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VAT Design and Energy Trade: The Case of Russia and Ukraine

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Given the substantial rents involved in oil and gas trade and the incentives for noncooperative behavior, Russia and Ukraine have chosen to deviate from standard tax considerations, which suggest the use of a destination-based value-added tax (VAT) regime. Oil and gas trade is a major source of Russian tax revenue, which is collected partly through an origin-based VAT on energy trade within the Commonwealth of Independent States. This paper shows that, if nondistorting taxes were unavailable, Ukraine would benefit by taxing away the pure profits of the domestic seller of natural gas imports from Russia. The paper also assesses the circumstances under which Ukraine would benefit from simultaneously providing a credit for Russian VAT payments by importers. [JEL F12, H21, Q43]

Russia is one of the world's largest energy producers and the largest producer in the Commonwealth of Independent States (CIS).[1] It benefits from the application of value-added tax (VAT) on oil and gas exports to other CIS countries based on the origin principle. Much of Russia's energy exports within the CIS are purchased by Ukraine. While oil and gas imports from Russia are exempt from

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[1]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.

Ukrainian VAT, Ukraine does not provide a VAT credit to importers who have paid Russian VAT; thus, these imports are effectively taxed twice.[2]

Although the Ukrainian authorities apparently believe that 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 both the selling and buying sides. This paper analyzes whether Ukraine has benefited from the current regime of double taxation and explores the likely economic effect of moving to a destination basis for VAT on energy trade between Russia and Ukraine. Although the paper focuses on Russia and Ukraine, the topic is of broader interest, as VAT regimes often must be designed in a regional context.

Following the breakup of the Soviet Union, Russia adopted a VAT based on the destination principle for trade with non-CIS countries and on 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.[3] The IMF staff advised the CIS countries to use the destination basis for VAT[4] to avoid production distortions[5] and for consistency 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 use the destination principle for energy products, certain incentives for noncooperation by individual CIS countries would have to be overcome to reach this cooperative solution. Given that Russia has chosen to maintain the origin principle for its VAT on energy trade with other CIS countries, this paper considers whether it is in Ukraine's interest to maintain its present system of double taxation of energy imports from Russia. It also considers the effect on export prices and quantities and national tax revenues if Russia were to move fully to a destination basis. A number of combinations of VAT regimes are possible, as shown in the matrix in Table 1.

Russia and Ukraine are currently in region III,[6] which leads to a double taxation of energy trade that is inferior to the situation in region IV. Region I is also a possible outcome, but even if the Ukrainian government were willing to forgo VAT revenue from Russian energy exports, application of the origin principle to energy

[2]The origin and destination principles for the VAT are explained in Box 1.

[3]Baer, Summers, and Sunley (1996) describe this hybrid system and its exceptions.

[4]Baer, Summers, and Sunley (1996) discuss why use of the destination principle would be desirable for the CIS countries. They explain that the literature on the conditions under which origin and destination principles are equivalent (which includes Whalley, 1979; Grossman, 1980; Berglas, 1981; Lockwood, de Meza, and Myles, 1994; Genser, 1996; and Keen and Lahiri, 1998) has limited applicability to the CIS countries. Chapter 17 of Ebrill and others (2001) considers more generally the merits of destination-based versus origin-based VAT regimes.

[5]Keen and Wildasin (2004) 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 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.

[6]See the discussion in Section I below.

Box 1. Origin and Destination Principles and the VAT

The two broad approaches to the application of the VAT are referred to as the *origin* and *destination* principles. Under the origin principle, the VAT is applied to sales of goods and services originating in the domestic market, regardless of whether they are sold at home or abroad. Under the destination principle, the VAT is applied to goods and services sold in the domestic market, regardless of whether they were produced at home or abroad.

Although definitions vary, under the origin principle as defined in this paper, VAT is applied to domestic production regardless 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. Using the VAT rate in the importing country to compute the credit given for VAT paid to the exporting country ensures that the value added in each country is taxed at the tax rate of that country.

Under the destination principle as defined in this paper, VAT is applied to domestic consumption regardless 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 and others (2001) for an introduction to the VAT.

The following example illustrates the equivalence of the current system of taxation for energy trade between Russia and Ukraine, and the regime in which Russia maintains its VAT on energy exports but Ukraine applies VAT to Russian imports consistent with the destination principle. Suppose a Ukrainian firm sells $100 of steel produced using $10 of imported Russian gas. The Ukrainian firm would (assuming, for simplicity, no other material inputs) pay $20 in VAT according to the current 20 percent Ukrainian VAT rate. Alternatively, if Ukrainian VAT were applied to imported Russian gas based on the destination principle, the gas importer would pay $2 in VAT (based on Russia's current 20 percent VAT rate) and the steel firm would pay $18 in VAT ($20 on its sales less a credit for $2 of tax charged on its inputs). No credit for Russian VAT is given under the present system, and none would be given based on the destination principle, since the latter system is based on taxation of imports. Section III considers whether Ukraine would benefit from providing a credit, possibly partial, for Russian VAT paid by Ukrainian gas importers.

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

		Russia	
		Origin	Destination
Ukraine	Origin	I	II
	Destination	III	IV

Source: See text.

trade combined with use of the destination principle for all other trade would result in an efficiency loss owing to production distortions. Similarly, an outcome in region II is unlikely, as both Russia and Ukraine would have to forgo tax receipts related to energy trade.

This paper provides information concerning the structure of energy trade between Russia and Ukraine, as well as the tax regimes on such trade and market structures in each country. It considers the effect of moving from origin- to destination-based VAT for the oil sector and analyzes Ukraine's optimal response if Russia were to maintain its origin-based regime for the natural gas sector, using a bilateral monopoly model. The paper shows that, given Russia's current VAT regime, Ukraine would benefit from taxing away the pure profits of its monopoly seller but might or might not benefit from providing a credit for Russian VAT paid on gas imports.

I. Energy Trade, Market Structure, 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.[7] The majority of Russia's exports of oil and gas are supplied to countries outside the CIS and the Baltics (see Tables 2 and 3). Ukraine is broadly self-sufficient in coal and electricity but produces only around one-fourth of its domestic consumption of crude petroleum and natural gas; it imports the rest (Tables 4 and 5). In 2000, Ukraine was the largest buyer of Russian gas within the CIS and Baltic countries, the second-largest buyer of crude oil (behind Lithuania), and the third-largest buyer of refined products (behind Estonia and Latvia).[8]

Much of the Russian oil industry is now in private hands following rapid privatization that led to the divestiture of majority stakes in all but two oil companies. With the notable exception of transportation, competition in these markets is generally robust. Oil-processing capacity is predominantly integrated with the larger extractive firms. Russia has considerable excess refining capacity, a situation that also prevails in a number of neighboring states. The Russian oil transportation system is overwhelmingly dominated by the state-owned enterprise Transneft. The administrative allocation of crude and refined oil exports in Russia drives a wedge between domestic and world export prices (see Dodsworth, Mathieu, and Shiells, 2002). Ukraine has six crude oil refineries, which are operating significantly below capacity. Until recently, Ukraine's refineries did not even receive enough crude oil to supply domestic demand.[9]

[7] Dodsworth, Mathieu, and Shiells (2002) discuss the role of Russia and Ukraine in the energy markets of the CIS countries at greater length.

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

[9] The increase in crude oil imports in 2001 shown in Table 5 appears to reflect Ukraine's success in securing sufficient crude oil imports for its refineries by offering oil exporters in Russia and Kazakhstan a stake in the country's refineries (see U.S. Department of Energy, 2003).

Table 2. Oil Balance for the Russian Federation, 1998–2000[1]

(Millions of metric tons)

	1998	1999	2000
Crude oil production	303.2	305.0	323.2
Refinery throughput	162.9	170.1	174.1
Direct use of crude/residual[2]	9.6	5.9	10.9
Refined products consumption	113.3	120.3	112.6
Oil exports			
Crude oil	137.1	134.5	144.5
CIS and Baltic countries	25.2	22.2	21.2
Other countries	111.9	112.3	123.4
Refined products	53.8	50.8	61.9
CIS and Baltic countries	2.6	3.0	3.5
Other countries	51.2	47.8	58.4
Oil imports			
Crude oil	6.4	5.6	6.3
CIS and Baltic countries	6.4	5.6	6.3
Other countries	——	——	——
Refined products	4.1	0.9	0.4
CIS and Baltic countries	1.8	0.5	0.3
Other countries	2.4	0.4	0.1

Source: PlanEcon.

[1] Crude oil production − oil exports + oil imports = refinery throughput + direct use of crude/residual

[2] Balancing item.

Table 3. Gas Balance for the Russian Federation, 1998–2000

(Billions of cubic meters)

	1998	1999	2000
Gas production	591.0	590.7	584.2
Gas consumption (total apparent)	390.8	389.8	404.4
Deliveries	331.6	339.9	347.1
Pipeline use/changes in storage[1]	59.2	49.9	57.3
Pipeline use and losses (reported)	53.0	53.0	51.0
Change in storage (residual)	6.2	−3.1	6.3
Gas exports	202.5	204.5	217.1
CIS and Baltic countries	82.0	77.7	88.1
Other countries	120.5	126.8	129.0
Gas imports	2.3	3.6	37.3
CIS and Baltic countries	2.3	3.6	37.3
Other countries	——	——	——

Source: PlanEcon.

[1] Balancing item.

Table 4. Production and Consumption of Major Energy Products by Ukraine, 1998–2001

	1998	1999	2000	2001
Production				
Crude petroleum (in millions of tons including gas condensate)	3.9	3.8	3.7	3.7
Natural gas (in billions of cubic meters)	17.3	17.3	17.2	17.6
Coal (in millions of tons)	59.5	62.8	62.4	61.7
Electricity (in billions of kilowatts)	172.8	172.1	171.4	173.0
Domestic consumption				
Crude petroleum (in millions of tons including gas condensate)	13.7	13.3	9.4	16.9
Natural gas (in billions of cubic meters)	71.1	71.5	68.4	65.8
Coal (in millions of tons)	60.8	63.0	63.3	64.2
Electricity (in billions of kilowatts)	142.1	138.5	136.4	135.8

Source: State Statistics Committee of Ukraine.

Table 5. Values and Volumes of Energy Imports of Ukraine, 1998–2001

(Value in millions of U.S. dollars; other units as indicated)

	1998	1999	2000	2001
Crude oil	1,055	884	1,091	2,105
Volume (in millions of tons)	9.9	9.4	6.0	13.3
Unit price (in U.S. dollars per ton)	106.5	94.1	181.8	158.5
Oil products	802	816	1,270	501
Volume (in millions of tons)	4.7	4.0	4.6	2.1
Unit price (in U.S. dollars per ton)	170.6	209.1	276.2	238.7
Natural gas	3,524	3,256	3,324	3,288
Volume (in billions of cubic meters)	53.5	59.9	59.2	56.9
Unit price (in U.S. dollars per 1,000 cubic meters)	65.9	54.4	56.1	57.8
Coal	371	207	262	288
Volume (in millions of tons)	8.4	5.0	6.6	6.6
Unit price (in U.S. dollars per ton)	44.2	41.4	39.7	43.6

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

In 2000, Ukraine imported about two-thirds of its gas from Russia, of which roughly half was taken as in-kind payment for use of Ukraine's transit pipelines to Europe. Ukraine provides the main transit route for Russian natural gas shipments to Europe, accounting for 90 percent of Russia's total natural gas exports to Europe. 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. Turkmenistan supplied about one-third of Ukraine's total gas imports in 2000 (more than half of which was paid in barter), and minor quantities were imported from Uzbekistan.

With some caveats, Russian gas exports to Ukraine can be described as a bilateral monopoly. Gazprom is close to holding a monopoly in the Russian gas market; it controls some 90 percent of gas production in Russia, 80 percent of reserves, and the gas transportation network, and it has monopoly rights to export gas outside the CIS. Gas exports from Russia to Ukraine are generally handled by Gazprom, and gas imports into Ukraine are generally handled by the government-owned company Naftogaz, which in turn produces gas domestically and sells most gas, both domestic and imported, to consumers in Ukraine, including industry, households, and government. Naftogaz is the largest delinquent taxpayer in Ukraine, owing to a variety of factors that include the following: (1) Naftogaz receives the fee for transit of Russian gas through Ukraine as an in-kind rather than monetary payment; (2) gas tariffs remain below cost-recovery levels; and (3) the state provides poor governance and insufficient oversight (see IMF, 2003, Chapter VI).[10]

The extent to which Russia-Ukraine gas trade can be characterized as a bilateral monopoly depends on the exact definition of this trade and the period under consideration. In 1998–1999, some of the imports from Russia (20 percent to 30 percent) bypassed Naftogaz and were sold directly to Ukrainian enterprises by Itera, a privately held company that has become an increasingly important player in Russian gas trade. In 2001, Itera supplied Turkmen gas directly to some Ukrainian enterprises, although in 2002 the Turkmen gas was sold in Ukraine through Naftogaz. The imports of Turkmen gas in 2000–2003 somewhat weakened the monopoly features of the Gazprom-Naftogaz trade, but only to a limited extent, in part because Russia controlled the transit of Turkmen gas on its territory. Naftogaz also produces gas domestically at a cost of $11 per thousand cubic meters (official estimate), which is well below the cost of imported gas (see IMF, 2003, Chapter VI, for further discussion).

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 domestic sales. VAT on all trade with non-CIS countries was already based on the destination principle, with a rate of 20 percent. Russia's VAT on energy products is based on the origin principle, and the country levies VAT on its energy exports to other CIS countries, perhaps as a way of enhancing government revenue.[11] 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.

[10] Other factors cited as accounting for the large budgetary arrears of Naftogaz include lags between the time when payments to the budget and external suppliers are due and when consumer payments are received, as well as the increase over time in the share of the transit fee to be transferred to the budget.

[11] Prices of oil and oil products have largely converged to world market prices, in contrast to natural gas and electricity prices, which remain well below Western European levels. In the case of gas, it can be argued that this situation involves an element of implicit subsidization, even after including Russian taxes on exports (see Dodsworth, Mathieu, and Shiells, 2002).

Ukraine applies VAT to trade based on the destination principle; the rate is 20 percent. Imports of crude oil, natural gas, and condensate gas from Russia and Turkmenistan are exempt. Ukraine does not provide a credit for Russian VAT to oil and gas importers. Russian oil 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.[12] The method Russia uses to assess the value of oil and, especially, gas exports supplied to Ukraine as an in-kind transit fee for VAT purposes is unclear. If it is based on the negotiated accounting price, this may provide another venue for bargaining over the distribution of rents. Refined petroleum products (including imports from Russia and other CIS countries) are subject to specific excise taxes.

II. Russian Oil Exports to Ukraine

The Russian oil industry has been largely privatized and is, broadly speaking, amenable to a standard demand-and-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.[13] This change 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 (see Figure 1). The Russian treasury would lose VAT revenue from oil exports. Ukrainian VAT revenue would also change in response to the increased volume of oil imports and a lower price of output, though the direction is ambiguous.

III. Russian Gas Exports to Ukraine

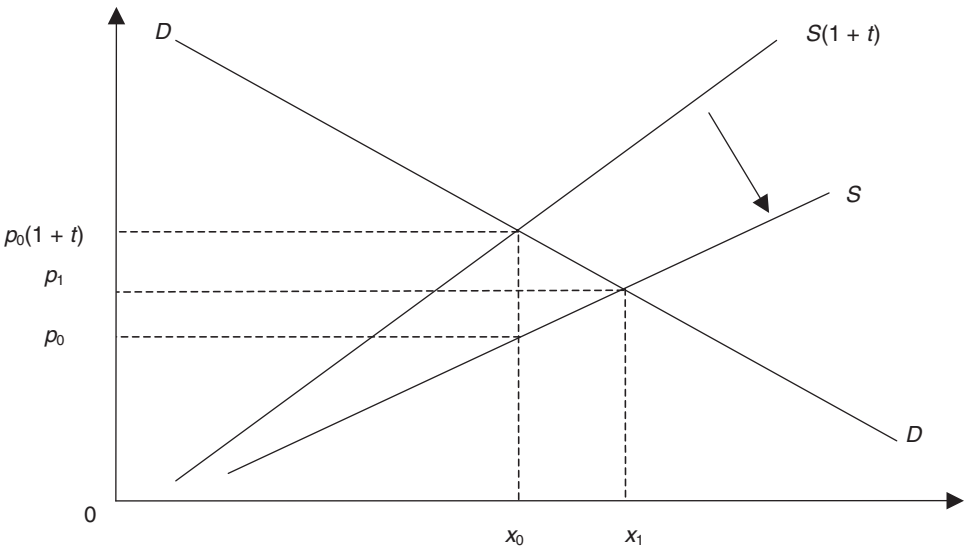
This section considers two questions. First, it briefly considers the effect if Russia were to move from an origin to a destination basis for its exports of gas to Ukraine. Second, assuming that Russia maintained its taxation of gas exports to Ukraine, the section considers Ukraine's optimal response. In particular, it considers whether Ukraine should eliminate its double taxation of gas imports (as described above) by providing a credit for Russian VAT paid by gas importers.

The first question is analytically more straightforward. In a standard monopoly model, if the Russian government were to drop its VAT on gas exports to Ukraine, either the Russian government would replace it with another tax (say, by raising the

[12] See Box 1 for an example illustrating this point.

[13] 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 (for example, VAT on a destination basis) and an export tax is equivalent to a production tax (for example, VAT on an origin basis). Alternatively, the Russian firms could collude with the government and charge a monopoly export price.

Figure 1. Effect of Russia Eliminating VAT on Its Oil Exports to Ukraine



export tax) or Gazprom would raise its export price commensurately, leaving the Russian export price, including taxes, unchanged. This situation would maximize the total rents accruing to the Russian economy from its exports of gas to Ukraine.

The second question is more complex. If Russia were to maintain its VAT on gas exports, should Ukraine eliminate its double taxation of gas imports? Should it, for instance, provide a credit for Russian VAT paid by importers? Can a case be made for Ukraine's simultaneously raising its VAT rate on goods produced using imported gas to tax away the pure profits from Naftogaz? What is the optimal tax/subsidy scheme for Ukraine's gas imports and sales, recognizing that nondistorting taxes are not available?

As noted above, Russian gas exports to Ukraine are (with some caveats) subject to a bilateral monopoly. If the Russian producer (Gazprom) and the Ukrainian seller (Naftogaz) were behaving cooperatively, they would choose the level of output at which the seller's marginal revenue equals the producer's marginal cost, which would maximize their total profits. If they were behaving noncooperatively, a variety of solutions would be possible, depending on the bargaining game between the producer and seller over who will earn the pure profits. This section develops a model based on the assumption that the Russian producer takes the lead by choosing its export price to maximize profits, incorporating the expected response of the Ukrainian seller, who is assumed to choose its level of sales to maximize profits, taking the export price as exogenous.[14]

[14] In fact, as noted above, gas prices paid by consumers are set administratively in Ukraine and fall well short of the levels that would be chosen by a monopolist. The optimal tax/subsidy measures derived below would have to be accompanied by a variety of supporting measures to achieve the first-best social optimum.

VAT Design in a Bilateral Monopoly Model

The model developed in this section extends one of the models used by Lahiri and Ono (1999). Their paper examined the issue of optimal import tariffs under a variety of market structures, including two in which there is a single foreign producer and a single domestic seller. These two models differ according to whether the foreign producer or the domestic seller is the leader. Lahiri and Ono also considered various oligopolistic situations by allowing for multiple producers and sellers. As described above, a model with a single producer and a single seller is broadly appropriate for modeling Russian gas exports to Ukraine. It is assumed here that the Russian producer is the leader, given its dominant position in the world market in general and the CIS market in particular.[15] Russia exports gas to many destinations, notably to Europe, but this paper will take it as a stylized fact that Russia is able to price discriminate because of market segmentation, as argued by Tarr and Thomson (2003). Ukraine also buys from other countries, such as Turkmenistan, although two-thirds of its imports are from Russia and Turkmen shipments have been indirectly controlled by Russia.[16] Also, as noted above, the marginal cost of producing gas domestically in Ukraine is reportedly well below the price of imported gas; therefore, domestic production of gas is inframarginal and does not influence the domestic seller's behavior at the margin.

In this model, a single Russian firm produces natural gas and sells it to a single Ukrainian firm, which in turn sells it to Ukrainian consumers. The Ukrainian seller, as the follower, chooses the level of imports in order to maximize profits, taking the price of Russian gas exports as given. This situation gives rise to a reaction function for the export price as a function of the export quantity and tax parameters. The Russian producer incorporates Ukraine's reaction function into its objective function and chooses its export quantity to maximize profits.[17] The Russian producer and the Ukrainian importer are assumed to take the Russian and Ukrainian VAT rates and the rate of Ukrainian credit for Russian VAT paid on gas imports as exogenous. A social welfare function is specified for Ukraine that is used to consider the optimal choices of the Ukrainian VAT and credit rates.[18]

The Ukrainian seller buys quantity x of gas from the Russian firm at price $q(1 + t_R)$ including Russian VAT and faces a downward-sloping (inverse) demand

[15] If Ukraine were assumed to be the leader, results obtained by Lahiri and Ono (1999) suggest that the optimal input subsidy would be unambiguously positive, which would considerably simplify the analysis in this paper.

[16] If there were two competing foreign producers and one monopolistic seller, it might be more appropriate to assume that the domestic seller is the leader.

[17] It may be more natural to think of the Russian producer as choosing the export *price* to maximize profits, incorporating the seller's reaction function for export *quantity* as a function of export price (and tax parameters). An equivalent but more tractable approach is to assume that the Russian producer chooses export *quantity* to maximize profits, incorporating the seller's reaction function for export *price* as a function of export quantity (and tax parameters).

[18] The assumption that the producer and seller take the VAT and credit rates as exogenous is consistent with the view that the firms are unable to influence these rates. If the firms are able to influence the rates, the strategic interaction between the firms and the governments should ideally be incorporated into the model. This would considerably complicate the model and is beyond the scope of this paper.

curve $p(x)$ for its sales in the domestic market at Ukrainian VAT-inclusive price p. The seller maximizes profits by choosing x as follows:

$$\max_x \pi_U, \tag{1}$$

where

$$\pi_U = \{[p(x)/(1 + t_U)] - [1 + t_R(1 - \mu)]q\}\ x, \tag{2}$$

and t_R is Russia's VAT rate, t_U is Ukraine's VAT rate, and μ is the proportion of Russian VAT credited by Ukraine. The seller's reaction function is obtained by solving its first-order condition for q:

$$q(x, t_R, t_U, \mu) = \frac{p(x) + xp'(x)}{(1 + t_U)[1 + t_R(1 - \mu)]}. \tag{3}$$

The Russian producer maximizes its profit function, which incorporates the seller's reaction function, by choosing x:

$$\max_x \pi_R = q(x,\ t_R,\ t_U,\ \mu)x - c(x), \tag{4}$$

where $c(x)$ is the cost function.

Ukraine's welfare is the sum of consumer (indirect) utility, the seller's profits, and government tax revenue:

$$v(\ p,\ y) = v(p) + \pi_U + \delta R_U, \tag{5}$$

where $y = \pi_U$,

$$R_U = [t_U/(1 + t_U)]px - \mu t_R qx, \tag{6}$$

and $\delta > 1$ reflects the absence of nondistorting taxes.

To facilitate the analysis of the socially optimal choices of t_U and μ, the model will be reparameterized as follows, using a combination of a profits tax at rate t and an input subsidy at rate s:

$$\begin{aligned} 1 - t &\equiv 1/(1 + t_U) \\ 1 - s &\equiv (1 + t_U)[1 + t_R(1 - \mu)] \end{aligned}. \tag{7}$$

If the Ukrainian government levies a profit tax t and an input subsidy s, Ukraine's profit function is as follows:

$$\pi_U = (1 - t)[\,p(x) - (1 - s)q]x. \tag{8}$$

The revenue function corresponding to a profit tax and an input subsidy is as follows:[19]

[19] The revenue function in (8) differs slightly from the revenue function in (6), reflecting the difference between a credit for Russian VAT and an input subsidy.

$$R_U = t[p(x) - (1 - s)q]x - sqx. \tag{9}$$

The next two sections derive: (1) the socially optimal choices of t and s under the simplifying assumption that input price q is exogenous; and (2) the optimal choices of t and s allowing the input price q to be endogenous based on the bilateral monopoly model.

Exogenous Input Price

Assuming that the input price q is exogenous, the social optimum is obtained by choosing t and s to maximize social indirect utility subject to the constraint that the monopoly seller's profits be nonnegative:

$$\begin{array}{l} \max_{t,\, s}\ v(p,\, y) \\ st: \pi_U \geq 0 \end{array}. \tag{10}$$

It will be shown that the socially optimal choice is to tax away 100 percent of the monopolist's pure profits ($t = 1$) and provide a positive input subsidy ($s > 0$) to correct (albeit partially) for the suboptimal level of the monopolist's sales.

The Kuhn-Tucker conditions for this problem are as follows:

$$\frac{\partial v(p, y)}{\partial t} = \lambda \frac{\partial \pi_U}{\partial t} \tag{11}$$

$$\frac{\partial v(p, y)}{\partial s} = \lambda \frac{\partial \pi_U}{\partial s} \tag{12}$$

$$(1 - t)[p(x) - (1 - s)q]x \geq 0;\ \lambda \leq 0 \tag{13}$$

$$\lambda\{(1 - t)[p(x) - (1 - s)q]x\} = 0, \tag{14}$$

where λ is the Kuhn-Tucker multiplier for the nonnegativity constraint on profits.

From equation (11), it follows that $\lambda = -(\delta - 1) < 0$; therefore, from equation (14), after-tax profits must be zero, implying that $t = 1$. From equation (12), it follows that

$$-xp' \frac{\partial x}{\partial s} = \delta sq \frac{\partial x}{\partial s}, \tag{15}$$

implying that

$$s = -xp' / \delta q = p / \delta \varepsilon q > 0, \tag{16}$$

where ϵ is the demand elasticity, defined to be positive. As shown, the rate of subsidy s is positive. Moreover, as $\delta \to +\infty$, $s \to 0$, implying that the rate of subsidy tends to zero as the marginal social utility of tax revenue becomes infinite. Finally, as $\delta \to 1$, $s \to -xp' / q$, ensuring that price equals marginal cost. If $\delta > 1$,

the subsidy falls short of the rate needed to bring price down to marginal cost, because there is a trade-off related to the loss of tax revenue.

Endogenous Input Price

This section allows for the possibility that Ukraine could improve its terms of trade by levying a tax (or subsidy) on its imports from Russia. It is assumed that Russia and Ukraine constitute a bilateral monopoly. The social optimum for Ukraine is obtained from the maximization problem specified in equation (10) above, but now the solution incorporates the bilateral monopoly behavior of the Russian producer and the Ukrainian seller. As the follower, Ukraine maximizes profits taking the input price q as exogenous. This yields the following reaction function:

$$q = q(x; s) = \frac{p + xp'}{1 - s}. \tag{17}$$

The Russian producer maximizes profits incorporating Ukraine's reaction function. The Kuhn-Tucker conditions for Ukraine's constrained social indirect utility maximization problem (10) were given in equations (11)–(14) above. In this case, equation (11) yields the result that $t = 1$ as before. Compared with equation (15), derived assuming that the input price is exogenous, equation (18) contains an additional term:

$$-xp' \frac{\partial x}{\partial s} = \delta s q \frac{\partial x}{\partial s} - \delta \frac{dq}{ds} x. \tag{18}$$

The extra term arises from the effect that changes in the subsidy rate have on tax revenue via changes in the input price. Rearranging this expression yields the following:

$$s = (p / \delta \varepsilon q) - (\rho / \sigma), \tag{19}$$

where

$$\rho = \frac{dq}{ds} \frac{s}{q}$$
$$\sigma = \frac{\partial x}{\partial s} \frac{s}{x}.$$

Compared with the exogenous input price case, the expression for the socially optimal input subsidy contains an additional term. This additional term renders the sign of the socially optimal input subsidy rate ambiguous for reasons analogous to those considered by Lahiri and Ono (1999). The gain from increasing the Ukrainian firm's sales toward the level at which price equals marginal cost may be offset fully or partially if this gain is accompanied by a deterioration in the terms of trade. Whether the terms of trade worsen in response to an input subsidy

depends on model parameters, including, in particular, the curvature of the demand function (see the appendix for a fuller discussion).

To sum up, the socially optimal policy is to tax away 100 percent of the seller's pure profits. Notwithstanding the ambiguity of the sign of the optimal subsidy rate, a simple, intuitive expression clearly shows the trade-offs in eliminating the domestic seller's monopoly distortion, sacrificing government revenue, and possibly worsening the terms of trade by granting an input subsidy.

Instruments t_U and μ are imperfectly suited to achieving the social optimum. Setting $t = 1$ would require $t_U \to +\infty$, whereas the feasible range for t_U would presumably be $0 \leq t_U \leq 0.2$, given the current 20 percent VAT rate in Ukraine. The rate at which Russian VAT payments are credited, μ, would normally lie between 0 and 1, precluding the possibility of a positive input subsidy rate ($s > 0$). Even if $\mu > 1$ were permitted, an increase in t_U designed to tax profits would require a commensurately large increase in μ to obtain $s > 0$. For instance, at the current 20 percent Russian and Ukrainian VAT rates, the credit rate μ would have to be higher than 1.8 to obtain a positive input subsidy rate s.

IV. Conclusion

This paper has examined the effect on Russia's tax revenue, Gazprom's profits, and Ukraine's tax revenue and economic welfare if the current hybrid VAT regime were replaced by a pure destination-based VAT. Under the current regime, there is double taxation of energy trade, which suggests that Russia and Ukraine are competing for 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, focusing mainly on the latter, as it is characterized by imperfect competition.

Starting with the market for oil, which is broadly competitive, 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. 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, reduce the cost to Ukrainian buyers, and lower Russian tax receipts, and could raise or lower Ukrainian tax revenues.

Natural gas exports from Russia to Ukraine can be characterized (subject to some caveats) as a bilateral monopoly, with the Russian firm Gazprom accounting for virtually all Russian production and exports, and the Ukrainian firm Naftogaz dominating imports and domestic sales. Moreover, Ukraine has substantial leverage with Russia because it owns the key gas transit pipelines that handle most Russian gas shipments to Europe. Russia chooses to maintain its VAT on gas exports to other CIS destinations, including Ukraine, as an important source of government revenue. If Russia were to move fully to a destination basis for VAT and thereby cease to apply VAT to energy exports to other CIS countries, the export price, inclusive of taxes, would likely remain unchanged, because the

Russian government would raise other taxes or the Russian producer would raise its export price.

This paper analyzed Ukraine's optimal response if, alternatively, Russia were to maintain its VAT on gas exports. If the export price were exogenous, it would be socially optimal for Ukraine to tax its domestic seller's pure profits at 100 percent and subsidize gas imports to offset the monopoly distortion. The monopoly distortion would be offset only partially, reflecting the impact of subsidies on government revenues and the absence of nondistorting taxes. If the export price were endogenous, in the bilateral monopoly model considered here, it would still be socially optimal for Ukraine to tax the seller's pure profits at 100 percent, but the optimal input subsidy rate could be either positive or negative, depending on the terms-of-trade effect. Notwithstanding this ambiguity, the paper provides a simple expression for the optimal subsidy rate for imported gas (which may be negative) that depends on the subsidy's effect on the monopoly seller's distortion, government revenue, and the terms of trade.

APPENDIX

Terms-of-Trade Effects in the Endogenous Input Price Case

This appendix considers how the underlying model parameter values determine the terms of trade effects and the socially optimal input subsidy in the endogenous input price model analyzed in Section III. This depends on the magnitude and sign of the term ρ / σ in equation (19) in the text.

To begin with, consider σ, which is the elasticity of input quantity x with respect to the input subsidy rate s. A closed-form solution for this parameter can be obtained by differentiating the Russian producer's first-order condition with respect to s, which yields the following:

$$\frac{\partial x}{\partial s} = -\frac{c'}{(1-s)\Delta_R}, \tag{20}$$

where

$$\Delta_R = \frac{\partial^2 \pi_R}{\partial x^2} = q_{xx}x + 2q_x - c'' < 0, \tag{21}$$

by the concavity of the profit function.[20] If $s < 1$, then $\sigma > 0$.

The other parameter in equation (19) that needs to be considered is ρ, which depends on

$$\frac{dq}{ds} = q_x \frac{\partial x}{\partial s} + q_s = \frac{(2p' + xp'')}{1-s}\frac{\partial x}{\partial s} + \frac{q}{1-s}, \tag{22}$$

where q_x and q_s were obtained by differentiating Ukraine's reaction function (17). It is apparent from (22) that a sufficient (but not necessary) condition for $\rho > 0$ is that

$$2p' + xp'' > 0 \tag{23}$$

[20] Here, $q_x \equiv \frac{\partial q}{\partial x}$ and $q_{xx} \equiv \frac{\partial^2 q}{\partial x^2}$.

or, equivalently,

$$\theta \equiv xp'' / p' < -2, \tag{24}$$

where θ is a measure of the curvature of the demand function. For a linear demand function, $\theta = 0$, and this condition is not satisfied. For a constant elasticity demand function with elasticity (defined to be positive) ε, $\theta = -(\varepsilon + 1)$; therefore, equation (24) is satisfied if $\varepsilon > 1$.

If $s < 1$ and hence $\sigma > 0$, as shown by equation (19), whether the socially optimal subsidy rate is positive or negative depends on how changes in the input subsidy rate s affect the terms of trade q, an effect measured by parameter ρ. If an increase in s improves the terms of trade by lowering q (implying that $\rho < 0$), this raises tax revenue by reducing the fiscal cost of the subsidy sqx, increases social welfare, and ensures that the socially optimal subsidy is strictly positive. A necessary (but not sufficient) condition for $\rho < 0$ and hence $s > 0$ is that $\theta > -2$, which means that the demand function is sufficiently concave. A linear demand function satisfies this condition ($\theta = 0$); unfortunately, the sign of the socially optimal subsidy rate is nevertheless ambiguous. If an increase in s worsens the terms of trade by raising q (implying that $\rho > 0$), this lowers tax revenue by increasing the fiscal cost of the subsidy sqx, lowers social welfare, and makes the sign of the socially optimal subsidy ambiguous. A sufficient (but not necessary) condition for $\rho > 0$ is that $\theta < -2$. The constant elasticity demand function satisfies this condition; hence, the sign of the socially optimal subsidy rate is ambiguous in this case as well.

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