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A NEW DATASET OF DISTANCE AND TIME RELATED TRANSPORT COSTS FOR EU REGIONS

DAMIAAN PERSYN, JORGE DIAZ-LANCHAS, JAVIER BARBERO, ANDREA CONTE, AND SIMONE SALOTTI

- Transport costs data are a key input for trade analysis and for industry-level studies focusing on spatial distribution and logistics. Surprisingly, good transport estimates at a detailed spatial level for the EU are not readily available.
- This Policy Insight presents a new freely available dataset containing estimates of distance and time related transport costs between all NUTS-2 EU regions.
- This Insight briefly illustrates both the main assumptions behind the construction of the dataset and its core characteristics.
- The estimates take into account both the time needed and the distance covered by a representative truck travelling along optimal routes between samples of points within the EU regions.
- The resulting dataset contains an origin-destination cost matrix in euros at the region pair level. Moreover, the sampling approach allows calculating average transport costs within each region.
- Both arithmetic and harmonic averages are considered - the latter may be more relevant for interaction modelling such as the estimation of trade gravity equations.

1. Context

Seminal contributions in the economic literature on trade such as Samuelson (1954) suggest that transport costs play a key role for the trade patterns of goods and the location of economic activity. Surprisingly, there is a lack of reliable cost estimates for the EU, and in particular for its NUTS-2 regions.

This Policy Insight presents the main characteristics of a new dataset of estimated transport costs between EU regions, freely available for download from the European Commission's Science Hub. The main information contained in the dataset is the estimated average cost of road freight transport between regions, alongside more basic variables such as the average geodesic distance, and the average time and distance travelled by road.

The estimated transport costs (whose construction is fully explained in Persyn et al., 2019) take into account both the time needed and the distance covered by a representative truck travelling along optimal routes between EU NUTS-2 regions. The resulting dataset contains an origin-destination cost matrix in euros for each region pair in the EU.

The dataset is meant to be used for spatial economic modelling. Indeed, it is used for the parameterization of the "iceberg" transport costs of the spatial dynamic model RHOMOLO (Lecca et al., 2018), used by the European Commission for policy impact assessments.

This novel dataset is freely available for any researcher and policy maker interested in the characteristics of road transport costs in the EU. The region-pair-specific data provided are as follows:

- average transport costs;
- average distance (straight-line and by road), and distance-related transport costs;
- average time travelled, and time-related transport costs.

The dataset focuses on transport costs by road. These represent more than 75% of total freight transport in the EU. Future research may address alternative transport modes so to reach a more comprehensive understanding of the costs behind the trade flows of goods in the EU. This dataset contains estimated data, which depend on a number of assumptions explained in the next section.

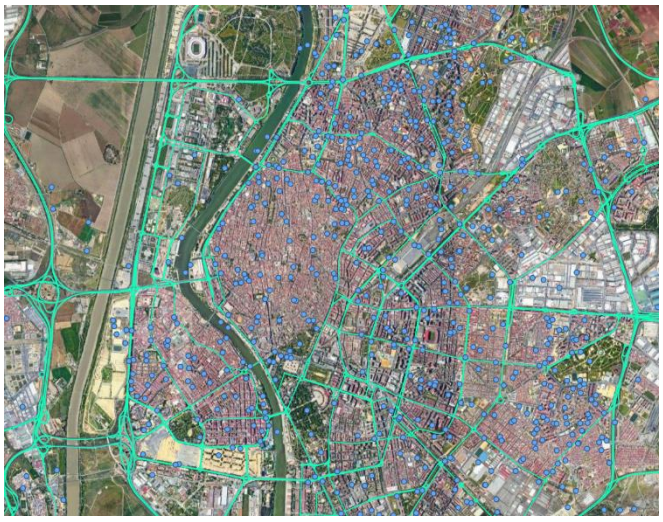
2. Construction of the dataset

The transport costs are estimated as the average cost of road freight transport between the 267 NUTS-2 regions of the EU. NUTS-2 regions can be large, so in each one a large number of centroids was sampled so to account for the spatial distribution of the within-region economic activity. The composite cost from one centroid to another was computed by considering the cost of traversing each road segment between them, calculating the optimal route minimising the cost for a representative 40t

articulated heavy-duty vehicle. Over 1,000 million optimal routes between centroid pairs were computed by using on average 60 centroids for each of the 267 regions and repeating the analysis 10 times in order to increase precision and to obtain bootstrap estimates of the sampling error.

As an example, Figure 1 shows an aerial picture of the city of Seville, and the superimposed road network which is used in the analysis.

Figure 1. Example of road network



Source: own elaborations.

The complete road network contains information on more than 4 million road segments for a total length of over 1.5 million km. Figure 1 also reports the centroids (in blue) drawn from a population density grid at a 1km resolution. Transport costs are calculated between a sub-sample of these points. For example, for the calculation of the average transport costs within the region of Andalusia, 160 of these points were sampled in the entire region. The reported results average over 10 such simulations.

The data includes characteristics of the roads such as the presence of traffic lights and roundabouts, their curvature, and the surface material. All these characteristics allow associating the segments with the costs related to time and distance of driving a truck delivering goods.

The distance-related costs pertain to the consumption of fuel, the payment of tolls and taxes, and the tyres and maintenance costs. The time-related costs include travel time over the road segment (influenced by the maximum speed, the length, and road characteristics), salaries in the transport sector, national speed limits, and the European transport regulations on resting times. Additional information on the slope of the roads allow modifying fuel consumption, speed, and travel times according to the gradients of each road segment.

The cost-minimising optimal route among the set of all possible within a region pair are reported in a baseline origin-destination cost matrix expressed in euros in the downloadable dataset. Thanks to the sampling approach with many centroids, average transport costs within the region can also be calculated. The dataset contains both the arithmetic and harmonic averages over the point-based distance and cost measures.

The policy impact of this research

The dataset illustrated in this Policy Insight is freely available at this link here.

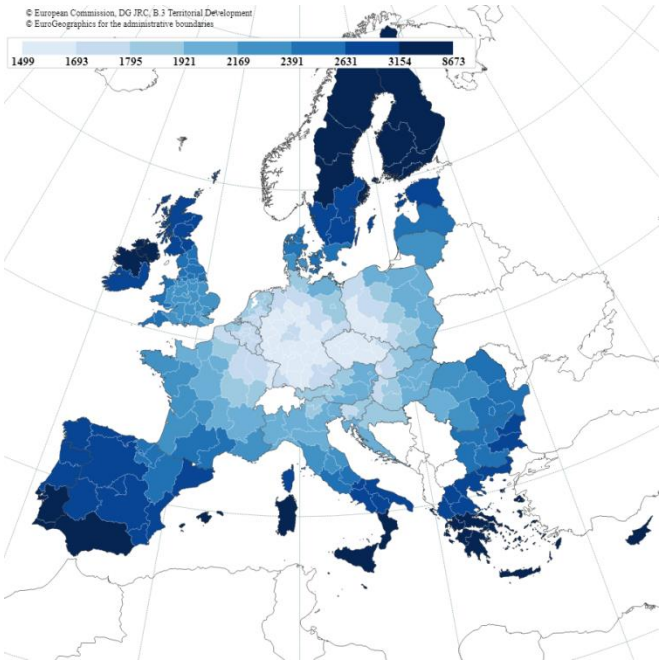
The dataset is currently used for calculating the transport costs included in the RHOMOLO model which is routinely used by the European Commission for policy impact assessments (see, for example, Sakkas et al., 2018, and Christensen et al., 2019).

3. Main characteristics of the data

The transport costs considered here are strictly related to the cost of trucking, and exclude warehousing or load/unload costs. They do, however, include costs such as vehicle maintenance costs (including yearly taxes and insurance), tolls and vignettes. With the exception of taxes and vignettes, the costs are assigned either to the distance travelled or to the time spent on the road. The largest cost related to time is associated with the wage of the driver. We assume that the relevant hourly wage for a trip between two regions is the mean drivers' wage in the regions of origin and destination. The largest cost related to distance is the cost of fuel consumption.

The median estimated cost for a shipment by a representative 40t articulated truck is €1.50 per km travelled, even though the regional variation in transport costs is large. Figure 2 plots the average transport cost of each region, weighting all possible destinations by their regional GDP. Geographically central regions have the lowest transport costs due to their location in the road network, whereas remote regions are characterised by higher transport costs.

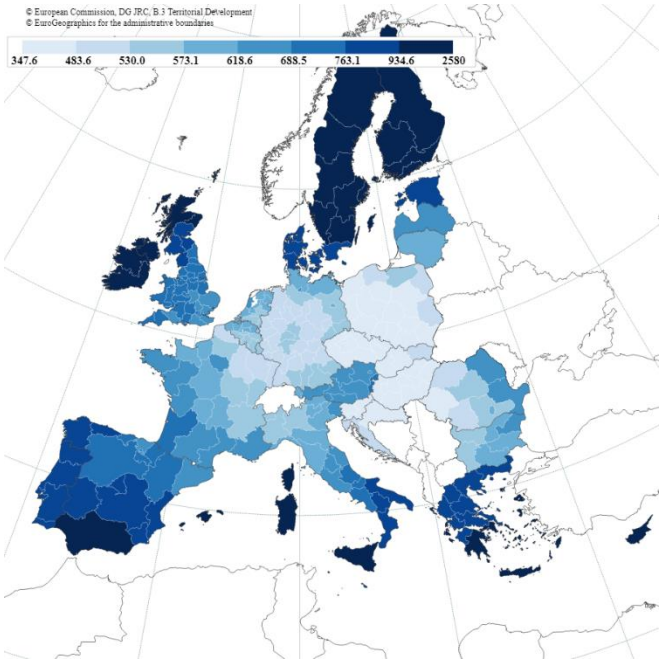
Figure 2. Average regional transport cost



Source: own calculations.

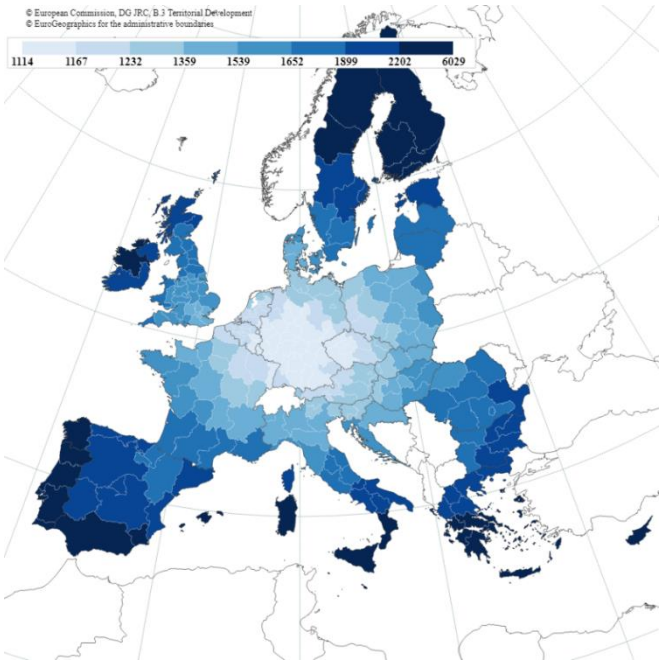
The average transport cost can be disaggregated in time and distance related cost (see Figures 3 and 4, respectively). Since wages account for a large share of time related costs, countries and regions with relatively low wages enjoy lower time-related costs. On the other hand, the cost of fuel is the main driver behind distance-related costs and peripheral regions and countries with high fuel taxes have relatively high distance-related transport costs.

Figure 3. Average regional time-related transport cost



Source: own calculations.

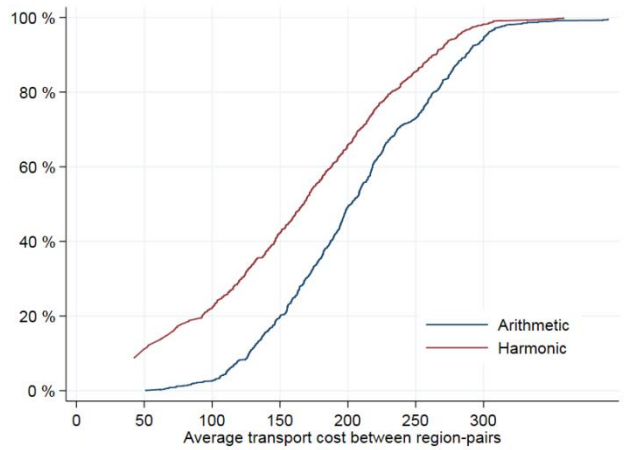
Figure 4. Average regional distance-related transport cost



Source: own calculations.

The reported distance and cost variables on the region-pair level average over large numbers of centroids, as explained above. This dataset includes both the harmonic and arithmetic averages. The former gives more weight to nearby points, and is relevant especially for interaction modelling such as gravity equations for trade or migration. The difference between the two averages is mostly relevant at relatively short distances. Figure 5 shows that when considering different region-pairs at an average distance-by-road of less than 200 km, about 20 percent of region-pairs have a harmonic average cost of €100 or lower, where there are almost no region-pairs for which the arithmetic average of the transport cost is that low.

Figure 5: Comparison between arithmetic and harmonic averages



Source: own calculations.

4. Conclusions

This Policy Insight presents a new dataset on road transport costs between EU regions, which take into account both the distance travelled and the time spent by a representative truck travelling along optimal routes.

As for any type of estimated data, the results depend on a number of assumptions. The selection of variables used to estimate transport costs is particularly relevant. Through the provision of more basic variables such as the geodesic distance, distance by road and travel time, an interested researcher can easily construct estimates of transport costs between regions using alternative assumptions tailored to her needs.

For more technical details on the dataset construction, please refer to Persyn et al. (2019). The dataset is freely available for download by clicking on *RegTCs_dset* (under *Related documents*) at the following page:

https://ec.europa.eu/jrc/en/rhomolo

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Read more

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RHOMOLO

Main author: Damiaan Persyn
mailto:damiaan.persyn@ec.europa.eu

Andrea Conte,
Project Leader, Regional Modelling team, JRC
https://ec.europa.eu/jrc/en/rhomolo/team
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