

Źródło danych

<https://comtrade.un.org/data/> (<https://comtrade.un.org/data/>)

Analizę przeprowadzono na podstawie danych dotyczących eksportu między Polską i państwami z nią graniczącymi, a pozostałymi krajami. Dane zostały przygotowane przez United Nations (ONZ) i dotyczą roku 2018 zawierając (po wstępnym przetworzeniu przy użyciu programu CSVed) kolejno: państwo eksportujące, państwo importujące, sumaryczny koszt transakcji podany w US\$.

In [4]:

```
import tabulate
import pandas as pd
fileName = "data.csv"
data = pd.read_csv(fileName, sep = ',', usecols= [0,1,2])

data.head()
```

Out[4]:

	Reporter	Partner	Trade Value (US\$)
0	Poland	Afghanistan	9596572
1	Poland	Albania	66487707
2	Poland	Antarctica	499190
3	Poland	Algeria	376354867
4	Poland	American Samoa	2404

Utworzenie grafu

In [5]:

```
import networkx as nx

g=nx.from_pandas_edgelist(data,
                        source='Reporter',
                        target='Partner',
                        edge_attr='Trade Value (US$)',
                        create_using=nx.Graph())
```

Analiza grafu

In [6]:

```
print(f'Liczba wierzchołków: {g.number_of_nodes()}')
print(f'Liczba krawędzi: {g.number_of_edges()}')
print(f'Gęstość: {nx.density(g)}')
print(f'Średnica: {nx.diameter(g)}')
print(f'Liczba węzłów: {g.order()}')
print(f'Rozmiar: {g.size()}')
```

Liczba wierzchołków: 230
Liczba krawędzi: 1570
Gęstość: 0.059616479969622174
Średnica: 3
Liczba węzłów: 230
Rozmiar: 1570

In [7]:

```
import matplotlib.pyplot as plt
import warnings
warnings.filterwarnings('ignore')

degree = dict(g.degree(weight='Trade Value (US$)'))
sorted_degree = {r: degree[r] for r in sorted(degree, key=degree.get)}

plt.figure(figsize=(5, 10))
plt.barh(list(sorted_degree.keys()), sorted_degree.values())
plt.show()
```

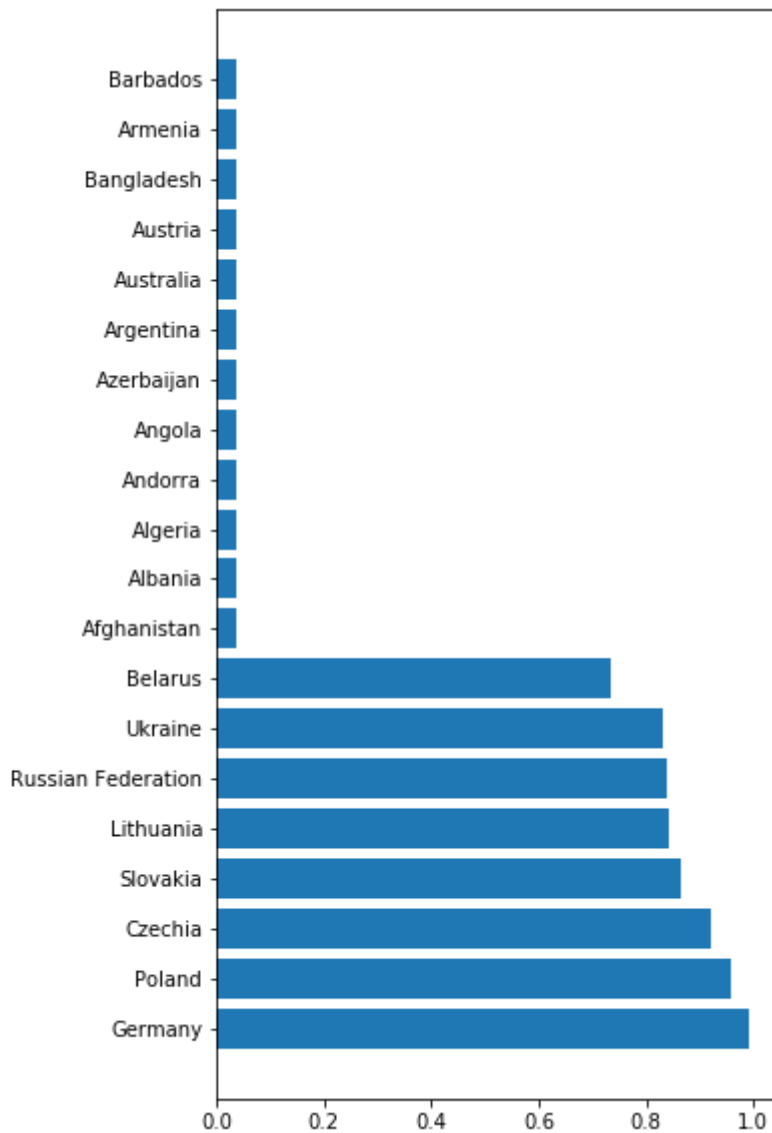
<Figure size 500x1000 with 1 Axes>

Wyznaczamy stopień centralności dla każdego z wierzchołków. Aby wykres był czytelny, pod uwagę wzięto jedynie pierwszych 20 węzłów z największym stopniem. Oczywiście dane opisują eksport z Polski i państw z nią graniczących, dlatego dla nich stopień będzie największy. Widać natomiast, że naszym najbliższym sąsiedztwie niemiecki eksport jest największy, jednak tuż za nimi jest Polska.

In [8]:

```
degree centrality = dict(nx.degree centrality(g))
sorted_degree centrality = {r: degree centrality[r] for r in sorted(degree centrality,
key=degree centrality.get, reverse = True)[:20]}

plt.figure(figsize=(5, 10))
plt.barh(list(sorted_degree centrality.keys()), sorted_degree centrality.values())
plt.show()
```

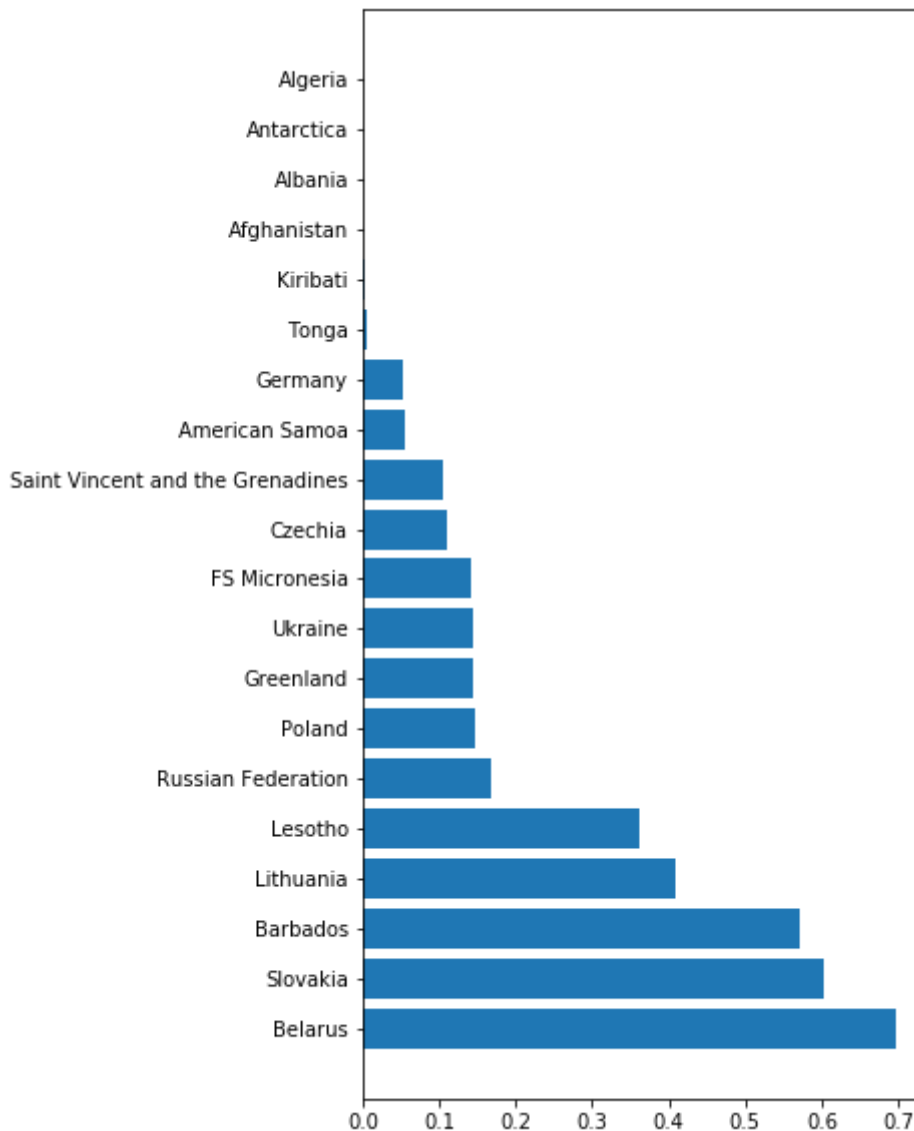


Sprawdzamy jak ważne dla (sieci) eksportu z okolicznego regionu są poszczególne węzły (państwa) za pomocą miary centralności przechodniości.

In [9]:

```
betweenness centrality = dict(nx.betweenness centrality(g, weight='Trade Value (US$)'))
sorted_betweenness centrality = {r: betweenness centrality[r] for r in sorted(betweenne
ss centrality, key=betweenness centrality.get, reverse = True)[:20]}

plt.figure(figsize=(5, 10))
plt.barh(list(sorted_betweenness centrality.keys()), sorted_betweenness centrality.valu
es())
plt.show()
```

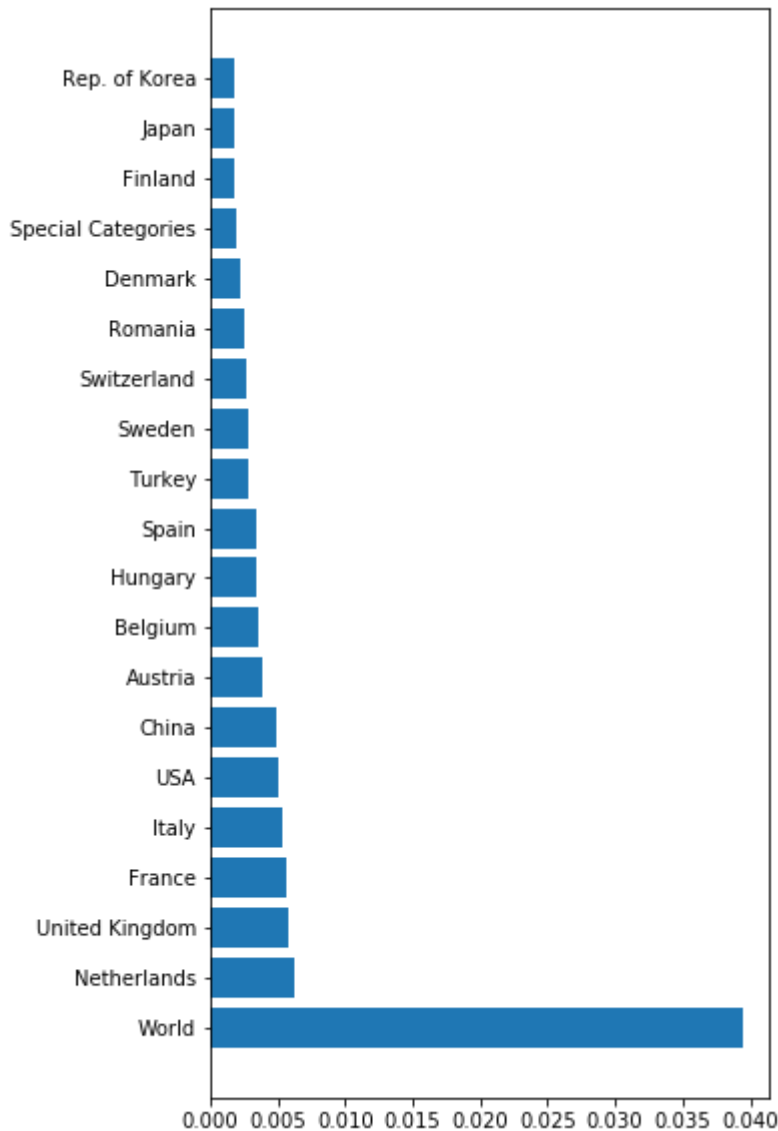


Wyznaczenie współczynnika grupowania, który jest miarą stopnia, w jakim węzły wykazują tendencję do skupiania się

In [23]:

```
clustering_coefficient = nx.clustering(g, weight='Trade Value (US$)')
sorted_clustering_coefficient = {r: clustering_coefficient[r] for r in sorted(clustering_coefficient, key=clustering_coefficient.get, reverse=True)[:20]}

plt.figure(figsize=(5, 10))
plt.barh(list(sorted_clustering_coefficient.keys()), sorted_clustering_coefficient.values())
plt.show()
```

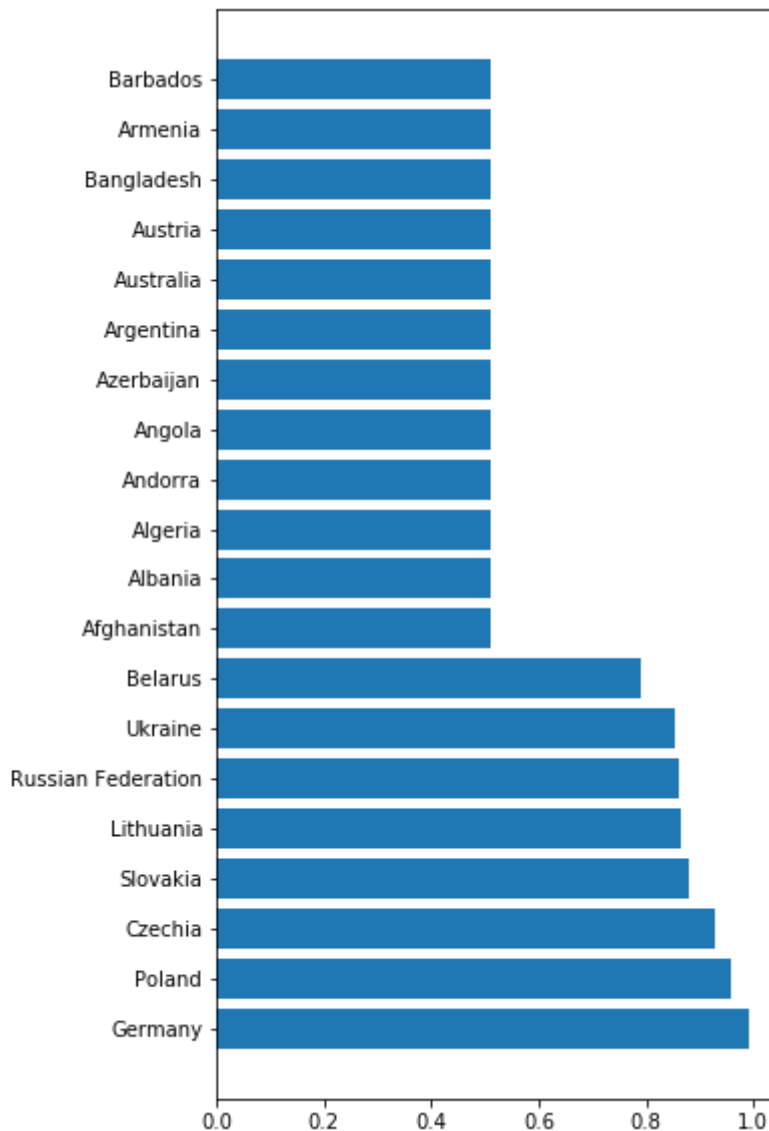


Miara centralności bliskości mówi o tym, jak ważną rolę w grafie odgrywa dany wierzchołek. W tym przypadku mowa o tym, jak ważną rolę pełni w przepływie pieniędzy płynących z okolicznego eksportu. Mierzy się ją jako średnią odległość do wszystkich pozostałych węzłów.

In [11]:

```
closeness centrality = dict(nx.closeness centrality(g))
sorted_closeness centrality = {r: closeness centrality[r] for r in sorted(closeness centrality, key=closeness centrality.get, reverse = True)[:20]}

plt.figure(figsize=(5, 10))
plt.barh(list(sorted_closeness centrality.keys()), sorted_closeness centrality.values())
plt.show()
```

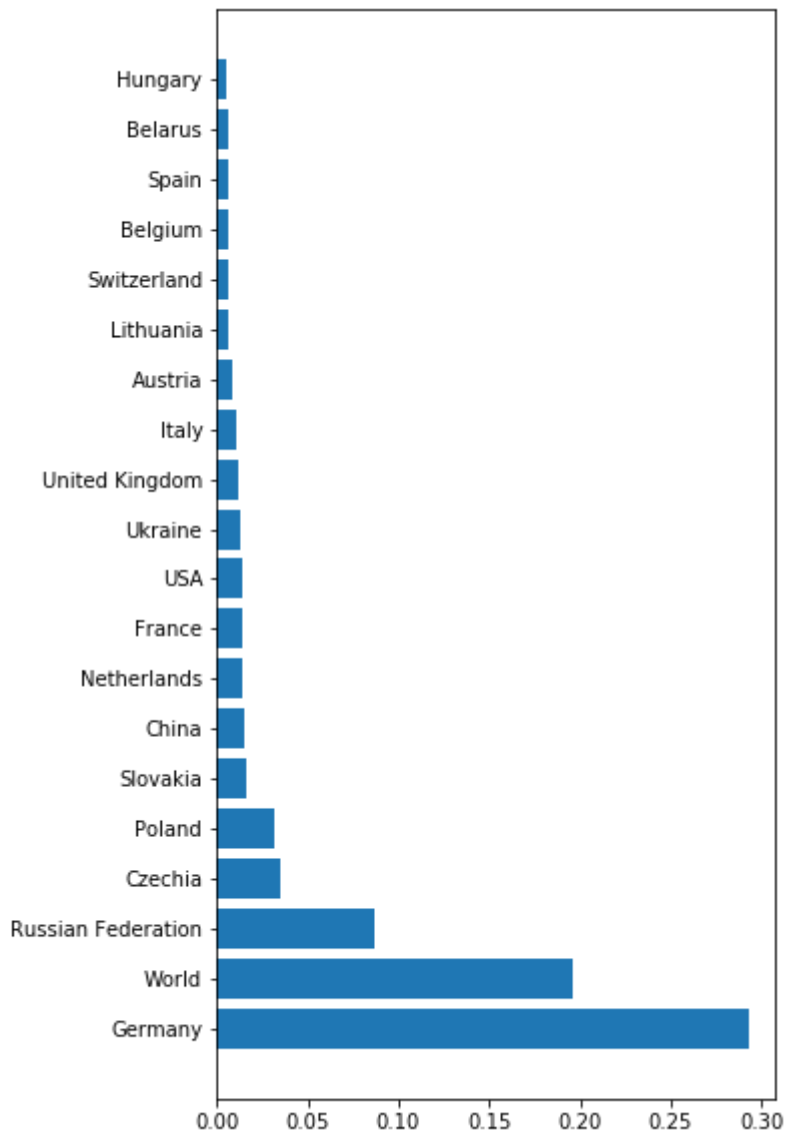


Miara PageRank pozostała zaprojektowana przez założycieli przedsiębiorstwa Google i nazwana nazwiskiem jednego z nich. PageRank jest rozwinięciem znanej od dawna heurystyki, wedle której jakość węzła jest proporcjonalna do liczby węzłów z nim powiązanych.

In [12]:

```
pagerank = dict(nx.pagerank(g, weight='Trade Value (US$)'))
sorted_pagerank = {r: pagerank[r] for r in sorted(pagerank, key=pagerank.get, reverse =
True)[:20]}

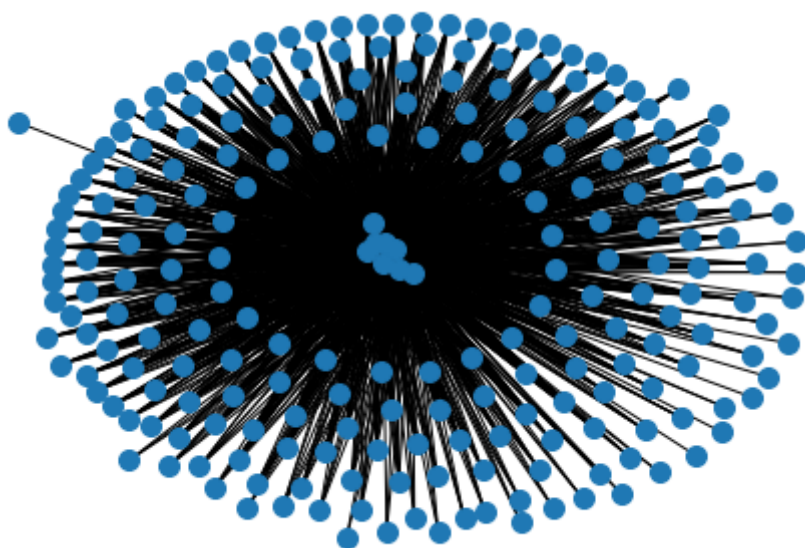
plt.figure(figsize=(5, 10))
plt.barh(list(sorted_pagerank.keys()), sorted_pagerank.values())
plt.show()
```



Wizualizacja grafu

In [13]:

```
nx.draw_kamada_kawai(g, node_size=100, weight='Trade Value (US$)')
```



Kraje pełniące najważniejszą rolę w eksporcie z okolicznego regionu (których udział w tym procesie przewyższa średnią).

In [24]:

```
degrees = dict(g.degree(weight='Trade Value (US$)').values())
avg = sum(degrees) / len(degrees)

selected_nodes = {k: v for k, v in dict(g.degree(weight='Trade Value (US$)').items() if v > avg}
subgraph = g.subgraph(selected_nodes)
nx.draw_kamada_kawai(subgraph, node_size=100, with_labels=True, label_color='r', weight='Trade Value (US$)')
```



Stosunek krawędzi do węzłów - możliwy eksport towarów do pozostałych krajów

In [18]:

```
countries = dict(g.degree(weight='Trade Value (US$)').keys())
countries_ordered = sorted(countries)

datas = []

for key in countries_ordered:
    data = {}
    data['Kraj'] = key
    data['Liczba partnerów'] = len(g.edges(key))
    edges = [tuple[1] for tuple in list(g.edges(key))]
    data['Lista partnerów'] = '\n'.join(sorted(edges))
    datas.append(data)

sorted_datas = sorted(datas, key=lambda x:x['Liczba partnerów'], reverse=True)

import tabulate

print("Pierwsze 8 (interesuje nas jedynie Polska i kraje graniczące - pozostałe zawsze  
będą mieć liczbę krawędzi <= 8)")
header = ['Kraj', 'Liczba partnerów', 'Lista partnerów']
rows = [x.values() for x in sorted_datas[:8]]
print(tabulate.tabulate(rows, header, "fancy_grid"))
print('...')
```

Pierwsze 8 (interesuje nas jedynie Polska i kraje graniczące - pozostałe zawsze będą mieć liczbę krawędzi ≤ 8)

Kraj	Liczba partnerów	Lista partnerów
Germany	227	Afghanistan
		Albania
		Algeria
		American Samoa
		Andorra
		Angola
		Anguilla
		Antarctica
		Antigua and Barbuda
		Argentina
		Armenia
		Aruba
		Australia
		Austria
		Azerbaijan
		Bahamas
		Bangladesh
		Barbados
		Belarus
		Belgium
		Belize
		Benin
		Bermuda
		Bhutan
		Bolivia (Plurinational State o
		Bonaire
		Bosnia Herzegovina

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		Botswana
		Bouvet Island
		Br. Virgin Isds
		Brazil
		Brunei Darussalam
		Bulgaria
		Bunkers
		Burkina Faso
		Burundi
		Cabo Verde
		Cambodia
		Cameroon
		Canada
		Cayman Isds
		Central African Rep.
		Chad
		Chile
		China
		Christmas Isds
		Colombia
		Comoros
		Congo
		Cook Isds
		Costa Rica
		Croatia
		Cuba
		Curaçao
		Cyprus
		Czechia
		Côte d'Ivoire

		Dem. People's Rep. of Korea
		Dem. Rep. of the Congo
		Denmark
		Djibouti
		Dominica
		Dominican Rep.
		Ecuador
		Egypt
		El Salvador
		Equatorial Guinea
		Eritrea
		Estonia
		Eswatini
		Ethiopia
		FS Micronesia
		Faeroe Isds
		Falkland Isds (Malvinas)
		Fiji
		Finland
		Fr. South Antarctic Terr.
		France
		French Polynesia
		Gabon
		Gambia
		Georgia
		Ghana
		Gibraltar
		Greece
		Greenland
		Grenada
		Guam

		Guatemala
		Guinea
		Guinea-Bissau
		Guyana
		Haiti
nds		Heard Island and McDonald Isla
		Holy See (Vatican City State)
		Honduras
		Hungary
		Iceland
		India
		Indonesia
		Iran
		Iraq
		Ireland
		Israel
		Italy
		Jamaica
		Japan
		Jordan
		Kazakhstan
		Kenya
		Kiribati
		Kuwait
		Kyrgyzstan
		Lao People's Dem. Rep.
		Latvia
		Lebanon
		Lesotho
		Liberia

- | Libya
- | Lithuania
- | Luxembourg
- | Madagascar
- | Malawi
- | Malaysia
- | Maldives
- | Mali
- | Malta
- | Marshall Isds
- | Mauritania
- | Mauritius
- | Mexico
- | Mongolia
- | Montenegro
- | Montserrat
- | Morocco
- | Mozambique
- | Myanmar
- | N. Mariana Isds
- | Namibia
- | Nauru
- | Nepal
- | Netherlands
- | New Caledonia
- | New Zealand
- | Nicaragua
- | Niger
- | Nigeria
- | Norfolk Isds
- | North Macedonia

es

	Norway
	Oman
	Pakistan
	Palau
	Panama
	Papua New Guinea
	Paraguay
	Peru
	Philippines
	Poland
	Portugal
	Qatar
	Rep. of Korea
	Rep. of Moldova
	Romania
	Russian Federation
	Rwanda
	Saint Barthélemy
	Saint Helena
	Saint Kitts and Nevis
	Saint Lucia
	Saint Maarten
	Saint Pierre and Miquelon
	Saint Vincent and the Grenadin
	Samoa
	San Marino
	Sao Tome and Principe
	Saudi Arabia
	Senegal
	Serbia

			Seychelles
			Sierra Leone
			Singapore
			Slovakia
			Slovenia
			Solomon Isds
			Somalia
			South Africa
			South Sudan
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			Special Categories
			Sri Lanka
			State of Palestine
			Sudan
			Suriname
			Sweden
			Switzerland
			Syria
			Tajikistan
			Thailand
			Timor-Leste
			Togo
			Tokelau
			Tonga
			Trinidad and Tobago
			Tunisia
			Turkey
			Turkmenistan
			Turks and Caicos Isds
			Tuvalu
			USA

Poland	219	Afghanistan
		Albania
		Algeria
		American Samoa
		Andorra
		Angola
		Anguilla
		Antarctica
		Antigua and Barbuda
		Argentina
		Armenia
		Aruba

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			Australia
			Austria
			Azerbaijan
			Bahamas
			Bahrain
			Bangladesh
			Barbados
			Belarus
			Belgium
			Belize
			Benin
			Bermuda
			Bhutan
			Bolivia (Plurinational State o
			Bonaire
			Bosnia Herzegovina
			Botswana
			Br. Virgin Isds
			Brazil
			Brunei Darussalam
			Bulgaria
			Bunkers
			Burkina Faso
			Burundi
			Cabo Verde
			Cambodia
			Cameroon
			Canada
			Cayman Isds
			Central African Rep.
			Chad

	Chile
	China
	Colombia
	Comoros
	Congo
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	Cuba
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	Djibouti
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	Egypt
	El Salvador
	Equatorial Guinea
	Eritrea
	Estonia
	Eswatini
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	Faeroe Isds
	Falkland Isds (Malvinas)

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			Iraq
			Ireland
			Israel
			Italy

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		Mozambique
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		New Caledonia
		New Zealand
		Nicaragua
		Niger
		Nigeria
		North Macedonia
		Norway
		Oman
		Pakistan
		Panama
		Papua New Guinea
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		Saint Lucia
		Saint Maarten

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			United Rep. of Tanzania
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			Vanuatu
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	Iraq
	Ireland

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		Morocco

	Mozambique
	Myanmar
	N. Mariana Isds
	Namibia
	Nepal
	Netherlands
	New Caledonia
	New Zealand
	Nicaragua
	Niger
	Nigeria
	Niue
	North Macedonia
	Norway
	Oman
	Pakistan
	Panama
	Papua New Guinea
	Paraguay
	Peru
	Philippines
	Poland
	Portugal
	Qatar
	Rep. of Korea
	Rep. of Moldova
	Romania
	Russian Federation
	Rwanda
	Saint Barthélemy

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		Saint Vincent and the Grenadin
		Samoa
		San Marino
		Sao Tome and Principe
		Saudi Arabia
		Senegal
		Serbia
		Seychelles
		Sierra Leone
		Singapore
		Slovakia
		Slovenia
		Somalia
		South Africa
		South Sudan
		Spain
		Sri Lanka
		State of Palestine
		Sudan
		Suriname
		Sweden
		Switzerland
		Syria
		Tajikistan
		Thailand
		Timor-Leste
		Togo

slands |

Slovakia

198 | Afghanistan

- | Tonga
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- | Turkmenistan
- | Turks and Caicos Isds
- | USA
- | Uganda
- | Ukraine
- | United Arab Emirates
- | United Kingdom
- | United Rep. of Tanzania
- | United States Minor Outlying I
- | Uruguay
- | Uzbekistan
- | Vanuatu
- | Venezuela
- | Viet Nam
- | World
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- | Zambia
- | Zimbabwe
- | Albania
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- | Andorra
- | Angola
- | Anguilla
- | Antigua and Barbuda

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	Central African Rep.
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	Denmark
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	Dominica
	Dominican Rep.
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	Estonia
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			Greenland
			Grenada
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			Guinea-Bissau
			Guyana
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			Iceland
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			Indonesia
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			Iraq
			Ireland
			Israel
			Italy
			Jamaica
			Japan

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		Kyrgyzstan
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		Latvia
		Lebanon
		Lesotho
		Liberia
		Libya
		Lithuania
		Luxembourg
		Madagascar
		Malawi
		Malaysia
		Maldives
		Mali
		Malta
		Mauritania
		Mauritius
		Mexico
		Mongolia
		Montenegro
		Morocco
		Mozambique
		Myanmar
		Namibia
		Nepal
		Netherlands

		New Caledonia
		New Zealand
		Nicaragua
		Niger
		Nigeria
		North Macedonia
		Norway
		Oman
		Pakistan
		Palau
		Panama
		Paraguay
		Peru
		Philippines
		Poland
		Portugal
		Qatar
		Rep. of Korea
		Rep. of Moldova
		Romania
		Russian Federation
		Rwanda
		Saint Barthélemy
		Saint Kitts and Nevis
		Saint Lucia
		Saint Maarten
		Saint Pierre and Miquelon
		San Marino
		Saudi Arabia
		Senegal
		Serbia

			Seychelles
			Sierra Leone
			Singapore
			Slovenia
			Somalia
			South Africa
			Spain
			Sri Lanka
			State of Palestine
			Sudan
			Suriname
			Sweden
			Switzerland
			Syria
			Tajikistan
			Thailand
			Timor-Leste
			Togo
			Trinidad and Tobago
			Tunisia
			Turkey
			Turkmenistan
			Turks and Caicos Isds
			USA
			Uganda
			Ukraine
			United Arab Emirates
			United Kingdom
			United Rep. of Tanzania
			United States Minor Outlying I
lands			

| Uruguay

| Uzbekistan

| Venezuela

| Viet Nam

| World

| Yemen

| Zambia

| Zimbabwe

| Lithuania

193 | Afghanistan

| Albania

| Algeria

| Andorra

| Angola

| Antigua and Barbuda

| Argentina

| Armenia

| Aruba

| Australia

| Austria

| Azerbaijan

| Bahamas

| Bahrain

| Bangladesh

| Barbados

| Belarus

| Belgium

| Belize

| Benin

| Bermuda

| Bhutan

f)

| Bolivia (Plurinational State of)

| Bosnia Herzegovina

| Botswana

| Brazil

| Brunei Darussalam

| Bulgaria

| Bunkers

| Burkina Faso

| Burundi

| Cabo Verde

| Cambodia

| Cameroon

| Canada

| Central African Rep.

| Chad

| Chile

| China

| Colombia

| Congo

| Costa Rica

| Croatia

| Cuba

| Curaçao

| Cyprus

| Czechia

| Côte d'Ivoire

| Dem. Rep. of the Congo

| Denmark

| Djibouti

| Dominica

		Dominican Rep.
		Ecuador
		Egypt
		El Salvador
		Equatorial Guinea
		Estonia
		Eswatini
		Ethiopia
		Faeroe Isds
		Fiji
		Finland
		France
		French Polynesia
		Gabon
		Gambia
		Georgia
		Germany
		Ghana
		Gibraltar
		Greece
		Greenland
		Grenada
		Guam
		Guatemala
		Guinea
		Guinea-Bissau
		Guyana
		Haiti
		Honduras
		Hungary
		Iceland

		India
		Indonesia
		Iran
		Iraq
		Ireland
		Israel
		Italy
		Jamaica
		Japan
		Jordan
		Kazakhstan
		Kenya
		Kuwait
		Kyrgyzstan
		Lao People's Dem. Rep.
		Latvia
		Lebanon
		Lesotho
		Liberia
		Libya
		Luxembourg
		Madagascar
		Malawi
		Malaysia
		Maldives
		Mali
		Malta
		Marshall Isds
		Mauritania
		Mauritius

		Mexico
		Mongolia
		Montenegro
		Morocco
		Mozambique
		Myanmar
		Namibia
		Nepal
		Netherlands
		New Caledonia
		New Zealand
		Nicaragua
		Niger
		Nigeria
		North Macedonia
		Norway
		Oman
		Pakistan
		Panama
		Papua New Guinea
		Paraguay
		Peru
		Philippines
		Poland
		Portugal
		Qatar
		Rep. of Korea
		Rep. of Moldova
		Romania
		Russian Federation
		Rwanda

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		Saint Barthélemy
		Saint Kitts and Nevis
		Saint Lucia
		Saint Maarten
		Saint Vincent and the Grenadin
		Samoa
		San Marino
		Saudi Arabia
		Senegal
		Serbia
		Seychelles
		Sierra Leone
		Singapore
		Slovakia
		Slovenia
		Somalia
		South Africa
		South Sudan
		Spain
		Sri Lanka
		State of Palestine
		Sudan
		Suriname
		Sweden
		Switzerland
		Syria
		Tajikistan
		Thailand
		Timor-Leste
		Togo

Russian Federation	192	Afghanistan
		Albania
		Algeria
		Andorra
		Angola
		Antigua and Barbuda
		Argentina
		Armenia
		Aruba
		Australia
		Austria

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			Costa Rica
			Croatia
			Cuba
			Curaçao
			Cyprus
			Czechia
			Côte d'Ivoire
			Dem. People's Rep. of Korea
			Dem. Rep. of the Congo
			Denmark
			Djibouti
			Dominica
			Dominican Rep.
			Ecuador
			Egypt
			El Salvador
			Equatorial Guinea
			Eritrea
			Estonia
			Eswatini
			Ethiopia
			FS Micronesia
			Faeroe Isds
			Falkland Isds (Malvinas)
			Fiji
			Finland
			France
			French Polynesia
			Gabon
			Gambia
			Georgia

		Germany
		Ghana
		Gibraltar
		Greece
		Greenland
		Guam
		Guatemala
		Guinea
		Guyana
		Haiti
		Honduras
		Hungary
		Iceland
		India
		Indonesia
		Iran
		Iraq
		Ireland
		Israel
		Italy
		Jamaica
		Japan
		Jordan
		Kazakhstan
		Kenya
		Kuwait
		Kyrgyzstan
		Lao People's Dem. Rep.
		Latvia
		Lebanon

			Liberia
			Libya
			Lithuania
			Luxembourg
			Madagascar
			Malawi
			Malaysia
			Maldives
			Mali
			Malta
			Marshall Isds
			Mauritania
			Mauritius
			Mexico
			Mongolia
			Montenegro
			Morocco
			Mozambique
			Myanmar
			Namibia
			Nepal
			Netherlands
			New Caledonia
			New Zealand
			Nicaragua
			Niger
			Nigeria
			North Macedonia
			Norway
			Oman
			Pakistan

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	Panama
	Papua New Guinea
	Paraguay
	Peru
	Philippines
	Poland
	Portugal
	Qatar
	Rep. of Korea
	Rep. of Moldova
	Romania
	Rwanda
	Saint Kitts and Nevis
	Saint Lucia
	Saint Vincent and the Grenadin
	San Marino
	Sao Tome and Principe
	Saudi Arabia
	Senegal
	Serbia
	Seychelles
	Sierra Leone
	Singapore
	Slovakia
	Slovenia
	Somalia
	South Africa
	South Sudan
	Spain
	Sri Lanka

		State of Palestine
		Sudan
		Suriname
		Sweden
		Switzerland
		Syria
		Tajikistan
		Thailand
		Togo
		Tokelau
		Trinidad and Tobago
		Tunisia
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		Uganda
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		United Arab Emirates
		United Kingdom
		United Rep. of Tanzania
		Uruguay
		Uzbekistan
		Venezuela
		Viet Nam
		Western Sahara
		World
		Yemen
		Zambia
		Zimbabwe
Ukraine	190	Afghanistan

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				Albania
				Algeria
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				Argentina
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				Bangladesh
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				Belarus
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				Belize
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				Bolivia (Plurinational State o
				Bosnia Herzegovina
				Botswana
				Br. Virgin Isds
				Brazil
				Brunei Darussalam
				Bulgaria
				Burkina Faso
				Burundi
				Cabo Verde

			Cambodia
			Cameroon
			Canada
			Central African Rep.
			Chad
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			Comoros
			Congo
			Cook Isds
			Costa Rica
			Croatia
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			Curaçao
			Cyprus
			Czechia
			Côte d'Ivoire
			Dem. People's Rep. of Korea
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			Denmark
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			Ethiopia

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		Netherlands
		New Caledonia

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			Singapore
			Slovakia
			Slovenia
			Somalia
			South Africa
			South Sudan
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			State of Palestine
			Sudan
			Suriname
			Sweden
			Switzerland
			Syria
			Tajikistan
			Thailand
			Togo
			Trinidad and Tobago
			Tunisia
			Turkey
			Turkmenistan
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			United Arab Emirates
			United Kingdom
			United Rep. of Tanzania
			Uruguay
			Uzbekistan
			Vanuatu
			Venezuela

			Viet Nam
			Western Sahara
			World
			Yemen
			Zambia
			Zimbabwe
Belarus	168		Afghanistan
			Albania
			Algeria
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			Armenia
			Aruba
			Australia
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			Benin
f)			Bolivia (Plurinational State o
			Bosnia Herzegovina
			Botswana
			Br. Virgin Isds
			Brazil
			Brunei Darussalam

			Bulgaria
			Burkina Faso
			Burundi
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			Central African Rep.
			Chad
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			Czechia
			Côte d'Ivoire
			Dem. Rep. of the Congo
			Denmark
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			Dominica
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		Kyrgyzstan
		Lao People's Dem. Rep.

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			Marshall Isds
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			Morocco
			Mozambique
			Myanmar
			Namibia
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			New Caledonia
			New Zealand
			Nicaragua
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			North Macedonia
			Norway

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		Russian Federation
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		Senegal
		Serbia
		Sierra Leone
		Singapore
		Slovakia
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		South Sudan
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		Sri Lanka
		State of Palestine
		Sudan
		Sweden

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			Turkmenistan
			USA
			Uganda
			Ukraine
			United Arab Emirates
			United Kingdom
			United Rep. of Tanzania
			Uruguay
			Uzbekistan
			Venezuela
			Viet Nam
			World
			Yemen
			Zambia
			Zimbabwe

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Pytania biznesowe

1. Który z krajów jest największym eksporterem w okolicznym dla Polski regionie?

Wcześniejsza analiza wykazała, że największą liczbę partnerów oraz największe zyski z eksportu zarabiają Niemcy

2. Jakie 6 krajów pełnią najważniejszą rolę w przepływie towarów z okolicznego regionu (Polski i państw z nią graniczących)?

Są to: USA, Wlk. Bryt. Francja, Holandia, Włochy. Ich udział 3-krotnie przewyższa średnią.

3. Rola którego z krajów biorących udział w przepływie pieniędzy wygenerowanych z okolicznego eksportu jest największa?

Odpowiedź na to pytanie dostarcza nam miara centralności przechodniości (betweenness centrality), która opisuje wpływ konkretnego wierzchołka na dyfuzję informacji w grafie. Tym krajem jest Białoruś.