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Estimating the Optimization of School Networks

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Ukrainian secondary education, as measured for example by average class size or by average school size, is very inefficient. There are many sources of this inefficiency. The main of these reasons is historical: for many years, secondary schools outside of large cities were managed by rayons, who had very little incentive to close schools and to optimize local school networks. Moreover, the decision of rayons could have been stopped by local councils (gromadas), which were exceedingly small and had no managerial or financial competence in education, but held veto power over the decisions of rayon councils. Moreover, rayons whose actual class size fell were awarded somewhat increased allocation, further reducing the inventive to optimize. One reaction to this adverse process was the legal restriction that schools with less than 20 students could not be financed from education subvention. Apart from the difficulty of verifying that this restriction is obeyed, the subsequent evolution of secondary education showed that this restriction did not have its intended effect.

In large cities, so called *cities of oblast subordination*, the responsibility for management and financing of secondary schools were exercised by city councils without the obstruction of gromadas.

The secondary schools in 173 cities of oblast subordination were much more efficient, which however is not surprising.

This irrational system was replaced with the beginning of the decentralization process, in which rayons as founders of secondary schools were gradually replaced by so called *amalgamated territorial gromadas* (known by their Ukrainian acronym OTG). The process started in 2016 with 136 OTG, and concluded in 2021, when 1438 OTG totally replaced previous system of over 470 rayons. In the process, also cities of oblast subordination became OTG, and this historical administrative distinction disappeared.

In parallel, a new grant from the national government to local budgets for financing of education was introduced, called *education subvention*. The responsibility for proposing, maintaining, and monitoring of the allocation formula for education subvention rests with the Ministry of Education and Science. The main parameter of the present allocation formula, namely *normative class size*, represents rational assumption about what average actual class size may be achieved through optimization of local school network. It depends of student population density and on share of rural population in the OTG, but does not depend on actual class size. This means that optimization of local school network by OTG may lead to an increase of average class size, but will not lead to a reduction of the allocation. In other words, the decentralization process created a system which should incentivize OTG to optimize their networks of secondary schools.

An important policy tool to support more rational management of school network by OTG was introduction of hub schools and satellite schools in 2017 (previously secondary schools could not have satellites). Presently, out of about 15 200 communal secondary schools in Ukraine, there are about 1 200 hub schools (8,0%) and 1 600 satellite schools (10,7%), while the remaining schools are so called *regular* schools, which are neither hub nor satellite schools (see Table 1).

The purpose of the present Short Note 133 is to propose analytical measures to assess this optimization, at the local, regional, and national level. Two measures are proposed, namely changes to the local network of secondary schools (such as closing a school or changing it from autonomous school into a satellite of larger school), and lowering of school level (meaning the discontinuation of teaching at upper secondary level, grades 10 to 11, or at basic level, grades 5 to 9, whichever is the higher).

In the first section we propose the methodologies for conducting this assessment, based on statistical data collected on September 5 every year. For this reason, the optimization effort of school founders is measured for a school year, from September of one year to September of the following year. Since the complete network of TG has been created only at the beginning of 2020, we have two school years which may be analyzed, namely school year 2019/20 (changes between September 2019 and September 2020), and school year 2020/21 (changes between September 2020 and September 2021). The key concept of *functioning school* is introduced and discussed in Annex.

The following two sections present the results of these two types of assessments of optimization achieved in Ukraine in the school year 2019/20 and in the school year 2020/21. In the last section we formulate brief conclusions of the SN. The main conclusion is that optimization during the school year 2020/21 became much stronger than in the school year 2019/20. This indicates that the decentralization process provided correct incentive mechanisms in secondary education in Ukraine.

The present Short Note 133 is continuation of analytical support to the Ministry provided by the Ukrainian-Swedish project “Support to Decentralization in Ukraine” (SDU). The efficiency of networks of rural schools were addressed by the report on 40 rural rayons, prepared with SDU support in 2016. Policy options regarding the fragmented networks of rural schools were proposed in SN 25 (August 2015). Recent changes in the networks of secondary schools were reviewed in SN 116 (January 2020).

1. Types of optimization of local school networks

By optimization of school network we mean any change which leads to more efficient use of school resources, especially resulting in increased class sizes and higher student-teacher ratio. By local networks of secondary schools we mean networks of schools managed by territorial gromadas. Three main types of optimization of local networks of secondary schools can be listed:

1. School closure,
2. Transformation of regular schools into hub or satellite schools,
3. Lowering of school level.

All three type of optimization have the effect that some students, often those in basic or upper secondary grades, need to move to study to a different school, usually located further from their home. This should have the result of increased class sizes and consequently of reduction of required number of teachers.

The first two types of optimization may be analyzed together, as both are examples of changes to local network introduced by the school founder. Besides school closures and transformations of regular schools, the changes of school network include also transformation of other school types and opening of new schools (see section 1.1). Lowering of school level means discontinuation of teaching at one of three school levels recognized in Ukraine (see section 1.2).

Alongside these three types of optimization, there are also more subtle optimization measures, for example merging of parallel classes within one school (this sometimes happens in grade 10), but these are more difficult to identify using available statistical data and are not discussed here.

The identification of changes to school network and of lowering of school level is performed using data from statistical forms ZNZ-1, collected in DISO system. Since there are some data issues in DISO, an appropriate methodology needs to be developed. In particular, it is necessary to identify records in DISO which correspond to functioning schools, that is to actual communal schools which teach students and which report them to DISO. This preliminary methodological step is reviewed in the Annex. Further methodological issues for two types of optimization measures are discussed in the next two subsections.

1.1. Changes in the network of secondary schools

Changes to local school network cover such situations as school closures, change of status of school (for example, when a regular school is changed into a satellite), and creation of new schools. Internal reorganization of school activities (consolidation of classes, change of school level) is not included. We identify 12 different changes which may be made to local network of schools, and which depend on the status of school (regular, hub, satellite). These are:

- Three forms of school closures (depending on school type),
- Six possible changes of the status of school,
- Three forms of creation of new schools (depending on school type).

The most important and most common changes of status are transformation of regular school into a hub school or into a satellite school. We include in this list all possible changes of status, but some of them may be very rare (for example, change of satellite school back into a regular school) or may reflect data errors (for example, when a hub school is changed into satellite). All these specific changes are reported in Table 1. Only school closures and school opening change the overall number of schools.

Technically speaking, creation of new schools or transformation of a satellite into a regular school is not in itself an optimization measure. New schools are required especially in large, growing cities to satisfy increasing demand for education, especially in rapidly increasing residential rayons. We need to include these types of changes of local school network in our review in order to ensure that the all considered changes together explain the evolving number of different types of schools from one school year to the next one.

Only communal schools identified as functional are considered (see Annex). For each such school, DISO system records the type of school, namely regular, hub, or satellite. A regular school is considered to be closed during the school year 2019/20 if it is recorded as regular school in September 2019 and as not functioning school in September 2020. A regular school is considered to be created during the school year 2019/20 if it is recorded as not functioning school in September 2019 and as a regular school in September 2020. A regular school is considered to be transformed into a satellite during the school year 2019/20 if it is recorded as a regular school in September 2019 and as a satellite school in September 2020. Analogous definitions apply for other types of schools and for the school year 2020/21. Data for the whole country are reported in Table 1.

Data inconsistencies in DISO discussed in Annex indicate that at least some cases of school opening or closures are due to data errors. However, it was decided not to correct the relevant records, in part because it is not always clear how to correct them, and in part because the school founders should correct them themselves. A table analogous to Table 1 was created for every TG and is published together with subvention statements, allowing territorial gromadas to review and correct the information in DISO.

1.2. Lowering of school level

Ukrainian secondary schools operate with three school levels: initial (grades 1 to 4), basic (grades 5 to 9) and upper secondary (grade 10 and 11). The levels are denoted I, II, and III. Accordingly, there are six possible grade configurations, namely I, I-II, I-III, II, II-III, III (no schools with just initial and upper secondary grades exist). Grade configuration is reported in DISO, although in many cases it is different from grade configuration determined by enrollment of students from different levels in the school. Moreover, it may happen that grade configuration reported in DISO is different from grade configuration stated in school statutes, especially if that status was adjusted.

Lowering of school level covers situations in which the highest level of school is discontinued, and its students are transferred to nearby schools. Often this is related to satellite schools, covering only initial or initial and basic school, with students moving on into the hub school. As mentioned above,

we do not separately consider discontinuation of upper secondary and of basic instruction. Nevertheless, the lowering of school level may depend on the following conditions:

- Whether the lowering of school level applies to a regular school, applies to a satellite school, or is introduced together with the change of the status of the school from regular to satellite (three options),
- Whether the lowering of school level is identified on the basis of information reported to DISO, or on the basis of actual disappearance of students in formerly highest school level in the school (two options).

Lowering of school level should not apply to hub schools, which are always assumed to be schools with grade configuration I-III.

In this manner, we can identify 6 types of lowering of school level. Only schools identified as functional are considered (see Annex). A school is considered to have lowered school level according to DISO in the school year 2019/20 if between September 2019 and September 2020 it's reported in DISO grade configuration changes from I-III or II-III to I-II or I, or from I-II to I. Of course, in both years the school must be identified as functioning (see Annex). Analogous definitions apply if instead of grade configuration reported in DISO one uses grade configuration determined on the basis of student enrollment, and for school year 2020/21. Data for the whole country are reported in Table 4.

2. Review of changes to the network of secondary schools 2019-2021

The following Table 1 presents changes to the network of secondary schools introduced in school years 2021/20 and 2020/21.

Table 1. Changes to the network of schools 2021-2021, Ukraine

		Number of schools			
		Regular	**Hub**	**Satellite**	**Total**
Schools on September 5, 2019		14 020	772	1 189	15 981
Schools closed during the school year 2019/20		-151	-1	-47	-199
Change of school status introduced during the school year 2019/20	Regular into hub	-280	280		
	Regular into satellite	-217		217	
	Hub into regular	55	-55		
	Hub into satellite				
	Satellite into regular	16		-16	
	Satellite into hub				
Schools opened during the school year 2019/20		8		59	67
Schools on September 5, 2020		13 451	996	1 402	15 849
Schools closed during the school year 2020/21		-508	-1	-209	-718
Changes introduced during the school year 2020/21	Regular into hub	-232	232		
	Regular into satellite	-435		435	
	Hub into regular	11	-11		
	Hub into satellite		-1	1	
	Satellite into regular	23		-23	
	Satellite into hub				
Schools opened during the school year 2020/21		46		19	65
Schools on September 5, 2021		12 356	1 215	1 625	15 196

We notice very significant increase in the number of changes to local school network introduced in school year 2020/21 compared to school year 2019/20. In particular, the number of schools closed more than tripled, and the number of regular schools transformed into satellites doubled. This indicates that as the new school founders have learned their new responsibilities and consolidated their control over the school networks, they were able to undertake more active role.

Small number of changes to hub schools and to satellite schools may indicate data errors. Similarly, schools opened as satellites may represent satellite schools which were not reported in DISO a year earlier.

To put the data in Table 1 into proper context, in the following Table 2 we provide the share of schools of different types which underwent changes in the two school years considered.

Table 2. Share of schools undergoing changes 2019-2021, Ukraine

		Share of schools			
		Regular	**Hub**	**Satellite**	**Total**
School year 2019/20	Schools closed	1,08%	0,13%	3,95%	1,25%
	Schools with changed status	3,54%	7,12%	1,35%	
	Schools opened	0,06%		4,96%	0,42%
School year 2020/21	Schools closed	3,78%	0,10%	14,91%	4,53%
	Schools with changed status	4,96%	1,20%	1,64%	
	Schools opened	0,34%		1,36%	0,41%

Data from the school year 2020/21 should be viewed as more reliable, because by then all territorial gromadas had at least one full year of managerial experience. We note that about 4,5% of all communal secondary schools have been closed, and 5% of all regular schools transformed into hub or satellite schools.

The most significant finding of Table 2 is that almost 15% of all satellite schools were closed. There are several possible explanations of this:

- Data errors: non-reporting of satellite schools in DISO in the following year,
- Closures of satellites created previously by the rayons in situations, when the hub turned out to belong to one TG while the satellite to another TG (different founders of satellite and hub schools),
- Transformation of a regular school to satellite is the first step towards closing the school, followed by lowering of school level, and then completed by closing the remaining, very small school.

The intensity of changes introduced to local school network is differentiated regionally. The following Table 3 presents selected data from Table 2 broken by oblast. We present the share of regular schools transformed into either hub schools or satellite schools, as well as the share of all schools closed. The shares are presented for 2 school years for which we have complete data.

Table 3. Share of closed and transformed regular schools 2019-21, by oblast

	Share of regular schools with changed status		Share of all schools closed	
	2019/20	**2020/21**	**2019/20**	**2020/21**
Ukraine	3,54%	4,96%	1,25%	4,53%
Вінницька	5,06%	11,08%	1,09%	6,20%
Волинська	4,45%	1,27%	1,34%	8,13%
Дніпропетровська	2,21%	3,03%	0,32%	1,39%
Донецька	1,41%	4,52%	1,14%	2,50%
Житомирська	4,20%	1,48%	1,78%	6,86%
Закарпатська	6,88%	9,56%	0,61%	3,22%
Запорізька	1,60%	6,13%	1,08%	2,73%
Івано-Франківська	4,20%	9,43%	1,81%	3,22%
Київська	5,73%	10,89%	0,00%	3,37%
Кіровоградська	10,32%	5,15%	2,41%	3,48%
Луганська	1,53%	3,91%	0,68%	5,44%
Львівська	0,90%	2,11%	0,85%	4,38%
Миколаївська	1,96%	1,57%	1,16%	4,50%
Одеська	3,91%	9,00%	0,38%	2,71%
Полтавська	7,26%	7,75%	1,57%	6,84%
Рівненська	1,62%	1,09%	0,76%	5,63%
Сумська	4,36%	4,94%	3,00%	6,64%
Тернопільська	1,79%	1,99%	1,56%	4,62%
Харківська	2,28%	1,71%	0,92%	3,57%
Херсонська	5,17%	4,40%	2,24%	2,06%
Хмельницька	2,09%	0,51%	4,20%	6,76%
Черкаська	5,99%	4,01%	1,02%	6,36%
Чернівецька	4,39%	17,07%	0,48%	4,31%
Чернігівська	4,01%	3,29%	1,98%	8,45%

Table 3 shows that regional differences of optimization effort in Ukraine are very large. For example, the share of transformed regular schools in 2020/21 ranges from 0,51% to 17,07%, while the share of closed schools ranges from 1,39% to 8,45%. We also note that some regions, like Volynska and Chernihivska, have strong preference for closing schools, and conduct few changes of school status, while other regions, like Chernivecka or Kyivska, do the opposite.

We also note that while overall there is a significant increase of changes to local school networks introduced in 2020/21 in comparison to 2019/20, there is a difference between shares of school transformations and of school closures. There are 10 regions, in which the share of regular schools transformed declined in 2020/21 compared to the previous year, while the share of closed schools increased in all regions except one (Hersonska), in some cases very significantly (note for example the case of Chernivecka).

3. Review of lowering of school level 2019-2021

The following Table 4 summarizes lowering of school level in secondary schools introduced in school years 2021/20 and 2020/21.

Table 4. Lowering of school level 2019-2021, Ukraine

		Based on DISO	Based on student numbers
School year 2019/20	Regular	243	379
	Regular transformed into satellites	32	33
	Satellites	70	45
	Total	345	457
School year 2019/20	Regular	398	543
	Regular transformed into satellites	99	121
	Satellites	98	82
	Total	595	746

It is interesting to note in Table 4 the differences between changes of school level reported in DISO and assessed on the basis of student numbers. Actual lowering of the school level, that is discontinuation of instruction in the previously highest education level, is about 25% higher as lowering of level reported in DISO. This almost certainly reflects the fact that school founders take managerial decisions to optimize school network, but for different reasons delay formalizing those decisions in school statutes and in DISO. This interpretation is supported by the fact that the reported and the actual numbers lowering of school level are quite close for regular schools being transformed into satellites. Indeed, when such a change is implemented, school statutes need to be adjusted the school loses its status of legal person), and the change is more correctly and more quickly reported in DISO. It is also supported by the fact that lowering of school level of satellites as reported in DISO is higher than the lowering based on student numbers (the opposite situation to regular schools). This indicates that in satellites, instruction in the highest school level is discontinued in fact first, and recorded in DISO with some delay.

The difference between the school years 2019/20 and 2020/21 is striking. The number of cases of lowering school level doubled. This is quite similar to the difference between the two school years evident for changes of local school networks (Table 1).

Similarly to the previous section, we provide the share of all schools (excluding the hub schools) which had their school level lowered.

Table 5. Share of schools with lowered school level 2019-21, Ukraine

		Based on DISO	Based on student numbers
School year 2019/20	Regular	1,73%	2,70%
	Regular transformed into satellites	14,75%	15,21%
	Satellites	5,89%	3,78%
School year 2019/20	Regular	2,96%	4,04%
	Regular transformed into satellites	22,76%	27,82%
	Satellites	6,99%	5,85%

Apart from the increased frequency of lowering of school level in the school year 2020/21 compared to the previous school year, and higher incidence of lowering based on student numbers than based on DISO (already seen in Table 4), we also observe important differences between the school types. Clearly, school level is reduced much more often in satellite schools than in regular schools. This is to be expected, indeed one of the main reasons for transforming a regular school into a satellite is to be able to reduce the school level. However, most often we notice the lowering of school level for

regular schools at the same moment when they are transformed into satellites. In other words, these two types of optimization are relatively often performed together, however not always: as Table 5 shows, in the school year 2020/21 over 70% of regular schools which were transformed into satellites did not have their school level lowered.

As for the changes of local school network, our final step is a review of regional differentiation of intensity of lowering of school level. We consider only lower based on student numbers.

Table 6. Share of schools with lowered school level 2019-21, based on student numbers, by oblast

	Share of regular schools with lowered level		**Share of transformed regular schools with lowered level**		**Share of satellite schools with lowered level**	
	2019/20	**2020/21**	**2019/20**	**2020/21**	**2019/20**	**2020/21**
Ukraine	2,70%	4,04%	15,21%	27,82%	3,78%	5,85%
Вінницька	2,39%	3,84%	6,25%	24,59%	1,52%	2,47%
Волинська	1,37%	1,09%	0,00%	25,00%	1,69%	0,00%
Дніпропетровська	3,20%	8,08%	27,27%	62,50%	2,47%	3,26%
Донецька	3,43%	3,70%	0,00%	28,57%	11,76%	0,00%
Житомирська	2,63%	6,46%	0,00%	20,00%	4,17%	0,00%
Закарпатська	0,15%	0,49%	0,00%	7,69%		6,90%
Запорізька	4,60%	4,91%		43,48%	0,00%	10,71%
Івано-Франківська	2,10%	2,20%	0,00%	7,14%	11,90%	3,45%
Київська	1,59%	6,20%	9,09%	34,21%	4,08%	3,39%
Кіровоградська	3,17%	5,58%	36,36%	12,50%	10,06%	14,86%
Луганська	3,05%	2,34%	0,00%	28,57%	10,53%	0,00%
Львівська	0,72%	1,01%	25,00%	15,79%	0,85%	3,36%
Миколаївська	4,36%	6,94%	66,67%	0,00%	2,38%	0,00%
Одеська	1,54%	3,19%	28,57%	36,17%	0,00%	12,33%
Полтавська	6,72%	5,17%	6,67%	36,84%	0,00%	7,27%
Рівненська	0,36%	3,64%	0,00%	25,00%	0,00%	5,41%
Сумська	5,45%	4,94%	50,00%	53,85%	5,56%	5,56%
Тернопільська	1,04%	2,61%	0,00%	0,00%	0,00%	4,29%
Харківська	3,50%	3,42%	60,00%	55,56%	0,00%	5,08%
Херсонська	2,58%	6,87%	33,33%	0,00%	0,00%	2,17%
Хмельницька	4,18%	4,12%		100,00%	0,00%	0,00%
Черкаська	4,12%	7,41%	15,00%	20,00%	5,26%	20,00%
Чернівецька	1,55%	0,81%	28,57%	32,35%	5,00%	0,00%
Чернігівська	5,79%	6,34%	16,67%	54,55%	9,09%	0,00%

In Table 6, empty cell indicates either that there was no satellite school in 2019 (Zakarpatska oblast) or that there were no regular schools transformed into satellites in the school year 2019/20 (Zaporiska and Hmelnitska oblasts). The value 0,00% indicates that not a single school of appropriate group had its school level lowered.

Once again, similarly to Table 3, we note significant regional differentiation of optimization efforts of territorial gromadas. The share of regular schools which had lowered school level ranges from 0,41% in Zakarpatska oblast to 8,08% in Dnipropetrovska. The values for regular schools transformed into satellites are less reliable because they are based on small numbers of cases (for example, in

Hmelnitska oblast there was just one such school, and its school level was reduced, leading to value of 100%).

Relatively high share of regular schools with lowered school level (such as in Dnipropetrovska, Cherkaska, Mikolaivska oblasts) may indicate an alternative strategy towards optimization, in which a regular school first has it school level lowered before being transformed into a satellite. More years of data are needed to assess whether this strategy is widely used by territorial gromadas.

4. Conclusions

In order to assess the effort of founders of secondary schools to optimize their local school networks, a methodology has been developed to identify school closures, transformation of school status, and lowering of school level (section 1, Annex). These measures have been applied to available statistical data on secondary education for school years 2019/20 and 2020/21 (sections 2 and 3). The analysis covers the whole country, but is restricted to the period after the amalgamation process of territorial gromadas was finally completed.

The following general conclusions may be formulated on the basis of available information:

- The optimization effort of territorial gromadas was radically strengthened during the school year 2020/21 in comparison to year 2019/20. This is most likely related to the fact that many amalgamated territorial gromadas appeared in 2020 for the first time, and had no experience and no administration able to design and implement optimization measures to their local school networks.
- The intensifying of optimization in successive school years is especially evident for school closures. For transformations of regular schools, despite overall increased intensity in 2020/21, there were several regions where this intensity fell, especially if in the previous year territorial gromadas undertook many such transformations (for example, in Kirovogradska).
- Analogously, the intensity of lowering of school level increased in the school year 2020/21 compared to the previous year. Interestingly, the share of regular schools transformed into satellites which had their school level lowered at the same time increased from 15,21% in 2019/20 to nearly 28% a year later.
- Optimization effort of founders of secondary schools exhibits significant regional variation. This may be due to different local conditions (in some regions optimization is very difficult to implement), to different experience of education departments of territorial gromadas (the gromadas which were formed more recently need time to fully assume their strategic responsibilities in the sector), or to different political decisions (some school founders may prefer to maintain small schools with very small class sizes to avoid conflict with parents and teachers). However, such differentiation should be expected in a truly decentralized education system.
- We may conclude that availability of different strategies for optimization of school networks (school closures, transformation of regular schools into hub or satellite schools, lowering of school level), coupled with the fact that such changes lead to cost savings but do not lead to a reduction of allocated education subvention, is increasingly being used by the founders of secondary schools. It may be expected that this process will continue in future years, resulting in gradual increase of overall efficiency of Ukrainian education.

An important lesson from the analysis presented in the present Short Note is that system DISO, which collects and maintains statistical data about Ukrainian secondary education, exhibits data problems and inconsistencies between years. This is due to the lack of a proper *registry of secondary schools*, which would allow to clarify which changes to local school network are actually implemented, and which merely reflect some data errors. Creation of an effective, well-organized school registry is an urgent task of the Ministry of Education and Science of Ukraine.

Kyiv, December 16, 2021

Annex. Identification of "functioning schools" in DISO

The methodology employed in the present SN is based on statistical data collected from schools using ZNZ-1 statistical forms and maintained in EMIS-type database DISO (in the future will be known as AIKOM). The forms are collected in September of every year, with data valid on September 5.

The system DISO includes many records of schools which for different reasons are not relevant for the purposes of school registry or of education subvention. The following criteria (filters) are used to identify whether a record in DISO database corresponds to a functioning school:

- No test records: budget code not equal to 00000000000 and not empty,
- School active: data item Активна(1)не активна(0) = 1;
- School activity not stopped: data item activity_is_stopped = 0;
- School is not closed for other reasons: data item not_work_other_reasons = 0;
- School not closed for reconstruction: data item overhaul = 0 (in 2021, there appeared a school which had this data item set to 1 but which had to be included, so this part of the filter was not used),
- School is obliged to submit ZNZ-q form: data item school_rep_send_znz1 = 1;
- School submitted ZNZ-1 form: data item znz1_exists = 1,
- Correct year of the record.

Since the data items listed above are entered into DISO separately, some internal contradictions are possible. For example some schools identified as functioning had no reported students (in September 2021, 25 schools, including private ones), and some schools identified as not-functioning had reported students (in September 2021, 8 schools with 438 reported students). We consider these special cases to be data errors.

The following criteria were used to identify communal schools:

- No state schools: budget code not equal to 30000000000,
- No private school: budget code not equal to 27000000000 or to 29000000000.

Similarly to the identification of functioning schools, the budget code is entered separately for the data item Форма_власності (form of ownership) and in some cases these are different from the identification of private or communal schools according to the budget code. We consider the budget code to be more reliable.

Data collected in DISO reveal also additional problems. For example, there are five communal schools which are reported as functional in 2019 and 2020, but not in 2020. Since it is not possible that a school was closed for one year and reopened, this is certainly data error. Similarly, there are 12

communal schools which are reported as functioning only in 2020, but not in 2019 or 2021. It is not possible that schools are opened and then closed a year later. Thus identification of changes of school network according to methodology described in section 1.1 is not always reliable.