The distance of hauling commodities to export gateways: The case of Russian railways

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1. Introducing the problem
2. Data and methodology
3. Results
4. Conclusions
1. Introducing the problem

• Distance between trading partners is a very important determinant of trade flows [Tinbergen, 1962]
  – Gravity models that account for the distance and size effects has now become a standard tool [Yotov et al., 2016]
  – The distance between trade partners is one of the proxies for trade costs, along with freight charges and CIF/FoB ratios

• But trade doesn’t start or stop at national borders [Atkin & Donaldson, 2015]
  – Intra-national trade costs are worth studying
  – Also, they are less-understood than international trade frictions [Agnosteva et al., 2019]
1. Introducing the problem

- Detailed studies focus on particular countries or products
  - [Celik & Guldmann, 2007] proxy transport costs by the av. distance of hauled commodities based on 1993 US commodity flows survey
  - [Cosar & Demir, 2016] examine the role of the road infrastructure for Turkey’s export (they account for the capacity of the roads)
  - [Svanidze & Gotz, 2019] calculate grain transportation costs for Russia and the US as a percentage of international prices
  - [Perez-Mesa et al., 2019] present transport costs in € of dispatching a refrigerated truck to a particular area (Spanish agri-food products)
1. Introducing the problem

- I follow this strand of research and study the distance of hauling exported commodities carried by Russian railways
  - Russia’s export is dominated by basic commodities that are often hauled by railways due to the large area of the country
  - Private database on railway cargo transportation by commodities, stations of dep. and arr., and final destination (domestic or foreign)
  - To obtain the distance between the stations of departure and arrival, I use the geolocation parsed from the internet
  - To account for the cargo transportation data coverage, I compare the volumes of commodities transported to foreign destinations with export volume data from Russian customs
1. Introducing the problem

2. Data and methodology

3. Results

4. Conclusions
2. Data and methodology

- The **data** on cargo transportation by Russian railways
  - Date of departure
  - Final destination type (domestic or foreign)
  - Country of departure
  - Country of arrival
  - Cargo nomenclature code
  - Station of departure code (Russia)
  - Station of arrival code (Russia)
  - Station of arrival code (CIS)
  - Volume (in tons)
2. Data and methodology

• The **data coverage**
  
  – The data for 2017-2019 accounts for less than 550 products, while customs data is available for almost 1200 products (4-digit codes)
  
  – The data coverage is about 43% overall, but it jumps to 77% after excluding oil and gas (HS 2709-2711). And it is nearly 100% for some commodities that account for a considerable fraction of export
2. Data and methodology

- The **choice of products**
  - I focus on 12 products that are important in terms of export volumes and are finely covered by railway transportation data
  - The chosen products account for more than 60% of export volume and almost 30% of export value (after excluding oil and gas)

<table>
<thead>
<tr>
<th>Commodity name</th>
<th>Commodity HS code</th>
<th>Sector</th>
<th>Customs volumes of export, million tons</th>
<th>Railway data coverage, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal (уголь)</td>
<td>2701</td>
<td>Mining</td>
<td>181.4 – 207.0</td>
<td>100.0 – 104.4</td>
</tr>
<tr>
<td>Iron ores (железные руды)</td>
<td>2601</td>
<td>Mining</td>
<td>19.4 – 22.4</td>
<td>73.7 – 85.6</td>
</tr>
<tr>
<td>Sawn wood (пиломатериалы)</td>
<td>4407</td>
<td>Timber</td>
<td>18.0 – 19.8</td>
<td>82.9 – 83.7</td>
</tr>
<tr>
<td>Semi-finished products of iron (полуфабрикаты из железа)</td>
<td>7207</td>
<td>Metals</td>
<td>14.4 – 16.0</td>
<td>93.1 – 95.0</td>
</tr>
<tr>
<td>Logs (необработанные лесомат.)</td>
<td>4403</td>
<td>Timber</td>
<td>13.1 – 15.7</td>
<td>72.0 – 73.5</td>
</tr>
<tr>
<td>Nitrogenous fertilizers (азотные уд.)</td>
<td>3102</td>
<td>Chemicals</td>
<td>13.1 – 14.4</td>
<td>98.1 – 105.6</td>
</tr>
<tr>
<td>Complex fertilizers (комплекс. уд.)</td>
<td>3105</td>
<td>Chemicals</td>
<td>10.5 – 11.3</td>
<td>92.2 – 99.4</td>
</tr>
<tr>
<td>Potassic fertilizers (калийные уд.)</td>
<td>3104</td>
<td>Chemicals</td>
<td>8.8 – 11.0</td>
<td>87.6 – 103.2</td>
</tr>
<tr>
<td>Steel hot rolled coilsheet (прокат)</td>
<td>7208</td>
<td>Metals</td>
<td>5.0 – 6.3</td>
<td>84.7 – 86.6</td>
</tr>
<tr>
<td>Pig iron (чугун)</td>
<td>7201</td>
<td>Metals</td>
<td>4.3 – 5.8</td>
<td>104.7 – 113.9</td>
</tr>
<tr>
<td>Ferrous products (продукты прямого восстановления железной руды)</td>
<td>7203</td>
<td>Metals</td>
<td>2.9 – 4.1</td>
<td>99.0 – 107.3</td>
</tr>
<tr>
<td>Unwrought aluminum (алюминий)</td>
<td>7601</td>
<td>Metals</td>
<td>3.1 – 3.4</td>
<td>83.6 – 95.9</td>
</tr>
</tbody>
</table>
2. Data and methodology

• The methodology
  – The distance between the stations of origin and destination
    • the distance between the stations of departure and arrival in Russia
    • PLUS the distances between the latter and the final station of
      arrival (export gateway) that may be located in Russia or not
  
  \[ D_{i,j} = \cos^{-1}[\sin \theta_i \sin \theta_j + \cos \theta_i \cos \theta_j \cos (\varphi_i - \varphi_j)] \]

  where \( \theta_i \) and \( \theta_j \) are the latitudes of the stations of origin and destination, respectively, and \( \varphi_i \) and \( \varphi_j \) are the longitudes

  – The average length of haul for each commodity \( k \) in year \( t \)
    (weighting the distances for all routes by the volumes in tons)

  \[ L_{k,t} = \sum_r (D_r T_r / \sum_r T_r) \]

  where \( D_r \) is the distance for the route \( r \) (described by the combination of the stations of origin and destination), and \( T_r \) is the volume for route \( r \)
1. Introducing the problem
2. Data and methodology
3. Results
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- The distances of hauling aluminum and coal to export destinations are the largest (> 3,000 km), despite that key export gateways for these commodities are located in Russia.

- Iron ores and ferrous products are often hauled to export gateways outside Russia, but the av. length of haul is moderate (< 1,000 km).
3. Results

- Most commodities are hauled to export sea ports
  - coal (HS 2701), metals (HS 72, 76), fertilizers (HS 31); exception: timber (HS 44)
- Iron ores (HS 2601) are equally exported by sea and by land
- The high share of domestic stations for steel hot rolled coilsheet (HS 7208) and sawn wood (HS 4407) is explained by export to CIS
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• The patterns of hauling commodities by Russian railways differ much depending on the particular commodity
  – This is true for both the av. length of haul and export gateway types

• Future research prospects
  – The results may be further detailed by country of destination and region of departure
  – Constructing the density functions for distances at the commodity level is also worth trying
  – The list of commodities may be extended by including commodities from sectors other than mining, metals, timber and chemicals