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Grain logistics in Ukraine: the main challenges and effective ways to reach sustainability

Abstract. One of the most important sectors of the economy in Ukraine is agriculture. Ukraine today is one of the world's leading grain producers and exporters. The growth of world food needs contributes to the integration of Ukrainian agricultural products into the EU economy. It is a key for the Ukrainian agricultural products to be a part of EU economy. However, this outcome may depend on the constraints on growth.

The article summarizes the arguments and counterarguments in the scientific discussion of the identification of the main challenges and ways in the sustainable development of grain logistics in Ukraine, compares the situation in Ukraine, Poland, Romania and the Czech Republic.

The main purpose of the study was to identify the peculiarities of logistics and search for alternative forms and methods of grain products delivery to the storage and sale sites (ports). The research was done on existing transport corridors and the cost per ton. The relevance of the problem lies in the fact that current growth trends in the volume of grain transportation and current situation of transport infrastructure require improvement of the logistic quality and the formation of new logistic routes.

The article presents issues of the development of freight logistics in the following way: determination of the actual situation of freight logistics; identification of the main trends in recent years; determination of freight transportation advantages and efficiency level using various types of transport; formation of proposals and prospects of the development of grain products transportation considering the existing needs as well as prospects for growth of agricultural production in Ukraine. Methods used in the study included empirical research and scientific retrospective analysis.

Ukrainian grain logistics was chosen as the object of research, as the trends in the agro-industrial complex and the growing volumes of grain exports through seaports require finding better ways to improve the efficiency of freight transportation on the basis of cost reduction as well as increase in transportation speed. The article presents the results of an empirical analysis of freight transportation of grain products. The analysis showed that railroad is the main mode of grain transport.

The state of the railway system of Ukraine was featured as the most serious problem reported and a limitation on market participants in the results of our survey. 80% of the respondents consider high railway tariffs a problem; 70% consider the poor quality of the railway network and infrastructure to be a problem; and 60% noted the lack of freight cars.

At the same time, road transport is used for transportation over relatively short distances. However, it has limitations due to the low road capacity. In addition, water transport can be an important reserve for increasing the volume of transportation. Nevertheless, it will be possible only in case of investment growth and infrastructure restoration. The study empirically confirms and theoretically proves that improvement and optimization of Ukraine's transport infrastructure is a prerequisite for ensuring the growth of agricultural exports and overall economic growth. The results of the study can be useful for grain products exporters and authorities.

Keywords: Agricultural Logistics; Grain Export; Transport; Land Reform; Vertical Restructuring; Competition; EU

JEL Classification: L43; L92; O18; P31; Q15; Q17; Q18; R40; R42

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Зернова логістика в Україні: основні виклики та ефективні шляхи досягнення стійкості

Анотація. У статті узагальнені аргументи й контраргументи наукової дискусії щодо виявлення основних проблем і шляхів сталого розвитку зернової логістики в Україні. Основною метою дослідження є виявлення особливостей логістики та пошук альтернативних форм і способів доставки зернової продукції на місця зберігання та продажу (порти). Актуальність проблеми полягає в тому, що сучасні тенденції зростання обсягів транспортування зерна і поточний стан транспортної інфраструктури вимагають поліпшення якості логістики й формування нових логістичних маршрутів.

Дослідження питань розвитку вантажних перевезень представлено в статті в наступним чином: визначення фактичного стану логістики вантажів; виявлення основних тенденцій, що мають місце в останні роки; визначення переваг і рівня ефективності вантажних перевезень різними видами транспорту; формування пропозицій і перспектив розвитку перевезень зернової продукції як з урахуванням існуючих потреб, так і з урахуванням перспектив зростання сільськогосподарського виробництва в Україні. Окрім того, здійснено порівняння ситуації в Україні, Польщі, Румунії та Чехії. Аналіз засвідчив, що головним видом транспорту для перевезень зернових є залізниця. Вона має пріоритетне значення в перевезенні переважної більшості вирощеної зернової продукції. Стан залізничної системи України фігурував як найбільш серйозна проблема в результатах проведеного авторами опитування. Так, 80% респондентів вважають проблемою високі залізничні тарифи; 70% - низьку якість мережі залізниць й інфраструктури; 60% відзначили в якості проблеми відсутність вантажних вагонів.

Автомобільний транспорт застосовується для перевезення на відносно невеликі відстані, але він має обмеження через низьку пропускну здатність автомобільних доріг. Одночасно важливим резервом для підвищення обсягів перевезень може слугувати водний транспорт. Однак він зможе перебрати на себе частину вантажопотоку тільки за умови відновлення інфраструктури та відповідних обсягів інвестицій. Методи, використані в дослідженні, включали емпіричні дослідження й методи наукового ретроспективного аналізу. Дослідження емпірично підтверджує й теоретично доводить, що поліпшення та оптимізація транспортної інфраструктури України є необхідною умовою для забезпечення зростання експорту сільськогосподарської продукції та загального економічного зростання.

Ключові слова: аграрна логістика; експорт зерна; транспорт; земельна реформа; вертикальна перебудова; конкуренція; ЄС.

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Зерновая логистика в Украине:**основные проблемы и эффективные пути достижения устойчивости****Аннотация**

В статье обобщены аргументы и контраргументы научной дискуссии относительно основных проблем и путей устойчивого развития зерновой логистики в Украине. Основной целью исследования является выявление особенностей логистики и поиск альтернативных форм и способов доставки зерновой продукции к местам хранения и продажи (порты). Актуальность проблемы заключается в том, что современные тенденции роста объемов транспортировки зерна и текущее состояние транспортной инфраструктуры требуют улучшения качества логистики и формирования новых логистических маршрутов.

Исследование вопросов развития грузовых перевозок представлено в статье следующим образом: определение фактического состояния логистики грузов; выявление основных тенденций, имеющих место в последние годы; определение преимуществ и уровня эффективности грузовых перевозок различными видами транспорта; формирование предложений и перспектив развития перевозок зерновой продукции как с учетом существующих потребностей, так и с учетом перспектив роста сельскохозяйственного производства в Украине. Помимо этого, осуществлен сравнительный анализ ситуации в Украине, Польше, Румынии и Чехии.

Анализ показал, что основным видом транспорта для перевозок зерновых является железная дорога. Она имеет приоритетное значение в перевозке подавляющего большинства выращенной зерновой продукции. Состояние железнодорожной системы Украины фигурировало как наиболее серьезная проблема в результатах нашего опроса. 80% респондентов считают проблемой высокие железнодорожные тарифы; 70% – низкое качество сети железных дорог и инфраструктуры; и 60% отметили в качестве проблемы отсутствие грузовых вагонов. Автомобильный транспорт применяется для перевозки на относительно небольшие расстояния. Он имеет ограничения из-за низкой пропускной способности автомобильных дорог. Одновременно важным резервом для повышения объемов перевозок может служить водный транспорт. Однако он сможет взять на себя часть грузопотока только при условии восстановления инфраструктуры и наличия соответствующих объемов инвестиций.

Методы, использованные в исследовании, включали эмпирические исследования и методы научного ретроспективного анализа. Исследование эмпирически подтверждает и теоретически доказывает, что улучшение и оптимизация транспортной инфраструктуры Украины является необходимым условием для обеспечения роста экспорта сельскохозяйственной продукции и общего экономического роста.

Ключевые слова: сельскохозяйственная логистика; экспорт зерна; земельная реформа; вертикальная перестройка; конкуренция; ЕС.

1 Introduction

«The future of [Kazakh, Russian, and Ukrainian] grain exports depends mainly on whether productivity and yield in grain production will continue to grow» (Liefert & Liefert, 2015).

Ukraine is one of the world's leading grain producers and exporters. The country is the world's leading exporter of sunflower oil, 2nd leading exporter of maize, 5th leading exporter of wheat, and 3rd to 5th leading exporter in the smaller volumes of oats, rye, and sorghum (USDA, 2017). Agriculture accounts for 12 percent of Ukrainian GDP, almost 16 percent of employment, and 42 percent of exports (FAO, 2012; Ministry of Infrastructure, 2018).

Grain transportation is among the top 3 cargo types in Ukraine, and in 2030 grain freight will take from 13% to 15% in Ukrzaliznytsia (UZ) scenarios (Strategies of JSC «Ukrzaliznytsia» for 2019-2023).

As Table 1 shows, the agricultural sector is considerably more important to the overall economy in Ukraine than in neighbouring countries.

2. Brief Literature Review

Growing global food needs and the hoped-for integration of Ukrainian agricultural products into the EU economy emphasizes the importance of agriculture and agricultural exports for

Table 1:
Share of Agriculture, Industry, and Services in GDP, 2018

COUNTRY	AGRICULTURE	INDUSTRY	SERVICES
Bulgaria	3.6	23.8	59.2
Czech Republic	2.0	32.2	55.8
Hungary	3.6	26.3	54.4
Poland	2.4	29.6	56.4
Romania	4.3	29.0	57.1
Russian Federation	3.1	32.1	54.1
Slovak Republic	3.0	31.3	55.5
Ukraine	10.1	23.3	51.3

Source: Authors' study based on data of official statistics

the Ukrainian economy. The Ukrainian government has forecast a near doubling of grain exports by 2020 (Ministry of Infrastructure, 2015; 2017). As former US ambassador to Ukraine Geoffrey Pyatt has remarked concerning the current situation, «Those numbers could easily be doubled.... Ukraine is already one of the world's great agricultural producers. But it should be an agricultural superpower.» (Timchenko, 2016). These forecasts are confirmed by a constant increase in productivity.

Ukrainian economists Stolbunenko N. M., & Tserkovna A. V. (2017), Maslak O. (2016), Martynuk M. (2018) considered the main problems that negatively affect the quality of grain logistics are the following:

- 1) increased load on railway infrastructure;
- 2) corruption in the public sector and excessive regulation of investments, inappropriate management of state assets in the field of logistics of the agro-industrial complex, irrational state regulation;
- 3) underdevelopment of river transport and insufficient use of river transport;
- 4) the unsatisfactory technical condition of the railway transport, in particular, the large deterioration of the fleet of wagons, unfair state regulation of the transportation process, lack of traction and locomotives;
- 5) a sharp increase in the cost of grain transportation in 2019;
- 6) inefficient use of grain storage and transshipment infrastructure;
- 7) narrowing the geography of grain shipments by rail. In order to optimize its own costs, ultrasonic actual loading of grain produces 10% of the total number of large linear elevators;
- 8) deterioration and destruction of the road surface and an increase in carbon emissions into the atmosphere due to the excessive use of road transport in the transportation of grain from the producer to the port;
- 9) the limited capacity of the railway to increase the volume of transportation of grain.

3. Purpose

In this paper, we examine the most costly obstacles of grain logistics and discuss the prospects for their alleviation in Ukraine in the context of its integration with EU.

4. Results

According to expert estimates, in the coming years, grain yields are expected to increase to 100 million tons per year and exports to 70 million tons per year. This will contribute to an increase in the demand of farmers for the transportation of grain cargo to seaports (Tkachev, 2019). The trend of reorientation of grain cargo from the railway will continue in the future.

However, this clearly welfare-enhancing outcome may depend on the country overcoming a number of obstacles that are already beginning to act as constraints on growth. At the same time, these same obstacles, by increasing the logistics costs of selling agricultural products into world markets, also harm the population - and thus the support for economic reforms - by reducing both the amount and the share of export earnings that accrue to farmers both large and small (World Bank, 2015). We argue that it is useful to analyze these obstacles in the framework of the «growth diagnostics» framework of Hausman et al. (2008; see also Rodrik, 2008, 2017), which seeks to identify which obstacles hindering growth in a particular country are the «binding constraints» whose easing is the most productive target for reform efforts.

Tariffs for the transportation of grain cargoes have increased every year since at least 2011; in 2018, the increase was 10.9% (See Table 2).

As shown in Table 3, grain yields in Ukraine are steadily increasing. With a steady increase in grain yields in Ukraine and an increase in transportation tariffs and freight volumes, export earnings also increased.

As can be seen in Table 4, during 2013-2018 there was a general increase in the volume of grain transportation by all transport modes. This is directly related to the growth of both production and export of agricultural products. Broad increases in volume over the 2015-2017 period of time were interrupted by a decline in 2018, but partial data from 2019 suggest a resumption of growth.

Today in Ukraine there is an active use of road transport for transporting grain to port elevators. The role of road transport in grain logistics has grown in recent years. Currently, about 36% of all grain is transported by road. However, this was not influenced by the efficiency of transportation and the development of road infrastructure, but by the practice of reloading grain trucks and reducing the cost of transporting products.

Summarizing, it should be noted that the volume of traffic both in general and in the context of individual modes of transport is associated with an increase in the level of grain production within the country. At the same time, a significant increase in demand for water transport indicates its promise and potential for growth.

According to experts, the main problems in the export of Ukrainian grain are significant costs and the duration of internal transshipment and transportation of grain (agricultural logistics). Due to the inconsistency of the logistics routes with the modern requirements of agricultural export, the current costs of moving grain from linear elevators to the ports of the Black Sea are approximately 40% higher than similar costs in France or Germany and 30% higher than the same costs in the USA, that is, transporting grain for export costs an average of USD 20/t more expensive than similar services in European countries. As a result, domestic producers of grain in Ukraine annually lose about USD 600 million (Maslak, 2016). As we will discuss below, our survey of grain producing enterprises in Poltava region yielded results consistent with these findings.

The main prerequisite for the fact that logistics in European countries remains cheaper is that in these countries 50% of the volume of transportation is accounted for by cheap river transport (in Ukraine its part is only 5%).

For a country with recent success in agricultural exports, Ukraine as a whole has a logistics sector of decidedly mediocre quality by world standards; in fact it stands at exactly 69th place out of 160 countries in the Logistics Performance Index of the World Bank (Arvis et al., 2018). Even by regional standards its overall performance has been middling and unimpressive, as shown in Figure 1.

Table 2:
Tariff indices for freight transport by rail of grain cargo in 2008-2018, to the previous year, %

Year	2011	2012	2013	2014	2015	2016	2017	2018
Cereals, %	108.4	106.6	105.3	115.5	142.4	111.2	107.2	110.9

Source: Based on data from State Statistics Service of Ukraine (2018)

Table 3:
Ukrainian cereals production and exports/imports in 2011-2018 compared to the same period last year

Year	2011	2012	%	2013	2014	%	2015	2016	%	2017	2018	%
Production of cereals, million.t	56.75	46.22	81	63.05	63.86	101	60.13	66.09	110	61.92	70.06	113
Exports of cereals, million USD	3617	7008	194	6371	6544	103	6057	6074	100	6501	7241	111
Imports of cereals, million USD	220	249	113	307	367	120	155	149	96	177	191	108

Source: Based on data from State Statistics Service of Ukraine (2018)

Table 4:
The total volume of transportation of grain cargoes by modes of transport for 2013-2019 compared to the same period last year, thousand tones

Year	2013	2014	%	2015	2016	%	2017	2018	%	6 month of 2018	6 month of 2019	%
Railway transport	28000	25200	90	34000	36000	106	38500	35300	92	17200	21400	124
IWW	573	623	109	682	623	91	537	894	167	234	401	171
Road transport	13553	16960	125	14719	15794	107	17629	16697	95	6538	9294	142
Total	42126	42783	102	49401	52417	106	56665	52891	93	23973	31095	130

Source: Based on data from State Statistics Service of Ukraine (2018)

The index is made up of six components: customs, infrastructure, international shipments, logistics quality and competence, tracking and tracing, and timeliness. The possible individual and overall scores range from a low of 1 to a high of 5; in overall 2018 rankings the lowest performer was Afghanistan at 1.81, and the highest - Germany at 4.37.

Ukraine is not a small country, so the distances over which grain is shipped, for both domestic consumption and export, are sufficiently great that rail and water transport should have an economic advantage over motor transport. (For the same reason, motor transport should generally be an economic complement to, rather than substitute for, rail and water transport.) Currently only rail exercises that advantage, as the use of the Dnipro river and other inland waterways has dropped to almost negligible levels in recent years (an issue to which we return below).

Figure 2 shows that Ukraine is unique among its western neighbours in the importance of rail in the transport of agricultural products. In 2018, 67% of the total grain volume in Ukraine was transported by railway.

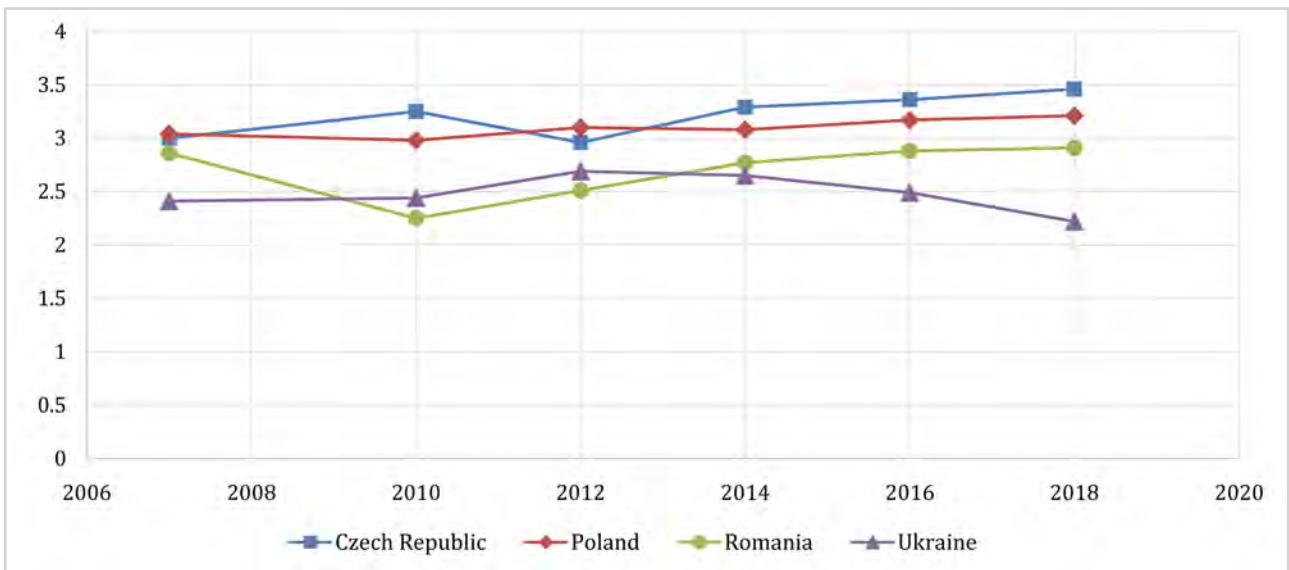


Figure 1:
Regional trends in World Bank Logistics Performance Index, 2018
Source: Authors' study based on data by Arvis et al. (2018)

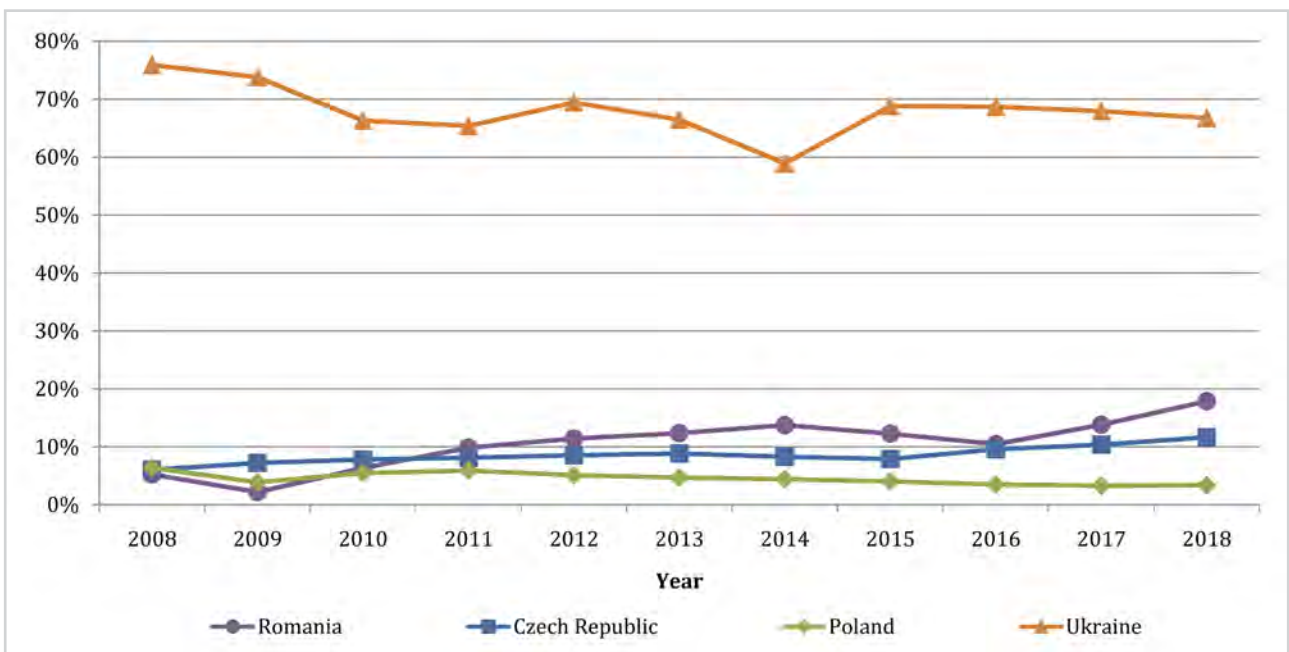


Figure 2:
Rail's share of total agricultural transport, thousand tonnes, selected countries
Source: Based on data from State Statistics Service of Ukraine (2018), Eurostat (2018) & Authors' study

Road transport has grown in recent years. 32% of all grain were transported by road in 2018 (Figure 3). Motor carriage is significant, especially over short distances from farms to elevators.

The share of inland waterways transport in grain logistics remains insignificant in Ukraine.

We surveyed twenty-grain processing companies in Poltava region to learn more about the importance of transportation and transportation charges for such companies in 2018. The companies we interviewed ranged in volume of transport use from less than 15 thousand to over 4 million ton-kilometres, and in spending on transportation from a little over USD 1 million to a little over USD 1 billion. With a wide range of both magnitudes and cost shares, they reported an average of 2.57 percent of revenues spent on goods as transport costs (see Figure 4).

The state of the Ukrainian railway system - that is, the state-owned monopoly Ukrzaliznytsia - figured prominently as the most serious stated problem and constraint in our survey results. 80 percent

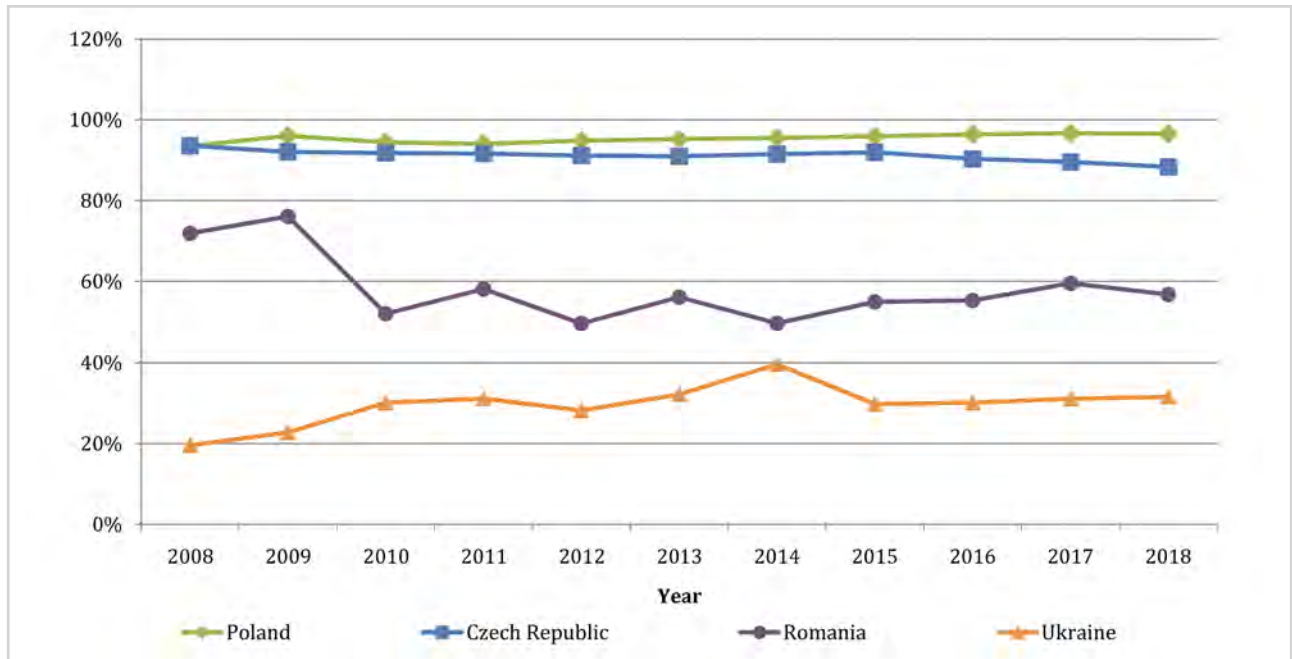


Figure 3:

Motor carrier share of total agricultural transport, thousand tonnes, selected countries

Source: Based on data from State Statistics Service of Ukraine (2018), Eurostat (2018) & Authors' study

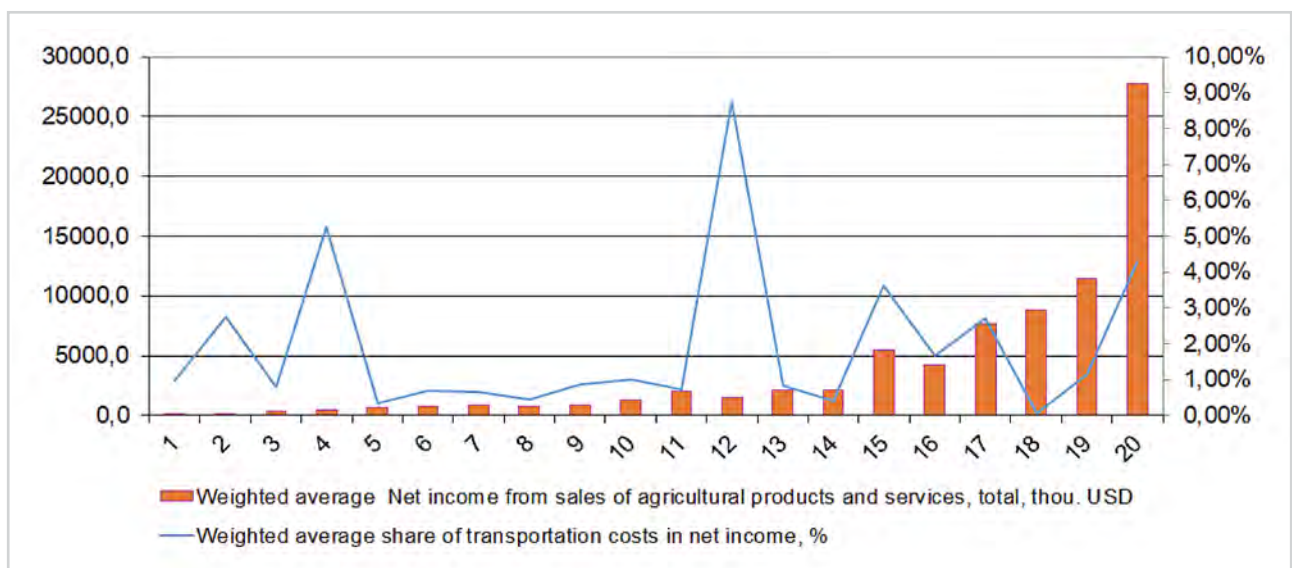


Figure 4:

Transport costs as a share of revenues for twenty agricultural processing companies in Poltava region, USD & %

Source: Authors' study

of our respondents listed high railway tariffs as a moderate or serious problem; 70 percent listed the state of the railway network itself - the infrastructure - as a moderate or serious problem; and 60 percent listed the availability of railway rolling stock (freight cars) as a moderate or serious problem.

In addition, 70% of respondents listed the poor quality of the roads network as a moderate or serious problem. Availability of equipment and expenses were not described as significant problems, likely reflecting the fact that most agricultural enterprises have at least some ability to haul their own grain on the roads. And we may assume that only big grain traders (for example, Nibulon and Kernel) use river transport.

The list of challenges facing Ukraine as it seeks to improve its infrastructure to support future growth of agricultural production and exports is a long one, and it is not easy to identify which of a number of problems might serve as a, or the, «binding constraint». Nevertheless, further analysis suggests a number of strategies that might be pursued by Ukrainian reformers in this context going forward, as well as which are mostly likely to make a significant difference - to remove constraints.

Step 1. Rail sector support and reform

Step 1a. Government subsidies to the railway

Ukraine's railway infrastructure is generally old and in poor repair, and capacity bottlenecks act to slow and disrupt agricultural and other freight shipments in multiple locations (Pittman, 2017; Bukovskiy & Kwartalna, 2012; Shepotylo et al., 2017). Most countries in Europe provide government subsidies to their railways (ECMT, 2005; Arrigo & Di Foggia, 2014). Generally, these subsidies are provided to infrastructure construction, infrastructure maintenance, and passenger operations, and may originate with a variety of levels of government. Ukraine, like many countries, does provide government subsidies to passenger operations as well as requiring the freight operations of the national railway company Ukrzhaliznytsia to cross-subsidize the passenger operations. However, almost uniquely in Europe, the Ukrainian government provides no infrastructure subsidies to Ukrzhaliznytsia, requiring the company to fund capital improvements from current operations and borrowing.

Ukrzhaliznytsia has recently estimated that the firm requires investments in the neighbourhood of USD 6 billion over the next five years simply to maintain its assets at current levels.

Step 1b. Private rolling stock

In addition to serious problems with the rail infrastructure, a widely noted problem regarding Ukrainian grain transport is the poor condition of the specialized rolling stock used for this purpose. Four-fifths of the rolling stock used to carry grain is owned by the government-owned monopoly railway company Ukrzhaliznytsia, and most of this is either fully depreciated (30+ years old, about one-third of the fleet) or will be within the next ten years (21-30 years old, over half the fleet) (Tovstopyat, 2013; Maslak, 2016).

Partly this is the result of the continued resistance to reform and restructuring of the railway (see next section), so that there is no competition within the railway sector. Partly it is a result of charges imposed by Ukrzhaliznytsia on the empty return trips of privately owned rolling stock that are not imposed on its own rolling stock, as well as alleged corruption in the allocation of Ukrzhaliznytsia-controlled rolling stock during periods of high demand. At the same time, even the Russian Federation, which has also resisted the restructuring of its government-owned monopoly railway company Rossiyskie Zheleznnye Dorogi (RZhD), has allowed and encouraged private investment into rolling stock in response to widespread shortages of capacity for carrying a variety of commodities (Pittman, 2013; Martsenyuk, 2014) - first by «unbundling» the wagon fee from the tariff in 2003, later by spinning off RZhD subsidiaries that owned rolling stock - to the degree that, according to the RZhD website, 80 percent of rolling stock is now owned by firms unrelated to RZhD.

An additional problem that compounds the overall shortage of rolling stock is the lack of price flexibility for use of the existing inventory (World Bank, 2015). Demand for grain hoppers is of course seasonal, and the absence of seasonal pricing means that marginal users have little incentive to moderate or reschedule their usage in periods of peak overall demand (Schroeder & Meyers, 2015).

The government estimates that the replacement of aging freight cars and locomotives will require a total of USD 2 billion over the next few years (Ministry of Infrastructure, 2015), while the World Bank (2015) estimates that investments of USD 640 million would be required for the 8500 new grain hoppers required to relieve the current and forthcoming shortages of rolling stock for

agricultural transport in Ukraine - though all three numbers could be reduced by improvements in incentives for allocating scarce cars during periods of peak demand.

Step 1c. Broader railways reform

Ukraine has the 14th largest railway system in the world, as measured by track-kilometres, and the 6th most densely operated, as measured by train unit per track-kilometre (see Table 5). Like the rolling stock park, the infrastructure is old, depreciated, and generally unable to keep up with demand. Unlike most of Europe, but like Russia, as well as China and India, Ukraine has a mostly unreformed and unrestructured railway system (Pittman, 2017). The long-standing state monopoly railway has been internally reorganized, and legislative proposals and initiatives for reorganization have been debated over the years, but so far the vertically integrated monopoly remains.

Table 5
Ukrainian rail compared to largest world rail systems, 2017

Country	km track	freight ton-km (m)	passenger-km (m)	(freight + passenger) / track (mm)	km track / land km ²
USA	227.058	2.788.230	9.935	12.3	0.0248 (Lower 48 0.0296)
Russia	84.158	2.400.000	175.800	30.6	0.0049 (European Russia: 0.138)
India	63.327	521.371	769.956	20.4	0.0193
China	60.809	2.511.804	772.834	54.0	0.0063
Ukraine	21.676	196.188	48.327	11.3	0.0359

Source: Author's study based on the latest data available at the Rail Database of the International Union of Railways (2017)

There are a number of reform paths that have been chosen for railway reforms around the world. In Europe, most countries have chosen one of two related «models», both of which involve opening up train operations to competition while maintaining the track and signalling network as a «natural monopoly». Under the *third-party access model*, the incumbent vertically integrated railway enterprise is required to open the network to independent, non-integrated train operating companies that will compete for traffic with the incumbent. This reform model preserves the economies of vertical integration of the incumbent but risks creating incentives for the vertically integrated incumbent to discriminate in favour of its own trains at the expense of the independent train-operating companies. Addressing such incentive issues, the *vertical separation model* requires the infrastructure operator - usually still a government-owned enterprise - to withdraw from train operations and act solely as a provider of network access and services (Pittman, 2007). In either case, the setting of access terms and conditions is an important and difficult part of the exercise (ECMT, 2005; Pittman, 2013).

A third reform model, chosen by a number of countries in the Americas but not in Europe, calls for the division of the incumbent system into a small number of independent railway companies that maintain both vertical integration and the exclusive right to run trains on their own infrastructure, while competing with other railway companies over parallel routes as well as to and from common points - sometimes called the *horizontal separation model*. This is the industry structure long favoured by the US and Canada and selected by, among others, Argentina, Brazil, and Mexico in the 1990's.

Ukrainian reformers considered all three restructuring models in the 1990's and 2000's, and in 2015 the Ministry of Infrastructure introduced, and the Verkhovna Rada of Ukraine (the Parliament) enacted, legislation that would open the system to entry by independent train-operating companies while also permitting Ukrzhaliznytsia to continue to operate trains - the third-party access model.

In 2019 there have been concrete steps taken to implement this restructuring legislation. The activities of the UZ are to be divided into 6 verticals: corporate center (administration plus think tank); cargo transportation and logistics (UZ Cargo); passenger transportation; infrastructure; production and service; and management of non-core assets.

The successes of other countries in implementing their reform legislation demonstrate what might be achieved in Ukraine. In the Americas, the choice of the horizontal separation model has resulted in the creation of vertically integrated railway companies - some owning their track infrastructure, others controlling it through long-term franchises - that have invested billions of dollars into maintenance and improvements in their networks. Ukraine's old and depreciated rail infrastructure, beset by bottlenecks caused in part by mounting deferred maintenance, could badly use such influxes of private investment.

In the formerly socialist countries of central and eastern Europe, implementation of vertical separation or third-party access regimes have resulted in the entry of numerous private train-operating companies competing for the business of freight shippers (See Figure 5).

Ukraine's freight shippers, very much including farmers and grain processors, must envy the competitive rail logistics services offered to their counterparts in other European countries.

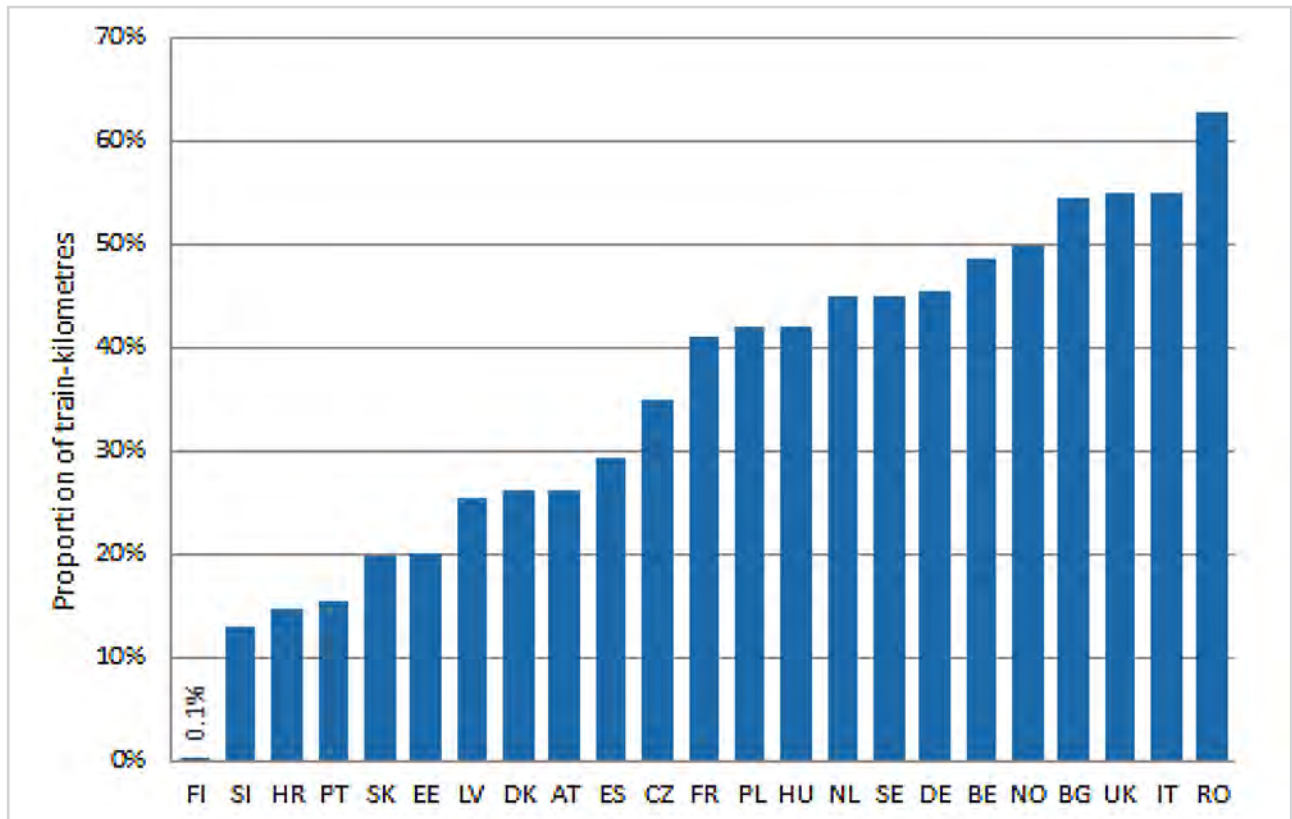


Figure 5:

Share of rail freight carried by independent train operating companies in European countries, 2018

Source: Figure 17 of RMMS (2018)

Step 2. Water transport sector support and reform

Step 2a. Upgrading internal waterway transport

A good deal of the grain shipments that crowd Ukraine's railways and roads could be transported instead along the country's extensive river system, including not only the Dnipro and Southern Bug but also the Danube and Dniester. Remarkably, a domestic river system that carried almost 66 million tons of freight in 1990 carried just a little over 3 million tons in 2014. Pidlisny (2016) notes that the inland waterways' share of freight transport in Ukraine is miniscule at 0.25% and compares unfavourably not only with Russia (1.4%) but also with the EU (3.5%), the US (7.7%), and China (15.4%). The proximate cause of the sudden drop after 1990 in Ukraine was the closure of gateways following the Chernobyl disaster, but there seems to have been no obvious reason beyond bureaucratic neglect, along with decisions to allot scarce investment resources to other uses, for the gradual deterioration since then of the conditions of commerce-supporting infrastructure such as locks and bridges as well as the failure to maintain the regular dredging operations required to restore and maintain navigability, especially along the length of the Dnipro that bisects the country.

The low-hanging fruit with regard to restoring the role of the inland waterways in Ukrainian grain logistics is probably the decision to reverse these decades of official fiscal neglect and devote significant resources to the restoration and improvement of the waterways, including but not limited to the repair and maintenance of locks and significant dredging operations, and the recent commitment of multimillion Euros to these projects by the European Bank for Reconstruction and Development and the European Investment Bank is good news in this regard. With such improvements, the

government may be willing and able to follow the advice of the World Bank and accept the urging of companies in this sector to extend the navigation period of the Dnipro into the early winter months, a time of peak demand for grain transport (World Bank, 2014). Similarly, although there have been concerns expressed regarding the deterioration of the barge fleet, companies like Nibulon and Ukr-richflot can be expected to expand their capacities significantly once the river conditions are supportive (Ryabova, 2017).

However, there is broad agreement among analysts and reformers that the inland waterways will achieve their potential in grain (and other freight) transport only with the implementation by the Verkhovna Rada of Ukraine (the Parliament) of the laws «On Inland Waterway Transport» and «On the International Register of Ships in Ukraine» (World Bank, 2015; Pidlisny, 2016; Ilchenko & Oneshko, 2017). The first would both a) drastically reduce the number and the level of fees that must be paid by shippers and vessel operators to make use of the inland waterways and their related facilities and b) remove fee-related penalties for the use of specialized «river-sea» vessels; the latter would eliminate the requirement that foreign vessels go through the expensive and time-consuming process of applying for a permit each time they wish to access the Ukrainian inland waterways.

The World Bank (2015) estimates that the improvements required to achieve fully operational inland waterways transport of grain in Ukraine would require public and private investments totalling USD 580 million: 10 million for river bed dredging, 270 million for improvements in river ports and terminals, and 300 million for new river barges and tugboats.

Step 2b. Seaport reform

Many of the same problems that plague internal waterway transport in Ukraine also plague the seaports on the Black and Azov Seas. The seaports of Ukraine, like those of Kazakhstan and Russia, were devoted in the Soviet era to the import rather than the export of grain - reflecting the Soviet policy of encouraging domestic livestock production - and the seaport infrastructure facilities continue to reflect that now outdated focus (Liefert & Liefert, 2015).

In addition, a large number of tariffs and fees charged to shippers and carriers combine to yield port user costs that are two to five times as high as those charged by competing ports on the Black Sea and comparable ports around the world (Laing & Nivievskiy, 2017; Lopakhin A., 2016). To add insult to injury, the proceeds from these user costs go directly to the Ukrainian treasury, which uses some but by no means all of these sums for investments in river and port facilities (Lang & Nivievskiy, 2017). As the Ministry of Infrastructure (2017, p. 83) notes, «In 2015, USPA [Ukrainian Seaports Administration] generated UAH 2.99 billion in net profits, of which over 60% were transferred to the State budget» - at the time, in the neighbourhood of USD 100 million. Seaport assets were and are heavily depreciated and obsolete, and dredging was and is inadequate. As noted by the experts of the Ministry of Infrastructure of Ukraine, the main problems with Ukrainian seaports and river ports are aging technologies and outdated infrastructure (Ministry of Infrastructure of Ukraine, 2015).

In the seaport sector, the crucial legislation that awaits enactment is that removing the designation of «strategic assets» from the state-owned stevedoring companies. Even without a new law, entry by private stevedoring companies has resulted in a reduction in the share of the state-owned enterprises in freight transshipment from 100 percent in 1991 to 34% in 2014 (Ministry of Infrastructure, 2017), but former Infrastructure Minister Andriy Pivovarsky has argued that only further reform and privatization would complete the task of ridding this sector of the inefficient remnants of the past (Timtchenko, 2016).

Step 3. Land reform

Like other post-Soviet and post-socialist countries, Ukraine began a program of agricultural land reform in the early 1990's (Csaki & Lerman, 1997; Murova, 2015). A series of official acts including the Resolution of Parliament on Land Reform (1990), the Law on Farming (1991), and the Presidential Decree on Land Reform in Agricultural Production (1994) resulted in a gradual transfer of formal ownership of most agricultural land from the state and collective farms to individual citizens in the form of certificates of ownership (Pugachov & Pugachov, 2017). However, a moratorium on resale of agricultural land was imposed, and in addition the actual physical location of the land within a former collective farm connected to individual certificates of ownership was often unspecified, so that a lease back to a large agricultural organization was the only realistic way to monetize the ownership share. The result has been an agricultural sector divided between small farms cultivated

by their owners at least partly for own-consumption and huge corporate farms assembled through lease and purchase transactions, sometimes of uncertain legality, with few farming enterprises of intermediate size (Allina-Pisano, 2007; Keyzer et al., 2017).

The moratorium on agricultural land sales was adopted in its current form in 2002. It was designed as a temporary measure (Lapa et al., 2015), in part to insure an orderly transition to a privately owned countryside and in part to prevent the immediate purchase of the best land by large and especially foreign firms and investors. However, it has been renewed repeatedly and remains in force, in part at least under pressure from politically powerful local agricultural interests.

The results are arguably the presence of a large gray market for agricultural land, the continued high rate of poverty in the countryside, constraints on the use of land as collateral for borrowing, uncertainty and limitations of property rights that lead to overintensive cultivation, inefficient crop mix, and suboptimal investment, and the continued bimodal distribution of farm size (Nizalov et al., 2015). The indirect result is agricultural productivity that - as with the situation in logistics discussed above - is significantly below that of other countries, despite the advantage of Ukraine's extremely fertile soils. Kayzer et al. (2017) estimate that maize yields in Ukraine are 15 percent below the levels of the EU-27 and wheat and barley yields are 40 percent below those levels (though the gaps have become smaller since 2000 - see Liefert and Liefert (2015)).

Ukraine joins Belarus as the only two post-Soviet or post-socialist countries that continue to prohibit the sale of agricultural land (Strubenhoff, 2016). Separate legislation prohibits the sale of remaining state-owned agricultural land (10.5 million hectares, about 25 percent of total agricultural land) and privately owned agricultural land (27.7 million hectares) (Establishment of a land market in Ukraine: current state and prospects, 2017). We consider that the termination of the moratorium on one and then the other source of land allowed to be traded freely would lead to increased production, productivity, and incomes in rural Ukraine - as it has in every other country in the region save Belarus. In addition, the sale of state-owned land would provide a windfall to the government budget - the former Minister of the Economy estimated that the sale of just 1 million of the 10 million hectares of the state-owned land would yield revenues of USD 1 to 2 billion (Abromavičius & Mushak, 2017).

5. Conclusions

As we have discussed, Ukraine has a number of reform steps open to her that would increase agricultural yields and remove constraints and bottlenecks holding back yields, earnings, logistics, and exports. The country lags most conspicuously behind its neighbours in its continued moratorium on the private sale of agricultural land; yet it is not clear that the transport and logistics system could easily handle the increased grain yields that might be expected to result from the removal of restrictions on agricultural land markets. On the contrary, it is rarely mentioned by advocates of land reform as a spur to agricultural productivity that state of the Ukrainian agricultural transport infrastructure that would be required to transport this increased production, either for domestic consumption or for export, is poor, depreciated, and congested. It is more likely that dramatic increase in grain production, even if forthcoming from land reform, would simply result in more output sitting in storage facilities or, worse, deteriorating while waiting for transport in informal storage. Indeed a recent paper emphasizes the importance of «increasing the carrying capacity of [rail] access lines to the seaports», noting that «there is an imbalance in the carrying capacity of ports (310 million tons/year) and port railway infrastructure (125 million tons/year)» (Okorokov & Bulakh, 2018; Klok, 2017).

Our own judgment is that investments and legal reforms related to river freight transport have the most potential for easing constraints that threaten to limit the ability of the agricultural sector to reach its production and especially export potential. This is partly because the vast Ukrainian river system so recently carried so much more freight traffic. As noted by one writer, «In Soviet times in Ukraine, about 60 million tons of cargo were delivered by inland waterways. This ... would be enough to transfer the entire harvest of grain collected by farmers in the year 2015.» (Ryabova, 2017). It is also because, as noted above, the sums required for refurbishment of both river port and seaport facilities are not great, for example as compared with those required by Ukrzaliznytsia.

Significantly increased volumes of grain moving down the Dnipro river (especially) would free scarce railway system capacity both for its own share of the growth of agricultural production and for its crucial role in carrying both non-agricultural bulk freight, especially for export, and passengers. This would in turn buy time for reform, restructuring, and reinvestment in Ukrzaliznytsia, actions that

have been extensively debated and should in principle be relatively quickly implementable. All of this would in turn ease some of the ongoing punishment suffered by the road system of Ukraine as it carries too many cars and trucks that weigh too much.

There is much to be done if incomes in the countryside are to improve and if Ukrainian agriculture is to grow to its potential to meet both domestic and international demand. We believe that there are policy steps waiting to be taken to allow the country to reach its goals.

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