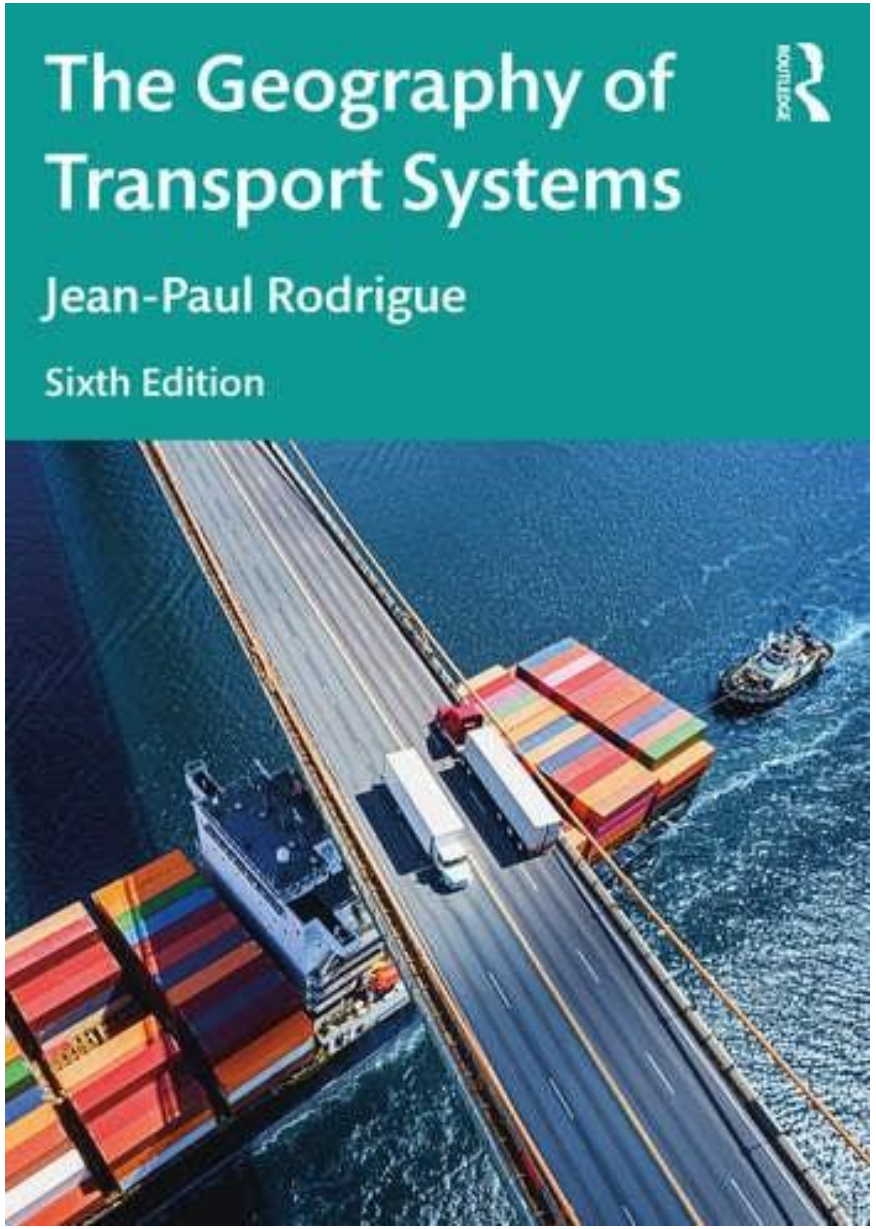

Transportation and Geography

CHAPTER 1

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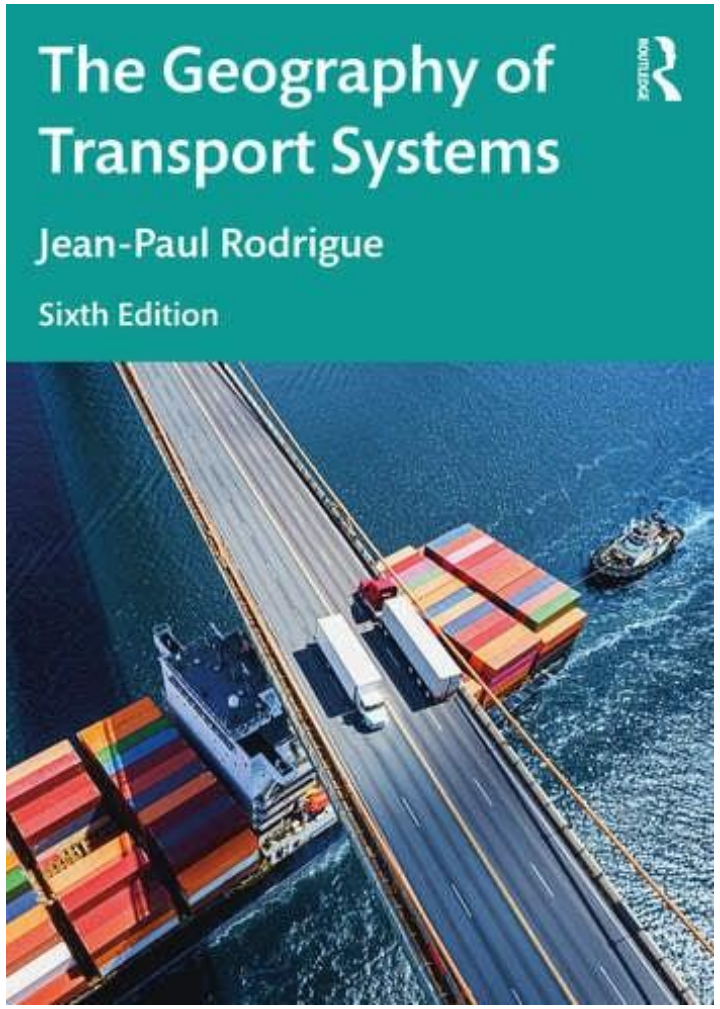


What is Transport Geography?

Chapter 1.1

The Core Principles of Transport Geography

1. 

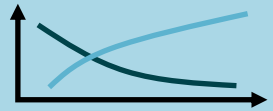
Transportation is the spatial linking of a **derived demand**

2. 

Distance is a relative concept involving space, time and effort (cost)

3. 

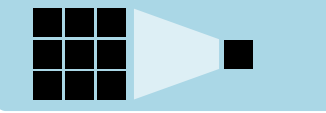
Space can be a generator, a support and a constraint for mobility

4. 
The relation between space and time can **converge** or **diverge**

5. 

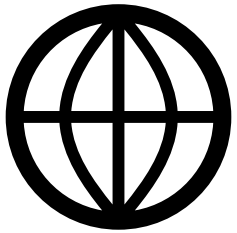
A **location** can be a central or an intermediate element of mobility

6. 
To overcome **geography**, transportation requires a footprint

7. 
Transportation seeks **massification** but is constrained by **atomization**

8. 
Velocity is a modal, intermodal and managerial effort

The Scales of Transport Geography

	NETWORK	FLOWS	SPATIAL CONSTRUCTS
 LOCAL	• Transit systems • Street networks	• Commuting • Personal and social trips • Deliveries	• Activity space • District / Neighborhood • Terminal / Development zone • Town / City
 REGIONAL	• Commuter rail • Regional air networks • National highway systems • National railway systems • Short sea shipping / feeders	• Intercity passenger flows • Distribution	• Metropolitan area • Market area • Hinterland / Corridor • Urban region
 GLOBAL	• International air networks • Maritime shipping networks • Telecommunication networks	• Trade • Tourism and business trips • Migration	• Value chains • Landbridge • Trade area

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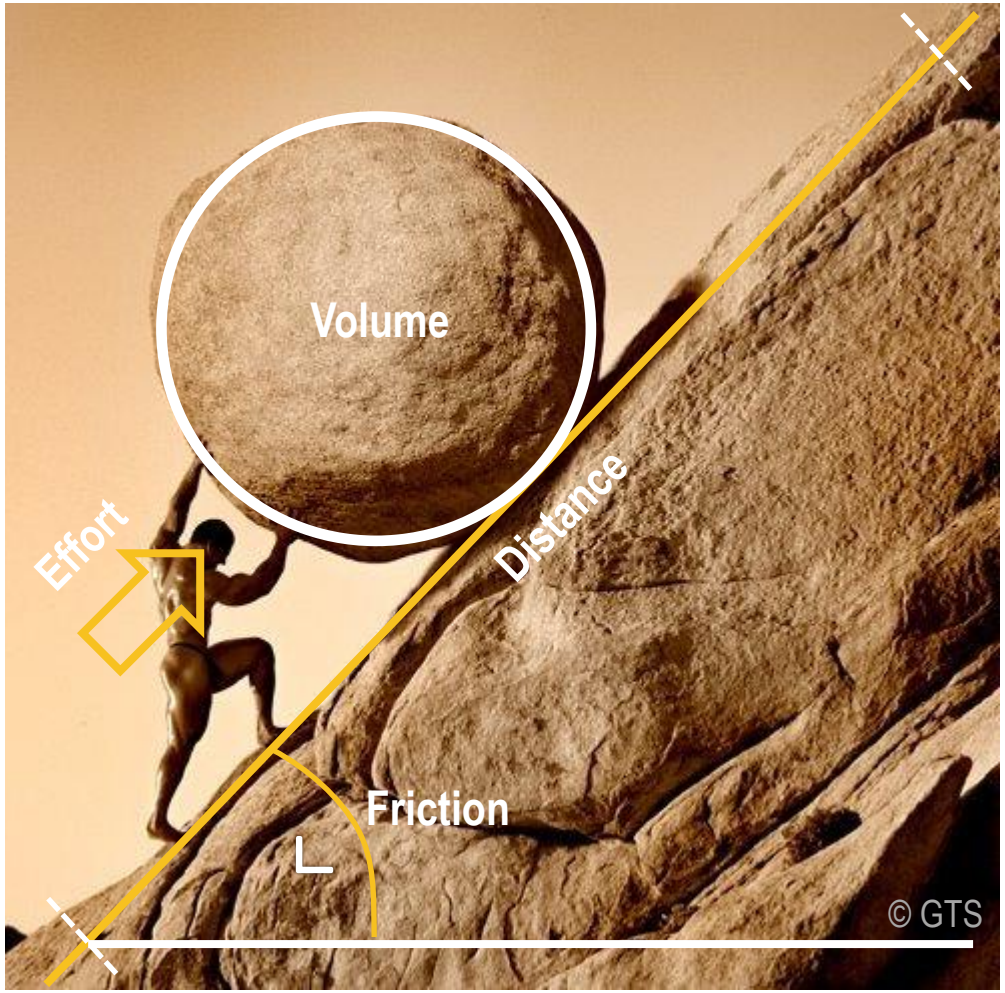
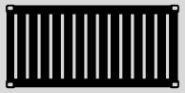
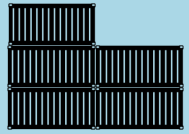
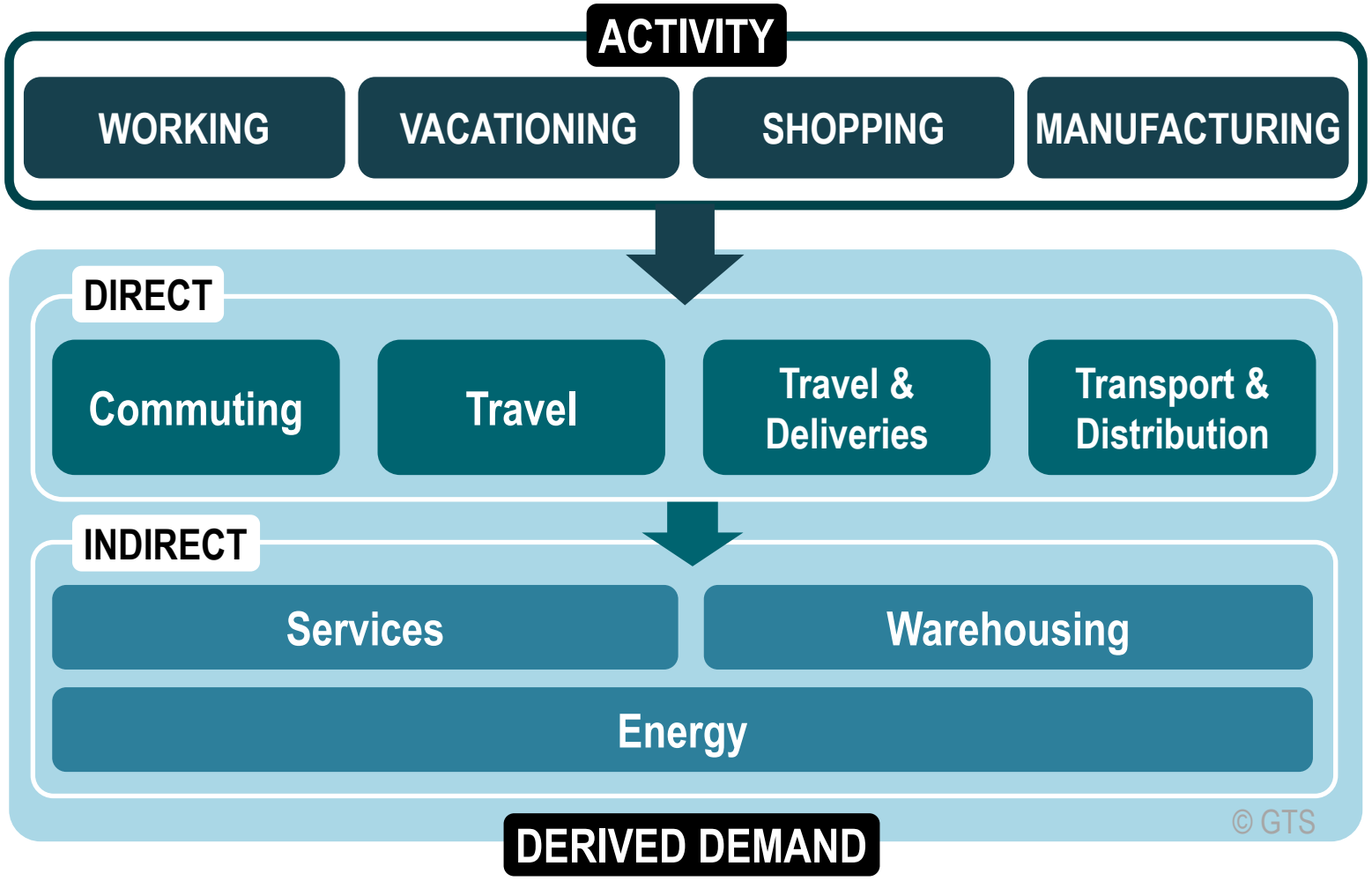
The Sisyphus Analogy in Transportation



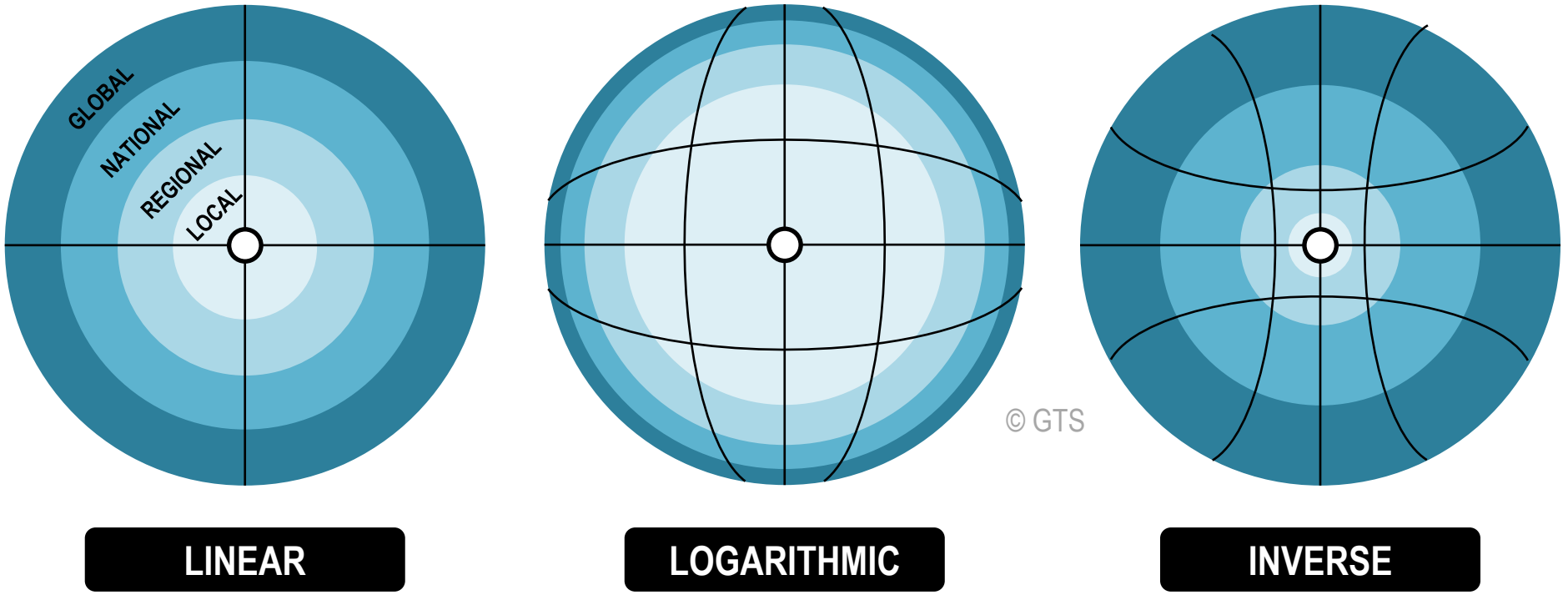
Mobility of Freight

	Weight	Storage	Fragility	Perishability
	**Ores** Heavy (0.83 g/cc)	 Piling	None	None
	**Grain** Heavy (0.83 g/cc)	 Silos	Low	Low
	**Petroleum** Heavy (0.88 g/cc)	 Tanks	None	None
	**Apparel** Average	 Warehouse	Low	None
	**Fruits & vegetables** Average	 Temperature controlled warehouse	High	High
	**Containers** Average (15-20 tons)	 Stacks	Cargo dependent	Cargo dependent

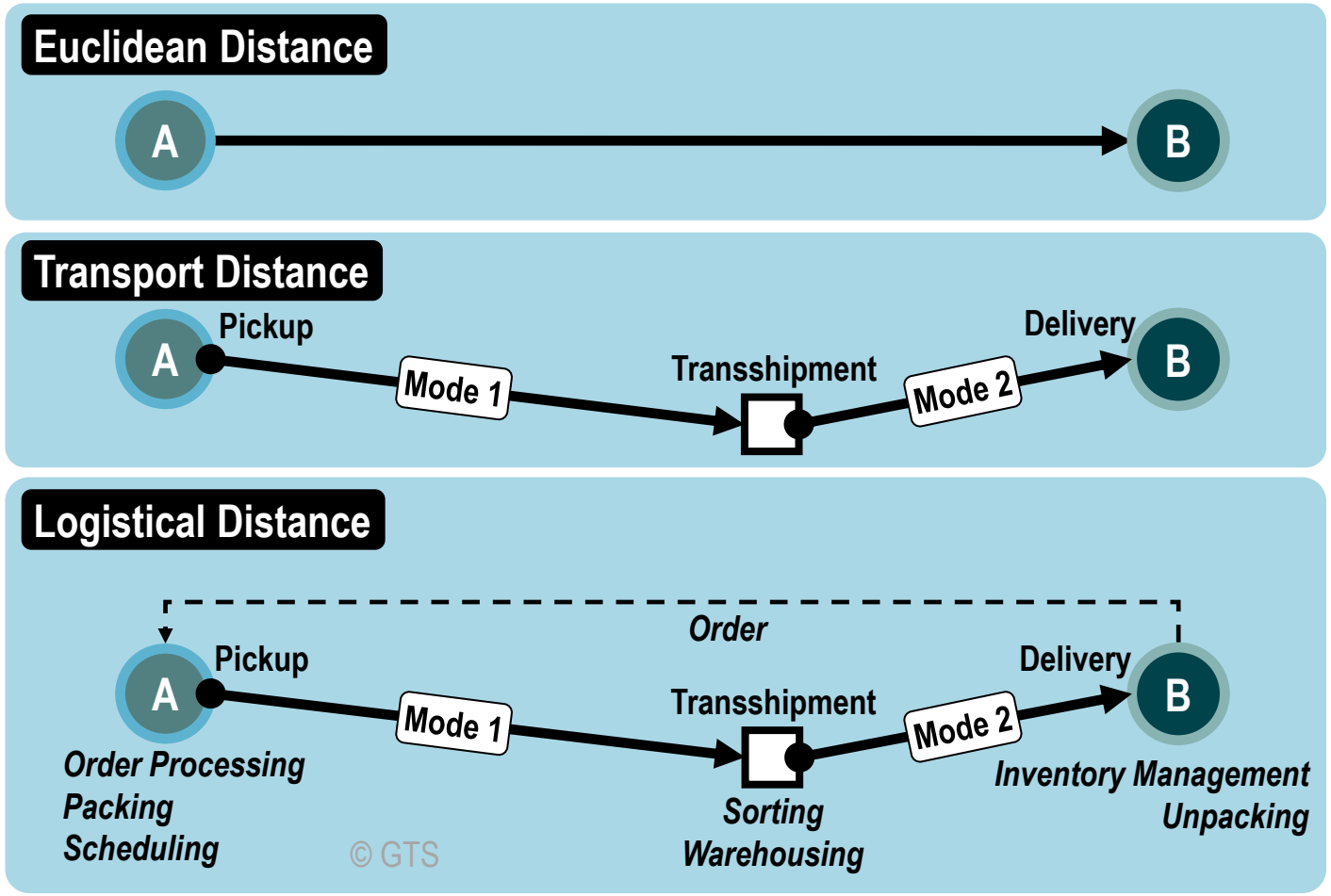
Transportation as a Derived Demand



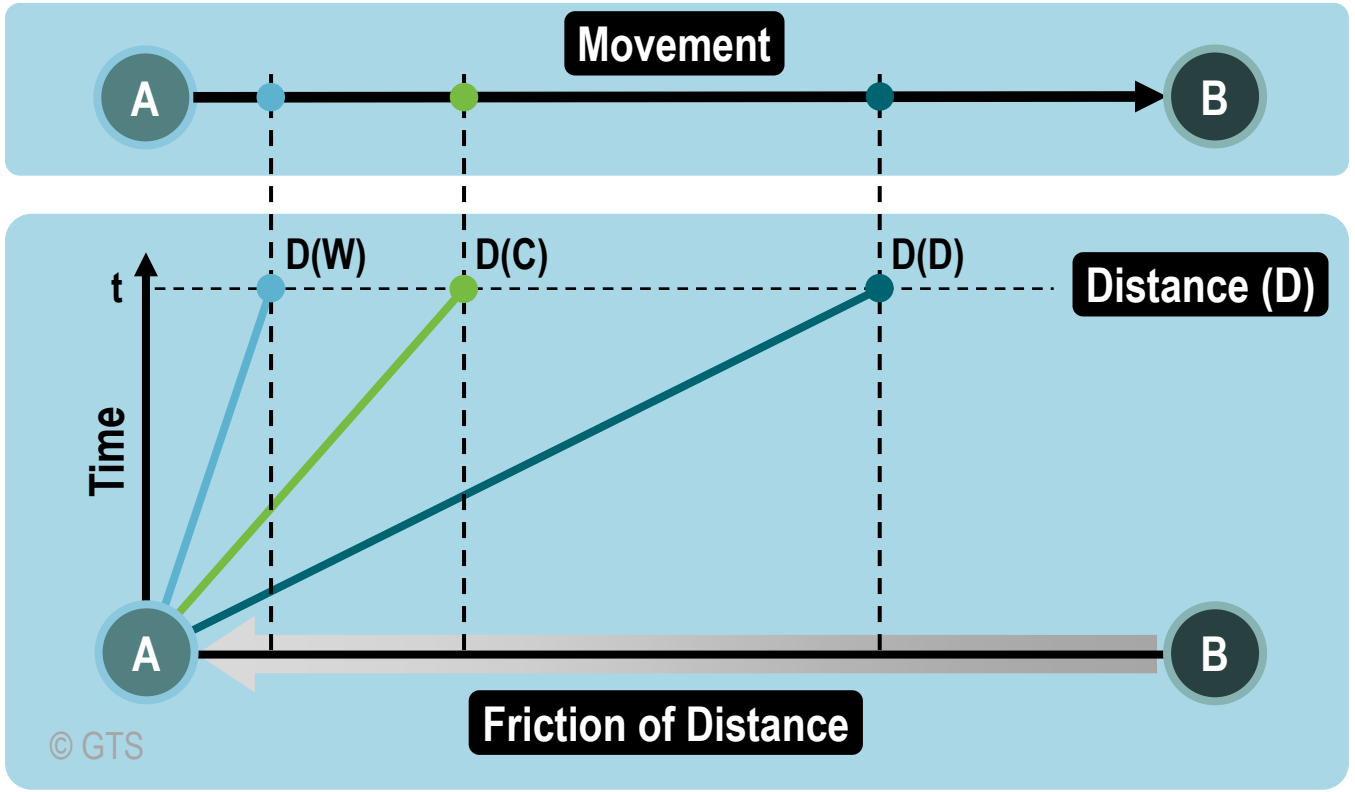
Representations of the Effects of Distance



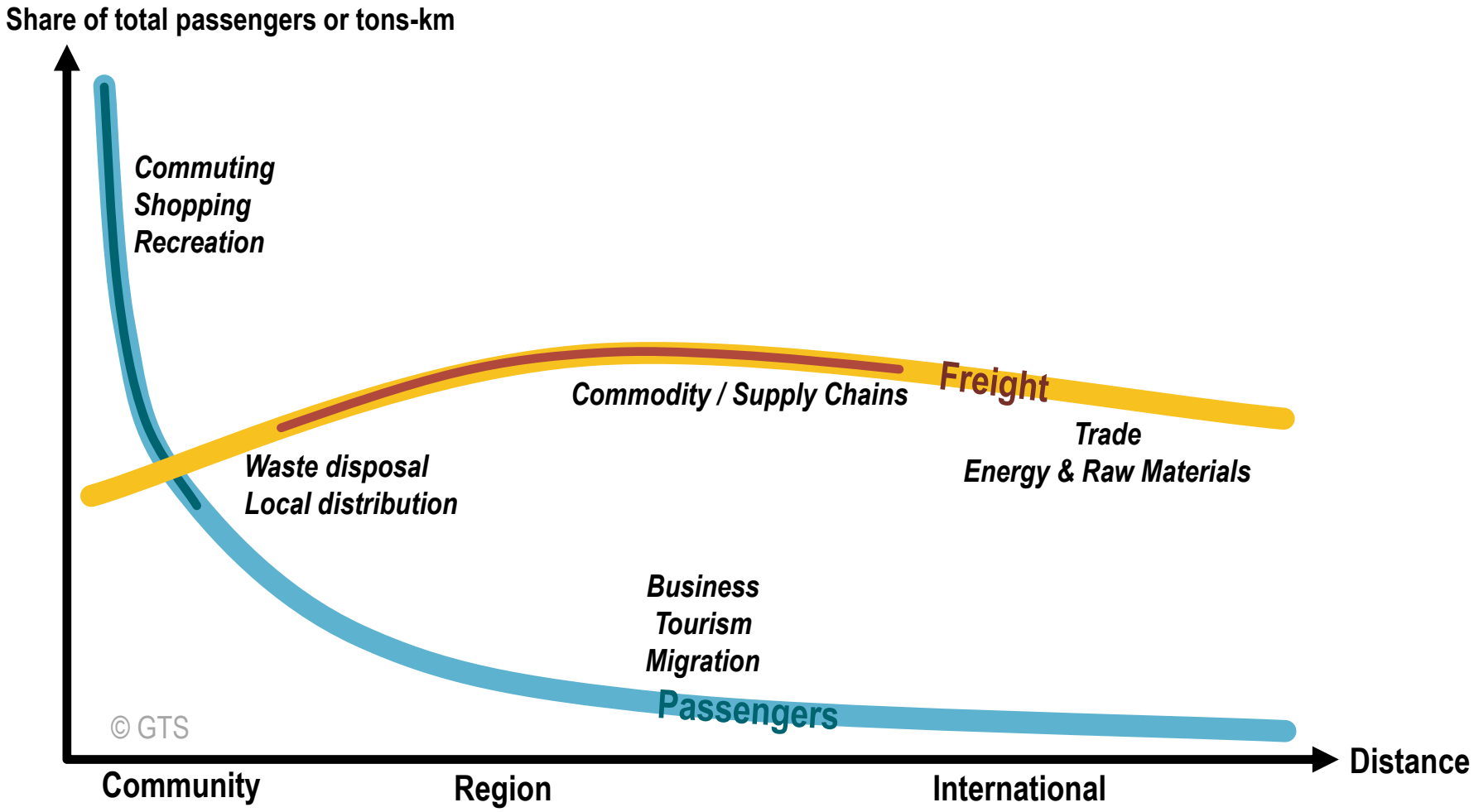
Different Representations of Distance



The Spatial Consideration of a Movement



Transportation and the Mobility of Passengers and Freight

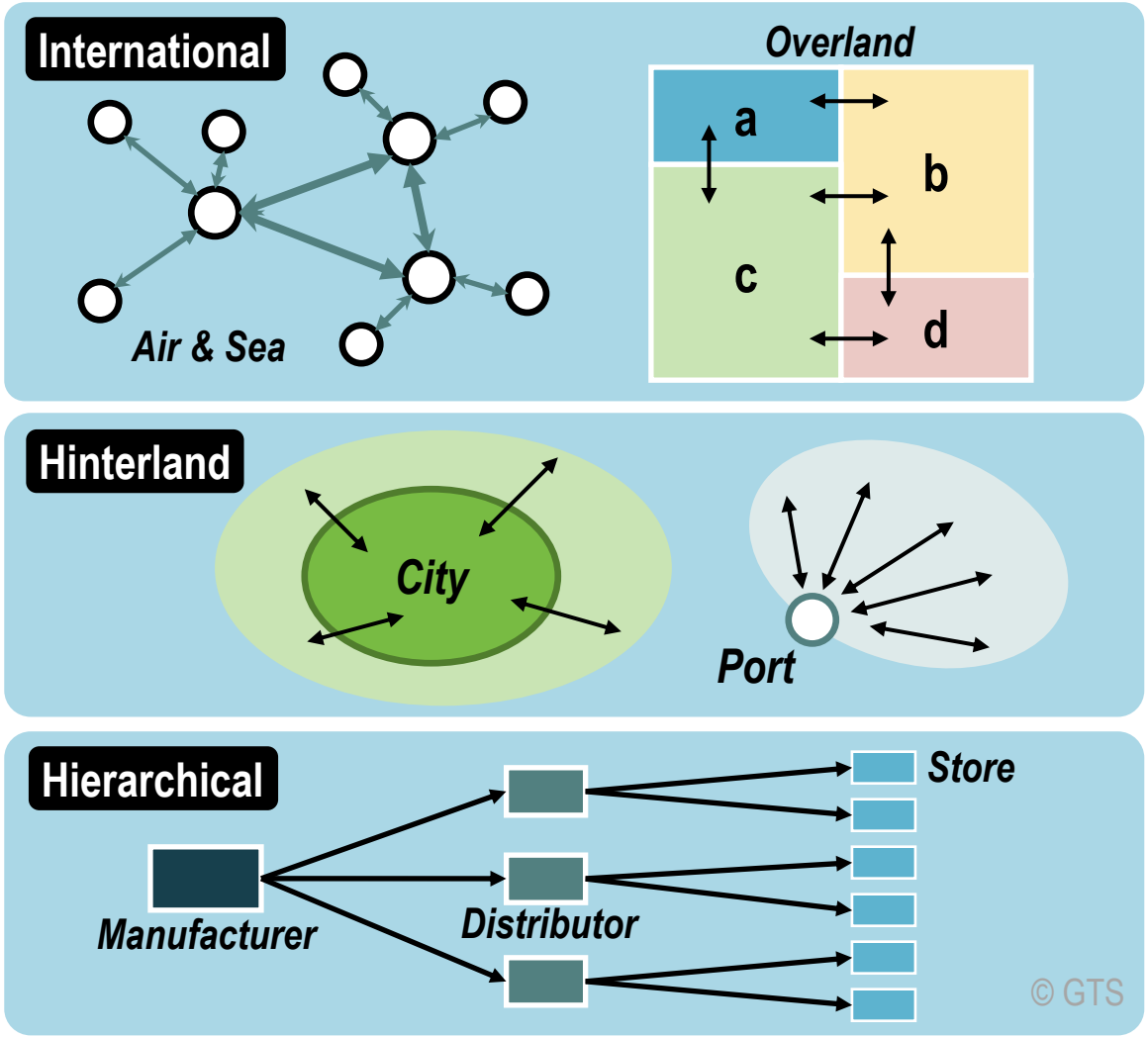


Operational Differences between Passengers and Freight Transportation

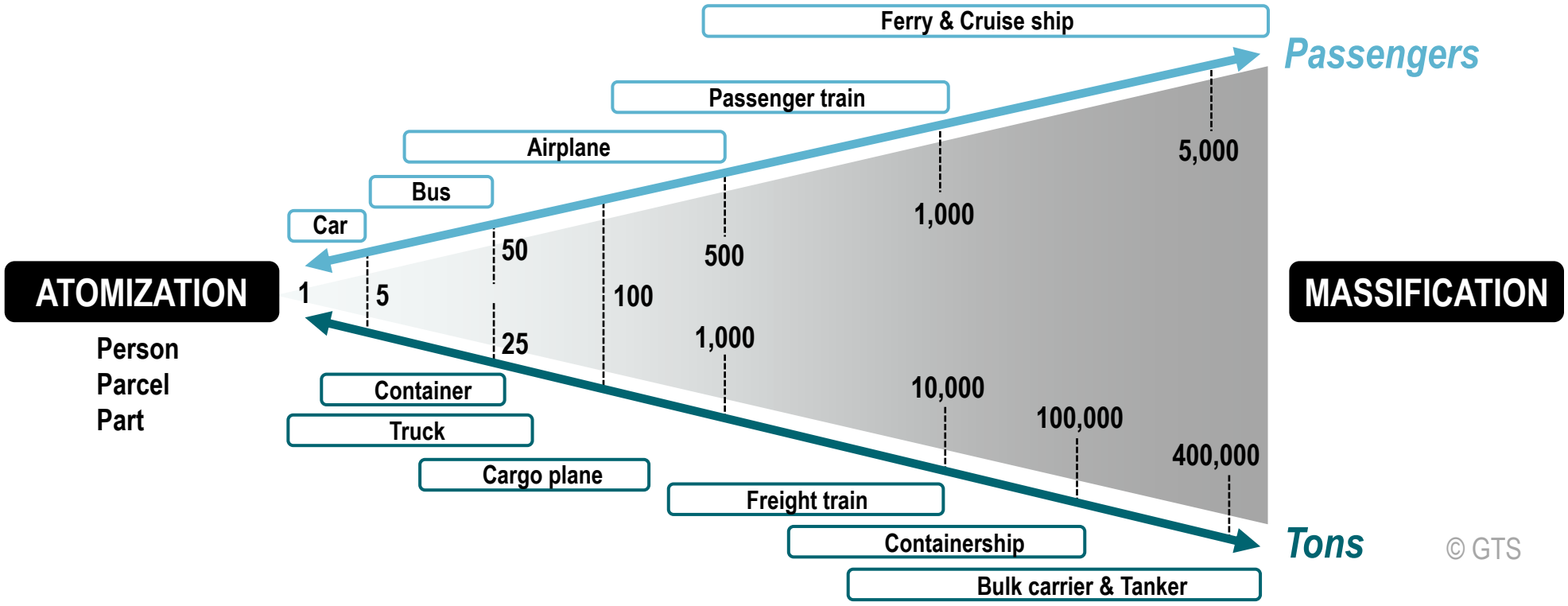
- Board, get off and transfer without assistance.
- Process information and act on it without assistance.
- Make choices between transport modes without assistance but often irrationally.
- Require travel accommodations related to comfort and safety.

- Must be loaded, unloaded and transferred.
- Information must be processed through logistics managers.
- Logistics managers meet choices between transport modes rationally.
- Require accommodations related to storage.

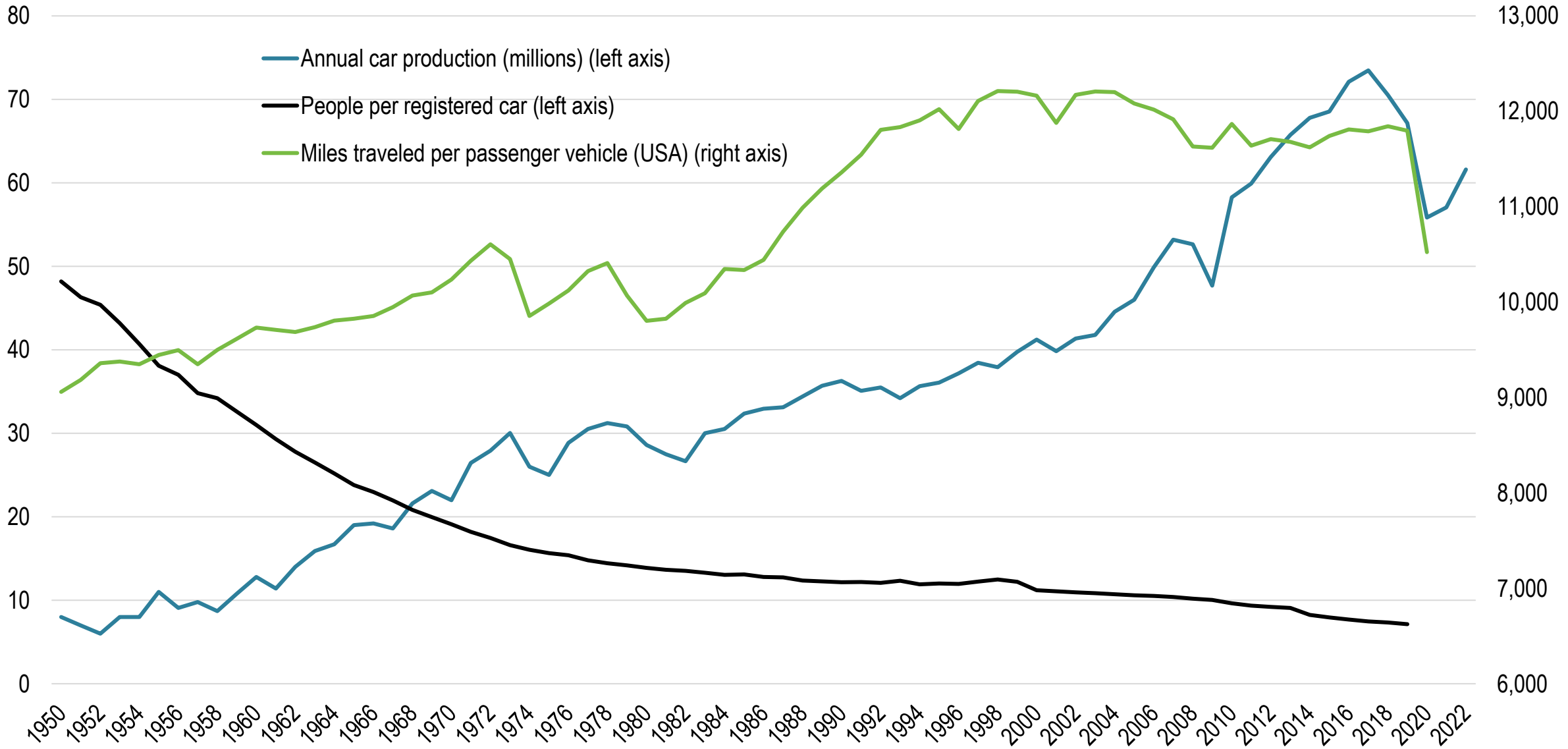
Spatial Flow Patterns



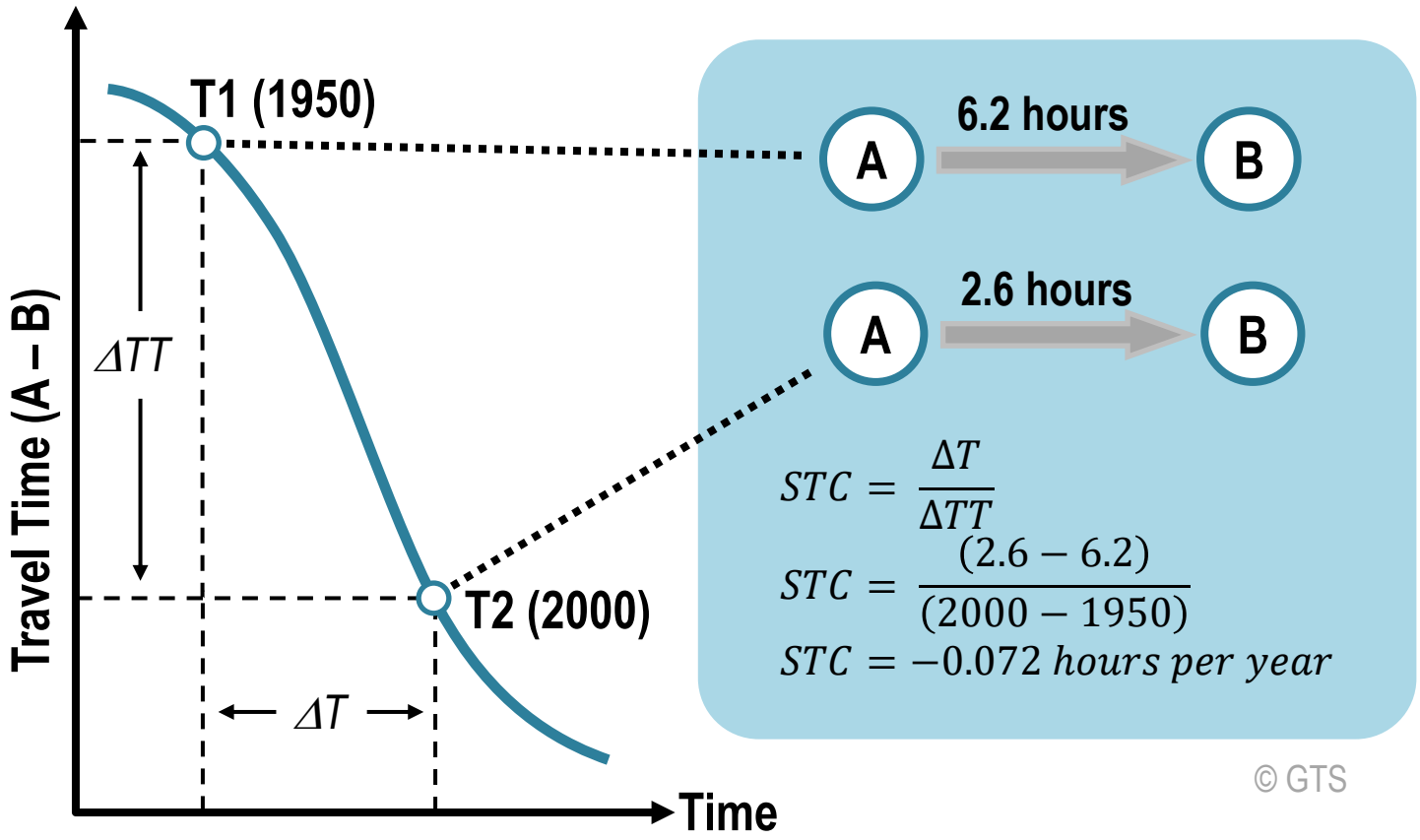
Atomization versus Massification in Transportation Modes



Vehicle Use Indicators, World, 1950-2022



Space / Time Convergence



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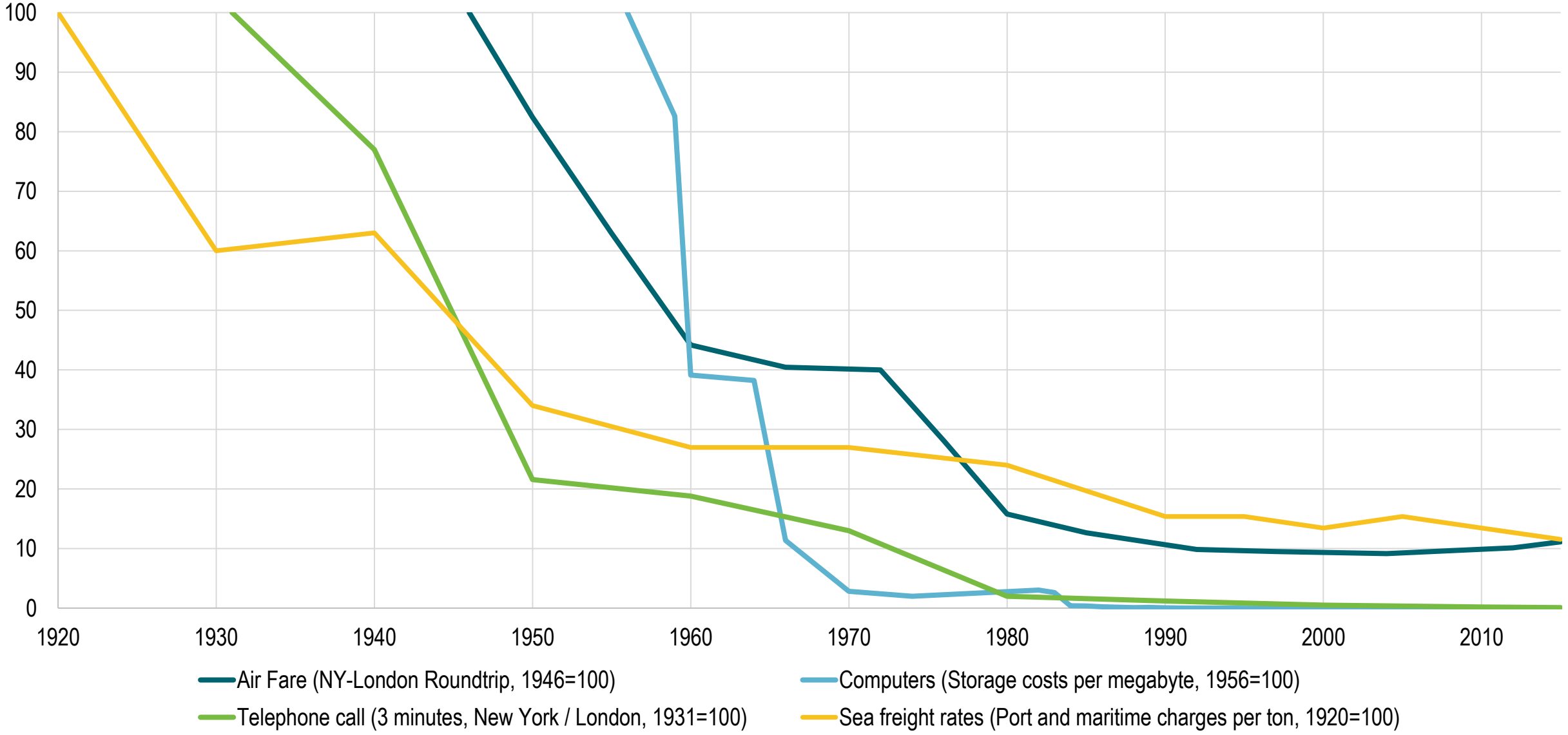
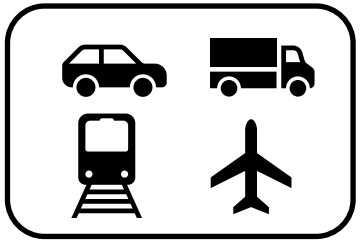
Transport and Communication Costs Indexes, 1920-2015



Key Dimensions of Transportation

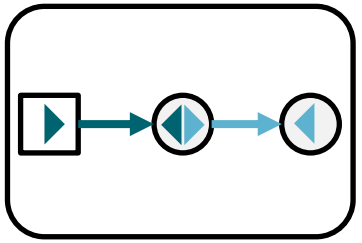
Dimension	
Historical	Changes brought by transport technologies. Rise of civilizations. Development of modern nation states. Globalization.
Economic	Transport and economic development (indirectly and directly). Factor in the production and added-value of goods and services. Facilitates economies of scale. Influences land (real estate) value. Contributes to the specialization of regions.
Social	Access to healthcare, welfare, and cultural events. Shape social interactions.
Political	Nation building and national unity. National defense. Rules and regulations. Subsidizing mobility (e.g. public transit or highways).
Environmental	Important environmental impacts. Pollution, exploitation of natural resources. Climate change.

Core Components of Transportation



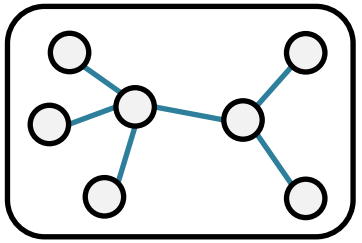
MODES

- Conveyances used for the mobility of passengers and freight.
- Mobile elements of transportation.



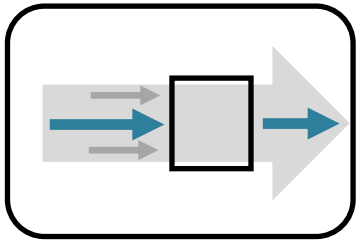
INFRASTRUCTURES

- Physical support of transport modes, such as routes and terminals.
- Fixed elements of transportation including superstructures.



NETWORKS

- System of linked locations (nodes).
- Functional and spatial organization of transportation.



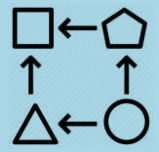
FLOWS

- Movements of people, freight and information over their network.
- Flows have origins, intermediary locations and destinations.

Complex Systems and Transportation

Adaptability

Competition



Adaptation to the actions of other components.
Adaptation to social, economic and technological changes.

Self-Organization

Routing

Autonomous adaptation to changing conditions as a result of the adaptability of the individual components.

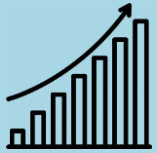
Stability

Land use

A recognizable dynamic state of a system that may continuously reappear.

Cumulative

Congestion



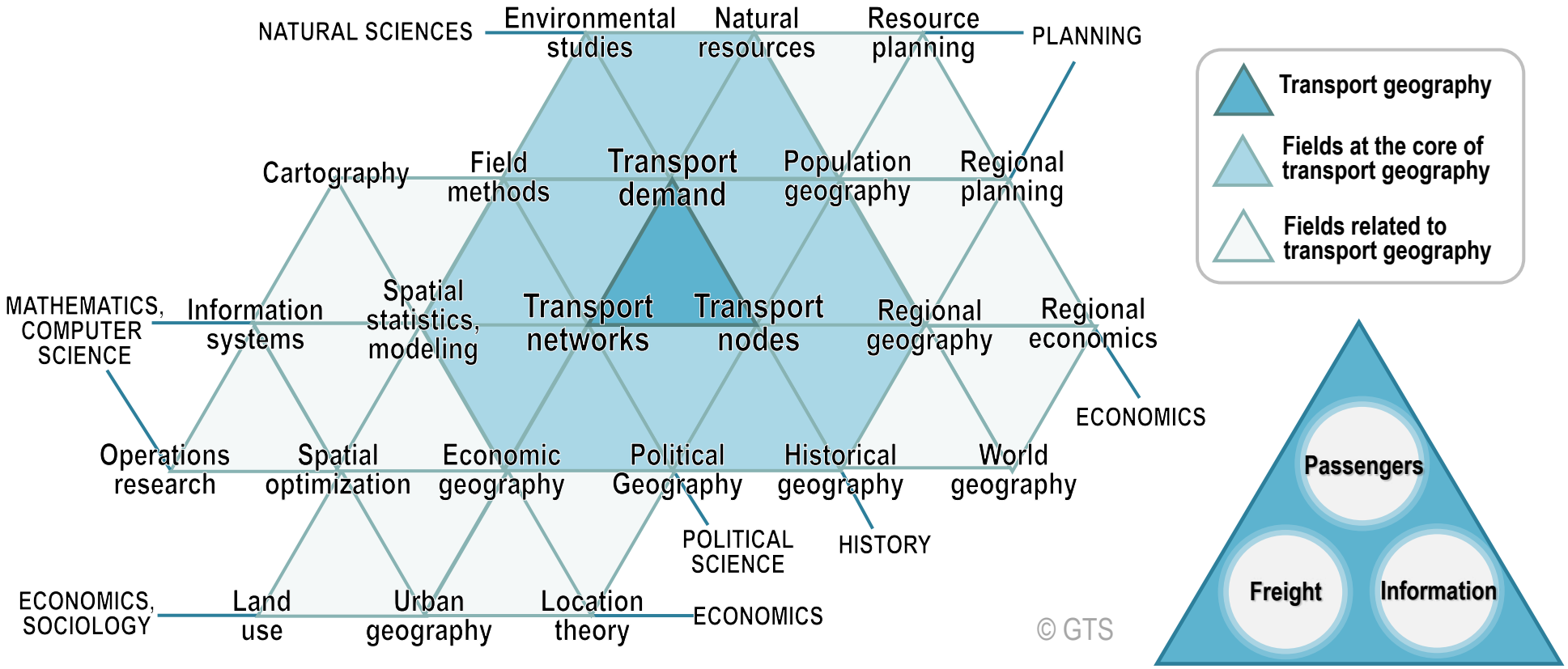
Changes in one property or component may have a disproportionately large effect on another property or component.

Transition

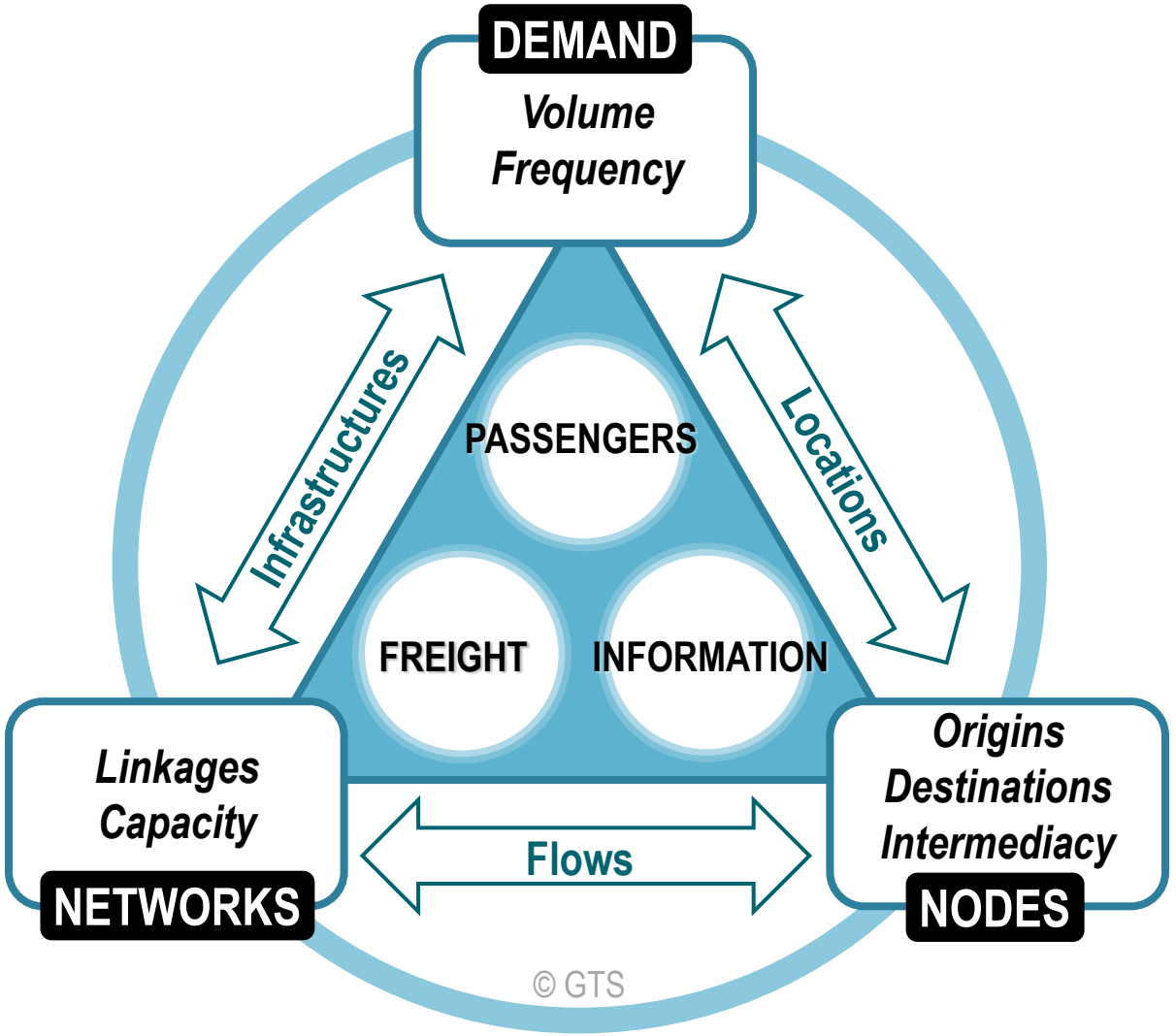
Containerization

A system's behavior may change radically, and sometimes irreversibly, when a tipping point is reached.

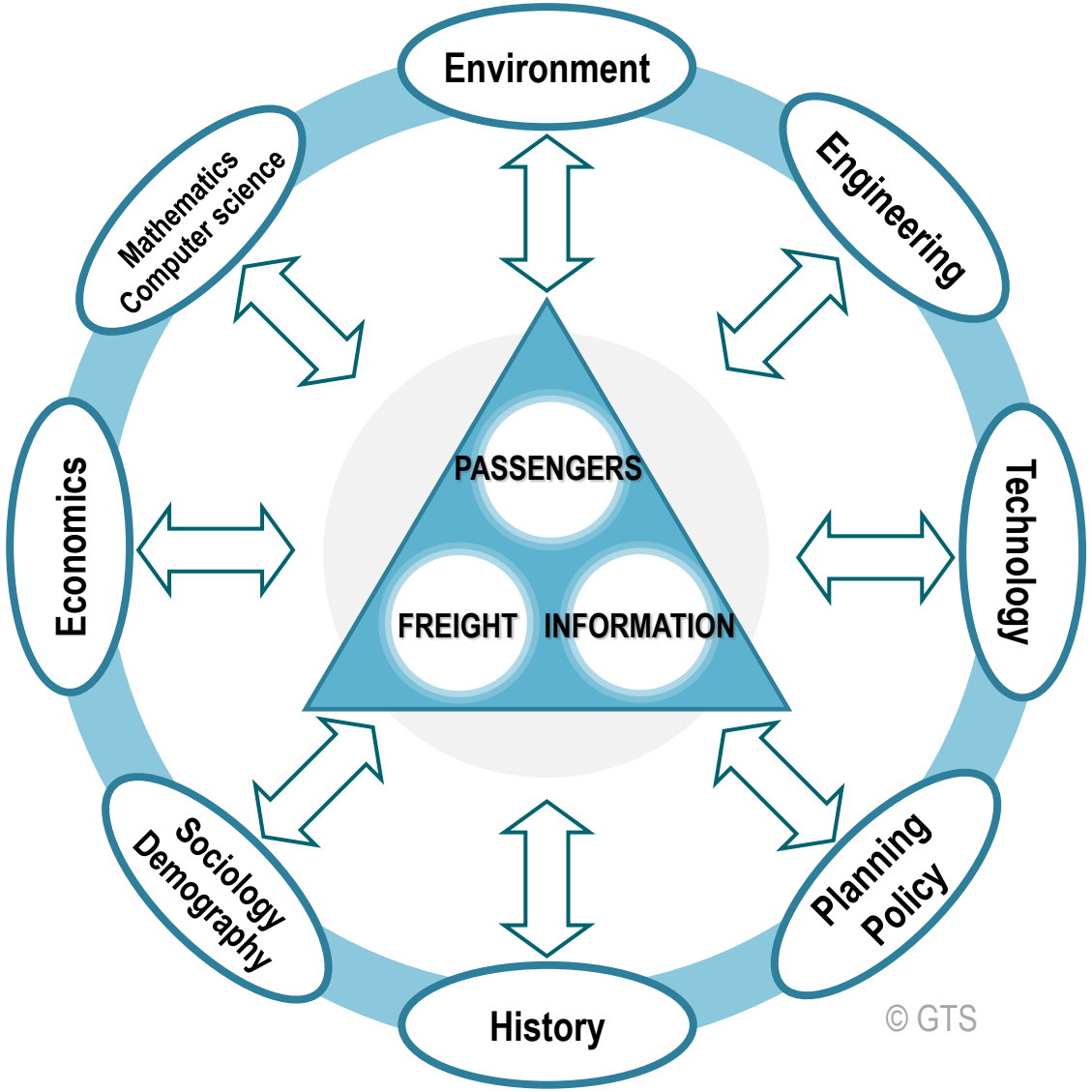
Fields of Transport Geography



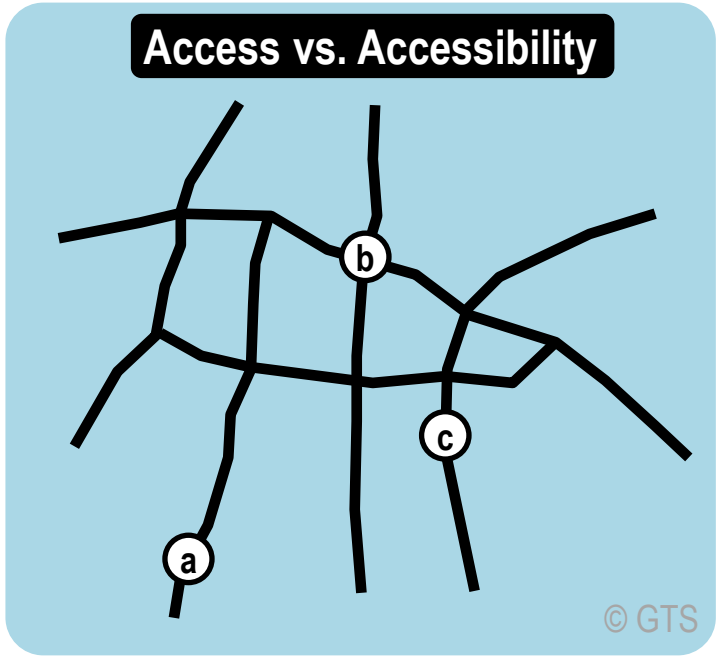
The Transport System

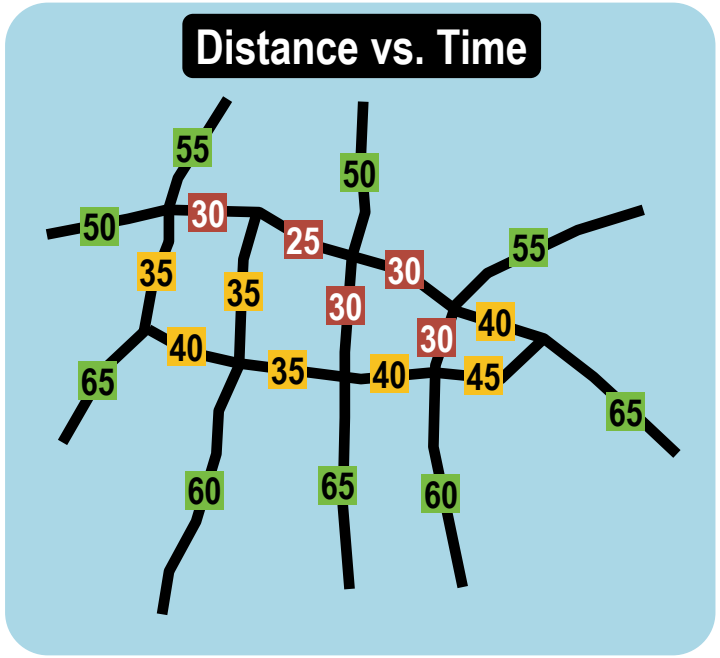


Dimensions of Transport Geography

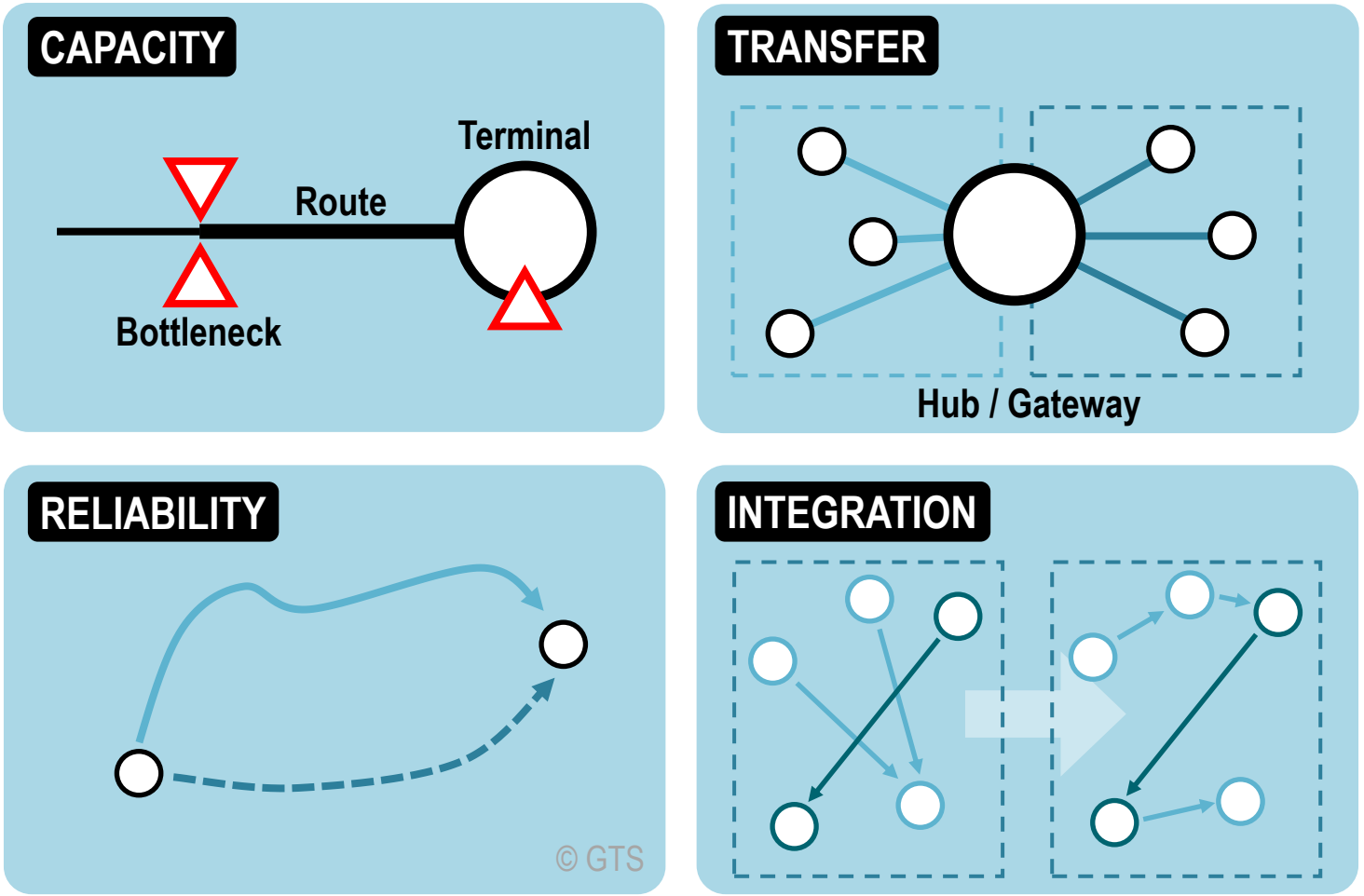


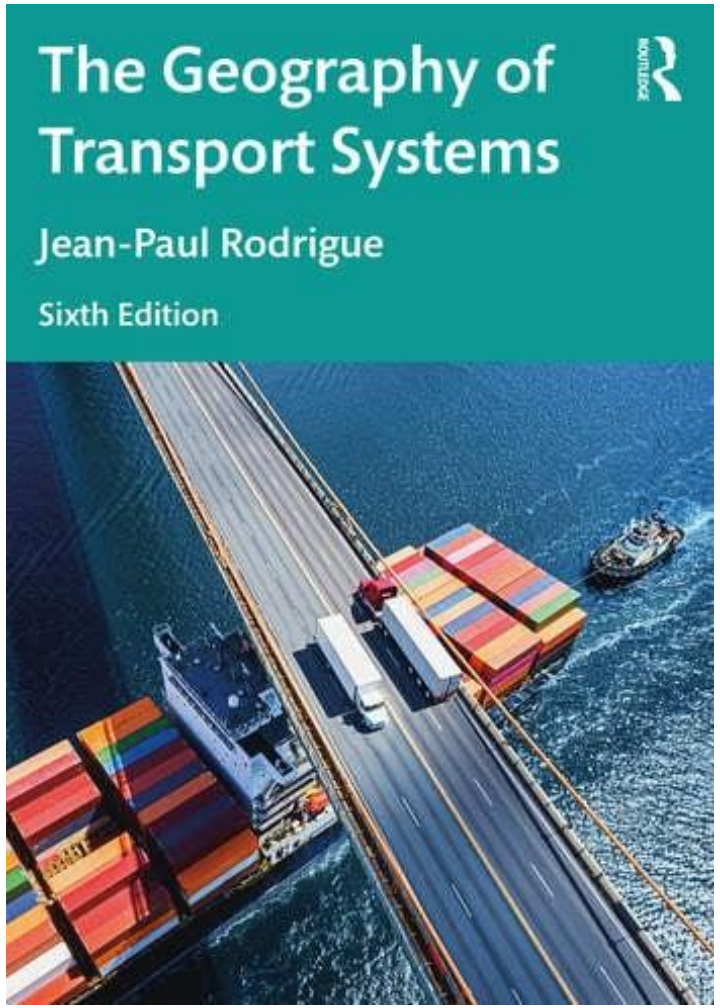
Two Common Fallacies in Transport Geography





Common Problems for Transport Systems

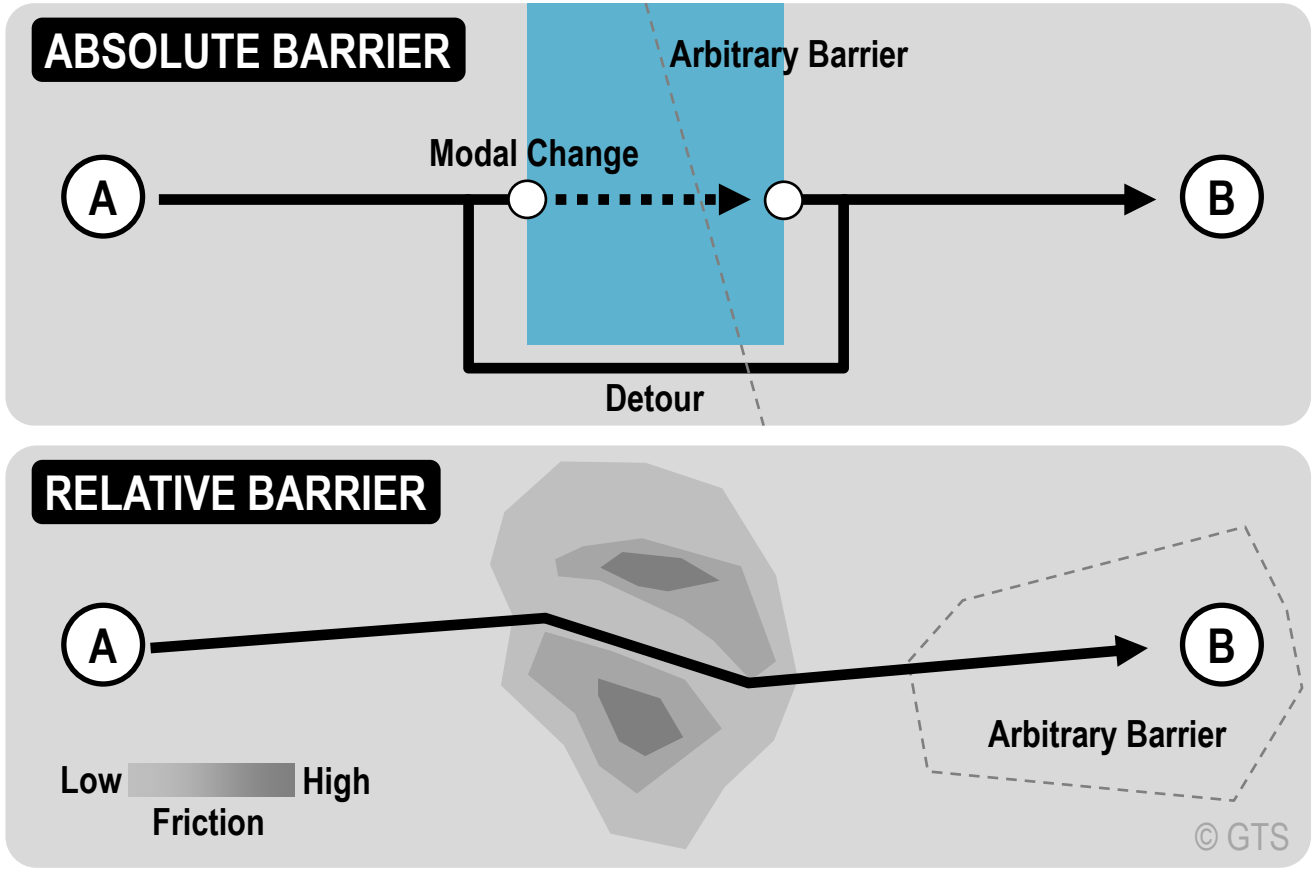




Transportation and the Physical Environment

Chapter 1.2

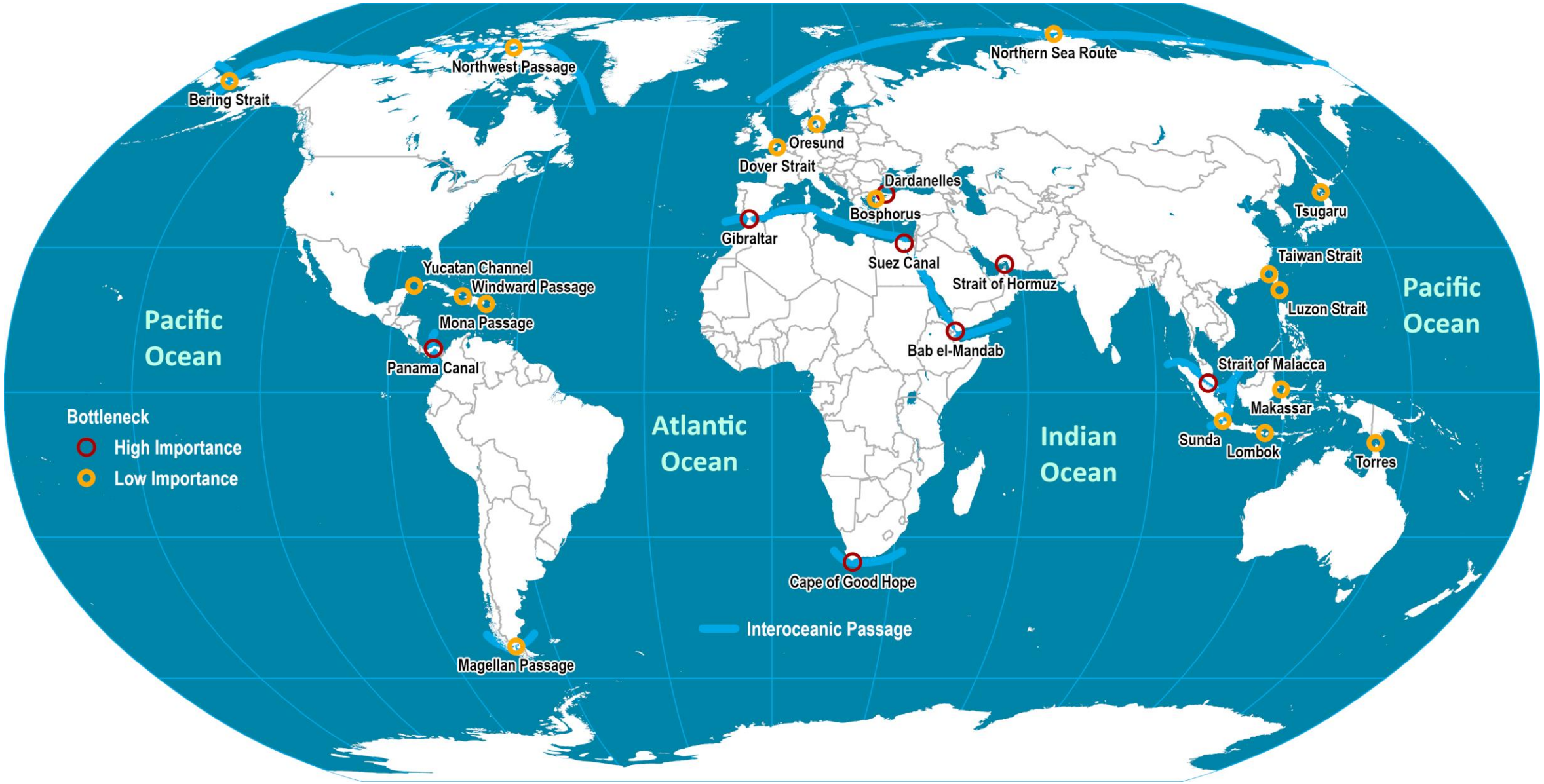
Absolute, Relative and Arbitrary Barriers



World's Longest Tunnels Used for Transportation

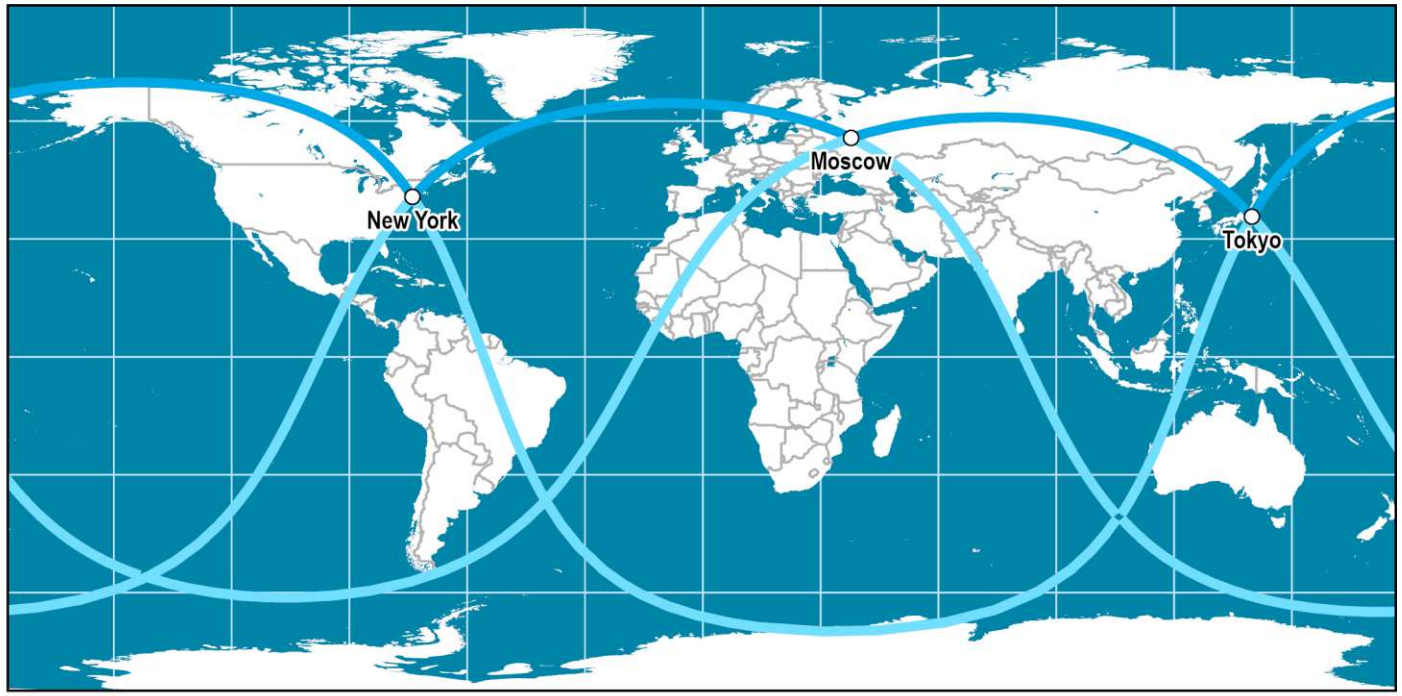
Name	Location	Traffic	Opening	Length
Gotthard Base Tunnel	Swiss Alps	Rail	2017	57.1 km
Seikan Tunnel	Strait of Tsugaru, Japan	Rail	1988	53.8 km
Channel Tunnel	English Channel (UK-France)	Rail (High speed)	1994	50.4 km
Lötschberg Base Tunnel	Swiss Alps	Rail	2007	34.6 km
Guadarrama Tunnel	Sierra de Guadarrama, Spain	Rail (High speed)	2007	28.4 km
Taihang Tunnel	Taihang Mountains, China	Rail (High speed)	2008	27.8 km
Iwate-Ichinohe Tunnel	Ōu Mountains, Japan	Rail (High speed)	2002	25.8 km
Lærdal Tunnel	Lærdal - Aurland, Norway	Road	2000	24.5 km
Daishimizu Tunnel	Mount Tanigawa, Japan	Rail (High speed)	1982	22.2 km
Wushaoling Tunnel	Wuwei, China	Rail	2006	21.0 km

The Geographical Space of Maritime Transportation

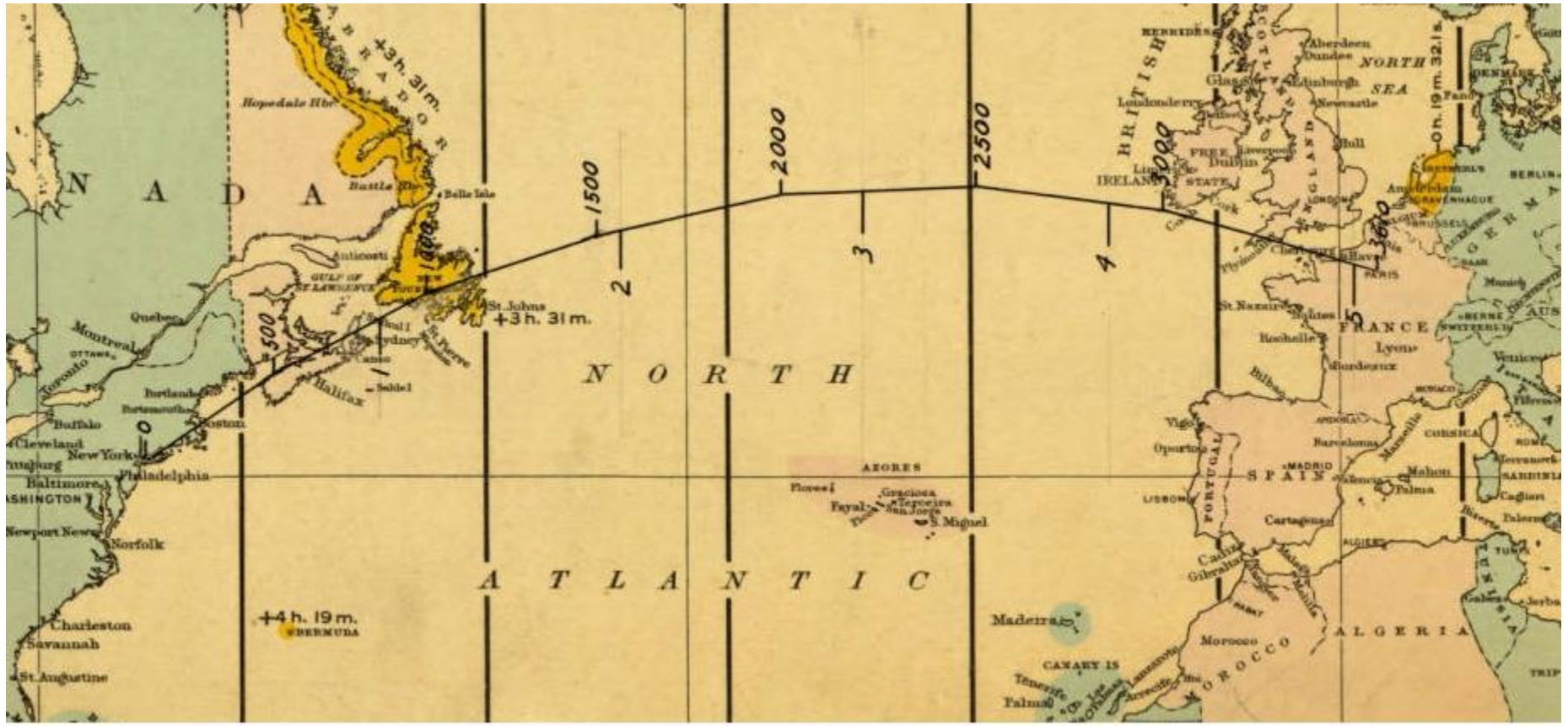


Polar Shipping Routes

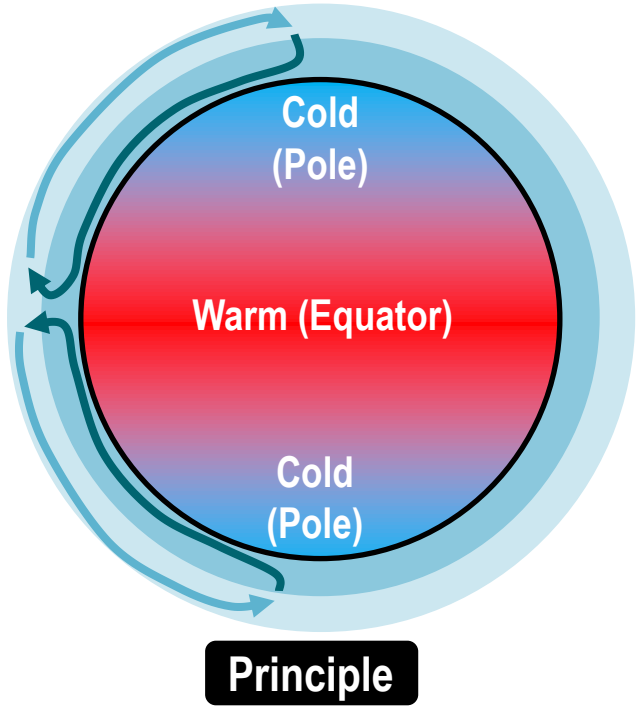
Great Circle Distance between New York, Moscow and Tokyo



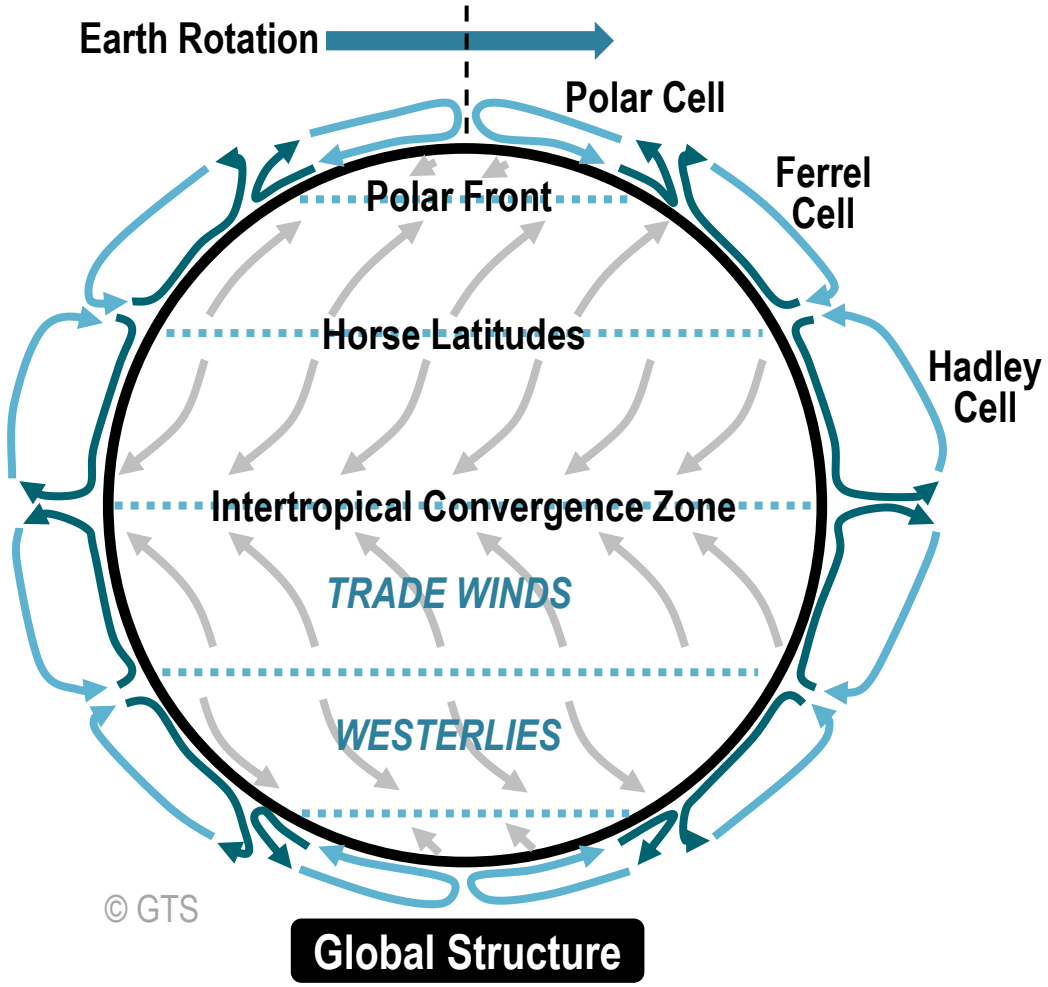
Lindbergh Great Circle Path, First Transatlantic Flight, 1927



Global Wind Patterns

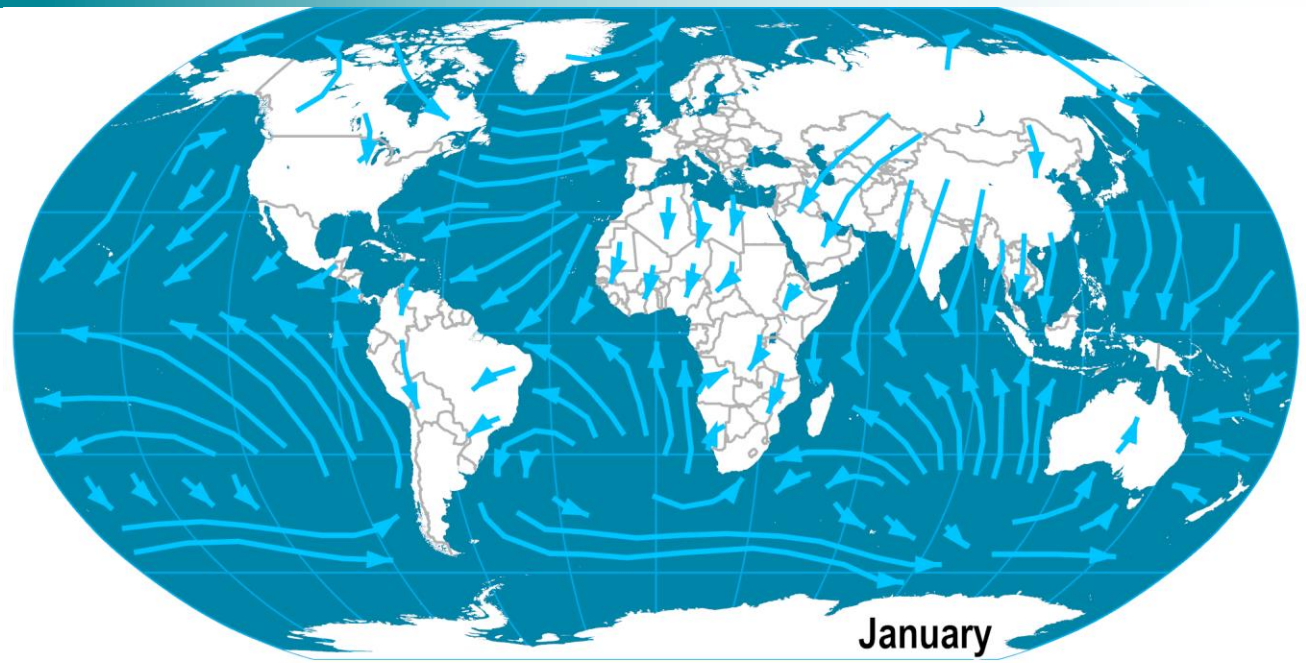


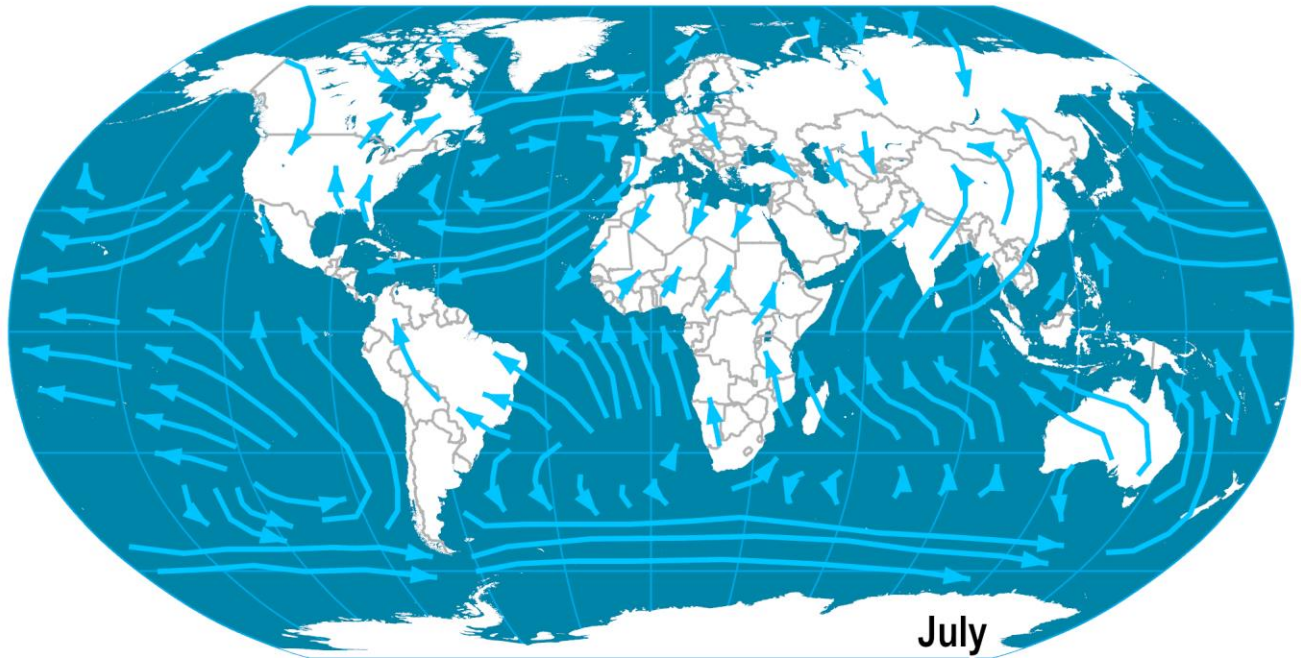
Principle



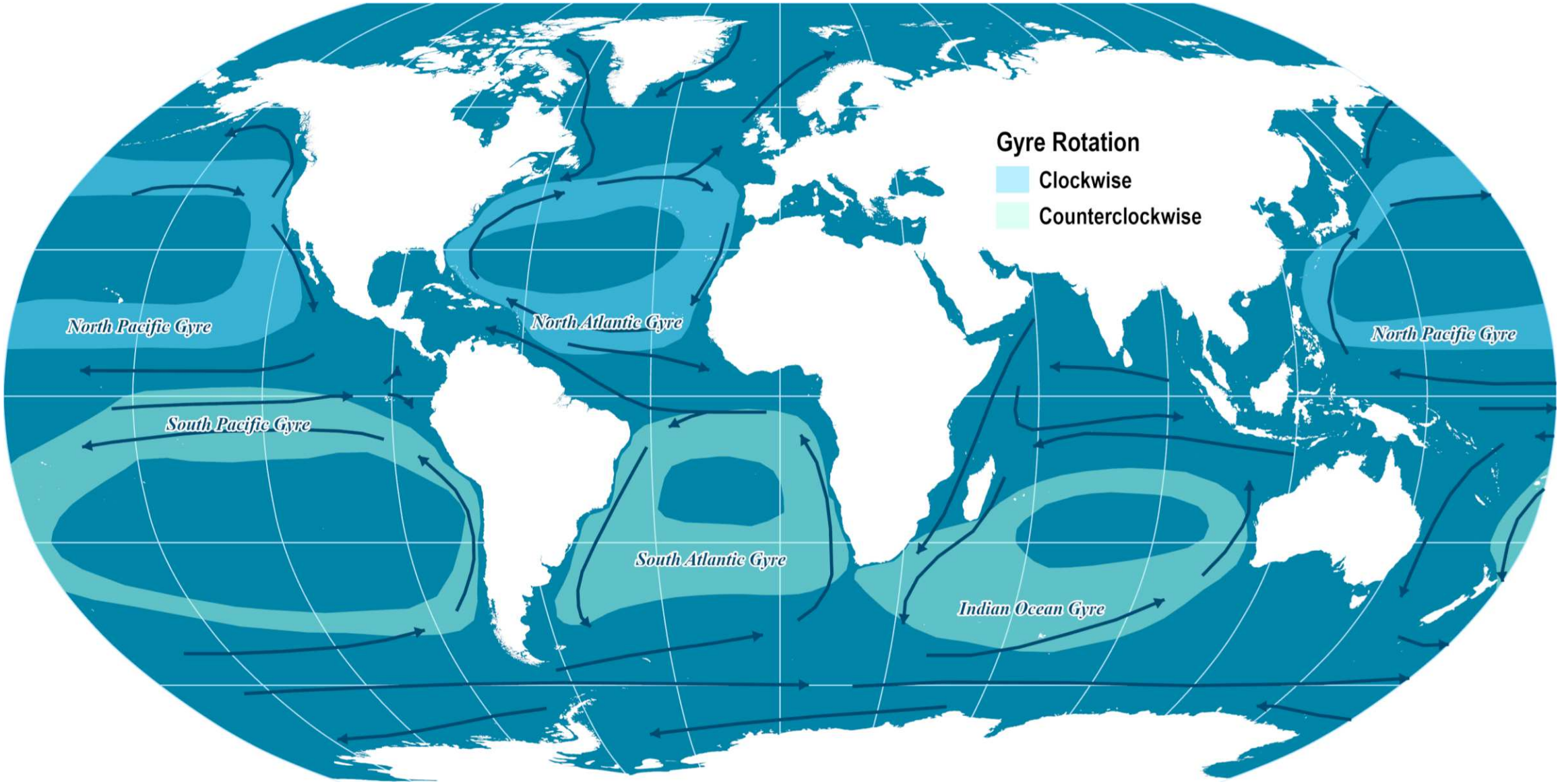
Global Structure

Seasonal Variation of Global Wind Patterns

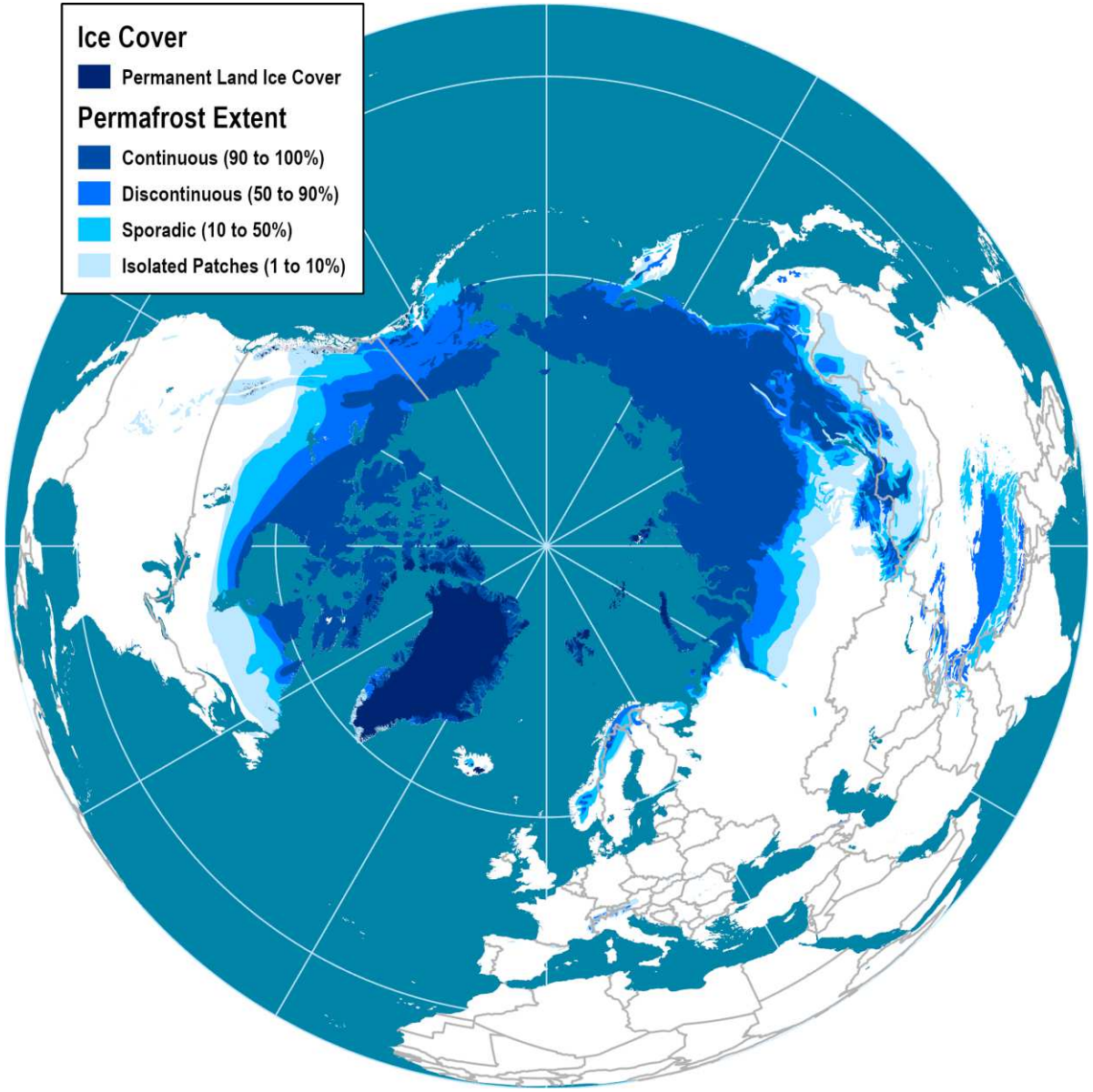




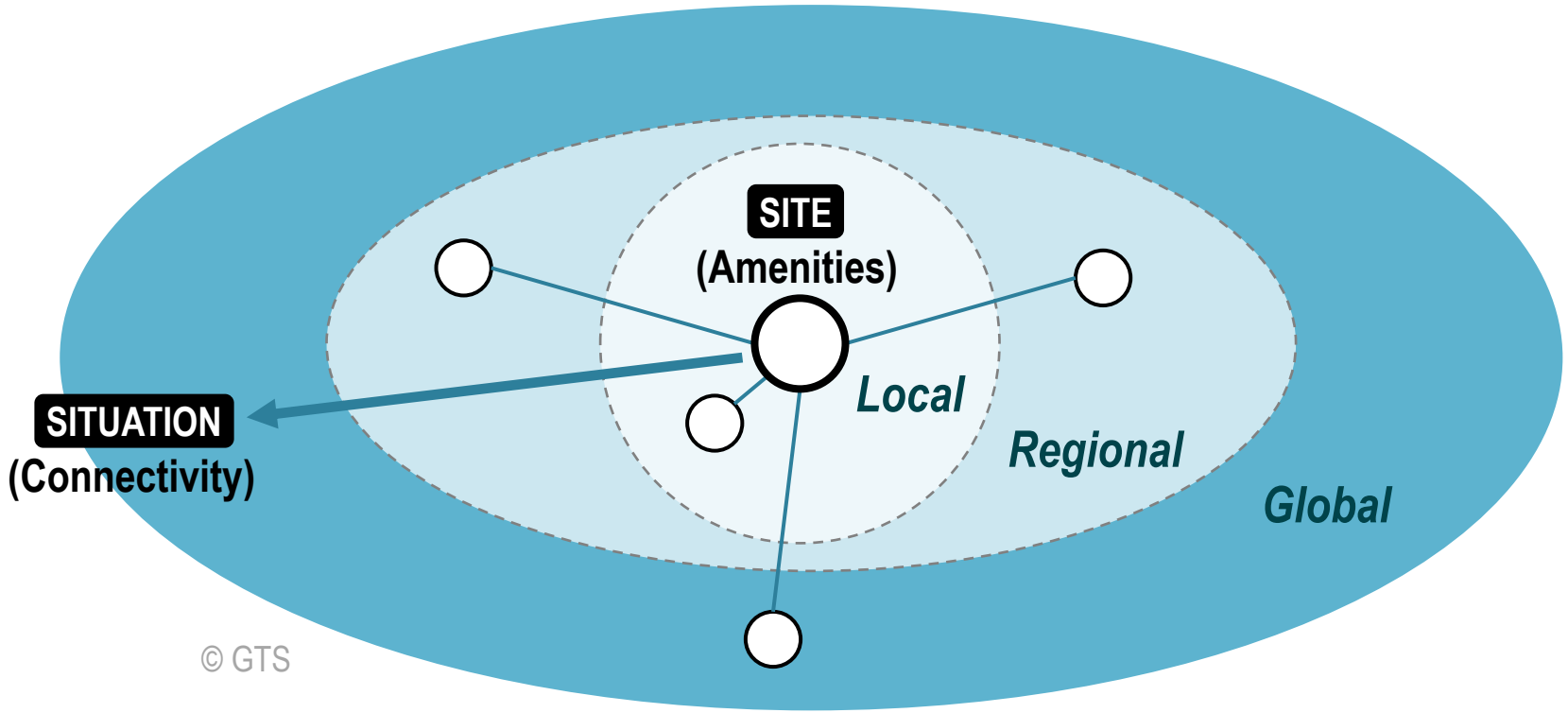
Major Oceanic Gyres and Sea Currents



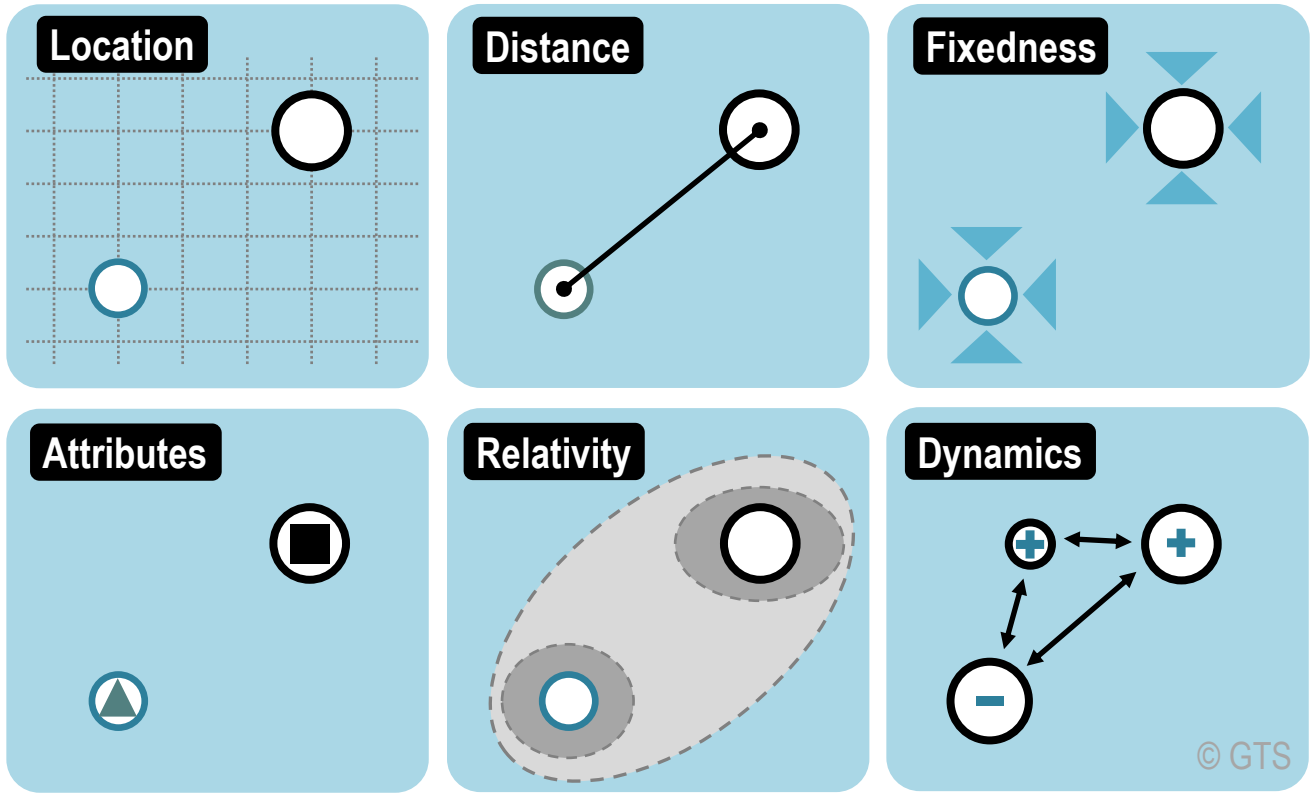
Land Covered by Permafrost



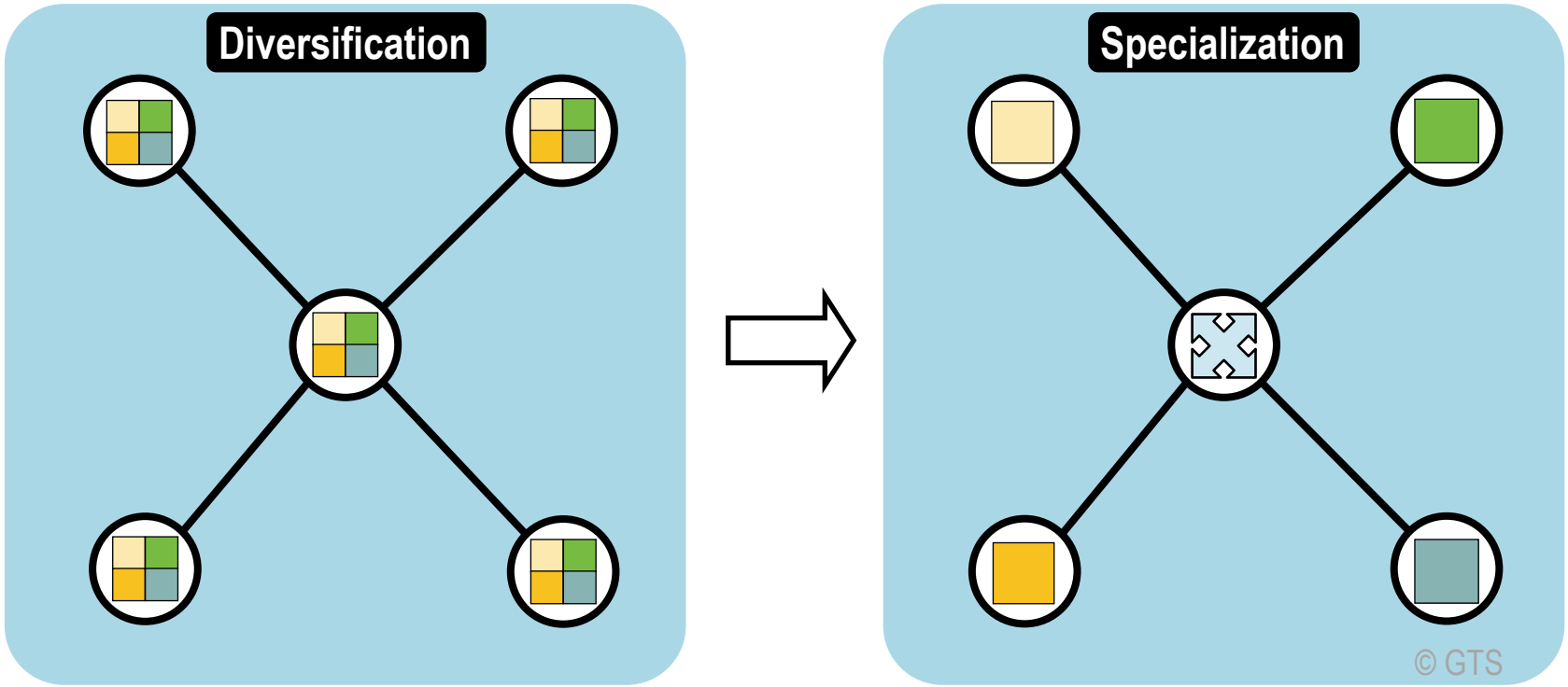
Transport, Site and Situation



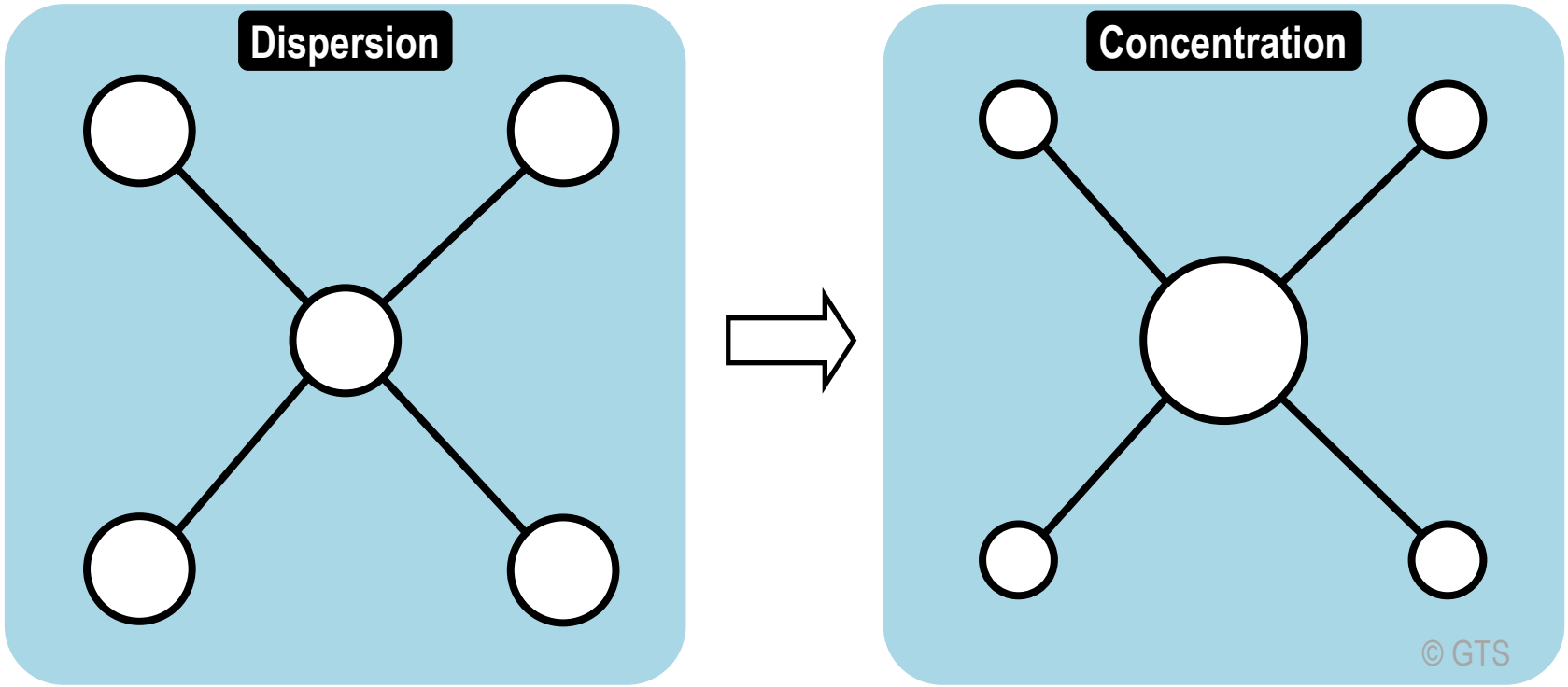
The Spatial Structure and Transportation



Transportation Networks and Geographical Specialization

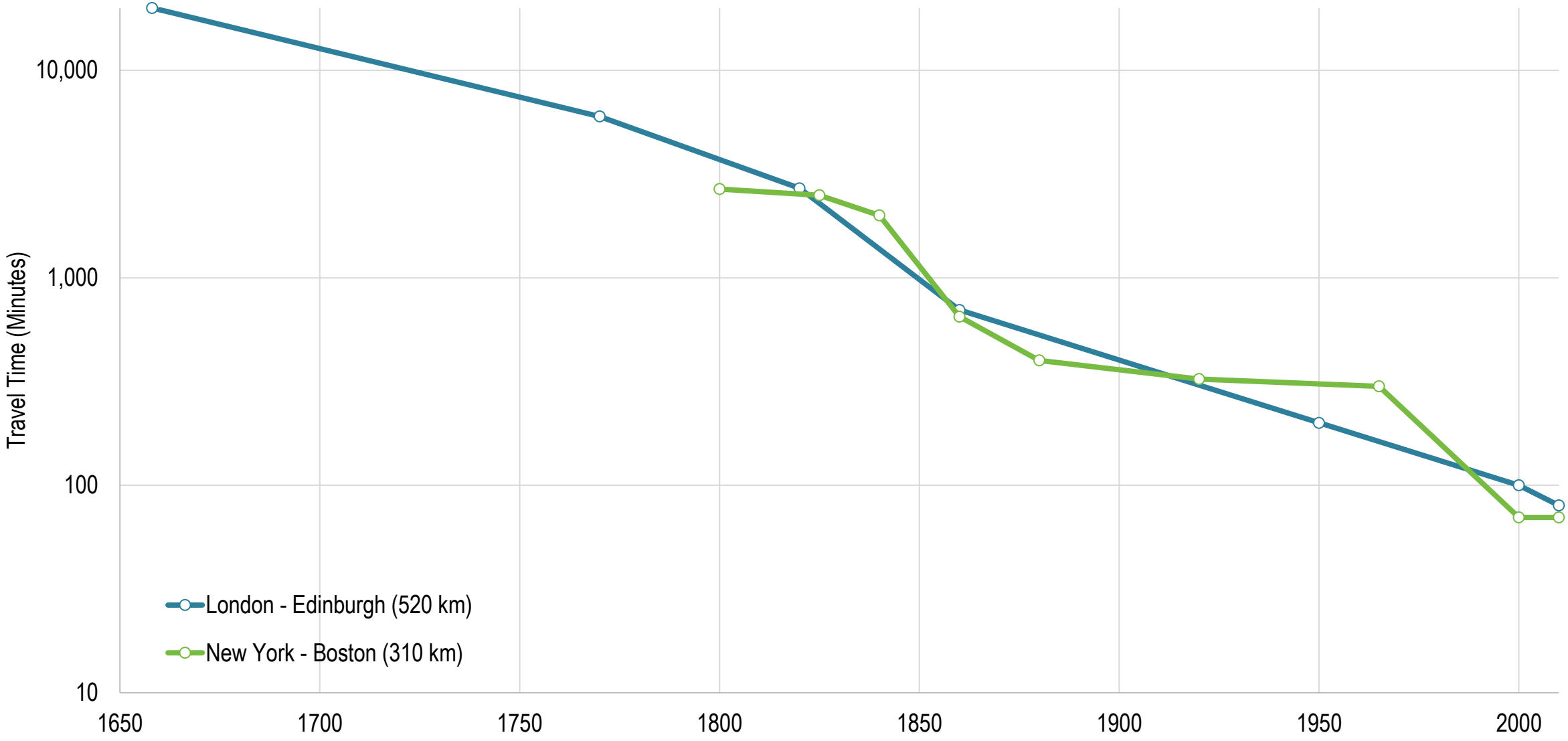


Transportation Networks and Geographical Concentration

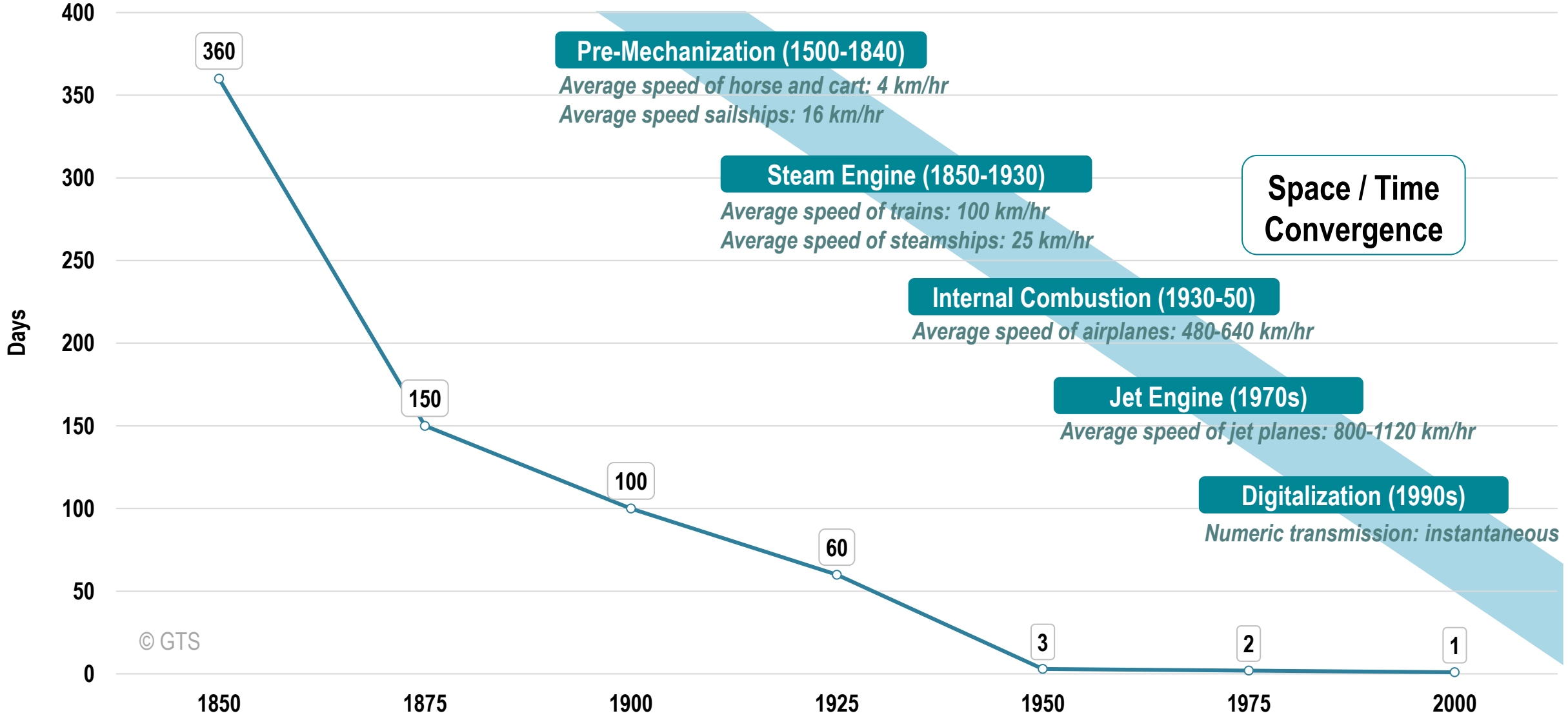


Transport as a Centralizing and Decentralizing Force (under construction)

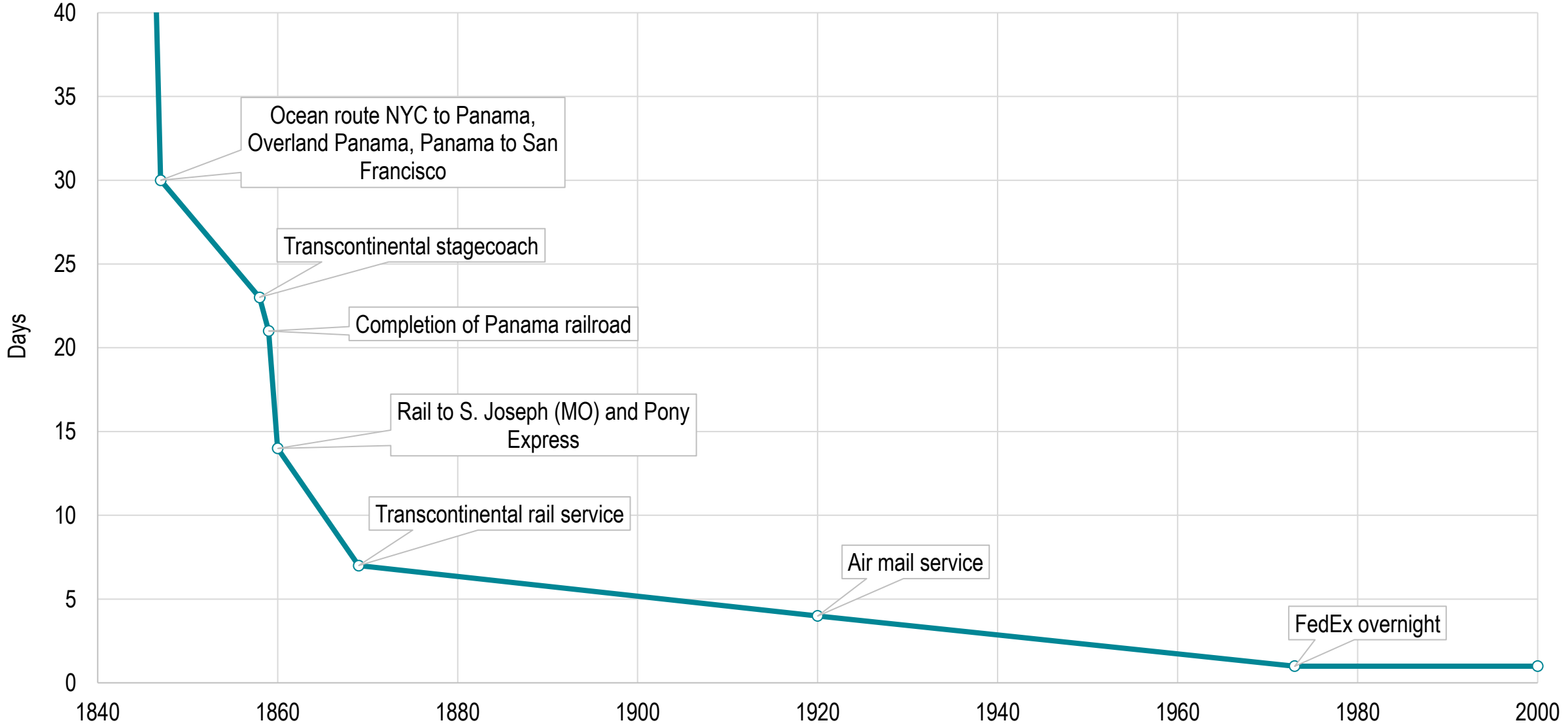
Regional Space / Time Convergence, (London – Edinburgh, New York – Boston)



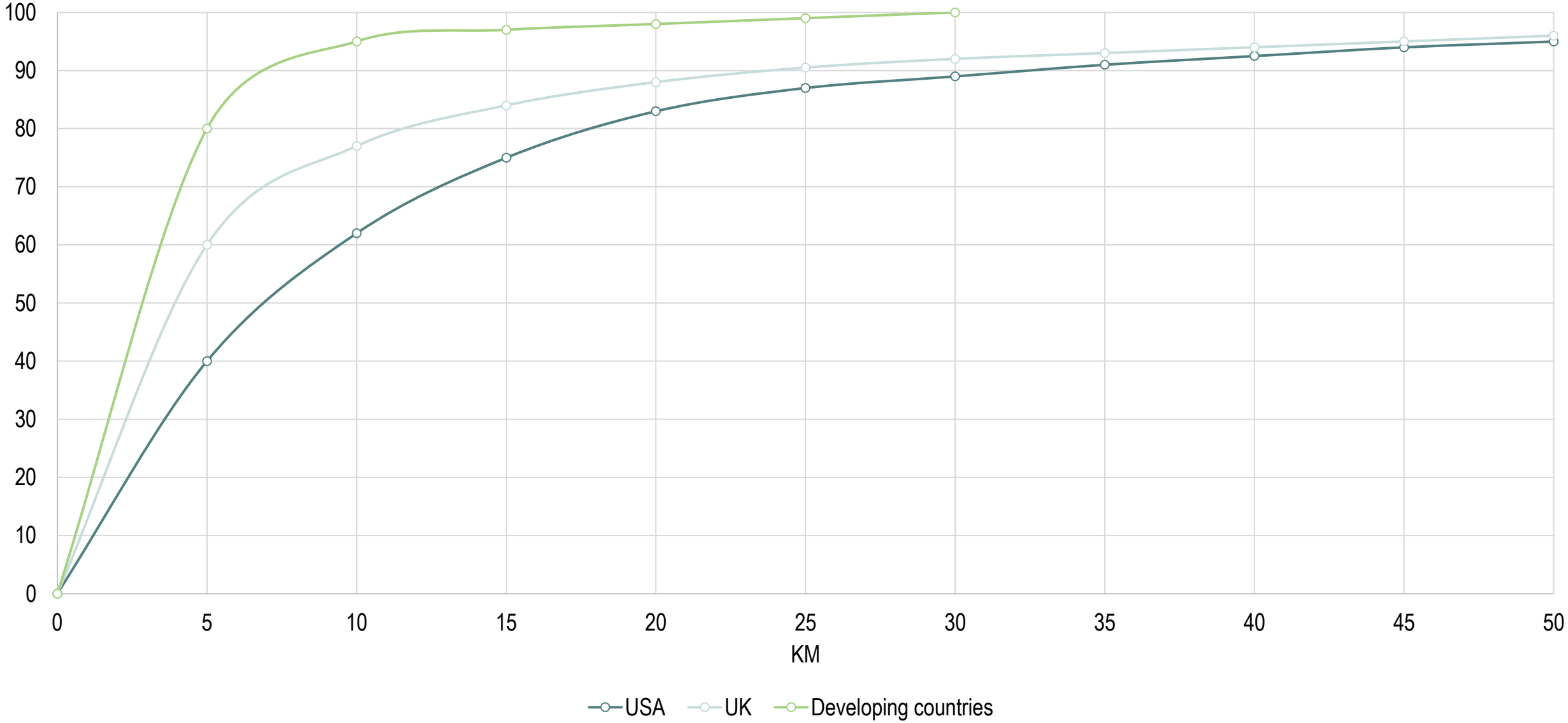
Global Space / Time Convergence: Days Required to Circumnavigate the Globe



Mail Delivery Times between New York and San Francisco, 1840-2000



Cumulative Distribution of per Capita Trip Rate for all Modes by Trip Distance, 1995

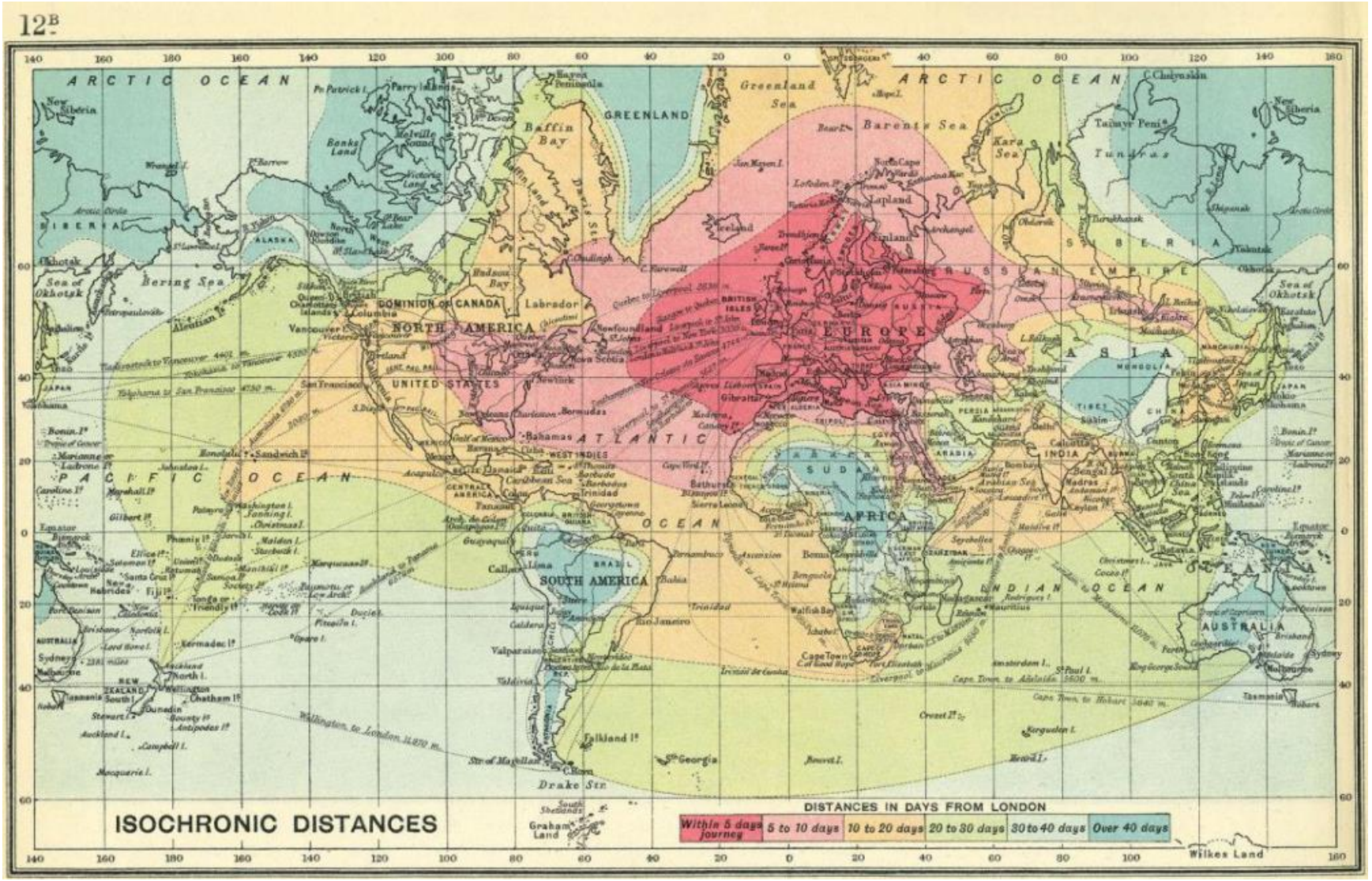


Speed Improvement Potential by Transport Mode [TO BE UPDATED]

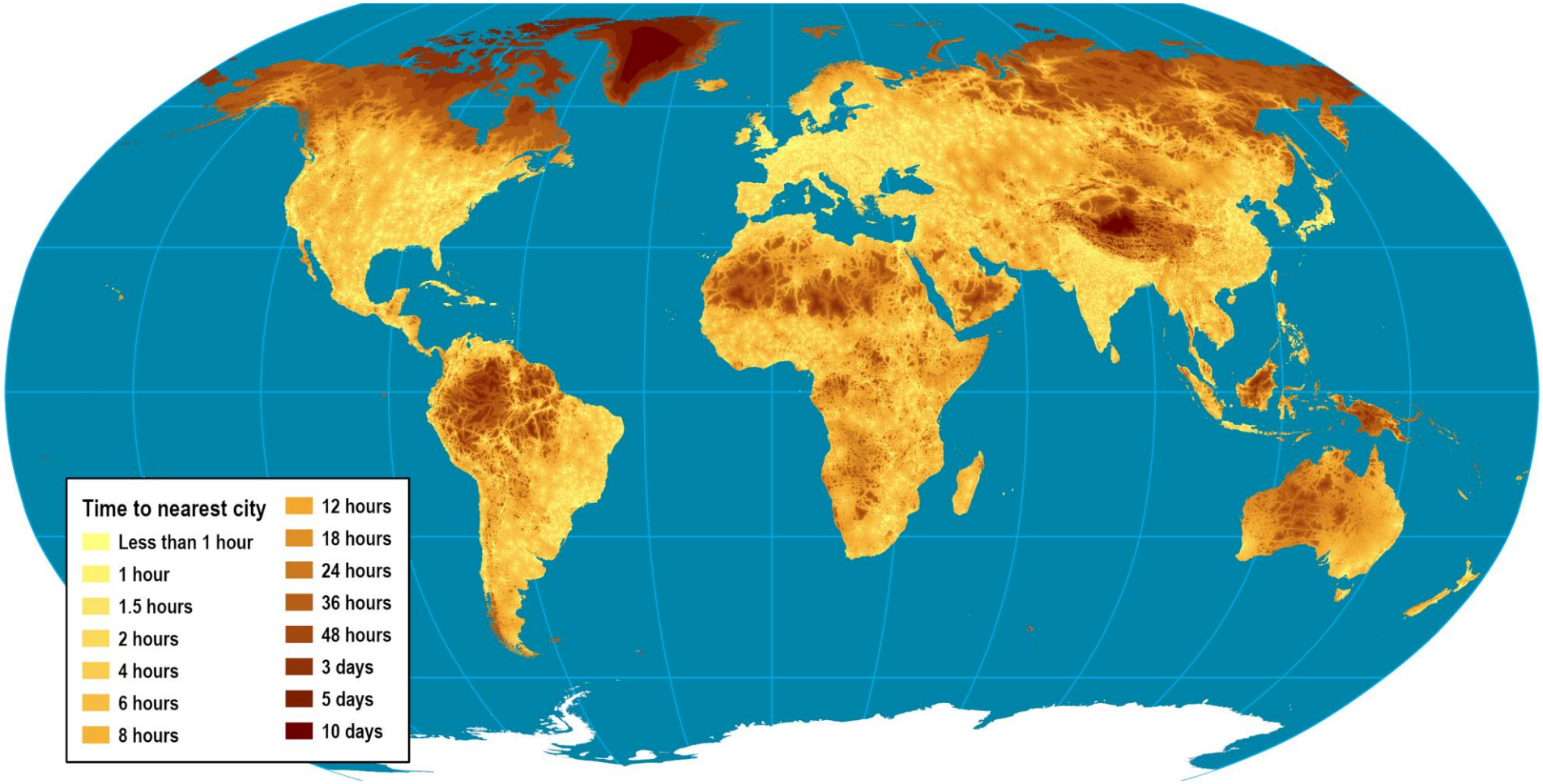
Mode	Potential	Main Issues
Road (automobiles, buses, trucks)	None to limited	Congestion. Operational safety (speed limits). Limited access highways.
Rail (Freight)	Limited	Operational safety (grade crossings). Availability of train slots. Terminal capacity.
Rail (Passengers)	Good to significant	Development of high speed rail systems. Long term potential of new technologies (e.g. Maglev).
Air	None to limited	Energy consumption. Congestion at airport terminals. Abandonment of supersonic services.
Maritime	None to limited	Energy consumption (slow steaming). Fast ferries.

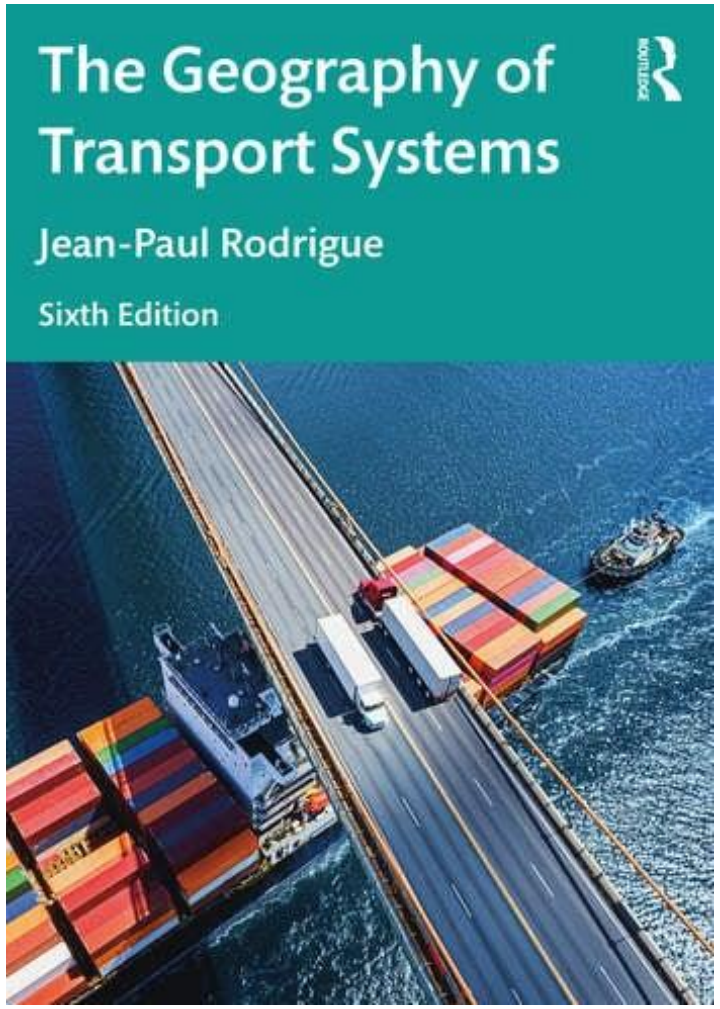
https://transportgeography.org/contents/chapter1/transportation-and-space/table_transport_speed/

Travel Time between London and the Rest of the World, 1914



Global Accessibility: Time to the Nearest Large City





The Emergence of Mechanized Transportation Systems

Chapter 1.3

The Genesis of Globalization

	ANTIQUITY	MODERN ERA	POST-MODERN
Time Frame	• Since the beginning of history	• Nineteenth century	• After World War II
Economic System	• Imperialism / Mercantilism	• Imperialism / Capitalism	• Capitalism / Corporatism
Foundation	• Exploration, war (expansion) and trade	• Mass production and consumption	• Trade liberalization
Acceleration	• Age of exploration of colonialism (15-16th century)	• Berlin Conference (1884)	• Fall of the Soviet Union • Entry of China in world trade
Form	• Empires	• Nation-states	• Economic blocs
Mobility	• Trails and sailships	• Mechanized (steamship and rail)	• Air transport, containerization and telecommunications

Transport Revolutions in Human History

ERA	DATE	MOBILITY
PALEOLITHIC	c. 700,000 years ago	First migrations from Africa
	c. 35,000 years ago	First migrations by sea to Australasia
	c. 18,000 years ago	First migrations to the Americas
AGRARIAN	c. 4,000 BCE	Animal-powered transport
	c. 3,500 BCE	Wheeled transport
	c. 1,000 BCE	Long distance navigation in Polynesia
MODERN	From 15th century	Improvements in shipbuilding and navigation
	From early 19th century	Railways and steamships
	From late 19th century	Internal combustion engines
	From early 20th century	Air travel
	From mid 20th century	Space travel

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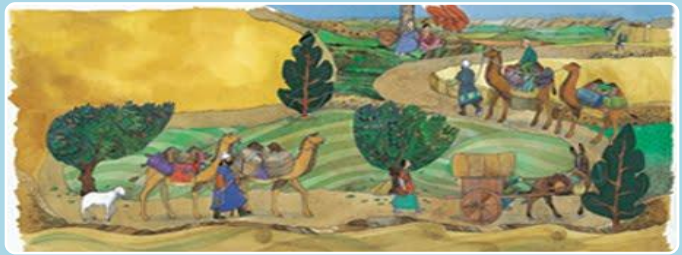
Main Technological Advances in Transportation and Telecommunication

	TRANSPORTATION	TELECOMMUNICATION
3000 BCE	Horses; Sailing ships; Wheeled carts; Aqueducts	Writing systems; Mail services
300 BCE – 500 CE	Wheelbarrow; Paved roads; Stirrups; Canals	Paper
500 – 1000 CE	Horse collars; Compass	Moveable type
1000 – 1500 CE	Rudder, Locks; Three-mast ships	Printing press (1456); Paper currency
1500 – 1800 CE	Steam engine (1712); Steam car (1769); Balloons (1783)	Newspapers and magazines
1800 – 1850 CE	Steamboat (1807); Bicycles (1816); Surfaced roads (1816); Steam rail (1825); Electric streetcars (1834); Iron hulls (1843)	Photographs (1830); Telegraph (1844)
1850 – 1875 CE	Airships (1852); Compound steam engine (1854); Subway (1863); Pipelines (1864); Internal combustion engine (1866); Asphalt roads (1872)	Transoceanic telegraph cable (1858); Typewriters (1867)
1875 – 1900 CE	Steam turbine (1884); Gasoline engine (1885); Pneumatic tires (1888); Diesel engine (1895); Trucks (1886)	Telephones (1876); Wireless radio (1895)
1900 – 1925 CE	Airplanes (1903); Helicopters (1907); Ford Model T (1908); Dirigibles (1910); Diesel locomotives (1917); Air passenger services (1919)	Transatlantic radio (1900); Commercial radio (1920); Facsimile (1925)
1925 – 1950 CE	Rockets (1926); Highways (1933); Jet engine (1940); Passenger jet (1949)	RADAR (1940); Commercial television (1940); Electronic computers (1946); Transistor (1947)
1950 – 1975 CE	Intermodal containers (1957); Space travel (1957); Jumbo jets (1966); Supersonic passenger jets (1969); Maglev (1969)	Integrated circuits (1958); Xerox copier (1959); Telecom satellites (1962); Internet (1970); Cell phones (1973)
1975 – 2000 CE	Double-stacked rail services (1984); Drones (1991); Hybrid cars (1997)	Laser printer (1977); Fiberoptic cable (1978); GPS (1978); Personal computers (1981); WWW (1991); Search engine (1994); E-commerce (1997)
2000 – 2025 CE	Ride-sharing (2011); Self driving vehicles (2014)	Smartphones (2002); Blockchain (2008); ChatGPT public (2022)

Ancient Trade Issues

Nature of Trade



- Limited market size geared to the elite.
- High-value commodities (silk, spices, perfumes, gems, gold, silver, ivory).
- Bulk commodities could be traded when maritime transport was available (grain, wine, olive oil).
- Many intermediaries.

Limiting Factors

- Limited capacity and speed of inland transportation.
- Diversity of currencies and units of measure.
- High tariffs.
- Unreliable navigation.
- Insecurity / piracy.

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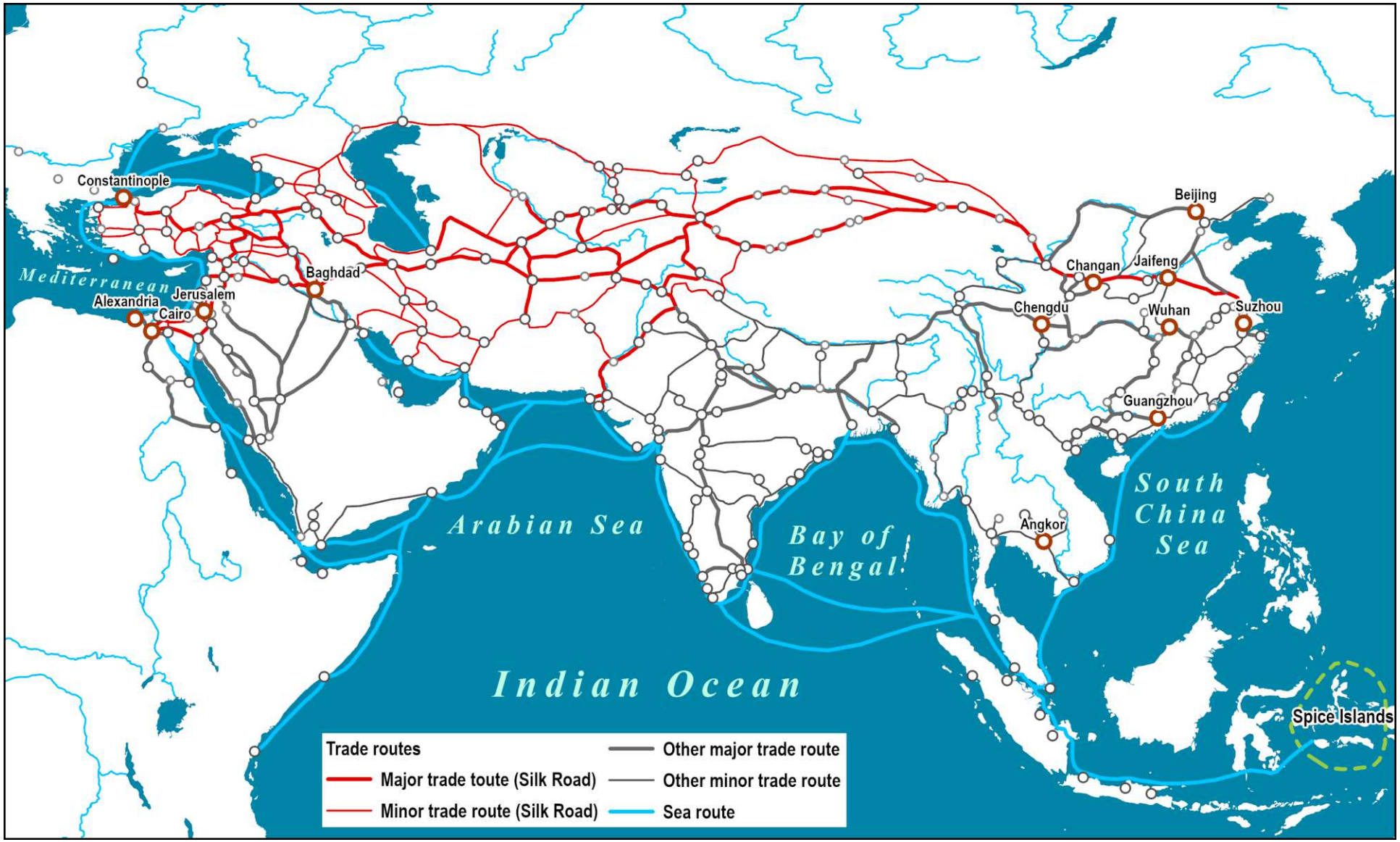
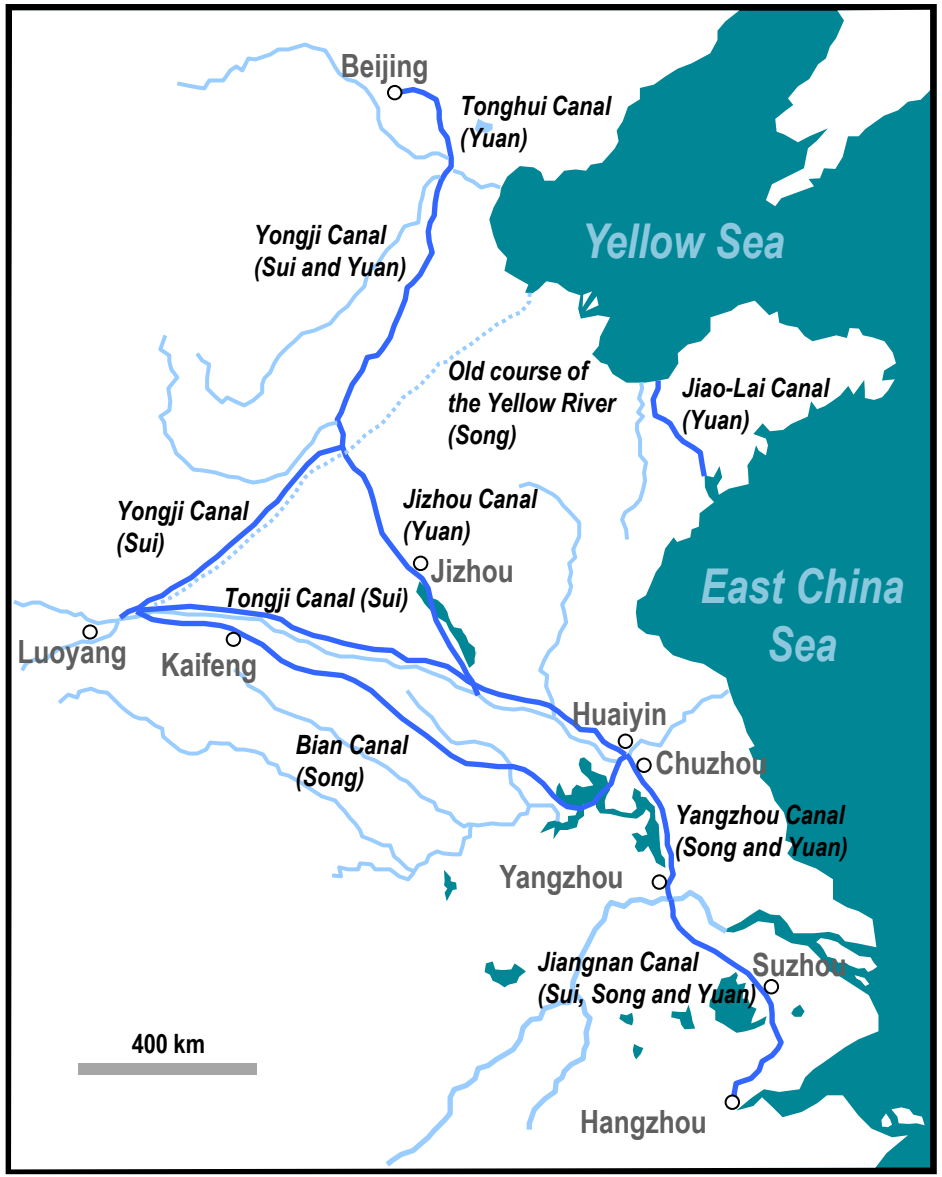
Roman Empire, c125AD

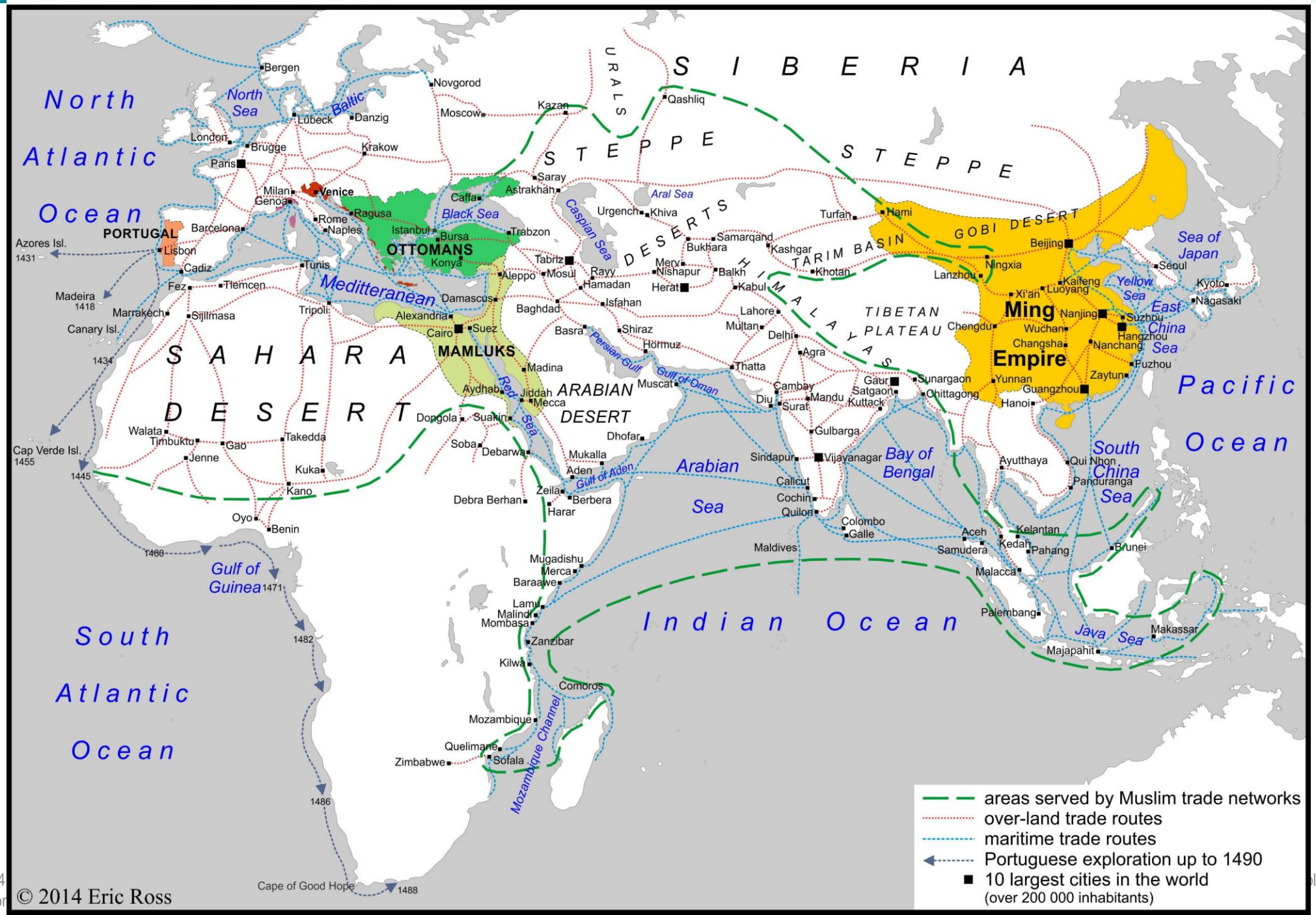
The Silk Road and Arab Sea Routes (11th and 12th Centuries)



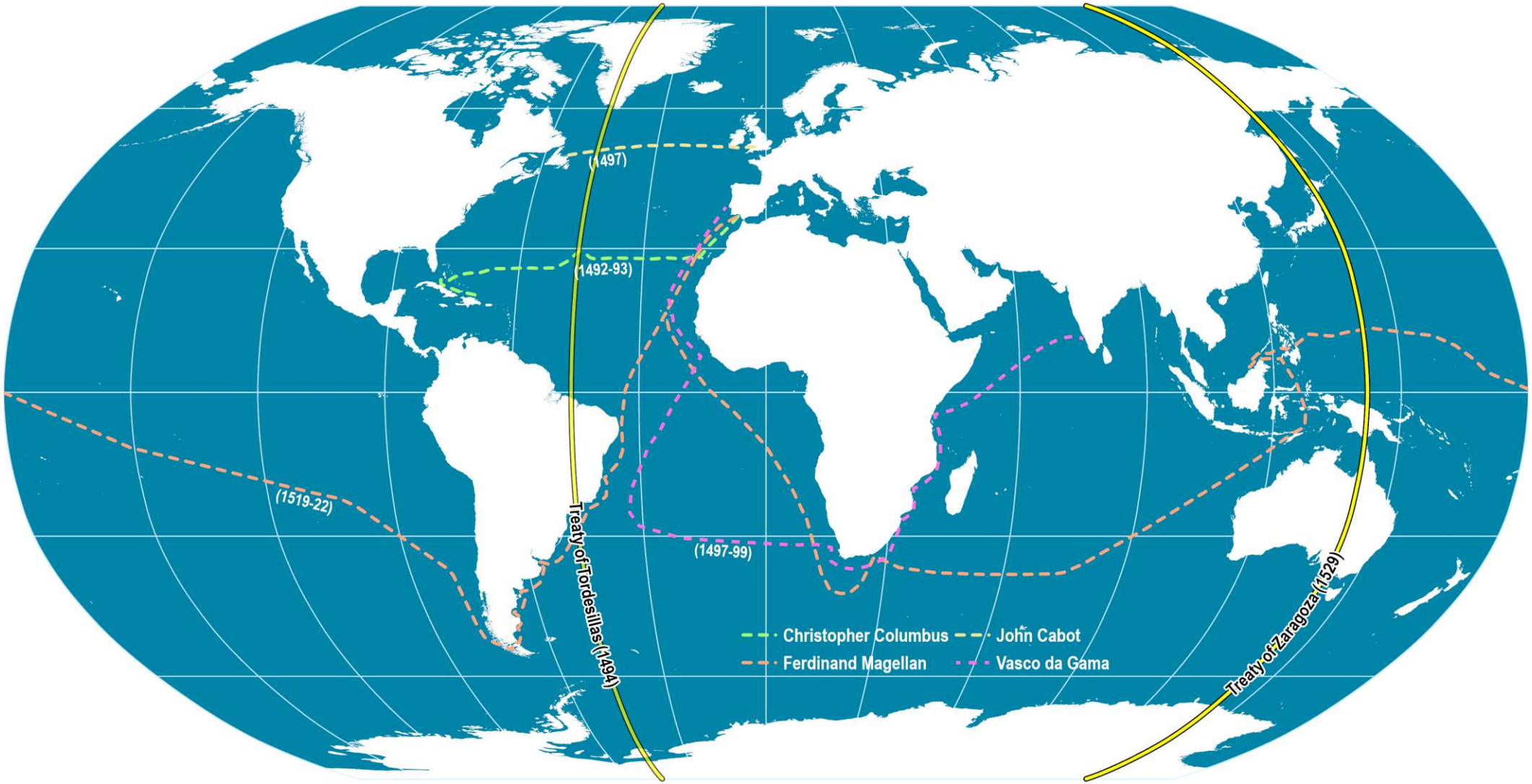
Grand Canal System

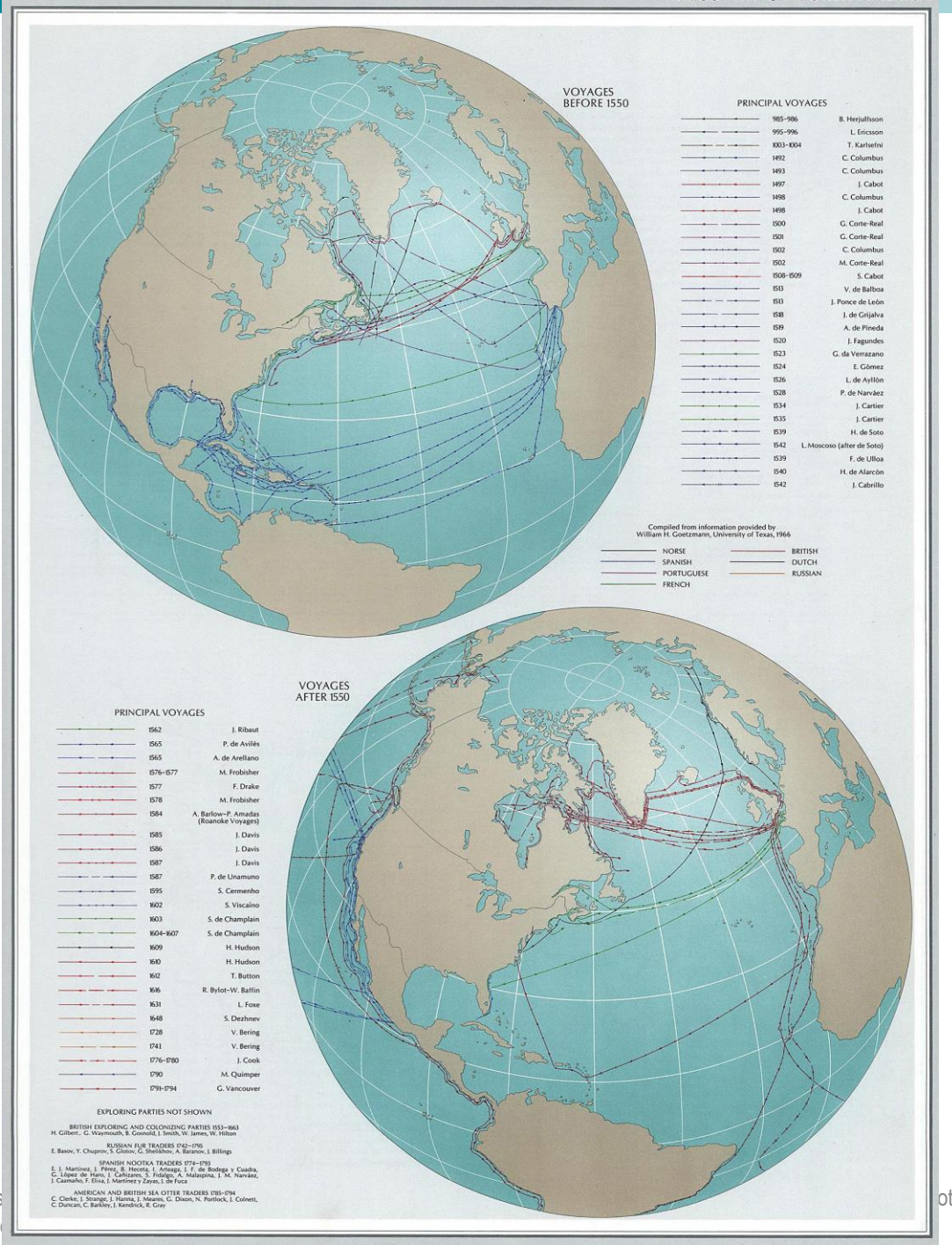


Old World Trade Routes c. 1490

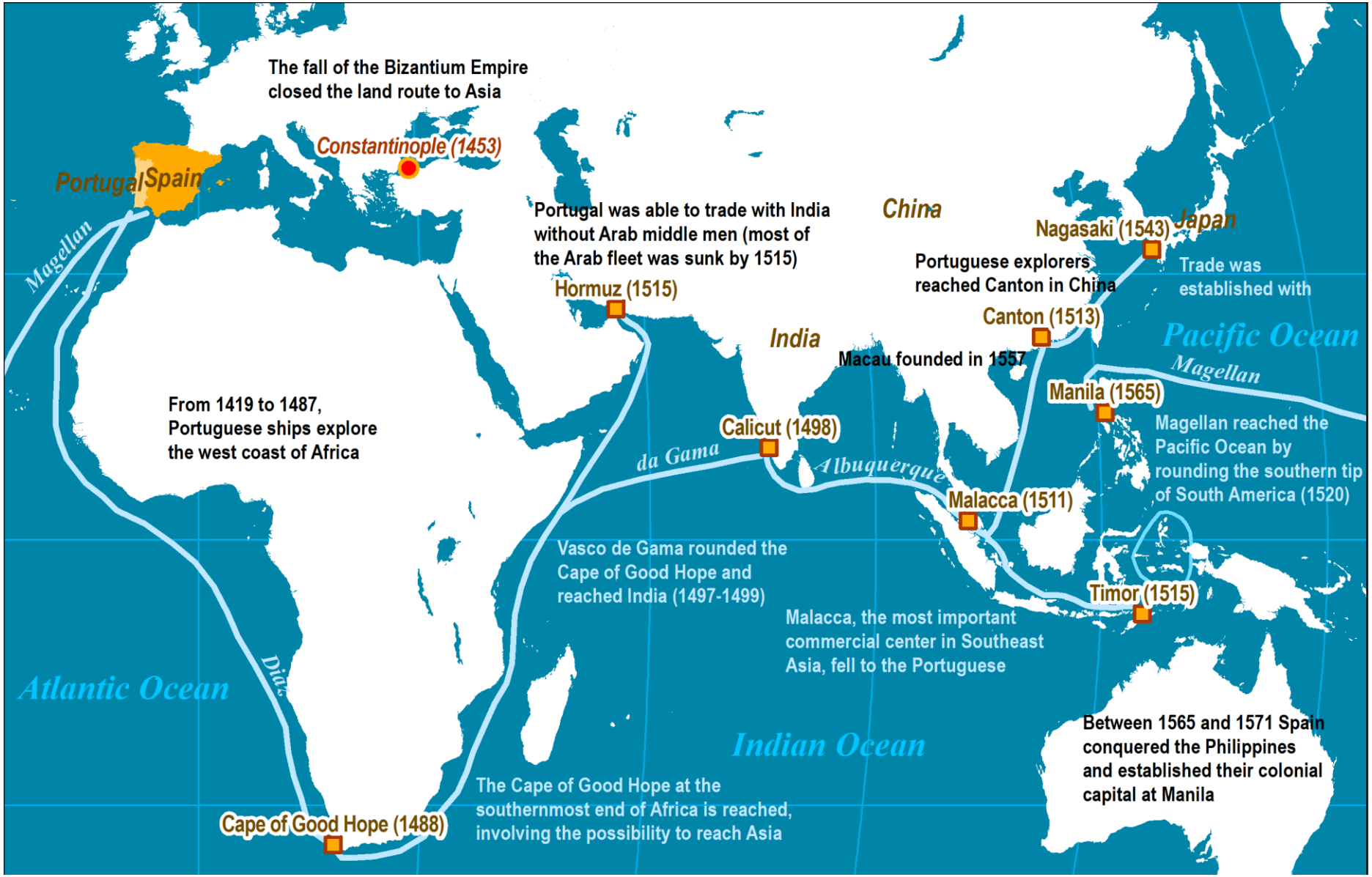


Early European Maritime Expeditions, 1492-1522



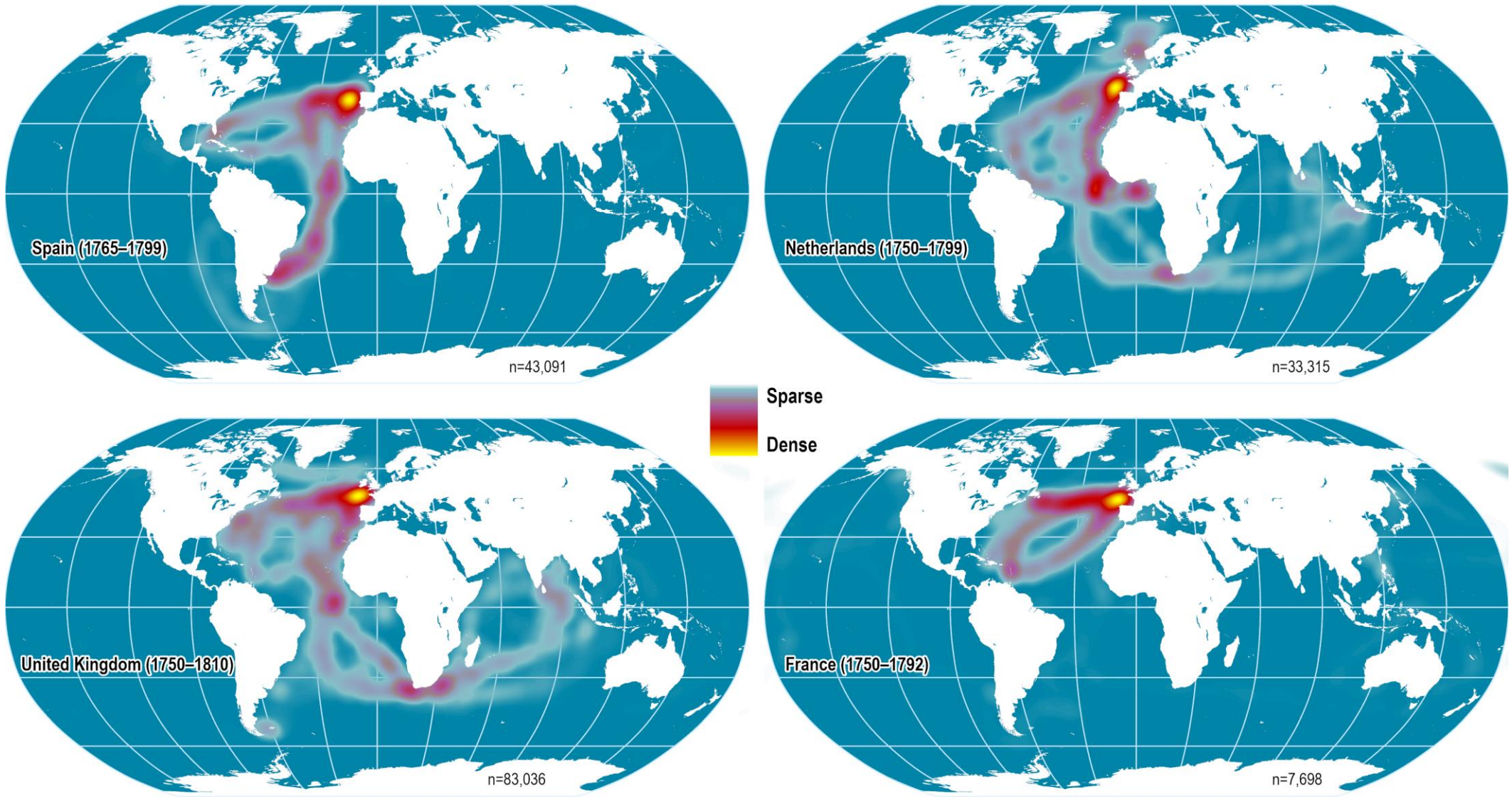


The Eastern and Western Maritime Routes to Asia

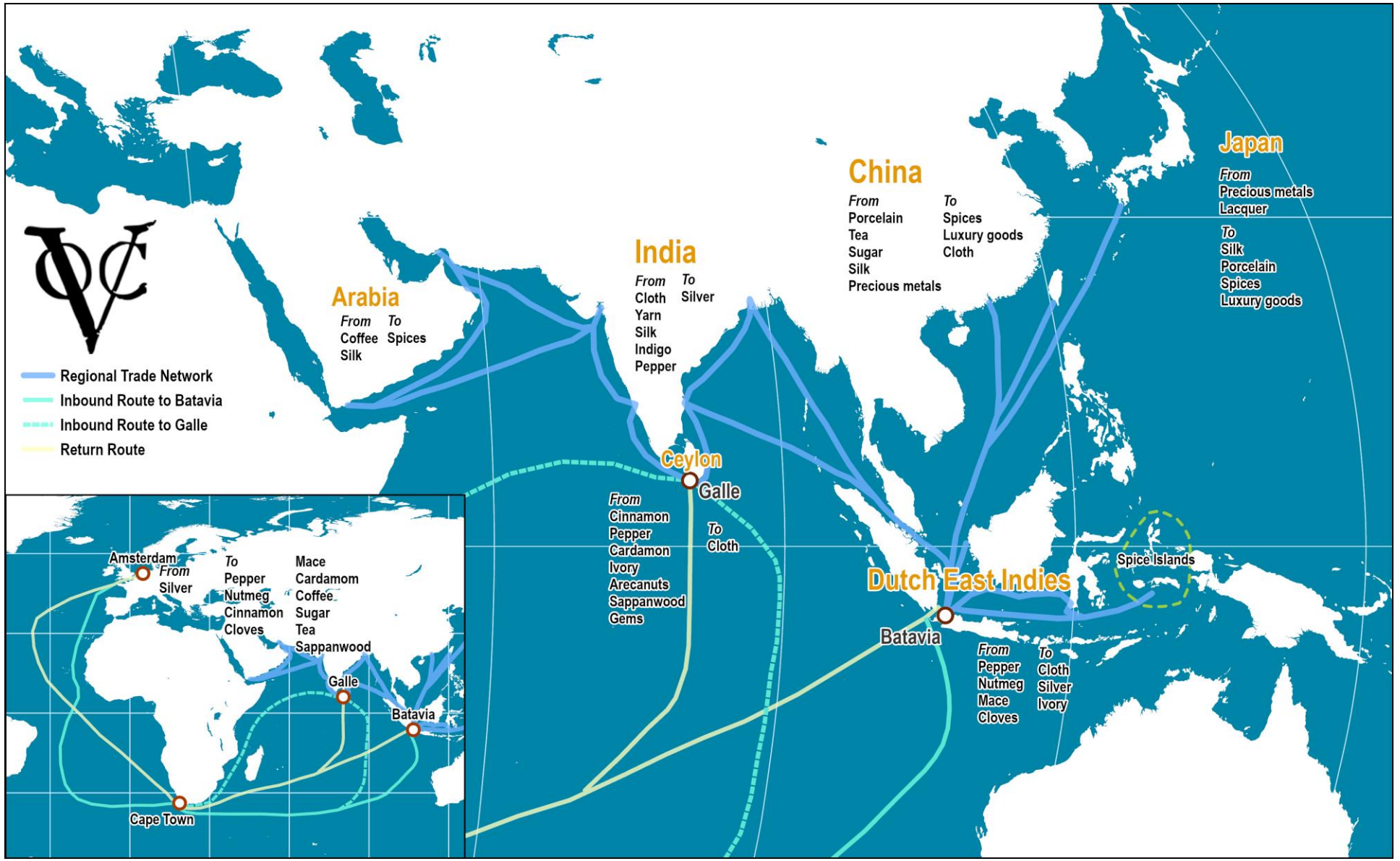


Spanish and Portuguese Empires (1581–1640)

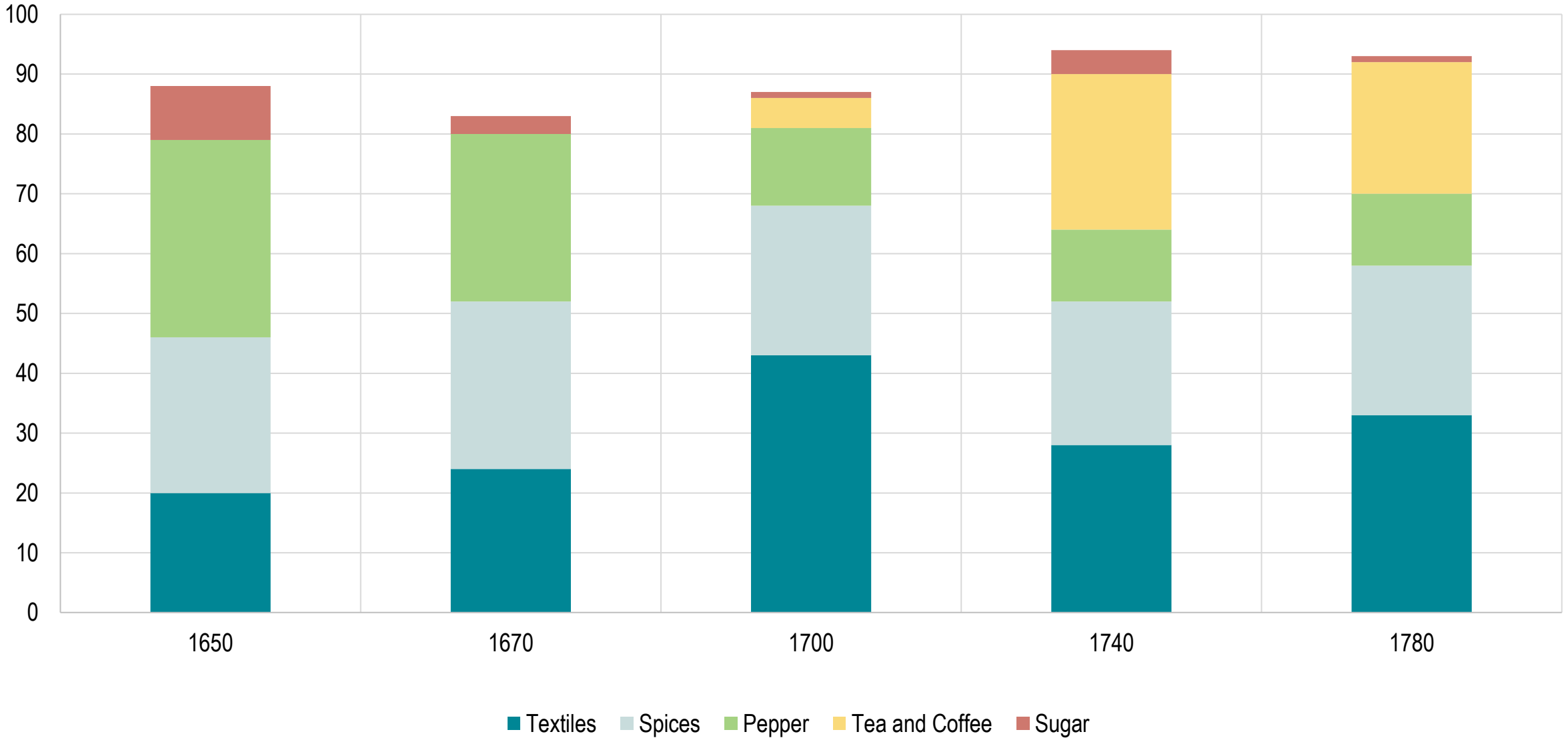
Density of Ship Log Entries, 1750–1810



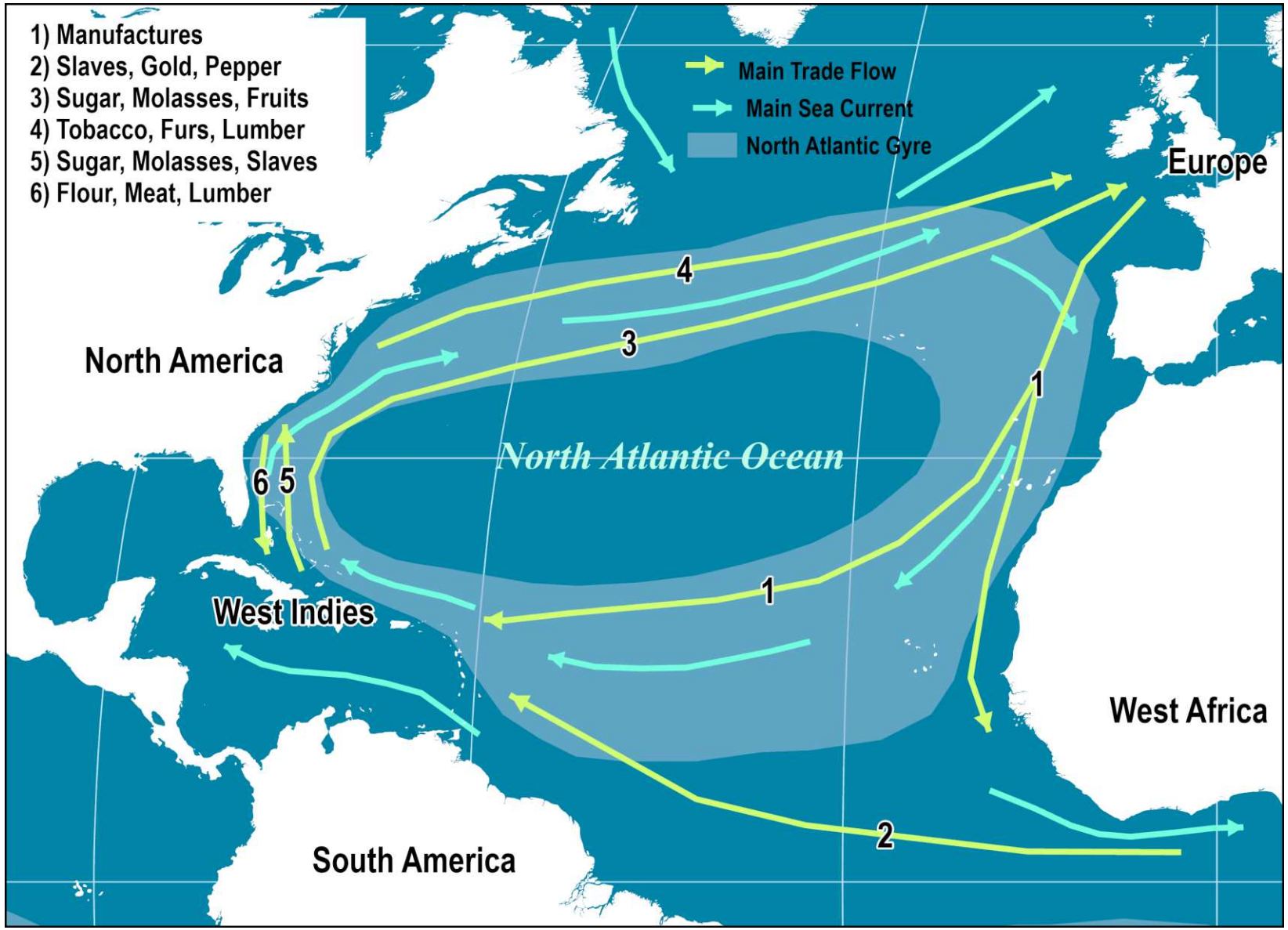
Dutch East India Company, Trade Network, 17th Century



Imports from the Dutch East India Company at Amsterdam, 17th and 18th Centuries



Colonial Trade Pattern, North Atlantic, 18th Century



North American Coastal Trade System, 18th Century

The Performance of Pre-industrial Means of Transportation

Walking

40 lbs / 18 kg
5 km/hr
30 km/day

Horse Riding

275 lbs / 125 kg
8 km/hr
60 km/day

Camel

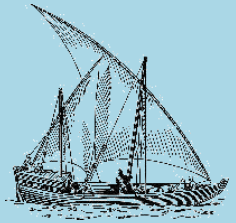
350 lbs / 160 kg
5 km/hr
40 km/day

Horse & cart

1 ton
3 km/hr
25 km/day

Barge pulled by horse

50-100 tons
4 km/hr
35 km/day

Dhow

15-300 tons
13 km/hr
150 km/day

Carrack (15th century)

500-1500 tons
10 km/hr
130 km/day

Galleon (17th century)

500-800 tons
15 km/hr
300 km/day

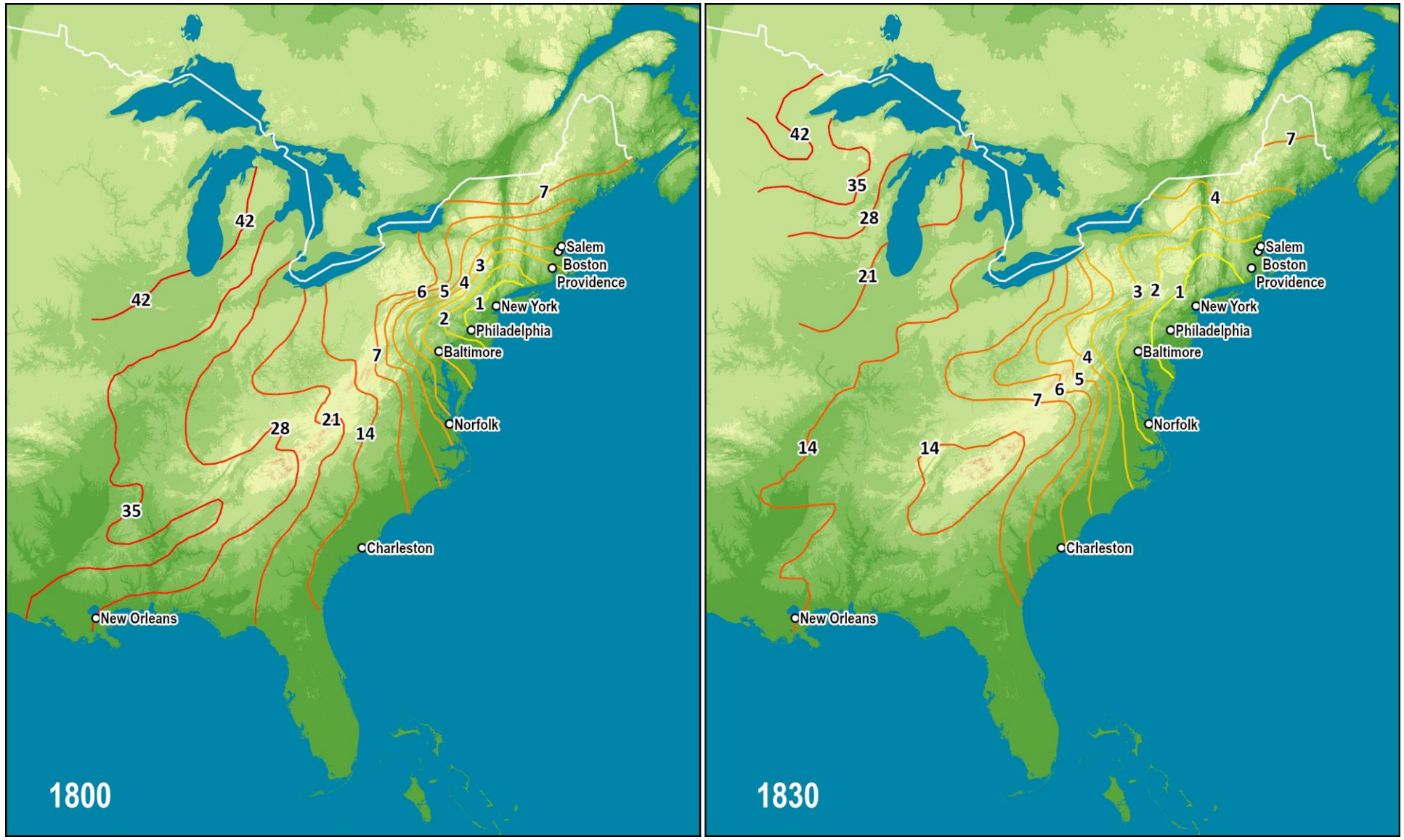
Clipper (19th century)

500-1500 tons
30 km/hr
700 km/day

Major Technological Innovations of the Industrial Revolution

Power Generation	Textiles	Metallurgy	Transportation
Thermal energy used for mechanical energy	Mechanization of spinning and weaving	Mass production of steel (shipbuilding, rails, construction and machines)	Modern transport and telecommunication systems
• First water pump (1712) in mines. • Watt (1769); significant improvements. • Steam locomotive (1824). • Electric generator (1831). • Steam turbine (1884).	• "Flying shuttle" (1733) doubled weaving productivity. • "Spinning jenny" (1765). • "Water frame" (1768); hydraulic power. • "Spinning Mule" (1779); steam power. • Sewing machine (1846).	• Coke instead of coal for iron production (1709). • Bessemer process (1855).	• Railroads (1825). • Telegraph (1834). • Steamship (1838). • Telephone (1876).

Inland Travel Time from New York, 1800 – 1830 (in Days)



American Rail Network, 1861

Turnpikes in Great Britain and Travel Hours from London, Late 18th and Early 19th Century

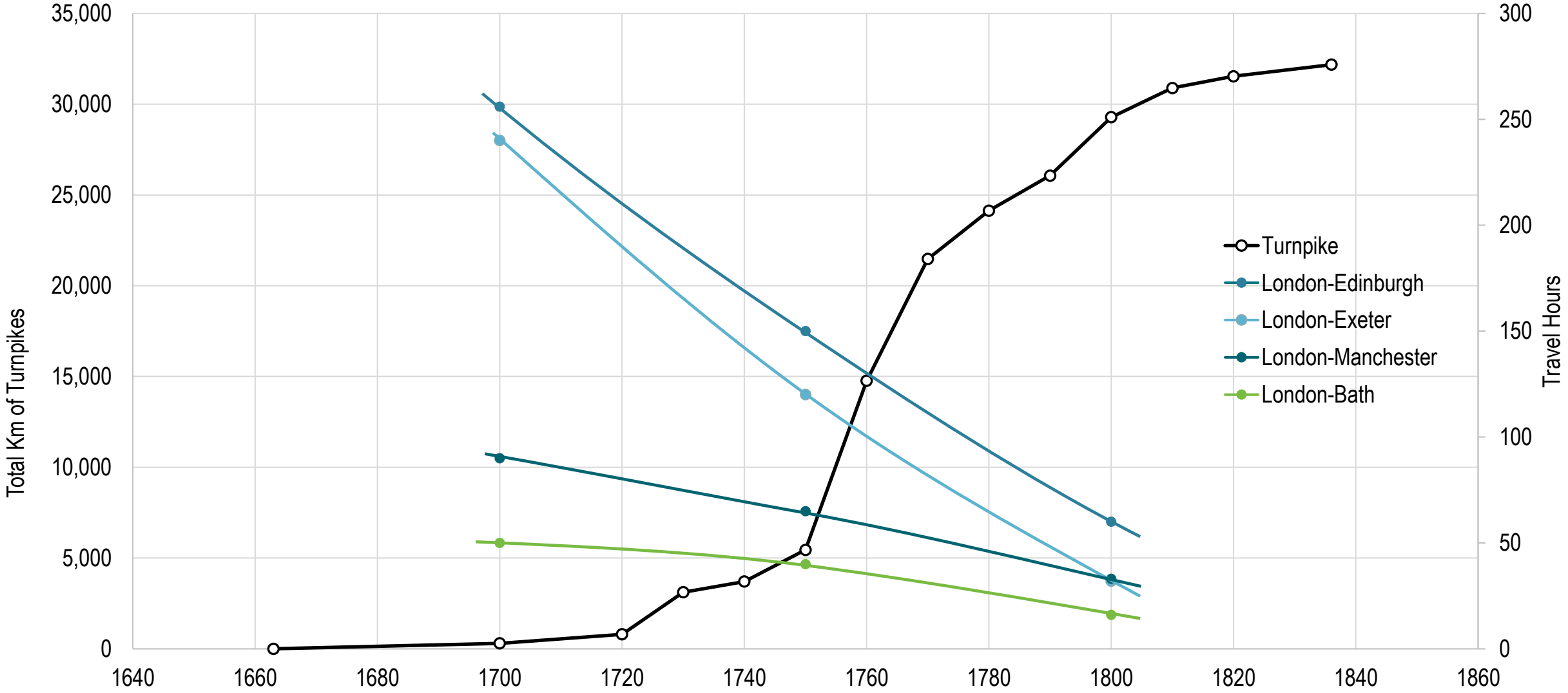


Table 1. Travel times from London 1700–1800 (in hours)

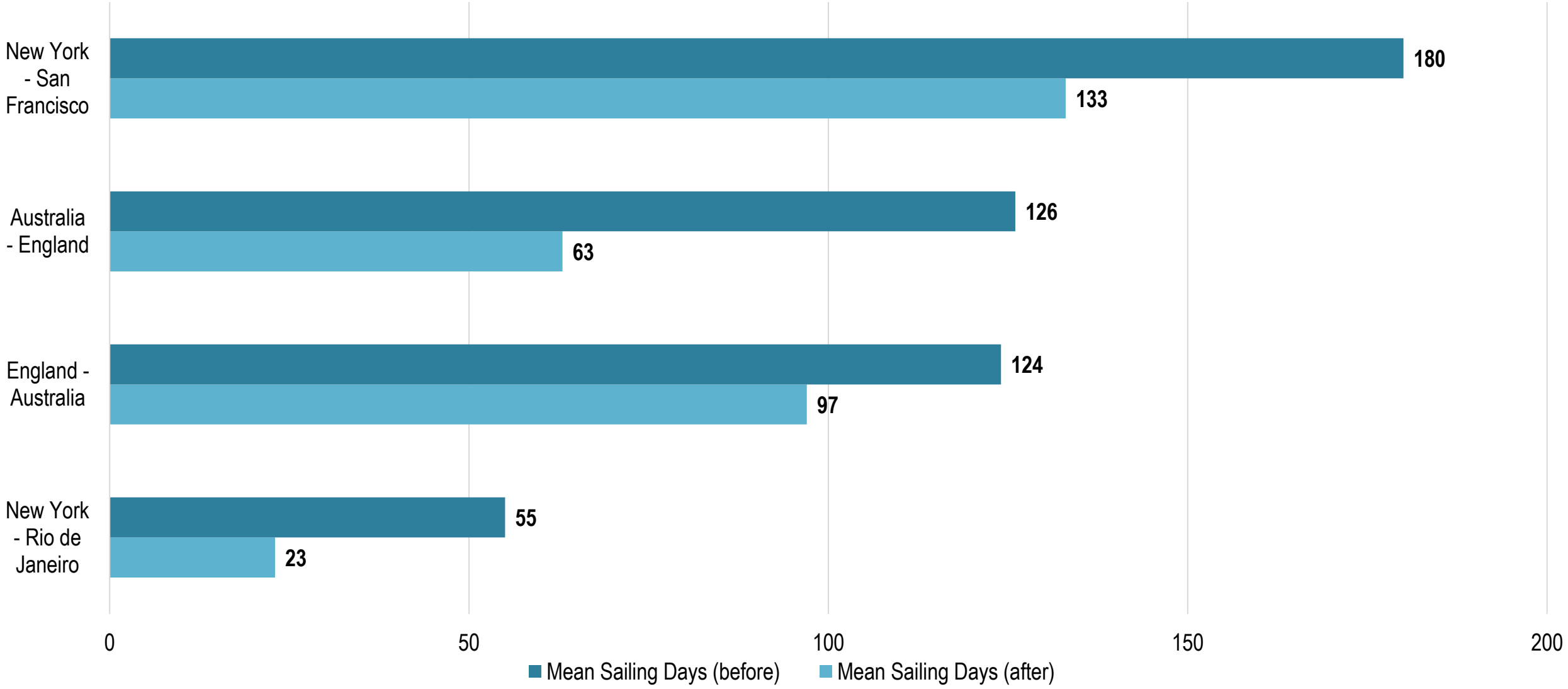
	1700	1750	1800
Bath	50	40	16
Edinburgh	256	150	60
Exeter	240	120	32
Manchester	90	65	33

Major Canals Built

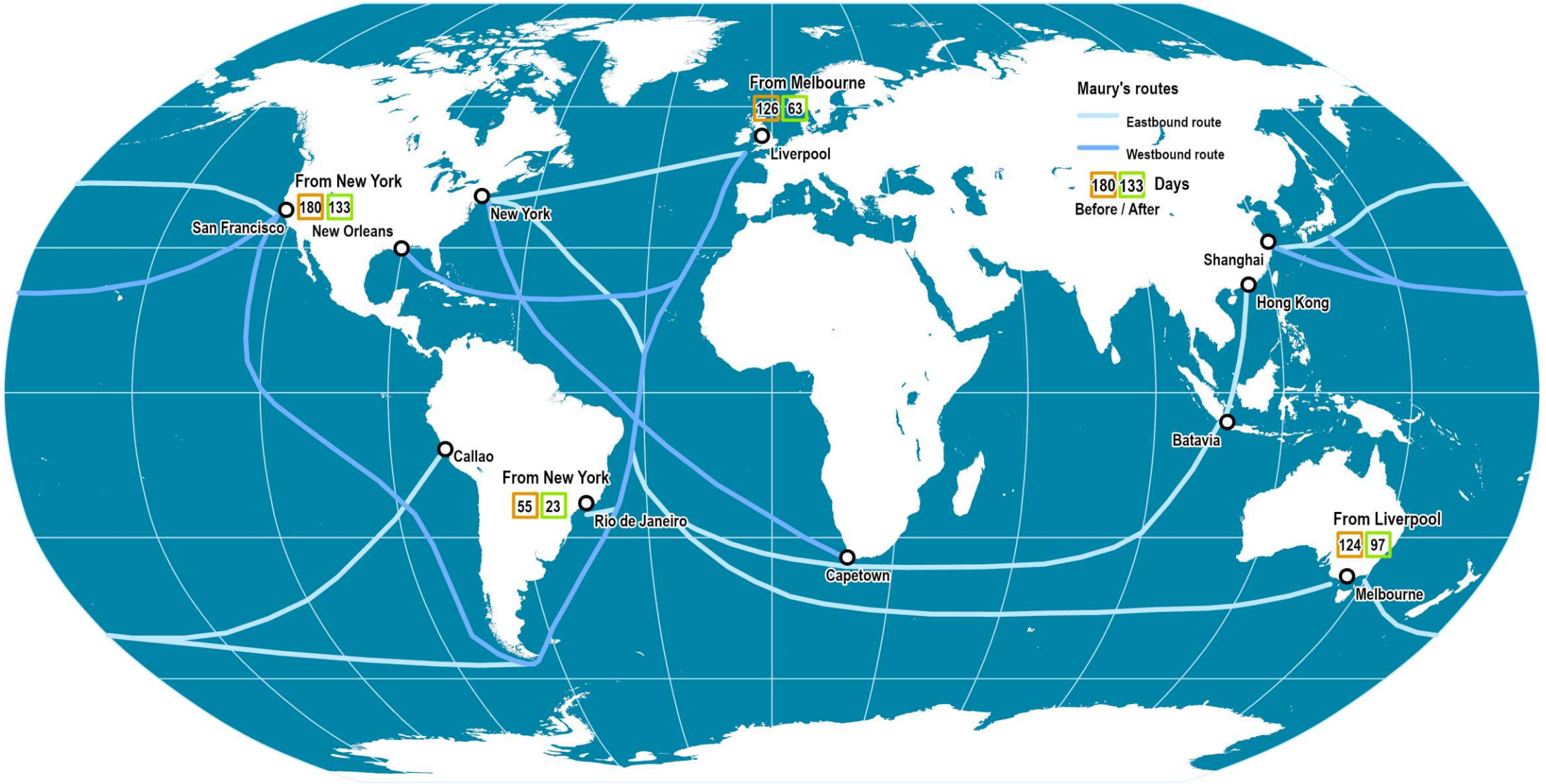
540-1320	Grand Canal	Beijing – Hangzhou (2,500 km)
11th Century	Naviglio Grande	Milan – Adriatic (30 km)
1390-97	Stecknitz Canal	Elbe – Trave (11 km)
1604-42	Briare Canal	Seine – Loire (58 km)
1667-81	Canal du Midi	Garonne – Mediterranean (279 km)
1732	Ladoga canal	St. Petersburg – Volga (110 km)
1759-61	Bridgewater Canal	Worsley – Manchester (16 km)
1784-1833	Rhine-Rhone canal	Strasburg-Mulhouse-Burgundy (319 km)
1810-24	North Sea canal	Amsterdam – North Sea (20 km)
1817-25	Erie canal	Buffalo – Albany (544 km)
1836-45	Ludwigskanal	Main – Danube (172 km)
1838-54	Rhine – Marne canal	Saverne gap (314 km)
1859-69	Suez canal	Mediterranean – Red Sea (112 km)
1894	Manchester Ship Canal	Manchester – Liverpool (64 km)
1887-95	Kiel canal	Baltic Sea – North Sea (99 km)
1906-14	Panama canal	Atlantic Ocean – Pacific Ocean (80 km)
1905-38	Mittellandkanal	Rhine – Elbe (320 km)

Major Canals Built in the 19th Century, American Northeast

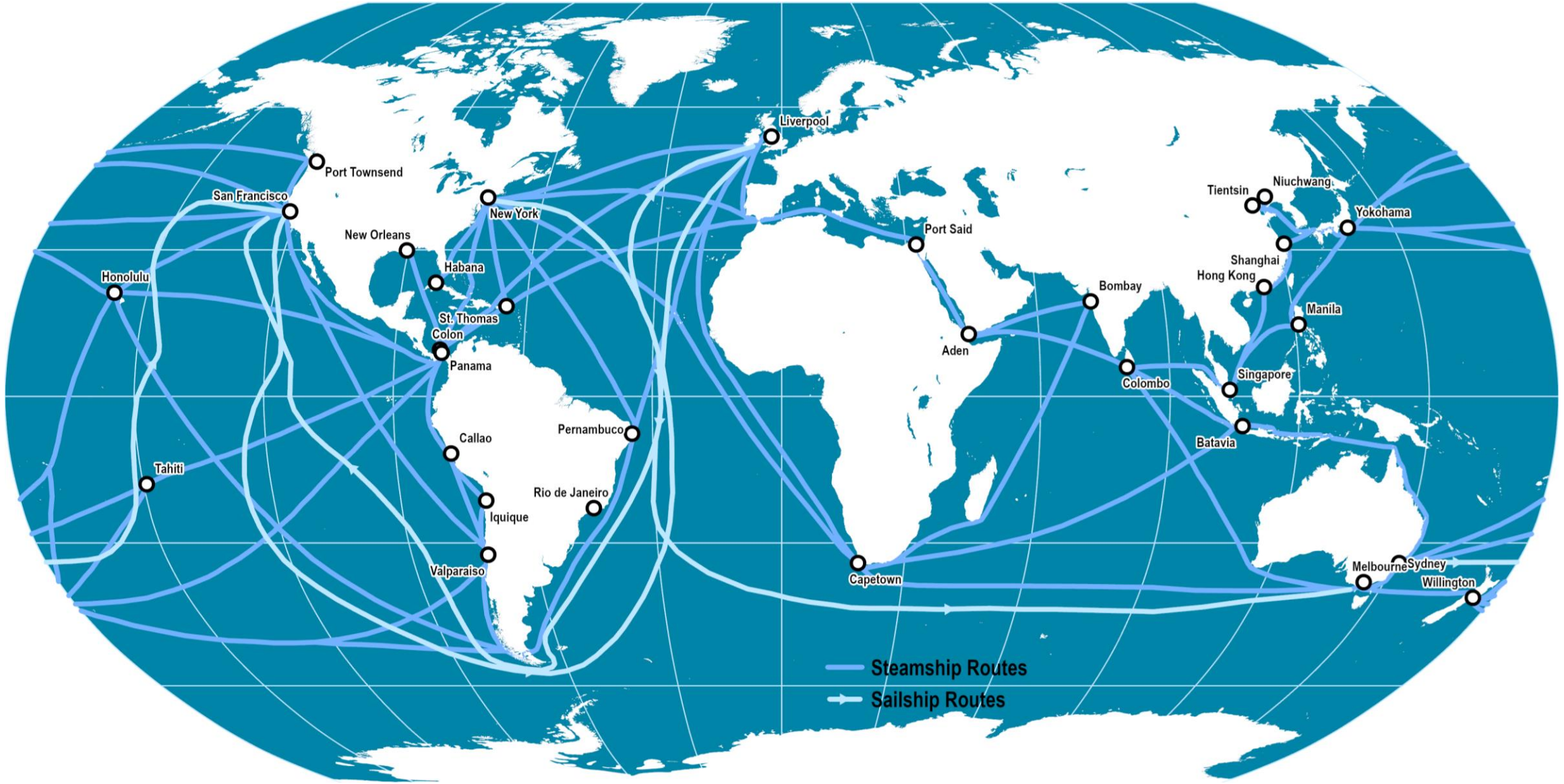
Impacts of Maury's Navigation Charts on Sailing Time, 1850s



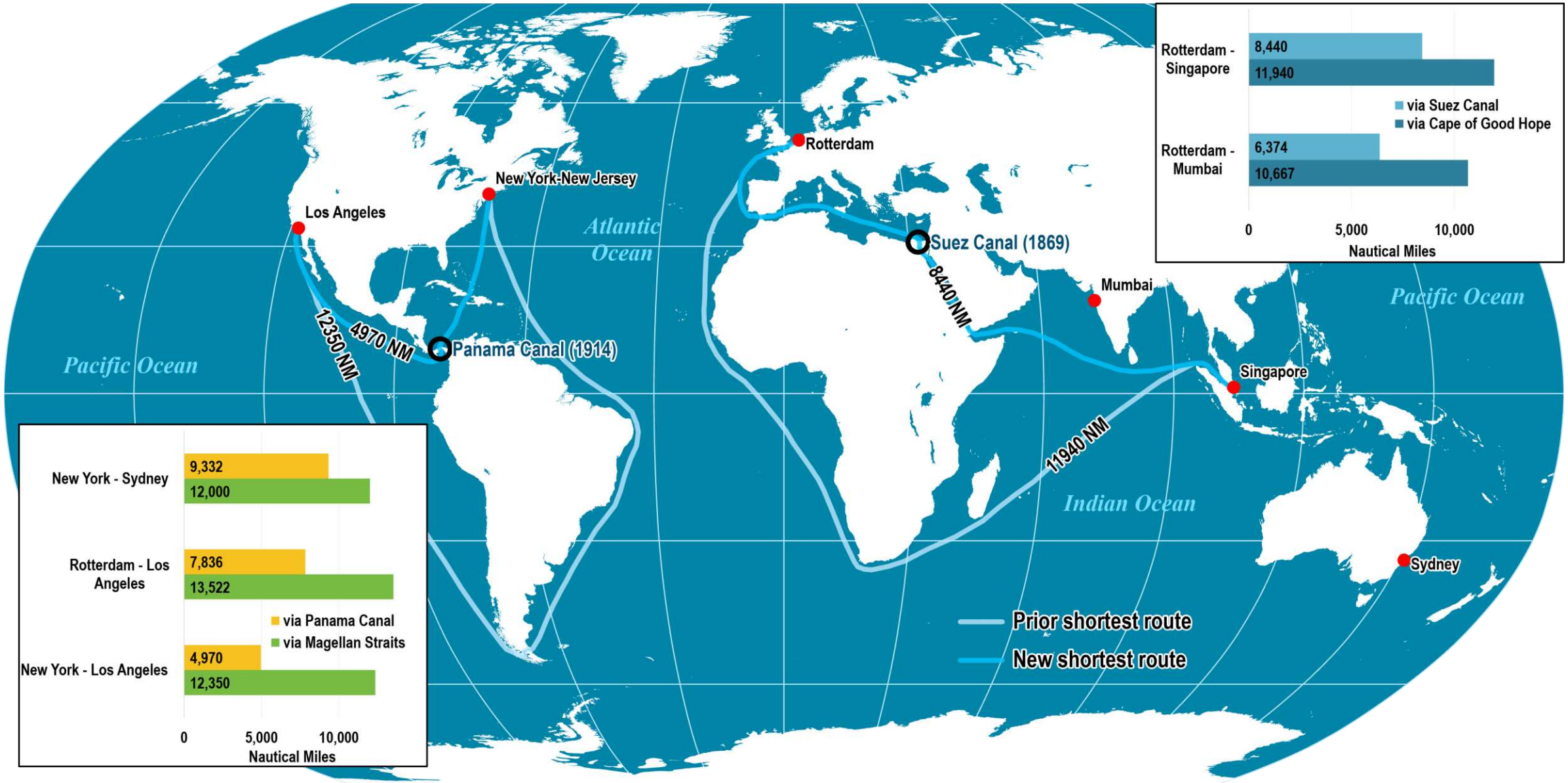
Impacts of Maury's Navigation Charts on Sailing Time, 1850s



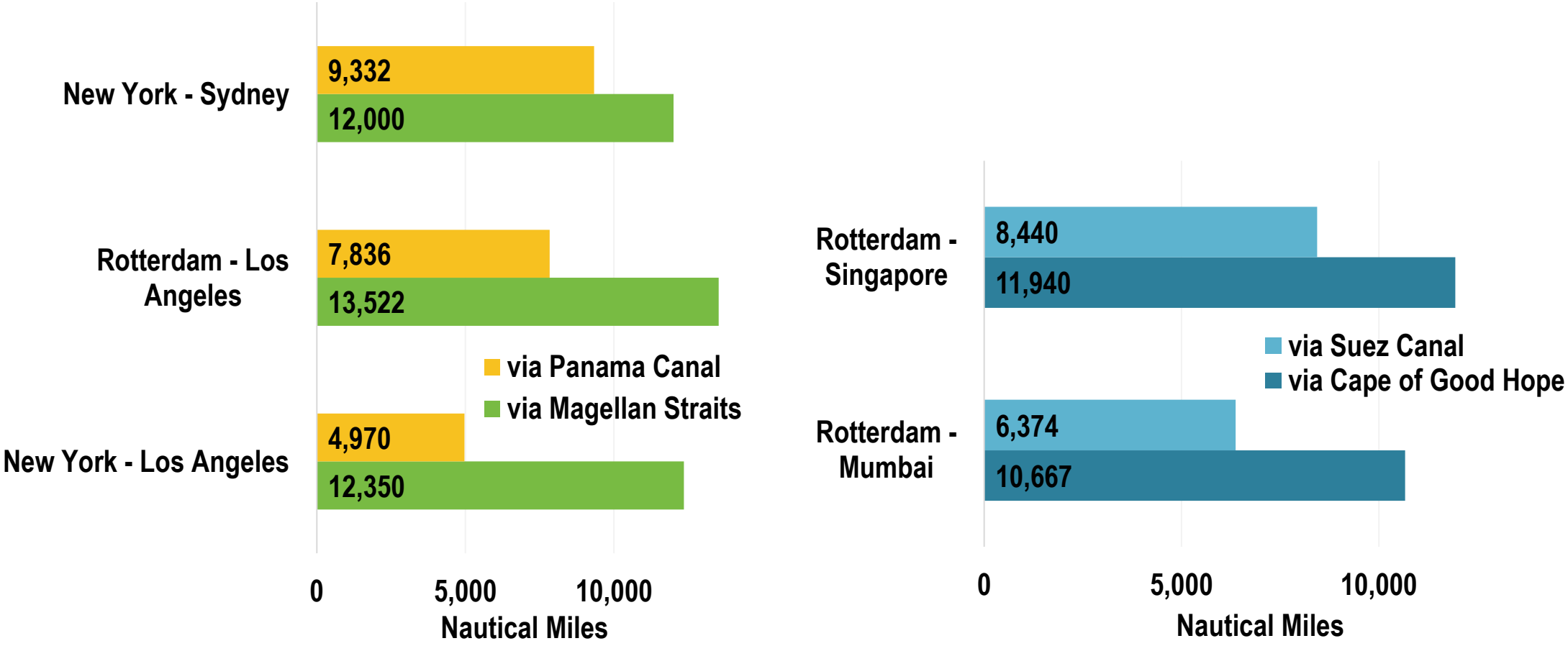
World Maritime Trade Routes, 1912



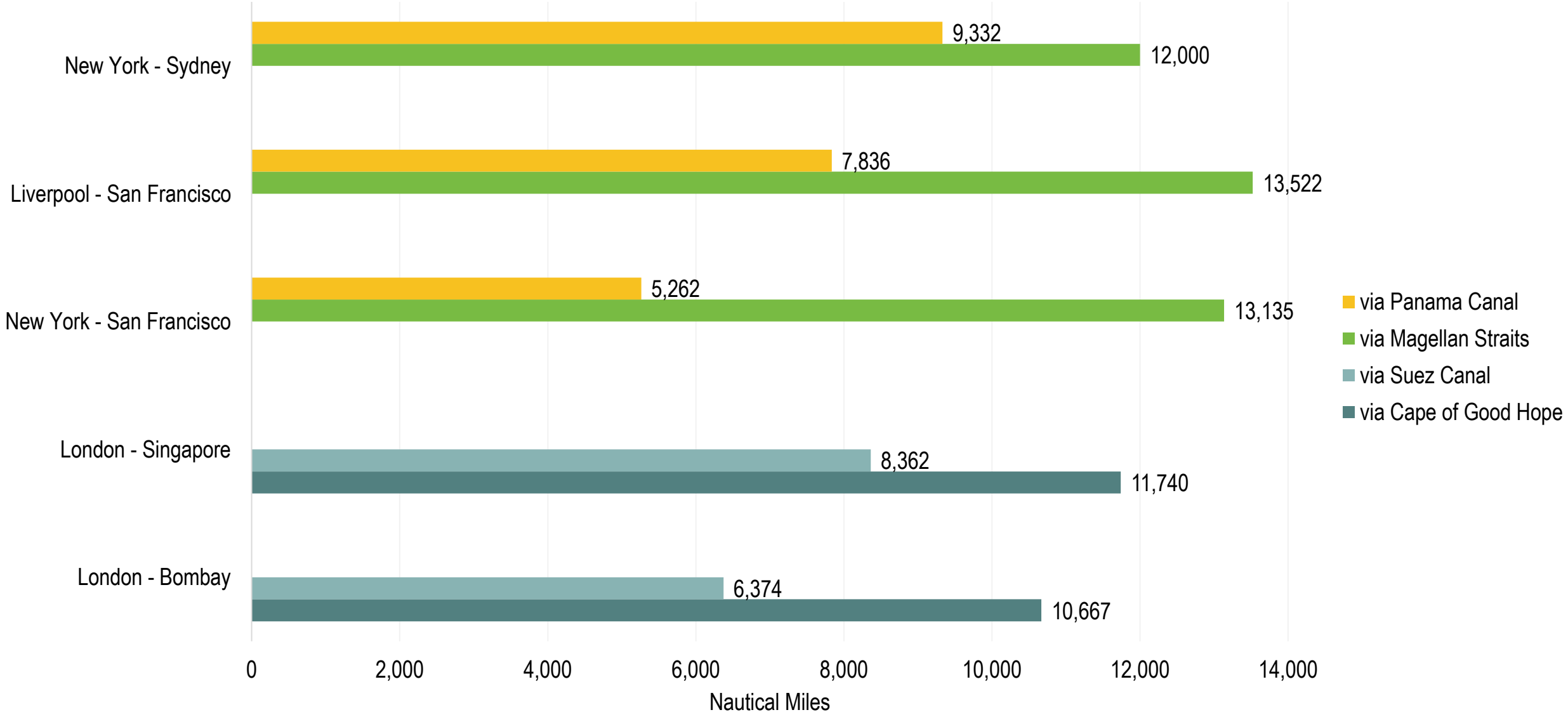
Geographical Impacts of the Suez and Panama Canals



Effects of the Suez and Panama Canals on Travel Distances

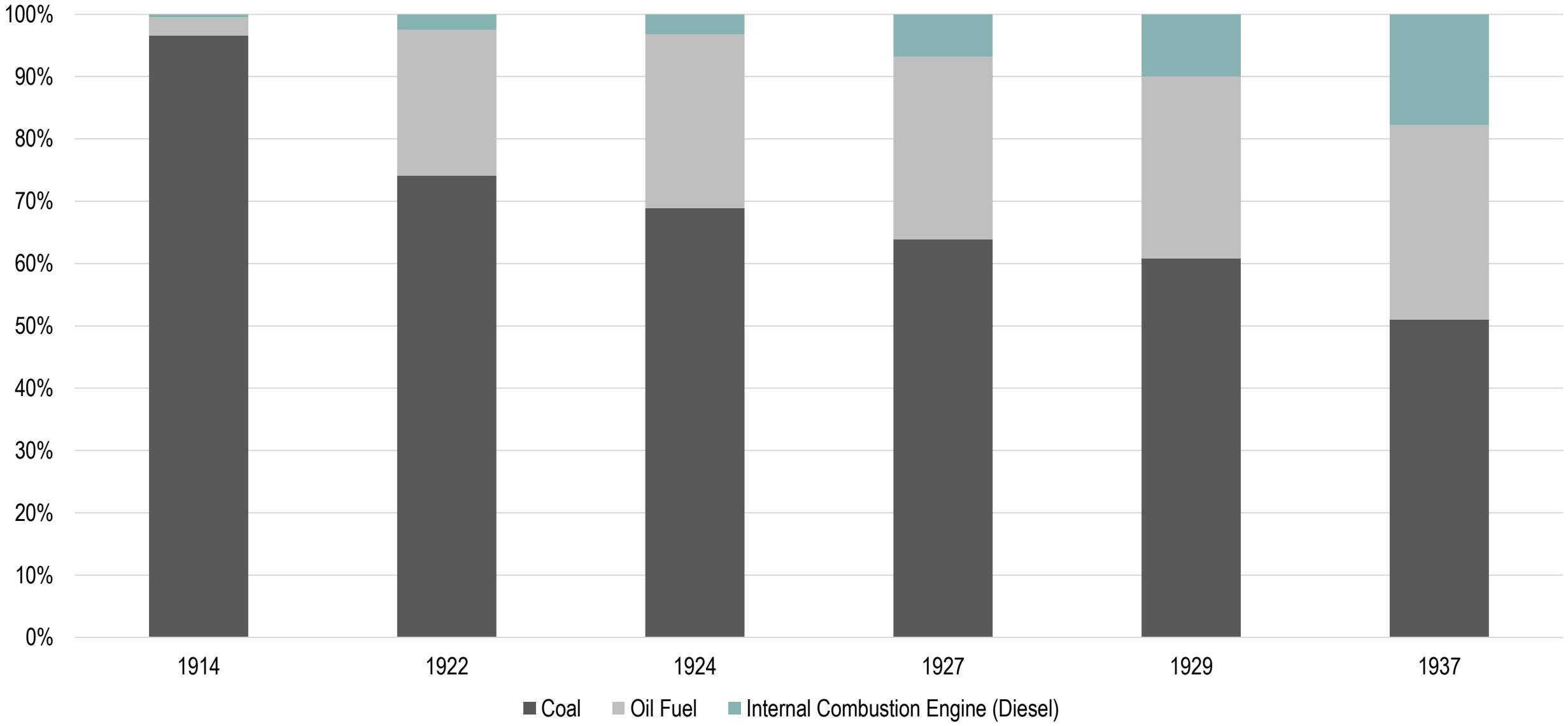


Effects of the Suez and Panama Canals on Travel Distances

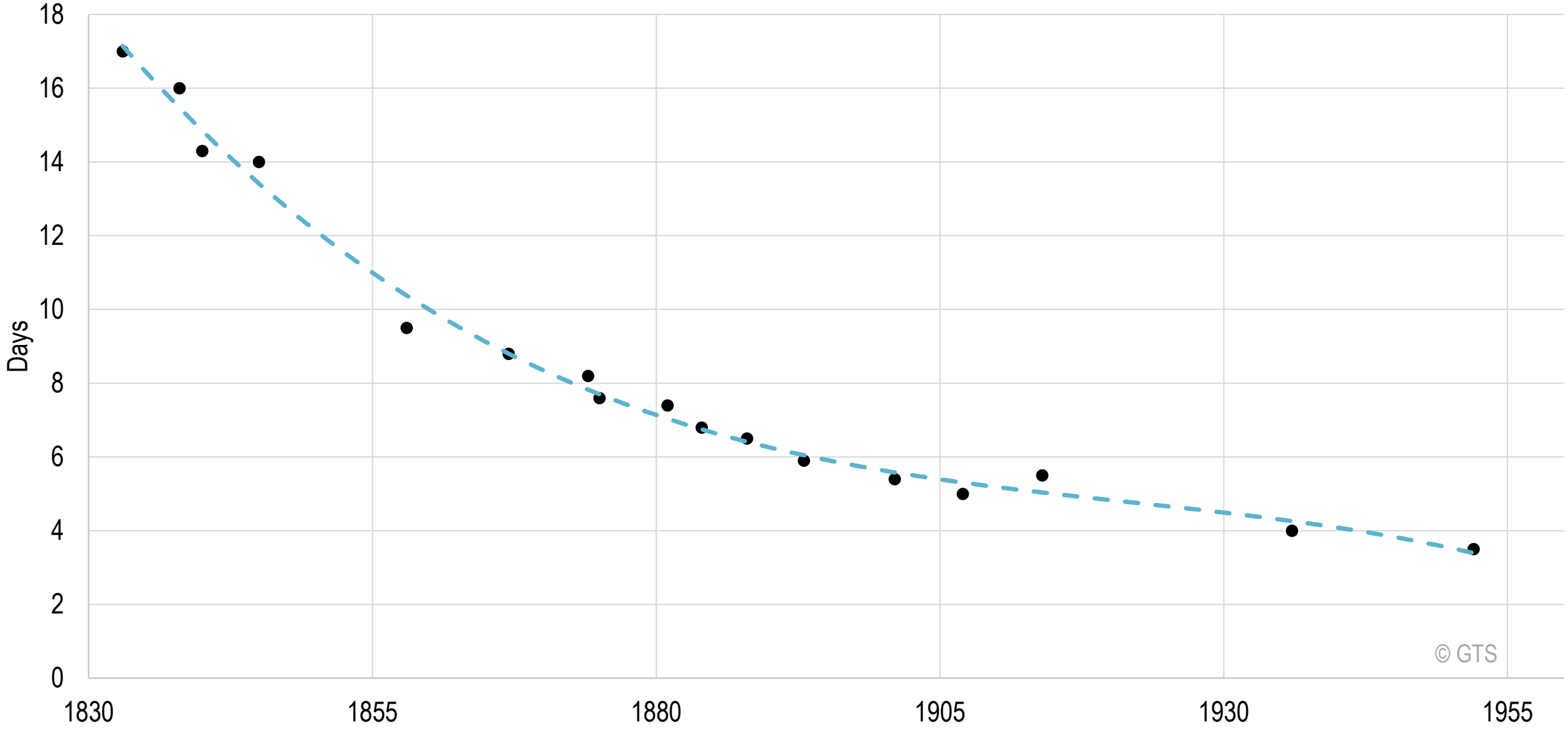


Break-Even Distance between Sail and Steam, 1850-1890

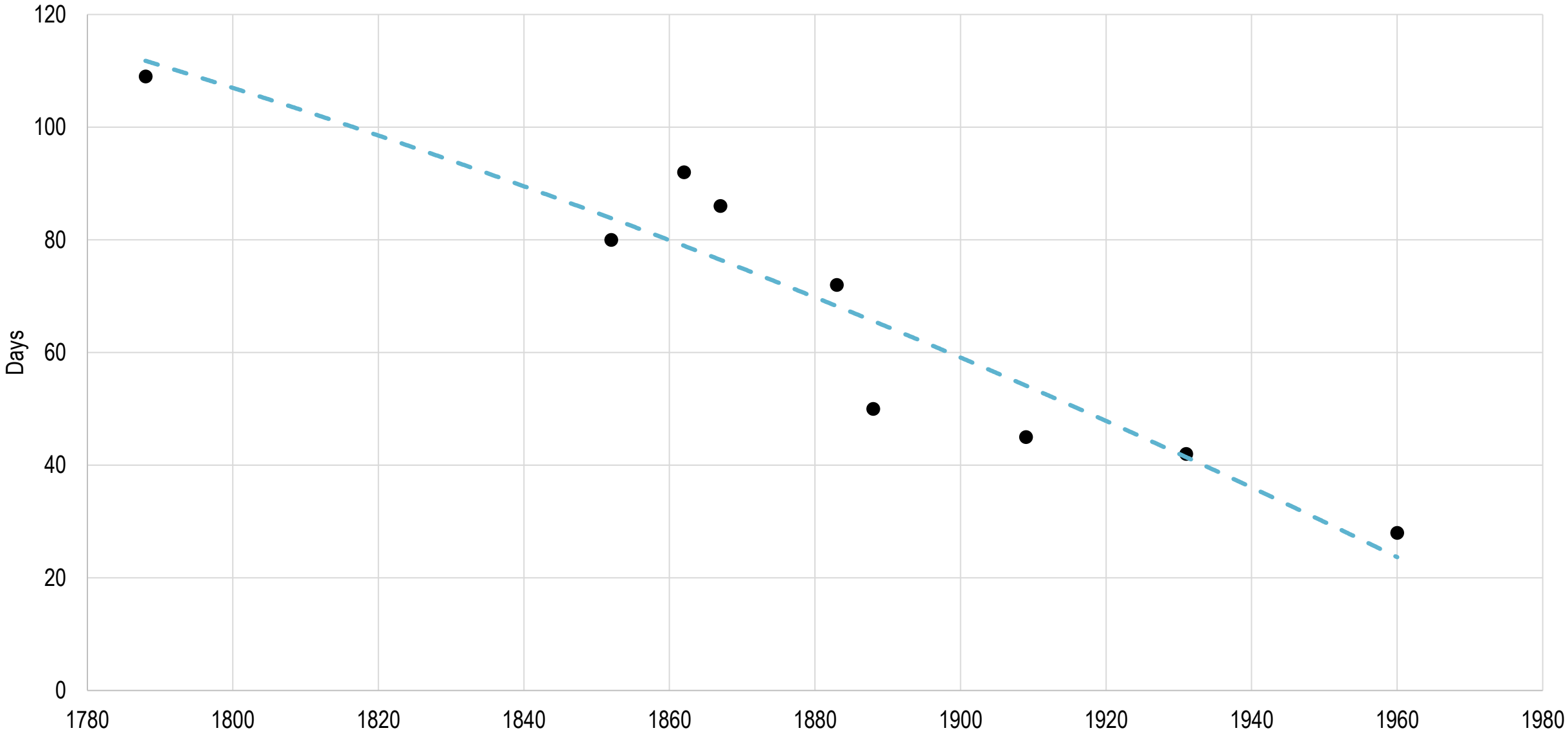
World Merchant Fleet by Motive Power, 1914-1937



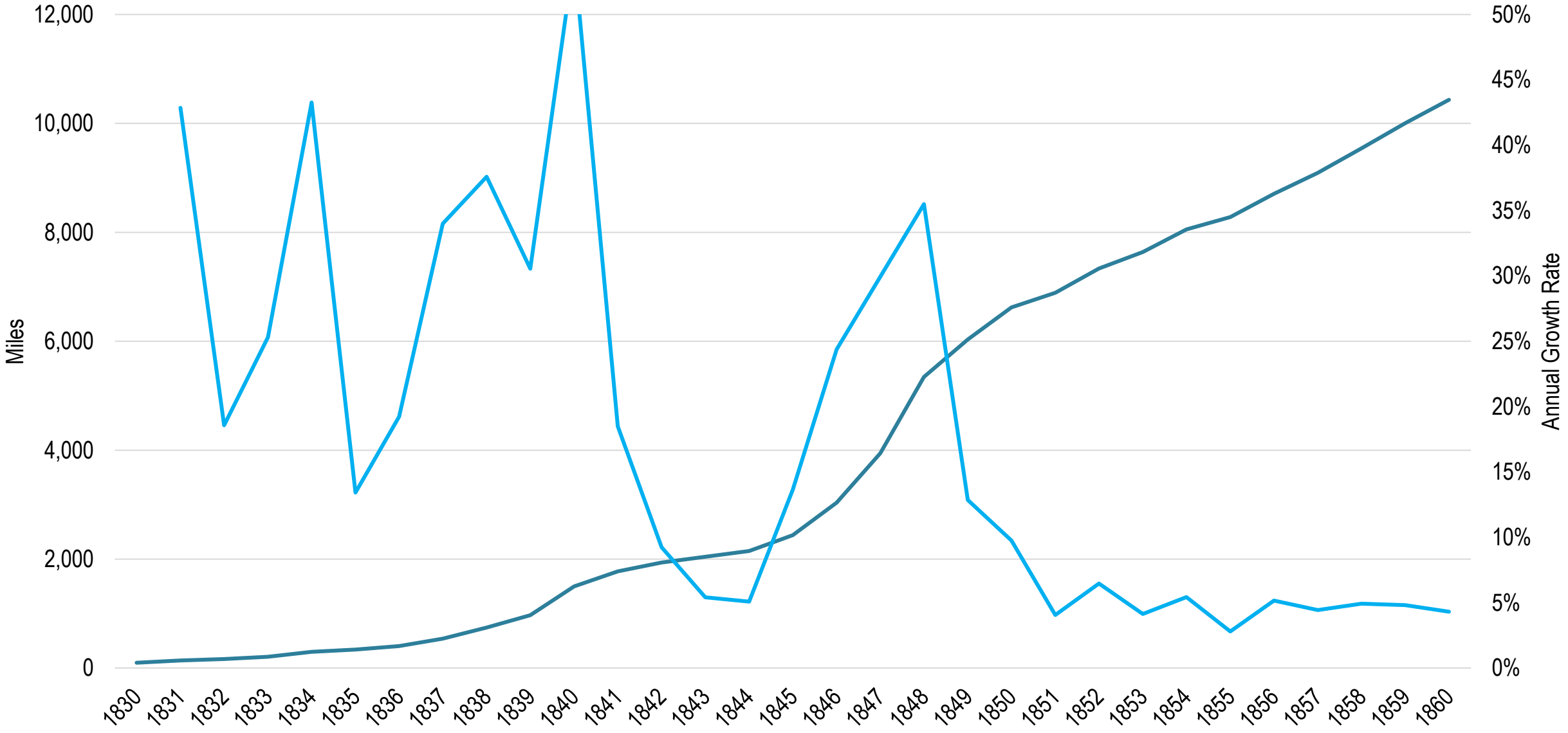
Liner Transatlantic Crossing Times, 1833 – 1952 (in days)



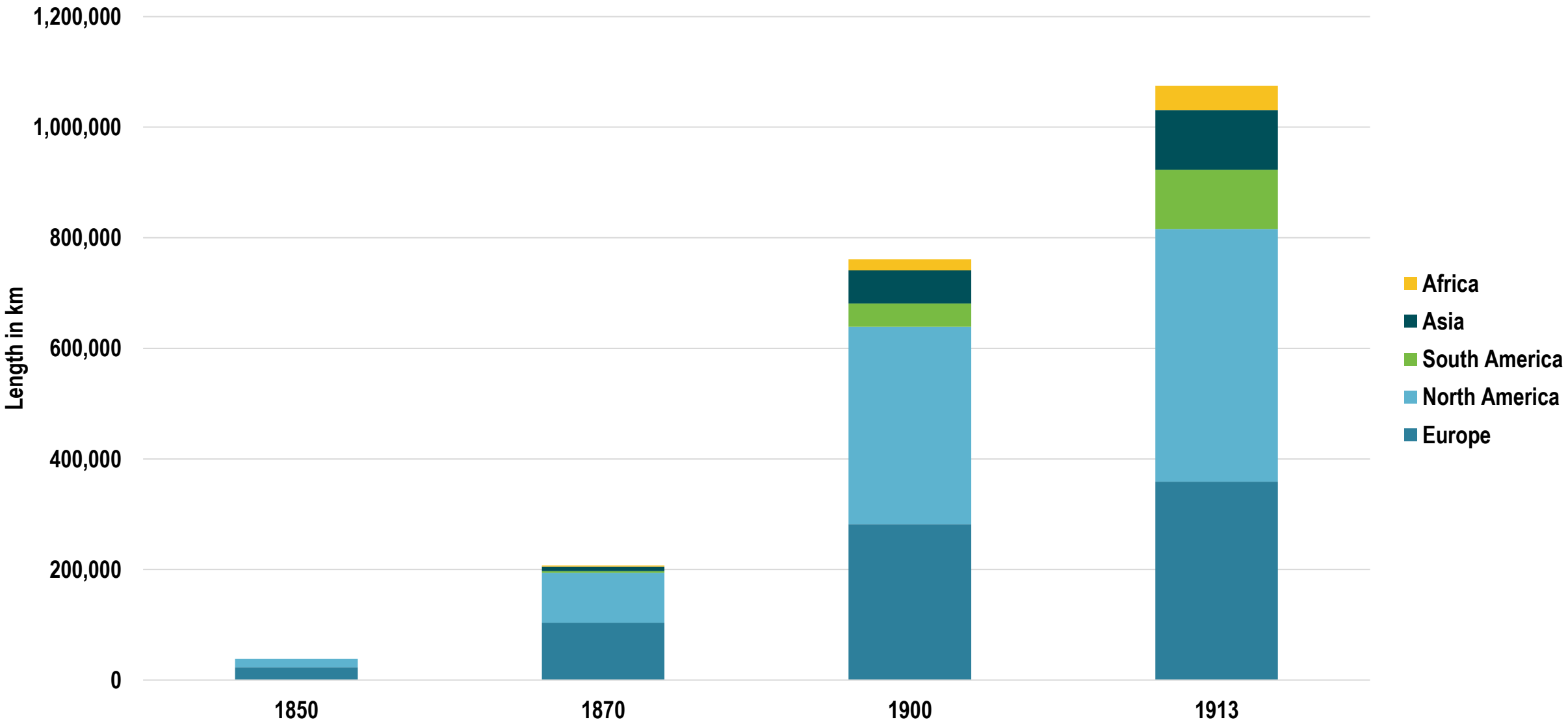
Maritime Journey from Britain to Australia, 1788-1960



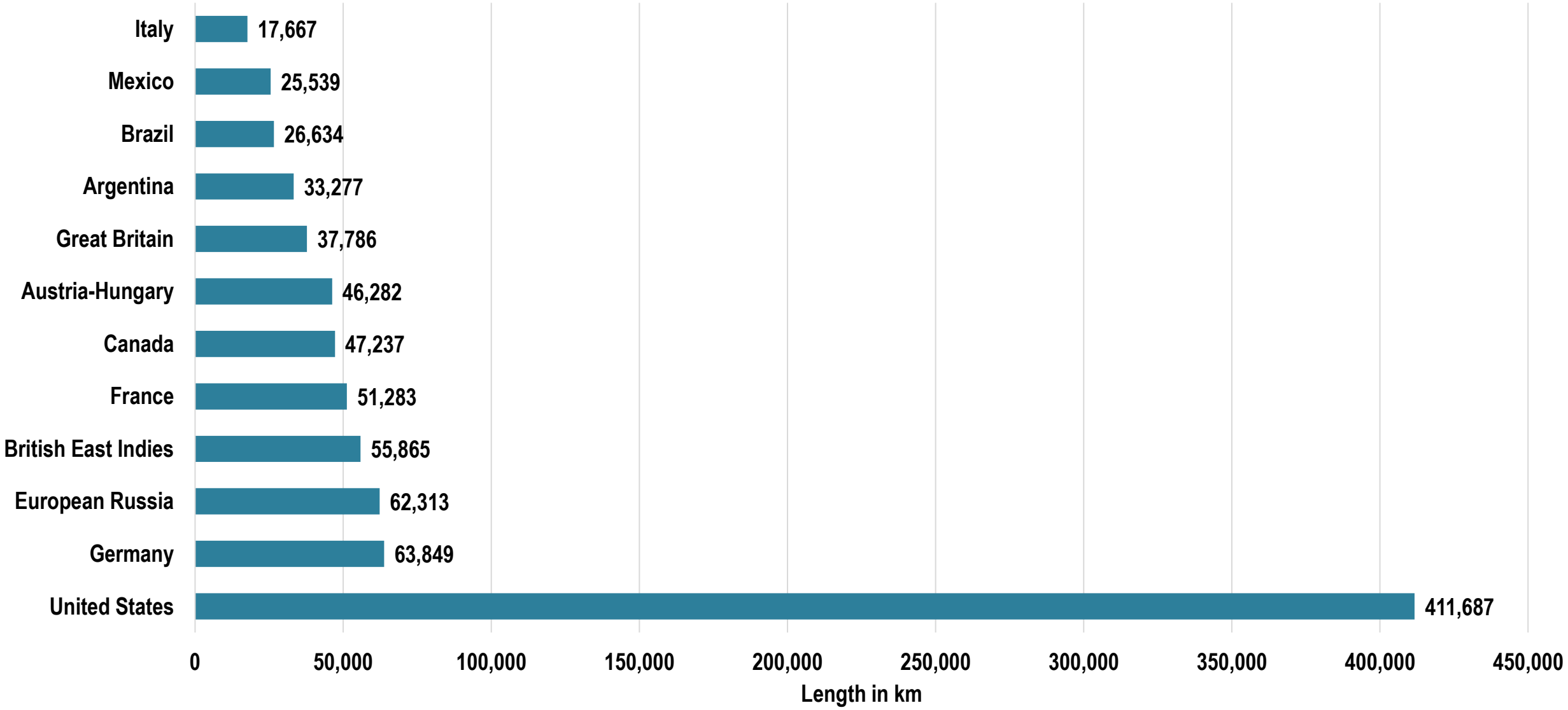
Length of the British Railway System, 1830-1860



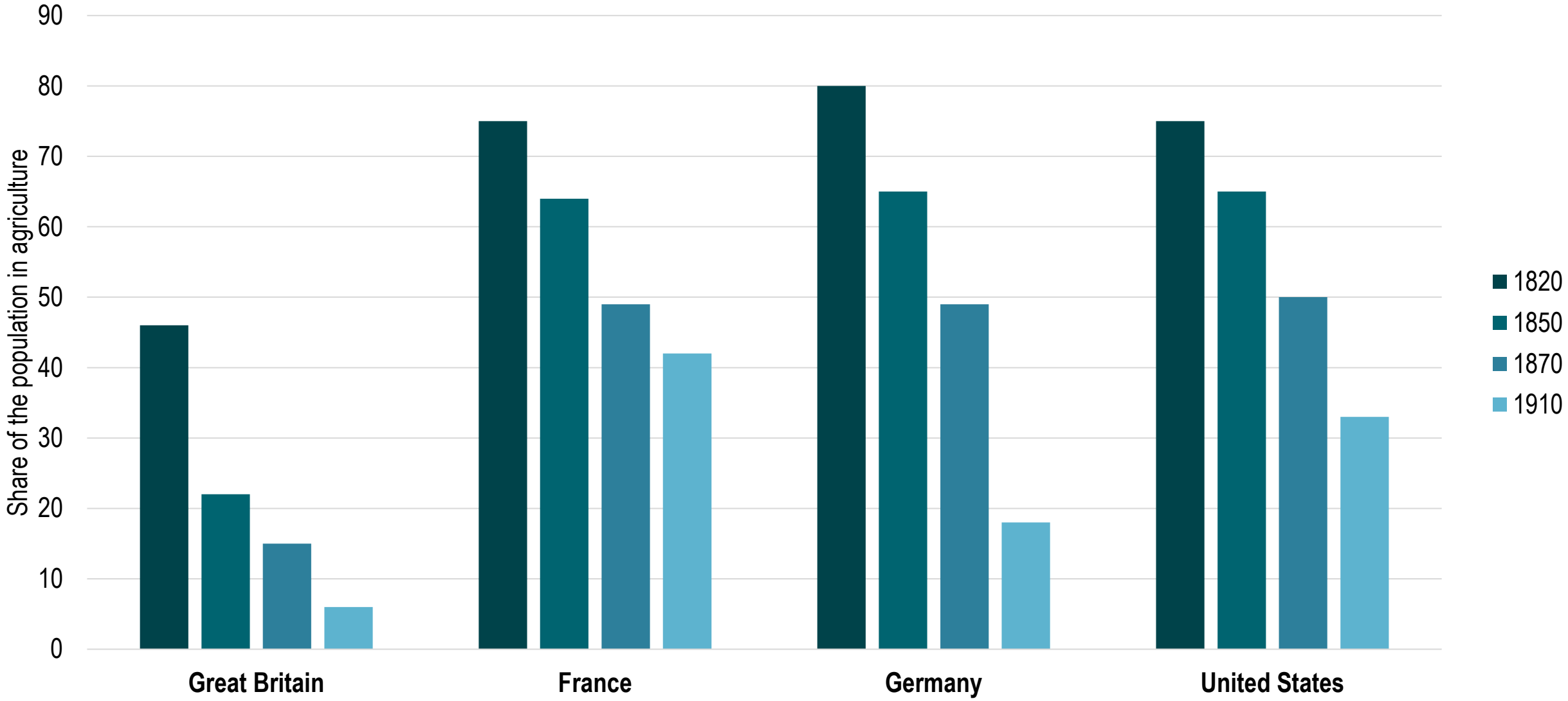
Evolution of the World Railway Network, 1850-1913



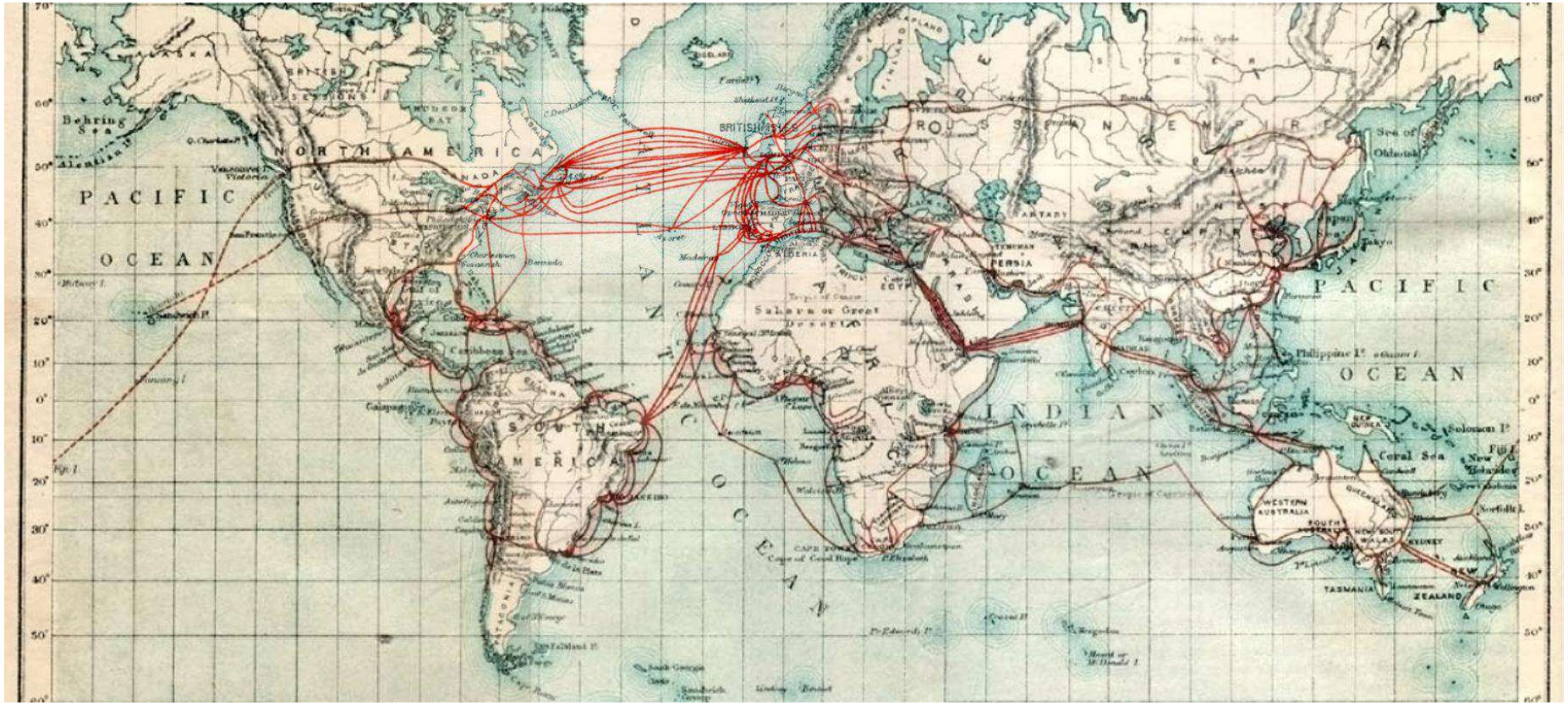
Length of the World's Largest Railway Systems, 1913



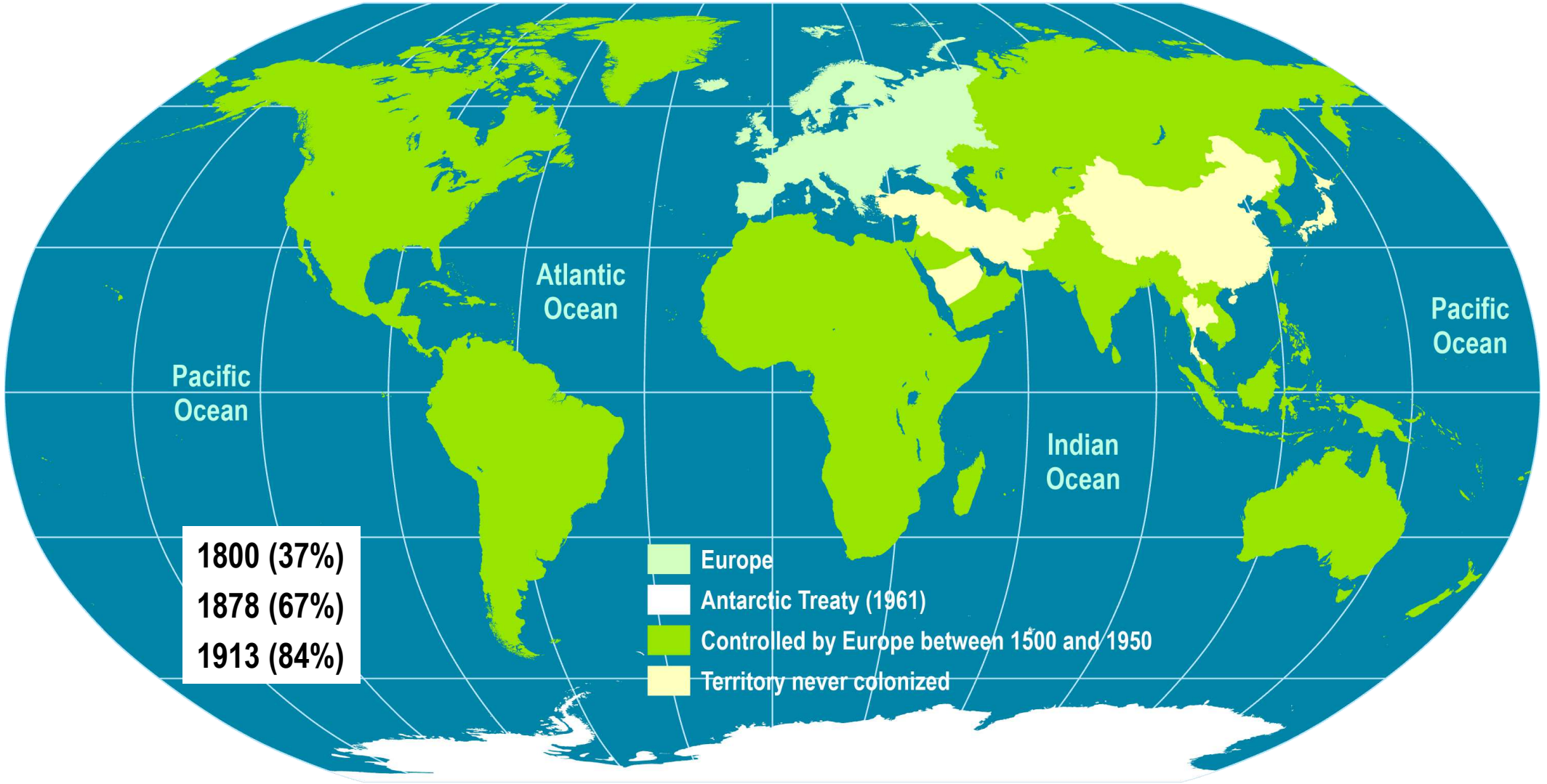
Share of the Population in Agriculture, Early Industrial Countries, 1820-1910



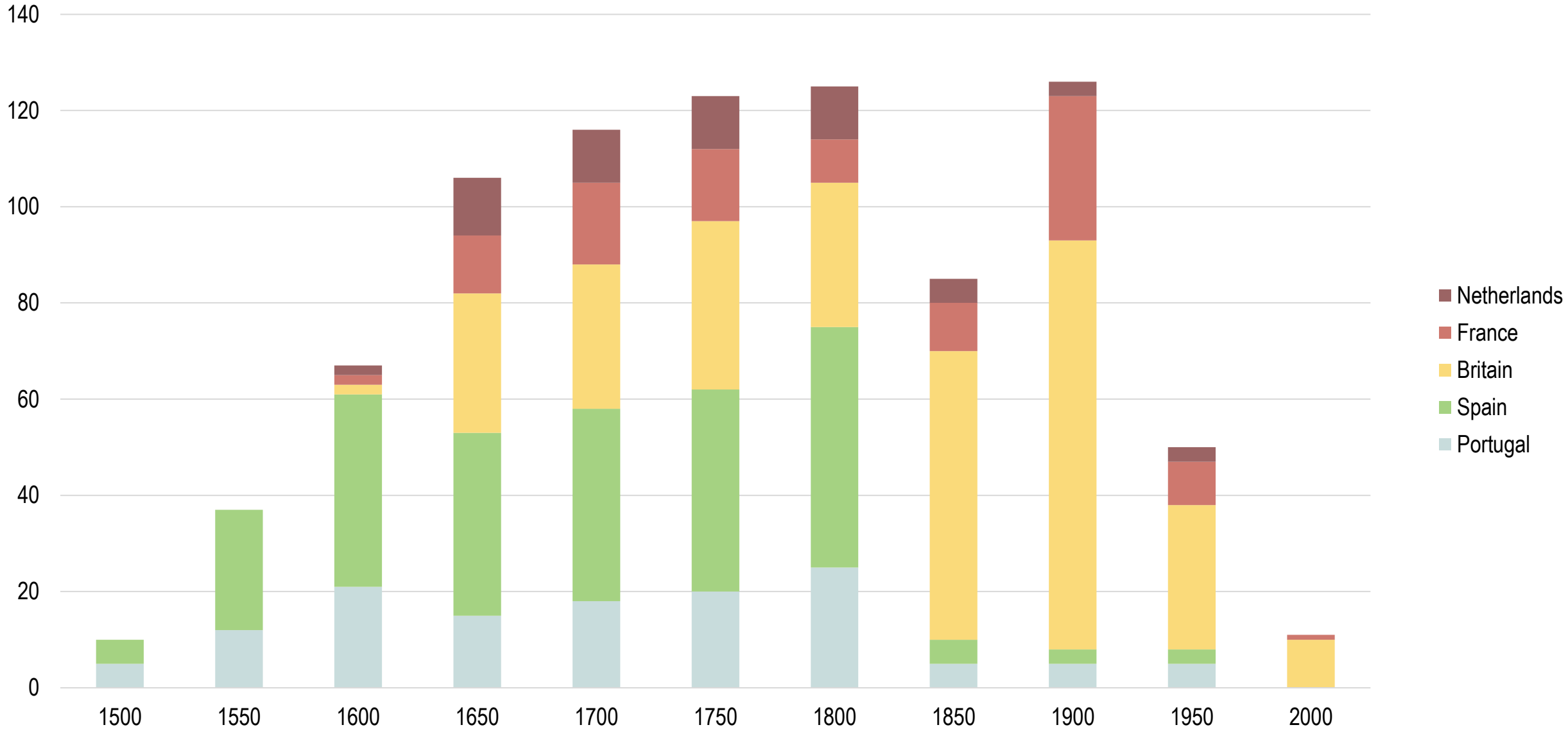
Global Telegraph System, c1901 (the Victorian Internet)



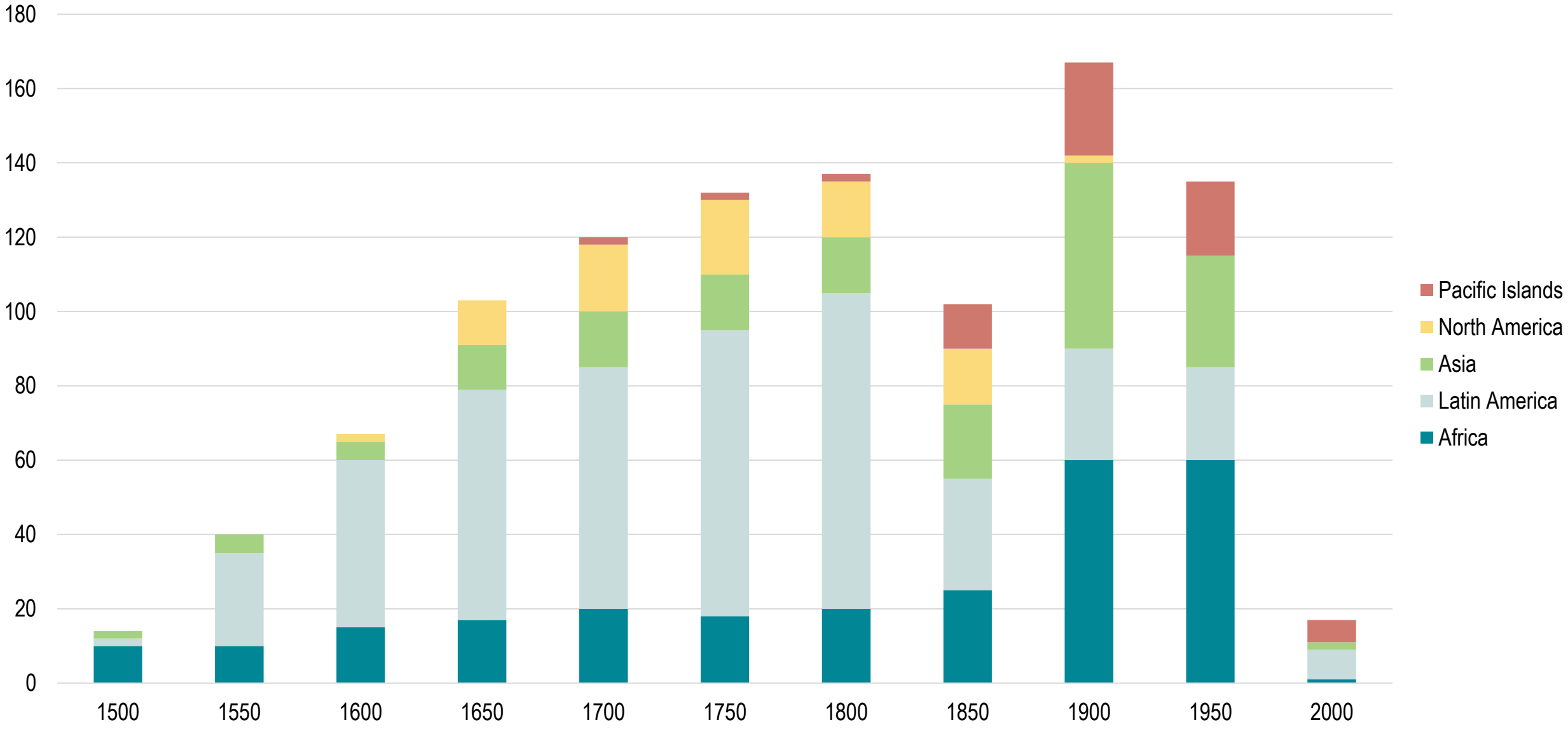
European Control of the World, 1500-1950

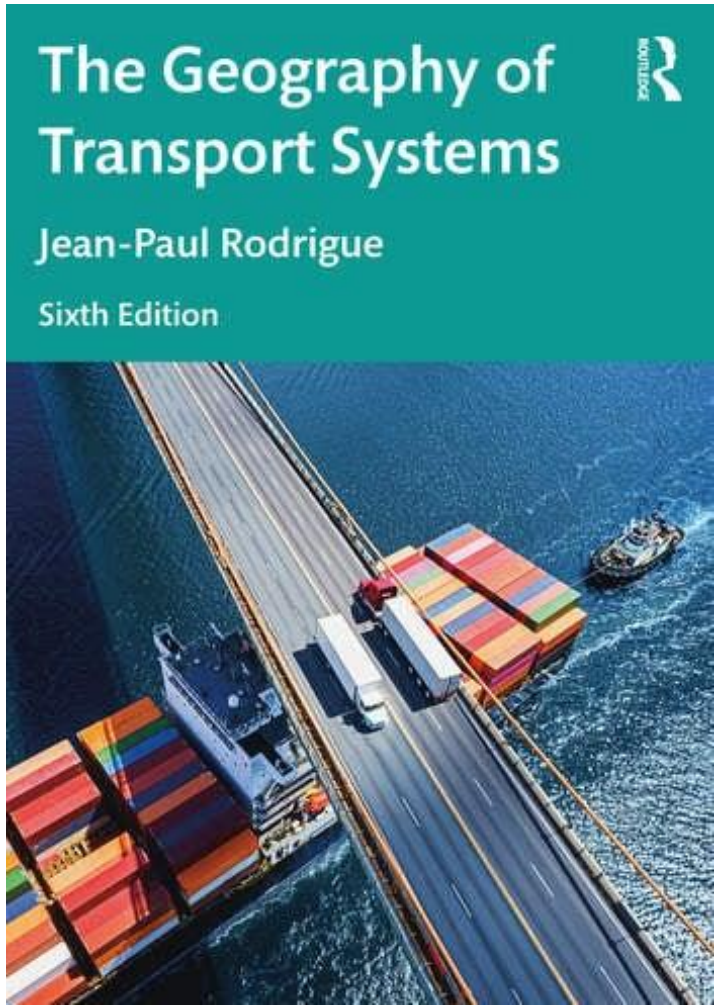


Colonies Controlled by Main Colonial Powers, 1500-2000



Colonies by Main World Region, 1500-2000

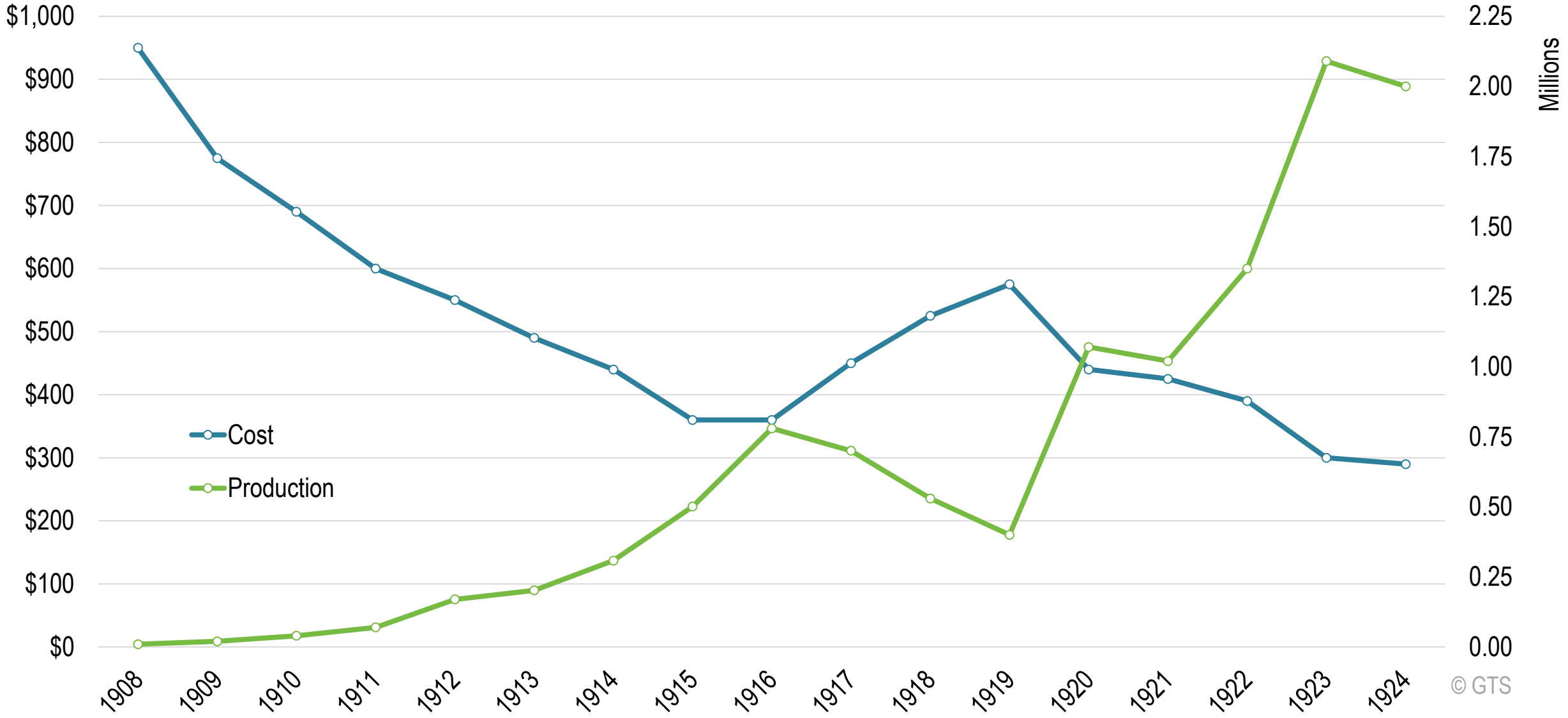




The Setting of Global Transportation Systems

Chapter 1.3

Cost and Production of Ford Vehicles, 1908-1924



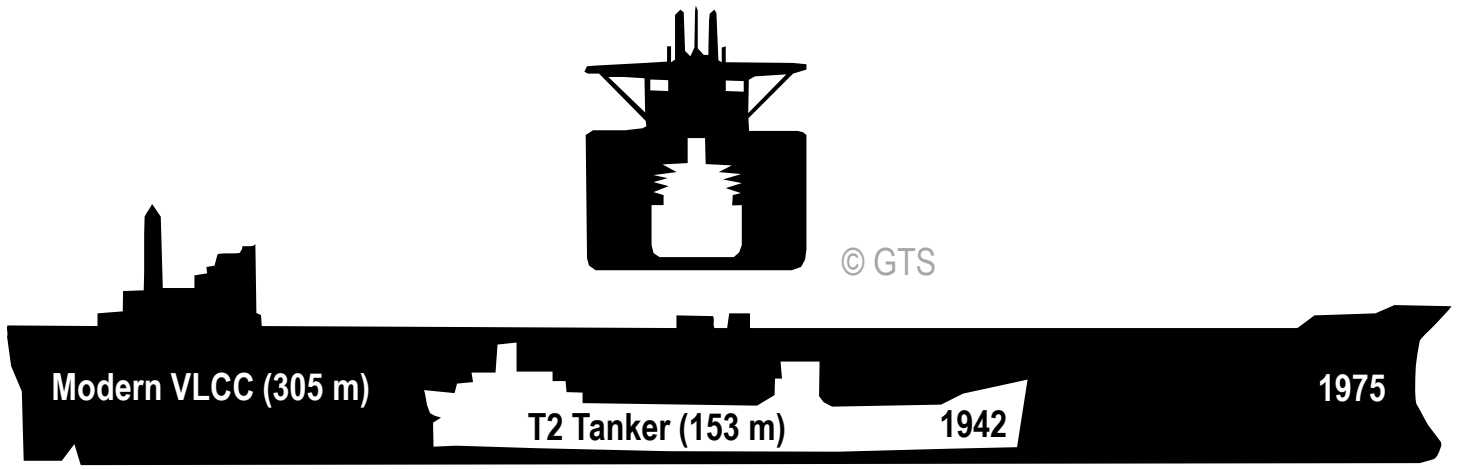
United States Maritime Commission Cargo Ships, 1938-1947

Type	Function	Period	Total constructed	Length (feet)	Beam (feet)	Deadweight tonnage
C-1	Small cargo	1940-1945	173	418	60	8,075
C-2	General cargo	1938-1945	173	460	63	8,794
C-3	General cargo	1940-1947	465	492	70	12,500
C-4	General cargo; Troop ship	1941-1946	75	523	72	6,100
EC-2	Emergency cargo; Liberty ship	1941-1945	2,710	442	57	10,419
VC-2	General cargo; Victory ship	1944-1946	534	455	62	10,734
T-2	Tanker	1940-1945	536	524	68	16,400
T-3	Tanker	1939-1946	63	553	75	18,400

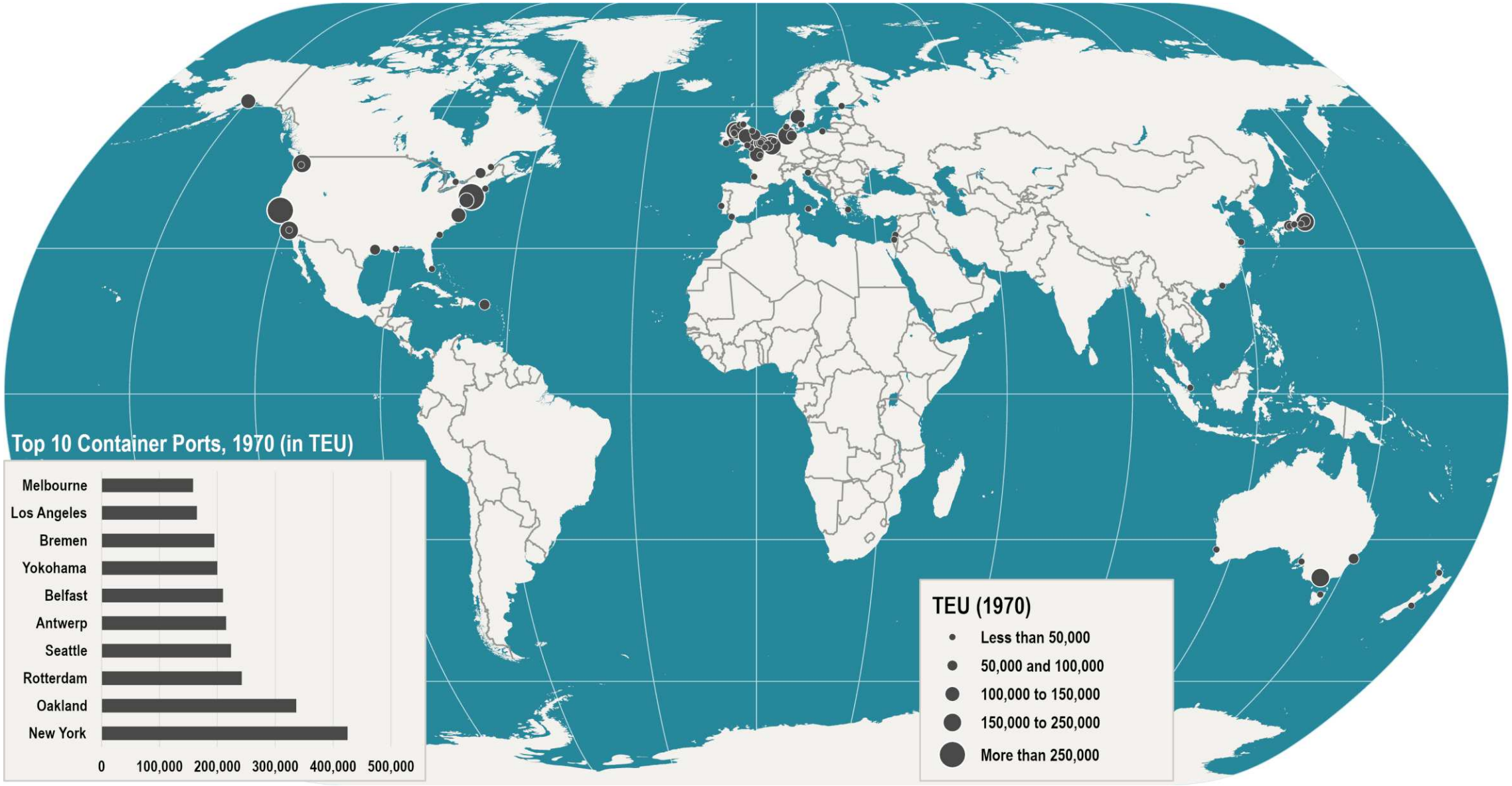
United States Maritime Commission Cargo Ships, 1938-1947

Type	Function	Period	# Constructed	Length (m)	Beam (m)	DWT
C-1	Small cargo	1940-45	173	127	18	8,075
C-2	General cargo	1938-45	173	140	19	8,794
C-3	General cargo	1940-47	465	150	21	12,500
C-4	General cargo; Troop ship	1941-46	75	159	22	6,100
EC-2	Emergency cargo; Liberty ship	1941-45	2,720	134	17	10,419
VC-2	General cargo; Victory ship	1944-46	534	138	19	10,734
T2	Tanker	1940-45	536	160	21	16,400
T3	Tanker	1939-46	63	159	23	18,400

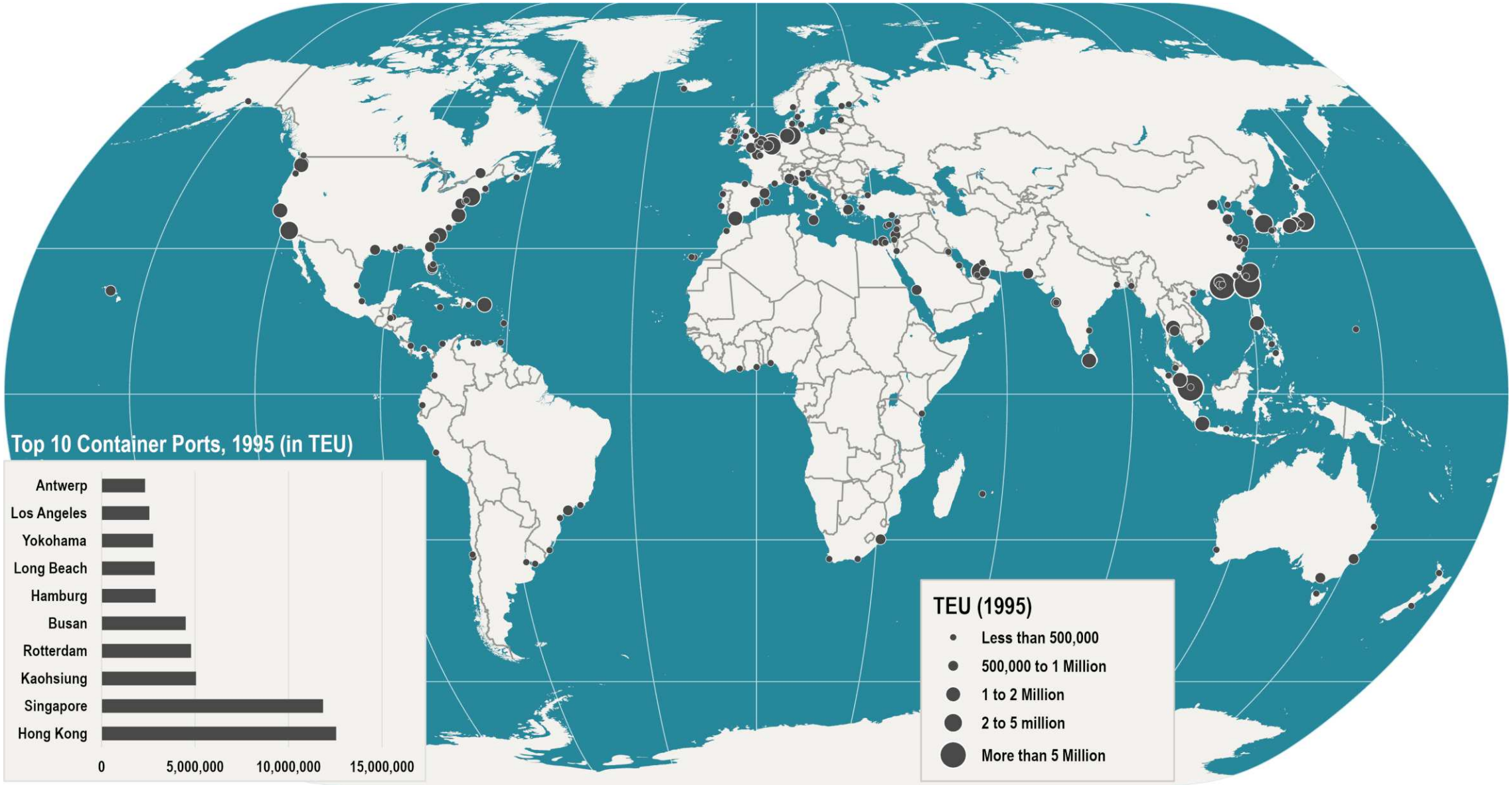
Comparison between a Contemporary and Second World War Tanker



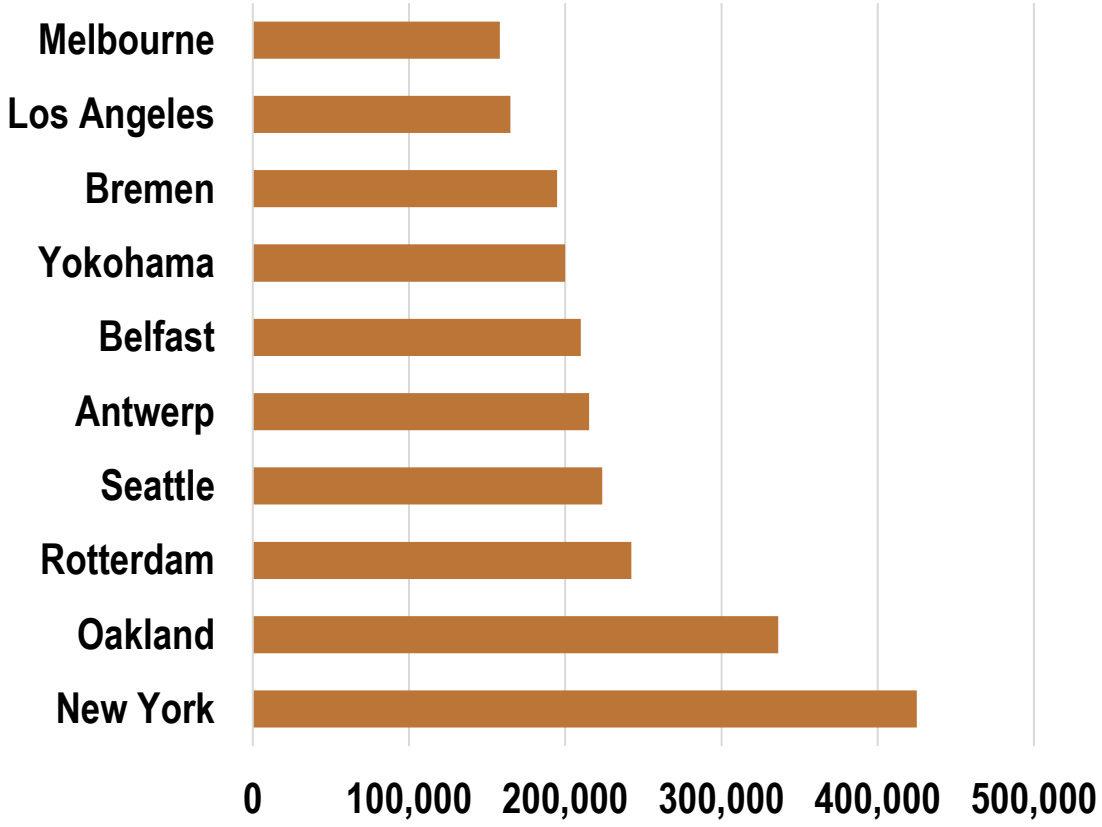
The Dawn of Containerization: 1970

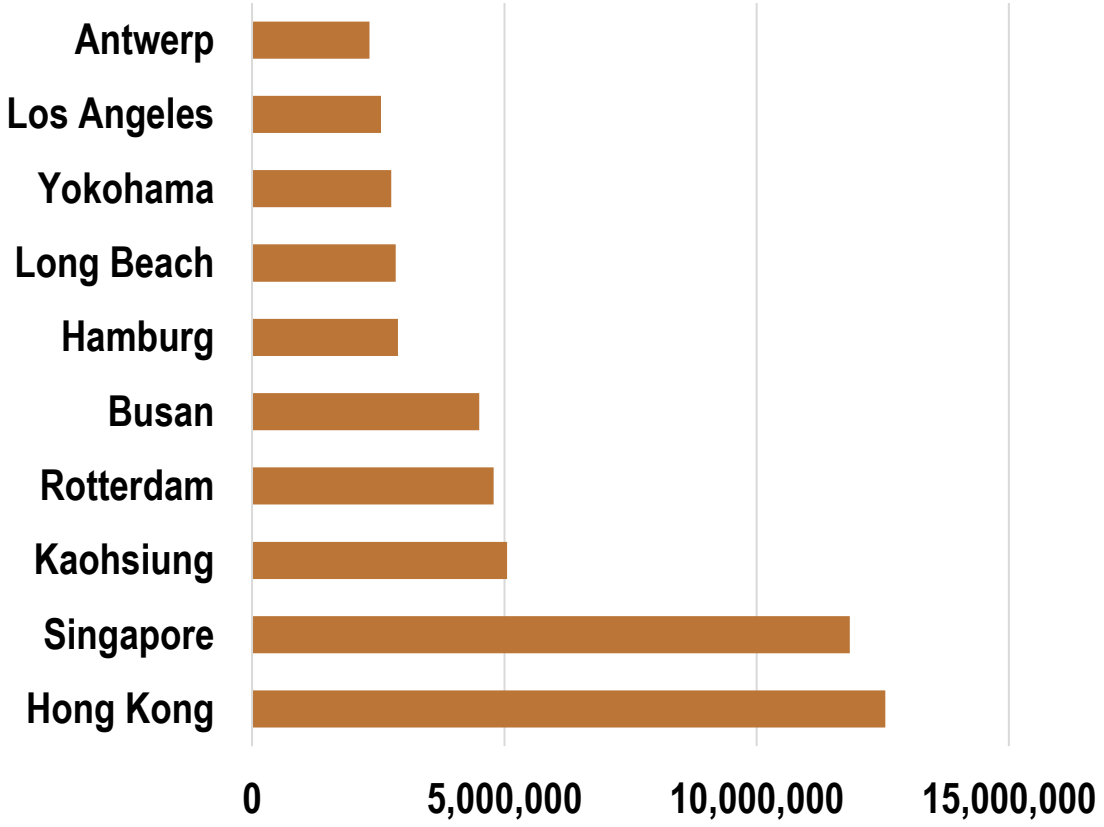


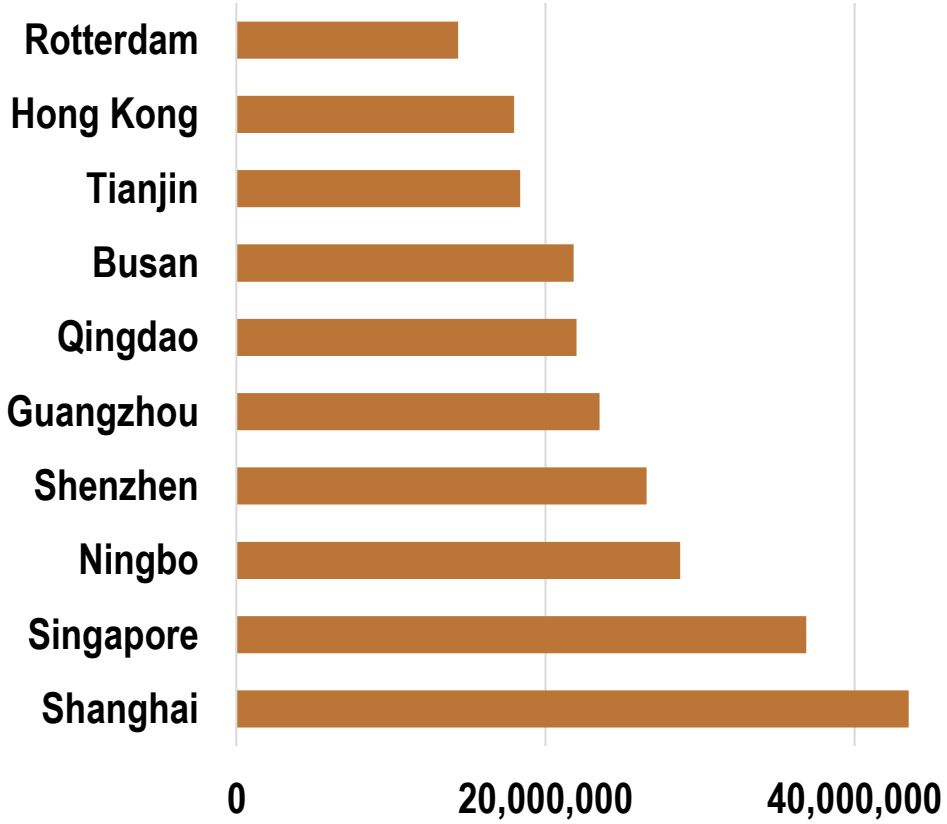
Containerization Coming to Age: 1995



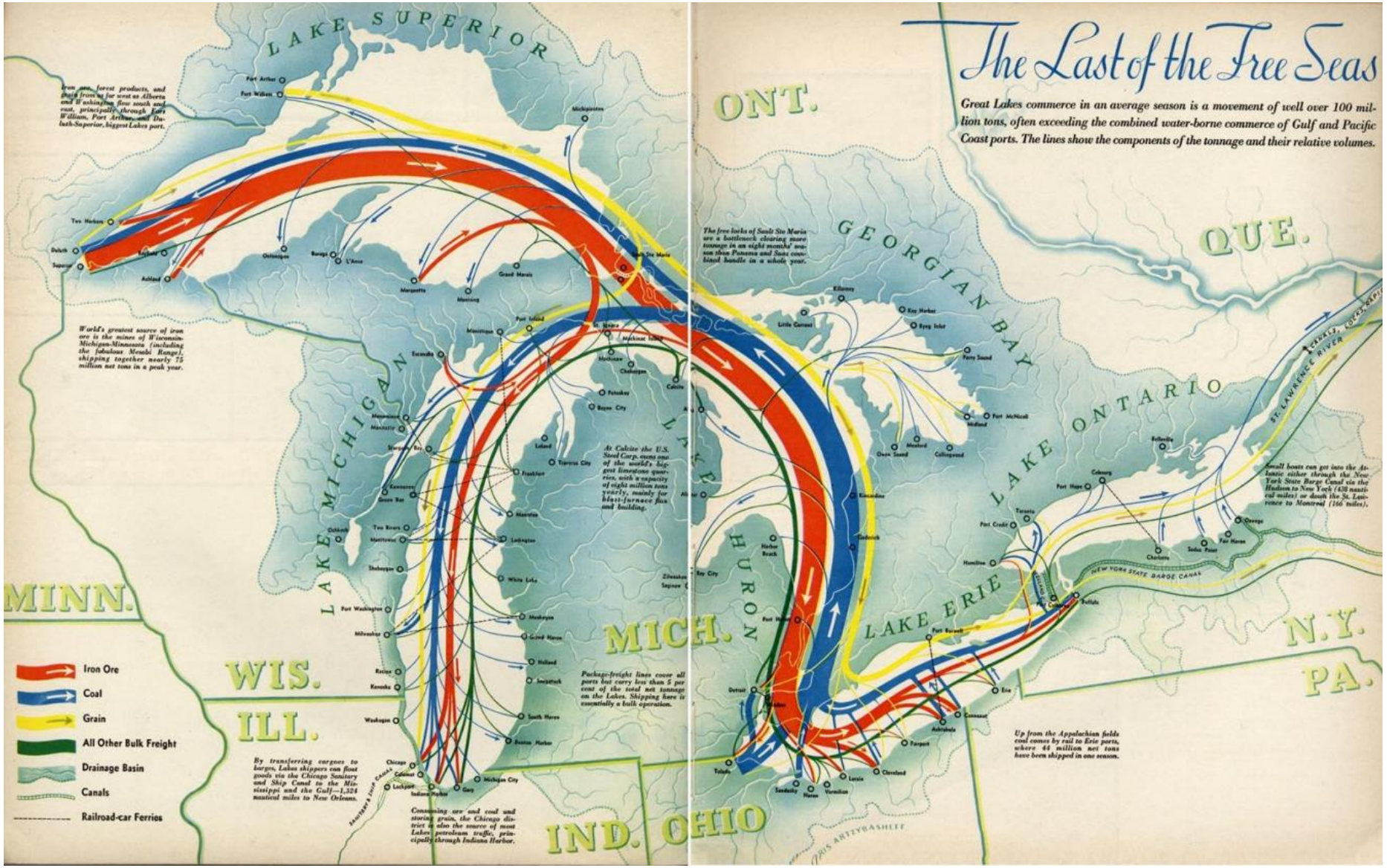
Peak Containerization: 2020



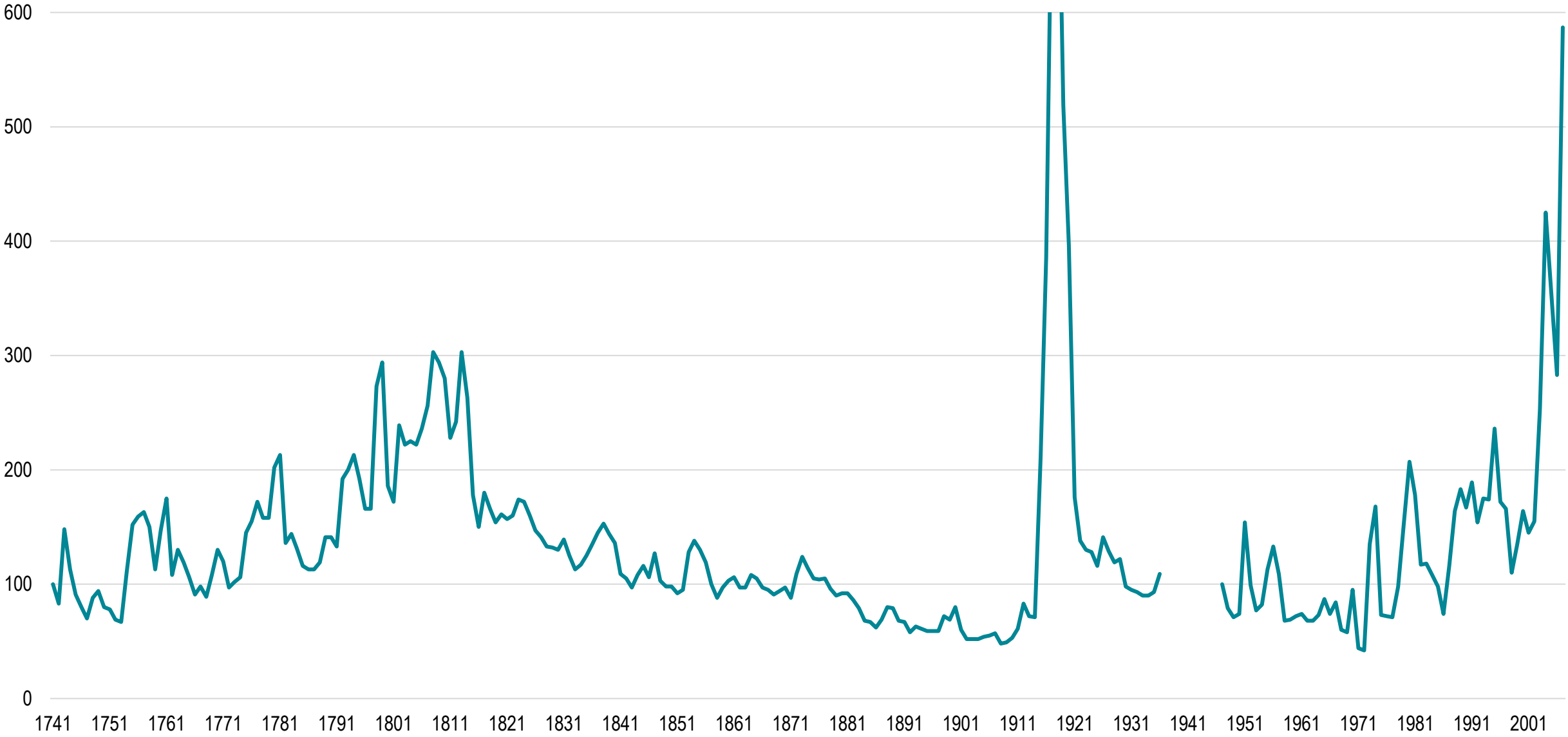




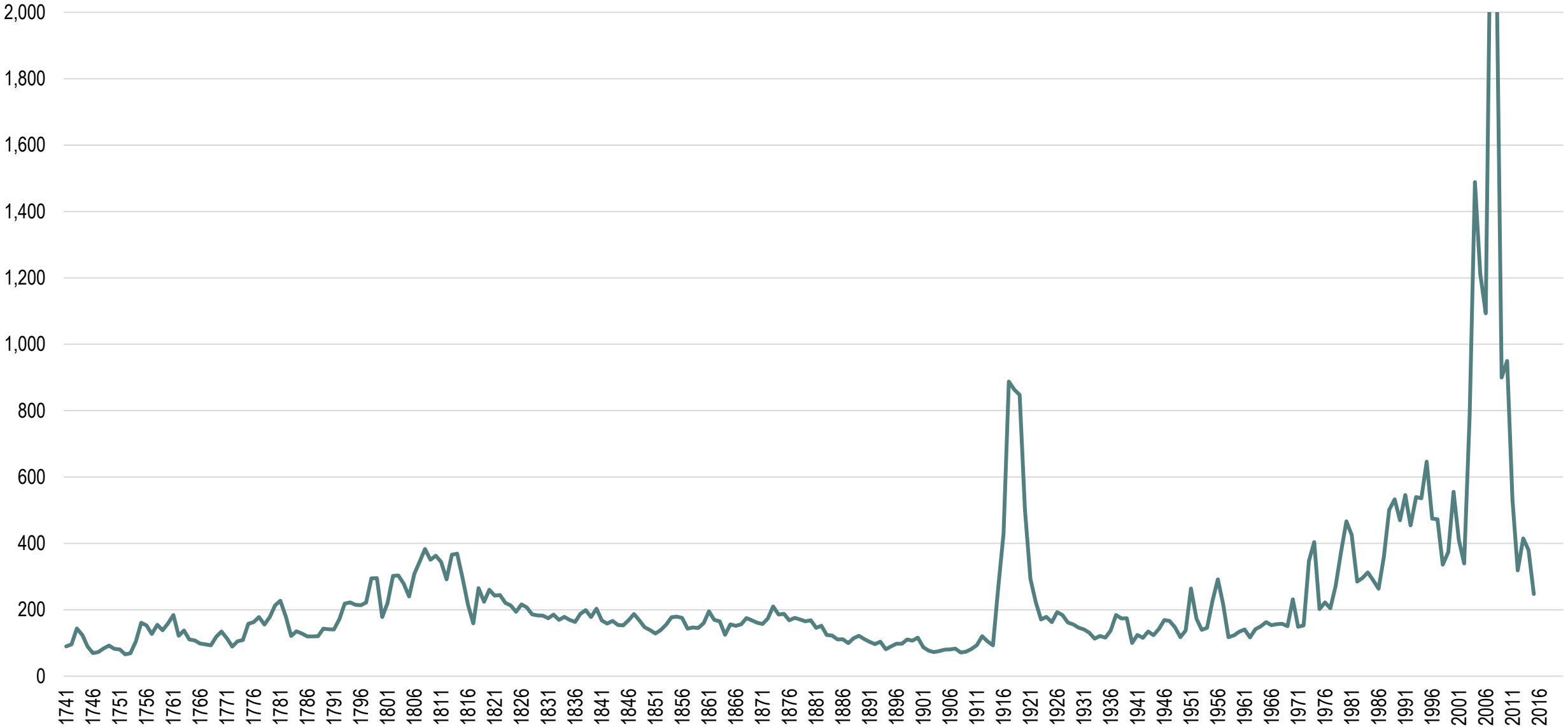
Major Commodity Flows over the Great Lakes, 1940



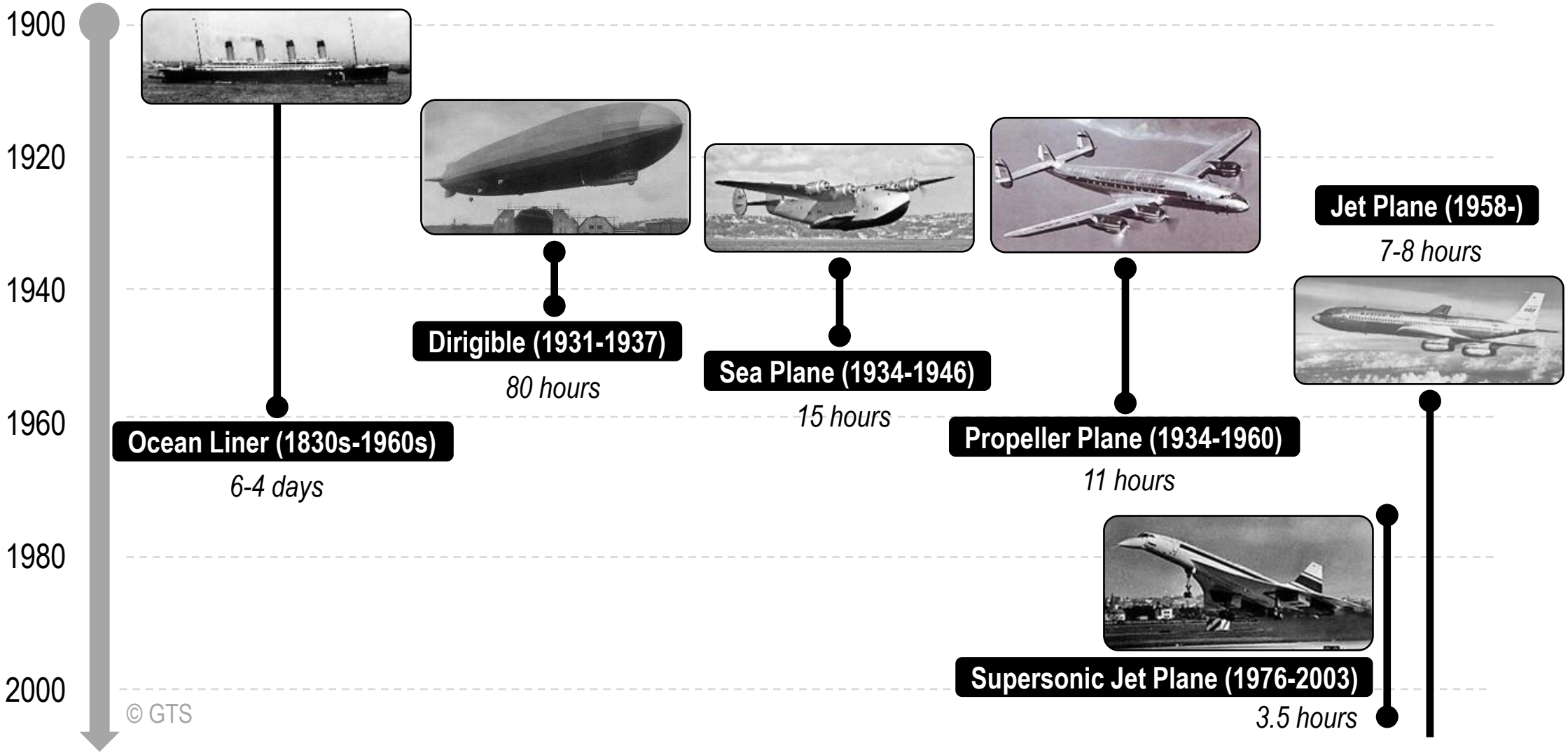
Maritime Economics Freight Index, 1741-2007



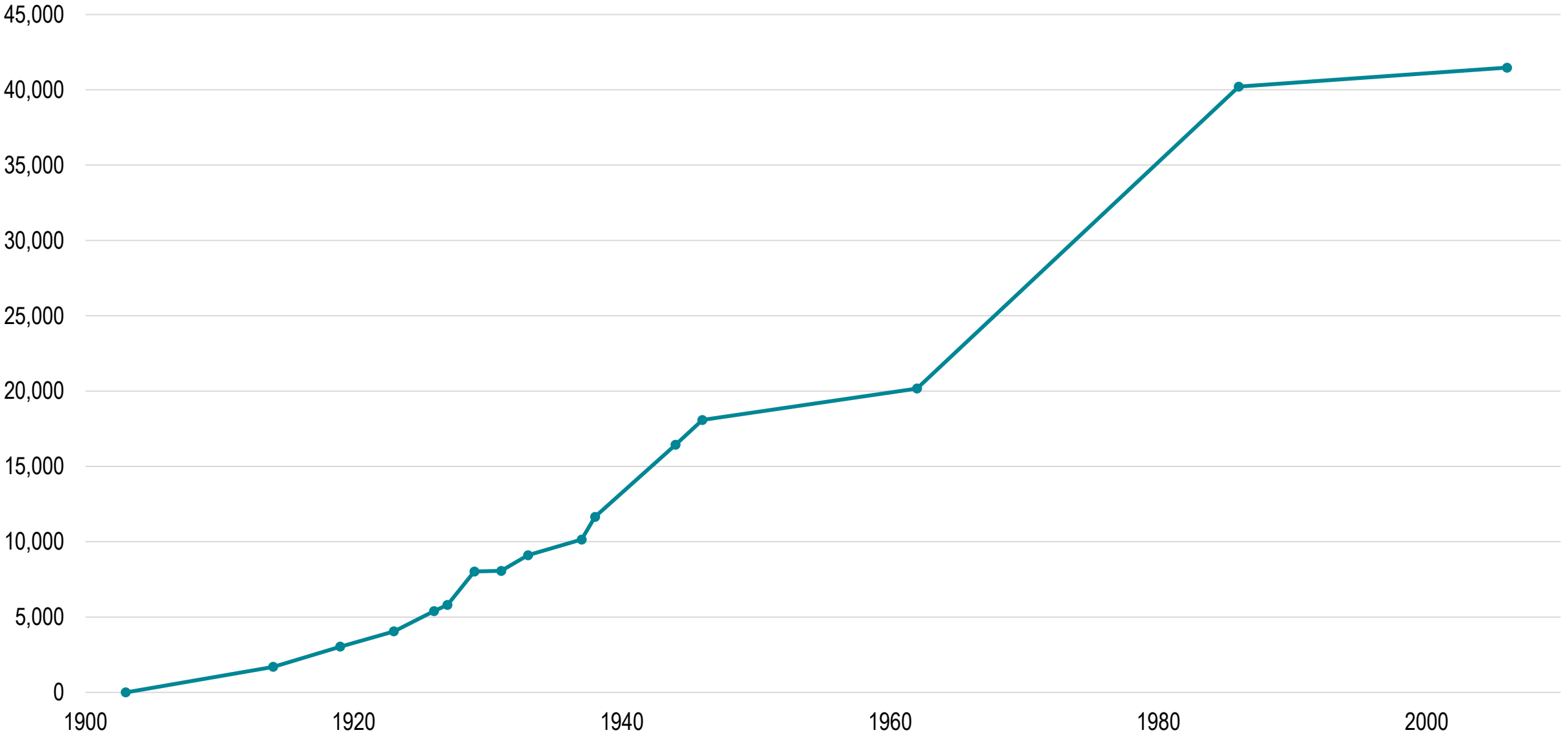
Long Term Freight Market Index (LFI), 1741-2015



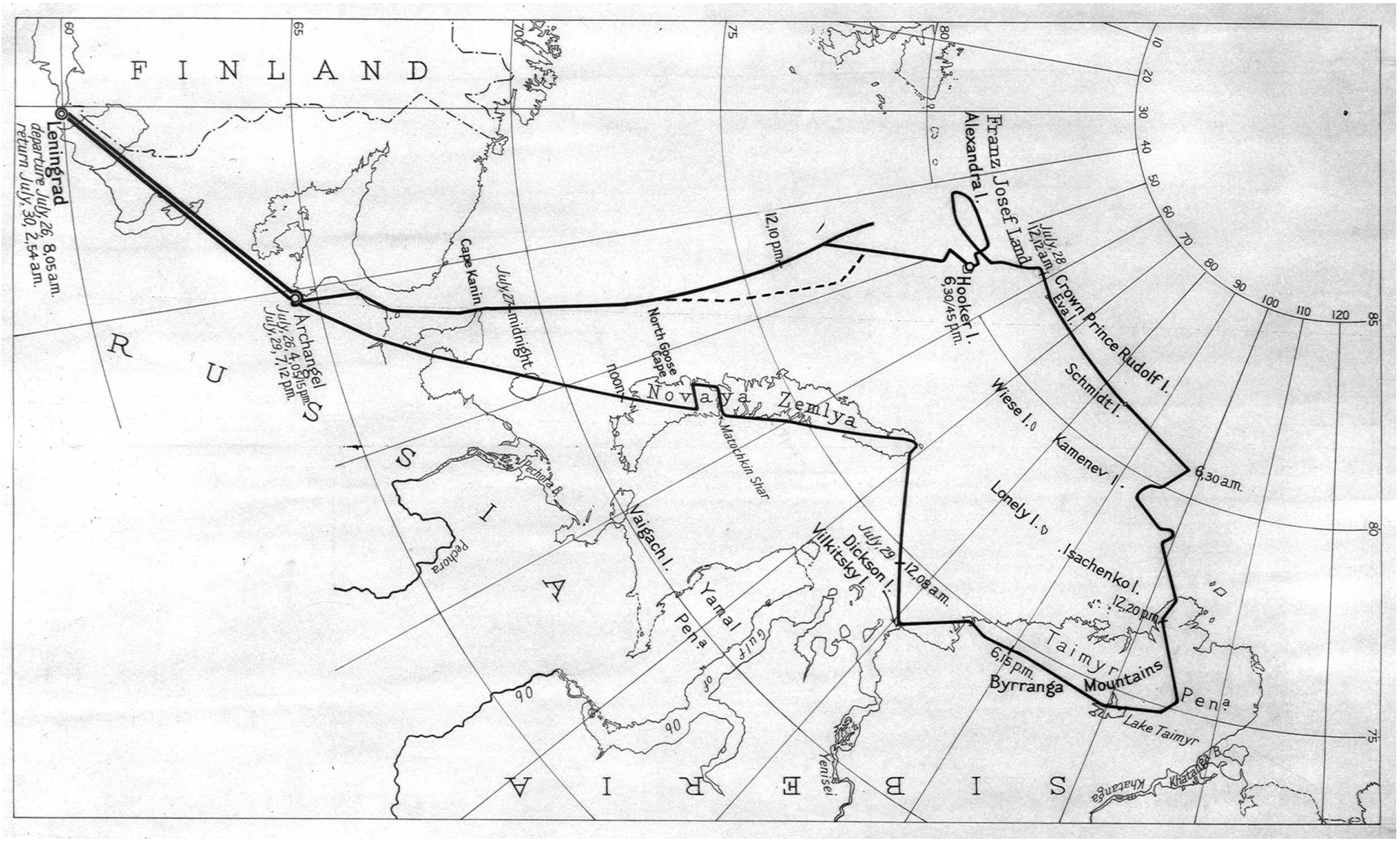
Evolution of Powered Transatlantic Passenger Modes



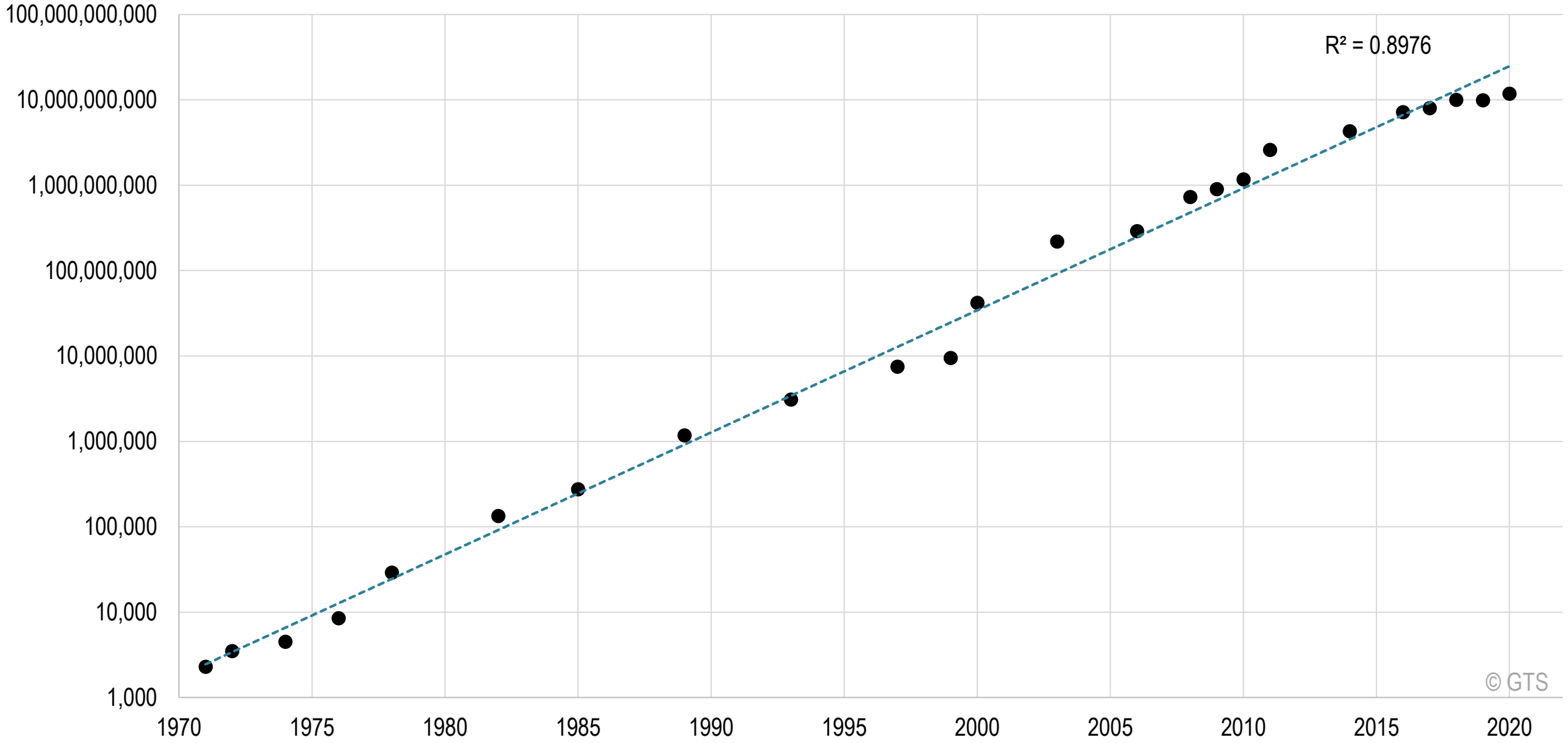
Longest Non-Commercial Flight Distance (in km)



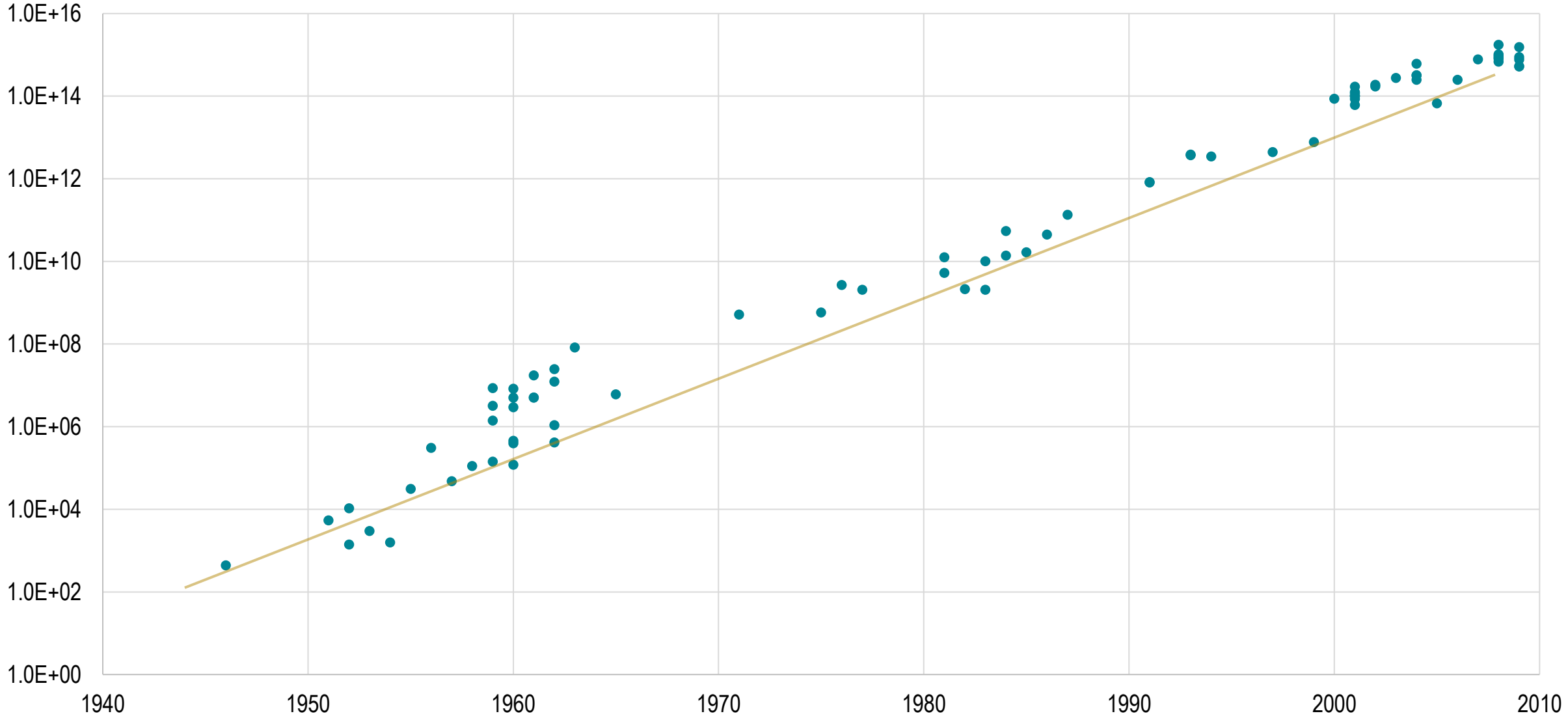
Route of the Graf Zeppelin into the Arctic (1931)



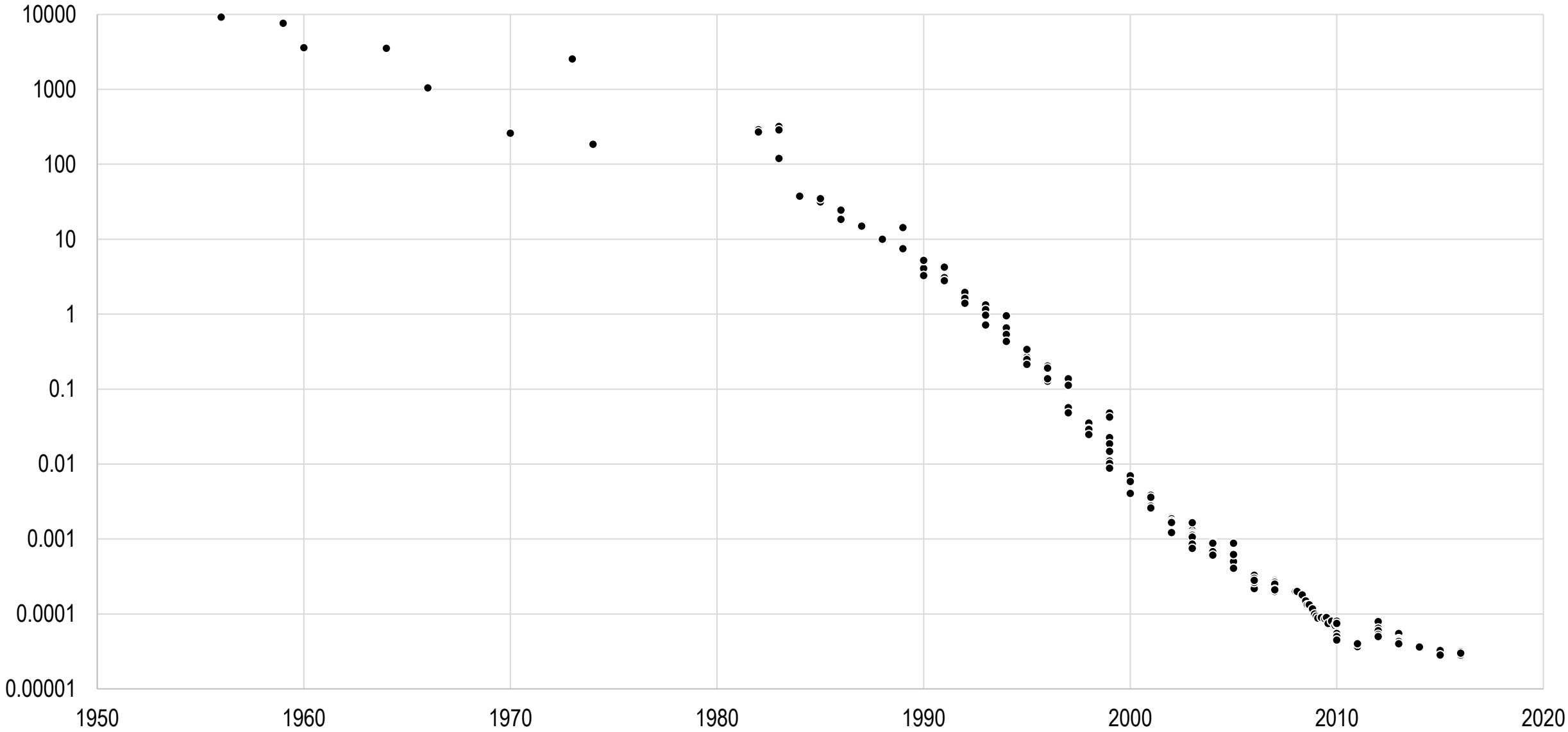
Moore's Law: Transistors per Microprocessor, 1971-2022



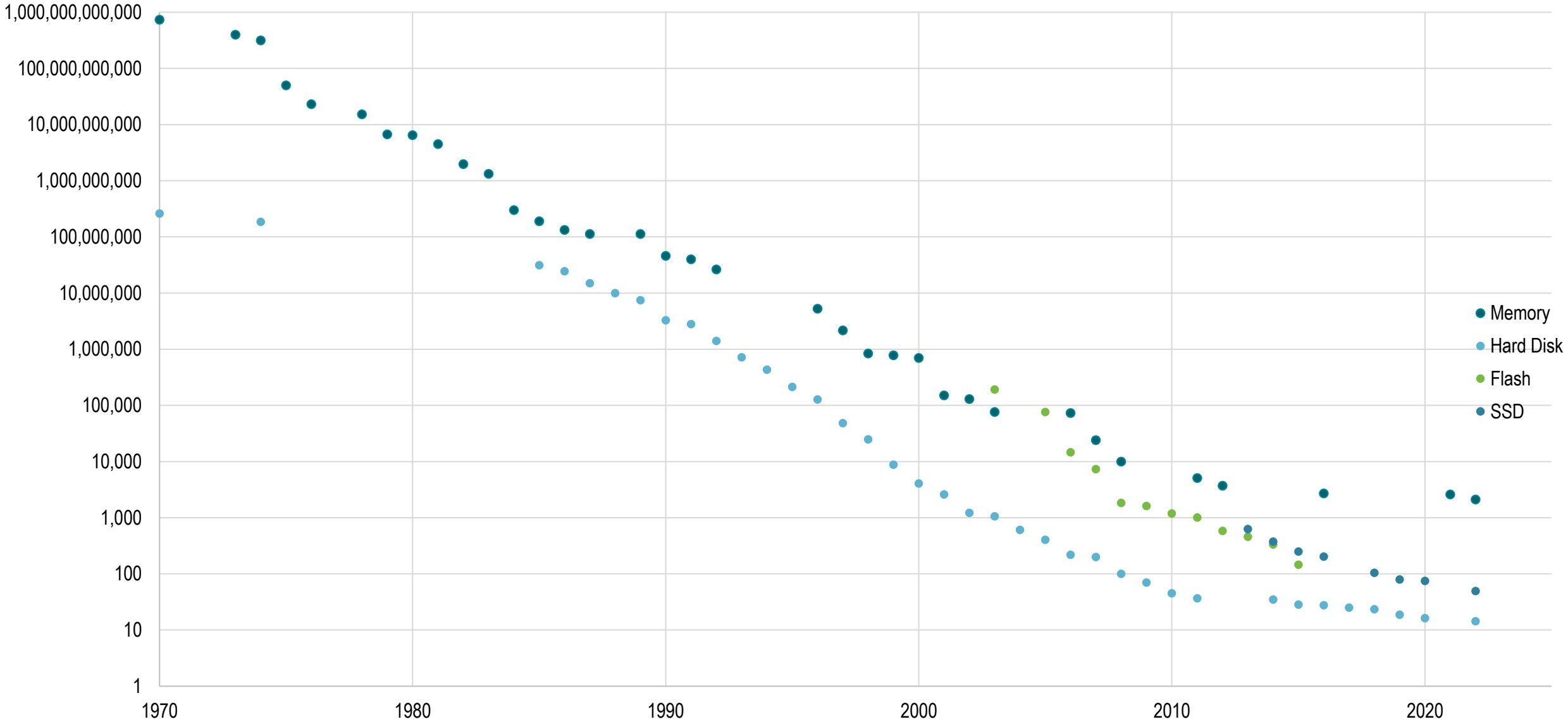
Computations per kWh, Selected Computers, 1946-2009



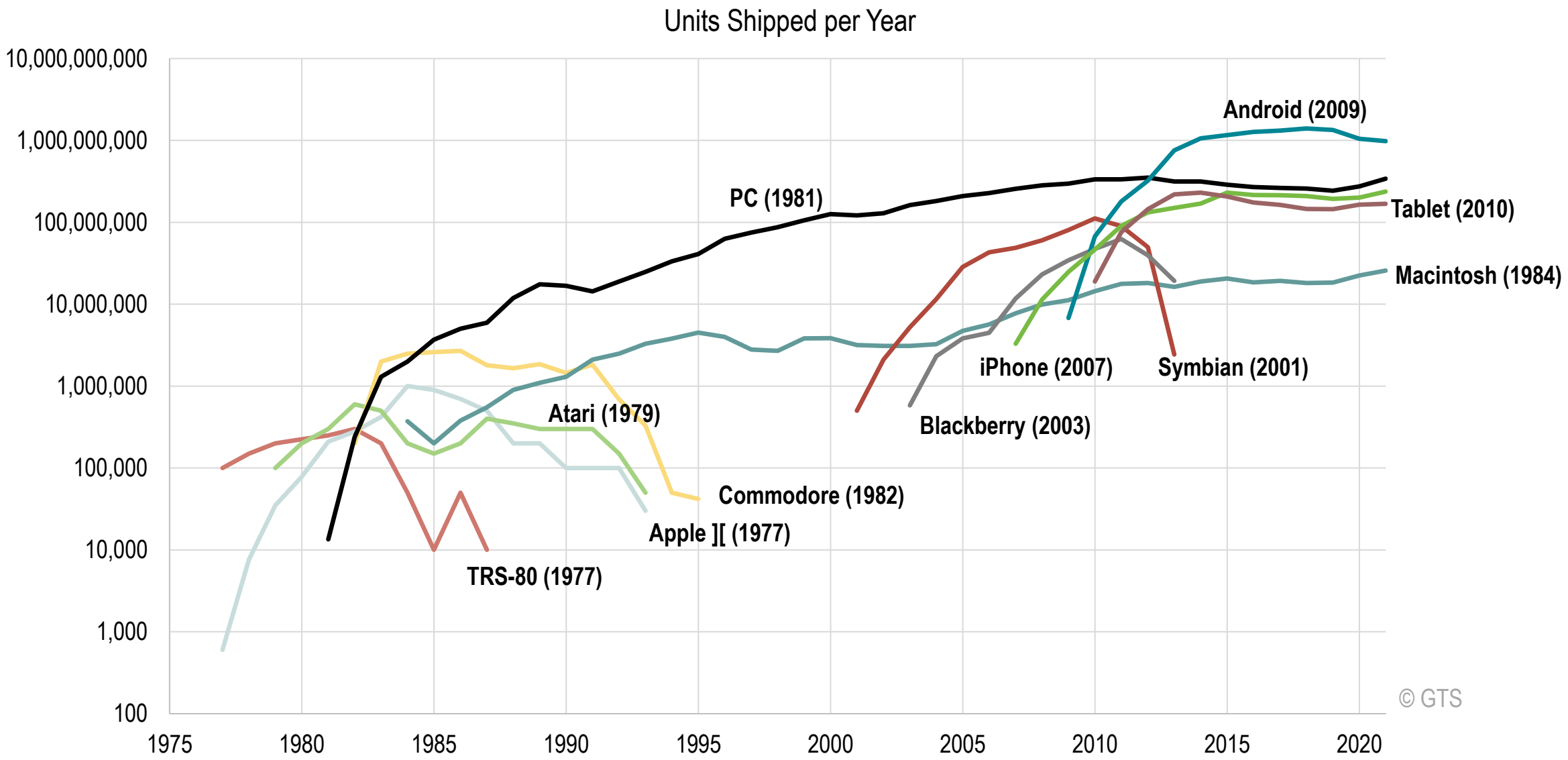
Computer Storage Space, 1956-2016 (Dollars per Megabyte)



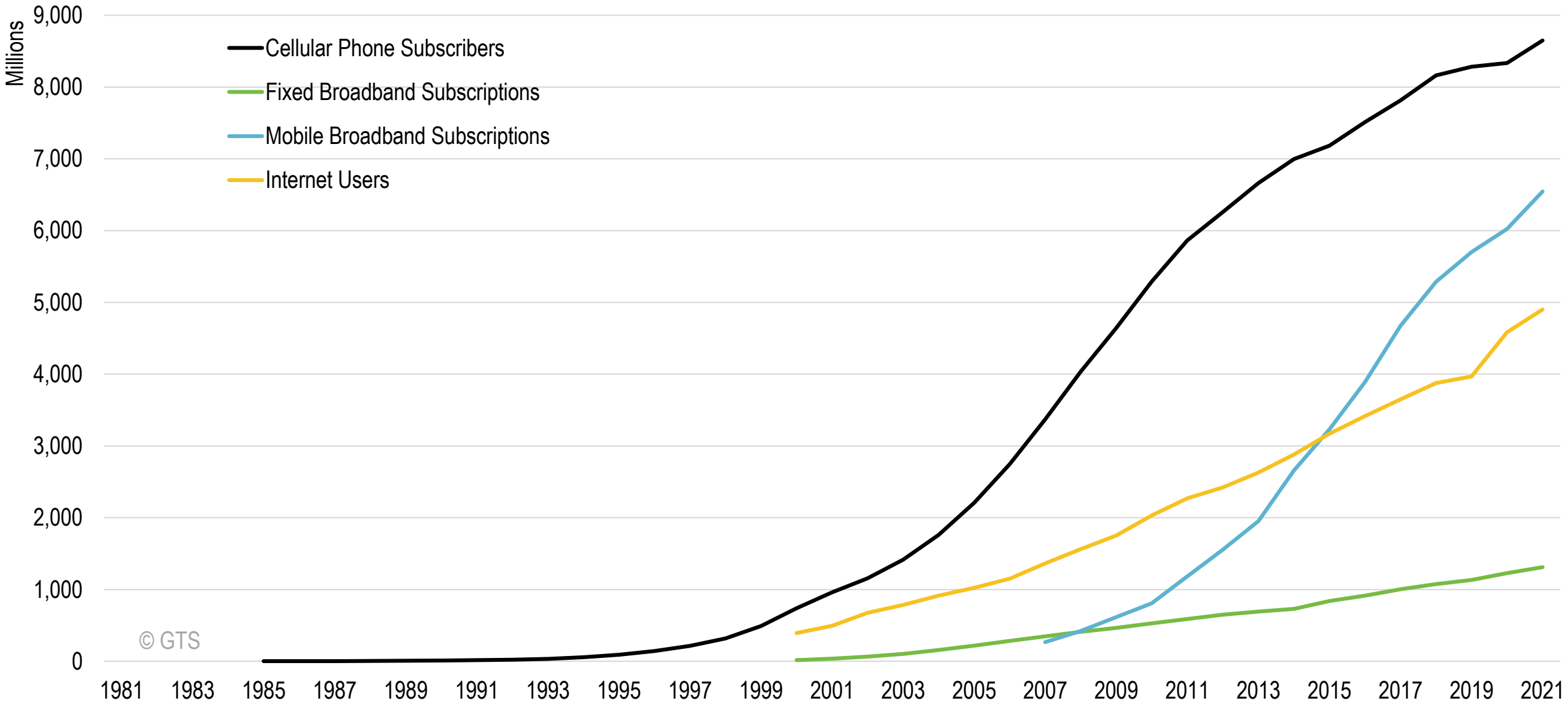
Computer Storage Space, 1970-202 (Dollars per Gigabyte)



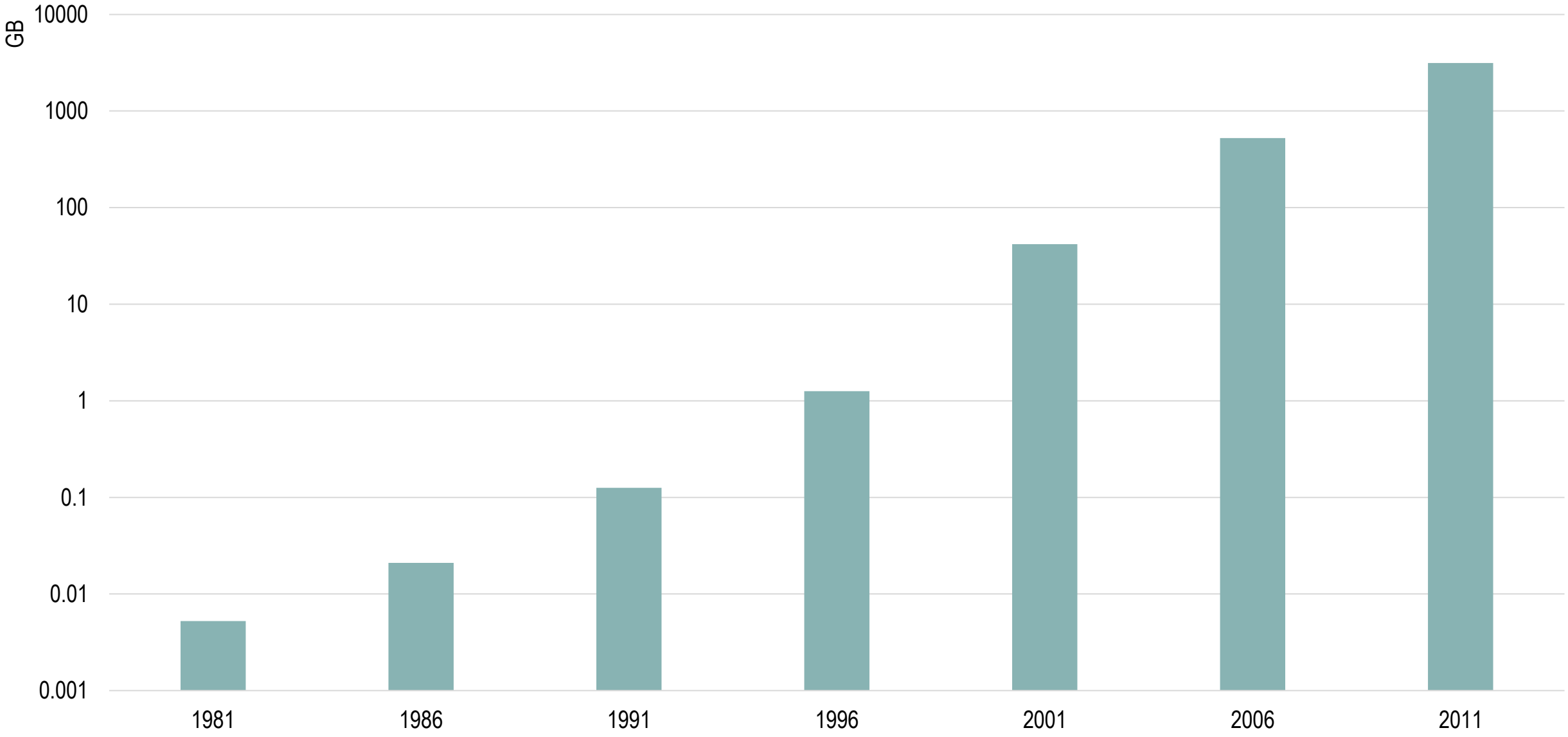
Diffusion of Personal Computing Devices, 1977-2021



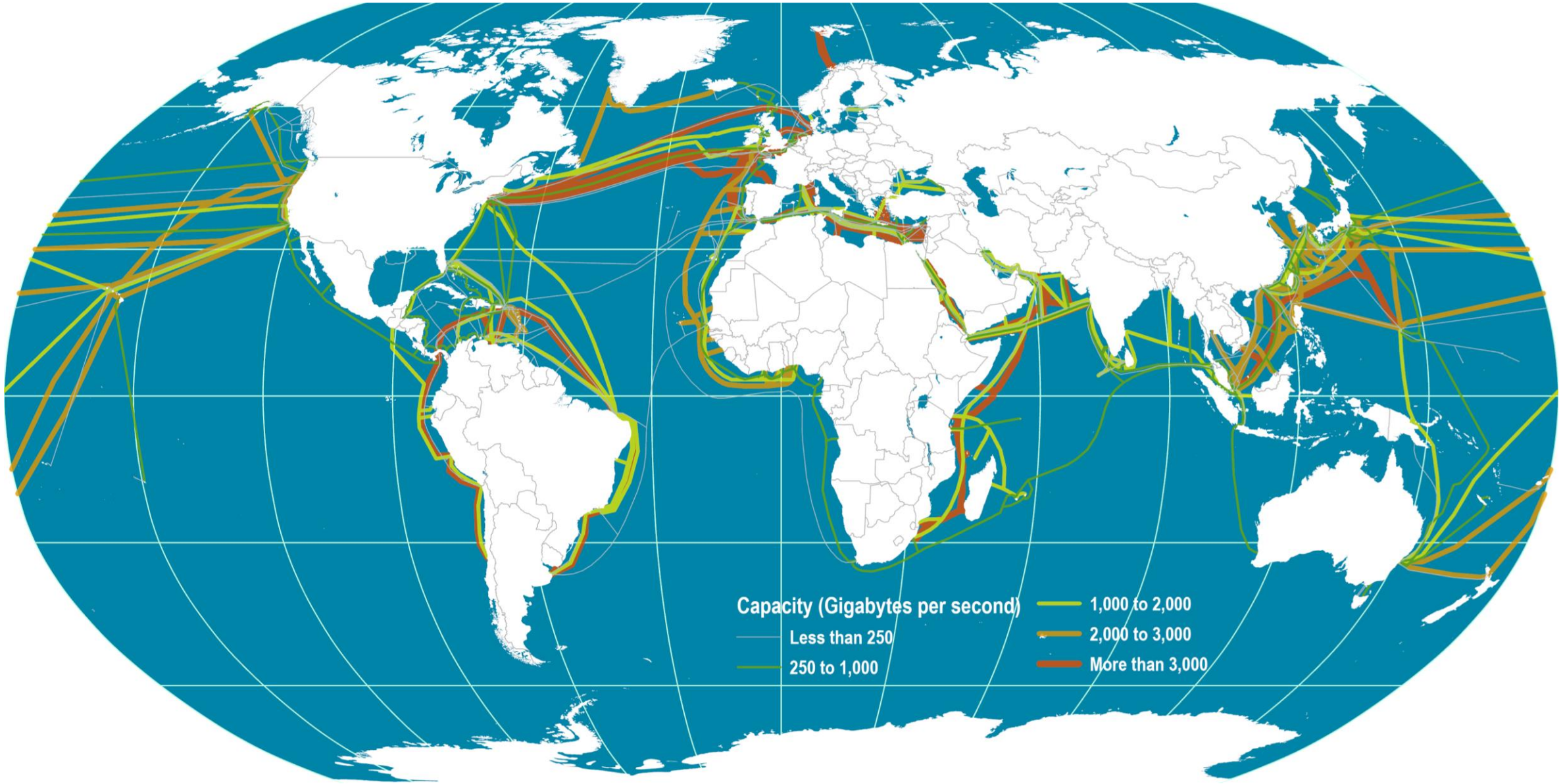
Diffusion of Telecommunication Services, 1985-2021



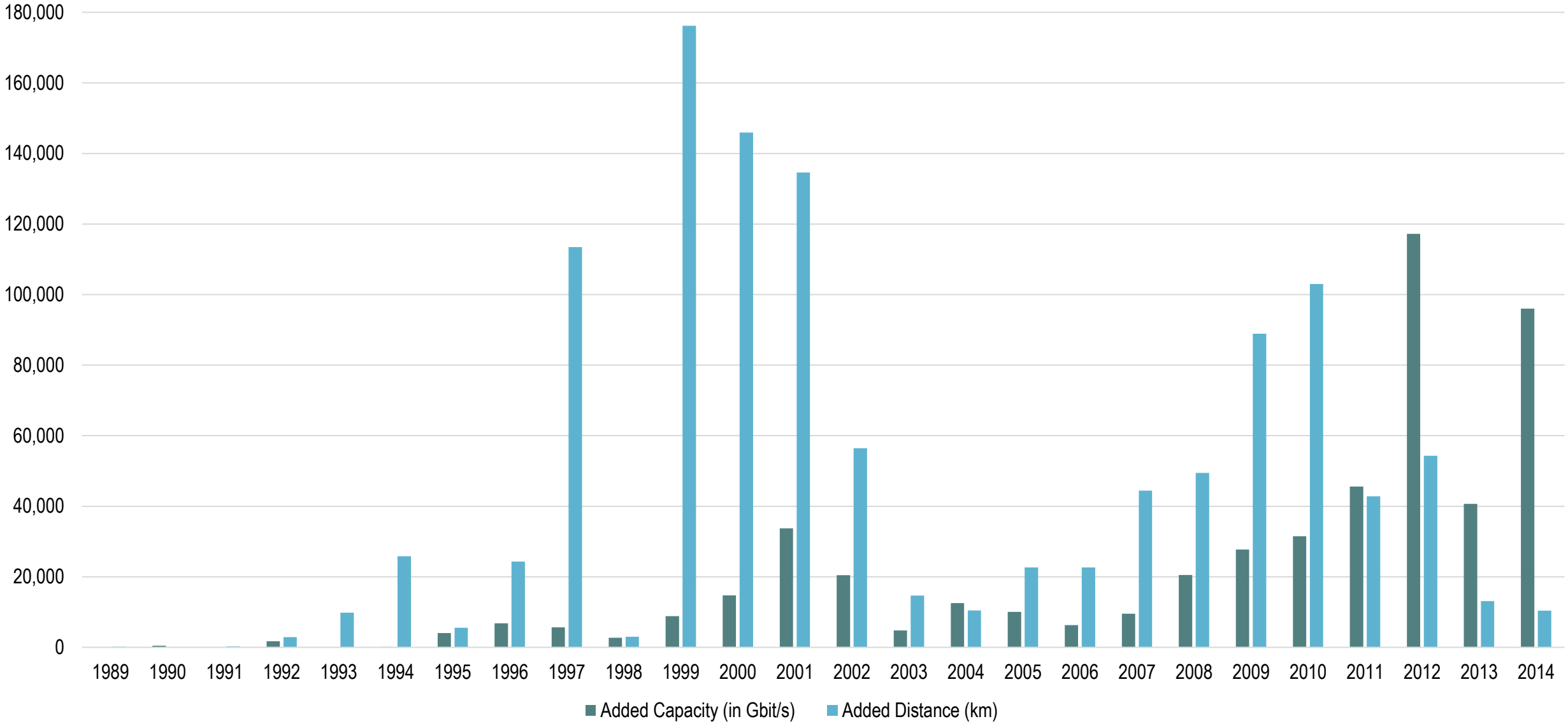
Typical Hard Drive Capacity, New Computer, 1981-2011



Global Submarine Cable Network



Annual Oceanic Cable Capacity Increase, 1989-2014



Some Long Distance Travel Costs

Link	Cost in Dollars (Current 2005 Dollars)
Transatlantic steamship (1880s)	$35 to $100 ($1,000 to $3,000)
Transcontinental rail (1880s)	$100 to $200 ($3,000 to $6,000)
Transcontinental rail (1940s)	$70 to $100 ($250 to $350)
Transcontinental air (1940s)	$300 ($3,600)
Transcontinental air (1960s)	$150 ($1,200)
Transcontinental air (2000s)	$600

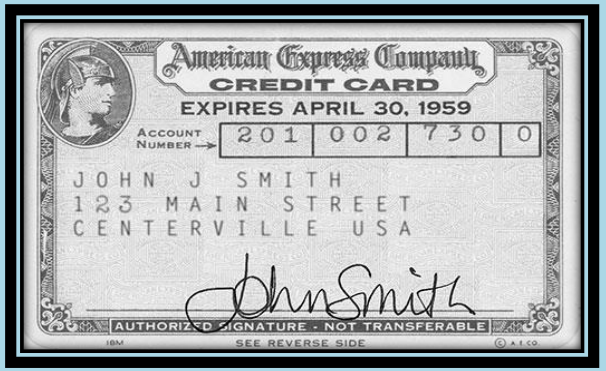
Evolution of Mobility, United States, 1800-2000

	Average ground travel speed	Average mobility	Per capita GDP
1800	3 mph	1,500 miles per year	$1,200
1850	4 mph	1,600 miles per year	$1,900
1900	8 mph	2,000 miles per year	$5,000
1950	23 mph	6,900 miles per year	$12,000
2000	34 mph	18,000 miles per year	$35,000

Some Impacts of Early Containerization

	Pre-Containerization (1965)	Post-Containerization (1970-71)
Dock labor productivity	1.7 tons per hour	30 tons per hour
Port concentration (loading ports servicing Europe/Australia trade)	11 ports	3 ports
Insurance costs (Australia / Europe imports)	£0.24 per ton	£0.04 per ton
Inventory holding costs (Hamburg/Sydney)	£2 per ton	£1 per ton

Corporate Adaptation to Transport Innovations: American Express and Wells Fargo

	Interstate Wagon Services	Rail Services	Financial Services
American Express			
	1850: Established in Buffalo, NY	1883: Express trains 1918: Exiting the express business	1857: Money orders 1891: Traveler's cheques 1958: Credit cards
Wells Fargo			
	1852: Established in San Francisco, CA 1866: Stagecoach services	1888: Express trains	1905: Wells Fargo Bank 1967: Credit cards 1995: Web banking accounts

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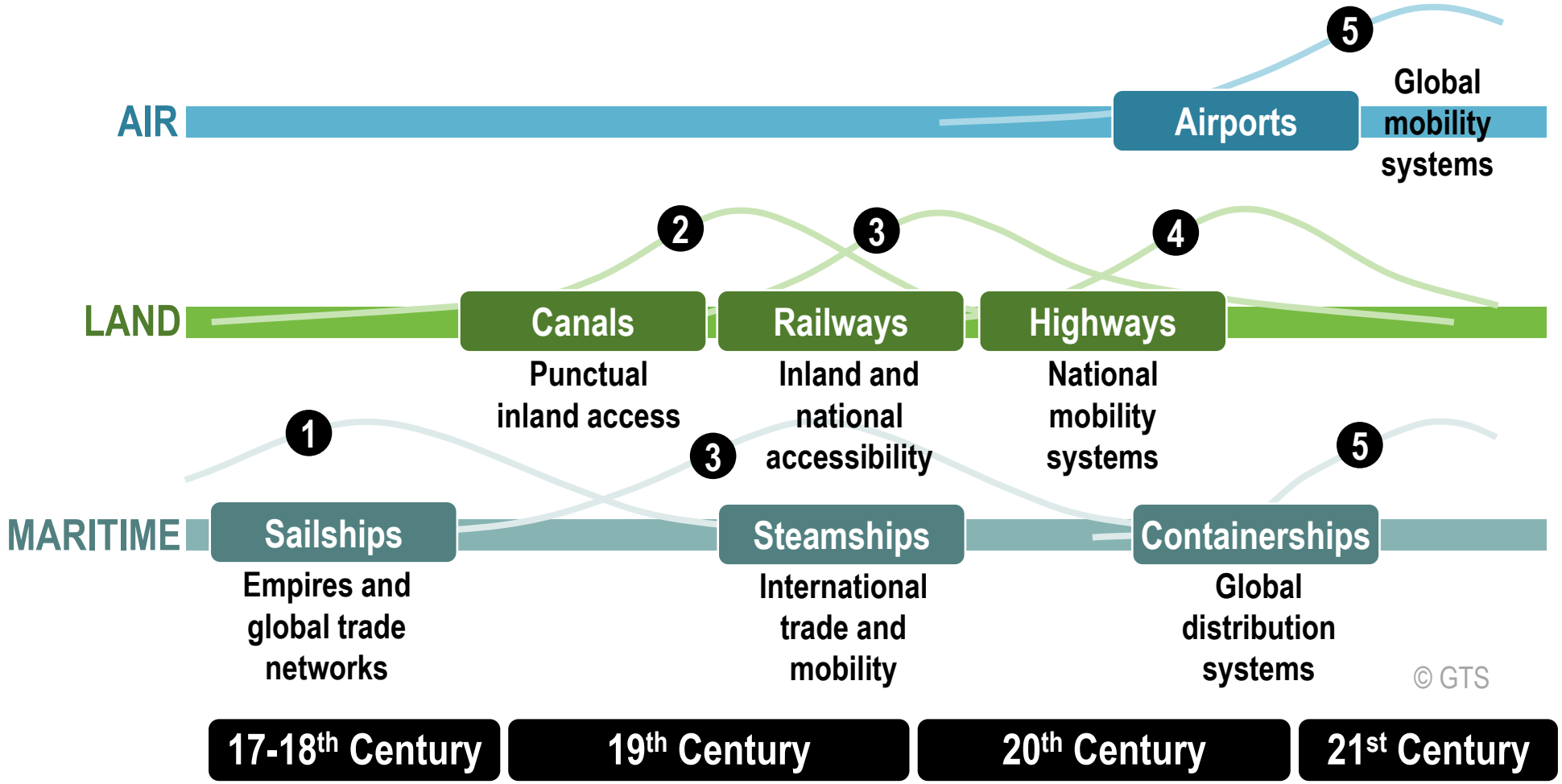
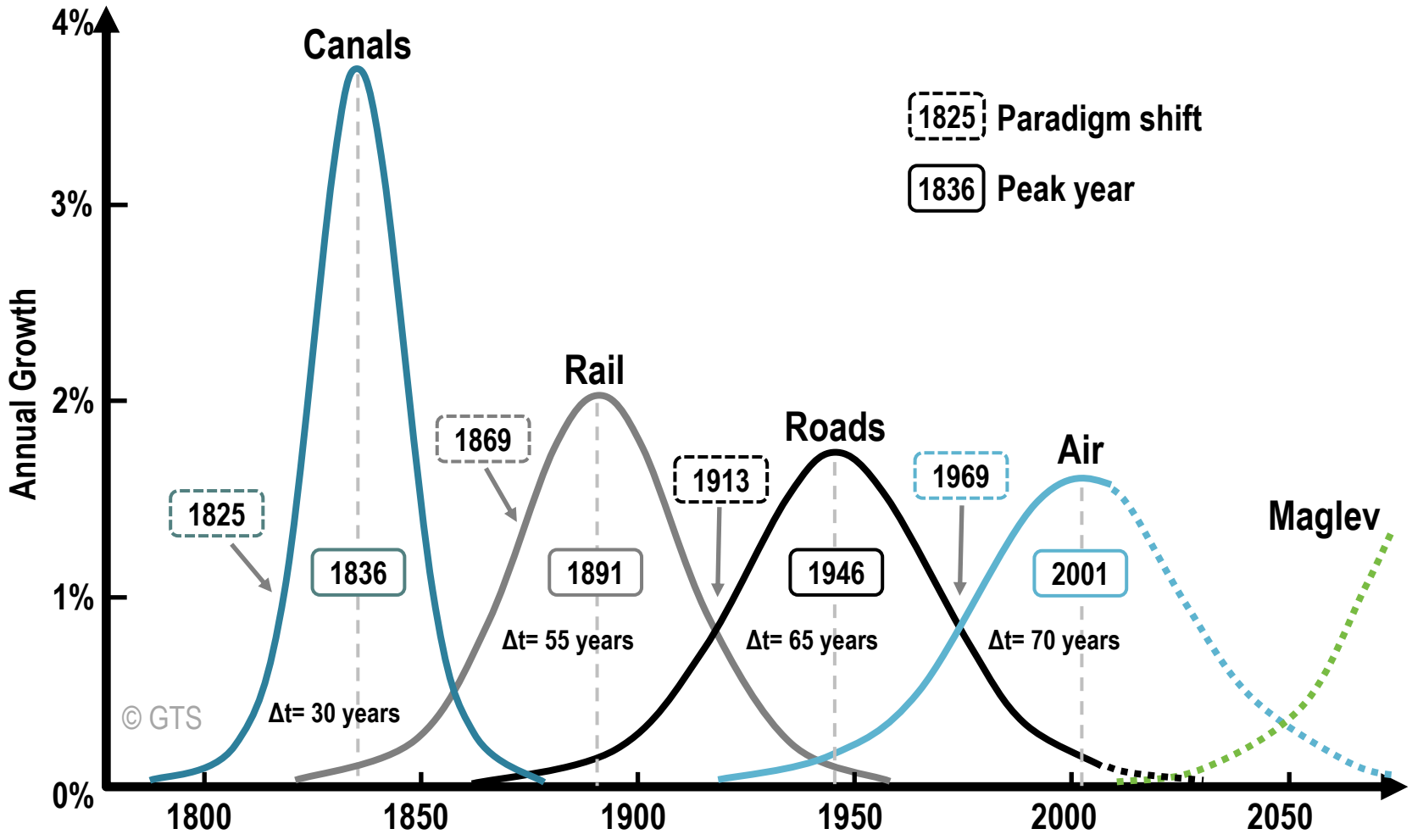
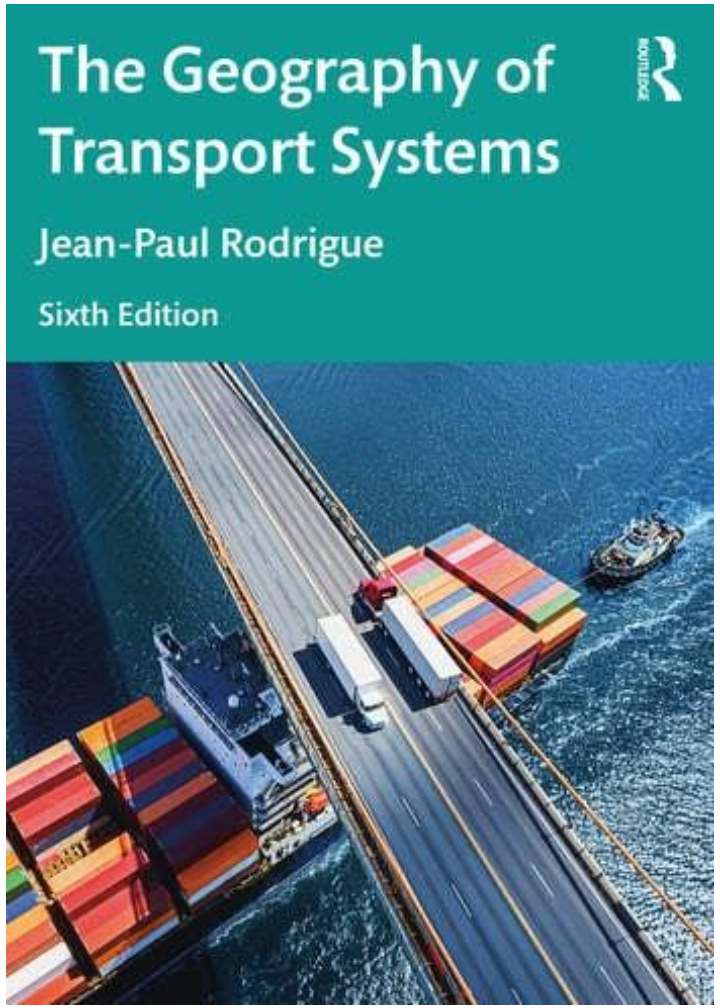
Cumulative Waves of Transport Development



Growth of the US Transport System, 19th - 21st Century



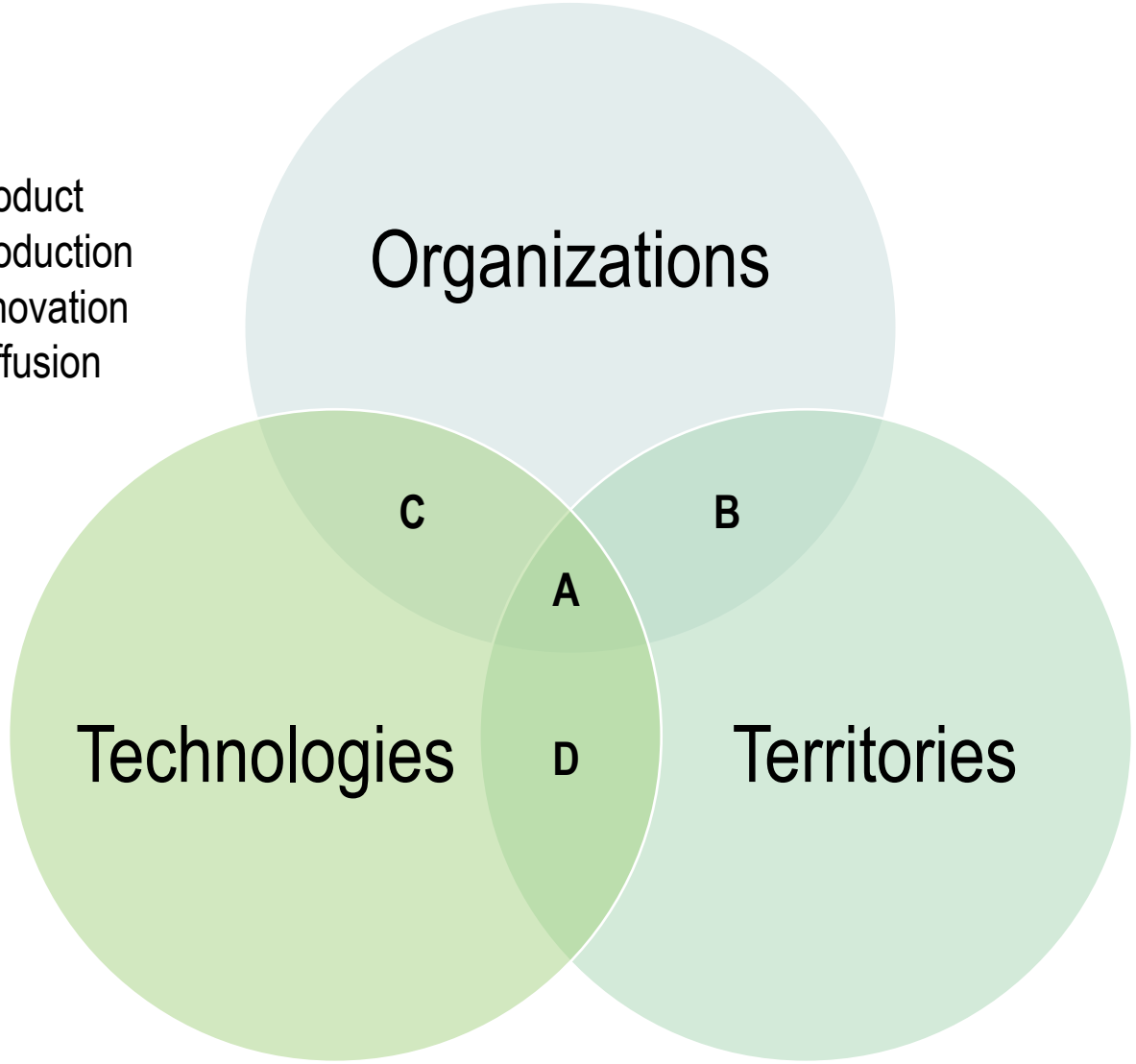


Transportation and Commercial Geography

Chapter 1.4

Dimensions of Economic Geography

A: Product
B: Production
C: Innovation
D: Diffusion

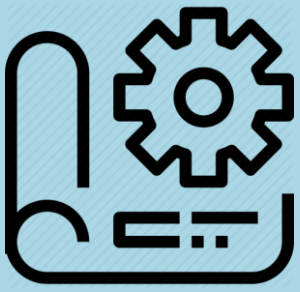


The Drivers of Trade and Globalization

INTEGRATION

- Regulatory chains.
- Harmonization of regulatory regimes.
- Trade agreements.

PRODUCTION



- Supply / value chains.
- Offshoring.
- Global production networks.

TRANSPORTATION

- Transport chains.
- Containerization.
- Transborder transportation.

TRANSACTIONS

- Information chains (ICT).
- Investment capital.
- Credit for transactions.

STANDARDS

Measures, voltage, telecommunications, containers, currencies

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Globalization as a Driver of Added Value

RESEARCH AND DEVELOPMENT

Finding better products and processes through innovation.

INPUT COSTS

Using the advantages of locations (land, labor, capital, resources).

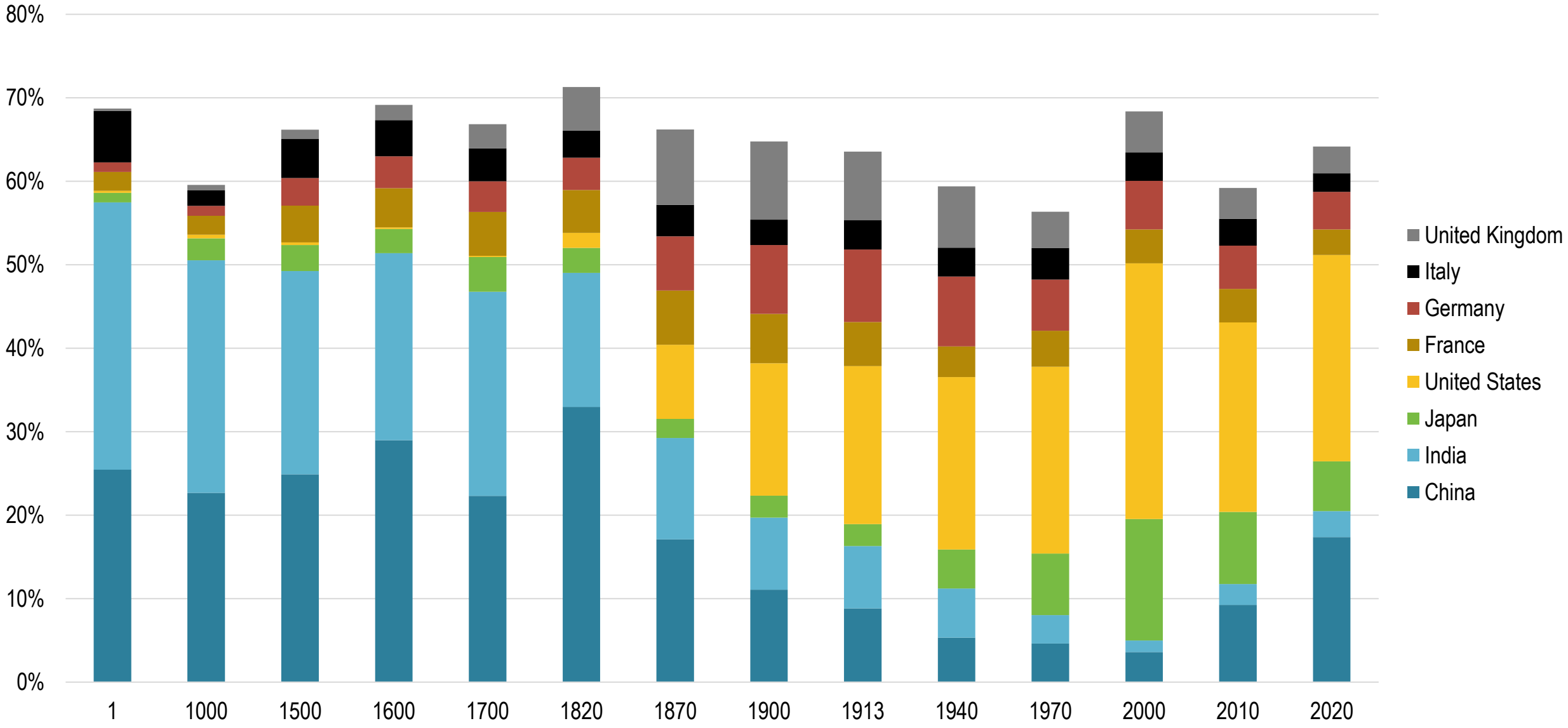
TRANSPORTATION

Effectively transporting and distributing resources, parts and finished goods.

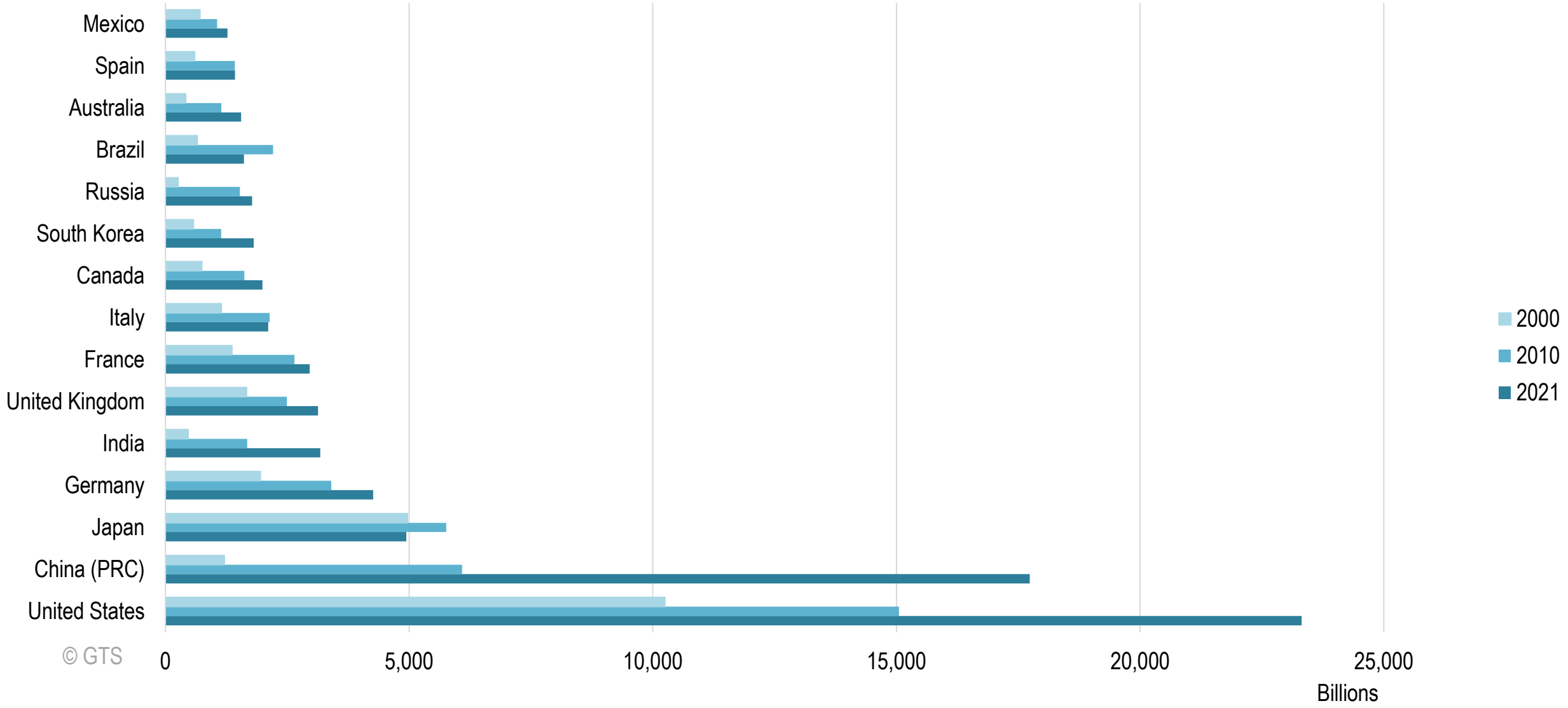
SUSTAINABILITY

Improving resource, environmental and energy efficiency.

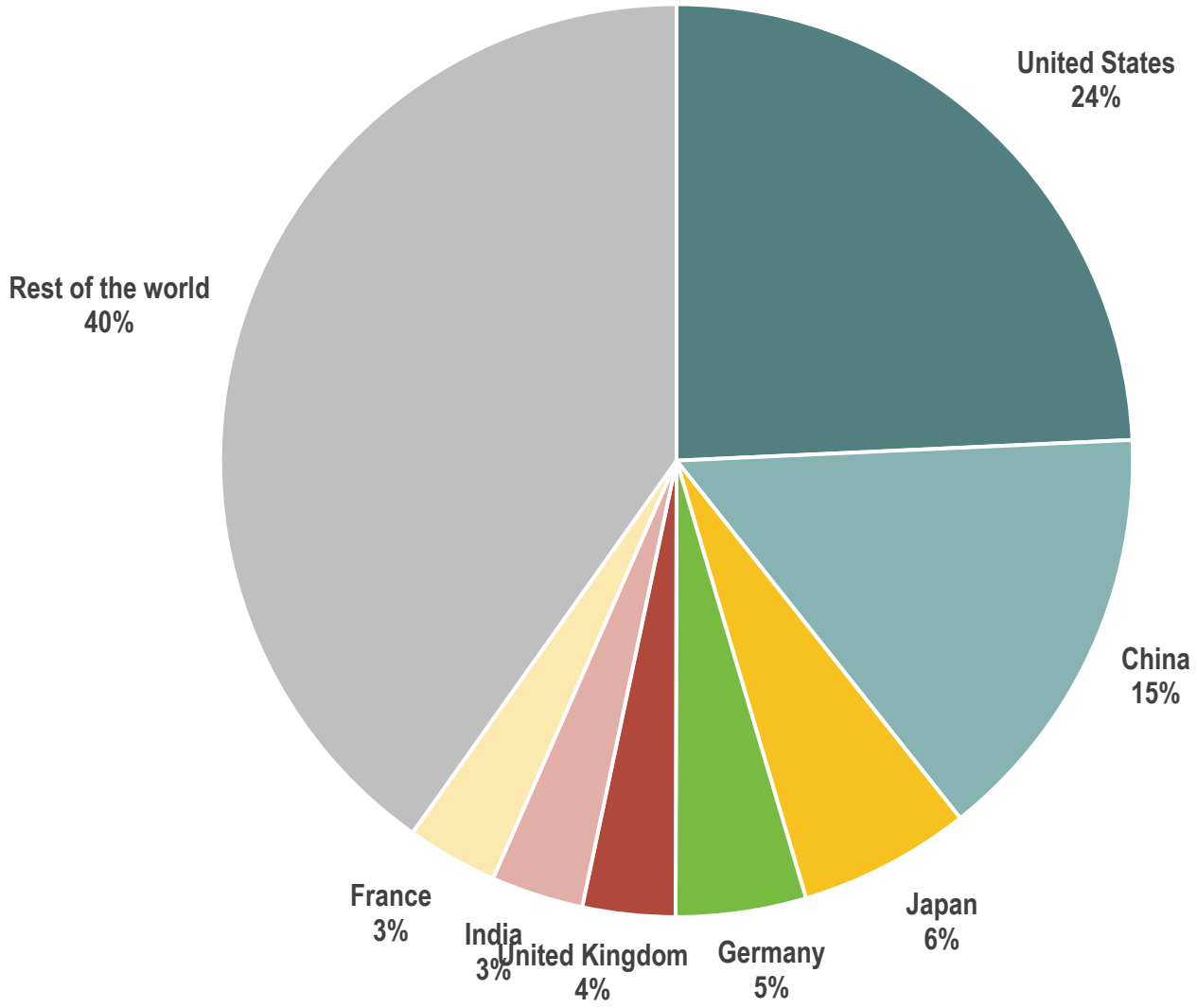
World GDP, 1CE - 2020



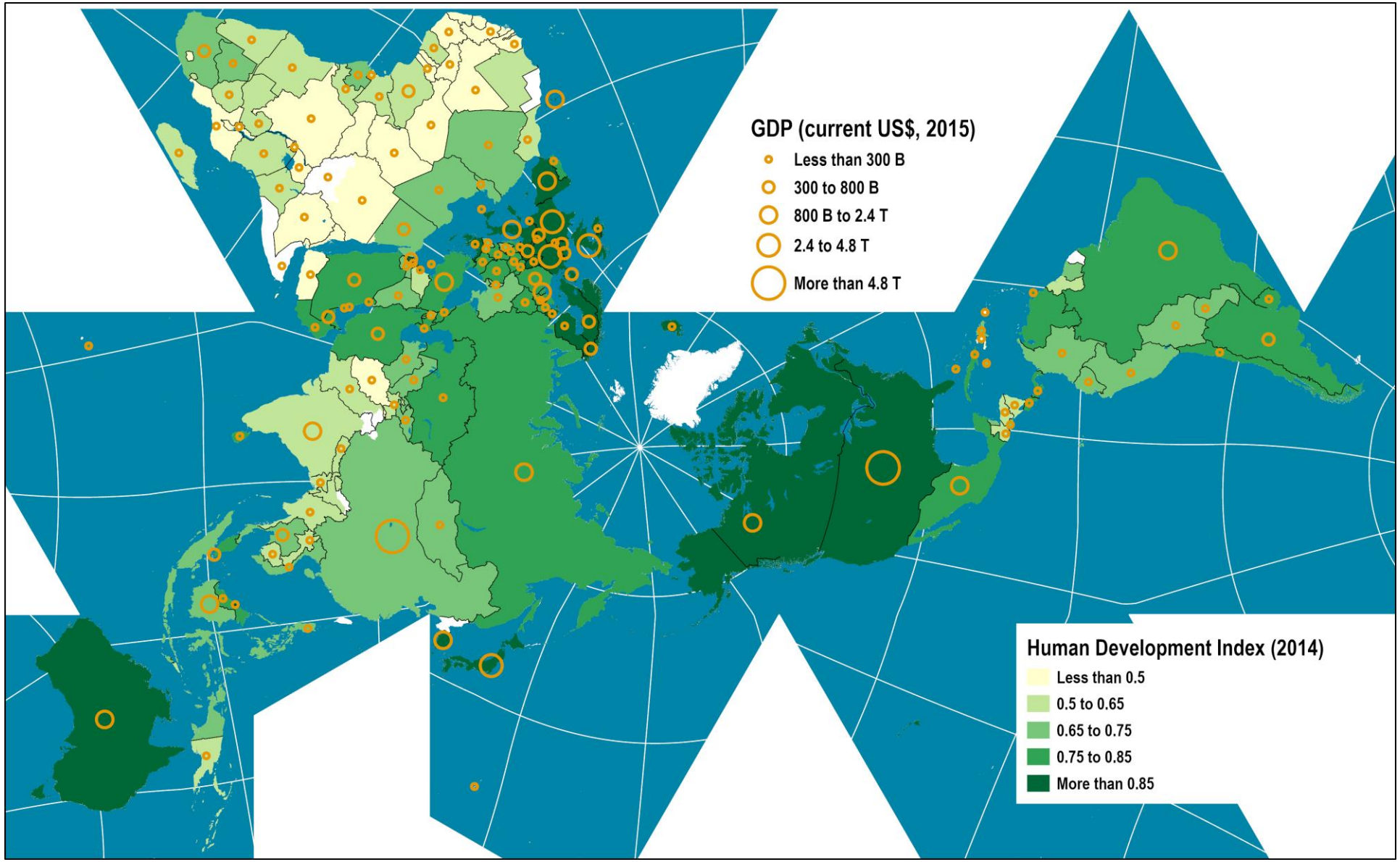
World Nominal GDP, 2000-2021 (in billion USD)



Share of the World GDP, 2016 (Current USD)

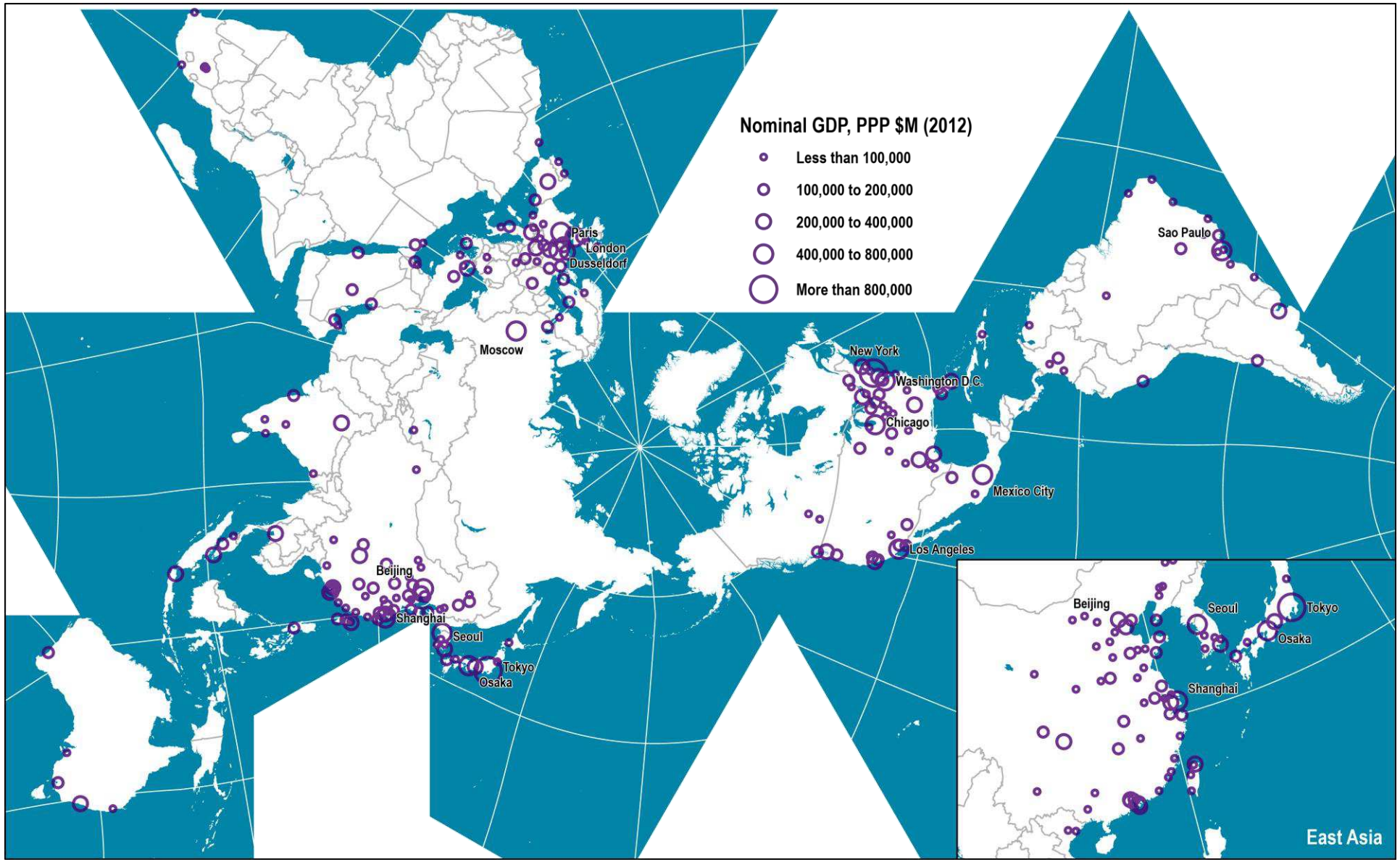


Global Gross Domestic Product and Human Development Index, 2015

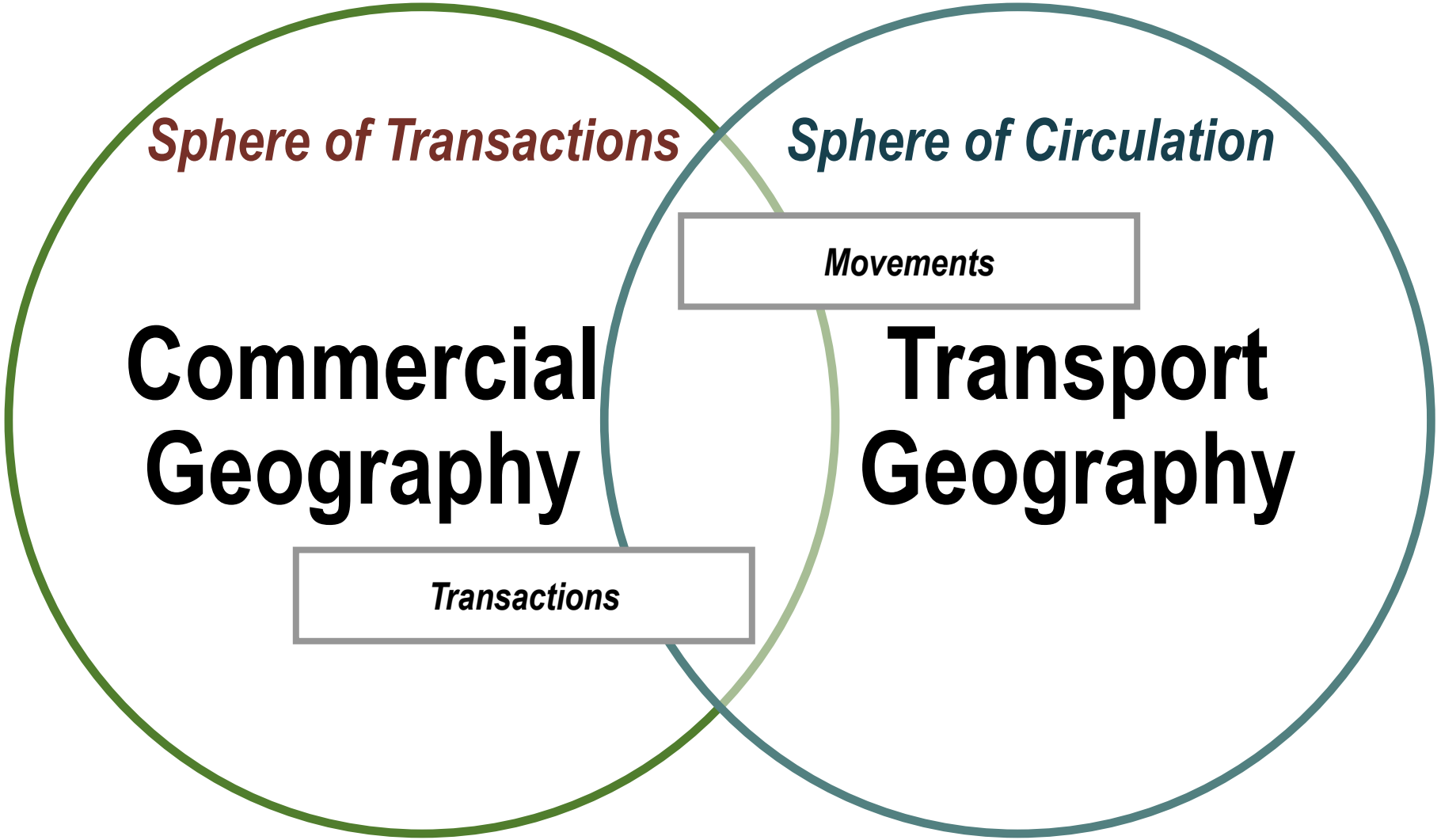


Global Competitiveness Index, 2018

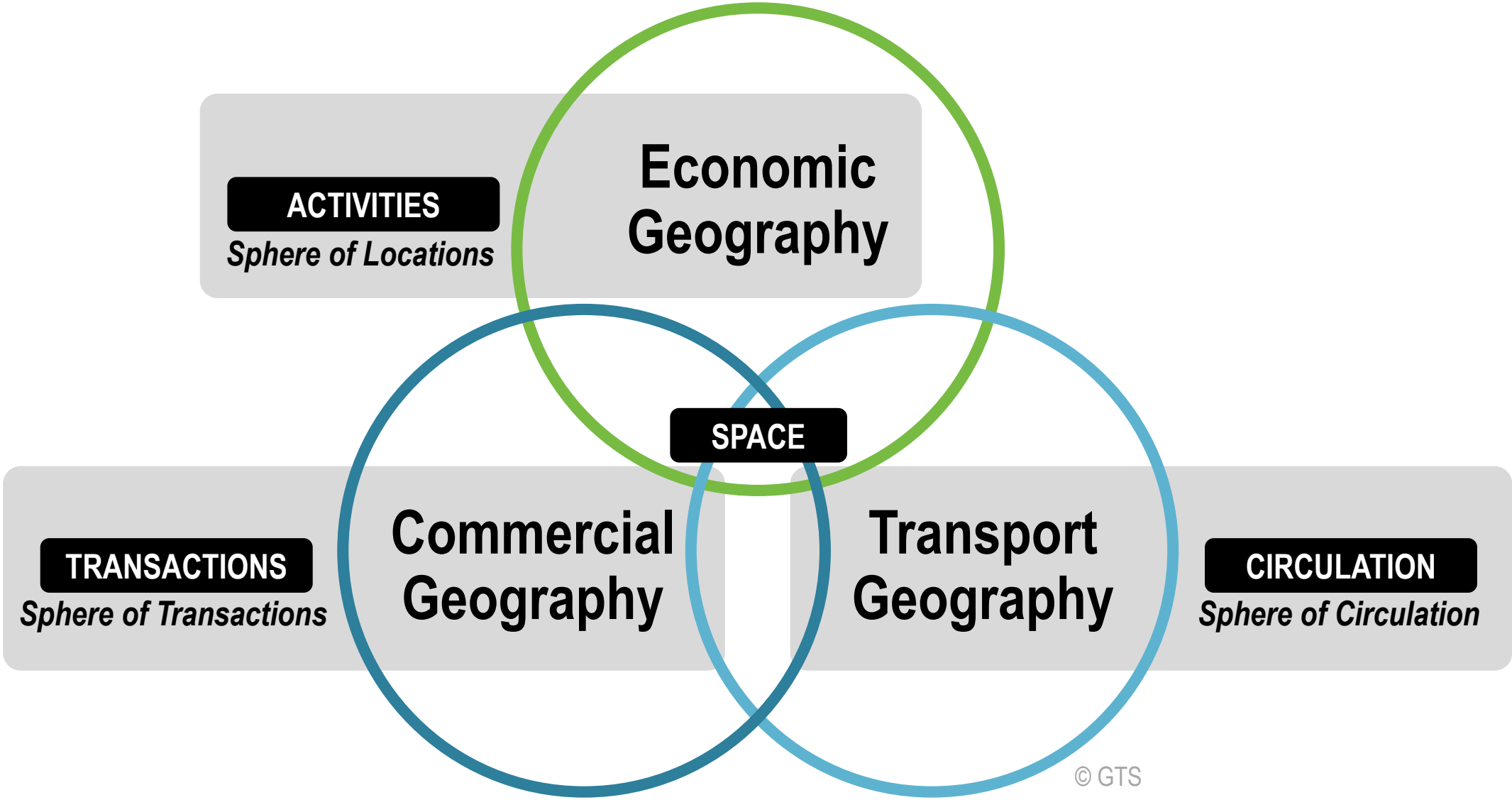
The Economic Output of the World's Major Metropolitan Areas, 2012



Economic, Transport and Commercial Geography



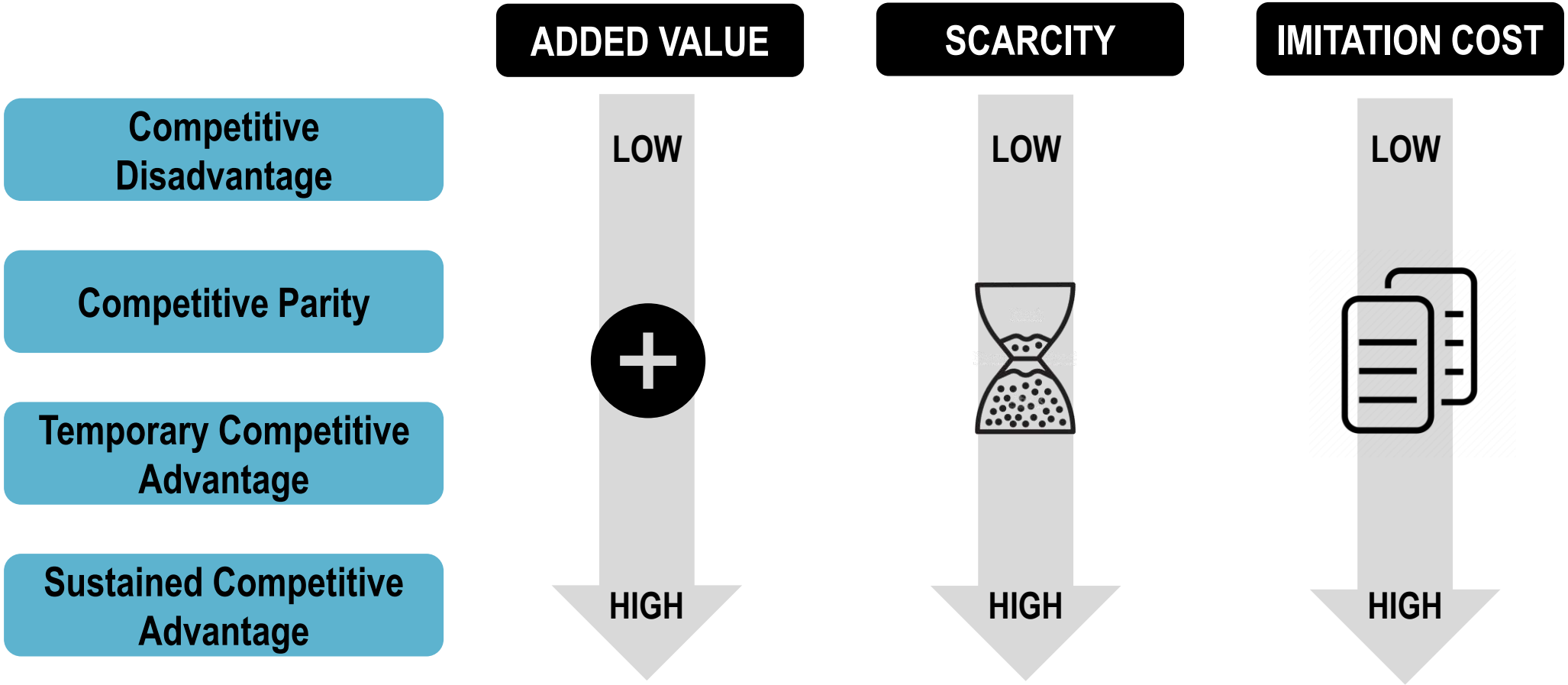
Economic, Transport and Commercial Geography



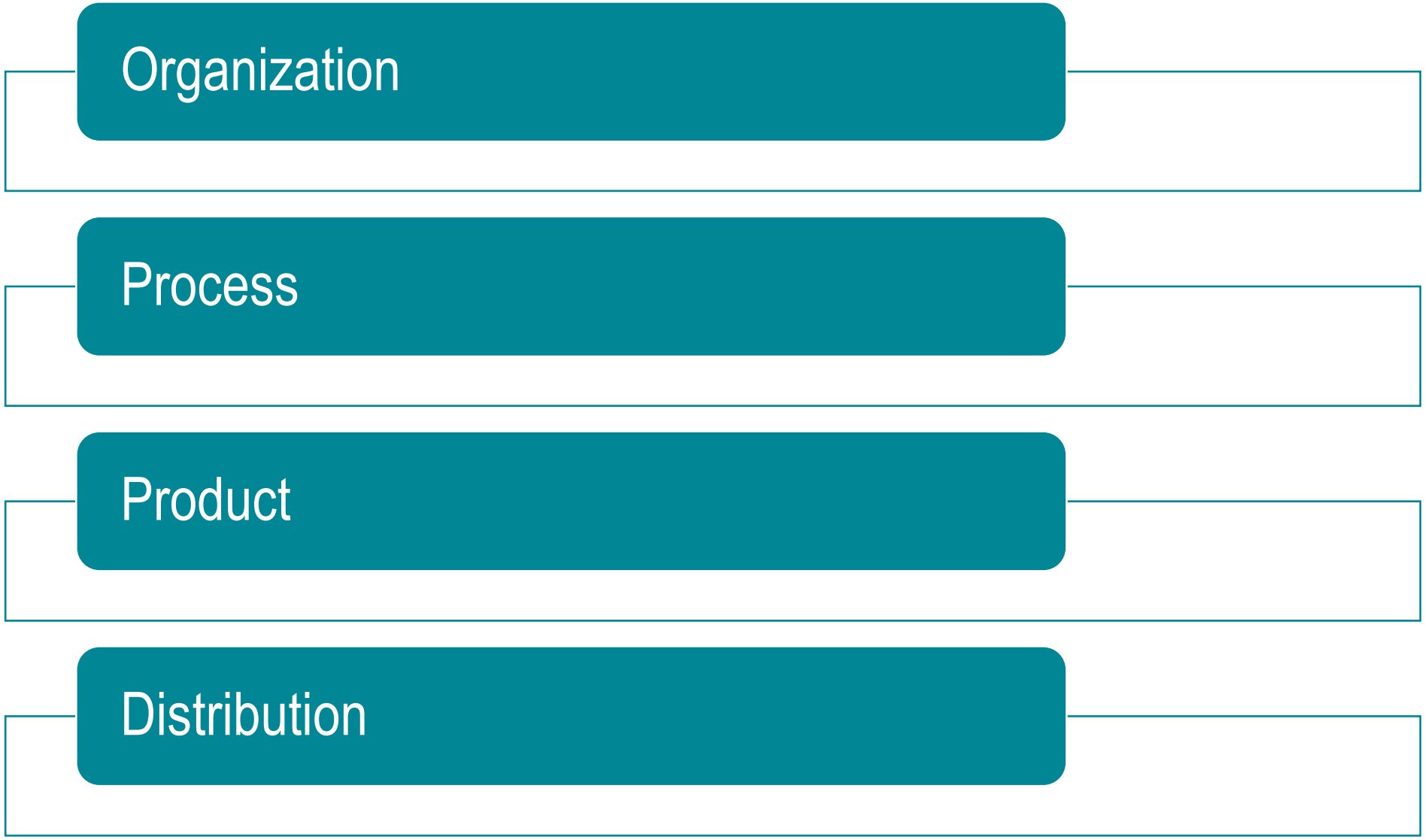
Main Forms of Competitiveness in Transportation (under construction)

Costs | Differentiation | Focus

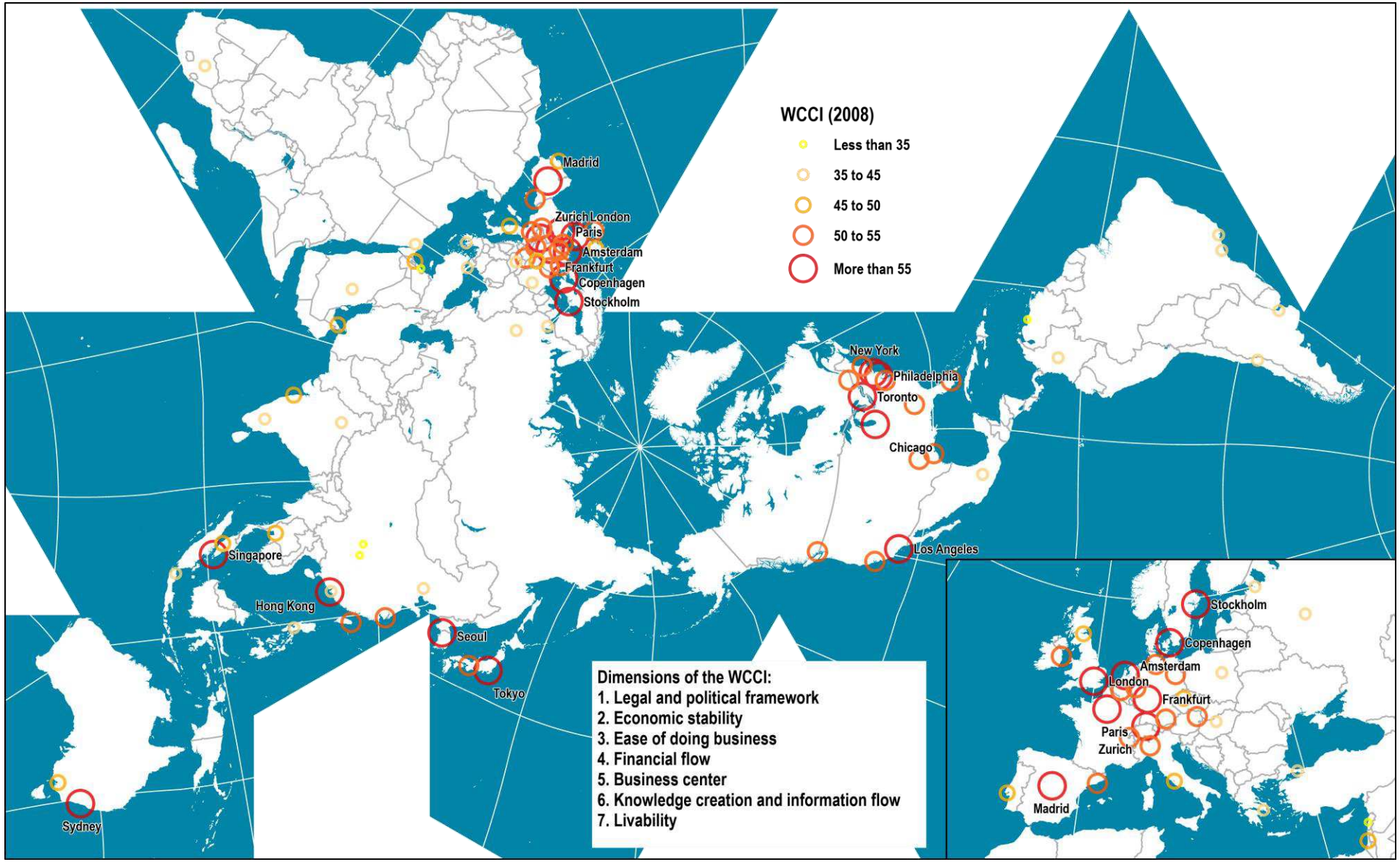
Types of Competitive Advantages



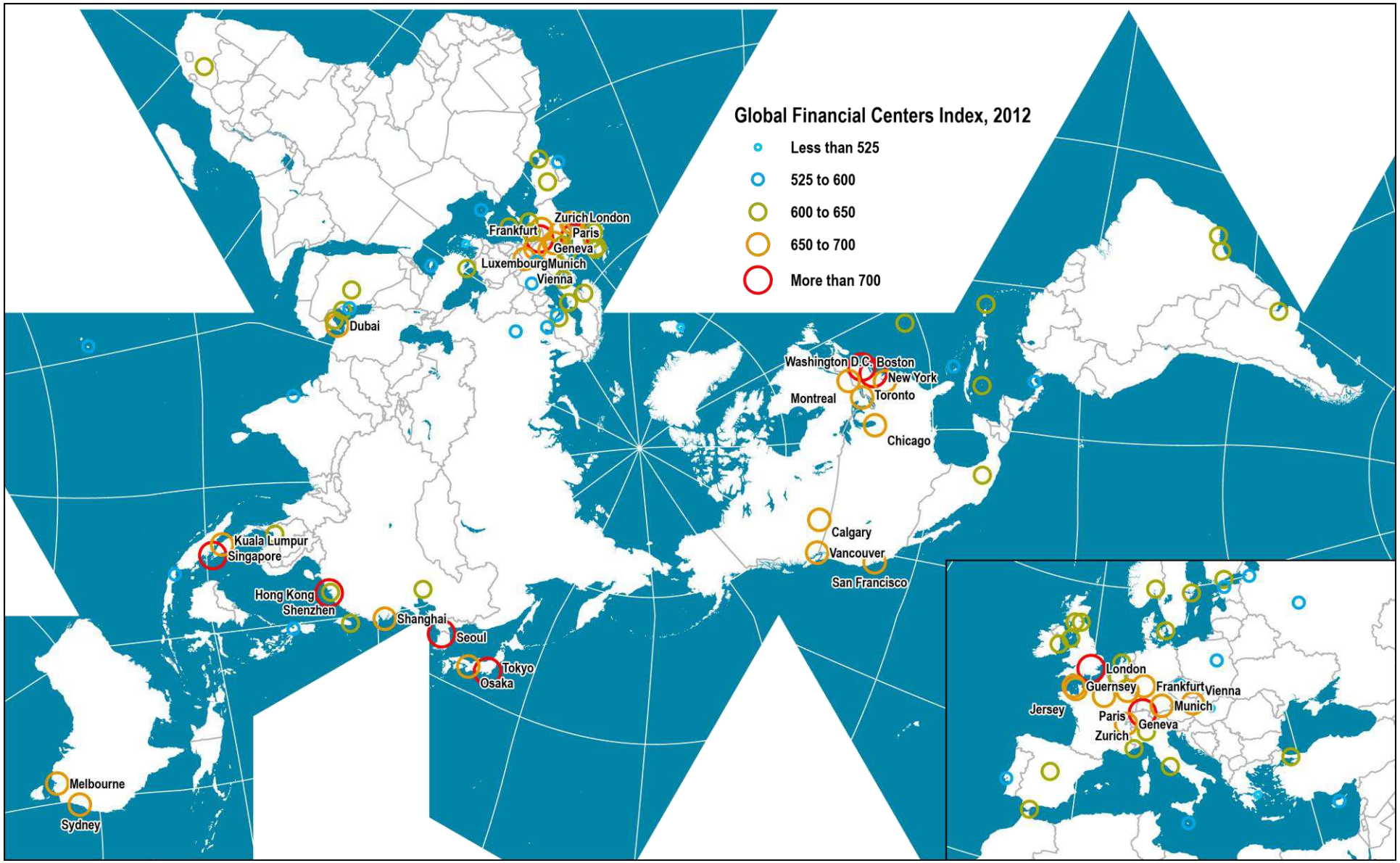
Types of Innovation



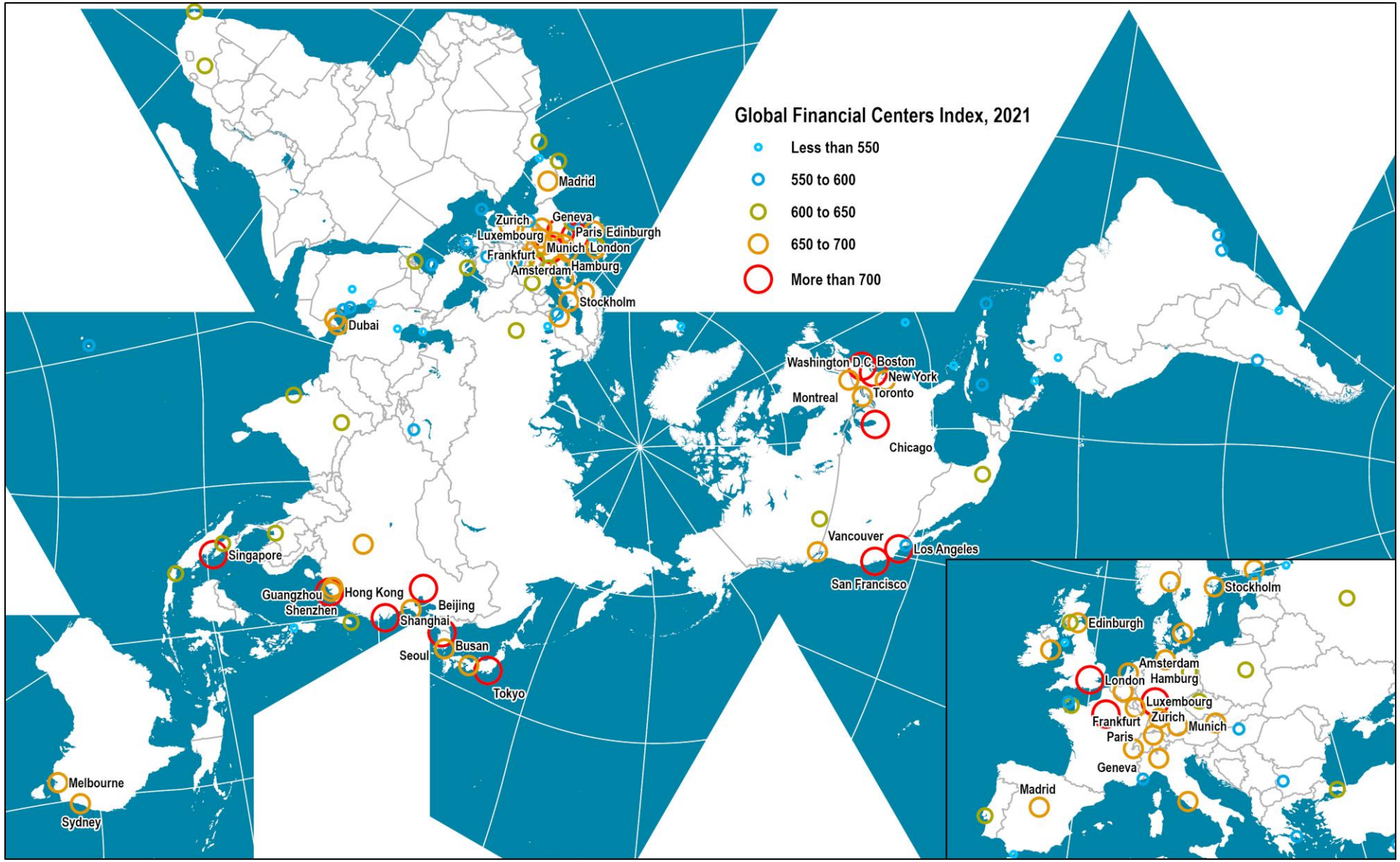
Worldwide Centers of Commerce Index, 2008 (Removed – no longer updated)



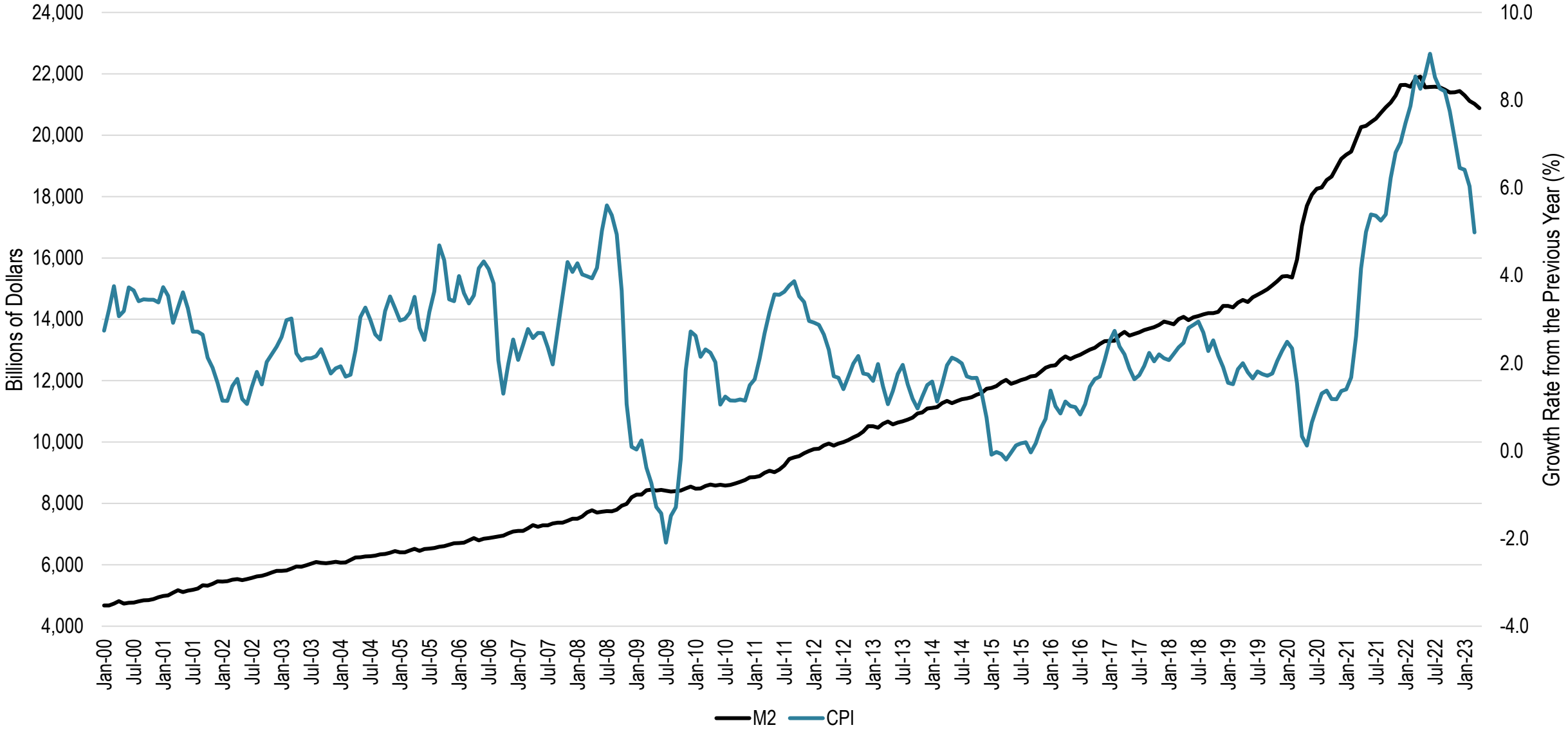
Global Financial Centers, 2012



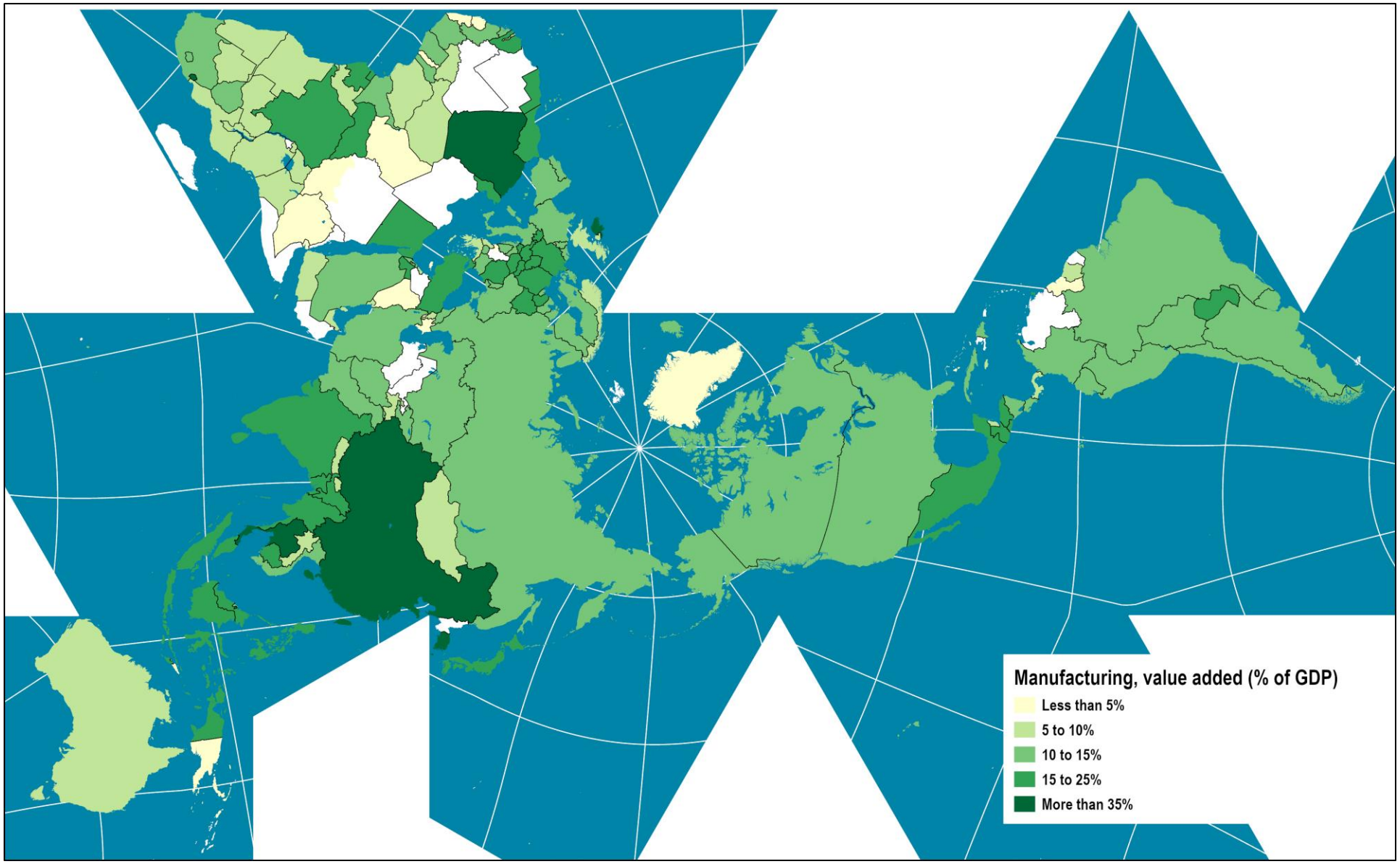
Global Financial Centers, 2021



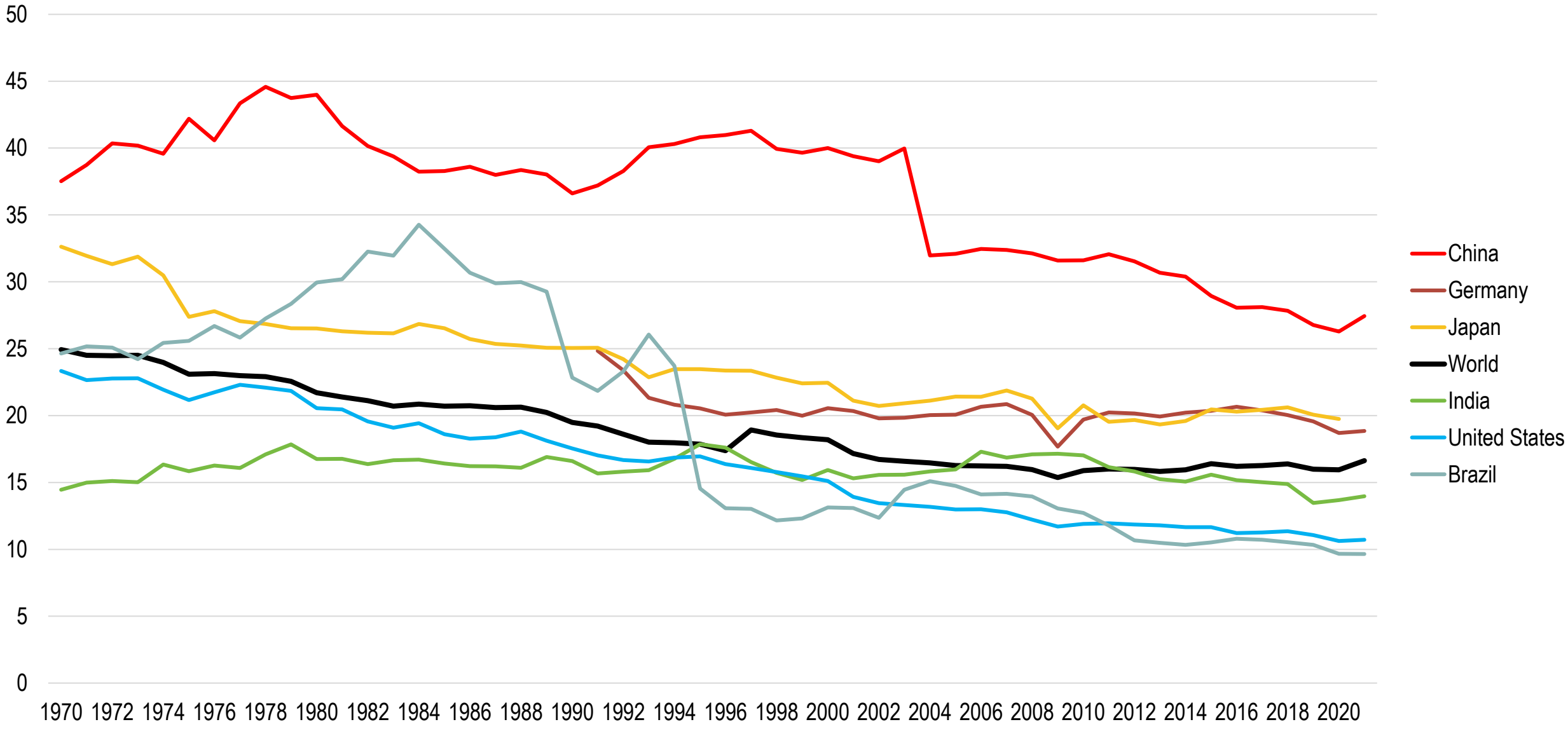
M2 Money Supply and Consumer Price Index, United States, 2000-2023



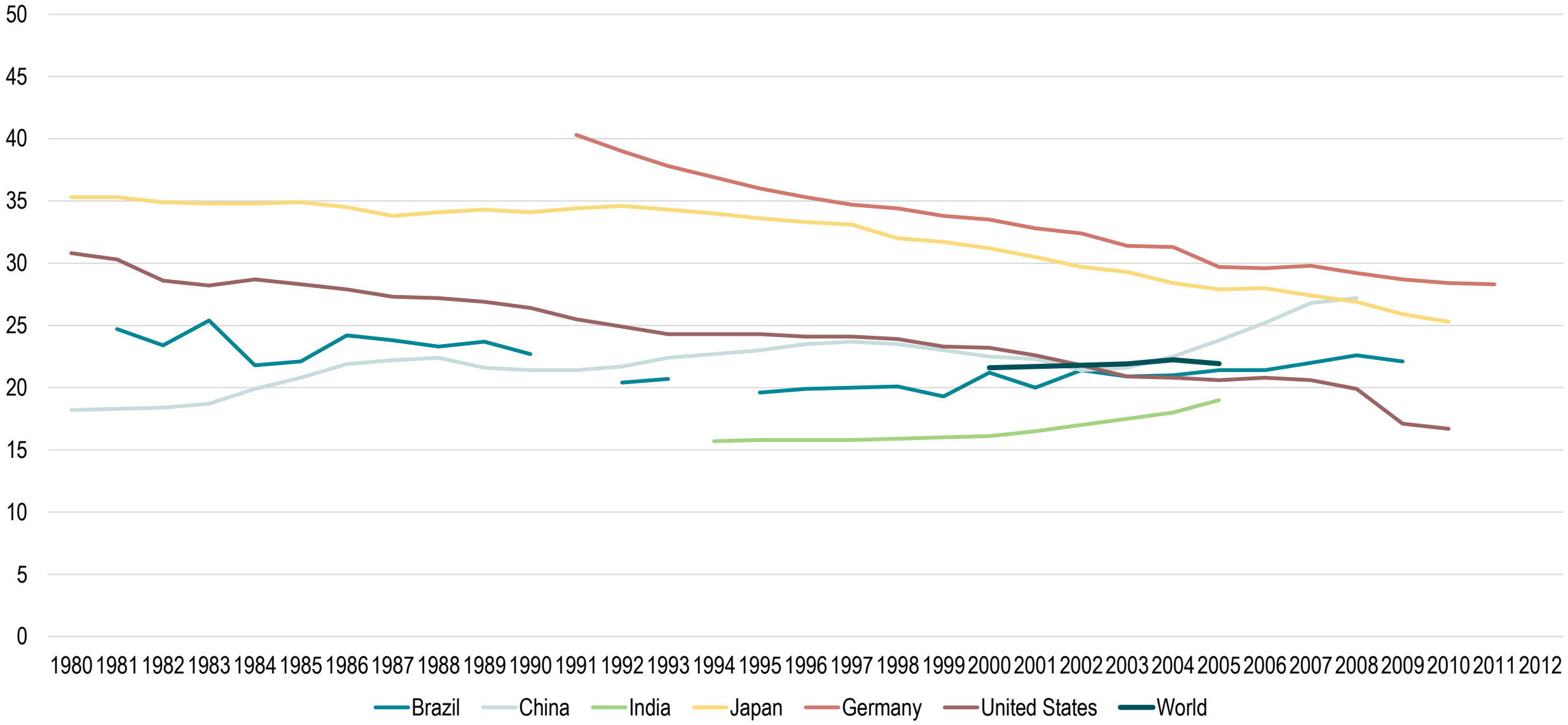
Global Manufacturing, 2015



GDP Share of Manufacturing, Selected Countries, 1970-2021



Employment in Industry (in % of total Employment), 1980-2011



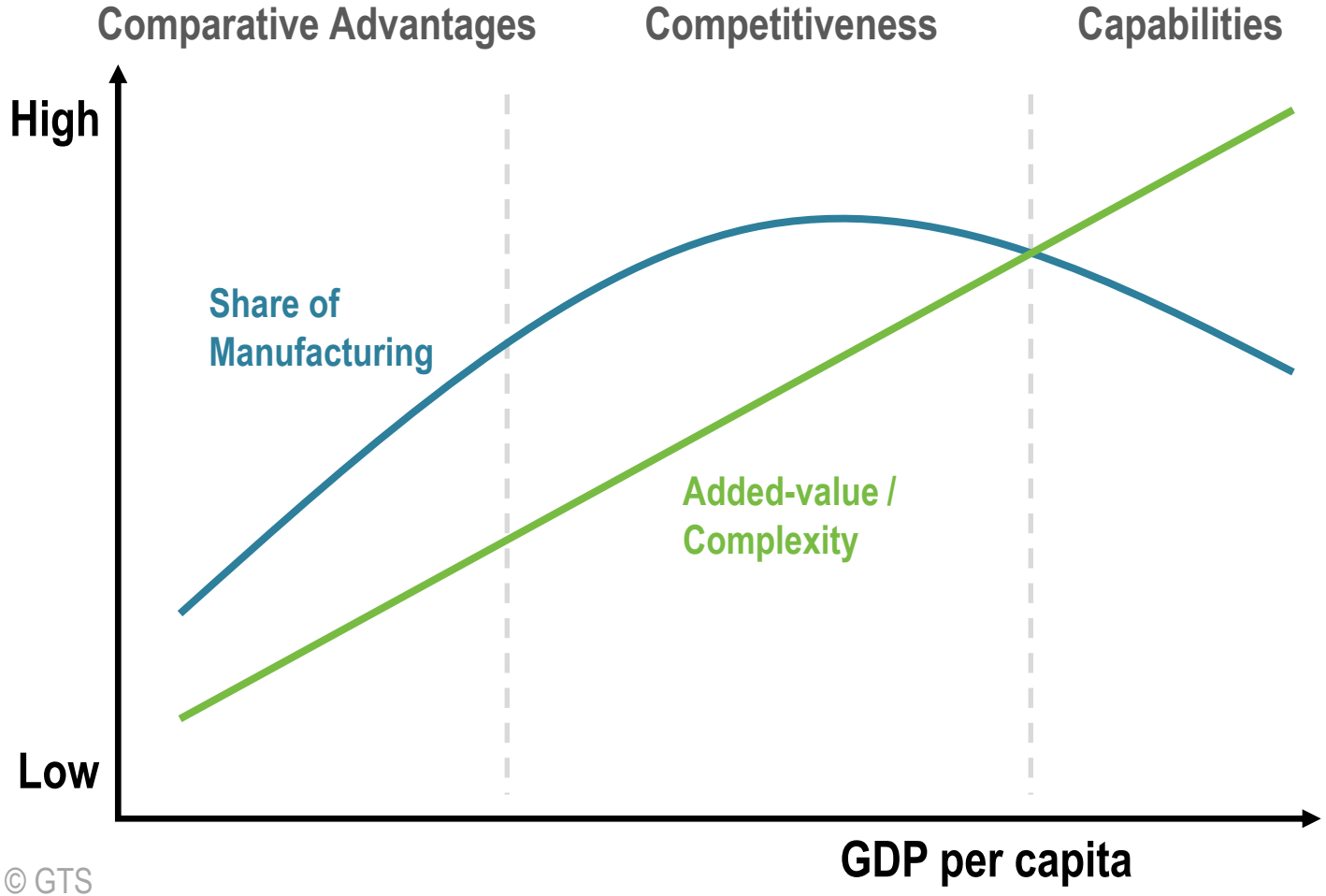
Drivers of Change in Manufacturing and the Transition Towards Added-Value

MARKET FORCES
- Growth in emerging markets
- Demographic shifts

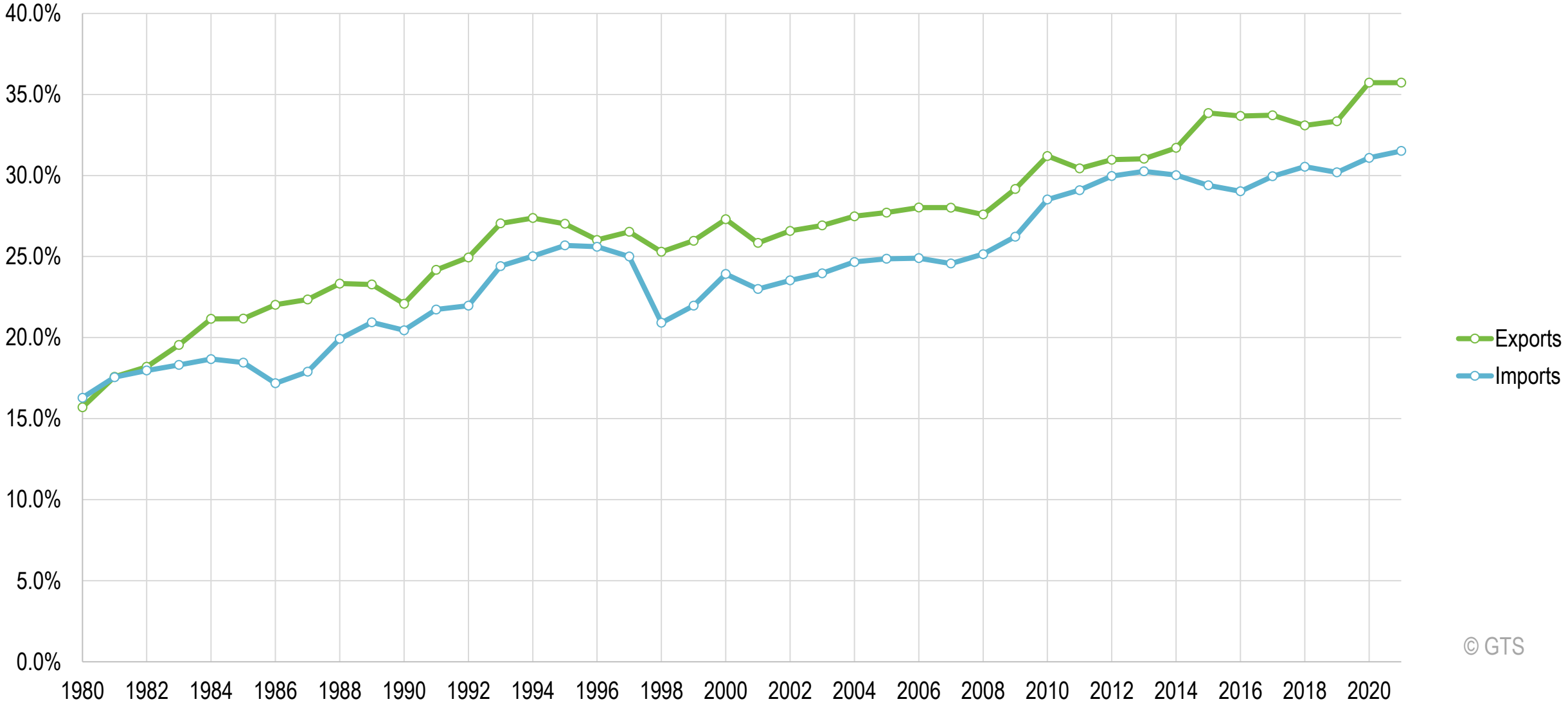
TECHNOLOGIES
- Digitalization and automation
- Production costs
- Improved logistics

RESOURCES
- Energy costs
- Natural resources

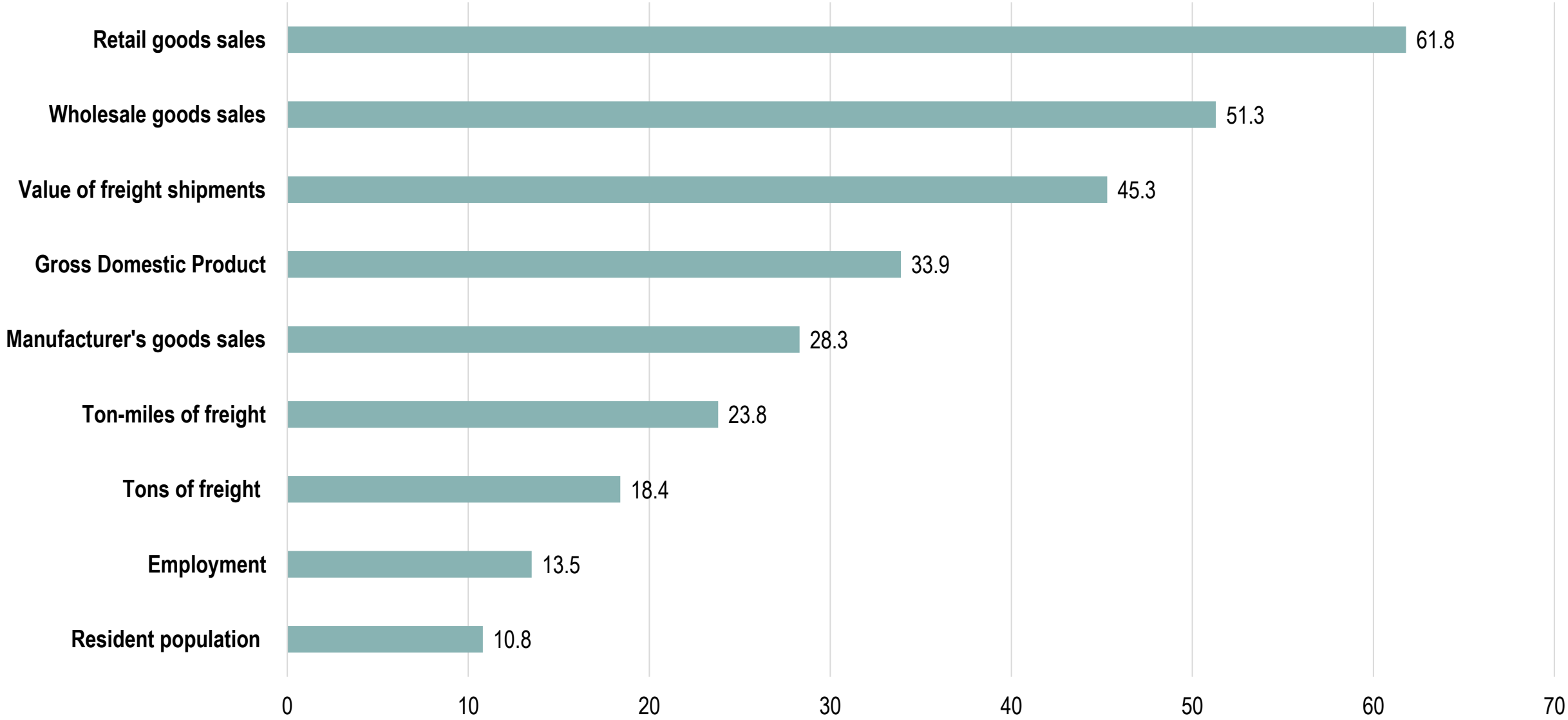
POLICY
- Environmental regulation
- Trade agreements
- Industrial policy



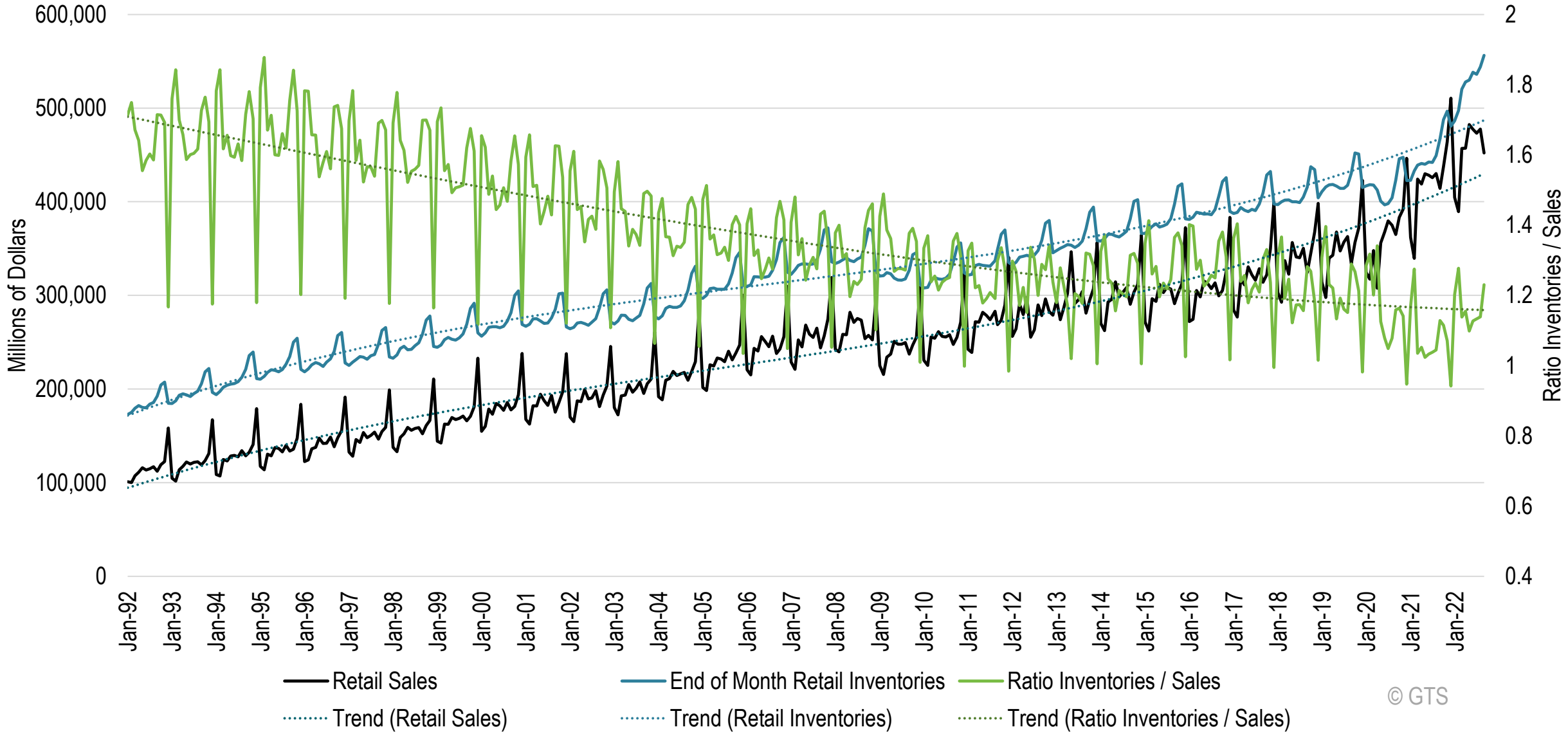
Share of East Asia in the Value of World Merchandise Trade, 1980-2021



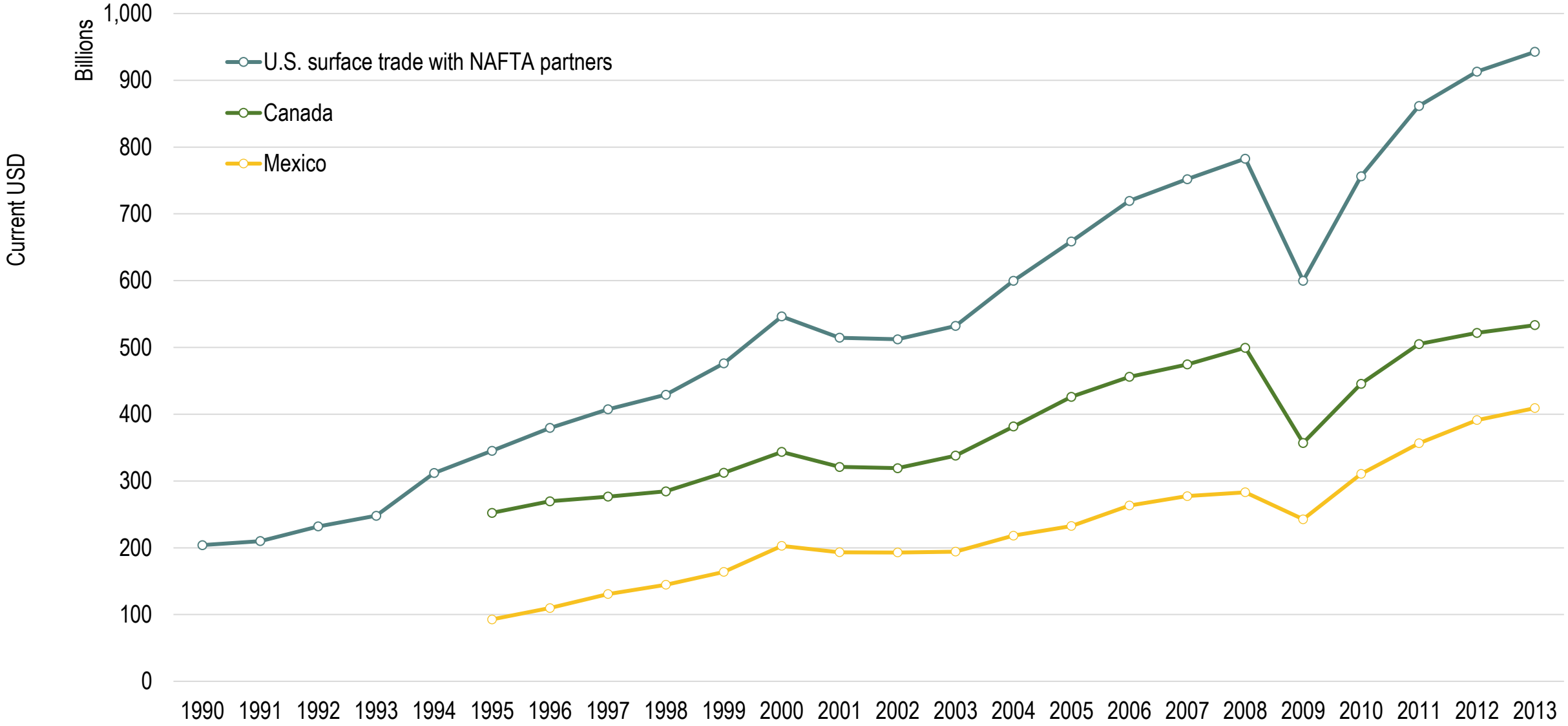
Increases in U.S. Commercial Freight Shipments and Related Growth Factors, 1993–2002



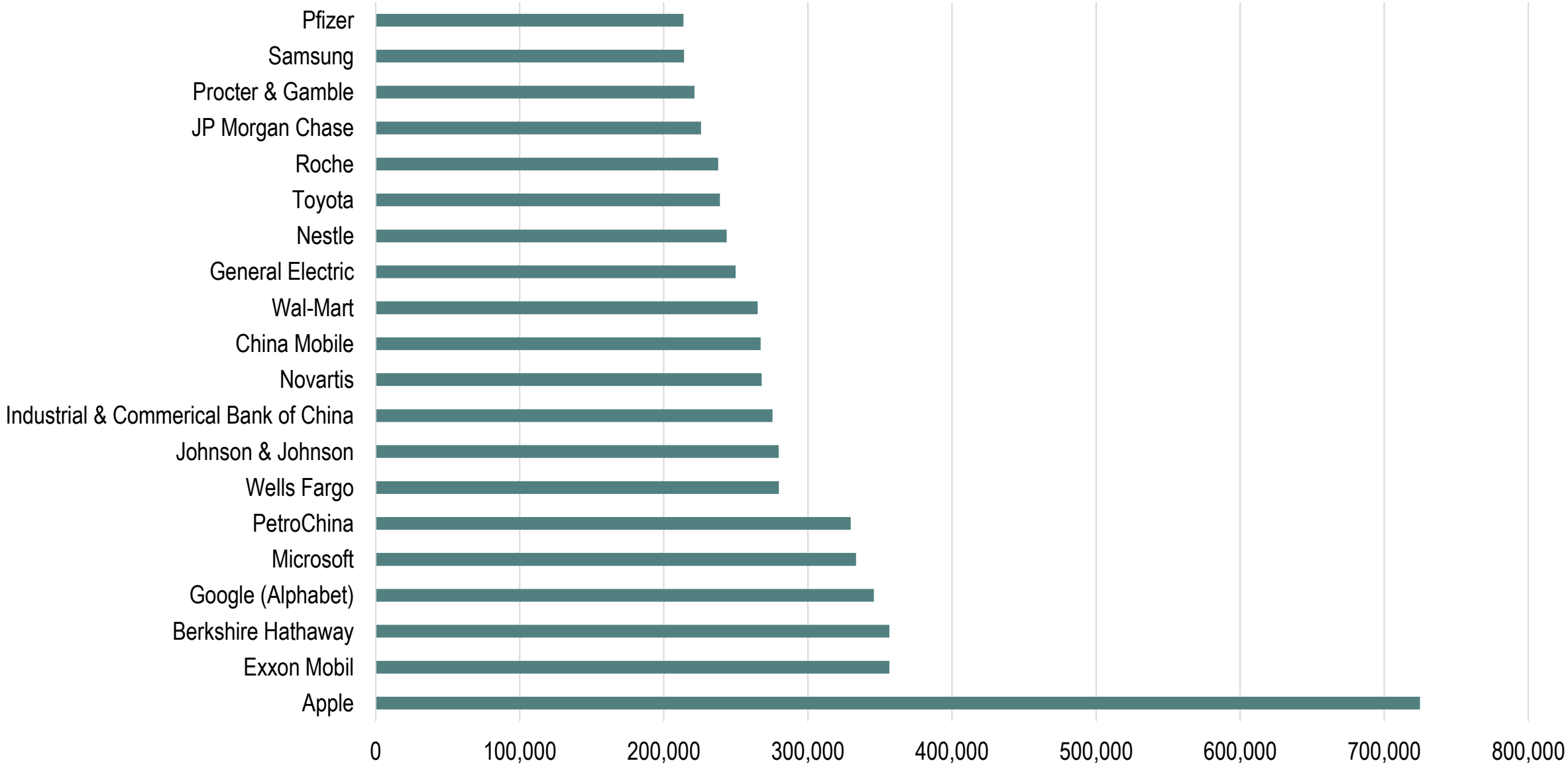
Monthly Retail Sales and Inventories, United States, 1992-2022



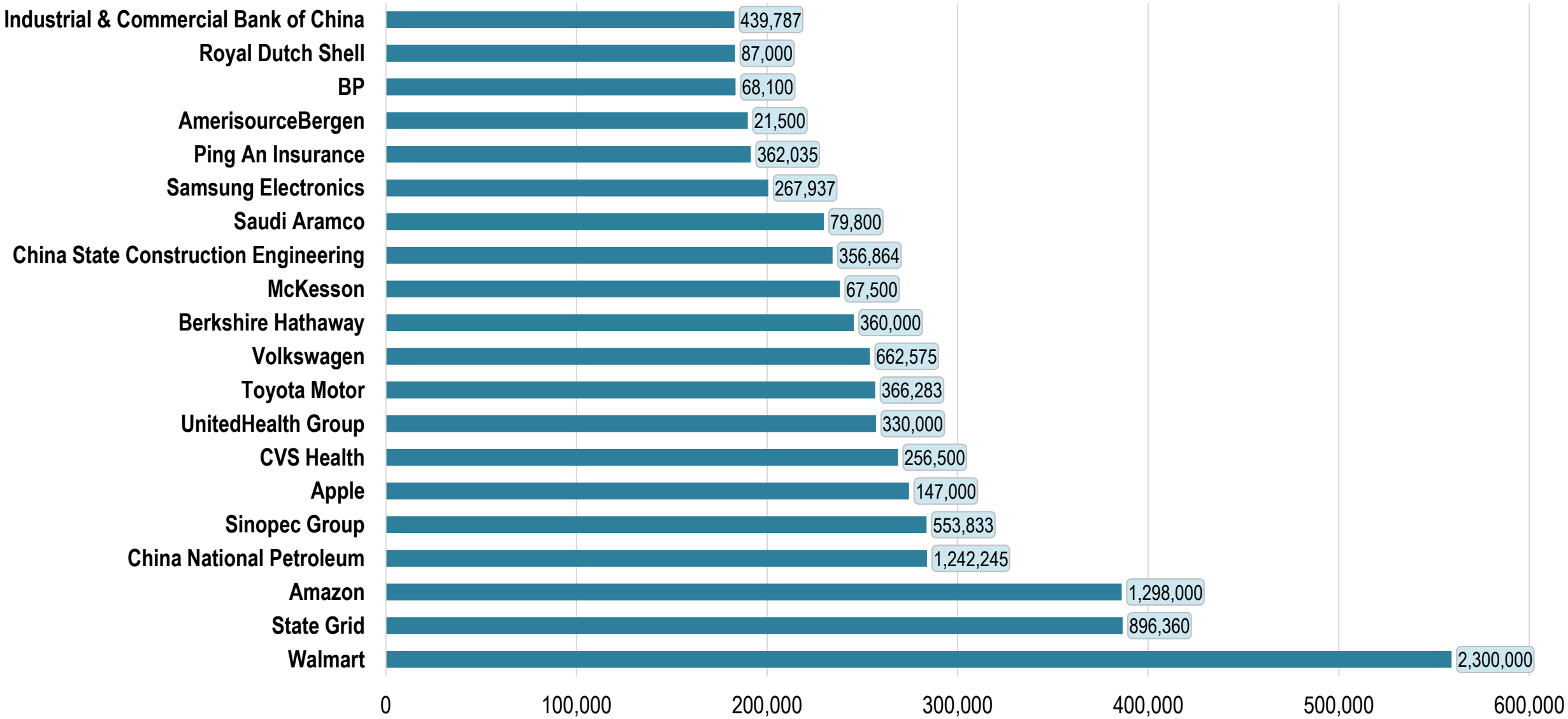
Value of U.S. Merchandise Trade with Canada and Mexico, 1990-2013



The World's 20 Largest Corporations by Market Value, 2015 ($US millions)

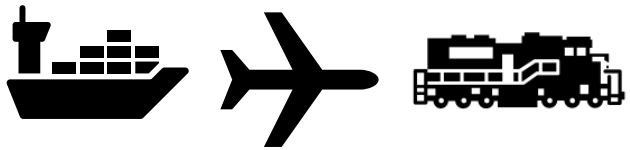


The World's 20 Largest Corporations by Revenue, 2021 ($US millions)



Transportation and Logistics Multinationals

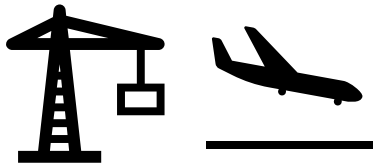
Carriers



- Transport passengers or freight.
- Own or lease their equipment.
- Contracts or spot rates.

- Maritime shipping (Maersk).
- Air carriers (Emirates).
- Rail carriers (BNSF).

Terminal Operators



- Transship passengers or freight.
- Own or lease (concessions) terminals.
- Contracts or spot rates.

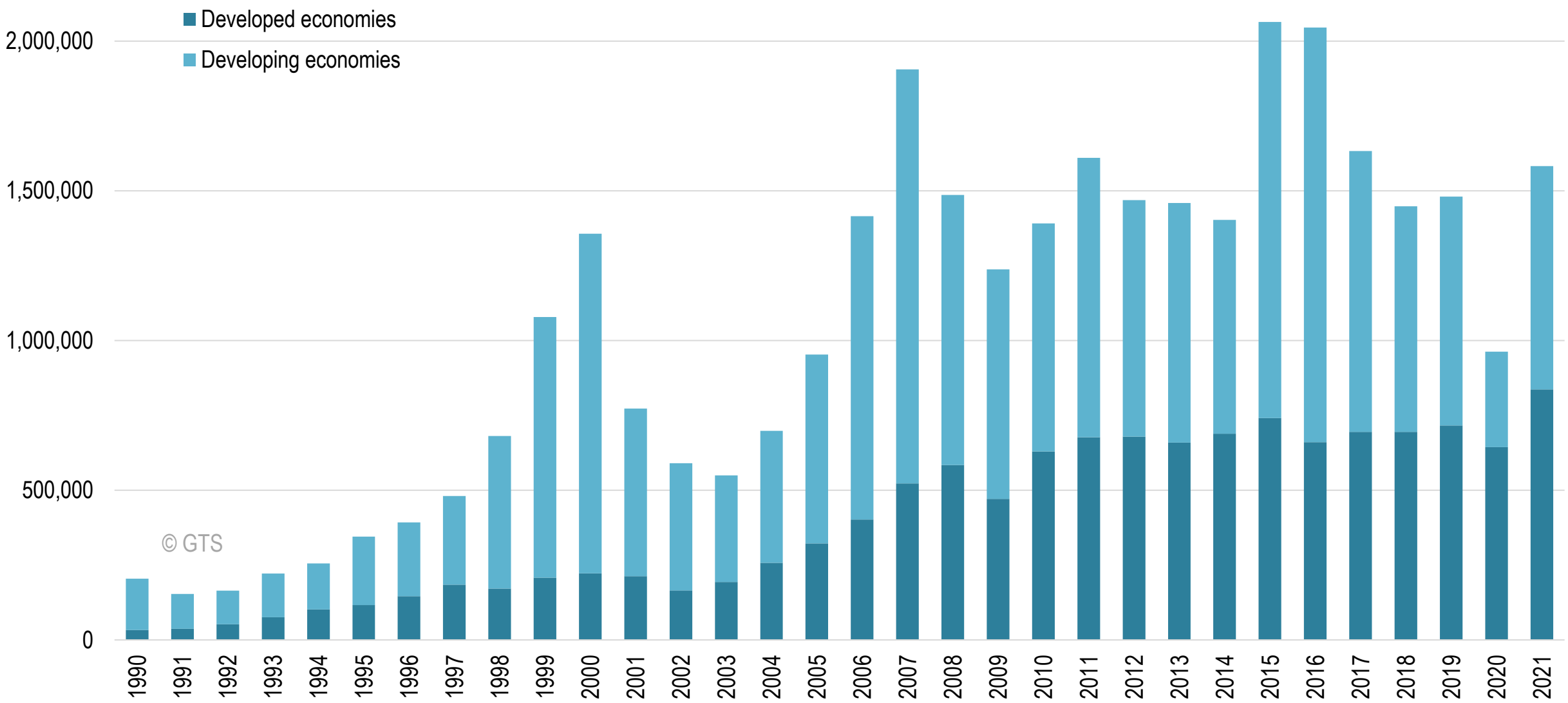
- Container terminals (HPH).
- Airports (Vantage Airport Group).
- Rail (Rail Management Services).

Logistics Service Providers

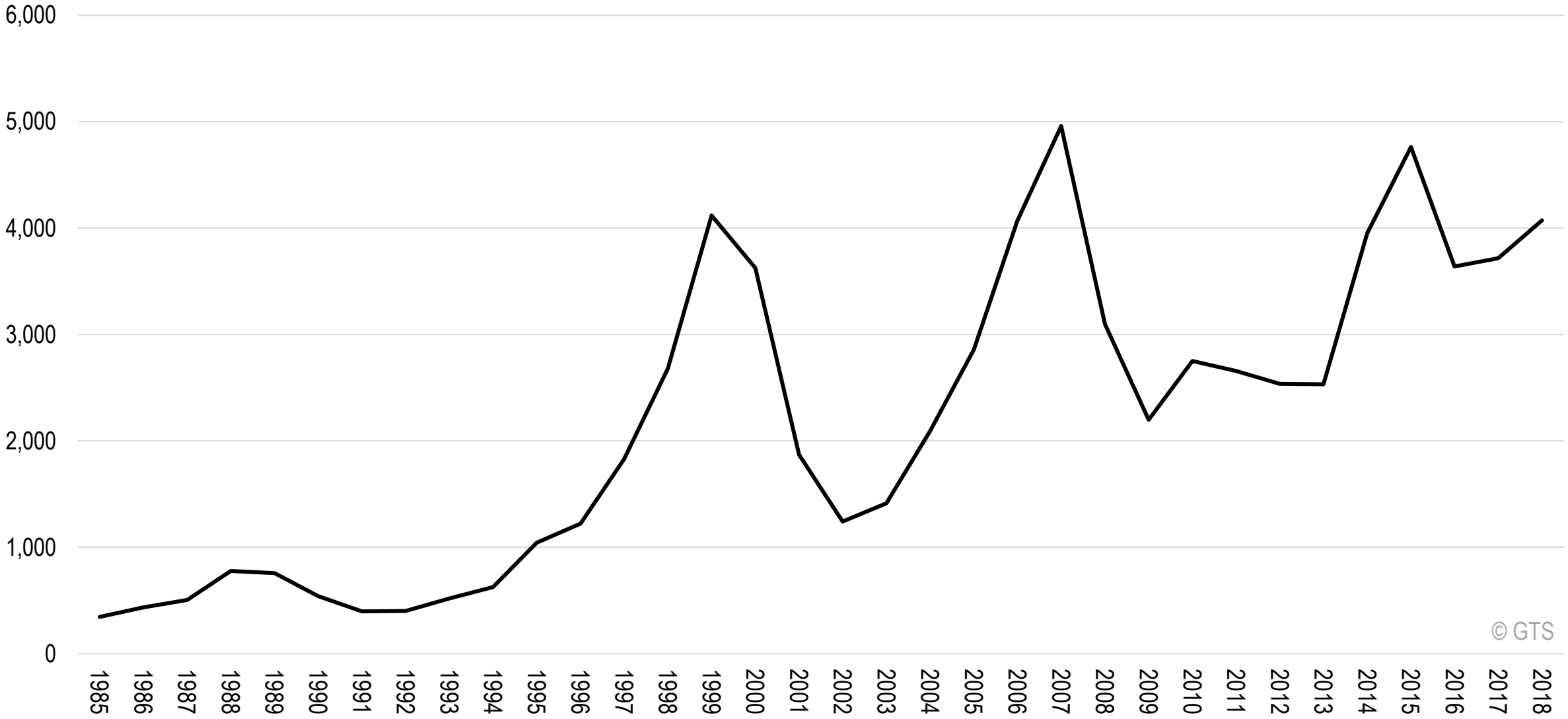
- Offer services such transport, warehousing and supply chain management.
- Arrange transport chains with their own assets or through third parties (carriers and terminal operators).
- Contracts or spot rates.

- Freight forwarders / Third Party Logistics (DHL).
- Logistics real estate (Prologis).

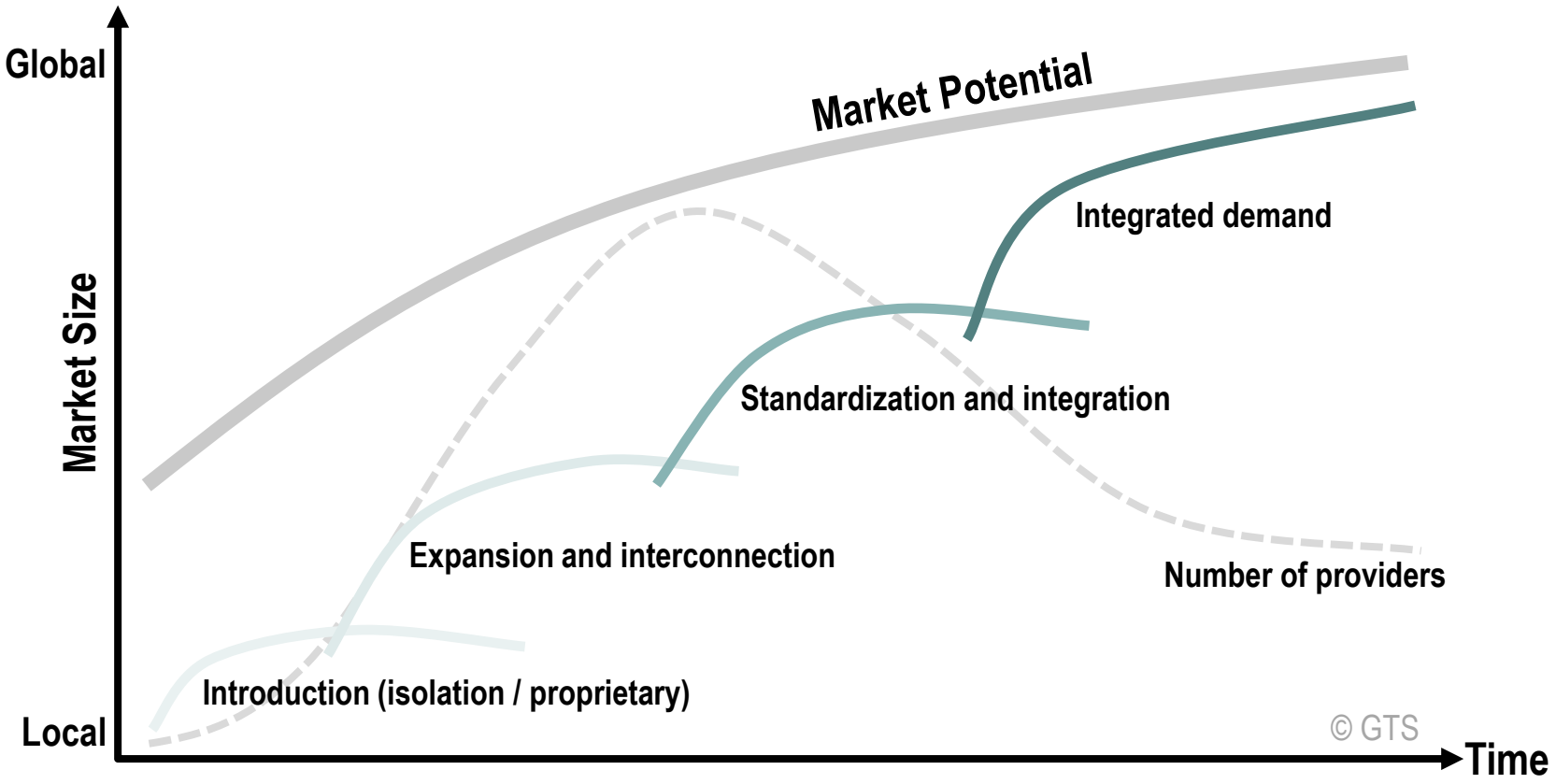
Global Inflows of Foreign Direct Investments, 1990-2021



Worldwide Mergers and Acquisitions, 1987-2018 (in millions current USD)



The Commercialization of Transportation



Selection of Transport Route

	Passengers	Freight
Type I	Individual selects route (private transport)	Shipper or consignee selects route (own account)
Type II	Charterer selects route	Freight forwarder selects route
Type III	Transport company selects route	Transport company selects route

Major Commercial Actors in Freight Distribution

Maritime Shipping Lines

- Control long-distance segments of global freight distribution linking major markets.
- Highly capital-intensive industry.
- Plan network configuration (ports of call).

Port Terminal Operators

- Own or lease terminals within the world's largest container ports.
- Strong linkages with maritime shipping companies.

Port Authorities

- Manage and plan port infrastructures.
- Tend to lease terminal operations.
- Intermediaries for regional distribution (hinterland).

Commercial Real Estate Developers

- Develop logistics zones (build to lease, build to suit), often in coordination with terminals operators.
- Real estate portfolio of distribution centers (leases).

Maritime Lock and Canal Operators

- Operate strategic passages in global and national distribution (e.g. Panama Canal, Suez Canal or St. Lawrence Seaway).

Truck Carriers

- Control vast and diverse assets, including critical segments of freight distribution.
- Short and medium-haul transport.

Rail Carriers and Terminal Operators

- Strategic inland freight carriers transporting a wide array of raw materials and commodities.
- Responsible for the transshipments between rail and road, (particularly for containerized freight).

Third-Party Logistics Providers

- Provide managerial and organizational skills within supply chains.
- Often act as brokers between transport customers and service providers.
- Some own and operate transport assets.

Air Freight Carriers

- Important assets for the rapid distribution of high added value freight.
- Network configuration (airports serviced).

Freight Forwarders

- Perform tasks such as packaging, labeling, and the consolidation of shipments on behalf of their customers.
- Operate distribution centers.
- Define how markets are serviced.
- Can subcontract to third-party providers.

The Relevance of Logistics

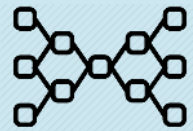
Costs ➡ **Friction of distribution**

- Efficient logistics has commercial benefits (costs, time and reliability).
- Logistics cost 10-15% of national GDP.

Growth ➡ **Growing material demand**

- Growth of global consumption and income.
- Diversity of consumption patterns.

Complexity ➡ **Complex value chains**



- Goods are getting more complex (parts and processes).
- Embeddedness of design, manufacturing, distribution and marketing.

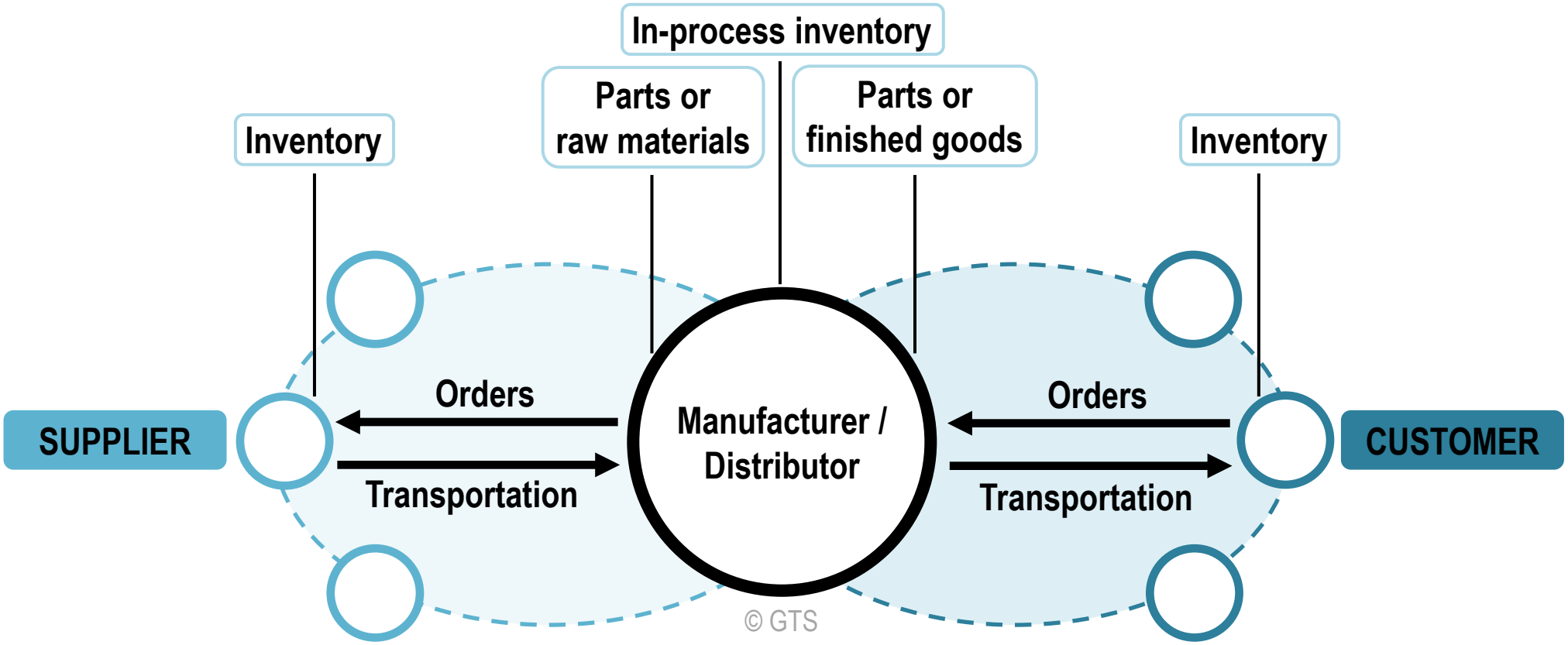
Geography ➡ **Spatial division of manufacturing**

- Stages of production are spatially separated.
- Final production and markets are spatially separated.

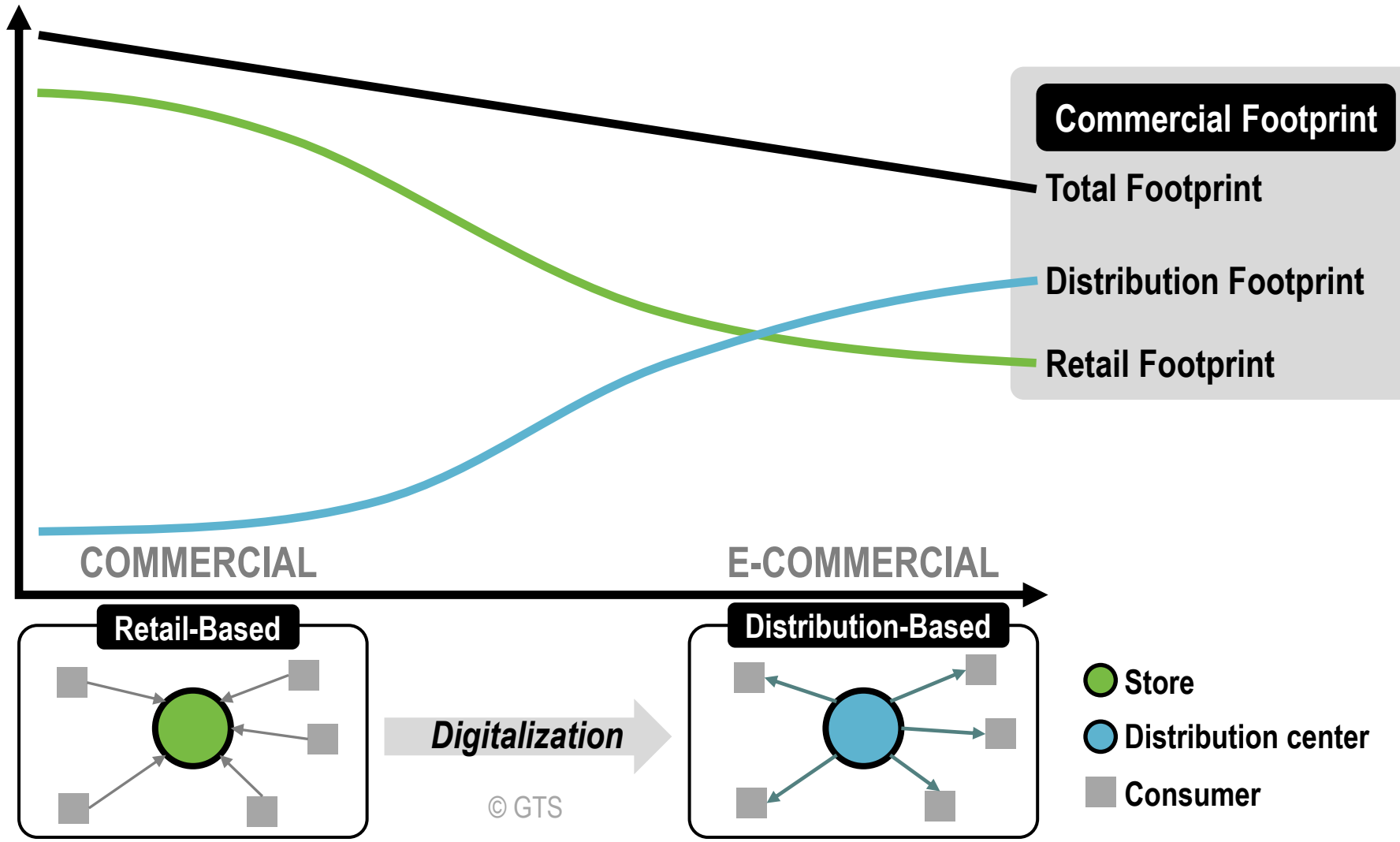
Environment ➡ **Sustainability**

- Energy and material efficiency.
- Reverse logistics / recycling.

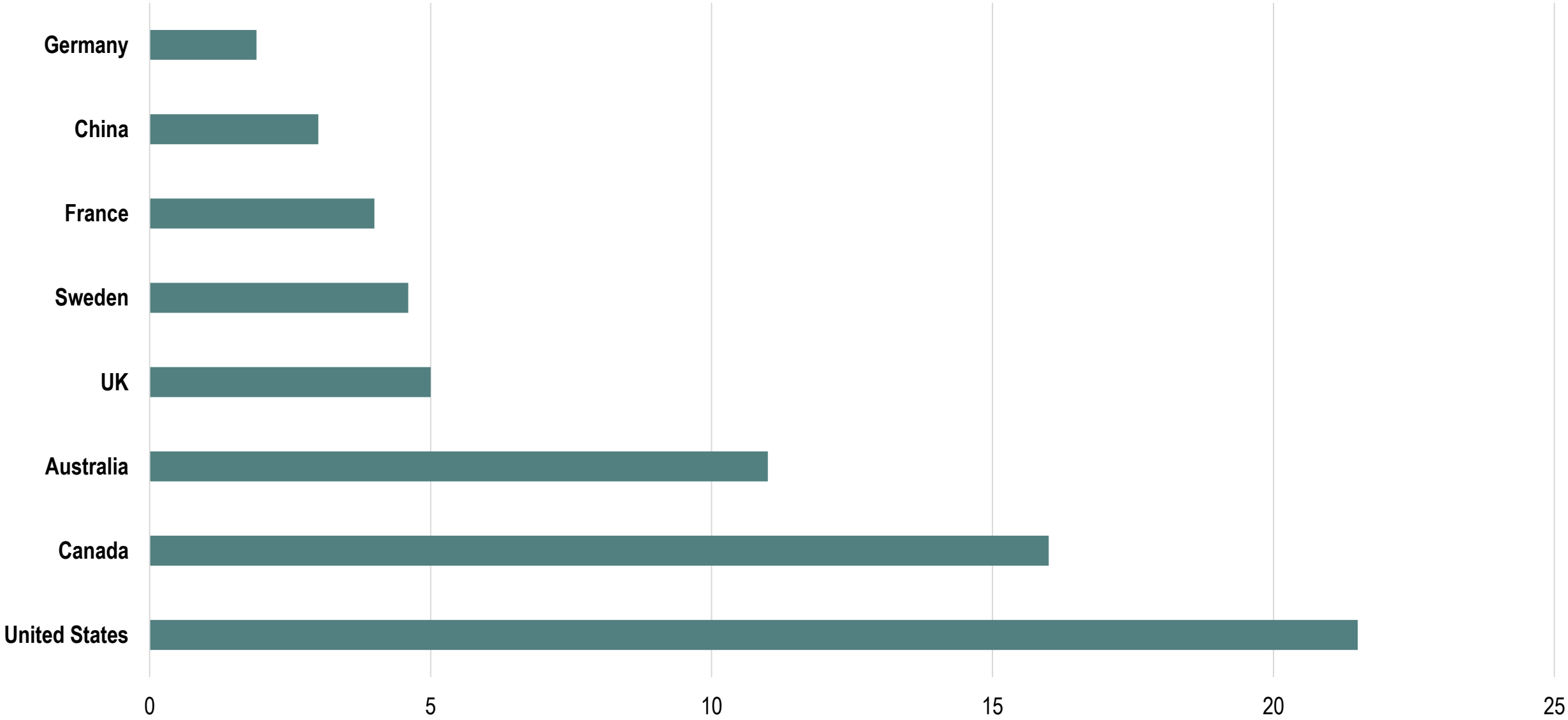
The Nature of a Supply Chain



Footprint of Retail-Based and Distribution-Based Commercial Activities



Retail Space per Capita, 2017 (in square foot)



Factors behind Empty Transport Flows