations which suggest use of a destination-based VAT regime. Oil and gas trade is a major source of Russian tax revenue, which is collected partly through an origin-based VAT on intra-CIS energy trade. The paper shows that Ukraine may try to capture part of the tax revenue if it has monopsony power. It is far from clear whether Ukraine would succeed in shifting the rents through taxation, since this depends on the form of imperfect competition and the curvature of Ukraine's import demand function.

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I. INTRODUCTION

Russia is one of the world's largest energy producers and the largest producer in the Commonwealth of Independent States (CIS).[2] Russia benefits from the application of value-added tax (VAT) on oil and gas exports to other CIS countries based on the origin principle.[3] Much of Russia's energy exports within the CIS are purchased by Ukraine. While oil and gas imports from Russia are exempt from Ukrainian VAT, Ukraine does not provide a VAT credit to importers who have paid Russian VAT, and as explained below, these imports are effectively taxed twice. Although the Ukrainian authorities apparently believe they have benefited from this double taxation through rent-shifting, it is not obvious that this is the case. The analysis for natural gas trade is complicated by the presence of market power on the selling (and perhaps the buying) side, and by the likelihood of collusion between the Russian government and gas monopolist Gazprom. This paper analyzes whether Ukraine is likely to have benefited from the current regime of double taxation and what would be the likely economic effect of moving to a destination basis for VAT on energy trade between Russia and Ukraine.

Following the breakup of the Soviet Union, Russia adopted a VAT based on the destination principle for trade with non-CIS countries and the origin principle for trade with CIS countries. The other countries in the CIS generally followed Russia's lead by applying the destination principle for trade with non-CIS countries and the origin principle for trade with CIS countries, although there were exceptions.[4] The IMF staff advised the CIS countries to use the destination

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[2] The CIS is an economic alliance of 12 of the former Soviet republics—Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, the Kyrgyz Republic, Moldova, Russia, Tajikistan, Turkmenistan, Ukraine, and Uzbekistan.

[3] Although definitions vary, under the origin principle as defined in this paper, VAT is applied to domestic production irrespective of destination, so that imports are exempt, credit is given for VAT paid in the exporting country based on the importing country's VAT rate, and VAT is paid on exports. Under the destination principle, VAT is applied to domestic consumption irrespective of origin, so that imports are subject to VAT while exports are "zero rated." Zero rating means that export sales are not taxed while credit is given for VAT paid on inputs. The credit reduces the firm's liability for payment of VAT. An exporter who has paid VAT on its inputs but whose sales are zero rated should receive a refund equal to the tax paid on its inputs. See Chapter 1 of Ebrill et al. (2001) for an introduction to the VAT.

[4] Baer et al. (1996) describes this hybrid system and its exceptions.

basis for VAT[5] to avoid production distortions[6] and consistent with international best practice. Russia (and many other CIS countries) moved to a destination basis for VAT on trade with other CIS countries on July 1, 2001, with the notable exception of energy products.

While it would be preferable for the CIS countries as a whole to employ the destination principle for energy products, there may be incentives for noncooperation by individual CIS countries which would need to be overcome to reach this cooperative solution. The paper considers whether it may be in Russia's interest (though not the region's) to maintain the origin principle for energy exports to other CIS countries to retain pure profits (or rents) and, in turn, whether Ukraine might succeed in capturing some of these rents through taxation. A number of possible combinations will be considered, as summarized in the following matrix:

Table 1. Alternative VAT Regimes on Energy Trade within the CIS

		Russia	
		Origin	*Destination*
Ukraine	*Origin*	I	II
	Destination	III	IV

Source: IMF staff.

Russia and Ukraine are currently in region III.[7] This corresponds to a situation of double taxation of energy trade which is inferior to region IV from a regional standpoint. While region I is also a possible outcome, even if the Ukrainian government were willing to forgo VAT revenue from Russian energy exports, application of the origin principle to energy trade

[5] Baer et al. (1996) discusses why use of the destination principle would be desirable for the CIS countries. It also explains that the large literature on the conditions under which origin and destination principles are equivalent (which includes notably Berglas (1981), Genser (1996), Grossman (1980), Keen and Lahiri (1998), Lockwood et al. (1994), and Whalley (1979)) have limited applicability to the CIS countries. Chapter 17 of Ebrill et al. (2001) considers more generally the merits of destination-based versus origin-based VAT regimes.

[6] Keen and Wildasin (2000) consider the desirability of production efficiency for the attainment of Pareto-efficient international tax regimes in the presence of national budget constraints. Production efficiency is nevertheless desirable in the presence of national budget constraints under certain conditions related to the availability of explicit or implicit devices for reallocating tax revenue across countries.

[7] See the discussion in Section II below.

combined with use of the destination principle for all other trade would result in an efficiency loss due to production distortions. Similarly, an outcome in region II is unlikely since both Russia and Ukraine would need to forgo tax receipts related to energy trade and, in addition, this regime would be inefficient compared to region IV.

The paper is organized as follows. Section II provides some information concerning the structure of energy trade between Russia and Ukraine as well as the tax regimes on such trade. Section III briefly considers the effect of moving from origin to destination based VAT for the oil sector. Section IV analyzes this change for the gas sector under a number of imperfectly competitive market structures. Finally, Section V offers some conclusions.

II. Structure of Energy Trade and Taxes

Russia produces about 80 percent of the region's crude oil and natural gas and accounts for a similar share of total net exports from the region.[8] The majority of Russia's exports of oil and gas are supplied to countries outside the CIS and Baltics (see Tables 2 and 3). Ukraine is broadly self-sufficient in coal and electricity but produces only around one quarter of its domestic consumption of crude petroleum and natural gas and imports the rest (Tables 4 and 5). Ukraine was the largest buyer of Russian gas within the CIS and Baltic countries in 2000, the second largest buyer of crude oil (behind Lithuania), and the third largest buyer of refined products (behind Estonia and Latvia).[9] In 2000, Turkmenistan also supplied about a third of Ukraine's total gas imports.

As noted above, effective July 1, 2001, Russia adopted the destination principle for VAT on nonenergy trade with CIS countries, except for Belarus, to which all exports are considered as domestic sales. VAT on all trade with non-CIS countries was already based on the destination principle. The VAT rate is 20 percent. Its VAT on energy products is based on the origin principle and Russia accordingly levies VAT on their energy exports to other CIS countries. Russia also levies excises on natural gas and export tariffs (mostly linked to world oil prices) on crude oil and oil products. The excise rates on natural gas are 15 percent for gas sold to other CIS countries and 30 percent for gas sold outside the CIS.

Ukraine's applies VAT to trade based on the destination principle. The VAT rate is 20 percent. Imports of crude oil, natural gas, and condensate gas from Russia and Turkmenistan are VAT exempt. Ukraine does not provide a credit for Russian VAT to oil and gas importers. Russian oil

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[8] Dodsworth et al. (2002) discusses the role of Russia and Ukraine in the energy markets of the CIS countries at greater length.

[9] According to data provided by the Russian authorities, Russia exported to Ukraine 39.7 billion cubic meters of gas, 4.0 million tons of crude oil, and 2.1 million tons of oil products, in 2000. There are, however, problems of comparability between these figures, the Ukrainian official statistics, and the oil and gas balances in Tables 2 and 3.

and gas exports to Ukraine are first subject to Russian VAT and then to Ukrainian VAT on sales of goods produced using the oil and gas. This is equivalent to the regime depicted in region III in Table 1.[10] Ukraine is also an important transit route for Russian oil and especially gas exports to western Europe; Ukraine collects a transit fee for such shipments.[11] Refined petroleum products (including imports from Russia and other CIS countries) are subject to specific excise taxes.

III. Russian Oil Exports to Ukraine

The Russian oil industry has been mostly privatized and is amenable to a standard demand/supply analysis based on perfect competition. Since Russia currently applies VAT based on the origin principle and Ukraine effectively applies VAT based on the destination principle, moving from region III to region IV would involve, inter alia, the elimination of Russia's VAT on oil exports to Ukraine, which acts as an export tax.[12] This would shift the Russian export supply curve down and to the right along an unchanged Ukrainian import demand curve, leading to an increase in export volume, an increase in the price net of Russian VAT received by Russian oil producers, and a decrease in price inclusive of the Russian VAT paid by Ukrainian importers. The Russian treasury would lose VAT revenue from oil exports, while Ukrainian VAT revenue would be unchanged since Ukraine already applies VAT to goods produced using Russian oil imports but does not provide a Russian VAT credit to its importers.[13]

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[10] For example, under the current system, a Ukrainian firm selling $100 of steel produced using $10 of imported Russian oil would (assuming for simplicity no other material inputs) pay $20 in VAT. Alternatively, if Ukrainian VAT were applied to imported Russian oil based on the destination principle, the oil importer would pay $2 in VAT and the steel firm would pay $18 in VAT ($20 on its sales less a credit for $2 of tax charged on its inputs).

[11] In fact, 90 percent of Russia's gas shipments to western Europe are shipped by pipeline through Ukraine. About half of Russian gas exports to Ukraine in 2000 (after losses and amounts used for pumping) were supplied as an in-kind transit fee whose value is based on a negotiated accounting price. While it is unclear how Russia assesses the value of such exports for VAT purposes, if it is based on the negotiated accounting price, this may provide another venue for bargaining over the distribution of rents.

[12] If Russia has market power, it could simply replace the VAT on oil exports with an export tax, notwithstanding concerns regarding the intensification of trade protection. For an exporter, the combination of a consumption tax (e.g., VAT on a destination basis) and an export tax is equivalent to a production tax (e.g., VAT on an origin basis).

[13] If Ukraine has monopsony power, it could try to raise the VAT rate applied to Russian oil on a destination basis to capture some of the benefits that would otherwise go to Russia. Alternatively, Ukraine could attempt to capture some of the rents through excises rather than

IV. Russian Gas Exports to Ukraine

A perfectly competitive model is inappropriate for the Russian gas market. Gazprom controls some 90 percent of gas production in Russia, 80 percent of reserves, the gas transportation network, and has monopoly rights to export gas outside the CIS. Moreover, the Russian government maintains significant control over Gazprom through its ownership of nearly 40 percent of Gazprom's shares and majority representation on its board of directors, suggesting the likelihood of collusion between the Russian government and Gazprom.[14]

If the Russian government and Gazprom were to collude, in the sense that they jointly chose the export tax rate and the export price to maximize the sum of tax revenue and profits, then the two parties would simply maximize pre-tax profits. Collecting tax revenue from an export tax would be equivalent to setting a higher tax-inclusive export price. Elimination of Russia's destination-based VAT on gas exports would in this case have no effect on Russia's tax-inclusive export supply function since the tax reduction would be exactly offset by a higher Gazprom profits. (If the Russian government and Gazprom were to act independently, higher equilibrium output and a lower equilibrium price would result, compared to the collusive case, as described in the Appendix.)

The remainder of this section considers the case of Russia exporting natural gas to Ukraine under the assumption that Russia is a monopoly supplier but Ukraine has monopsony power.[15] Three equilibria are analyzed below.[16] First, Ukraine is assumed to take Russia's choice of export price as given and Russia is assumed to take Ukraine's choice of import tax as given, leading to a Nash equilibrium. Alternatively, two Stackelberg equilibria will be considered, first with Ukraine assumed to be the leader, and then with Russia assumed to be the leader.

VAT. The implications of possible Ukrainian monopsony power will be explored in the models developed for the gas market below.

[14] See Dodsworth et al. (2002) for further discussion of market structure and state involvement in the energy sector of the CIS countries.

[15] Since Russia is not Ukraine's only supplier of natural gas and Ukraine is not Russia's only buyer, the actual market structure lies somewhere in between the pure monopoly/monopsony and pure competition cases. In this connection, if markets are segmented, there is no reason why Russia's export price to Ukraine need be equal to its export price to other destinations such as western Europe; Russia would simply choose the profit-maximizing point on the demand curve in each segmented market.

[16] Another complication would arise from the possibility of ex post renegotiation. Russia could set its notional price but then Ukraine could change the effective price through nonpayments. Under rational expectations, Russia could simply set the notional price given Ukraine's expected nonpayments rate to achieve its desired effective price.

A. Nash equilibrium

Ukraine is assumed to maximize its indirect utility function,[17] V(Q, R), which depends on the consumer price of gas in Ukraine, Q, and tax revenue, R, by choosing the tax rate, T:

(1) $V(Q, R) = V[P+T, T\,D(P+T)]$

where P is Russia's export price and D(Q) is Ukraine's demand for gas. (Ukraine takes P as given in the Nash equilibrium.) The first-order condition is as follows:

(2) $V_Q + V_R\,(D + T\,D') = 0$

where $V_Q = \partial V/\partial Q$, $V_R = \partial V/\partial R$, and $D' = dD/dQ$. If it is assumed that revenue R is redistributed in a lump sum,[18] then V_R is the marginal utility of income, and Roy's identity implies

(3) $V_Q + V_R\,D = 0,$
which in turn implies $T^* = 0$ for $D' < 0$.[19]

Russia, on the other hand, chooses the export price P to maximize profits:

(4) $\Pi = P\,D(P+T) - C[D(P+T)]$

where C(D) is the cost function. The first-order condition is as follows:

(5) $P + D/D' = C'$

$P - Q\,(1/\varepsilon) = C'$

$P\,(1 - 1/\varepsilon) = C'$ (evaluated at $T^* = 0$)

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[17] See Varian (1992).

[18] The critical assumption here is that revenue is returned as a lump sum to the consumer, so that the marginal utility of tax revenue is equal to the marginal utility of private income. One could alternatively imagine that the government can use only distortionary taxes, in which case the marginal utility of revenue would exceed that of private income and the optimal tax would be positive (related to the elasticity of demand).

[19] More simply, the indirect utility function maximizes (direct) utility subject to the following budget constraint: $(P + T)\,D + Q_2\,D_2 = Y + T\,D$ (where $Q_2\,D_2$ is expenditure on other goods and Y is factor income). This tax-inclusive budget constraint is identical to the budget constraint without the tax: $P\,D + Q_2\,D_2 = Y$.

where $\varepsilon \equiv - D' Q/D > 0$ is the elasticity of Ukraine's demand function.

B. Ukraine as Stackelberg leader

In this case, Russia is assumed to choose the export price P to maximize profits but now Ukraine recognizes that the export price will change—through Russia's first-order condition—as it changes the tax T. Ukraine's optimization problem acknowledges that Russia's optimal choice of export price is a function P(T) of Ukraine's import tax. Accordingly, Ukraine chooses T to maximize $V\{P(T)+T, T\, D[P(T)+T]\}$. The first-order condition is as follows:

(6) $\quad V_Q (P'+1) + V_R [D + T D' (P'+1)] = 0$

If it is assumed that revenue R is redistributed in a lump sum then, following equation (3), Roy's identity implies:

(7) $\quad T = D P' / D' (P'+1)$

$$T/Q = (-1/\varepsilon) [P'/(P'+1)]$$

where again ε is the elasticity of Ukraine's demand function. So $T^* > 0$ if, as might be expected, $-1 < P' < 0$. However, with imperfect competition, it is not obvious that (in particular) $P' < 0$.

To investigate the conditions under which $P' < 0$, let

(8) $\quad Z(P, T) \equiv D(P+T) + P\, D'(P+T) - C'[D(P+T)]\, D'(P+T)$

Russia's first-order condition, equation (5), is $d\Pi /dP = Z(P, T) = 0$. By the implicit function theorem:[20]

(9) $\quad P' = - Z_T/Z_P$

The second-order condition for profit maximization is $d^2\Pi /dP^2 = Z_P < 0$. Now, from (8):

(10) $\quad Z_P = 2D' + (P - C')\, D''$ $\quad$ (assume $C'' = 0$ for simplicity)

$$= 2D' - (D\, D''/D') \quad \text{(from (5))}$$

$$= D' [2 + (E/\varepsilon)] \quad \text{where } E \equiv D''\, Q/D' \text{ is the elasticity of the slope of demand}$$

Hence the second-order condition is satisfied if

(11) $\quad 2+(E/\varepsilon) > 0.$

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[20] See Varian (1992).

Now, differentiating (8) yields:

(12) $Z_T = D' + (P - C') D''$ (assuming for simplicity that $C'' = 0$)

$= D' [1 + (E/\varepsilon)]$ (following the argument in (10))

From (9), (10), and second-order condition (11), it follows that:

(13) $P' < 0$ iff $Z_T < 0$ iff $1 + (E/\varepsilon) > 0$

where the latter equivalence follows from (12).

In particular, $P' < 0$ is not implied by the second-order condition. From (10) and (12):

(14) $1 + P' = 1 + (- Z_T/Z_P)$

$= 1 / [2 + (E/\varepsilon)] > 0$ (by the second-order condition (11))

From (7), (13), and (14), it follows that $T^* > 0$ iff $1 + (E/\varepsilon) > 0$. If Ukraine is a Stackelberg leader, the sign of Ukraine's optimal tax rate is ambiguous and depends on the elasticity of the slope of its demand curve.

For a linear demand function, $E = 0$ and $T^* > 0$. For a constant elasticity demand function, $D = A Q^{-\varepsilon}$, $T^* < 0$ (implying an import subsidy), since:

$1 + (E/\varepsilon) = 1 - [(1 + \varepsilon)/\varepsilon] = - 1/\varepsilon < 0$, and so $T^* < 0$

C. Russia as Stackelberg leader

In this case, Russia would choose its export price P to maximize profits given T(P). Ukraine would choose its tax rate T to maximize indirect utility taking P as given:

$V(Q, R) = V[P+T, T D(P+T)]$

The first-order condition is as follows:

$V_Q + V_R (D + T D') = 0$

This case is straightforward since it follows the analysis of the Nash equilibrium and, in particular, equations (2) and (3) above; Ukraine will set T equal to zero for any P.

Russia will maximize profits based on $T(P) = 0$. Following the analysis in equation (5) above, Russia will charge an export price equal to a markup over marginal cost:

$P (1 - 1/\varepsilon) = C'$

Whether Russia or Ukraine would choose to be a leader or a follower would depend on which would be more profitable or lead to a higher level of indirect utility, respectively.

V. Conclusions

This paper has examined what would be the effect on Russian tax revenue, Gazprom's profits, and Ukraine's tax revenue and economic welfare, if the current hybrid VAT regime were replaced by a destination-based VAT. Under the current regime, there is double taxation of energy trade which suggests that Russia and Ukraine are competing over the revenue. This sort of noncooperative behavior may have impeded the establishment of an efficient VAT regime based on the destination principle. The paper analyzes the oil and gas markets separately since the latter is characterized by imperfect competition.

Starting with the market for oil, under the assumption of perfect competition, moving from an origin to a destination basis for application of the VAT to Russian oil exports to Ukraine would increase the price (net of tax) to Russian producers, reduce the price (inclusive of tax) paid by Ukrainian buyers, and increase oil export volume. This stems from the fact that Ukraine does not provide a credit for Russian VAT to oil importers, so the origin-based VAT acts effectively as an export tax. Removal of the Russian origin-based VAT would therefore raise the net return to producers and reduce the cost to Ukrainian buyers, lower Russian tax receipts and leave Ukrainian VAT revenues unchanged (VAT is already collected on goods produced using imported oil).

The Russian gas market is dominated by a single firm, Gazprom, which is subject to significant control by the Russian government. If the Russian government and Gazprom were to act jointly to maximize profits plus tax revenues, they would charge an export price based on a markup over marginal cost, with the markup being determined by the elasticity of Ukraine's demand for gas. In this case, replacement of the current origin basis for VAT on energy trade with a destination-based VAT would have no effect on imported energy prices or Ukrainian VAT collections. Elimination of Russian VAT on energy exports would induce an increase in the export price just sufficient to leave Ukrainian import prices unchanged. If, on the other hand, the Russian government and Gazprom were to act independently, eliminating the origin-based VAT on gas exports to Ukraine would in general affect the volume and price of such exports but the direction of change is ambiguous (it depends on the second derivative—or curvature—of Ukraine's import demand function).

If Ukraine had monopsony power in its gas purchases from Russia, Ukraine might attempt to capture some of the rents associated with Russian gas imports through taxation. As shown in the paper, whether or not Ukraine would benefit from applying a tax on Russian gas depends on the form of imperfect competition and model parameters. For the cases of Nash equilibrium and Russia as a Stackelberg leader, it would be optimal for Ukraine to set a tax rate of zero. For the case of Ukraine as a Stackelberg leader, whether it would be optimal for Ukraine to impose an import tax depends on demand parameters and, in particular, on the second derivative of Ukraine's demand for gas. Over a certain range of parameter values (including for example a linear demand function), Ukraine would be able to induce Russia to lower its export price by

imposing its own import tax. In other cases, either Ukraine would be unable to influence Russia's choice of export price or it might even be optimal for Ukraine to subsidize imported gas (e.g., with a constant elasticity demand function). The conclusion from this analysis is that it is unclear whether imposing import tax on Russian gas would be welfare-enhancing for Ukraine.

Table 2. Oil Balance for the Russian Federation, 1990-2000 1/
(in millions of metric tons)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Crude Oil Production	516.2	461.1	395.8	343.8	315.7	306.7	301.2	305.6	303.2	305.0	323.2
Refinery Throughput	295.5	286.5	257.2	220.1	180.6	179.0	173.8	176.3	162.9	170.1	174.1
Direct Use of Crude/Residual 2/	10.5	18.8	7.6	6.6	12.9	12.3	6.3	8.6	9.6	5.9	10.9
Refinded Products Consumption	250.6	228.7	216.5	176.6	138.7	137.9	121.2	121.6	113.3	120.3	112.6
Oil Exports											
Crude Oil	219.9	173.9	141.7	127.6	126.8	122.3	125.6	126.8	137.1	134.5	144.5
CIS and Baltic Countries	120.6	117.4	75.5	47.8	37.8	31.0	22.6	21.3	25.2	22.2	21.2
Other Countries	99.3	56.5	66.2	79.8	89.0	91.3	103.0	105.6	111.9	112.3	123.4
Refined Products	50.7	63.6	43.0	44.8	43.4	45.4	56.6	60.6	53.8	50.8	61.9
CIS and Baltic Countries	12.8	22.0	17.6	10.5	5.4	3.3	1.6	2.2	2.6	3.0	3.5
Other Countries	37.9	41.6	25.3	34.3	38.0	42.1	55.0	58.4	51.2	47.8	58.4
Oil Imports											
Crude Oil	18.8	18.1	10.7	10.5	4.6	6.9	4.5	6.1	6.4	5.6	6.3
CIS and Baltic Countries	18.8	18.1	10.7	10.5	4.6	6.9	4.5	6.1	6.4	5.6	6.3
Other Countries	--	--	--	--	--	--	--	--	--	--	--
Refined Products	5.8	5.8	2.3	1.3	1.5	4.3	4.0	5.9	4.1	0.9	0.4
CIS and Baltic Countries	5.6	5.1	1.4	1.1	1.1	2.9	2.3	2.3	1.8	0.5	0.3
Other Countries	0.2	0.7	0.9	0.2	0.4	1.4	1.8	3.5	2.4	0.4	0.1

Source: PlanEcon.

Notes:
1/ Crude Oil Production - Oil Exports + Oil Imports = Refinery Throughput + Direct Use of Crude/ Residual Refined Products Consumption
= Refinery Throughput + Direct Use of Crude/Residual
2/ Balancing item.

Table 3. Gas Balance for the Russian Federation, 1990-2000

(in billions of cubic meters)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Gas Production	640.6	642.9	640.4	617.6	606.8	595.4	601.5	571.1	591.0	590.7	584.2
Gas Consumption (total apparent)	460.7	468.7	454.7	453.2	424.4	408.4	409.5	377.5	390.8	389.8	404.4
Deliveries	404.0	409.0	395.3	382.1	348.0	339.0	336.8	330.0	331.6	339.9	347.1
Pipeline use/changes in storage 1/	56.7	59.7	59.4	71.1	76.4	69.4	72.7	47.5	59.2	49.9	57.3
Pipeline use and losses (reported)	63.6	63.5	59.6	57.1	56.3	54.2	56.3	47.7	53.0	53.0	51.0
Change in storage (residual)	-6.9	-3.8	-0.2	14.0	20.1	15.2	16.4	-0.2	6.2	-3.1	6.3
Gas Exports	249.7	173.0	195.3	171.0	184.4	190.6	196.5	198.4	202.5	204.5	217.1
CIS and Baltic Countries	153.2	83.0	106.4	78.3	78.6	73.2	73.0	81.7	82.0	77.7	88.1
Other Countries	96.5	90.0	88.9	92.7	105.8	117.4	123.5	116.7	120.5	126.8	129.0
Gas Imports	70.1	13.8	7.0	6.6	2.0	3.6	4.5	4.9	2.3	3.6	37.3
CIS and Baltic Countries	70.1	13.8	7.0	6.6	2.0	3.6	4.5	4.9	2.3	3.6	37.3
Other Countries	--	--	--	--	--	--	--	--	--	--	--

Source: PlanEcon.

Note:
1/ Balancing item.

Table 4. Production of Major Energy Products by Ukraine, 1997-2001

						In percent of domestic consumption				
	1997	1998	1999	2000	2001 1/	1997	1998	1999	2000	2001
Crude petroleum (in millions of tons including gas condensate)	4.1	3.9	3.8	3.7	3.7	31.1	28.5	28.6	39.4	21.9
Natural gas (in billions of cubic meters)	18.1	18.0	18.1	17.9	18.2	24.3	25.3	25.3	26.2	28.4
Coal (in millions of tons)	58.6	59.5	62.8	62.4	61.6	92.9	97.3	98.9	98.3	95.8
Electricity (in billions of kilowatts)	178.0	172.8	172.1	171.4	172.0	100.1	100.4	102.1	102.3	...

Source: Ukrainian State Statistics Committee.

Note:
1/ Preliminary data.

Table 5. Values and Volumes of Energy Imports of Ukraine, 1995-2001 1/
(Value in millions of U.S. dollars; other units as indicated)

	1995	1996	1997	1998	1999	2000	2001
Crude oil	1,330	975	1,012	1,055	884	1,091	2,105
Volume (in millions of tons)	13.3	9.2	9.0	9.9	9.4	6.0	13.3
Unit price (in U.S. dollars per ton)	100.0	106.0	112.8	106.7	94.1	182.2	158.5
Oil products	1,832	1,109	1,201	802	816	1,270	501
Volume (in millions of tons)	9.5	6.9	6.2	4.7	4.0	4.6	2.1
Unit price (in U.S. dollars per ton)	192.7	161.5	194.5	169.6	206.5	275.0	243.6
Gas	3,569	5,696	4,988	3,524	3,256	3,324	3,288
Volume (in billions of cubic meters)	64.4	71.2	62.4	53.5	59.9	59.2	56.9
Unit price (in U.S. dollars per 1,000 cubic meters)	55.4	80.0	80.0	65.8	54.3	56.1	57.7

Sources: State Statistics Committee of Ukraine; National Bank of Ukraine; and IMF staff estimates.

Note:
1/ Excludes exports of coal.

What if the Russian Government and Gazprom Act Independently?

If the Russian government and Gazprom are assumed to act independently, then Gazprom would maximize after-tax profits Π^* by choosing the net-of-tax export price P^*:

$$(A.1) \quad \Pi^* = P\,D(Q) - C[D(Q)] - S\,D(Q) = P^*\,D(P^*+S+T) - C[D(P^*+S+T)]$$

Comparing this expression with the Russian profit function in the case where the government and Gazprom are assumed to collude, shown in equation (4), in the absence of collusion, Gazprom's profits are lower by the amount of the tax paid to the Russian government. Here, P is the Russian export price including the Russian tax, Q is the price paid by Ukrainian consumers for Russian gas, D(Q) is Ukrainian demand for Russian gas, $C(\cdot)$ is the Russian cost function, S is the Russian export tax, and T is the Ukrainian import tax. It follows from these definitions that $Q = P + T = P^* + S + T$. The first-order condition is as follows:

$$(A.2) \quad P^* + D/D' = C'$$

which differs from equation (5) only by the presence of P^* instead of P.

The monopolist maximizes profit by increasing the level of output to the point where marginal revenue is equal to marginal cost. In this case (no collusion), the monopolist's marginal revenue function, MR^*, is as follows:

$$MR^*(P^*, S, T) = D(P^*+S+T) + P^*\,D'(P^*+S+T)$$

The marginal revenue function in the case of collusion, MR, is as follows:

$$MR(P^*, S, T) = D(P^*+S+T) + (P^*+S)\,D'(P^*+S+T)$$

Comparing MR^* with MR, it is apparent that $MR \leq MR^*$ with strict inequality if $S>0$ and $D'<0$. This implies, not surprisingly, that the profit-maximizing output choice in the case of collusion would be lower, and the export price would be higher, than in the case where the Russian government and Gazprom are assumed not collude.

The effect of a change in the Russian tax rate S on equilibrium output and prices depends on the second derivative of Ukraine's demand function:

$$\partial MR^*(P, S, T)/\partial S = D'(P^*+S+T) + P^*\,D''(P^*+S+T)$$

While the elimination of the Russian VAT on gas exports to Ukraine may influence the equilibrium price and quantity in the noncollusive case, in contrast to the collusive case, the direction of the changes is ambiguous.

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