Economic Complexity, Value Chain Networks and Québec's Global Competitiveness

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Mon Pays

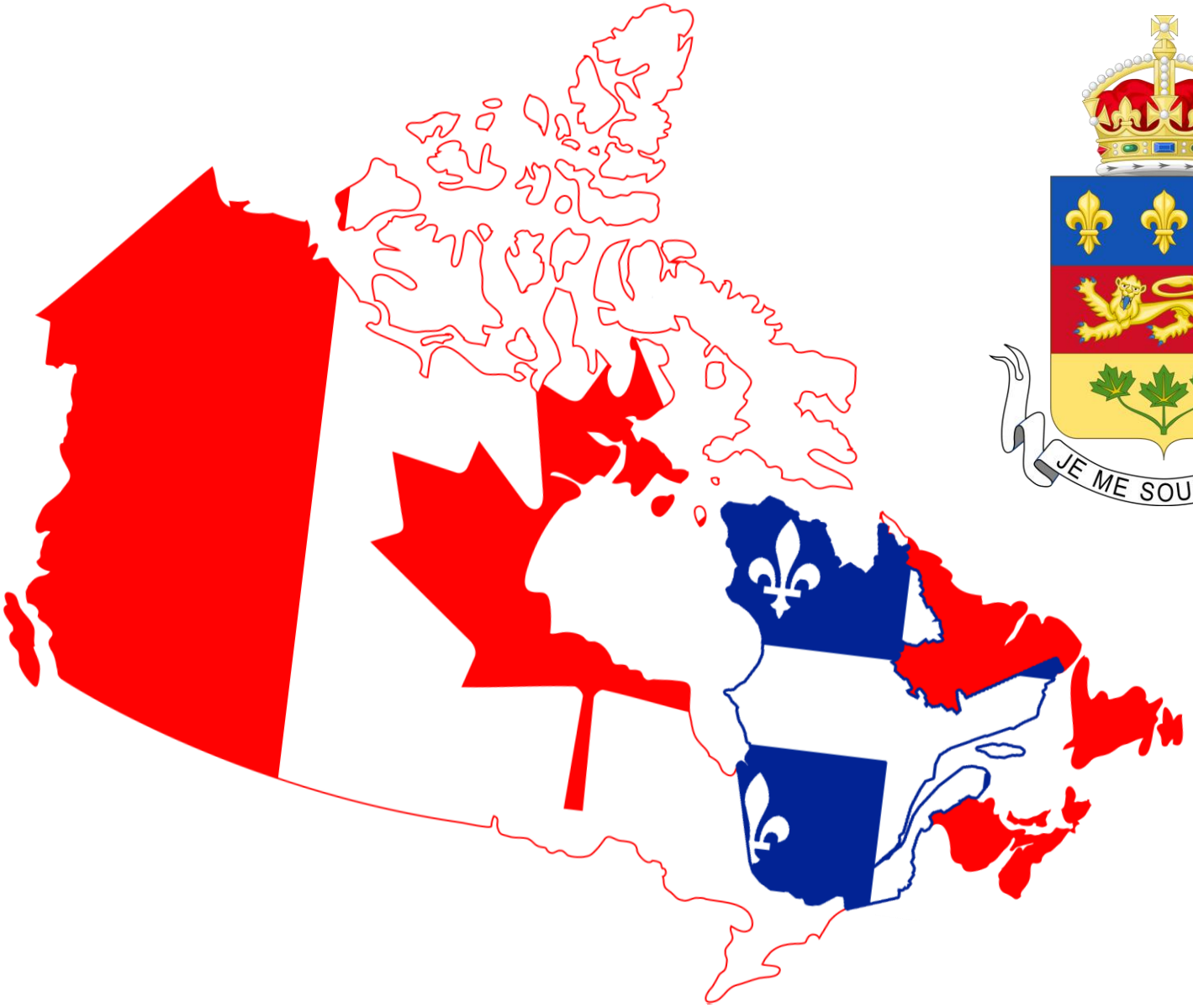
Mon pays ce n'est pas un pays, c'est l'hiver.
Mon jardin ce n'est pas un jardin, c'est la plaine.
Mon chemin ce n'est pas un chemin, c'est la neige.

My Country

My country is not a country, it's the winter.
My garden is not a garden, it's the plains.
My path is not a path, it's the snow.

- Gilles Vigneault

Where is Québec?



National images of Québec

Investissement Québec

- What are the most competitive economic sectors of Québec?
- What are the potential sectors to attract FDIs Québec?

What does Québec produce?

The Value Chains, Knowledge and Networks

- **Global Value Chains**
  - Incorporation of cross-border value-adding inflows and outflows in global production. (Porter, 1985)
  - Interconnectivity and interdependence between firms and regions in networks. (Gereffi et al. 2005; Sturgeon et al. 2008)
  - Coordination by collaborative alliances (horizontal linkages) and supplyer-buyer relationships (vertical linakges) (Turkina et al. 2016; Wang et al. 2017; Turkina & Van Assche, 2018)

- **Knowledge and Networks**
  - Complex knowledge exchanges and business relationships in networks (Ernst, 2002; Coe et al. 2008)
  - Hierarchical configuration and power distribution based on absorptive capacity of complex knowledge. (Cohen & Levinthal, 1990; Mudambi 2008)

Economic Complexity (Hidalgo, Hausmann, 2009)

- **Economic complexity**: the productivity of a country that resides in the diversity of its available non-tradable "capabilities".

  → Economic complexity predicts future economic growth and global competitiveness of a country.

  → Product space and opportunities to upgrade (Jankowska et al, 2012)

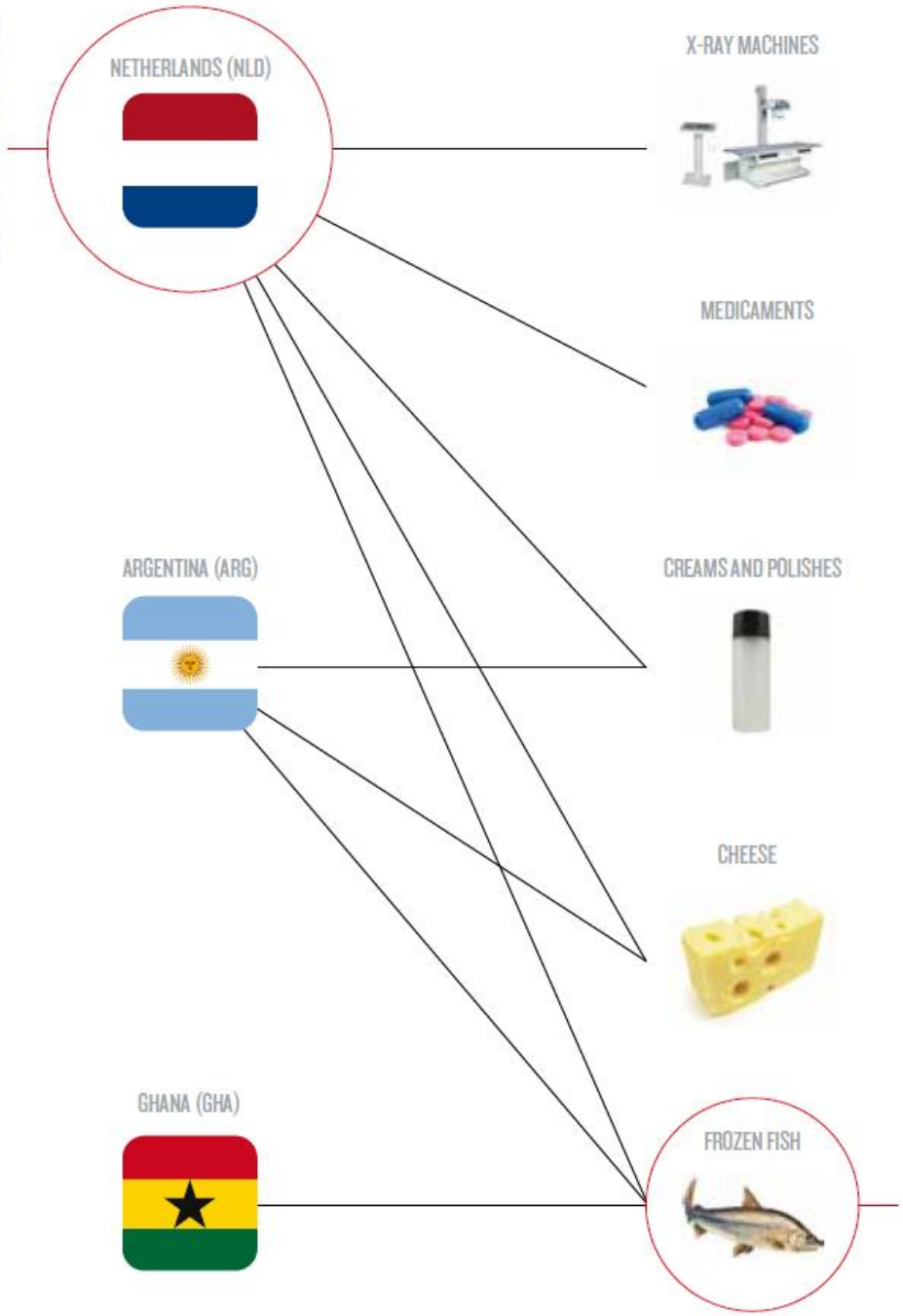
- **Measures:**
  - **Product Complexity Index (PCI):** knowledge intensity of a product by considering the **knowledge intensity of its exporters**.
  - **Economic Complexity Index (ECI):** Knowledge intensity of an economy by considering the **knowledge intensity of the products it exports**.

Economic Complexity (Hidalgo, Hausmann, 2009)

- **Product Proximity:** Probability that a pair of products is co-exported (similarity of knowledge base)
  - **Diversity (kc,0):** Number of products a country is capable to produce.
  - **Ubituity(kp,0):** Number of countries are capable to produce a products

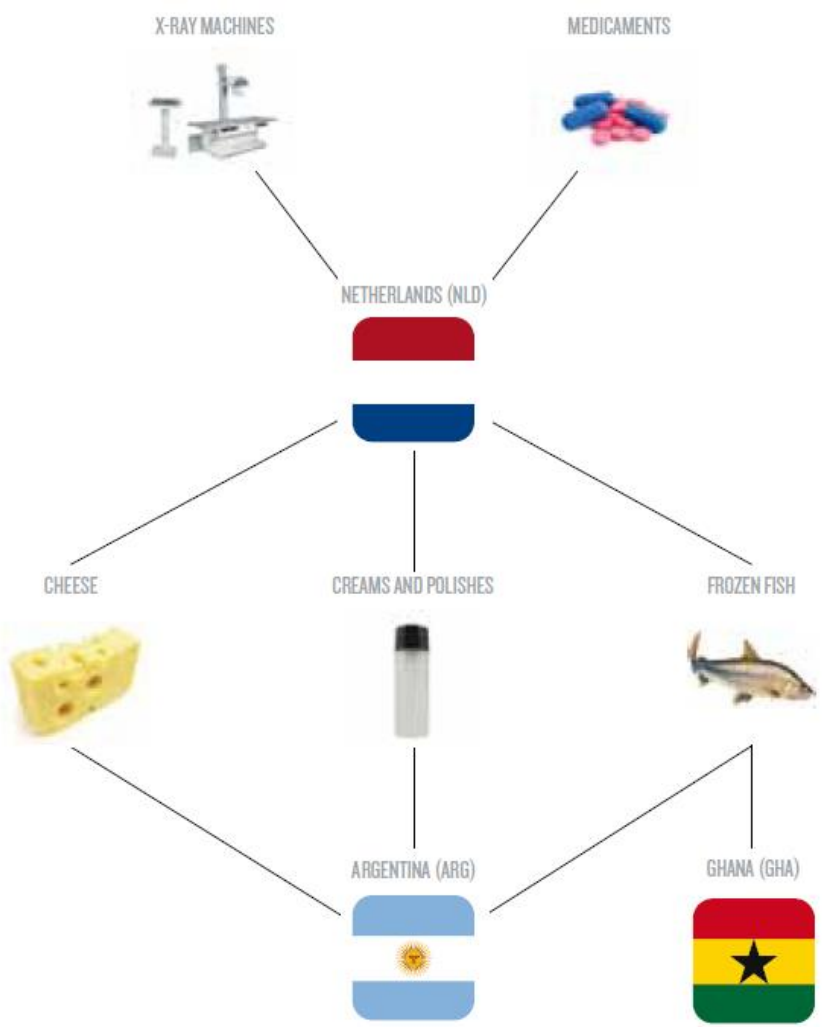
- **Revealed Comparative Advantage (RCA)**
  - Measurement of a country's capability to produce a product
  - Ratio of the share of a product in a country's export basket to the share of that product in world trade. (RCA>1 represents the competitive advantage in international trade)

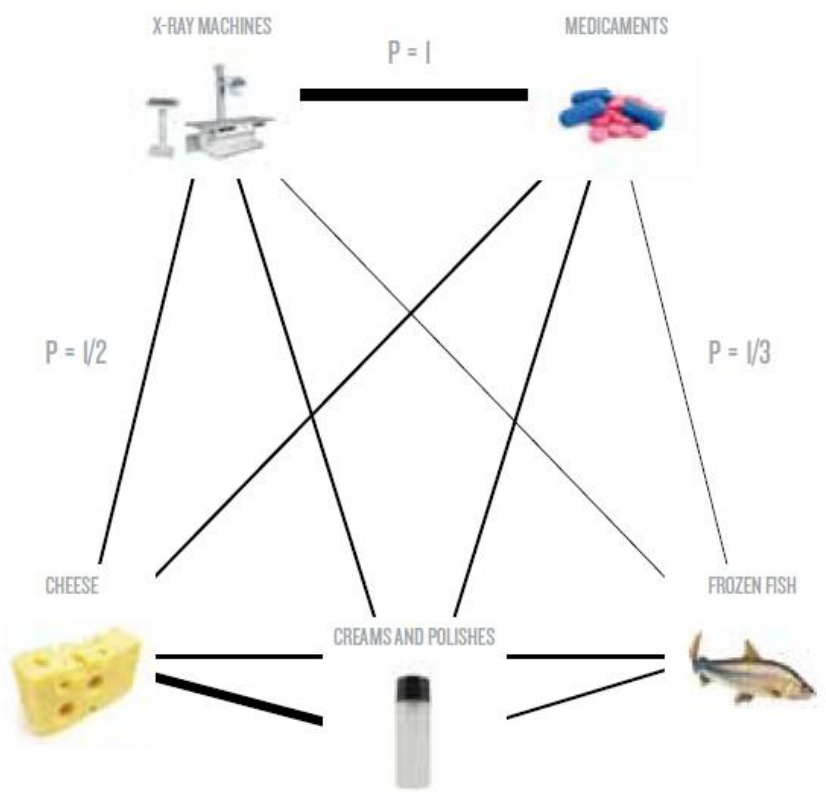
DIVERSITY ($k_{c,0}$):
Diversity is related to the number of products that a country is connected to. This is equal to the number of links that this country has in the network. In this example, using a subset of the 2009 data, the diversity of Netherlands is 5, that of Argentina is 3, and that of Gana is 1.



UBIQUITY ($k_{p,0}$):
Ubiquity is is related to the number of countries that a product is connected to. This is equal to the number of links that this product has in the network. In this example, using a subset of the 2009 data, the ubiquity of Cheese is 2, that of Fish is 3 and that of Medicaments is 1.

Source: *The Atlas of Economic Complexity* Hidalgo et al. (2011)



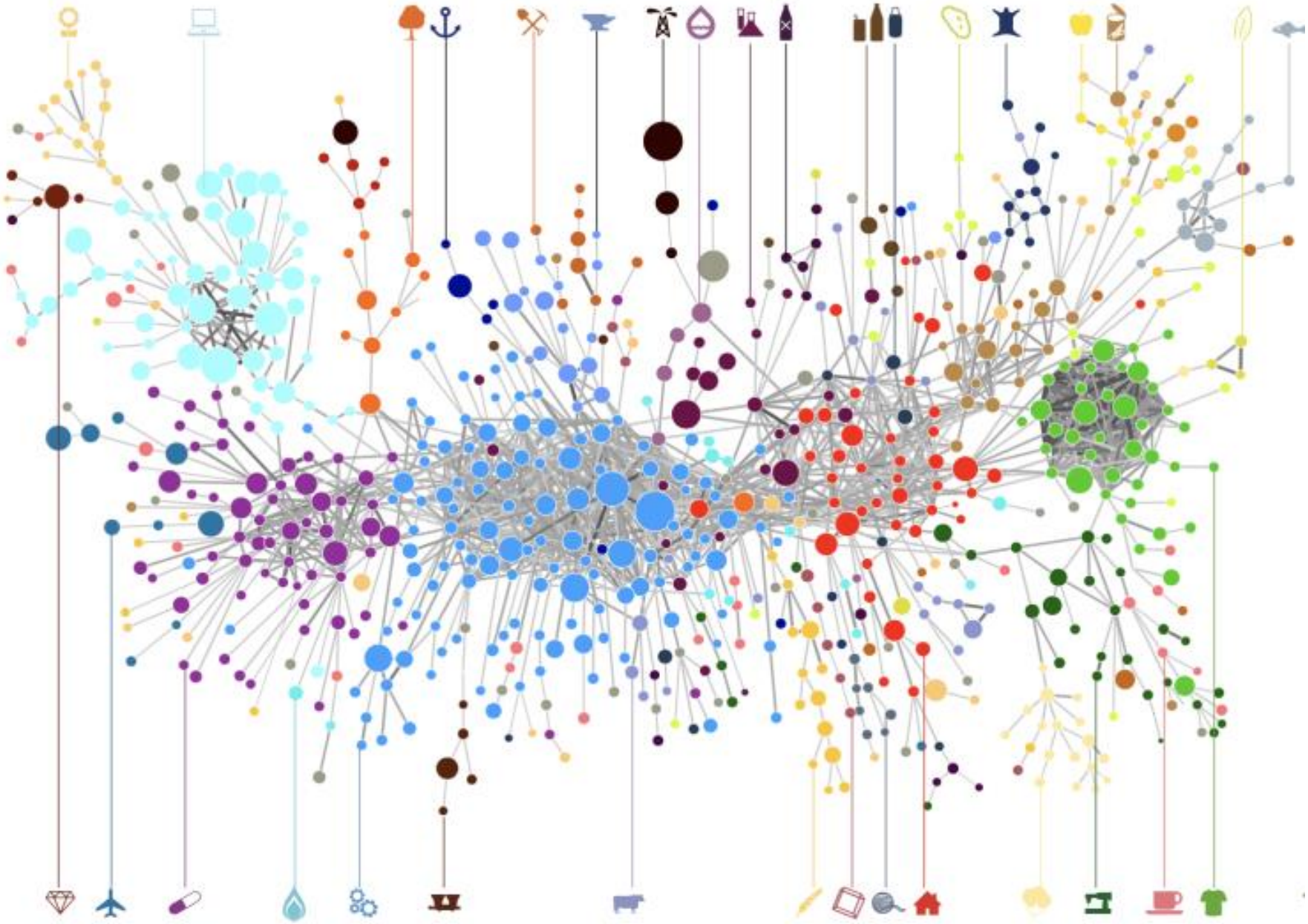


Source: *The Atlas of Economic Complexity* Hidalgo et al. (2011)

$$\phi_{pp'} = \frac{\sum_c M_{cp} M_{cp'}}{max(k_{p,0}, k_{p',0})}$$

Where M_{cp} =1 if country c exports product p with RCA>1 and 0 otherwise. $k_{p,0}$ is the ubiquity of product p.

Production Space Network (Hidalgo, Hausmann, 2009)



Data Collection

1. Trade data

- Québec, Canada and World
- By product value (HS92 code, 4-digit, value in USD)
- Sources: Statistics Canada, UN Comtrade Database, International Trade Centre

2. Production Space Network

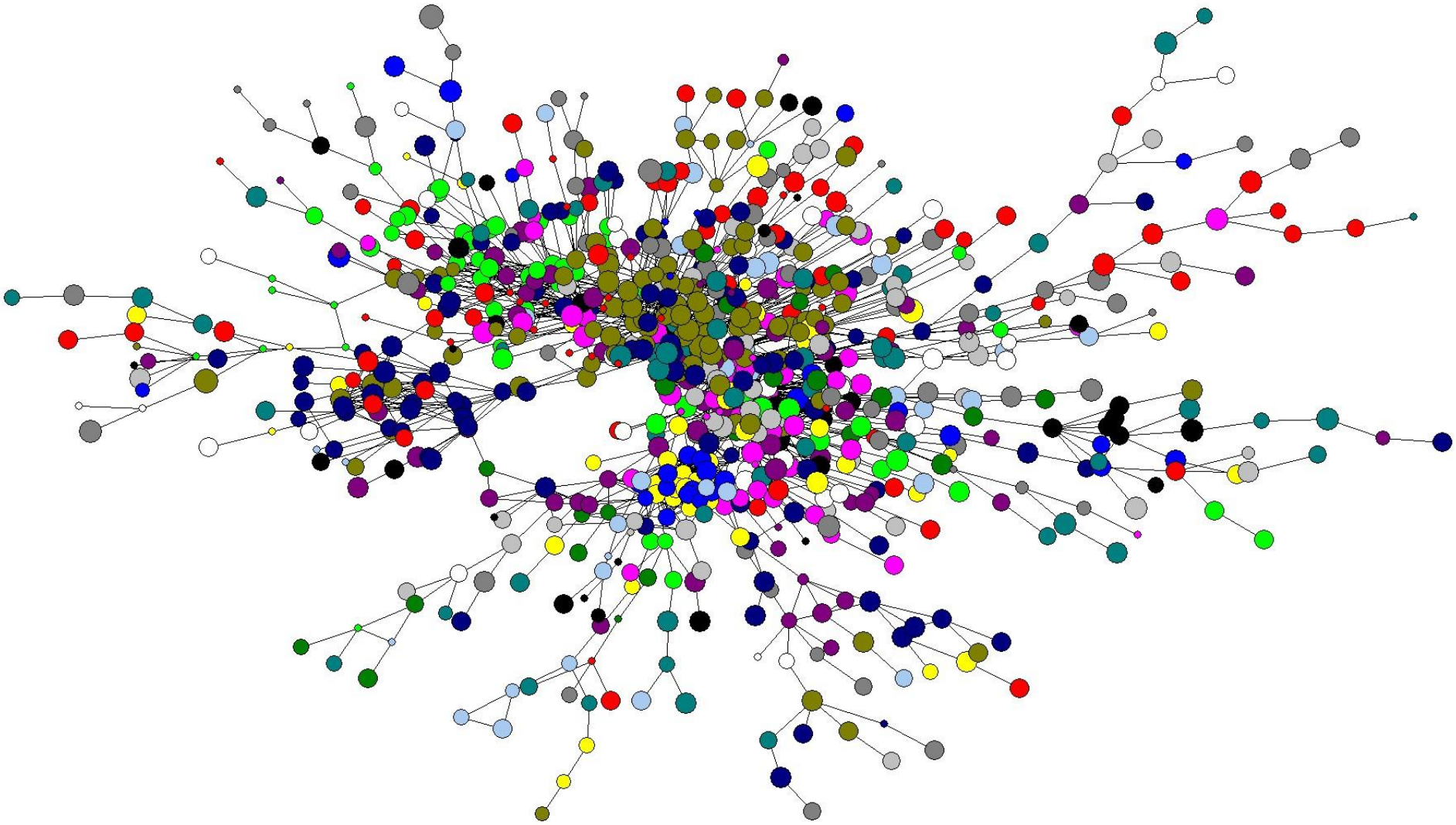
- Observatory of Economic Compexlity
- Dyadic connection between procuts

3. Product Complexity Index (PCI)

- ATLAS of economics complexity
- Five-year average PCI value (2011-2015)

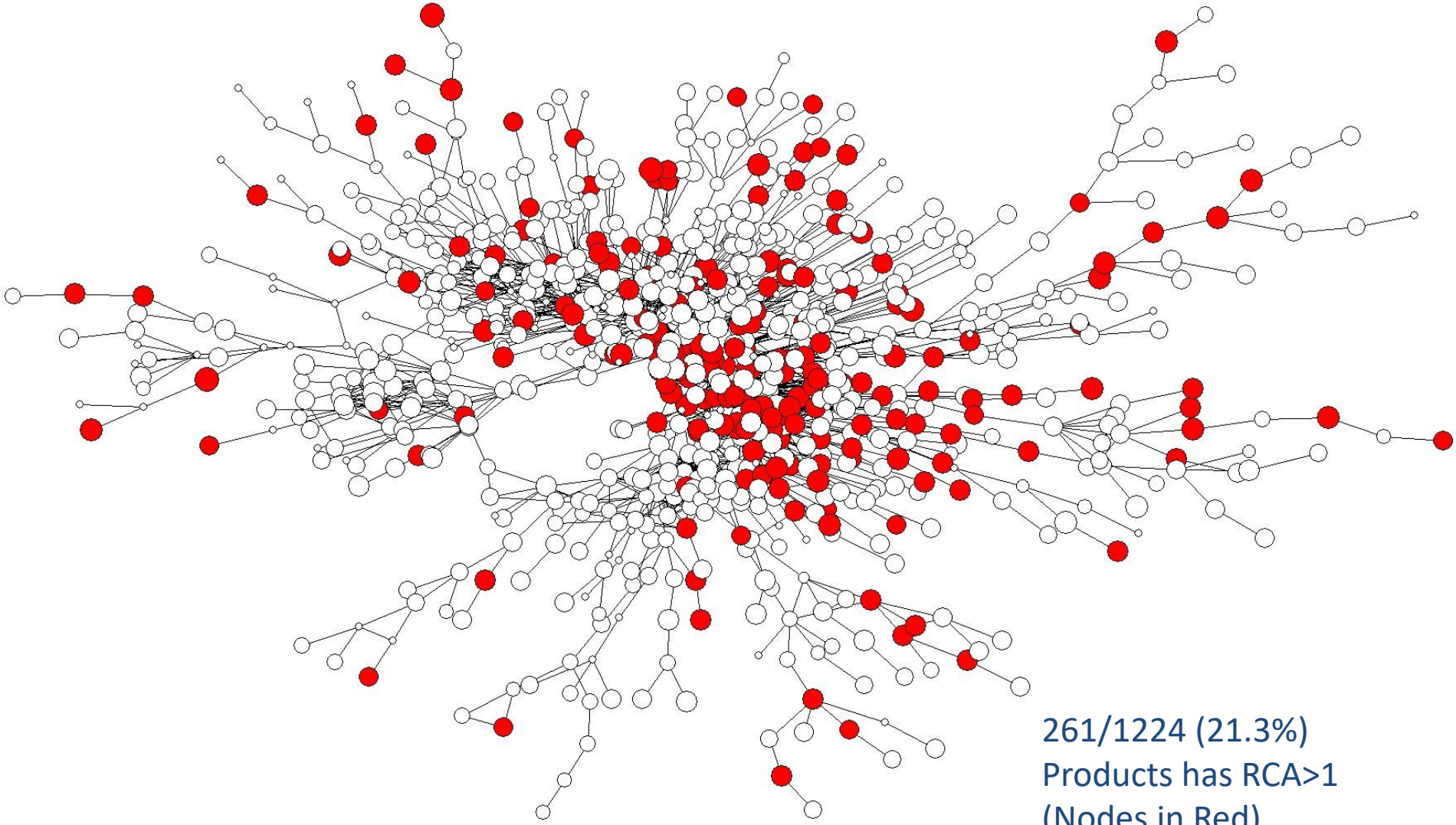
Production Space Network of Québec (2017)

(Node size: Export Value in USD)



RCA products of Québec (2017)

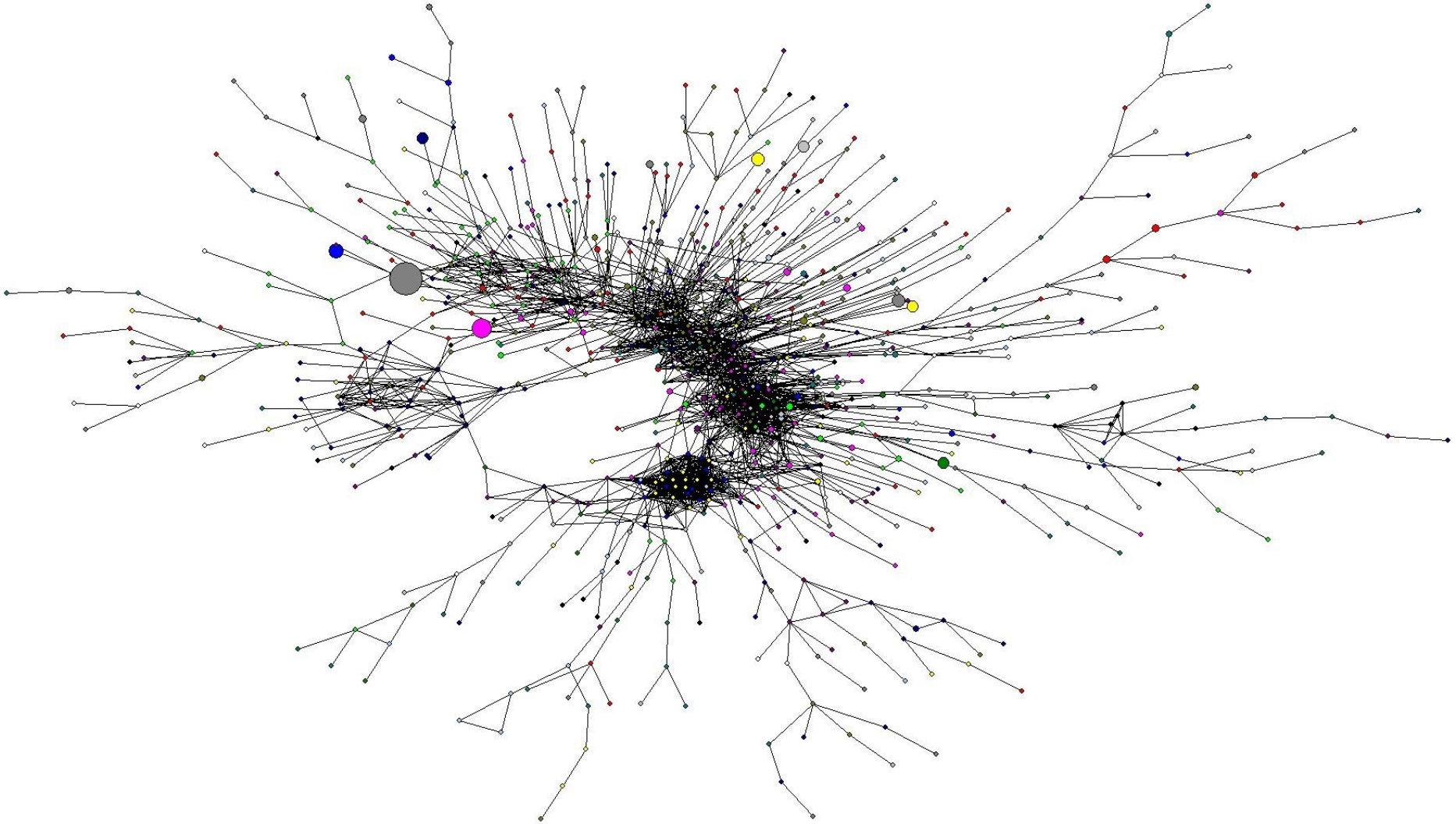
(RCA>1; Node size: Export Value in USD)



261/1224 (21.3%)
Products has RCA>1
(Nodes in Red)

Production Space Network of Québec (2017)

(Node size: Percentage in world export)



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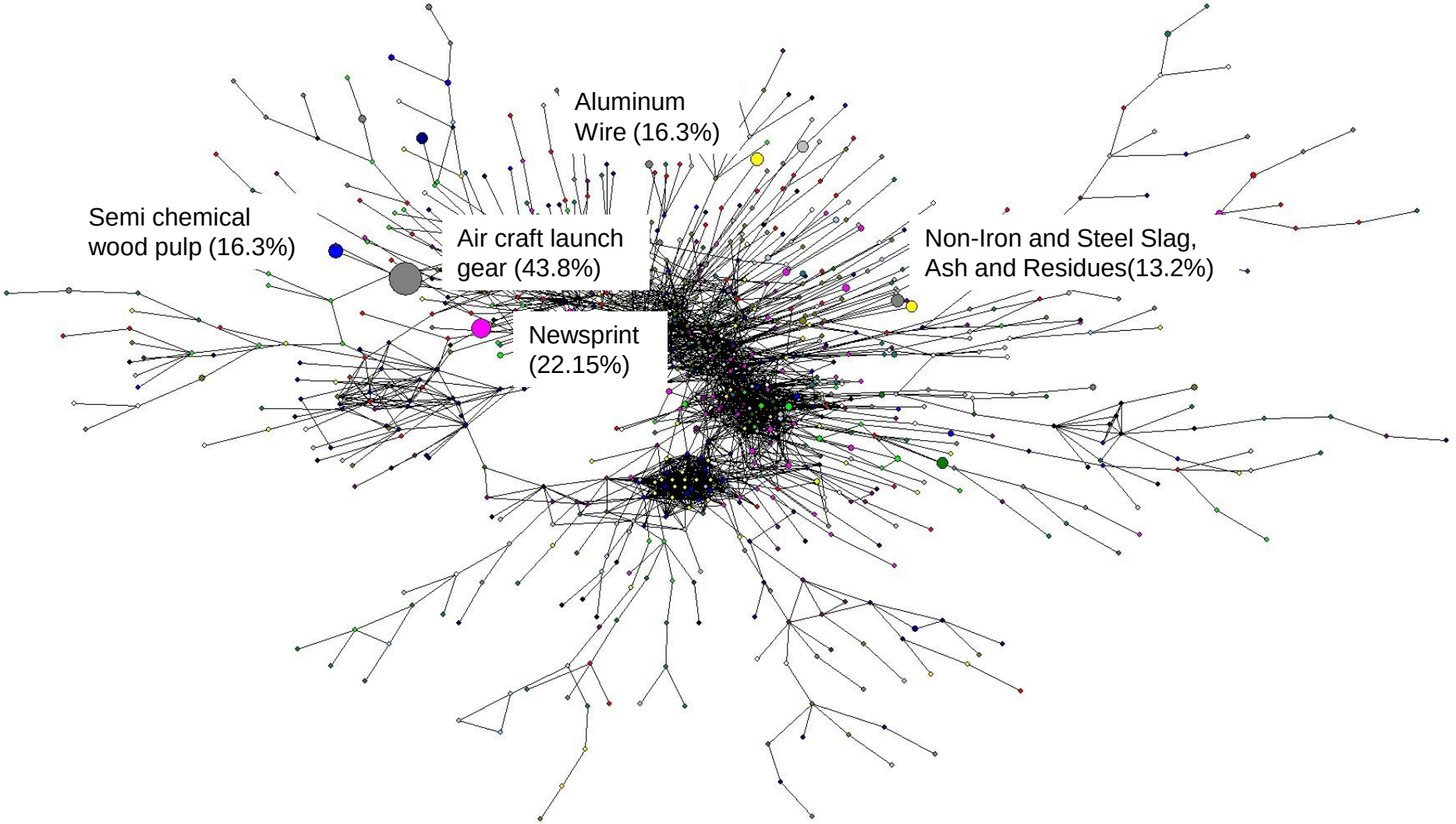
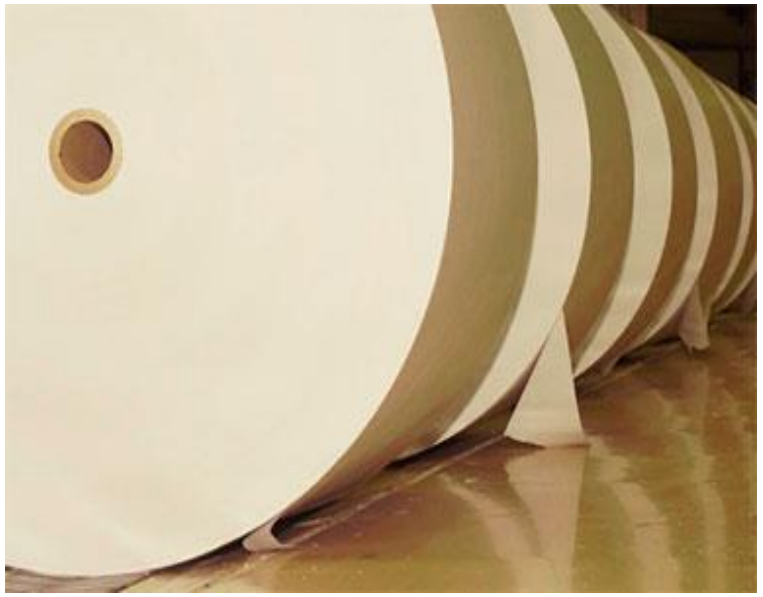


Québec's Top 10 Product with highest RCA

Rank	Product	PCI	Percentage of total export	RCA Index
1	Aircraft Launch Gear	0.274	1.07%	117.30
2	Newsprint	0.531	1.51%	59.31
3	Semi chemical Woodpulp	0.006	0.44%	43.75
4	Non-Iron and Steel Slag, Ash and Residues	-0.629	0.58%	35.27
5	Aluminium Wire	0.412	0.66%	32.69
6	Detonating Fuses	0.287	0.26%	30.70
7	Peat	-0.308	0.20%	27.15
8	Raw Aluminium	0.272	7.71%	25.97
9	Alkylbenzenes and Alkylnaphthalenes	0.390	0.25%	24.76
10	Sulfuric Acid	0.075	0.07%	16.75

- High diversity of RCA products
- Most high RCA products have positive PCI
- Dominance by metal materials and chemical products

What are Québec good at producing?



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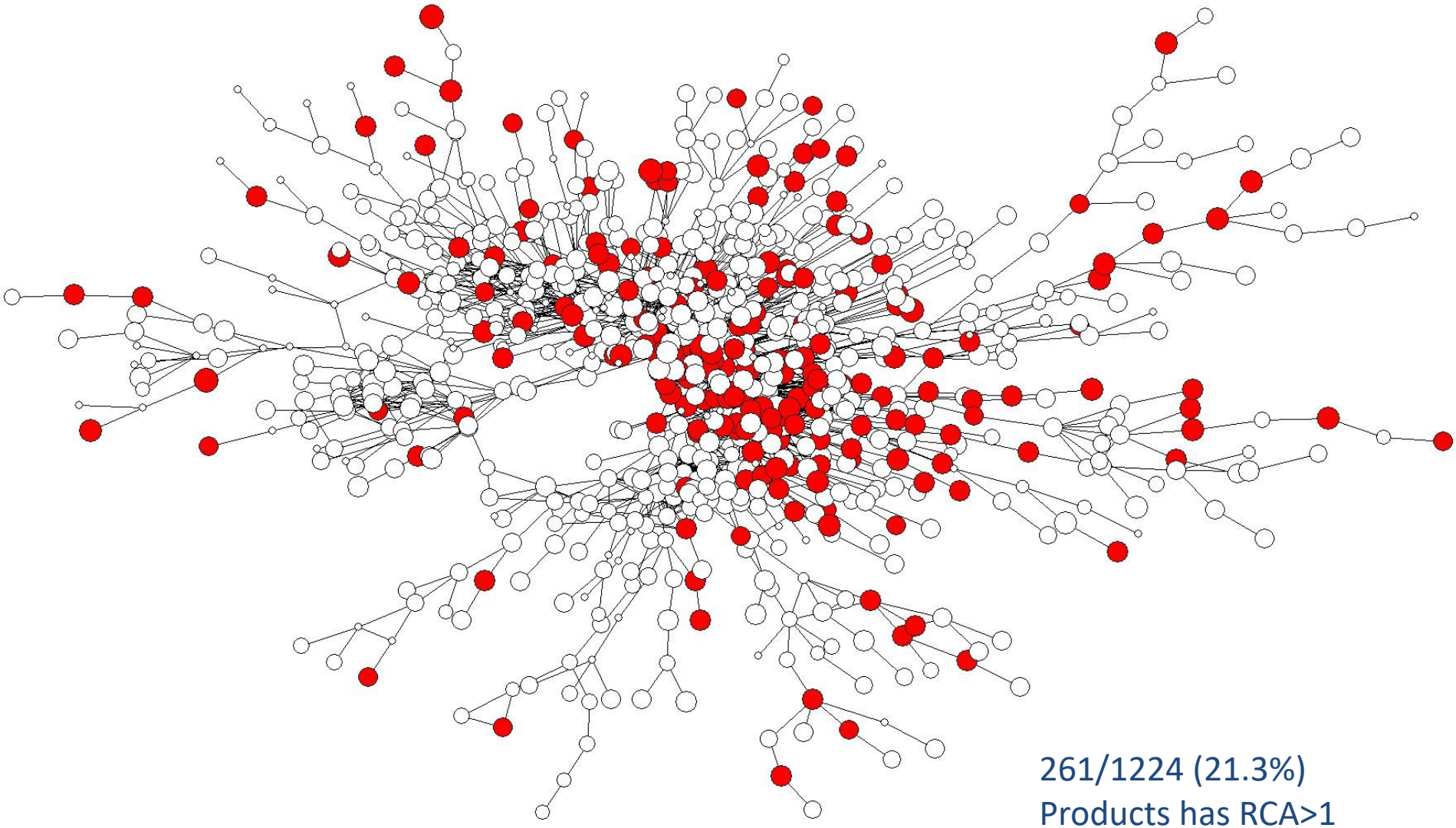

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RCA products of Québec (2017)

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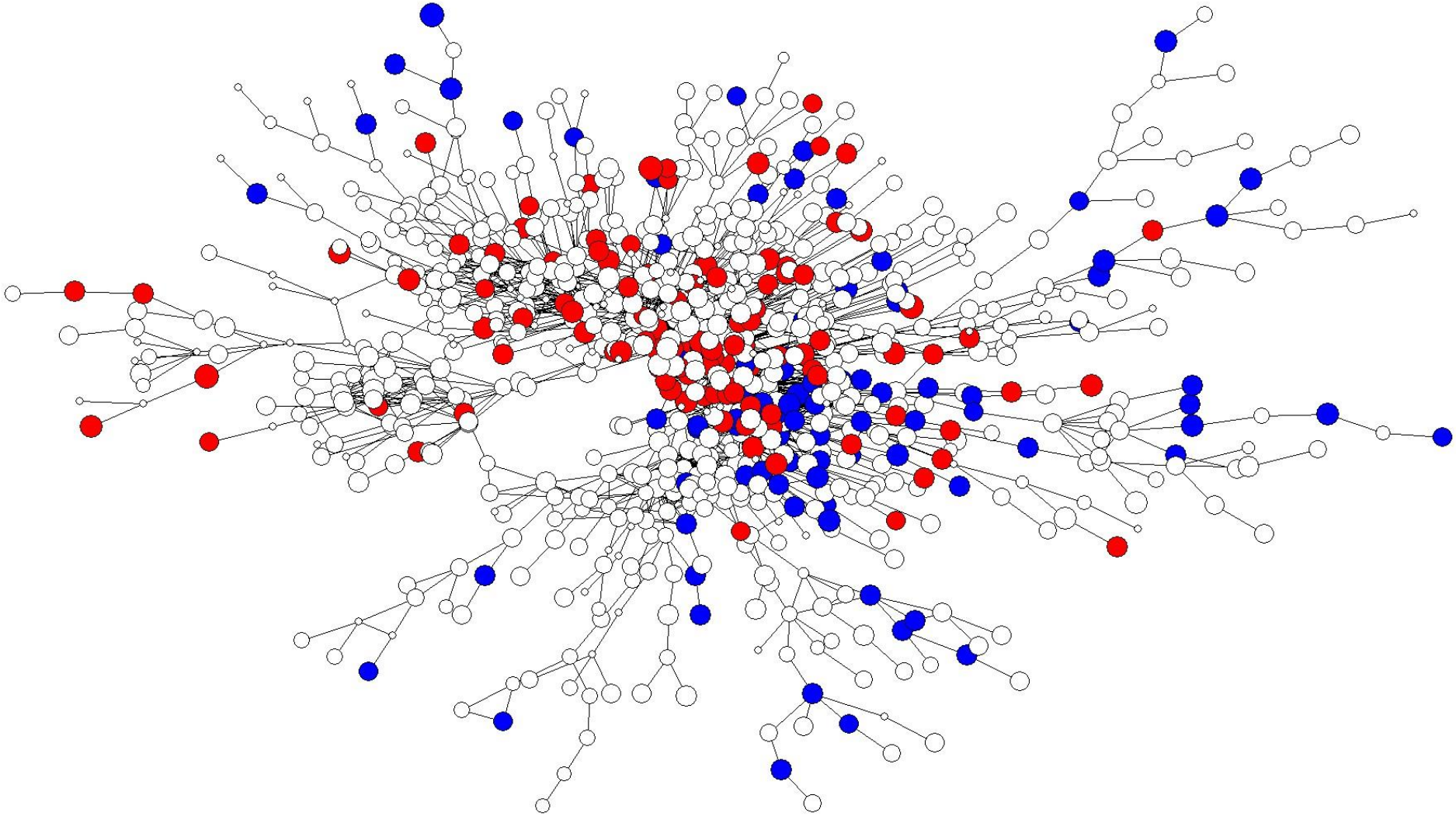
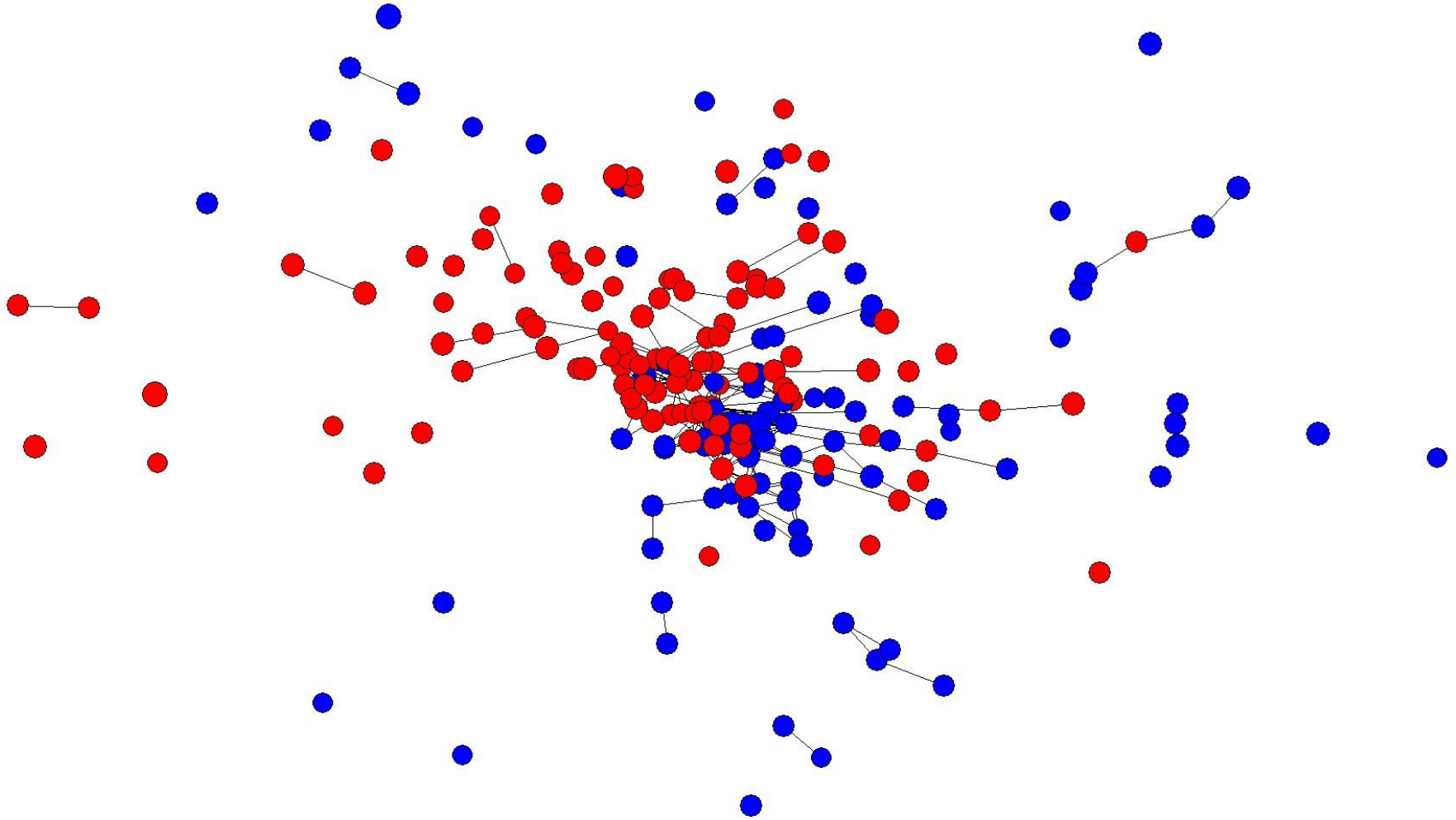


- 137/261 (67.82%) RCA products has positive ECI
- (Positive RCA products in Red; Negative RCA products in blue)

RCA Production Space Network of Québec (2017)

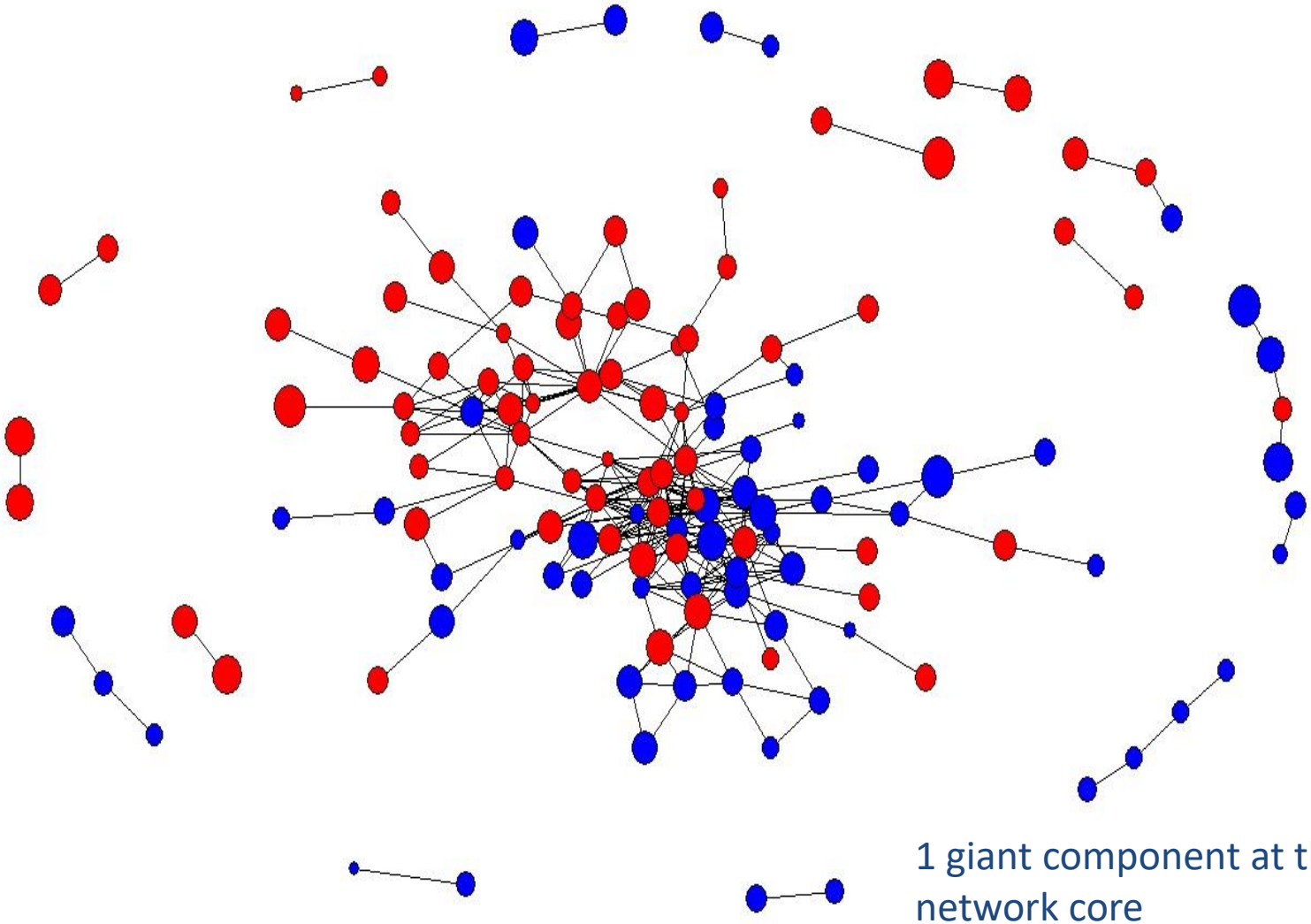
(RCA>1; Node size: Export Value in USD)



- 68/261 (26.05%) products are isolates in the RCA Production Space Network
- Large number of structural holes across RCA sectors

RCA Production Space Network of Québec without Isolates (2017)

(RCA>1; Node size: Export Value in USD)



1 giant component at the network core

Network Density: ρ=0.034

Core/Periphery fit=0.4894

Québec's Top 10 Product with highest Eigenvector Centrality in the RCA Production Space Networks

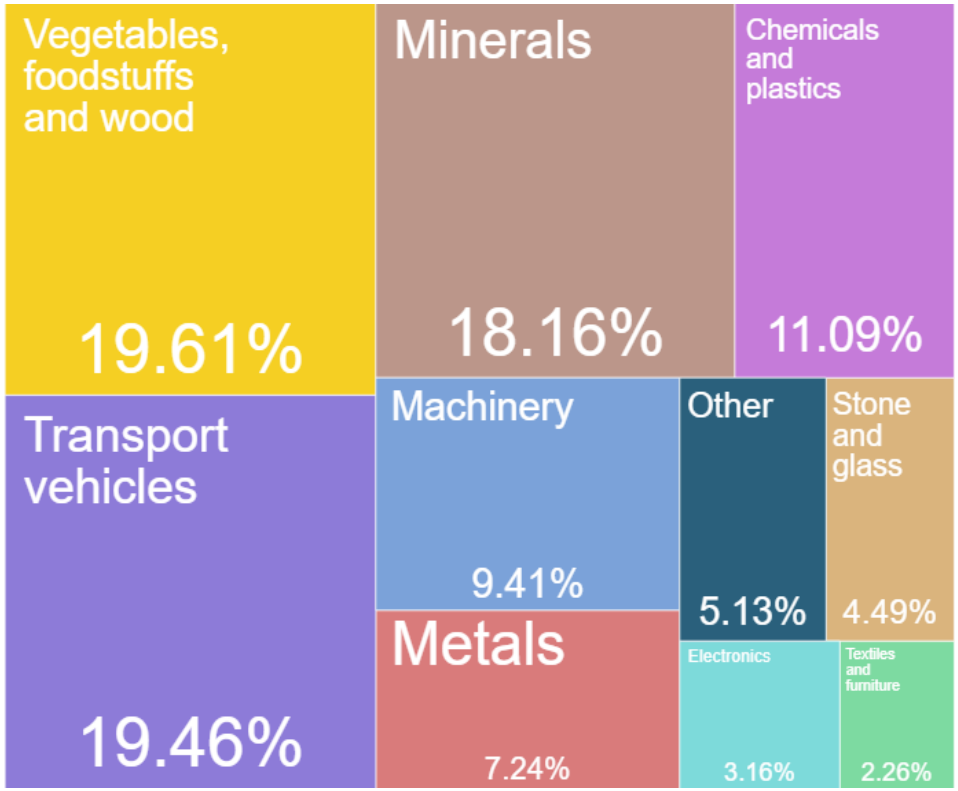
Rank	Product	PCI	RCA	Eigenvector Centrality
1	Cement Articles	0.774	2.269	1.000
2	Large Iron Containers	-0.683	2.381	0.971
3	Plastic Building Materials	-0.045	2.988	0.942
4	Wood Crates	-0.447	1.444	0.914
5	Aluminium Structures	-0.488	2.678	0.801
6	Other Aluminium Products	0.879	1.117	0.788
7	Trailers	0.245	1.209	0.787
8	Aluminium Bars	0.136	1.686	0.774
9	Other Plastic Sheetings	0.070	1.807	0.705
10	Particle Board	-0.512	11.000	0.668

- Strong construction sector domination
- Foreign firms specialized in these sectors will encounter fierce local competition.

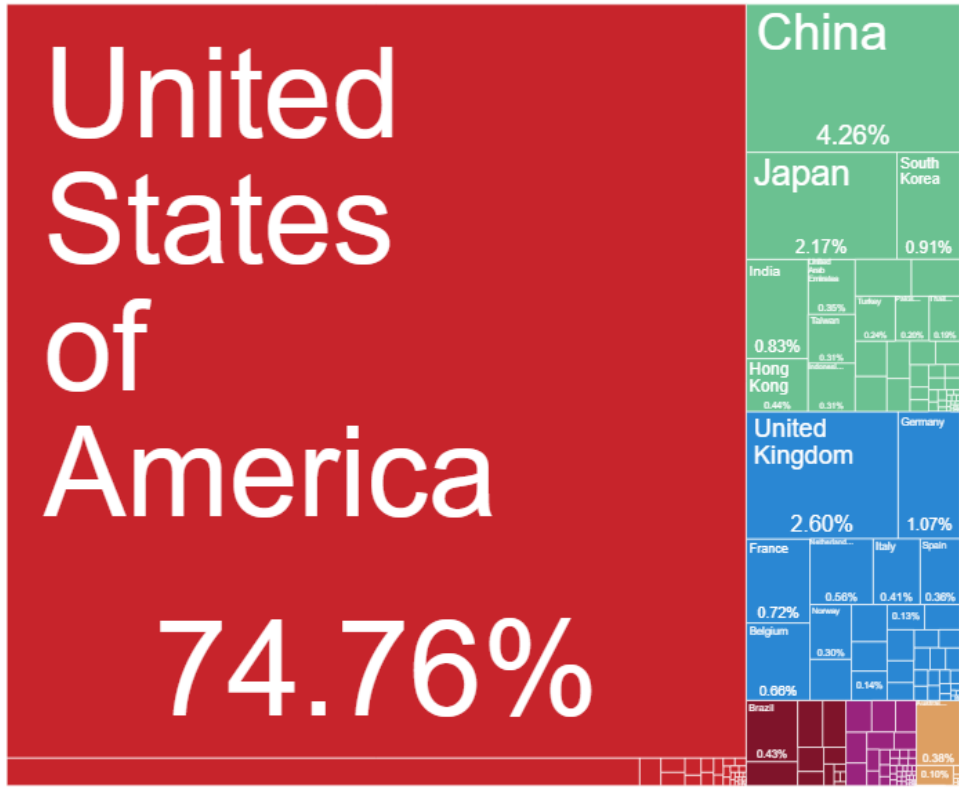

CIRCULATION
LOCALE
SEULEMENT
RUE
BARRÉ
DÉTOUR
TROTTOIR
BARRÉ
150 RUE KING

Composition of Commodity Exports of Canada (2016)

By Product



By Country



Total Export ($389.07 billion USD, 2.495%,12th in the world)
Product Space of Canada (2016) : http://atlas.media.mit.edu/t8q7kl

Source: UN Comtrade Database, The Observatory of Economic Complexity

Top 10 Exporting Products of Canada and Québec in 2017

Top 10 Exporting Products of Canada

Rank	Product	Value (bUSD)	Percentage
1	Crude Petroleum	54.04	13.94%
2	Cars	46.49	13.94%
3	Gold	13.21	4.60%
4	Refined Petroleum	11.34	4.14%
5	Vehicle Parts	10.51	4.00%
6	Petroleum Gas	10.18	4.04%
7	Sawn Wood	8.34	3.45%
8	Raw Aluminium	6.33	2.71%
9	Planes, Helicopters, and/or Spacecraft	6.08	2.68%
10	Gas Turbines	5.90	2.67%

Top 10 Exporting Products of Québec

Rank	Product	Value (bUSD)	Percentage
1	Planes, Helicopters, and/or Spacecraft	5.45	9.12%
2	Raw Aluminium	5.06	8.48%
3	Gas Turbines	3.29	5.51%
4	Iron Ore	1.83	3.06%
5	Refined Petroleum	1.47	2.46%
6	Sawn Wood	1.34	2.24%
7	Refined Copper	1.28	2.13%
8	Delivery Trucks	1.16	1.94%
9	Pig Meat	1.07	1.79%
10	Newsprint	0.99	1.66%

Top 10 Export Destinations of Canada and Québec in 2017

Top 10 Export Destinations of Canada

Rank	Country	Value (bUSD)	Percentage
1	United States	$319.298	75.86%
2	China	$18.184	4.32%
3	United Kingdom	$13.627	3.24%
4	Japan	$9.111	2.16%
5	Mexico	$6.048	1.44%
6	Korea, South	$4.086	0.97%
7	India	$3.294	0.78%
8	Germany	$3.186	0.76%
9	Belgium	$2.707	0.64%
10	France	$2.626	0.62%
	Others	$38.762	9.21%
	Total	$420.931	100.00%

Top 10 Export Destinations of Québec

Rank	Country	Value (bUSD)	Percentage
1	United States	$46.325	70.53%
2	China	$2.200	3.35%
3	Mexico	$1.352	2.06%
4	France	$1.304	1.98%
5	Japan	$1.049	1.60%
6	United Kingdom	$1.033	1.57%
7	Germany	$1.014	1.54%
8	Switzerland	$0.821	1.25%
9	Netherlands	$0.801	1.22%
10	Spain	$0.771	1.17%
	Others	$9.013	13.72%
	Total	$65.682	100.00%

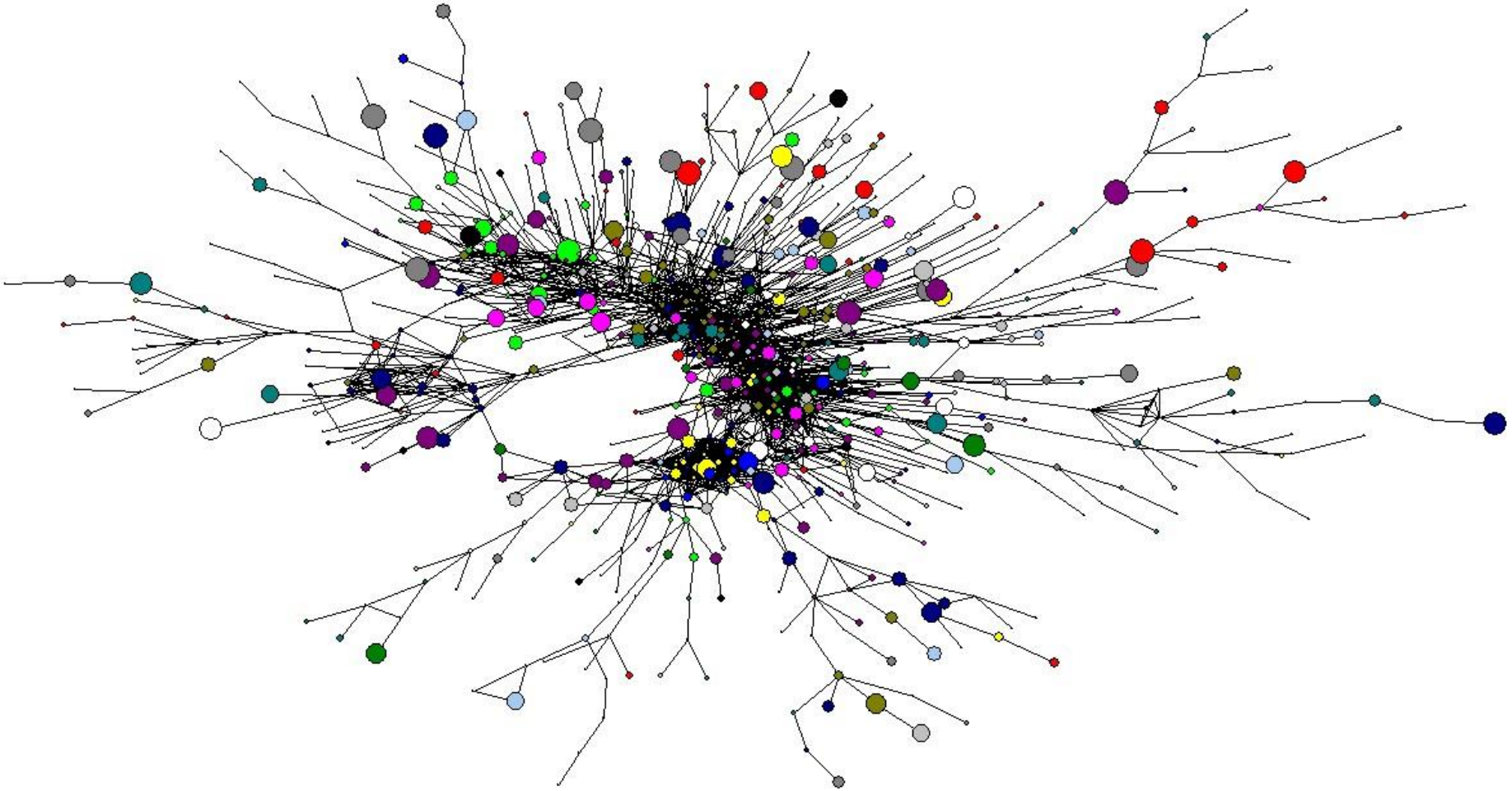
Comparison with national average

	Québec	Canada
No. of RCA Product	261 (21.32%)	268 (21.90%)
No. of RCA Product with positive PCI value	137 (52.49%)	136 (50.75%)
Export Index weighted by PCI	54.483	-150.263

- Similar number of RCA products and proportion of positive PCI products
- Higher export index weighted by PCI
  → Higher ECI (yet to confirm)

Production Space Network of Québec (2017)

(Node size: Percentage in Canadian export)



Observation of Québec's Production Space Network

- High level of diversity and above national average economic complexity.

- High RCA sectors are not in the core of the RCA Production Space Network.

  →Structural holes exist in intermediary sectors.

  →Opportunities to attract FDI from regions with high RCA

- Well-connected local RCA sectors form production modules/clusters.

  →FDI in this sectors will encouter strong local competition

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What are the most competitive economic sectors of Québec?

- Economic sectors of high Revealed Comparative Advantage (RCA)
- RCA sectors with high Product Complexity Index (PCI)
- RCA sectors with high local network embeddedness

What are the potential sectors to attract FDIs Québec?

- Enhance structural holes in the RCA production space network.
- Reduce redundancy and enhance effective size of the RCA production space network.

Implications and Criticisms of the Production Space Model in Regional Development

- **Implication**
  - Network perspective of cross-border production activities embodied in the global value chains
  - Global competitiveness resides in RCA sectors with high PCI
  - Divergence of economic complexity on subnational level
  - Importance of economic complexity in regional development
- **Criticisms**
  - Export orientation instead of manufacturing orientation
  - Commodity-based, service sectors are ignored
  - PCI calculation based on the “co-export” probability, not necessary the knowledge complexity and relevance of the sectors themselves.
    - e.g. Pig Meat (PCI=0.85) vs Aircraft Parts (PCI=0.537)
    - Plane, Helicopters, Spacecraft ~ Explosive Ammunition

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Thank you very much!
Merci beaucoup!

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