ABSTRACT

Title: Estimating road transport costs between EU regions: With an application using the spatial CGE model RHOMOLO

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Abstract: Transport costs are a crucial element of any spatial economic model. They directly affect trade flows, which are the main transmission channel for spillover effects between regions. The assumptions on transport costs directly affect the results of the analysis. Unfortunately, good transport cost estimates on the regional level are not readily available. Moreover, many economic models require appropriately transforming the transport costs in to the 'iceberg' form.

In this paper we address these issues by estimating a novel database of transport costs for the European Union (EU) regions at the NUTS 2 level. The costs are estimated as the weighted average cost of road freight transport between pairs of cities within these regions. By considering several cities in each region, we (1) account for the spatial distribution of economic activity within each region, and (2) allow calculating transport costs within every region. The computational burden of considering many city-pairs is considerable, however: as we consider on average 16 cities/towns in 268 regions, our analysis requires computing over 9.000.000 routes between city pairs.

In the spirit of the generalized transport cost (GTC) concept, we calculate the composite cost over each road segment, which allows us to calculate the optimal route among two regions (Combes and Lafourcade, 2005; Zofío et al., 2014). The optimal route is defined as the minimum costs entailed by a representative 40t Heavy Duty Vehicle (HDV). By resorting to geographical information systems and an open source database for digitalized road networks, OpenStreetMap (OSM), we accurately encompass these costs. From OSM we build a database with more than 4 millions road-segments (arcs) containing highways, primary and secondary roads (including bridges and tunnels), and ferries in Europe, with a total length of over 1.500.000 km. We also obtain from OSM characteristics of the road such as the presence of traffic lights and roundabouts, the curvature, and the surface material.

We then associate these arcs with a series of attributes related to various costs of the transport activity. Among these costs, we consider those related to the distance and the time dimensions of any single route. More concretely, for the distance-related costs, we combine the length of the arc with information on the fuel prices and fuel consumption, tolls, taxes and maintenance costs. For the time-related costs we focus on the travel time over the arc (influenced by the maximum speed, the length, and road characteristics), the salaries in the transport sector, maximum national speeds and European transport regulations on resting times. Additionally, actual geography is controlled by the use of the European digital elevation model, modifying the fuel consumption, the speed limits and the travel times according to the gradients of each road-segment.

After building the entire road-network, we calculate the minimum-cost route among the set of alternative itineraries between any pair of cities. The average costs associated to these optimal routes are portrayed in a baseline origin-destination cost matrix in euros. Due to the setup with detailed components within the GTC indicator, we can assess the effect of changes in its attributes, modifying our baseline origin-destination matrix. As a result, we are able to get a new counterfactual transport-cost matrix that can be used to evaluate transport policies. We perform a series of policy experiments by modifying the attributes of the GTC to prove the strengths of this methodology. Indeed, because of considering distance and time dimensions within the GTC, we are able to disentangle core-periphery structures of the EU regions due to transport costs. That is, the centrality of the regions within the road network is the main driver of the distance-related costs, being smaller for geographically central regions, whereas the salaries in the transport sector directly affect the time-related costs of the GTC, being higher in regions with higher wages and vice versa.

Because transport costs in many economic models model takes the form of iceberg transport costs, we move beyond the GTC matrix (in euros) to calculate the corresponding iceberg-type costs for each pair of European regions. To do this, we resort to a novel database on interregional trade flows for the EU regions in 2013 (Thissen et al., 2018).

In addition, we create a transport policy tool to assess the impact of road transport infrastructure investment in a region, by considering upgrading roads to highways. The roads are selected where the economic benefits would be largest relative to the amount of resources that are invested and the cost of building highways in each EU country. Among the road attributes, we modify those related to the maximum speed, or the ones related to penalties for curvature, slope, traffic lights and surface. After selecting and modifying all the upgraded roads, we re-calculate the set of cheapest routes between regions to get new transport cost matrices which can be compared to the baseline case.
Using the RHOMOLO CGE model (Lecca et al., 2018), we run a case study for transport infrastructure investment in the European Cohesion Policy program 2014-2020. We show that Eastern European countries are the ones clearly experiencing the biggest reductions in transport cost, although there exist significant positive spillover effects on central EU regions.

References

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