



INTENZITA NÁKLADNÍ DOPRAVY NA HLAVNÍCH TAZÍCH JIHOMORAVSKÉHO KRAJE

D.T2.4.1 - Mapping of road freight transport
flows crossing the South Moravian Region

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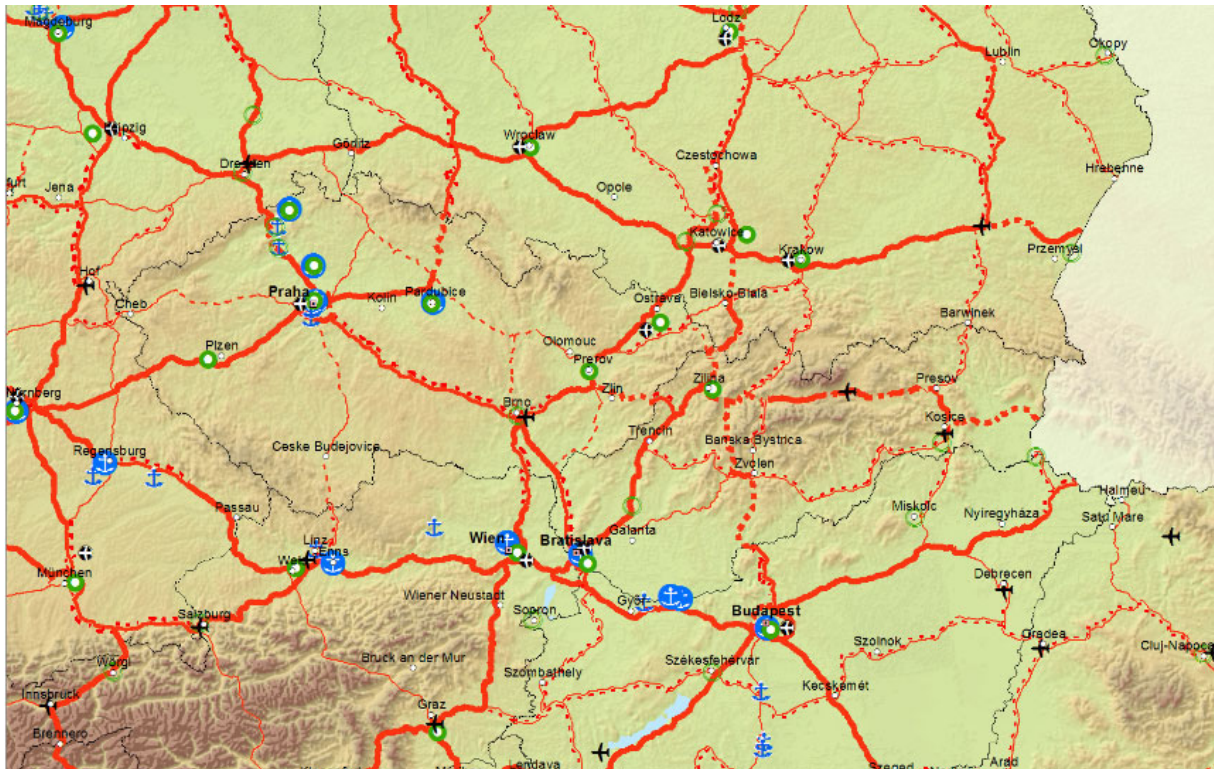
LIST OF ABBREVIATIONS USED

AT	Austria
BiH	Bosnia and Herzegovina
BUL	Bulgaria
BY	Belarus
CZECH REPUBLIC	Czech Republic
GER	Germany
HR	Croatia
HU	Germany
JMK	South Moravian Region
EN	Lithuania
EN	Latvia
MAK	Northern Macedonia
OST	Other
EN	Poland
ROM	Romania
RU	Russia
RZ	Registration mark
EN	Slovakia
SLO	Slovenia
SRB	Serbia
THERE	Turkey
UA	Ukraine

INTRODUCTION AND METHODOLOGY

The Czech Republic plays an important role in the European transport area, especially as a transit country connecting the North, North-East and North-West with the South and South-East of Europe. At the same time, it forms a crossroads of routes within the Central European region. The South Moravian Region and the international roads passing through it are a natural choice for transit traffic connecting the area south and east of Brno (Slovakia, Austria, Romania, Hungary, Serbia, Bulgaria) with the area of the northern half of Germany, Denmark, Poland and the Baltic States.

Figure 1 Trans-European road routes in Central Europe



Source.

The aim of this study is to map international freight traffic flows on the backbone roads leading through the territory of the South Moravian Region (hereinafter referred to as "SMR"). In this context, the D1, D2, D52 and D46 motorways and the first class roads I/43 and I/50 are considered as backbone road infrastructure. Attention is paid to the intensity and nationality structure of the road traffic flows in question, based on the registration marks (hereafter RZ) captured in the toll system.

A key part of the analysis is based on toll data from 2020, a year that was significantly affected by the covid-19 pandemic, which raises the question of whether the 2020 data is sufficiently reliable. To answer this question, we compared data from 2019 and 2020 where possible. This working comparison showed that overall annual traffic volumes on D1 were broadly unchanged. There has been a slight increase in the volume of movements by domestic hauliers (c.2%) and an equivalent decrease for international hauliers. On D2, the situation for domestic hauliers was almost the same in 2019 and 2020 (with the exception of the last section before the border with Slovakia, where there was a decrease of 14% for domestic hauliers). For international hauliers, the year 2020 on D2 is at about 95% of 2019. There were no significant deviations on D46.¹

¹ The other roads were not in the toll system in 2019 and therefore no comparison is possible.

The analysis is divided into three thematic units. The first chapter, which forms the first thematic part, compares the possibilities and limitations of different data sources that are applicable for the analysis of international traffic flows. As our analysis is based on data from the toll system, the data collection methods for international traffic analysis are compared and their weaknesses and strengths are identified. In the second part, which consists of Chapters 2 and 3, the framework context of freight transport in the Czech Republic and South Moravia is presented. The key part of the analysis consists of Chapters 4 to 9, which are devoted to the intensity and nationality structure of traffic flow on motorways and toll roads in the South Moravian Region. Each road is given its own chapter, which presents the share of domestic and foreign carriers, the nationality structure of foreign carriers and the directional asymmetry on individual motorway sections. For the sake of clarity, those sections where there are no significant changes are omitted from the analysis.

1 COMPARISON OF THE POSSIBILITIES AND LIMITS OF DATA SOURCES

Obtaining information on the size and routing of international carriers faces the issue of data validity in terms of number of cars, details of vehicle type, origin and destination of the vehicle, registration number, etc. In terms of potential sources of information, 4 main types of data sources were offered: i) toll system, ii) traffic census, iii) questionnaire survey and iv) mobile operators' big data. As will be seen below, none of the data collection methods is ideal in terms of the comprehensiveness of the information provided.

1.1 Toll system data

Toll section data provides robust information about the strength of traffic flow on a given section, including information about the tractor's RZ. The information value of the traffic flow strength on that particular section of the toll road is maximally accurate and there is no more reliable method of data collection from this perspective. Continuous data collection makes it possible to determine the seasonal, weekly, daily or even hourly temporality of the traffic flow. At the same time, it is also possible to investigate certain experimental situations on these data, such as the effect of closures or restrictions on the operation of selected sections during given periods, although for a comprehensive evaluation of such a phenomenon it would also be necessary to collect certain data on potential detour routes.

However, the above accuracy only applies to vehicles that are registered with the toll system. In addition, another weakness of this data source is that, although the information on the registration number of the tractor is as accurate as possible, it does not in itself tell us about the origin or destination of a particular vehicle. As there are no toll sections at all (major) border points in the Czech Republic, this data cannot (yet) be used to determine the origin and destination of freight transport in an exact way. Therefore, it is not possible to say whether a truck with a Slovak RZ ends its journey in Kladno or continues to Dresden, or if it has already started its journey in Budapest. On the other hand, it can be assumed that most of the registration marks will correspond to either the origin or the destination of the vehicle. Thus, a truck with a Polish licence plate will probably travel from Poland in the northbound direction and again to Poland in the southbound direction, etc. Thus, only half of the required journey information can always be identified (with high probability), while the other half can only be guessed (e.g. the destination of a truck with a Polish registration plate travelling on the D52 will most likely be Austria) or obtained from other sources (e.g. from a questionnaire survey).

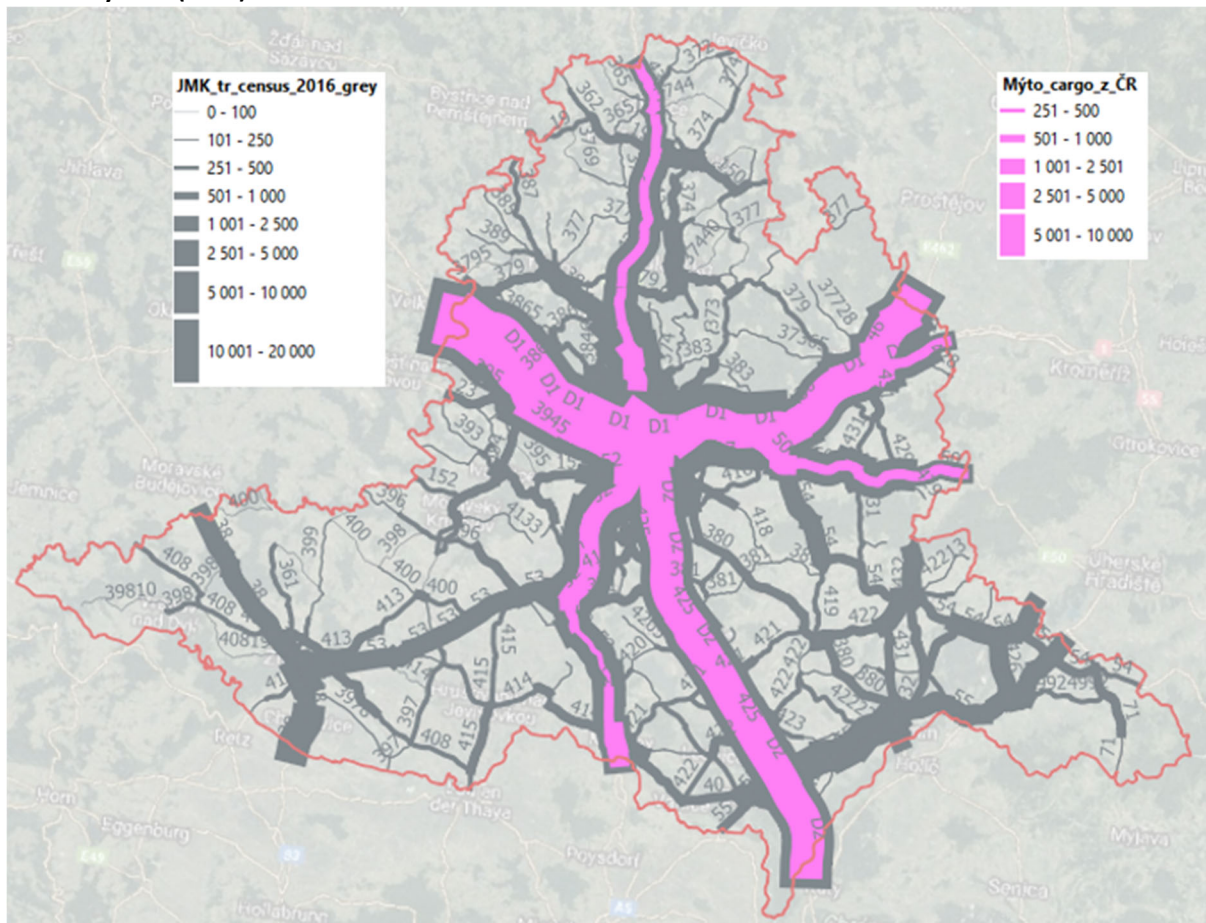
1.2 Transport census data

Traffic count data can be more information-rich than toll data, for example by allowing a more detailed classification of vehicles according to their primary destination. Another advantage of traffic count data is to capture traffic flows in places where the toll system is not in operation. On the other hand, the census data is burdened with statistical error, as the counts are only carried out in a few limited time periods, whereas the toll system captures vehicles continuously.

The following figure shows the results of the two data sources and their comparison with each other, namely the data from the 2016 traffic census (Ministry of Transport, 2016) and the data from the toll system (Regional Transport Authority, 2020). Both datasets capture the intensity of freight traffic on selected roads and motorways in the South Moravian Region. The input vehicle categories differ slightly between the sources:

- 1) Trucks over 3.5 tonnes enter the toll system net of bus passes.
- 2) For the 2016 transport census, the following categories were included: LN - Light Goods Vehicles (payload up to 3.5 t) without trailers and with trailers, SN - Medium Goods Vehicles (payload 3.5-10 t) without trailers, SNP - Medium Goods Vehicles (payload 3.5-10 t) with trailers, TN - Heavy Goods Vehicles (payload over 10 t) without trailers, TNP - Heavy Goods Vehicles (payload over 10 t) with trailers and NSN - Semi-trailer Sets of Goods Vehicles.

Figure 2 Comparison of daily freight vehicle volumes according to the traffic census (2016) and according to the toll system (2020)



Source: data Ministry of Transport (2016), RDS (2020); own processing

Although the traffic flows from the traffic counts are stronger than those from the toll data, the results cannot be interpreted to mean that the traffic counts overestimate the values of freight traffic flows. As already mentioned above, in the traffic census the category of trucks is more broadly defined, and the comparison of the data thus potentially allows to distinguish light trucks above 3.5 t. The comparison has methodological limitations, but nevertheless gives an interesting picture of the situation. Some of these limitations would be removed if the data from the traffic census and the toll system were collected in the same year.

1.3 Questionnaire survey

The advantage of a questionnaire survey is to find out precise information about the origin and destination of the vehicle and, if necessary, the nature of the cargo. The depth of information obtainable by questionnaire surveys is not replaceable by mass data collection methods. The disadvantage of this approach is the high time-consuming nature of the data collection and the risk of (even significant) deviations from the actual situation if the methodology is poorly chosen. However, a well conducted questionnaire survey combined with data from the toll system can provide very interesting information (e.g. if the questionnaire shows that most Slovak, Romanian and Hungarian hauliers end up in Germany).

The above also reveals the comparison of the results of this study according to the data from the toll system and the CORCAP study. The CORCAP study gives quite different results - the information on the significant role of Polish trucks completely disappears, and Germany, Hungary, Romania and Slovakia dominate. On the other hand, the information on Germany as a country of destination/origin essentially disappears from the toll data and this information can only be (imprecisely) estimated from the data based on knowledge and information from other

sources. These different results thus clearly show that both methodologies have weaknesses. When collecting data from questionnaire surveys, it might be advisable not to select drivers randomly, but to adjust the structure of the respondents to the national structure according to the toll system (e.g. if 50% of foreign RZs are Polish trucks, then 50% of Polish truck drivers should be interviewed). Such a modified methodology could then also answer the questions of where a typical Polish or Slovak truck comes from and where it goes to. Alternatively, it could confirm one of the possible reasons for the different results, i.e. the hypothesis that Polish trucks do not stop at rest areas in the South Moravian Region and are thus not captured by the questionnaire survey.

1.4 Big data of mobile operators

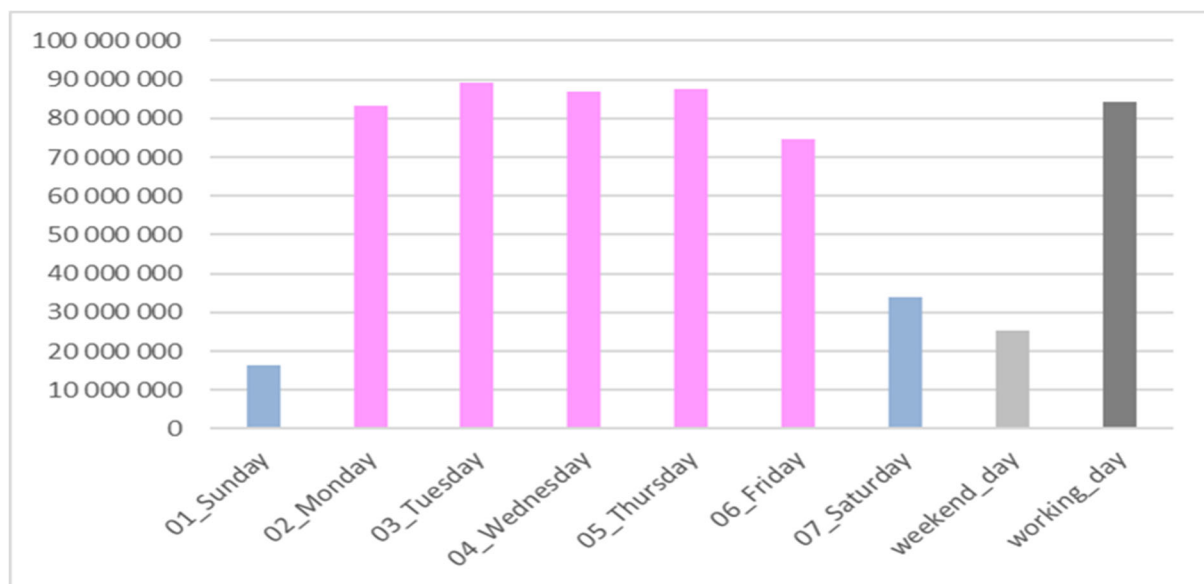
By mobile operators' big data, we mean residual signalling data, which is a rich source of information about the mobility of the population, including the relatively precise location of the start and end of the route.

For the purpose of monitoring total (passenger and freight) traffic flows, this method is applicable, albeit with some limitations. However, as it is not easy to distinguish freight, bus and passenger transport in the data, this method is not applicable for the analysis of freight flows alone.

2 SELECTED INFORMATION ON FREIGHT TRANSPORT IN THE CZECH REPUBLIC

Before the analysis of transport and its structure in the South Moravian Region is carried out, this chapter presents selected characteristics of transport in the country focusing on the seasonality and temporality of freight transport. Figure 3 below shows the load on the motorway network and selected toll sections of Class I roads in the CR in 2019 by day of the week. The most significant days in terms of road freight traffic were Tuesdays, followed by Thursdays and Wednesdays, and then Mondays. On all of the above days, the total number of truck movements through the toll gates for the entire year was above 80 million. A more significant drop occurred on Fridays, when the load dropped to around 75 million truck movements, the drop continued on Saturdays to around 30 million movements and the bottom fell out on Sundays with a level of under 20 million toll gate movements on the entire toll network for the year. Working days were therefore roughly three times as busy in terms of freight traffic as weekend days.

Figure 3 Average freight traffic load on motorways and selected Class 1 roads in the whole Czech Republic by day of the week in 2019 (number of toll gates)

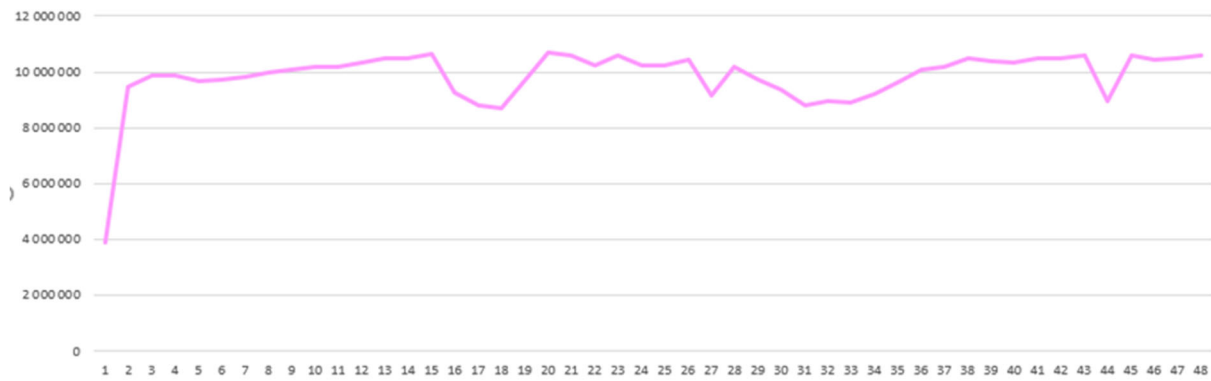


Source: data from ŘSD (2019), own processing

Figure 4 shows the network load of trucks in each week of 2019. There² is a clear decrease in freight traffic in the first days after the New Year, when the weekly load is around 4 million passes through the toll gates, while for the rest of the year this load oscillates around 10 million passes per week. Some other more significant decline is seen in the period from week 16 to week 18, which in 2019 was the period between the Easter holidays and the two public holidays in May. Other more significant declines occurred in late July and August, and then in the first week of November, which is a national holiday in many surrounding states.

² Except for the weeks of December when the toll collection method changed and the numbers would not be comparable.

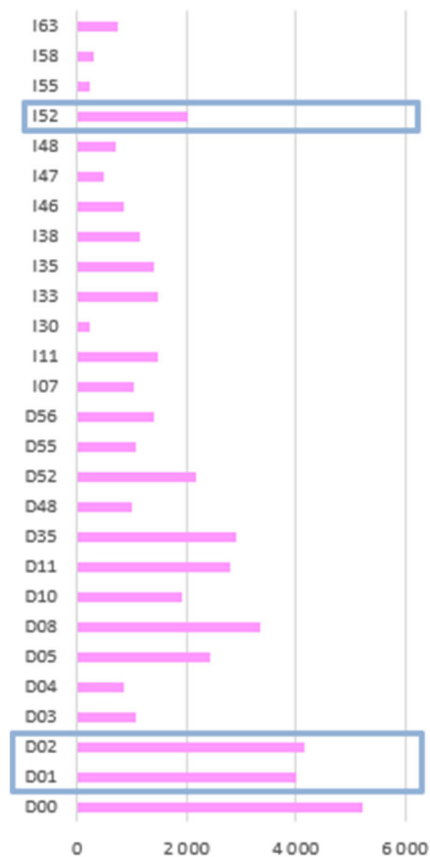
Figure 4 Average freight traffic load on motorways and selected Class 1 roads in the whole Czech Republic by week in 2019 (number of toll gates)



Source: data from ŘSD (2019), own processing

The following figure presents the average freight load on motorways and selected Class I roads in terms of average daily freight traffic volumes. It can be seen that the D1 and D2 motorways are among the most congested freight corridors in the Czech Republic, alongside the Prague D0 motorway bypass.

Figure 5 Average freight load on motorways and selected Class 1 roads in 2019

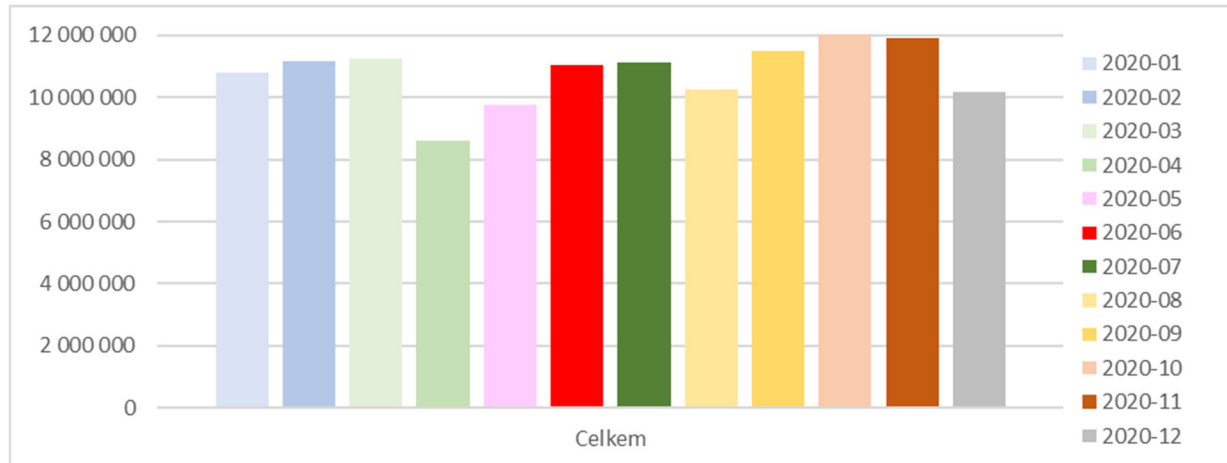


Source: data from ŘSD (2019), own processing

3 TEMPORALITY AND INTENSITY OF TRAFFIC IN 2020 IN THE SOUTH MORAVIAN REGION

In terms of seasonality, the results for the South Moravian Region are expressed in the following figure, which shows the number of truck passages in the South Moravian Region in total for all relevant toll sections in 2020.

Figure 6 Comparison of the number of truck passages through toll sections in the South Moravian Region in individual months of 2020



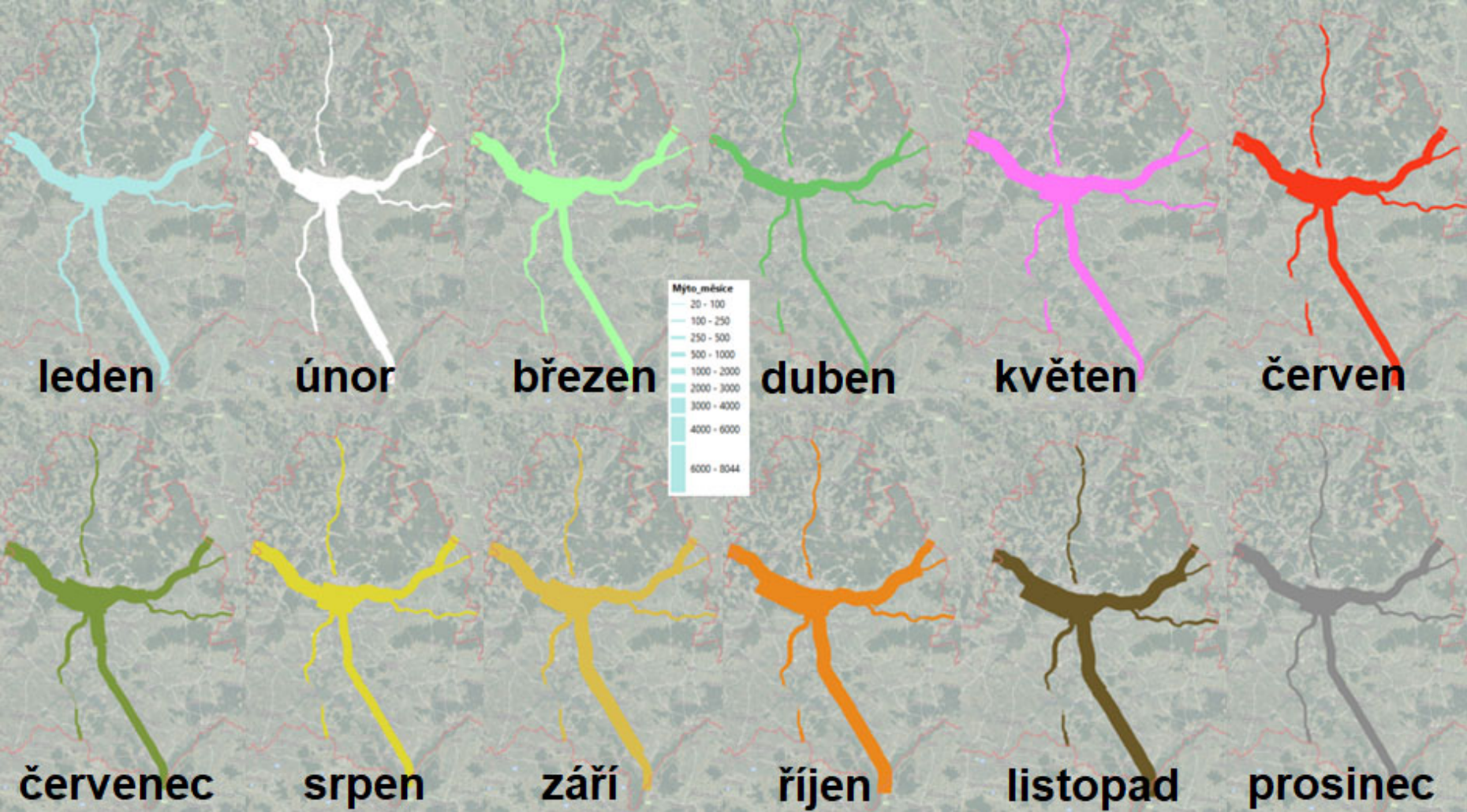
Source: data from ŘSD (2020), own processing

This year has been very specific due to the covid-19 pandemic, but freight transport can be expected to be less affected by the pandemic than passenger transport, as the supply of companies and households had to be ensured even in such crisis periods. Nevertheless, the data show a noticeable decline in freight transport in April 2020. This was, however, a temporary decline in response to the initial shock of the COVID pandemic, when life, including transport, came to a near standstill. In this context, it should be noted that April was also one of the rather weaker months in terms of freight traffic in 2019. However, the impact of the pandemic waned from May 2020 onwards and a gradual recovery was evident, which continued in June. The strongest months in terms of freight traffic in 2020 were October and November. In comparison, the strongest month in 2019 was October followed by May 2019. Conversely, the weakest months in 2019 were February and August.

The maps below show the monthly seasonality on each section of the analyzed corridors. Several interesting facts can be gleaned from the data:

- 1) The highest increases in the heavy traffic months (such as May, June, October or November) are located in the nearest neighbourhood of Brno and are therefore mainly related to short-distance freight transport. The D2 motorway in the direction from Brno to Bratislava, which appears to be a seasonally very balanced traffic arm of the South Moravian Region in terms of freight traffic intensity, is an exception to this trend.
- 2) The maps also show a noticeable drop in freight traffic volumes across the network, particularly in April 2020 due to the COVID pandemic. Also worth mentioning is the section in the direction from Brno to Mikulov (Vienna) on the D52 or I/52. At the time of the closure in the Novomlýnské nádraží area, freight traffic flows in 2020 are minimal.

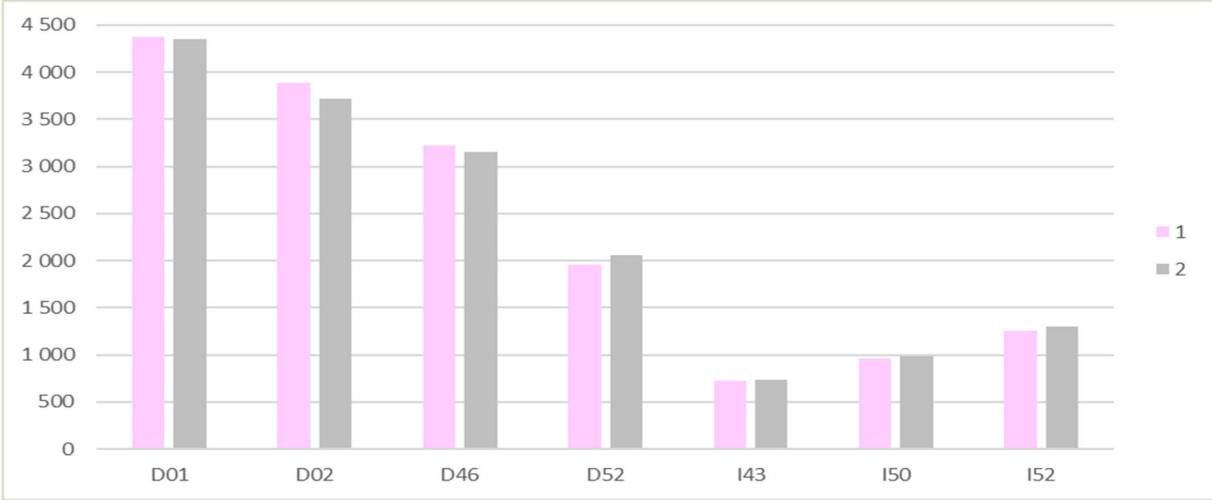
Figure 7 Seasonality of truck intensity by individual toll sections in JMK in 2020



Source: data of the Regional Directorate of Transport (2020), own processing

The following figure shows the average daily traffic volumes in each direction on the monitored motorways and roads of the South Moravian Region. As can be seen from a global perspective, the directions of freight traffic flows do not play a role, as there are no noticeable differences in the average intensity of truck passages on any of the monitored motorways and roads of the South Moravian Region.³

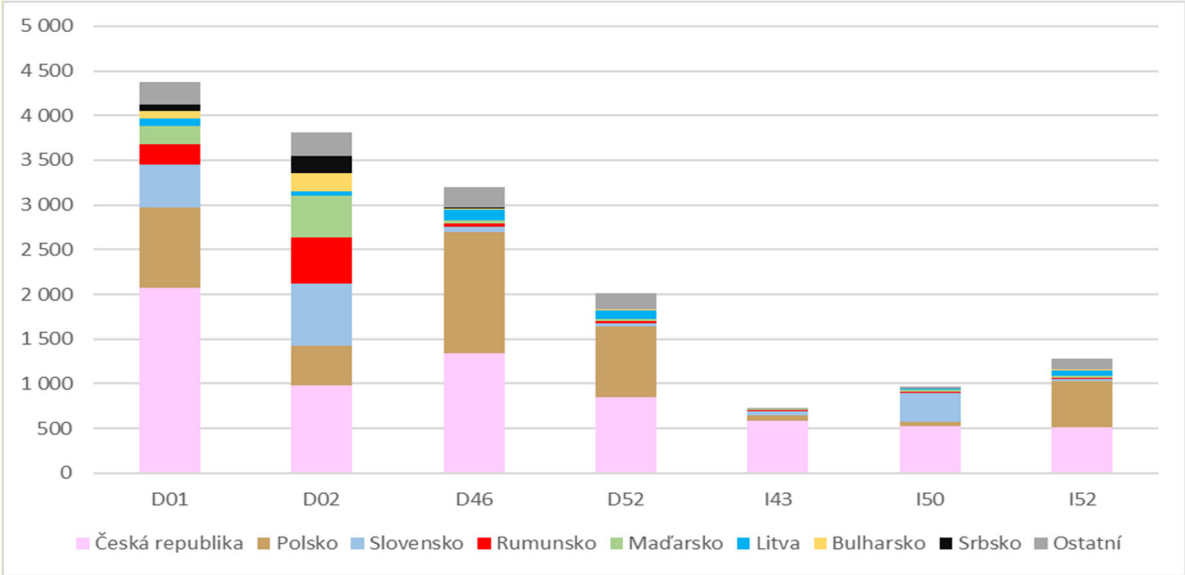
Figure 8 Average daily intensity of truck movements on toll sections of the South Moravian Region in 2020 by individual motorways and class I roads



Source: data of the Regional Transport Directorate (2020), own processing,
 Note: directions D1: 1... Prague-> Brno; D2: 1... Brno-> Breclav; D46: 1... Vyškov-> Olomouc; D53: 1... Brno-> Pohořelice; I/43: 1... Brno-> Svitavy; I/50: 1... SK-> Slavkov u Brna; I/52: 1... Pohořelice-> Mikulov

Figure 9 shows an overall overview of the daily freight traffic volumes by the most represented countries of origin. The Czech Republic dominates on most sections of the monitored roads, followed by Poland or Slovakia, and Romania and Hungary are also strongly represented on the D2 motorway.⁴

Figure 9 Origin of trucks on toll sections in the South Moravian Region in 2020



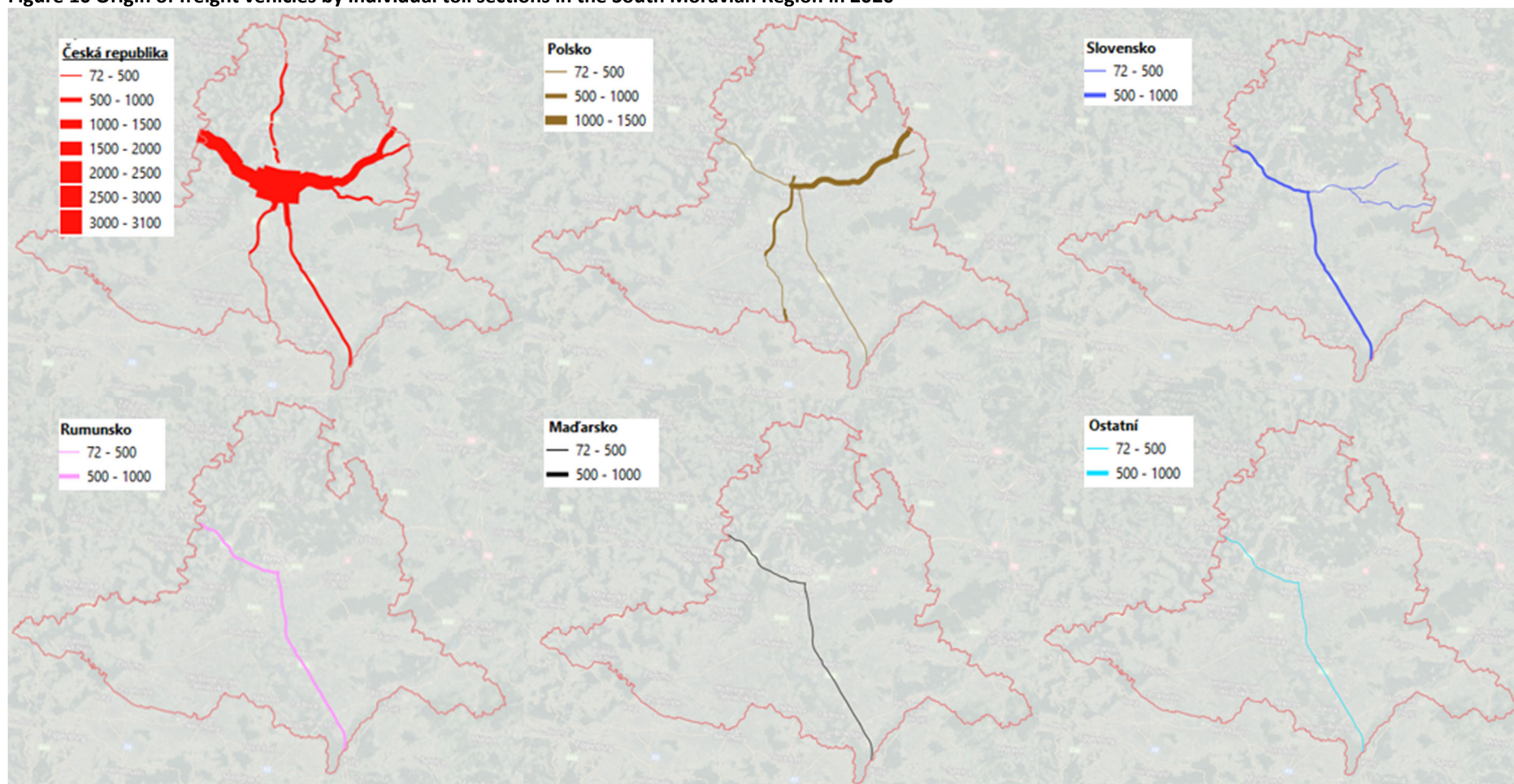
Source: data of the Regional Directorate of Transport (2020), own processing

³ A detailed analysis of flows and directions is carried out in the subchapters devoted to the individual examined roads of the South Moravian Region.

⁴ A detailed analysis of the nationality structure is carried out in the subchapters devoted to the individual roads of the South Moravian Region.

This fact is also captured by the maps below, which show only the most important countries of origin of RZ, i.e. the Czech Republic, Poland, Slovakia, Romania, Hungary, and in total the other countries.

Figure 10 Origin of freight vehicles by individual toll sections in the South Moravian Region in 2020

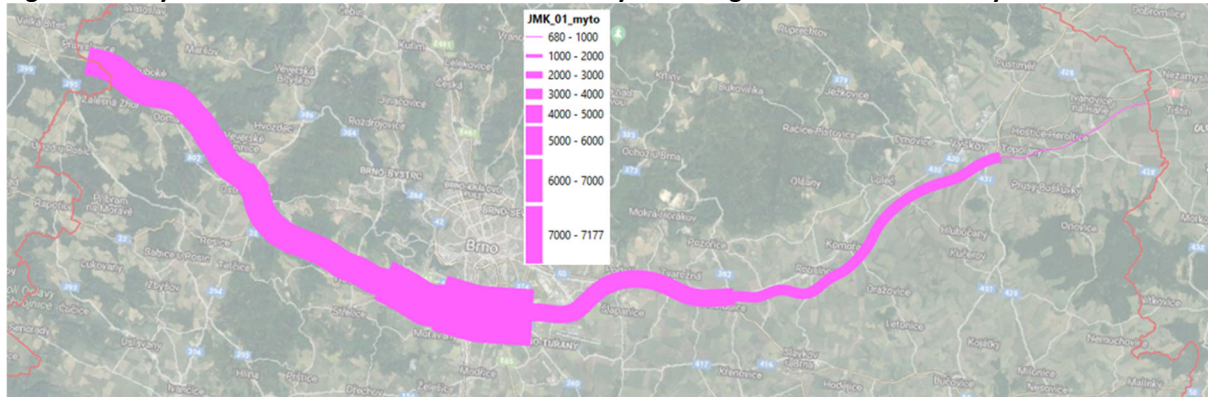


Source: data from ŘSD (2020), own processing

4 SITUATION ON D1

The D1 motorway represents the backbone route of the entire Czech Republic and the crucial link between Brno and Prague, and as such it is the most important and busiest traffic artery in the South Moravian Region. Particularly in the areas directly in the city of Brno/under the southern part of Brno, where other international road routes connect, D1 is under increasing pressure from international and domestic hauliers and it is the place which is the busiest for trucks on the whole D1.

Figure 11 Daily intensities of trucks on the D1 motorway according to data from the toll system in 2020

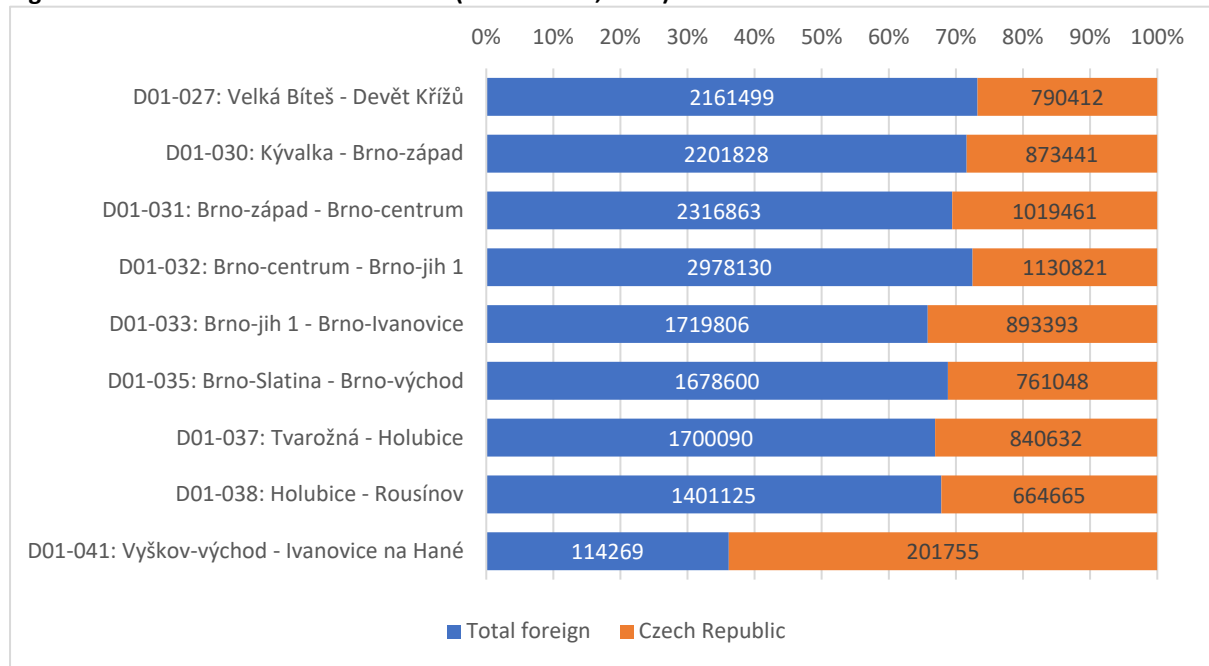


Source: data from the Regional Directorate of Transport (2020), own processing

The following analysis shows the structure of traffic flow at key points of this traffic artery - namely at the entrances and exits from the South Moravian Region and at crossings with other significant roads, which influence the strength and structure of freight traffic flow.

On all sections of D1 in the South Moravian Region, with the exception of the section between Vyškov and Ivanovice na Hané, foreign carriers dominate the traffic flow. The following graph shows their total annual representation (aggregated in both directions) compared to domestic carriers.

Figure 12 Structure of traffic flow on D1 (annual data, 2020)



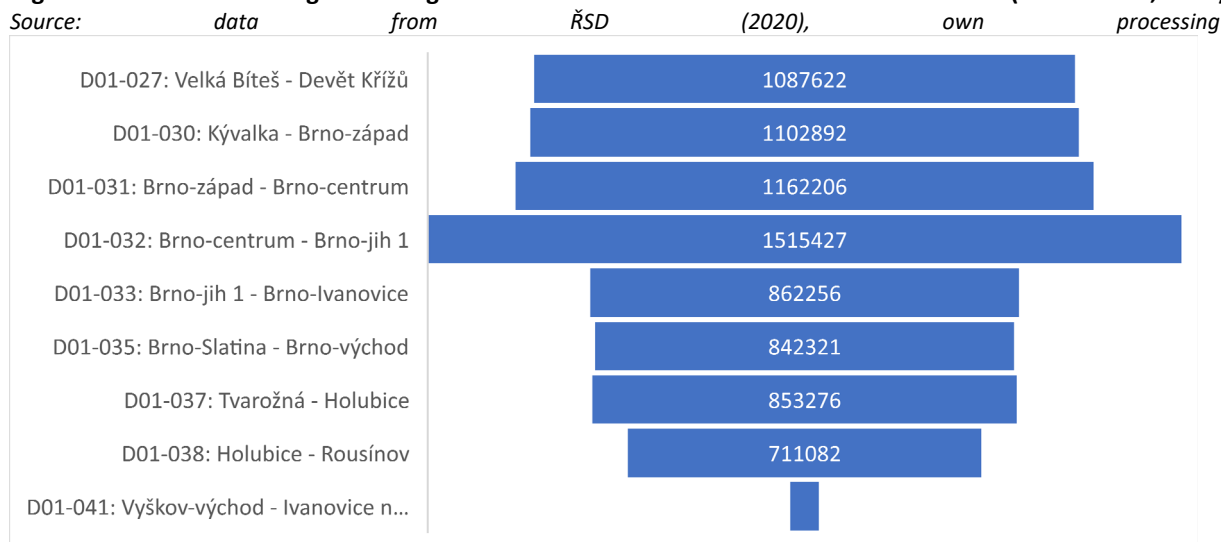
Source: data of the Regional Directorate of Transport (2020), own processing

It is clear that the unfinished D1 means a significant decrease in traffic flow and the number of international carriers. It is to be expected that after the completion of D1, some international traffic will shift from D46 to this thoroughfare.

4.1 Traffic flow of international carriers on D1 in JMK

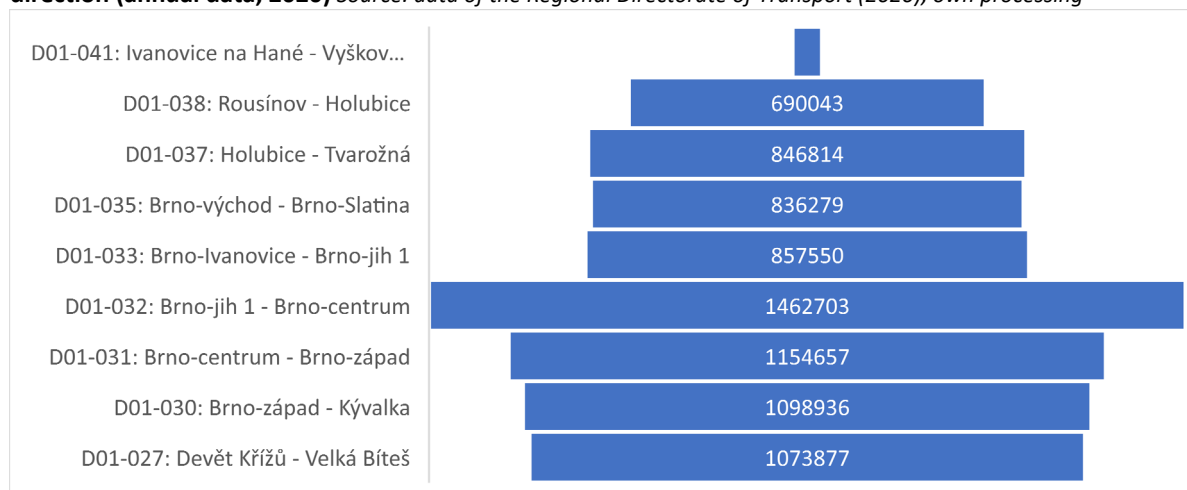
The intensity of the international traffic flow in the west-east direction reached a value of less than 1.1 million trucks per year at the border between the South Moravian Region and the Vysočina Region in 2020. At this point, international traffic accounts for 57.9% of total freight traffic. Towards Brno, the values increase to a maximum in the section Brno-Centre -> Brno South 1, where the annual flow of international truck traffic is more than 1.5 million vehicles. Subsequently, towards the east, the amount of foreign trucks decreases quite significantly, as a significant part of the traffic flow is directed to D2. Another significant break is the crossing with D46 near Vyškov, where most of the truck traffic is diverted and only 57.5 thousand trucks with foreign RZ per year continue on D1. In the last section of D1 in JMK, this volume corresponds to 22.2% of the total volume of freight traffic. D1 is thus becoming a motorway with a significant dominance of domestic carriers after Vyškov.

Figure 13 Traffic flow strength of foreign carriers on D1 in JMK in the direction West -> East (annual data, 2020)



As can be seen in Figure 14 below, essentially identical values for the number of foreign trucks also hold for the opposite direction of traffic flow, i.e., in the east-west direction.

Figure 14 Traffic flow strength of foreign carriers on D1 in the South Moravian Region in the east -> west direction (annual data, 2020) Source: data of the Regional Directorate of Transport (2020), own processing



The traffic flow in the east-west direction on D1 is several percent lower than in the opposite direction. Again, to the east of the merger with D46, D1 is characterised by a very low share of international carriers (21.6%) and a low absolute value of traffic volume, which reaches only 56.7 thousand vehicles with international registration plates in the section Ivanovice na Hané -> Vyškov. The sharp increase in foreign trucks after the merger with D46 is followed by a gradual further increase in intensity further towards Brno, where the intensity peaks again in the section Brno south 1 - Brno centre with a value of almost 1.5 million foreign vehicles over 3.5 t per year. Further towards Prague, the flow diminishes, reaching 1.07 million foreign freight vehicles per year at Devíti kříž, which is 57.6% of the total freight traffic in that direction.

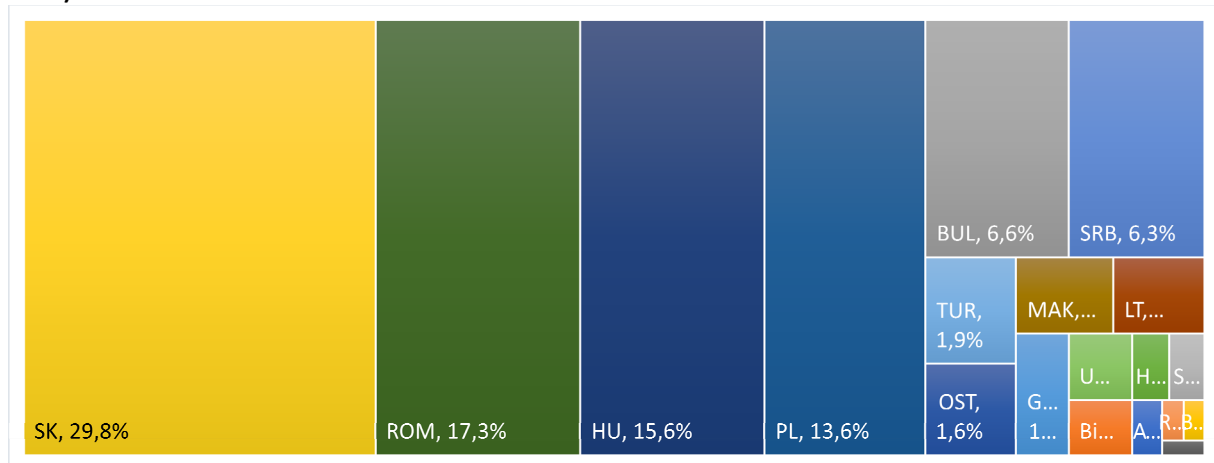
4.2 Nationality structure of carriers

The nationality structure of carriers (by RZ) changes significantly when crossing the D1 motorway, especially in relation to the crossing with other major roads. The following data shows the sections entering and leaving the JMK and the sections of significant changes in this nationality structure. The graphs presented show the nationality composition for both directions in a given section, but the analysis shows that the situation in each direction is almost identical in terms of nationality structure. Neither the position of the main nationalities of the

carriers nor their relative representation, which varies by no more than one percentage point, changes. Any deviations are mentioned in the text.

In the section between Velká Bíteš and Devíti kříži, approximately 1.08 million vehicles over 3.5 t (excluding buses) passed in each direction in 2020. The dominant position in terms of foreign representation on the western border of the South Moravian Region at Devíti kříž is held by carriers with Slovak licence plates with almost a third share, followed by Romanian, Hungarian and Polish carriers. The other countries do not have a share of more than 10%, with only carriers with Bulgarian and Serbian RZ getting above 5%. In this section of D1, the deviation between the directions is shown by carriers from Austria, with 59% more carriers travelling towards Brno than towards Prague (2655). This disproportion weakens slightly towards Brno, but persists up to the Brno Centre - Brno South intersection. The opposite situation can be observed for carriers with Lithuanian RZ, which passed from Prague to Brno less than 70% (approx. 12 thousand) of the number in the opposite direction (approx. 18 thousand). Another significant disproportion can be traced in the case of carriers from Ukraine, of which more than 10 thousand per year passed in the direction of Prague, in the opposite direction it was only about 7.5 thousand. It is also worth mentioning trucks with German registration plates, which in the direction of Brno passed by almost 30% more (15 thousand) than in the direction of Prague (less than 12 thousand).

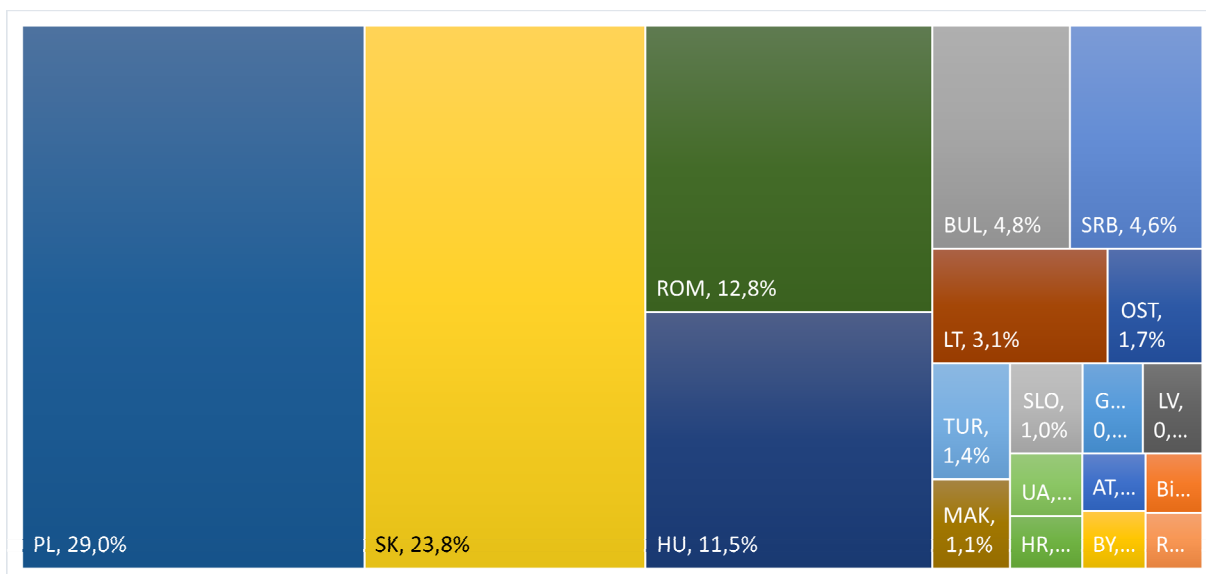
Figure 15 Nationality structure of foreign carriers on the D1 section Velká Bíteš - Devět křížů (annual data, 2020)



Source: data from ŘSD (2020), own processing

A significant change occurs after the intersection of the D1 motorway with the I/52 road, i.e. in the section Brno centrum - Brno Jih 1. On this section of D1 a strong traffic flow has been added and there is a concentration of carriers from D1 (who did not turn to D52) and from D52 (who did not turn to D1 in the direction of Prague).

Figure 16 Nationality structure of foreign carriers on the D1 section Brno Centre - Brno South 1 (annual data, 2020)

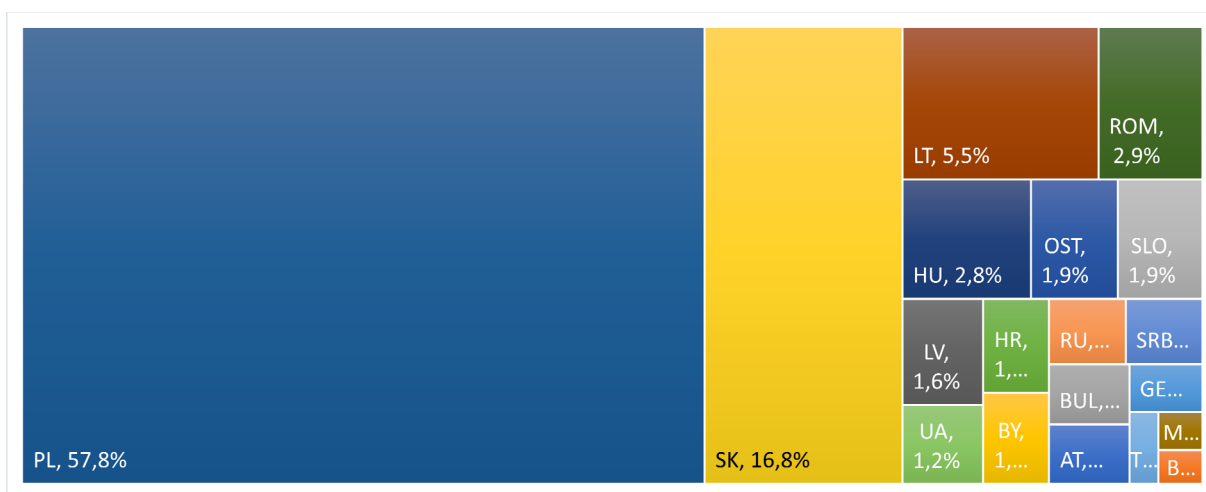


Source: data from ŘSD (2020), own processing

This section is the busiest section within the South Moravian Region. Approximately 1.5 million foreign freight vehicles pass in each direction annually, which accounts for approximately 56% of the total freight traffic flow. Of the foreign carriers, the dominant group are vehicles with Polish registration plates, accounting for less than a third of the international traffic present. Slovak RZs are next with more than a fifth of the total, followed by Romanian and Hungarian carriers. The other nationalities are represented by less than 5%. The directional disproportion of Ukrainian carriers continues (about 25% weaker flow towards the east), the directional disproportion of Lithuanian and Austrian carriers, which was on the western borders of the South Moravian Region, is still present but less pronounced.

Another significant change is brought by the crossing of D1 and D2. D2 will absorb a significant part of the carriers with Slovak RZ, and on the contrary it will increase the representation of Polish trucks on D1. Of the total annual number of about 860 thousand carriers with international RZ (49% of the total freight traffic), the representation of Polish RZ clearly stands out with almost 60% share. In this section, the second place is still held by Slovak RZs, followed by Lithuanian and Romanian trucks, whose share is insignificant compared to the first two carriers. The directional disproportion of Ukrainian and Lithuanian carriers corresponds to the previous section, the disproportion of Austrian carriers is no longer visible, and the same applies to the next section.

Figure 17 Nationality structure of foreign carriers on D1 section Brno South - Brno Ivanovice (annual data, 2020)



Source: data of the Regional Directorate of Transport (2020), own processing

The shift further east is marked by the increasing dominance of Polish RZs. In the Holubice - Rousínov section, which in 2020 was used by about 700 thousand foreign vehicles over 3.5 t in each direction (51% of total freight traffic), Polish RZs account for over 70% of foreign carriers. The increasing dominance of the Polish representation is not due to the absolute increase in the number of Polish trucks, which has been maintained at around 500 thousand per year in each direction since the crossing with the D/52, but to the decreasing representation of Slovak (D2 and I/43) and partly also Romanian carriers (especially D2).

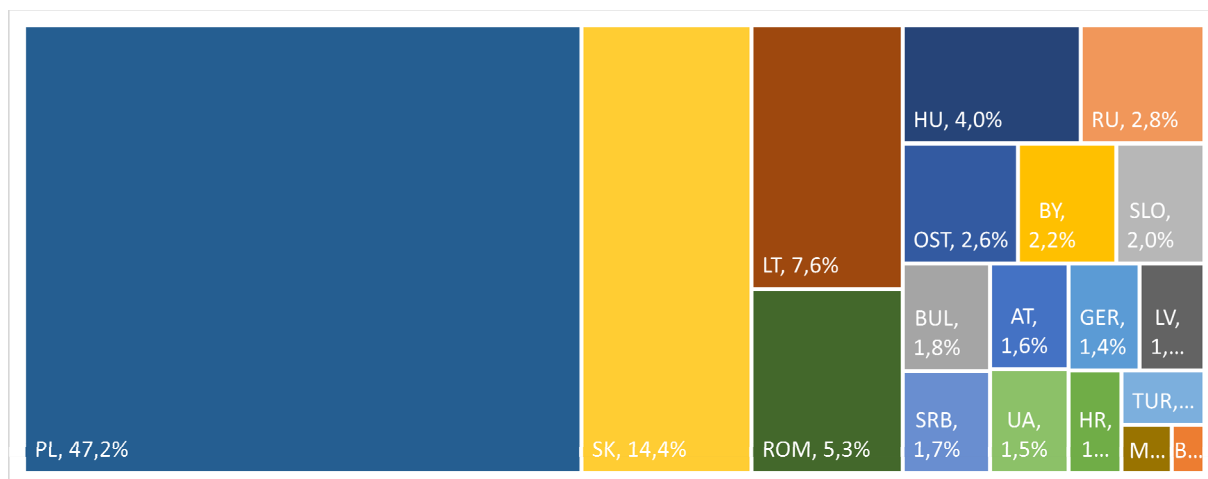
Figure 18 Nationality structure of foreign carriers on the D1 section Holubice - Rousínov (annual data, 2020)



Source: data from ŘSD (2020), own processing

At the point where D46 separates from D1, there is a significant decrease in traffic flow, both domestic and foreign carriers. The last section of D1 in the territory of the South Moravian Region is thus only used by about 57 thousand foreign vehicles per year, while these vehicles account for only about 22 % of the total traffic flow.

Figure 19 Nationality structure of foreign hauliers on the D1 section Vyškov East - Ivanovice (annual data, 2020)



Source: data of the Regional Directorate of Transport (2020), own processing

This section is also dominated by Polish RZs, with almost half of the nationality structure, but the flow strength is significantly weaker at less than 30 thousand vehicles in each direction (vs. about 500 thousand before the turn to D46). Due to the peak below Brno, the international traffic load on this section is only less than 4%.

As far as directional disproportions are concerned, the section Velká Bíteš - Devět křížů shows a deviation between the directions of carriers from Austria, who travelled 59% more towards Brno than towards Prague. This disproportions weakens slightly towards Brno but persists up to the Brno-Centre - Brno South crossing. The

opposite situation can be observed for carriers with Lithuanian RZ, which accounted for less than 70 % (approx. 12 000) of the number in the opposite direction (approx. 18 000) from Prague to Brno. Another significant disproportion can be traced in the case of carriers from Ukraine, of which more than 10 thousand per year passed in the direction of Prague, in the opposite direction it was only about 7.5 thousand. It is also worth mentioning trucks with German registration plates, which in the direction of Brno passed by almost 30% more (15 thousand) than in the direction of Prague (almost 12 thousand). A detailed view of the directional disproportionality along the entire D1 in the South Moravia Region is shown in the following tables.

Table 1: Directional asymmetries on D1 in 2020 - differences

	AT	BiH	BUL	BY	GER	HR	HU	EN	EN	MAK	EN	ROM	SRB	RU	SLO	EN	THERE	UA	OST
D01-027: Velká Bíteš -> Devět Křížů	1565	-34	1163	-515	3410	362	3230	-5814	111	169	2282	1246	1269	54	-182	7093	-913	-3198	2447
D01-030: Kývalka -> Brno-west	1484	-20	854	-609	3283	283	2112	-5968	105	103	1166	-339	1051	33	-274	2560	-965	-3171	2268
D01-031: Brno-west -> Brno-centrum	1470	210	729	-561	3232	186	3122	-6126	95	312	450	-272	1281	35	-462	5421	-745	-3222	2394
D01-032: Brno city centre -> Brno south	2369	350	743	-84	3283	47	2183	-9504	1628	253	37851	2012	1274	1113	674	10285	-827	-3570	2644
D01-033: Brno-jih 1 -> Brno-Ivanovice	681	-325	29	-153	272	-1422	-1793	-6229	1707	221	28036	-2336	62	985	9	-12614	103	-2987	460
D01-035: Brno-Slatina -> Brno-East	709	-323	121	-108	276	-1376	-1912	-6075	1768	243	28631	-2179	-84	1005	68	-12460	123	-2936	551
D01-037: Tvarožná -> Holubice	721	-316	159	-99	288	-1368	-1928	-5991	1842	234	29768	-2067	-31	994	60	-13606	122	-2903	583
D01-038: Holubice -> Rousínov	581	-328	84	2	-77	-1454	124	-5601	1839	343	26443	1361	-385	1094	279	-1983	156	-1838	399
D01-041: Vyškov-east -> Ivanovice na Hané	175	3	60	-343	86	-15	220	-324	163	-29	2176	-52	-128	-395	-153	-644	210	-285	132

Source.

Note: the number indicates how many more vehicles are moving in the direction corresponding to the arrow compared to the opposite direction (e.g. A->B for the GER is 2300 means that there are 2300 more German trucks moving in the direction from A to B compared to the direction from B to A, a negative number means that the direction from A to B is weaker by a given number). The 20% most significant positive and negative differences are shown in colour.

Table 2: Asymmetries on D1 in 2020 - shares

	AT	BiH	BUL	BY	GER	HR	HU	EN	EN	MAK	EN	ROM	SRB	RU	SLO	EN	THERE	UA	OST
Velká Bíteš -> Devět Křížů	1,59	1,00	1,02	0,74	1,29	1,07	1,02	0,67	1,09	1,01	1,02	1,01	1,02	1,03	0,96	1,02	0,96	0,69	1,15
D01-030: Kývalka -> Brno-west	1,51	1,00	1,01	0,74	1,28	1,05	1,01	0,68	1,08	1,01	1,01	1,00	1,02	1,02	0,95	1,01	0,95	0,70	1,14
D01-031: Brno-west -> Brno-centrum	1,40	1,03	1,01	0,77	1,27	1,03	1,02	0,68	1,07	1,02	1,00	1,00	1,02	1,02	0,93	1,02	0,96	0,71	1,14
D01-032: Brno-centrum -> Brno-jih 1	1,33	1,05	1,01	0,99	1,30	1,01	1,01	0,82	1,14	1,02	1,09	1,01	1,02	1,16	1,05	1,03	0,96	0,71	1,11
D01-033: Brno-jih 1 -> Brno-Ivanovice	1,09	0,87	1,00	0,98	1,05	0,87	0,93	0,88	1,13	1,09	1,06	0,91	1,01	1,13	1,00	0,92	1,03	0,74	1,03
D01-035: Brno-Slatina -> Brno-East	1,10	0,86	1,02	0,99	1,05	0,87	0,92	0,88	1,14	1,12	1,06	0,91	0,99	1,13	1,00	0,91	1,05	0,75	1,04
D01-037: Tvarožná -> Holubice	1,12	0,86	1,02	0,99	1,06	0,87	0,91	0,88	1,14	1,12	1,06	0,91	0,99	1,13	1,00	0,91	1,05	0,75	1,04
D01-038: Holubice -> Rousínov	1,12	0,86	1,02	1,00	0,98	0,85	1,01	0,89	1,14	1,19	1,05	1,10	0,93	1,15	1,02	0,93	1,08	0,69	1,03
D01-041: Vyškov-east -> Ivanovice na Hané	1,22	1,02	1,06	0,76	1,11	0,97	1,10	0,93	1,24	0,90	1,08	0,98	0,88	0,78	0,87	0,92	1,55	0,72	1,09

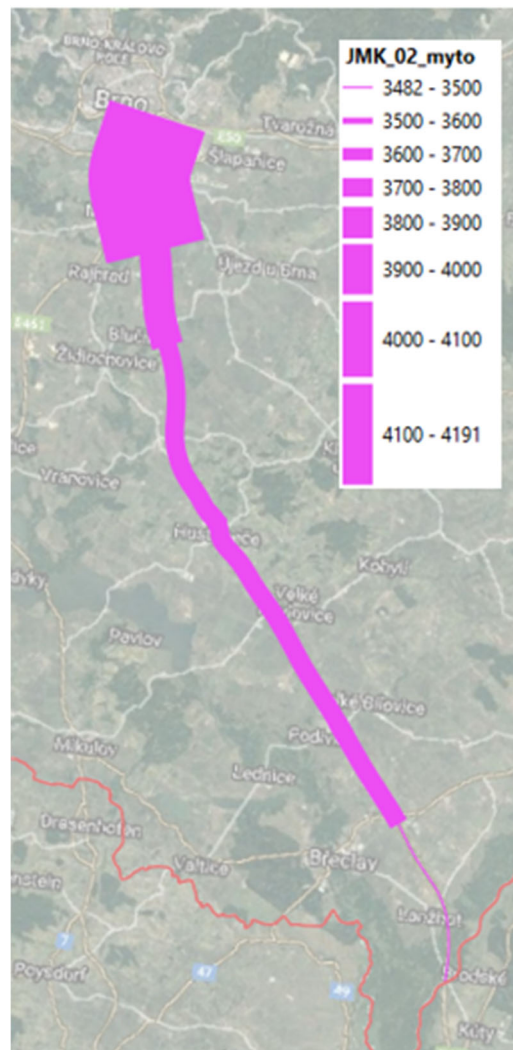
Source.

Note: the number indicates how many times a given nationality is moving in the direction corresponding to the arrow compared to the opposite direction (e.g. A->B for AT is 1.3, meaning that 1.3 times as many Austrian vehicles are moving in the given section in the direction from A to B compared to the direction from B to A). The 20% most significant deviations in both directions are indicated in colour.

5 SITUATION ON D2

The D2 motorway is the primary link between the Czech Republic and Slovakia and is a natural continuation of D1 towards Bratislava. It is the second most important freight transport corridor in the South Moravian Region. The visualised data shows at first glance that the traffic flow increases the closer the route gets to the South Moravian metropolitan area of Brno. Conversely, towards the border with Slovakia, the overall flow of freight traffic decreases.

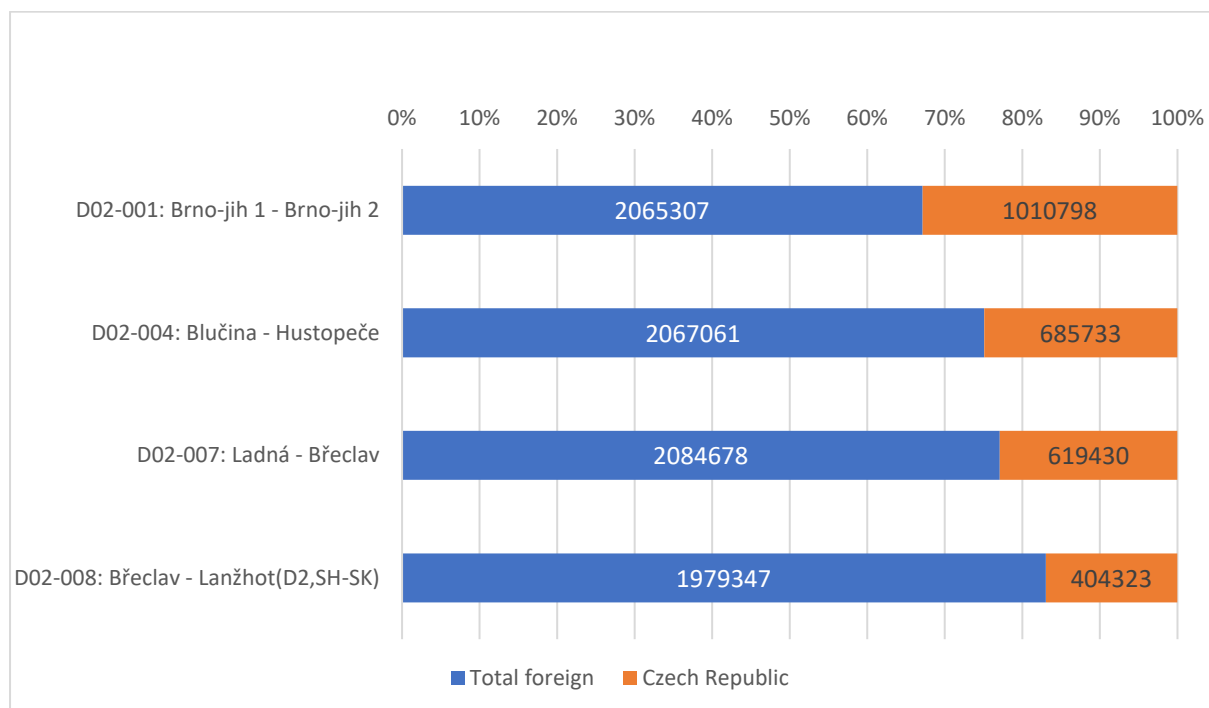
Figure 20 Daily truck volumes on the D2 motorway according to toll data in 2020



Source: data of the Regional Directorate of Transport (2020), own processing

Basically, all the dynamics of the traffic flow from its beginning in Brno to the border crossing Lanžhot is caused by the gradual decline of Czech carriers. The flow of international carriers does not show significant dynamics, both in terms of the intensity of the traffic flow and in terms of the nationality structure. The share of foreign RZs on D2 is between 83 % at the Slovak border and 67 % at the connection to D1.

Figure 21 Traffic flow structure on D2 (annual data, 2020)



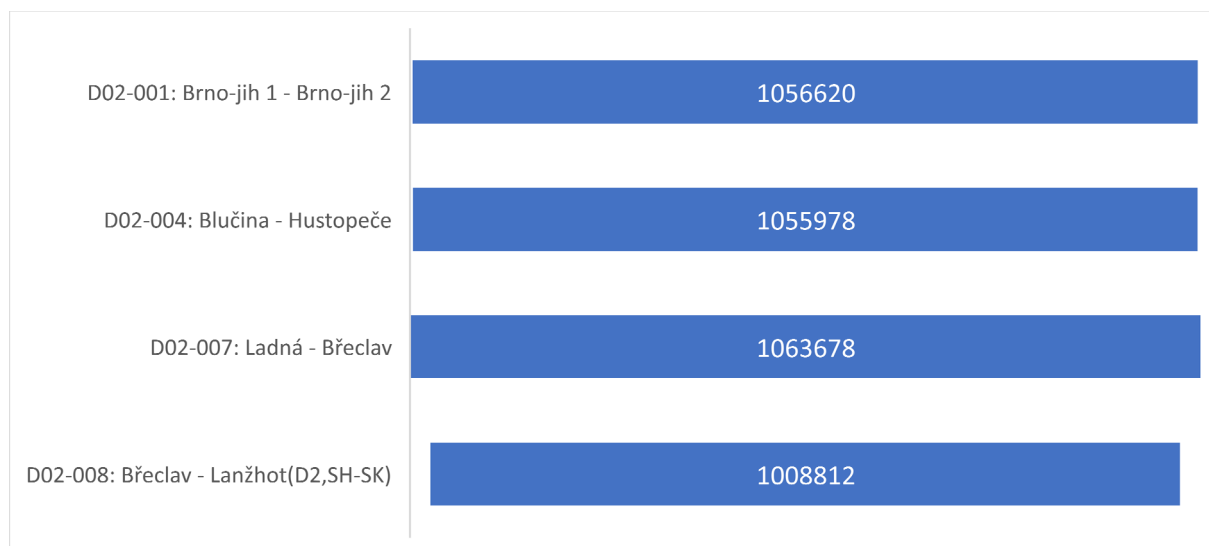
Source: data of the Regional Directorate of Transport (2020), own processing

D2 is primarily a road for international traffic. The share of freight carriers with foreign RZs exceeds the share of Czech carriers by a significant margin, and this share is increasing towards the Slovak border.

5.1 Traffic flow of international carriers on D2 in South Moravia

What does not change along the entire length of D2 is the number of foreign carriers. Their number is almost constant along the entire length, reaching around 1 million vehicles in each direction.

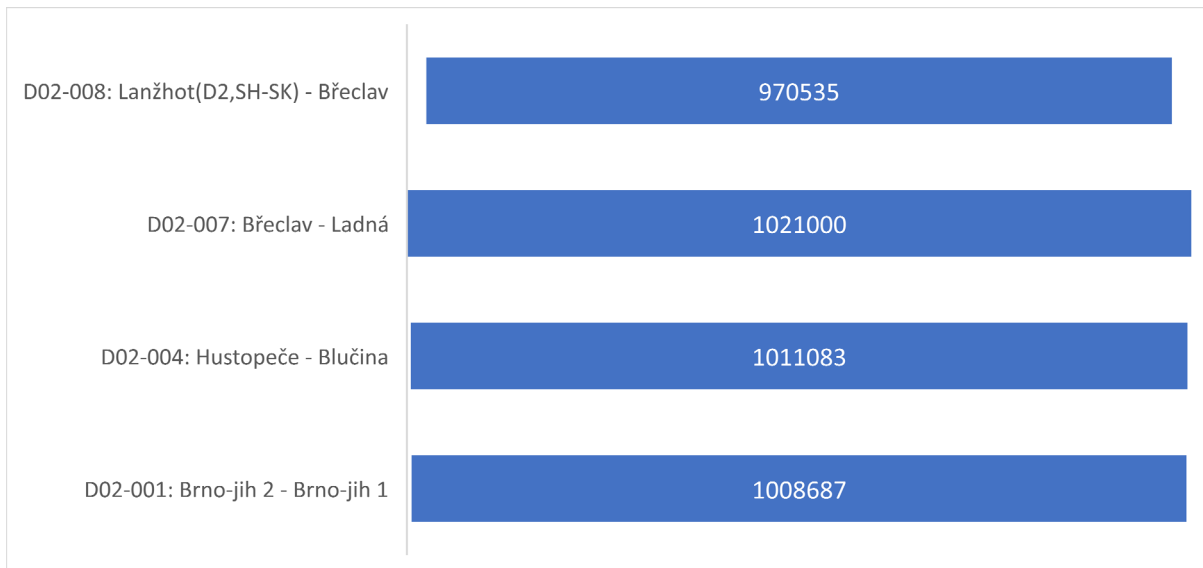
Figure 22 Intensity of foreign carriers on D2 in the north -> south direction (annual data, 2020)



Source: data of the Regional Directorate of Transport (2020), own processing

The data for the opposite direction from the border with Slovakia towards Brno show the same picture.

Figure 23 Intensity of foreign carriers on D2 in the south -> north direction (annual data, 2020)



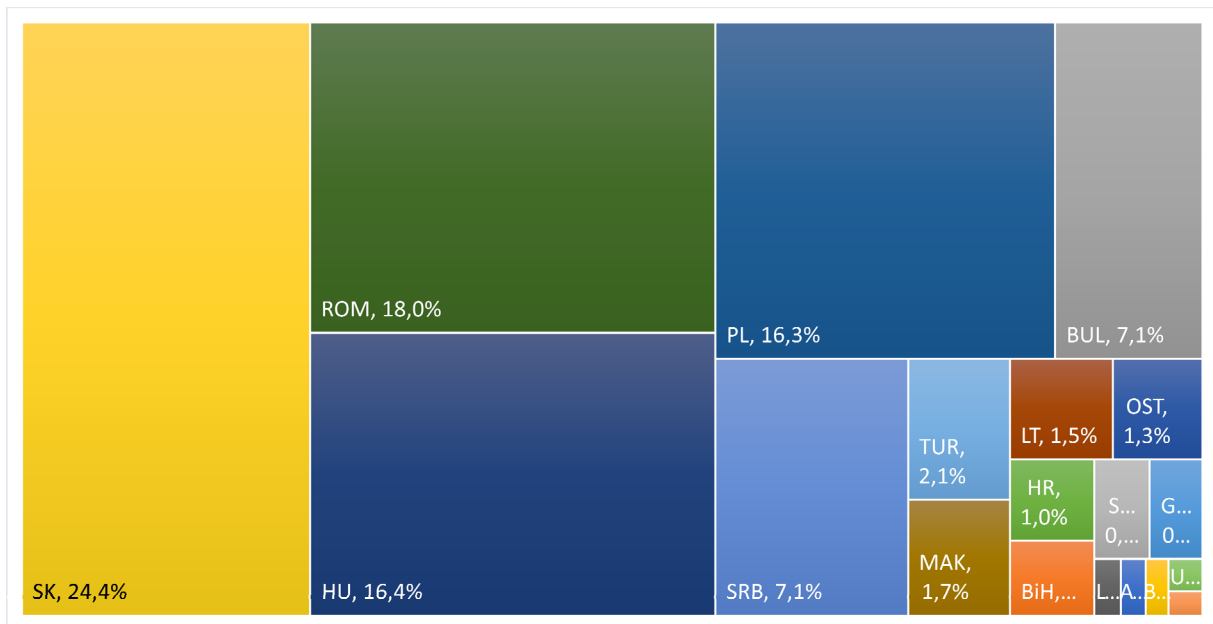
Source: data of the Regional Directorate of Transport (2020), own processing

Just as the intensity of traffic flow of international carriers along the route does not change, neither does their nationality structure.

5.2 Nationality structure of carriers

On the D2 motorway, in line with intuition, Slovak carriers dominate among foreign carriers (with a quarter share). Romania, Poland and Hungary also have a significant presence, with approximately one-sixth share each. It is also worth mentioning the presence of Bulgaria and Serbia with a share of around 7%, i.e. around 74 thousand vehicles per year in each direction.

Figure 24 Nationality structure of foreign carriers on the D2 section Brno south 1- Brno south 2 (annual data, 2020)



Source: data of the Regional Directorate of Transport (2020), own processing

From the point of view of directional disproportionality it is worth mentioning, as in the case of D1, carriers with RZ Austria, Germany, Lithuania and Ukraine. Detailed figures are shown in the following tables.

Table 3: Asymmetries in directions on D2 in 2020 - differences

	AT	BiH	BUL	BY	GER	HR	HU	EN	EN	MAK	EN	ROM	SRB	RU	SLO	EN	THERE	UA	OST
D02-001: Brno-jih 1 -> Brno-jih 2	1660	681	667	67	2984	1478	4231	-3275	-154	29	9583	4332	1312	141	611	22964	-939	-604	2165
D02-004: Blučina -> Hustopeče	1695	650	922	45	2889	1362	4008	-3442	-185	79	7412	3801	1380	92	585	23038	-845	-642	2051
D02-007: Ladná -> Breclav	1580	651	986	5	2775	1362	3683	-3362	-144	105	6659	2854	1271	45	598	23049	-779	-646	1986
D02-008: Breclav -> Lanzhot(D2,SH-SK)	1371	614	209	87	2767	1215	3050	-3001	-176	-329	4536	849	28	143	520	26155	-947	-578	1764

Source.

Note: the number indicates how many more vehicles are moving in the direction corresponding to the arrow compared to the opposite direction (e.g. A->B for GER is 2984 means that there are 2984 more German trucks moving in the direction from A to B compared to the direction from B to A, a negative number means that the direction from A to B is weaker by a given number). The 20% most significant positive and negative differences are shown in colour.

Table 4: Asymmetries on D1 in 2020 - shares

	AT	BiH	BUL	BY	GER	HR	HU	EN	EN	MAK	EN	ROM	SRB	RU	SLO	EN	THERE	UA	OST
D02-001: Brno-jih 1 -> Brno-jih 2	2,35	1,08	1,01	1,04	1,48	1,16	1,03	0,81	0,93	1,00	1,06	1,02	1,02	1,12	1,08	1,10	0,96	0,69	1,18
D02-004: Blučina -> Hustopeče	2,60	1,07	1,01	1,02	1,46	1,14	1,02	0,79	0,92	1,00	1,05	1,02	1,02	1,08	1,08	1,09	0,96	0,58	1,17
D02-007: Ladná -> Breclav	2,52	1,07	1,01	1,00	1,46	1,14	1,02	0,79	0,93	1,01	1,04	1,02	1,02	1,05	1,08	1,09	0,96	0,56	1,17
D02-008: Breclav -> Lanzhot(D2,SH-SK)	1,79	1,06	1,00	1,06	1,64	1,13	1,02	0,81	0,91	0,98	1,03	1,00	1,00	1,20	1,07	1,12	0,96	0,56	1,15

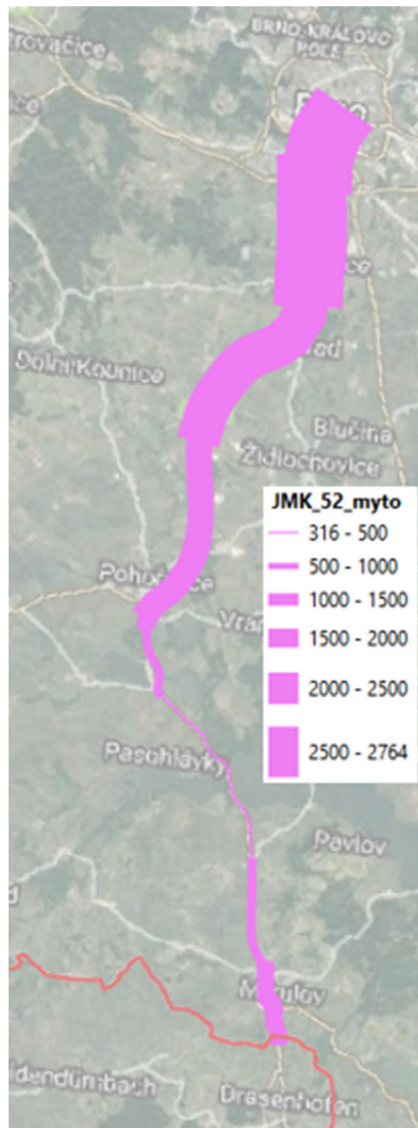
Source.

Note: the number indicates how many times the given nationality is moving in the direction corresponding to the arrow compared to the opposite direction (e.g. A->B for AT is 1.3, meaning that 1.3 times as many Austrian vehicles are moving in the given section in the direction from A to B compared to the direction from B to A). The 20% most significant deviations in both directions are indicated in colour.

6 SITUATION ON THE D52

The D52 road is a key link between the South Moravian Region and Austria and its significance will grow if it is completed to the Austrian border within motorway parameters. The year 2020 was characterised by an 8-month-long closure on the D52 and I/52 in the area of the Novomlýnské nádraží reservoirs, which can be clearly seen on the map below showing the total intensity of freight traffic on the D52 and I/52. Due to this closure, the following sections of the analysis focus only on the D52 motorway between Brno and Pohořelice.

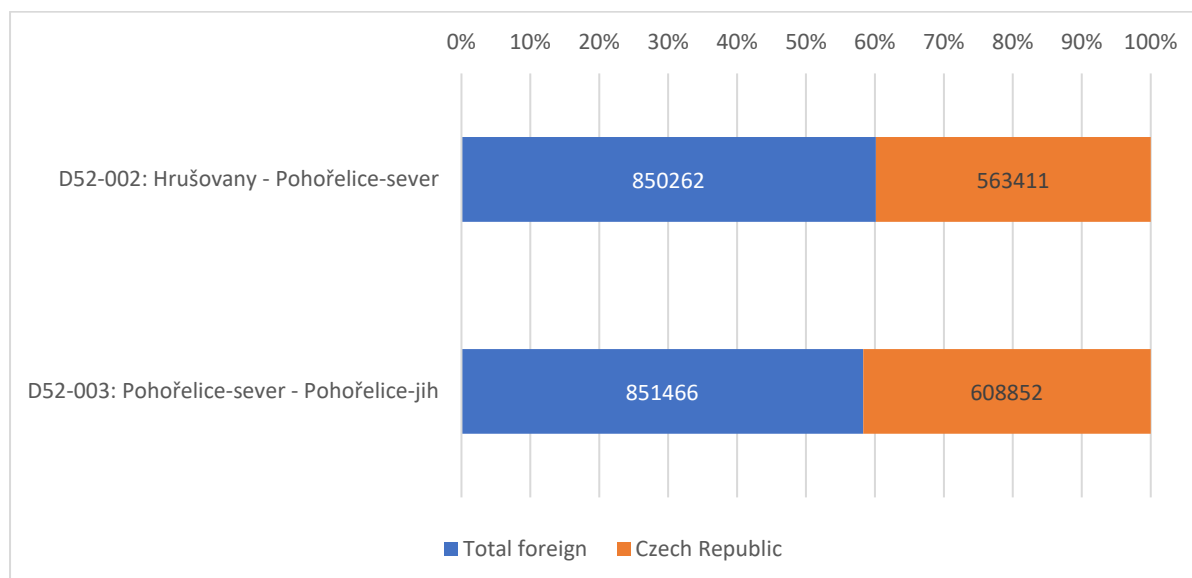
Figure 25 Daily truck volumes on the D52 motorway based on toll data in 2020



Source: data of the Regional Directorate of Transport (2020), own processing

The D52 motorway is primarily used by international carriers, which account for about 60% of the total traffic flow.

Figure 26 Traffic flow structure on the D50 (annual data, 2020)



Source: data of the Regional Directorate of Transport (2020), own processing

Although we use data only for D52 and not for the connecting I/52, we cannot expect a different development from other roads leading from Brno towards the border (D2, I/50). Therefore, it can be assumed that under the standard traffic condition (no closure), the strength and structure of international traffic will be stable along the route and the representation of Czech carriers will gradually decrease towards the border. From the traffic count data (see Figure 2), it can be assumed that the situation could change slightly at Mikulov, where the I/40 road connects to I/52. In particular, a higher representation of international traffic can be expected between the border and I/40.

6.1 Traffic flow of international carriers on D52 in South Moravia

Due to the relatively short length of this motorway, there are no significant changes in the intensity and nationality composition of trucks. The annual volume of foreign vehicles is about 400 000 vehicles in the north-south direction and about 440 000 vehicles in the opposite direction. However, it is possible that this relatively significant disproportion is the result of the closure of I/52 and the management of diversion routes.

Table 5: Intensity of foreign freight traffic on the D52 (annual data, 2020)

Highway section	Number of foreign RZ (over 3,5 t.)
Hrušovany -> Pohořelice-North	408955
Pohořelice-North -> Hrušovany	441307
Pohořelice-North -> Pohořelice-South	409577
Pohořelice-South -> Pohořelice-North	441889

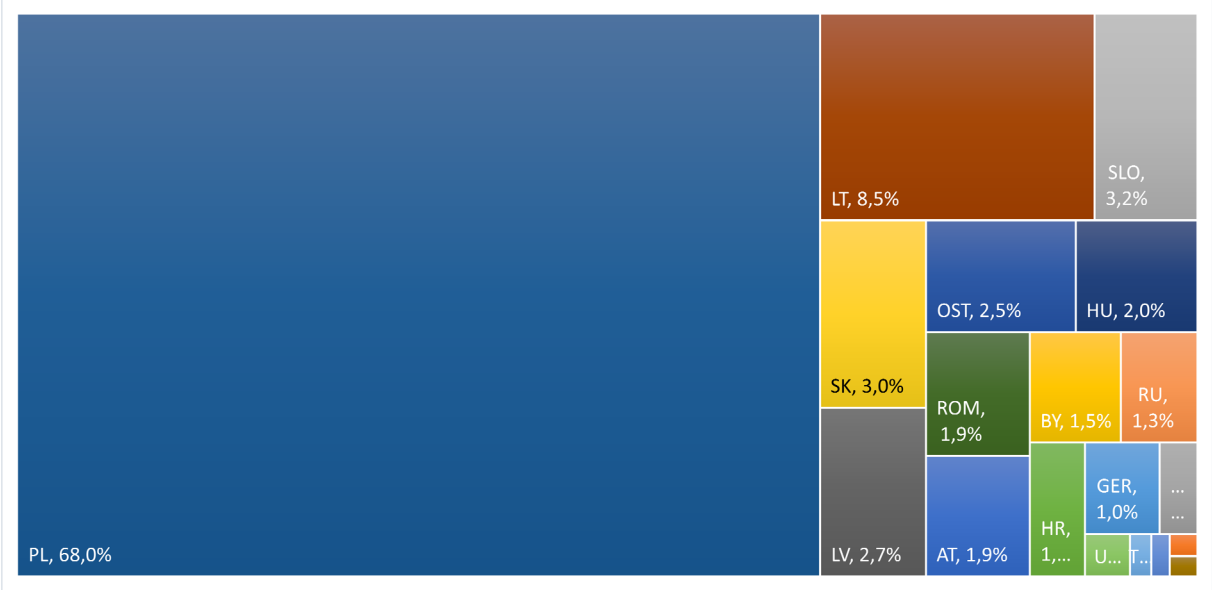
Source: data of the Regional Directorate of Transport (2020), own processing

Foreign carriers represent about 60% of the traffic flow.

6.2 Nationality structure of carriers

Polish RZs hold a two-thirds dominance with approximately 300,000 vehicles per year. The representation of other countries is marginal compared to Poland, with Lithuania coming second with less than 10% and accounting for around 35 thousand vehicles. The number of Polish trucks here is on a par with Czech trucks.

Figure 27 Nationality structure of foreign carriers on the D52 section Hrušovany -> Pohořelice (annual data, 2020)



Source: data of the Regional Directorate of Transport (2020), own processing

Also for this road, most traffic flows are similar in both directions, with the outliers being Serbia and Ukraine, whose southbound flows are about 45% and 37% higher, respectively. This is about 200 Serbian and about 400 Ukrainian extra trucks in the southbound direction. A detailed view of the directional disproportion is shown in the following tables.

Table 6: Asymmetries in directions on the D52 in 2020 - differences

	AT	Bi H	BU L	BY	GE R	HR	HU	EN	EN	MA K	EN	RO M	SR B	RU	SLO	EN	THER E	UA	OS T
D52-002: Hrušovany -> Pohořelice-North	- 866	- -65	73	- 431	195	32 5	195 2	378 8	- 1461	54	- 32665	-651	189	- 1009	- 993	- 1246	64	38 1	14
D52-003: Pohořelice-North -> Pohořelice-South	- 840	- -69	68	- 414	215	31 8	203 4	384 0	- 1437	53	- 32437	-510	186	- 1002	- 985	- 1830	60	40 1	37

Source.

Note: the number indicates how many more vehicles are moving in the direction corresponding to the arrow compared to the opposite direction (e.g. A->B for GER is 2300 means that there are 2300 more German trucks moving in the direction from A to B compared to the direction from B to A, a negative number means that the direction from A to B is weaker by a given number). The 20% most significant positive and negative differences are shown in colour.

Table 7: Asymmetries in directions on the D52 in 2020 - shares

	AT	BiH	BUL	BY	GER	HR	HU	EN	EN	MAK	EN	ROM	SRB	RU	SLO	EN	THERE	UA	OST
D52-002: Hrušovany -> Pohořelice-North	0,90	0,85	1,03	0,94	1,05	1,07	1,25	1,11	0,88	1,16	0,89	0,92	1,46	0,83	0,93	0,91	1,12	1,37	1,00
D52-003: Pohořelice-North -> Pohořelice-South	0,91	0,84	1,03	0,94	1,05	1,07	1,25	1,11	0,88	1,16	0,89	0,94	1,45	0,83	0,93	0,87	1,11	1,39	1,00

Source.

Note: the number indicates how many times the given nationality is moving in the direction corresponding to the arrow compared to the opposite direction (e.g. A->B for AT is 1.3, meaning that 1.3 times as many Austrian vehicles are moving in the given section in the direction from A to B compared to the direction from B to A). The 20% most significant deviations in both directions are indicated in colour.

7 SITUATION ON THE D46

From the point of view of traffic flow of foreign carriers, D46 is currently a natural continuation of D1. In each direction, less than 700 thousand trucks with foreign registration plates pass through annually. The road is used for freight transport by foreign hauliers more than by hauliers with a Czech RZ, with the share of foreign hauliers on this section being 58%.

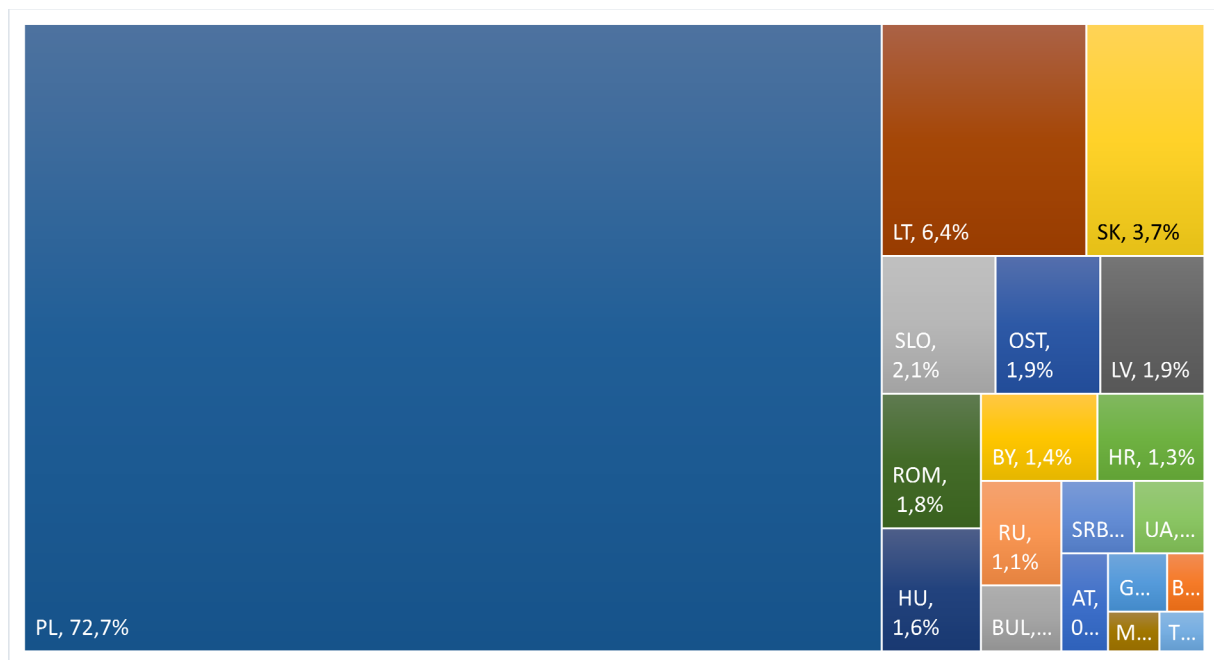
Table 8: Traffic flow structure on the D46 section Vyškov - Drysice (both directions, annual data, 2020)

Foreign RZ	Home RZ
1353197	968929

Source: data of the Regional Directorate of Transport (2020), own processing

Looking at the structure of foreign carriers, there is no significant difference compared to the downstream sections of D1. Polish carriers dominate among the carriers, which in absolute numbers of over 500 thousand closely surpass even Czech carriers. Lithuanian and Slovak carriers are worth mentioning, but with shares well below 10%.

Figure 28 Nationality structure of foreign carriers on the D46 section Vyškov -> Drysice (annual data, 2020)



Source: data of the Regional Directorate of Transport (2020), own processing

In terms of percentage similarities of traffic flows in both directions, Ukrainian vehicles stand out the most, with only 72% (3,907 vehicles) in the northbound direction compared to the southbound direction (5,433 vehicles). Among the other countries, Macedonia is worth mentioning with a northbound flow of 2045 trucks stronger (22%) compared to 1646 trucks southbound. The disproportion between the directions is illustrated in more detail in the following tables.

Table 9: Asymmetries in directions on the D46 in 2020 - shares and differences

	AT	BiH	BUL	BY	GER	HR	HU	EN	EN	MAK	EN	ROM	SRB	RU	SLO	EN	THERE	UA	OST
D46-002: Vyškov -> Drysice	1,06	0,85	1,01	1,04	0,95	0,83	0,99	0,89	1,14	1,22	1,05	1,13	0,95	1,22	1,03	0,97	0,97	0,72	1,02
D46-002: Vyškov -> Drysice	261	-326	26	376	-162	-1562	-73	-5215	1702	369	24785	1440	-247	1507	463	-816	-55	-1526	286

Source.

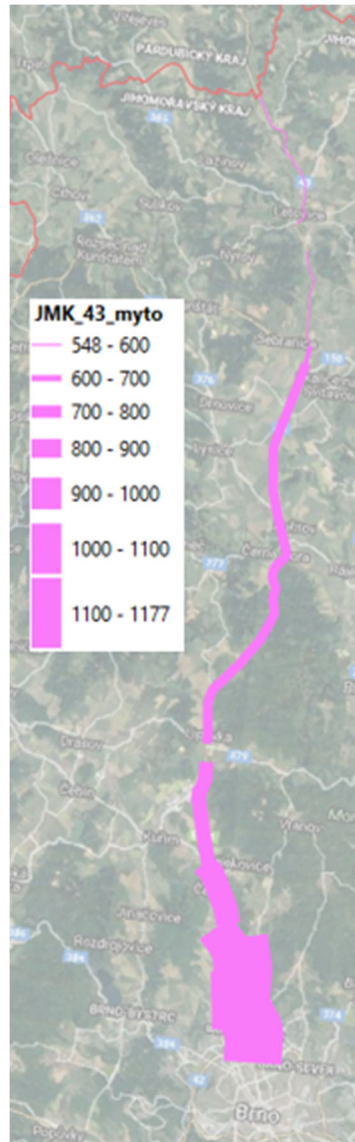
Note: the number in the first row indicates how many times the nationality is moving in the direction corresponding to the arrow compared to the opposite direction (e.g. A->B for AT is 1.3, meaning that 1.3 times as many Austrian vehicles are moving in the given section in the direction from A to B compared to the direction from B to A). The 20% most significant deviations in both directions are indicated in colour. The number in the second row indicates how many more vehicles are moving in the direction corresponding to the arrow compared to the opposite direction (e.g. A->B for GER is 2300 means that there are 2300 more German trucks moving in the direction from A to B compared to the direction from B to A, a negative number means that the direction from A to B is weaker by a given number). The 20% most significant positive and negative differences are shown in colour.

8 SITUATION ON I/43

The I/43 road is significantly less congested compared to the other roads analysed. The annual traffic flow (both Czech and foreign) is between 15% at Brno and 8% at the northern borders of the region compared to the busiest section of D1.

The following figure shows the freight traffic intensity in the direction from Brno to Svitavy and shows a similar tendency in the gradual weakening of the freight traffic flow with increasing distance from the Brno metropolitan area. In the case of the I/43 road, daily intensities average between 500 and 1200 trucks per day.

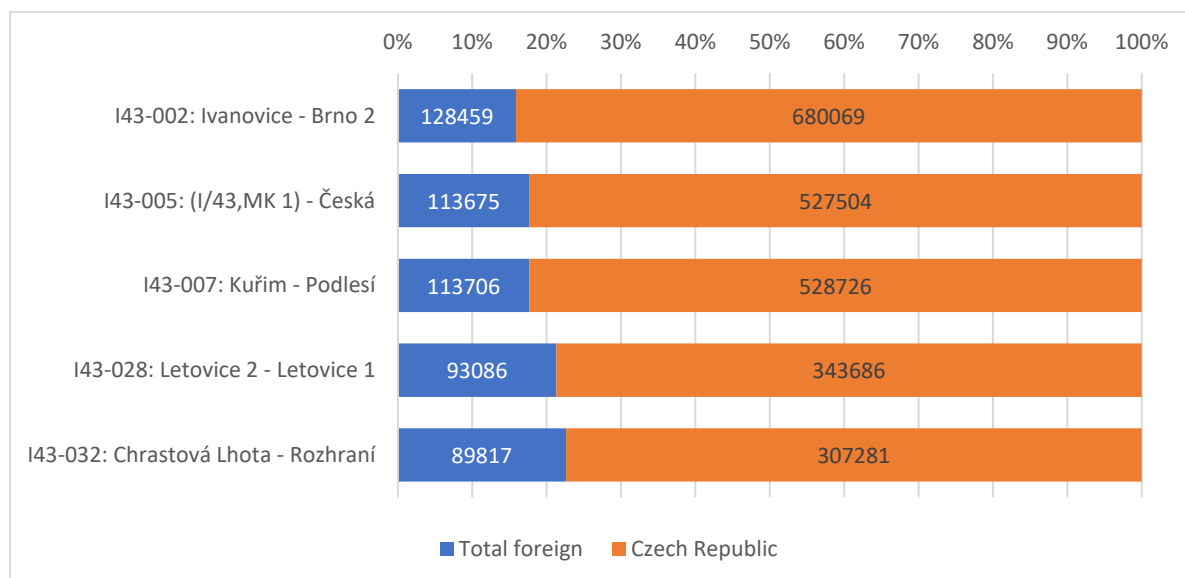
Figure 29 Daily truck volumes on the I43 motorway based on toll data in 2020



Source: data of the Regional Directorate of Transport (2020), own processing

The road is also characterised by a relatively low share and, towards the north, a decreasing number of foreign carriers.

Figure 30 Traffic flow structure on I/43 (annual data, 2020)



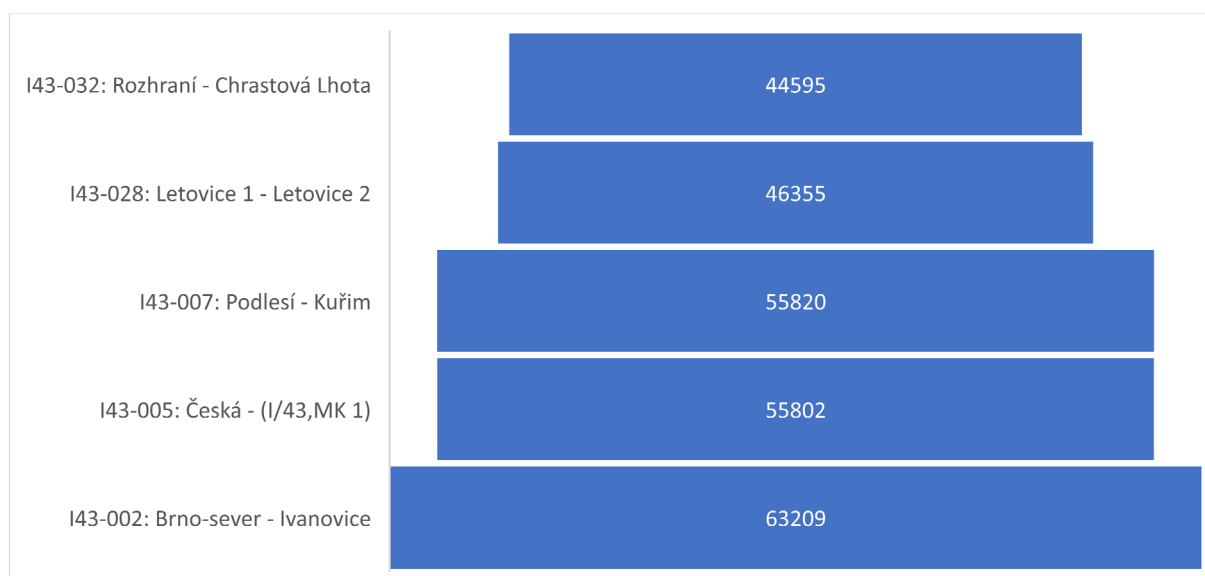
Source: data of the Regional Directorate of Transport (2020), own processing

On the other hand, as can be seen from the data, the intensity of domestic traffic also decreased northwards, even more intensively than foreign traffic, and the share of foreign carriers thus increased northwards (although the road was still dominated by domestic carriers).

8.1 Traffic flow of international carriers on I/43 in South Moravia

The following two charts show the strength of traffic flow of foreign carriers. From north to south, the number of foreign carriers increases slightly.

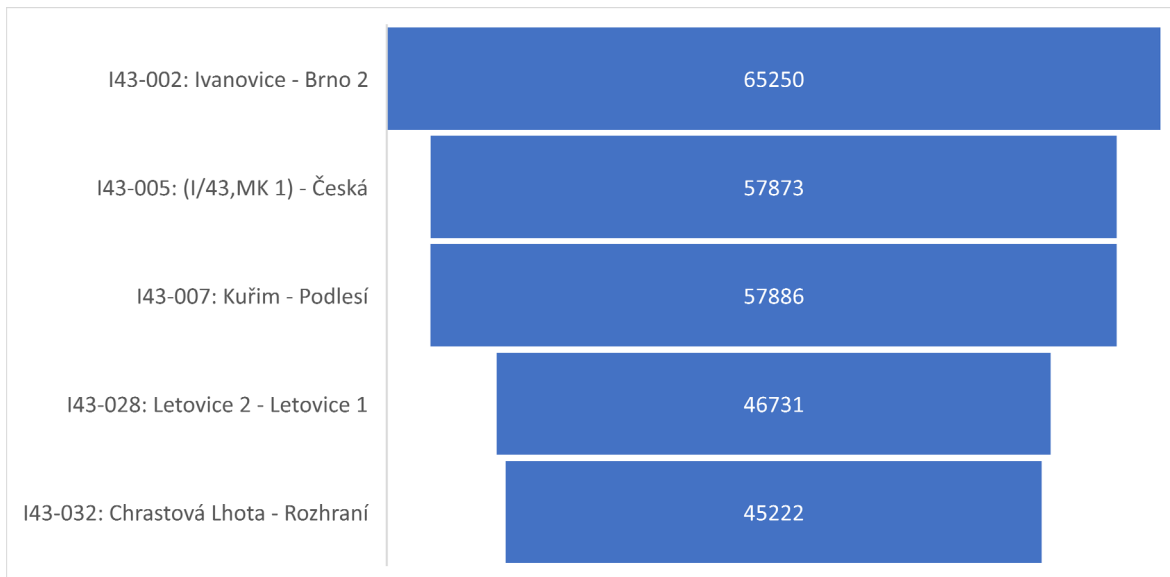
Figure 31 Intensity of international freight traffic on I43 north -> south (annual data, 2020)



Source: data of the Regional Directorate of Transport (2020), own processing

In a mirror-image fashion, we can see a slight decrease in the intensity of foreign vehicle traffic from Brno. On the northern borders of the South Moravian Region, the intensity of foreign vehicle traffic was about 71% of the situation on the northern outskirts of Brno.

Figure 32 Intensity of international freight traffic on I43 in the south -> north direction (annual data, 2020)



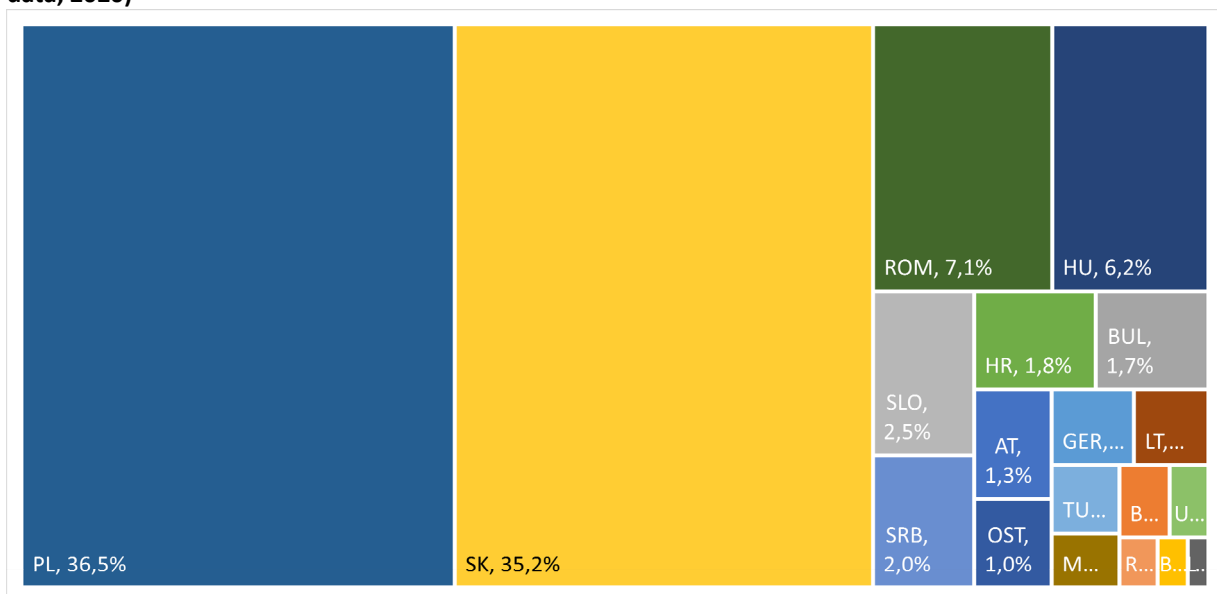
Source: data of the Regional Directorate of Transport (2020), own processing

From the data dynamics it can be concluded that a large part of carriers with foreign RZ end or start their journey on the territory of the South Moravian Region, which is confirmed by the analysis of the nationality structure below.

8.2 Nationality structure of carriers

The structure of foreign carriers does not experience any changes worthy of attention along the route of the road. It is also true what is true for the other roads that the nationality structure hardly differs in relation to the direction of traffic. The figures given are for both directions, but for the dominant RZ they also apply, with a maximum deviation of a few percentage points, to the individual directions. Statistically interesting percentage deviations in individual directions are given at the end of the chapter.

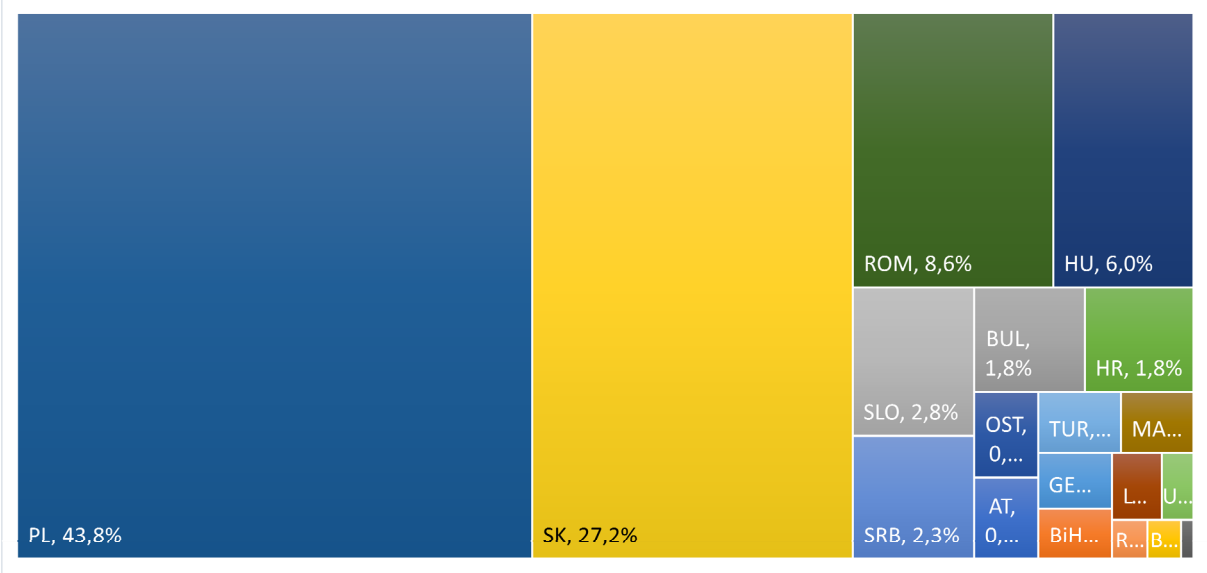
Figure 33 Nationality structure of foreign carriers on I/43 in the section Ivanovice - Brno 2 (north) (annual data, 2020)



Source: data of the Regional Directorate of Transport (2020), own processing

On Brno's northern border, Slovakia and Poland vie for first place among foreign carriers, together accounting for 70% of all foreign traffic. Romania and Hungary are also worth mentioning, with none of the other nationalities exceeding a 2.5% share. On the northern borders of the region, almost 45% of foreign vehicles (out of a total of 45,000) have Polish registration plates. This is followed by Slovakia with around 27% and again by Romania and Hungary by a considerable margin. It can therefore be assumed that some Slovak hauliers will end their journey in the South Moravian Region, while Polish trucks continue further north.

Figure 34 Nationality structure of foreign carriers on I/43 in the section Chrástová Lhota - Rozhraní (annual data, 2020)



Source: data of the Regional Directorate of Transport (2020), own processing

The directional disproportion is significant in percentage terms (but not significant in absolute terms) for vehicles from Bosnia and Herzegovina, Belarus, Macedonia and Turkey (which have a significant predominance in the northbound direction) and Bulgaria, Germany and Ukraine with a significant predominance in the southbound direction. The tables below show more.

Table 10: Asymmetries in directions on I/43 in 2020 - differences

	AT	BiH	BUL	BY	GER	HR	HU	EN	EN	MAK	EN	ROM	SRB	RU	SLO	EN	THERE	UA	OST
I43-002: Ivanovice -> Brno 2	13	240	-147	73	-89	-49	430	-14	7	165	-664	-693	63	13	-189	2656	190	-40	76
I43-005: (I/43,MK 1) -> Czech	-12	241	-111	73	-97	-34	554	42	9	163	-435	-548	85	23	-183	2048	198	-16	71
I43-007: Kuřim -> Podlesí	-12	241	-111	72	-96	-34	554	42	9	163	-449	-548	86	23	-184	2057	198	-16	71
I43-028: Letovice 2 -> Letovice 1	-42	216	-194	70	-140	-84	354	-8	9	150	-1243	-754	38	-6	-258	2128	175	-65	30
I43-032: Chrastová Lhota -> Interface	-38	219	-198	96	-146	-74	349	1	12	145	-1204	-765	33	85	-262	2270	162	-69	11

Source.

Note: the number indicates how many more vehicles are moving in the direction corresponding to the arrow compared to the opposite direction (e.g. A->B for GER is 2300 means that there are 2300 more German trucks moving in the direction from A to B compared to the direction from B to A, a negative number means that the direction from A to B is weaker by a given number). The 20% most significant positive and negative differences are shown in colour.

Table 11: Asymmetries in directions on I/43 in 2020 - shares

	AT	BiH	BUL	BY	GER	HR	HU	EN	EN	MAK	EN	ROM	SRB	RU	SLO	EN	THERE	UA	OST
I43-002: Ivanovice -> Brno 2	1,02	2,05	0,87	1,66	0,86	0,96	1,11	0,97	1,07	1,60	0,97	0,86	1,05	1,07	0,89	1,12	1,54	0,86	1,12
I43-005: (I/43,MK 1) -> Czech	0,98	2,16	0,89	1,70	0,84	0,97	1,16	1,10	1,12	1,63	0,98	0,88	1,07	1,14	0,89	1,11	1,63	0,93	1,13
I43-007: Kuřim -> Podlesí	0,98	2,15	0,89	1,69	0,84	0,97	1,16	1,10	1,12	1,63	0,98	0,88	1,07	1,14	0,88	1,11	1,63	0,93	1,13
I43-028: Letovice 2 -> Letovice 1	0,89	2,29	0,79	1,86	0,59	0,90	1,14	0,97	1,26	1,62	0,94	0,83	1,04	0,96	0,82	1,18	1,64	0,68	1,07
I43-032: Chrastová Lhota -> Interface	0,90	2,45	0,78	3,13	0,60	0,91	1,14	1,00	1,43	1,61	0,94	0,82	1,03	2,55	0,81	1,20	1,60	0,62	1,03

Source.

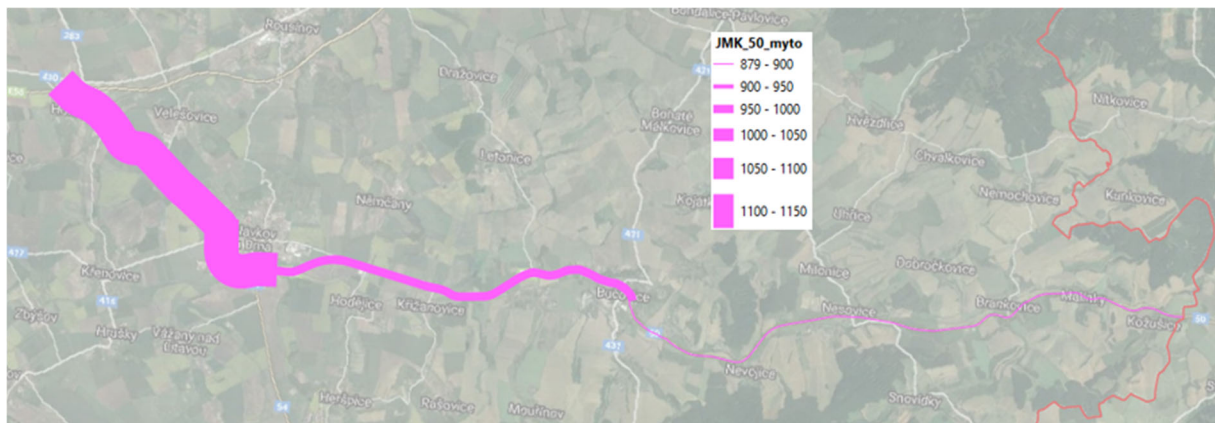
Note: the number indicates how many times the given nationality is moving in the direction corresponding to the arrow compared to the opposite direction (e.g. A->B for AT is 1.3, meaning that 1.3 times as many Austrian vehicles are moving in the given section in the direction from A to B compared to the direction from B to A). The 20% most significant deviations in both directions are indicated in colour.

9 SITUATION ON I/50

The I/50 road is an alternative to the D2 for the connection with Slovakia, specifically with the Trenčín region. Its freight load is between 12-16% of the maximum load of D1.

The following figure shows a strong traffic relationship between Brno and Slavkov u Brna on the I/50 road east of Brno, from where the intensity of freight traffic gradually decreases further towards the state border with Slovakia. On average, however, the intensities are fairly balanced at around 1 000 vehicles.

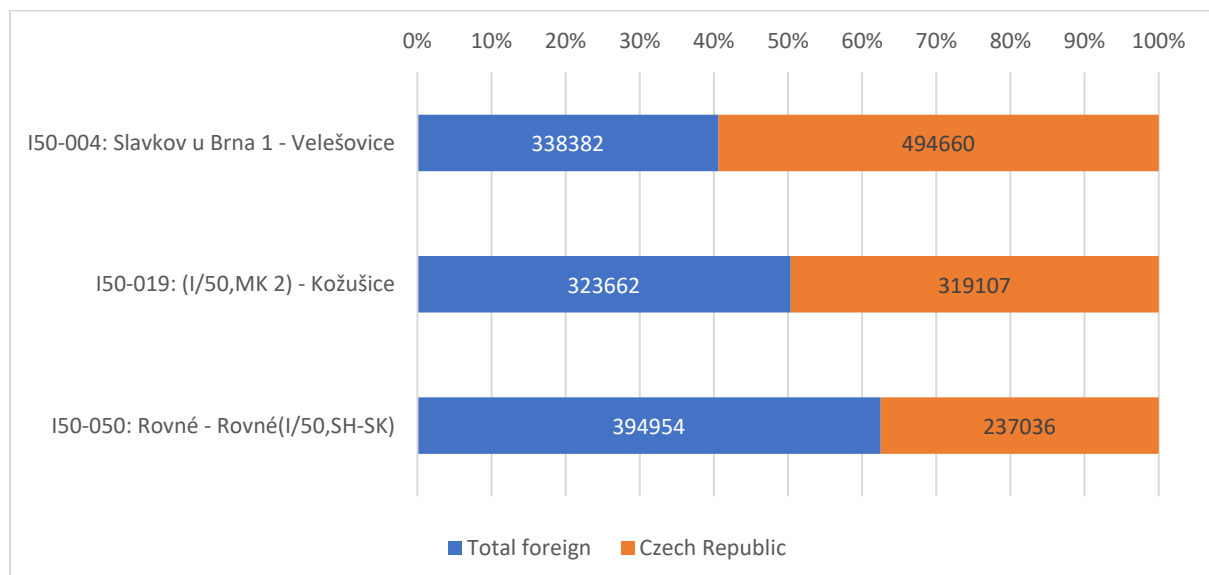
Figure 35 Daily truck volumes on the I50 motorway based on toll data in 2020



Source: data of the Regional Directorate of Transport (2020), own processing

Towards the border (listed here for a more complete picture, although it is not located in the South Moravian Region), the number of foreign carriers is slightly increasing and the number of Czech carriers is relatively significantly decreasing. The overall traffic intensity towards the border is decreasing and the share of foreign carriers is increasing towards the Slovak border.

Figure 36 Traffic flow structure on I/50 (annual data, 2020)



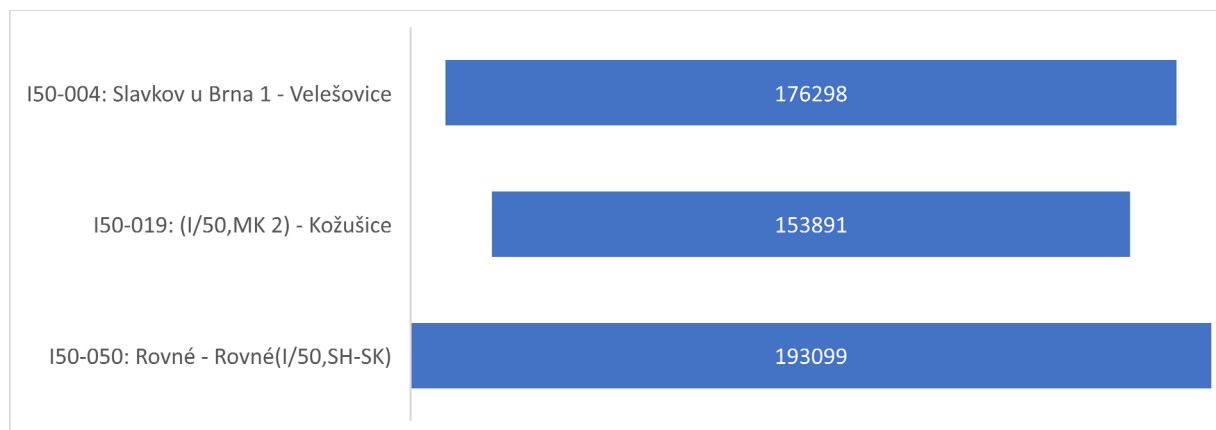
Source: data of the Regional Directorate of Transport (2020), own processing

From the data on the structure of traffic in the above graph it can be concluded that about 20% of carriers with foreign RZ end or start their journey between the border with Slovakia and Kožušice, i.e. on the territory of the Zlín Region. On the territory of the South Moravian Region, the flow is already basically stable along the entire length of the route.

9.1 Traffic flow of international carriers on I/50 in JMK

The traffic volume of foreign carriers does not vary significantly either along the route of the road or depending on the direction.

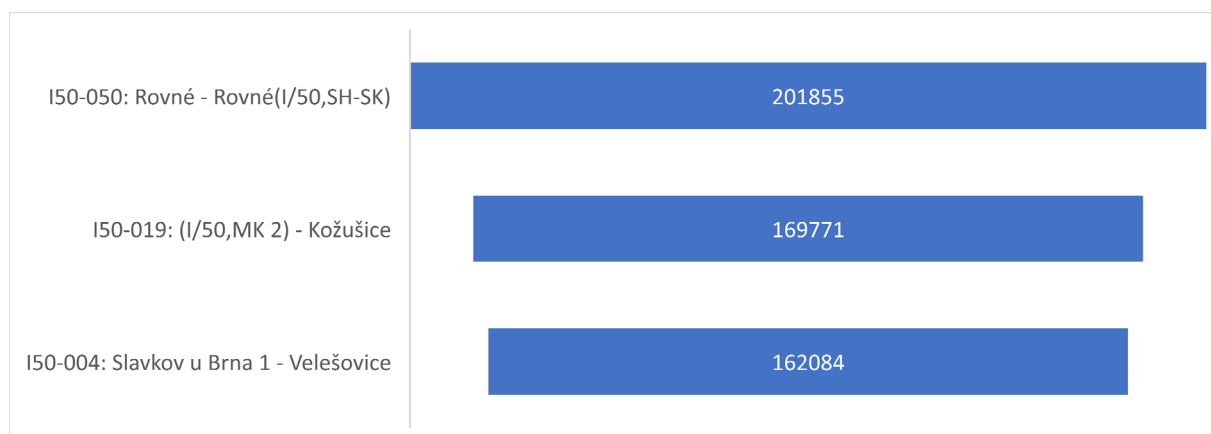
Figure 37 Traffic volume of foreign carriers on I/50 CZ->SK (annual data, 2020)



Source: data of the Regional Directorate of Transport (2020), own processing

The intensity of foreign carriers towards the border initially decreases as traffic disperses to serve the adjacent area, then concentrates again in a stronger stream towards the border.

Figure 38 Traffic volume of foreign carriers I/50 SK->CZ (annual data, 2020)



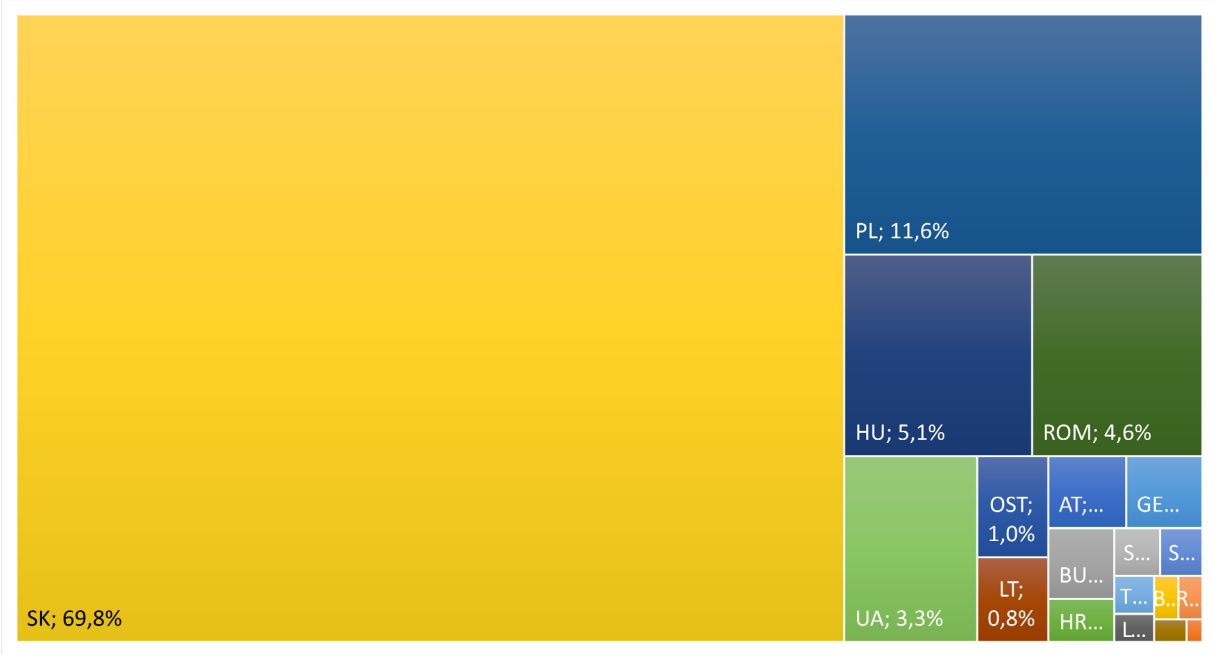
Source: data of the Regional Directorate of Transport (2020), own processing

From the Slovak border towards Brno, the number of foreign carriers initially decreases, but between Kozusice and Slavkov u Brna it is almost unchanged. This supports the assumption that part of the traffic (from Slovakia) is rather cross-border traffic between SK and the Zlín Region.

9.2 Nationality structure of carriers

The nationality structure of foreign carriers is dominated by Slovak carriers with more than two-thirds share. This is followed by Polish, Hungarian and Romanian carriers by a wide margin. Carriers with Ukrainian RZ are also worth mentioning.

Figure 39 Nationality structure of foreign carriers on I/50 in the section Slavkov u Brna -> Velešovice (annual data, 2020)



Source: data of the Regional Directorate of Transport (2020), own processing

Table 12: Asymmetries in I/50 directions in 2020 - differences

	AT	BiH	BUL	BY	GER	HR	HU	EN	EN	MAK	EN	ROM	SRB	RU	SLO	EN	THERE	UA	OST
I50-004: Slavkov u Brna 1 -> Velešovice	-125	-11	-76	109	-328	-167	2056	416	3	113	-2503	3437	-354	108	220	10370	33	1090	-177
I50-019: (I/50,MK 2) -> Kožušice	94	19	39	-111	378	241	-2278	-454	-3	-64	2030	-3560	313	-90	-253	-11239	-31	-1088	177
I50-050: Rovné -> Rovné(I/50,SH-SK)	59	-8	150	27	375	336	-1438	-816	-82	-2	1741	-2945	300	-42	-287	-5714	134	-817	273

Source.

Note: the number indicates how many more vehicles are moving in the direction corresponding to the arrow compared to the opposite direction (e.g. A->B for GER is 2300 means that there are 2300 more German trucks moving in the direction from A to B compared to the direction from B to A, a negative number means that the direction from A to B is weaker by a given number). The 20% most significant positive and negative differences are shown in colour.

Table 13: Asymmetries in I/50 directions in 2020 - shares

	AT	BiH	BUL	BY	GER	HR	HU	EN	EN	MAK	EN	ROM	SRB	RU	SLO	EN	THERE	UA	OST
I50-004: Slavkov u Brna 1 -> Velešovice	0,91	0,88	0,93	1,59	0,77	0,77	1,27	1,36	1,01	2,01	0,88	1,57	0,44	1,59	1,57	1,09	1,10	1,21	0,90
I50-019: (I/50,MK 2) -> Kožušice	1,44	1,34	1,04	0,54	1,41	1,29	0,75	0,64	0,98	0,60	1,16	0,62	2,55	0,57	0,48	0,91	0,90	0,82	1,13
I50-050: Rovné -> Rovné(I/50,SH-SK)	1,23	0,93	1,18	1,08	1,45	1,37	0,86	0,51	0,63	0,99	1,10	0,70	2,62	0,78	0,50	0,96	1,39	0,87	1,17

Source.

Note: the number indicates how many times the given nationality is moving in the direction corresponding to the arrow compared to the opposite direction (e.g. A->B for AT is 1.3, meaning that 1.3 times as many Austrian vehicles are moving in the given section in the direction from A to B compared to the direction from B to A). The 20% most significant deviations in both directions are indicated in colour.

SUMMARY AND CONCLUSION

Freight traffic flows in the South Moravian Region are an important component of the total traffic load. The Brno area is the second most important transport node (after Prague). The traffic intensity in the close vicinity of Brno is enhanced by the routing of several major international routes, which meet here at one of the key crossings in the Central European area. In particular, the D1 motorway in the southern parts of the Brno city cadastre is thus under a heavy load of domestic and international traffic.

The analysis showed that international transport is dominated by vehicles with Polish registration plates, followed by Slovak trucks. In 2020, trucks with Hungarian, Serbian, Lithuanian and Romanian registration plates were also significantly represented. In particular, vehicles registered in Poland are even reaching the same traffic flow intensity as Czech trucks on some sections east of Brno (this applies especially to the D46 motorway).

The data show that the strength and nationality of traffic flow is essentially the same in both directions on each section of the toll system. In contrast, within the course of the roads, crossings with other major roads bring about changes in both the strength of traffic flow and its ethnic structure. The detailed effects of these crossings are shown in the chapters devoted to sub-roads. In general, the findings are consistent with intuition in that there is an increase in the proportion of Polish vehicles to the north, and an increase in Slovak and Hungarian vehicles to the south-east. On the other hand, towards the south (Vienna) the representation of Austrian carriers is minimal, which is also true for the representation of German vehicles towards Prague and potentially further west. This contrasts with the findings of the questionnaire survey for the CORCAP project and shows the weaknesses of both approaches.

The analysis also showed that roads that do not have a direct connection to the border crossing (I/43) or have a higher capacity alternative (D1 vs. D46) are logically used significantly less.

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