

# The Geography of Transport Systems

Jean-Paul Rodrigue

Sixth Edition



# Trade, Logistics and Freight Distribution

## CHAPTER 7

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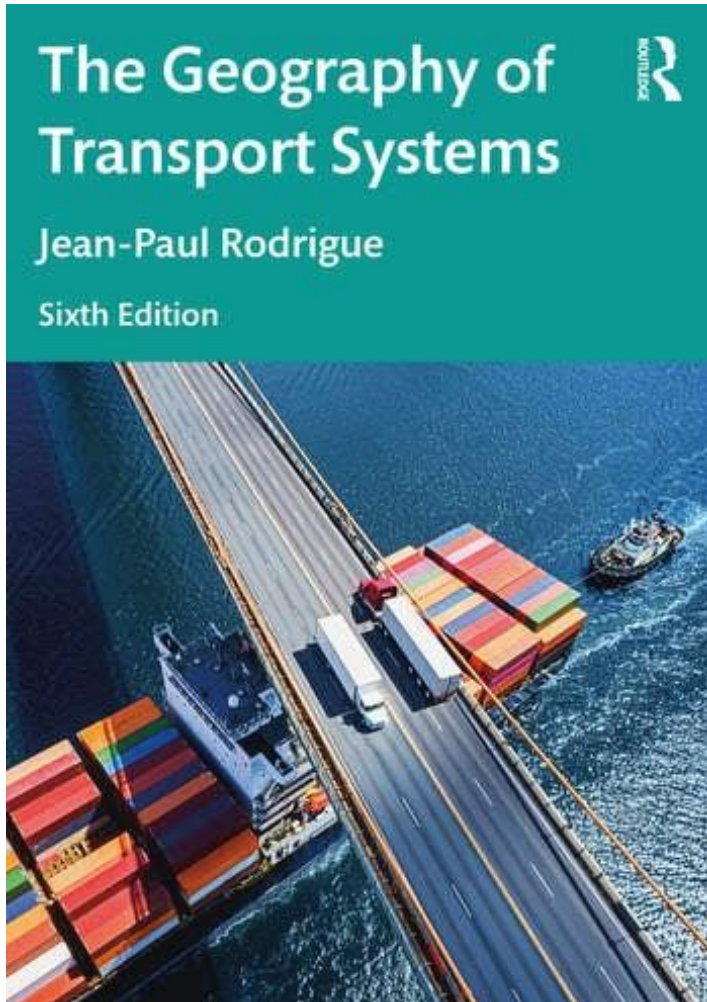
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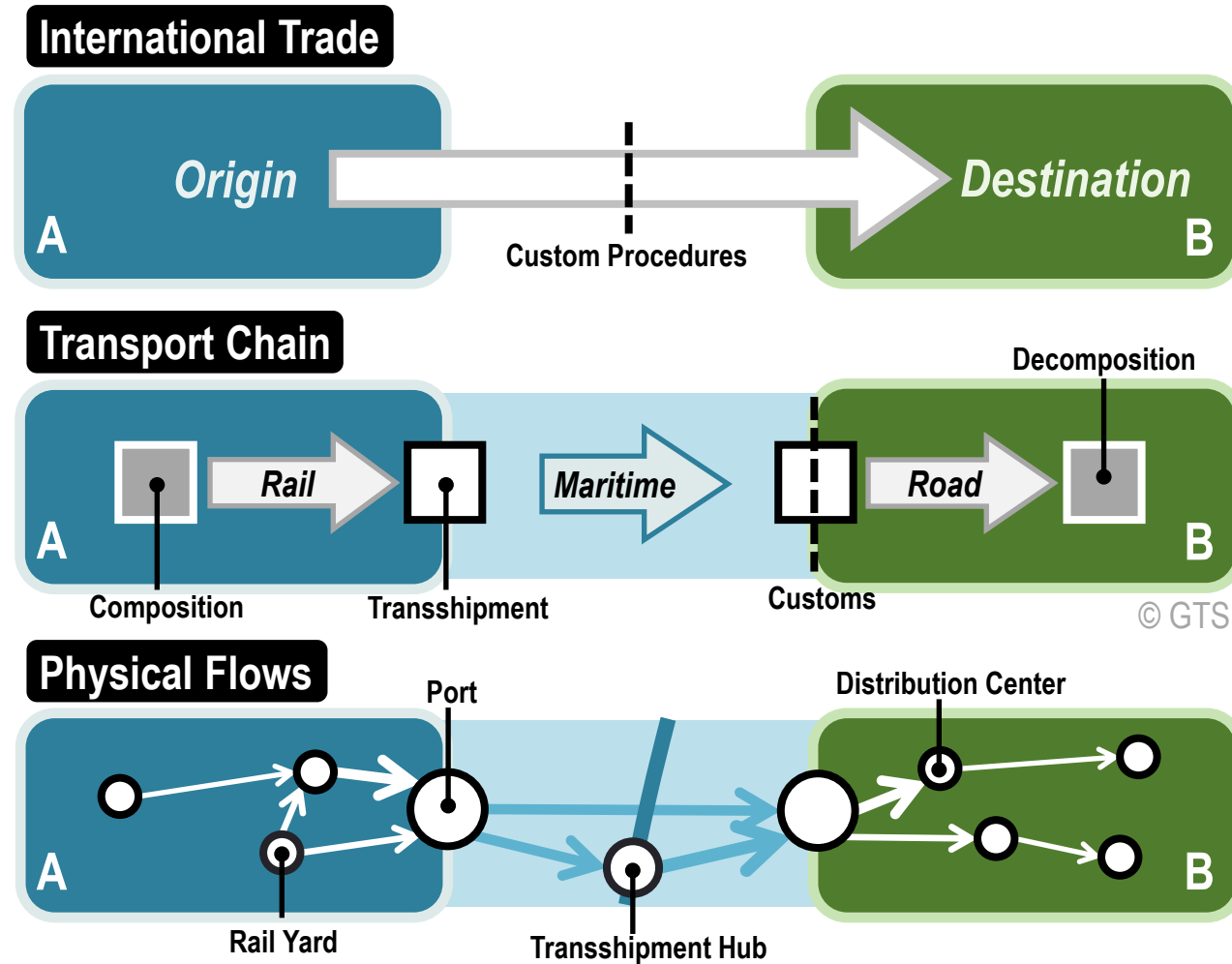
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# Transborder Transportation

## Chapter 7.1

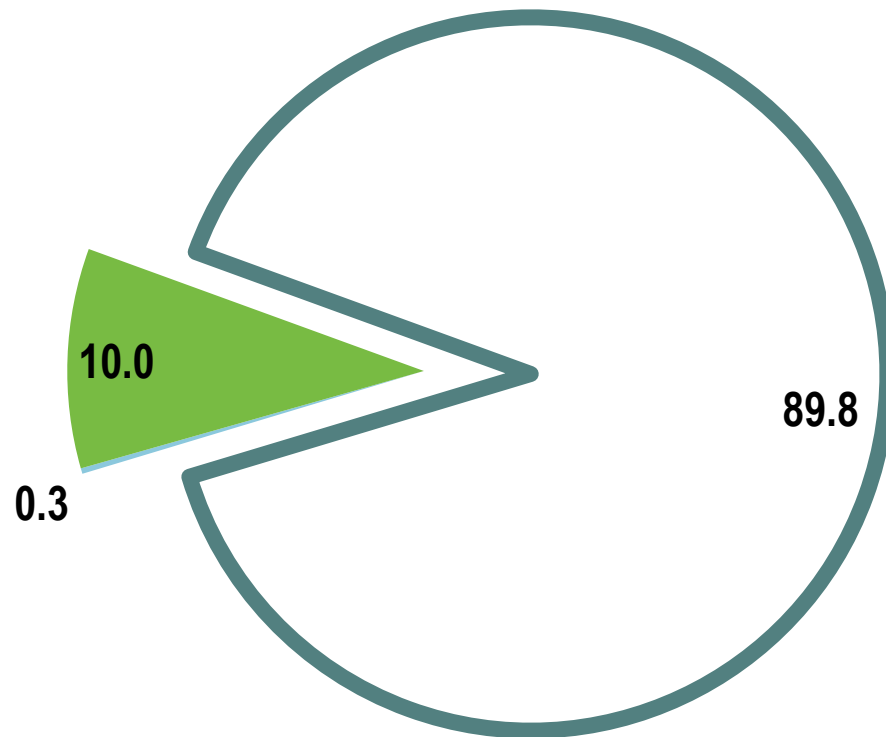
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# International Trade, Transportation Chains and Logistics



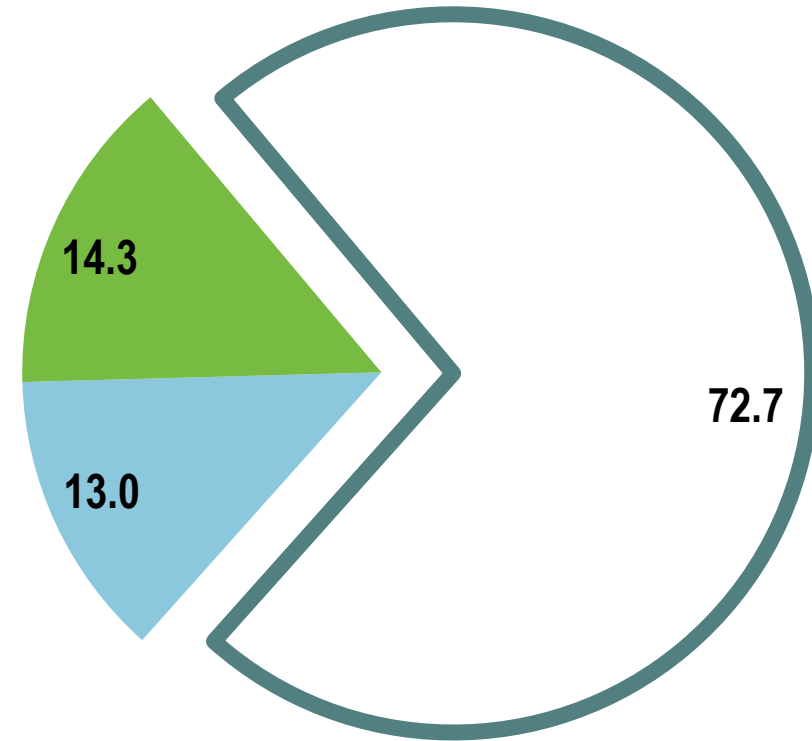
# Modal Shares of World Trade by Volume and Value, 2008

## Volume of World Trade



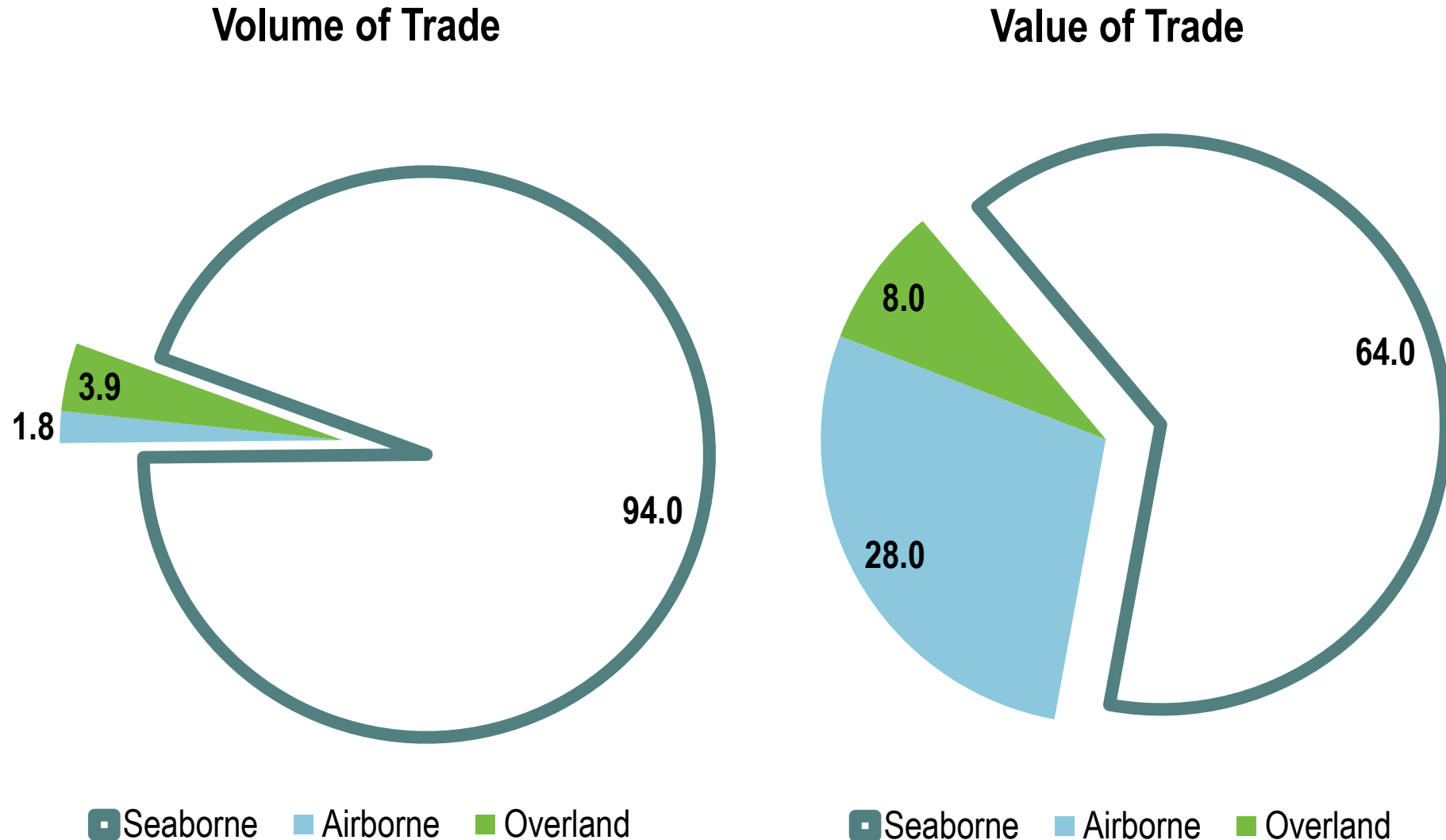
■ Seaborne ■ Airborne ■ Overland

## Value of World Trade



■ Seaborne ■ Airborne ■ Overland

# Modal Shares of China Trade with Europe by Volume and Value, 2016



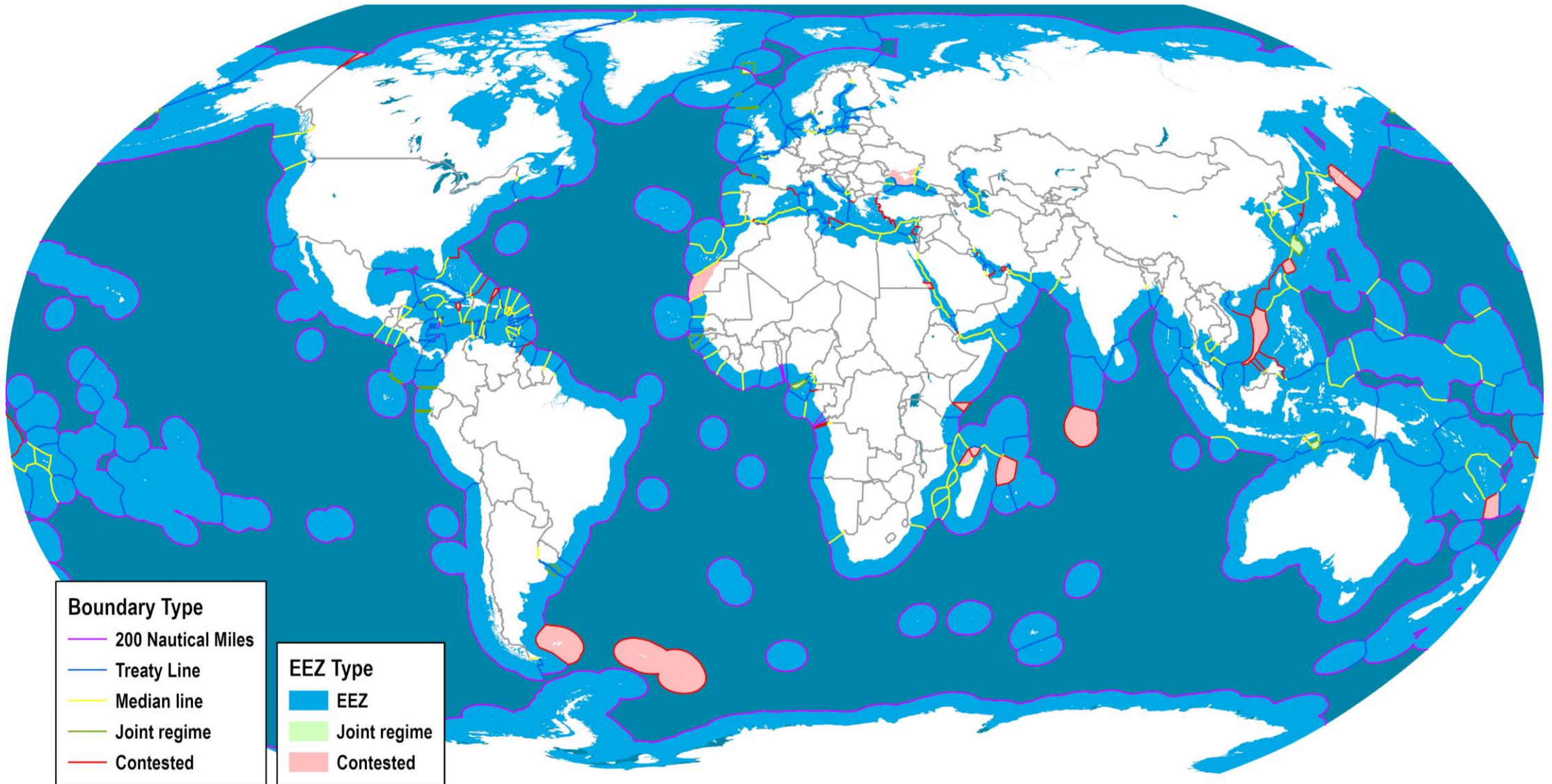


# Geostrategy of International Transportation

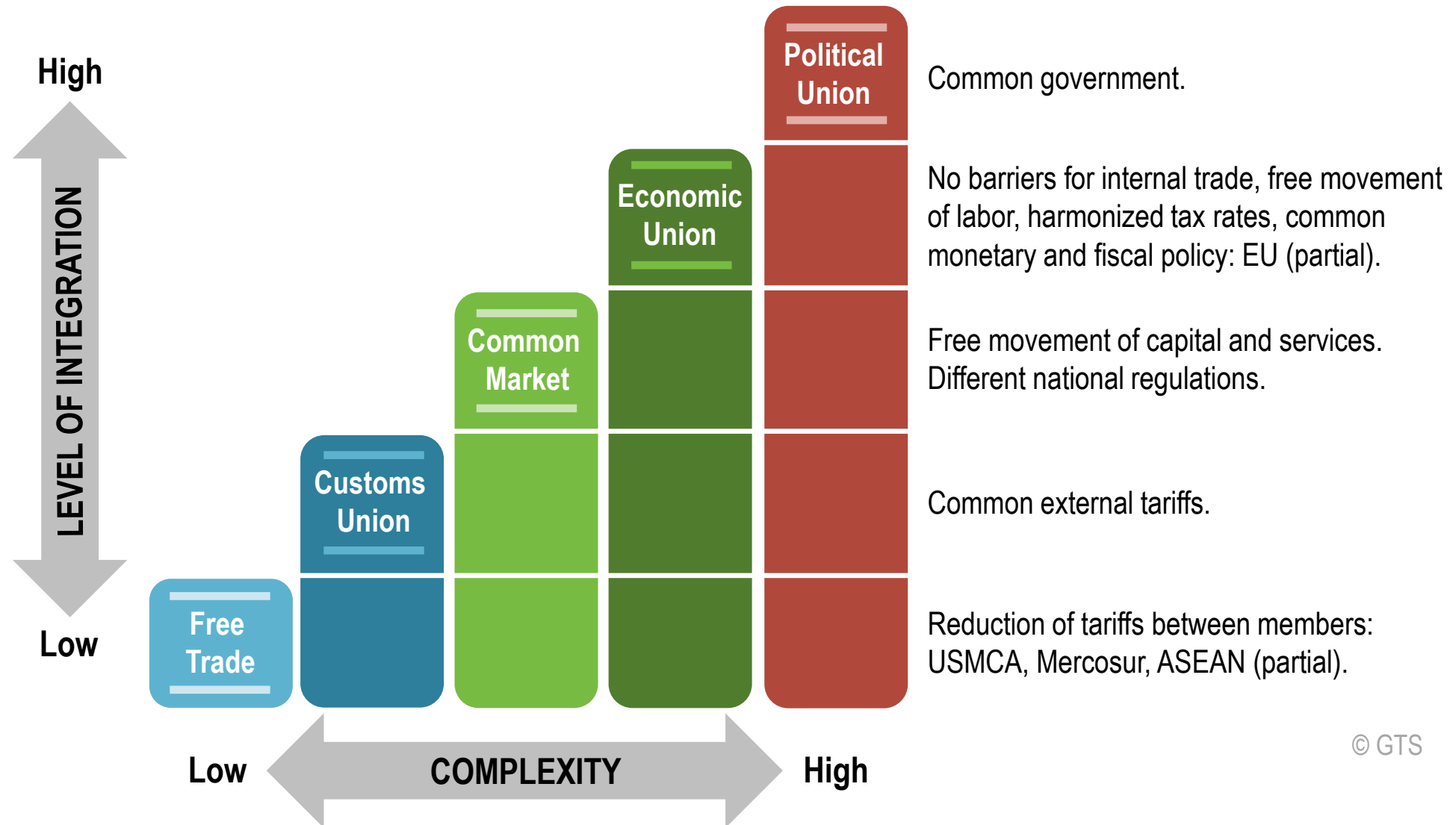
Perspective	Issues
Conquest	Acquire and conquer oceans, territories and resources. Maritime and railroad technology.
Competition	Mean to compete on the global economy. Prevalent force in shaping modern transportation systems. Right to carry national passengers and freight.
Jurisdiction	Subject to national rules and regulations. Territorial sea (22 km); complete jurisdiction. Exclusive Economic Zone (340 km); access to resources.
Cooperation	Common interests favor agreements. Involving access to infrastructures or setting standards (river navigation, rail gauge, trade agreements, transborder transportation).
Control	Controlling strategic locations. Reduce vulnerability to disruptions.



# Exclusive Economic Zones

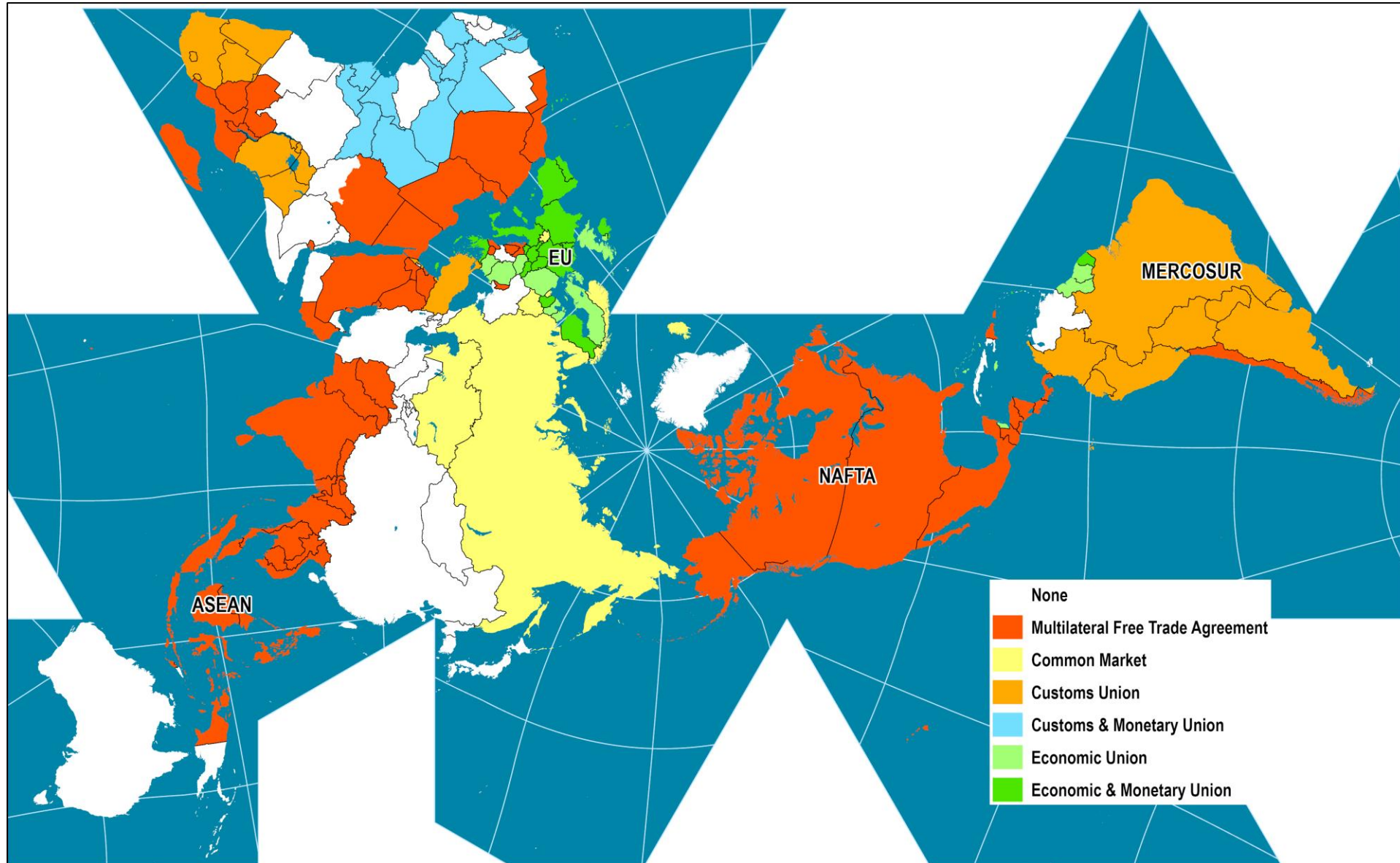


# Levels of Economic Integration

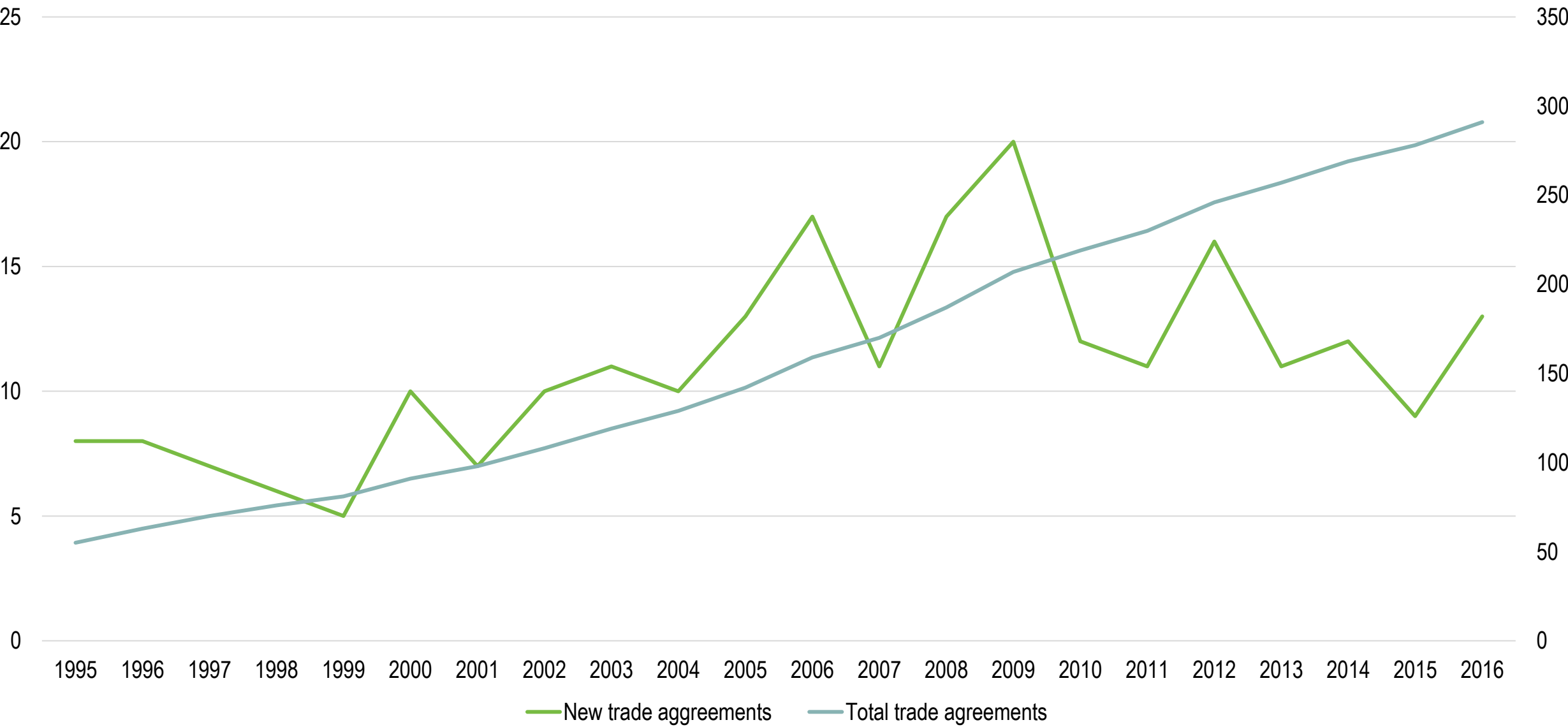


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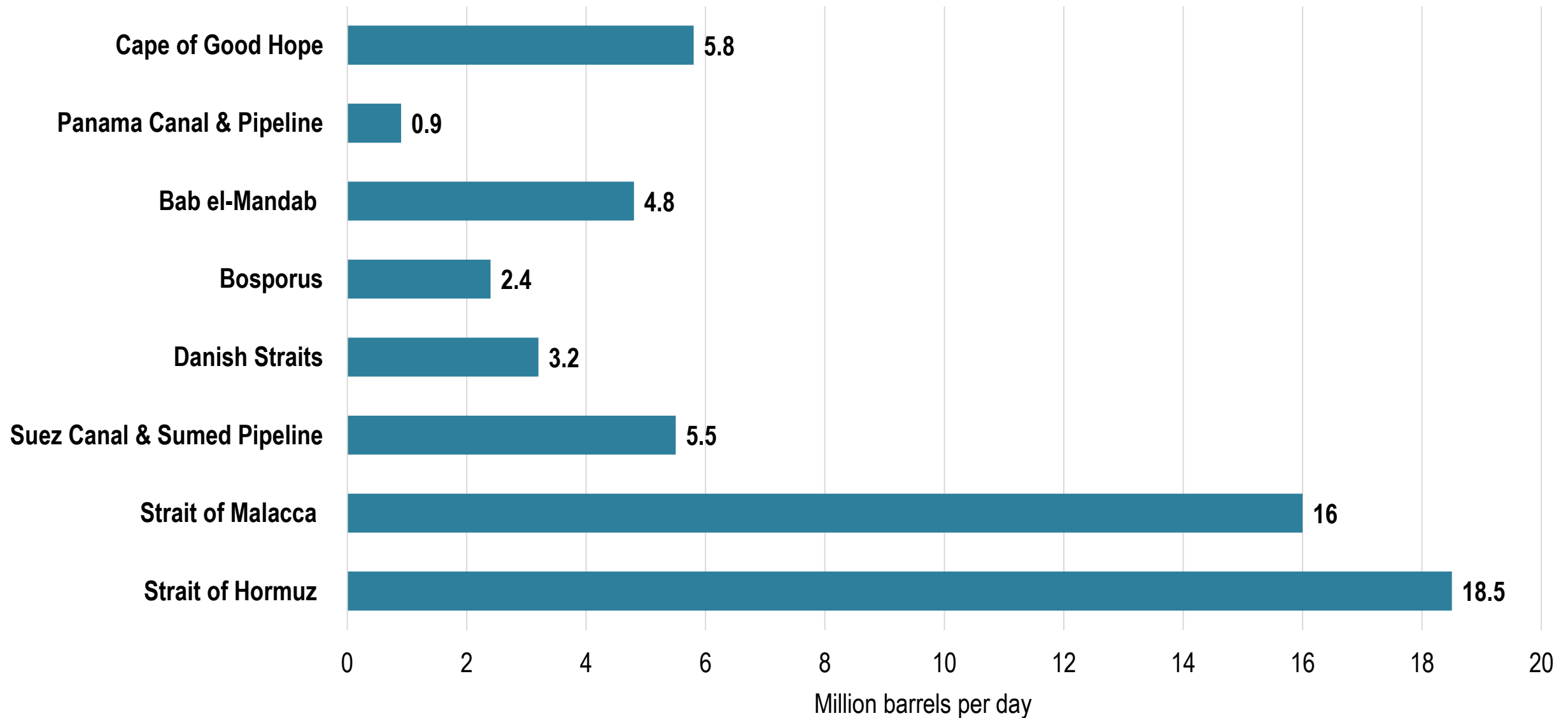
# Economic Integration Levels, 2015



# Number of Regional Trade Agreements on Customs and other Trade Facilitation Measures, 1995-2016

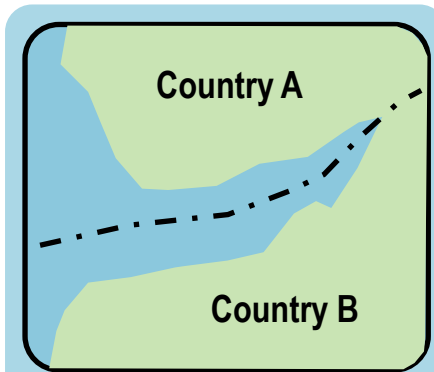


# Oil Transited at Major Strategic Locations, 2016



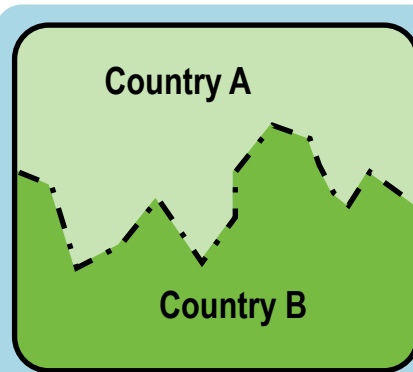


# Types of International Boundaries



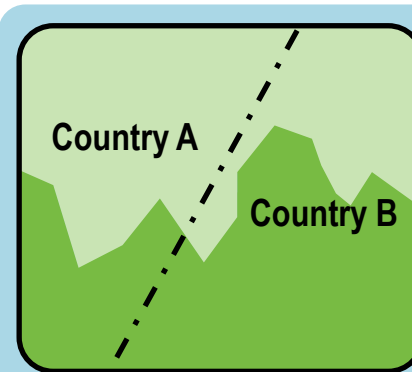
## ANTECEDENT

- Pre-existing.
- Commonly corresponds to a physical feature.
- Rivers, Bays, Lakes, Mountains.



## SUBSEQUENT

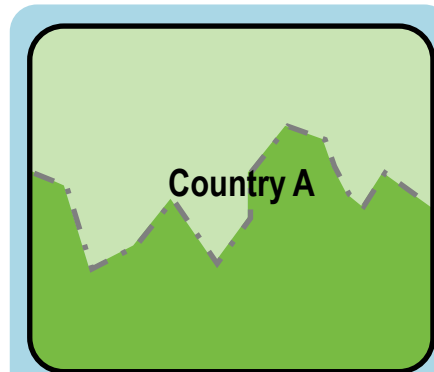
- Set after the settlements of different groups meet.
- Often correspond to their respective ecumene.



## SUPERIMPOSED

- Boundary is imposed by an outside force (treaty).
- May not reflect existing cultural landscape.

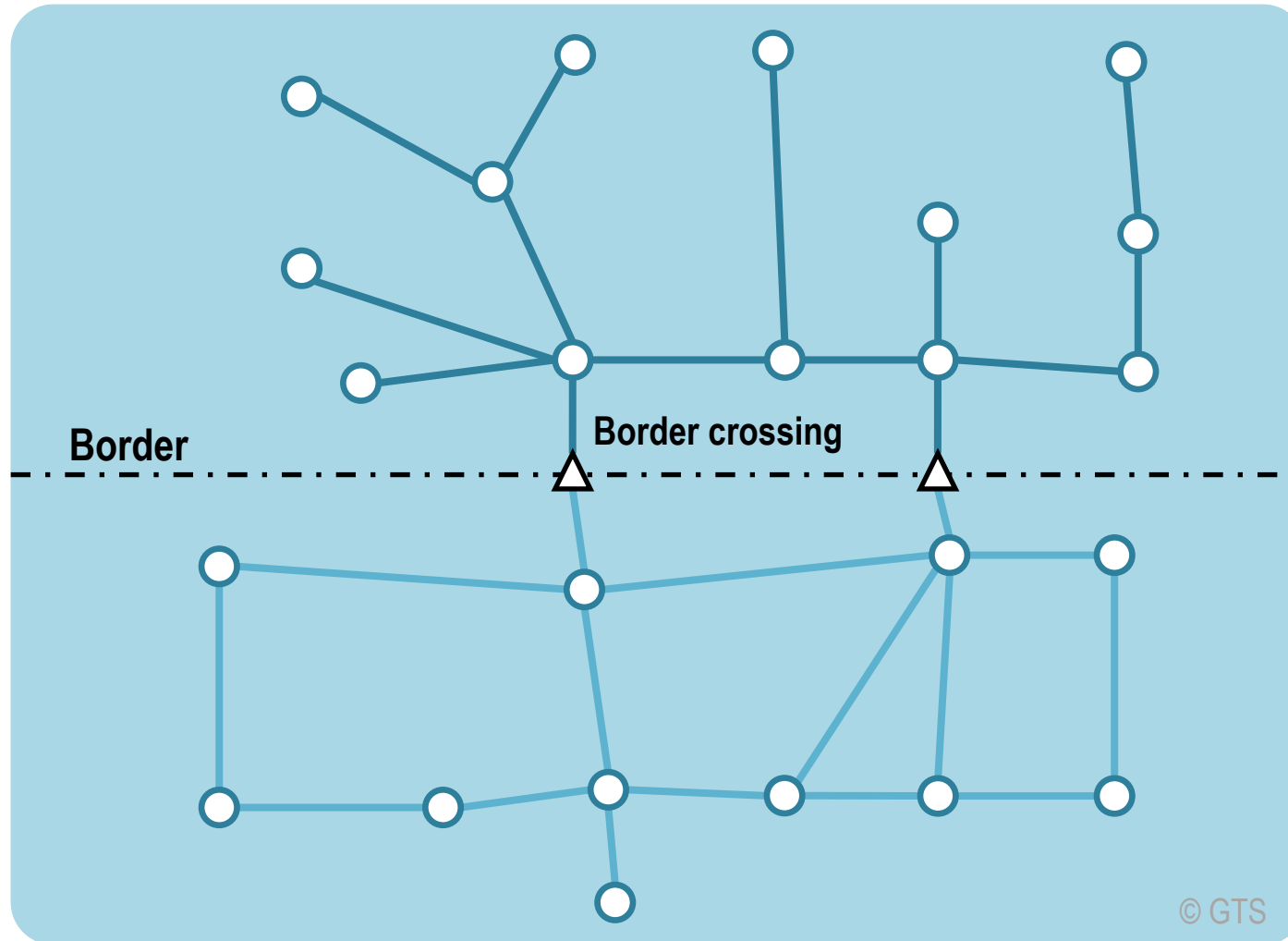
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## RELIC

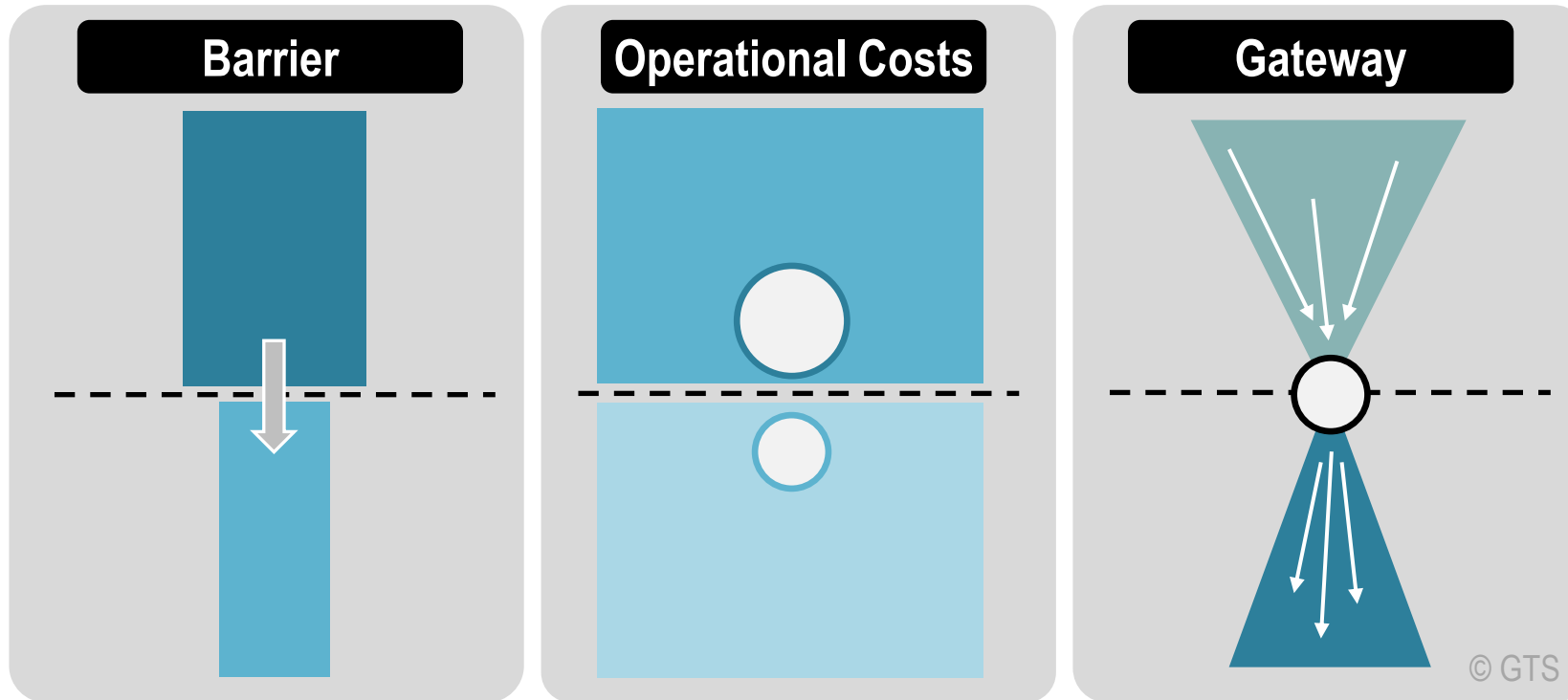
- No longer a boundary.
- Often the outcome of political changes.
- Still a visible imprint on the landscape.

# The Effect of a Border on a Transportation Network

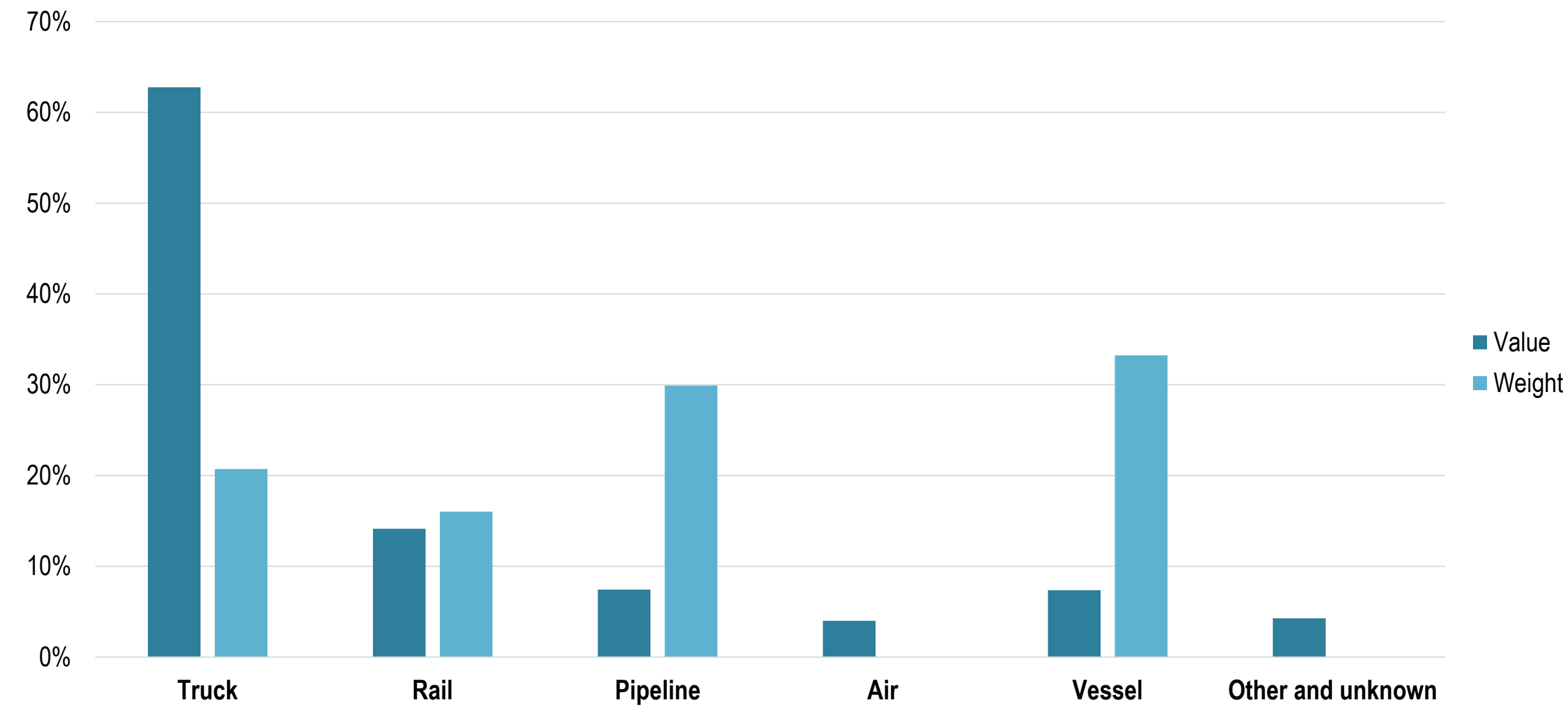




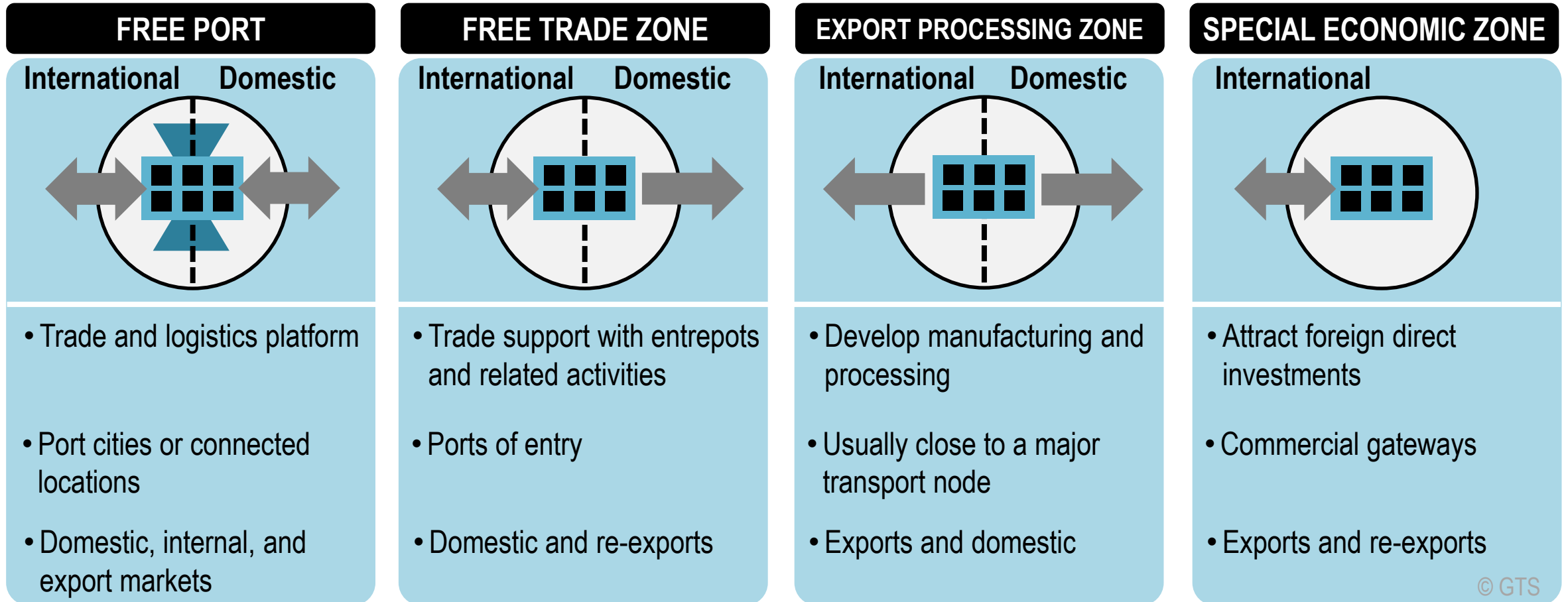
# The Effect of a Border on Freight Distribution



# Cross-Border North American Freight by Mode, 2021



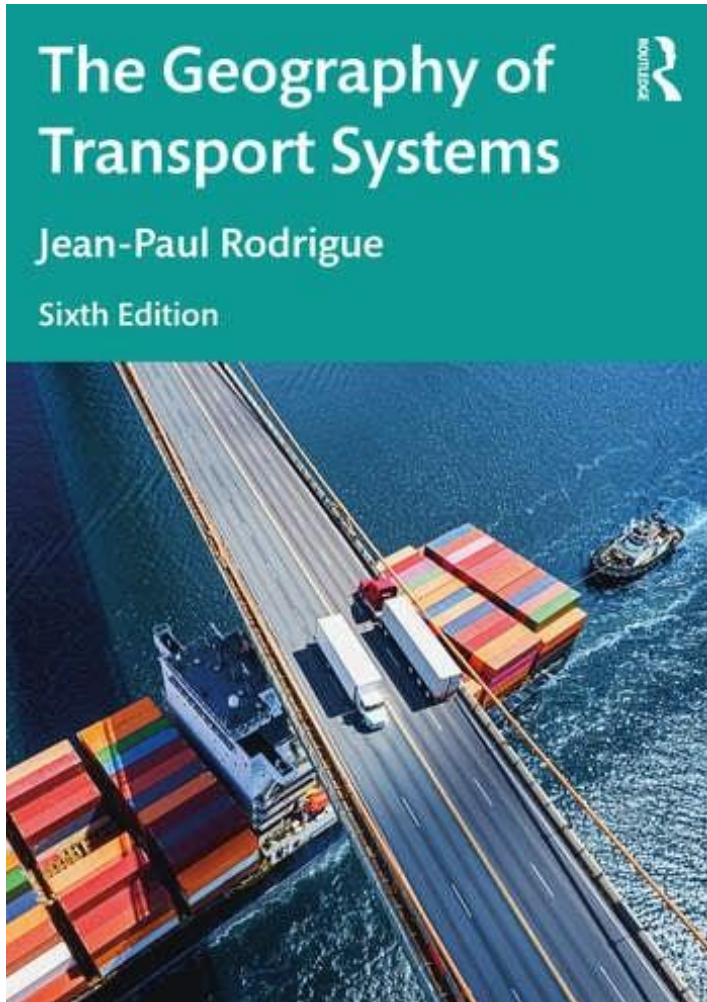
# Types of Free Zones



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# Specialized Free Zones

Type	Function	Location	Markets
Technology or Science Parks	Promote technology and scientific industries	Adjacent to universities and research institutes	Domestic and export
Energy Zones	Promote energy industries	Petrochemical hubs or energy sources	Domestic and export
Financial Services	Development of off-shore financial services	Varied	Export
Software and Internet	Development of information technologies	Adjacent to universities, urban areas	Export
Airport-based	Air cargo trade and handling	Connected airports	Re-export and domestic
Tourism	Integrated tourism development	Touristic amenities	Export and domestic
Logistics Parks	Support warehousing and transshipment	Near transport hubs	Re-export



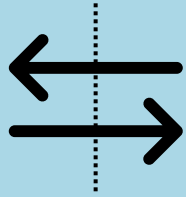
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# Globalization and International Trade

## Chapter 7.2

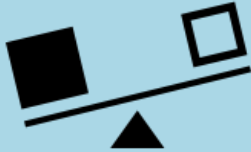
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# The Concept of International Trade



## EXCHANGE

- Exchange of goods or services across national jurisdictions.
- Trade between US states is not international trade.



## DIRECTIONAL

- Inbound trade: imports.
- Outbound trade: exports.

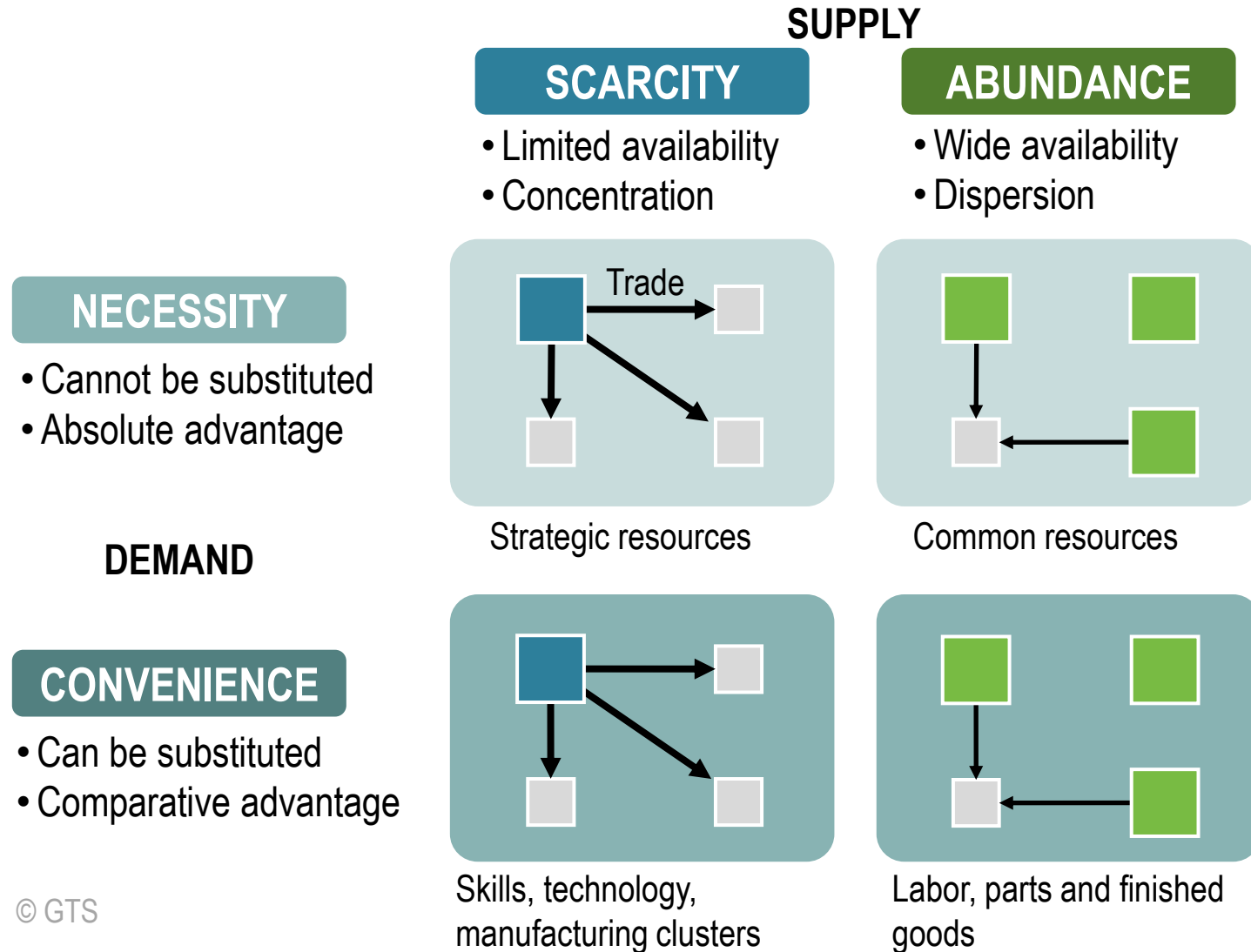


## REGULATORY OVERSIGHT

- Customs and tariffs.
- States control what crosses their borders.

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# The Rationale for Trade



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# The Benefits of Trade in a Global Economy



## ECONOMIC EFFICIENCY

- Sell what is produced in surplus and acquire what is lacking.
- Lower productions costs (cheaper inputs).
- Achieve economies of scale (larger markets).



## ACCESSIBILITY

- Large variety of resources being made accessible.
- Raw materials, energy, goods, food and labor.
- Exchanges of capital, goods, raw materials and services.

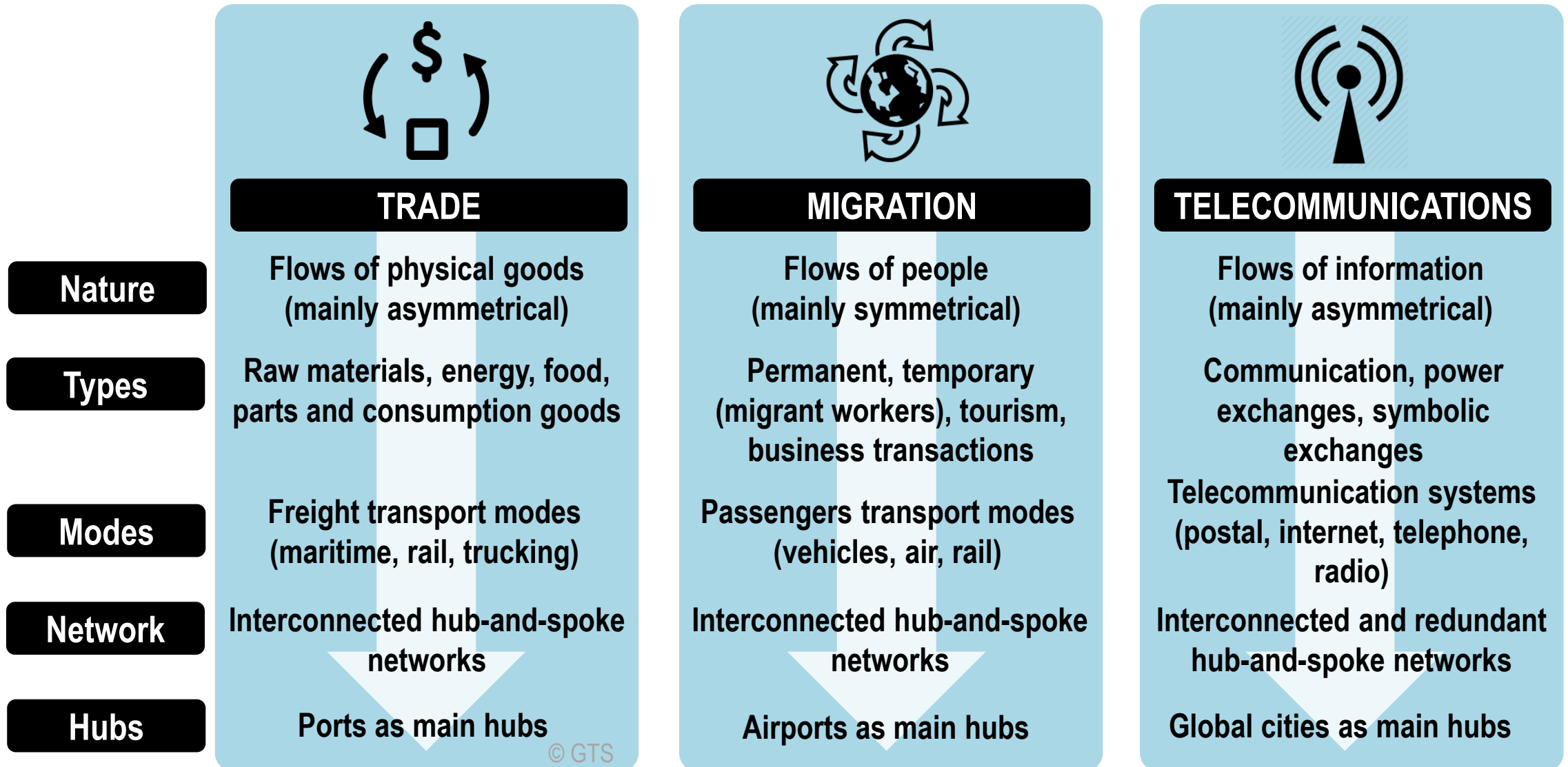


## INTERDEPENDENCIES

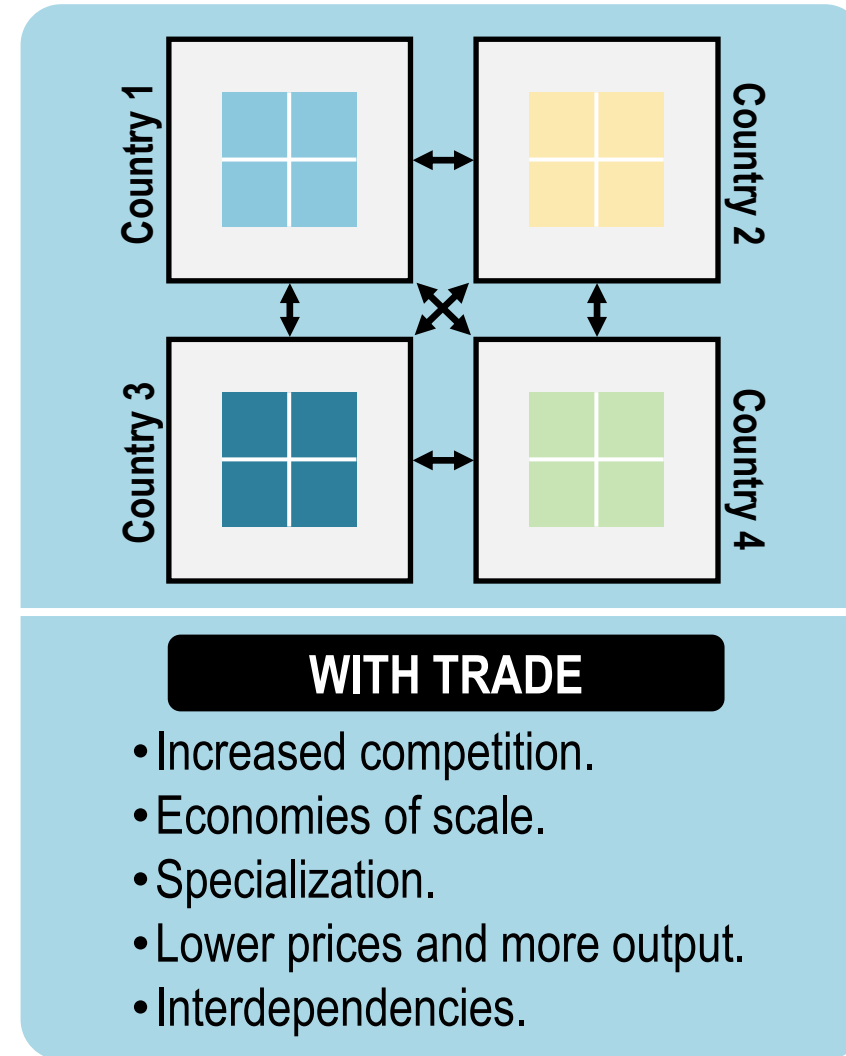
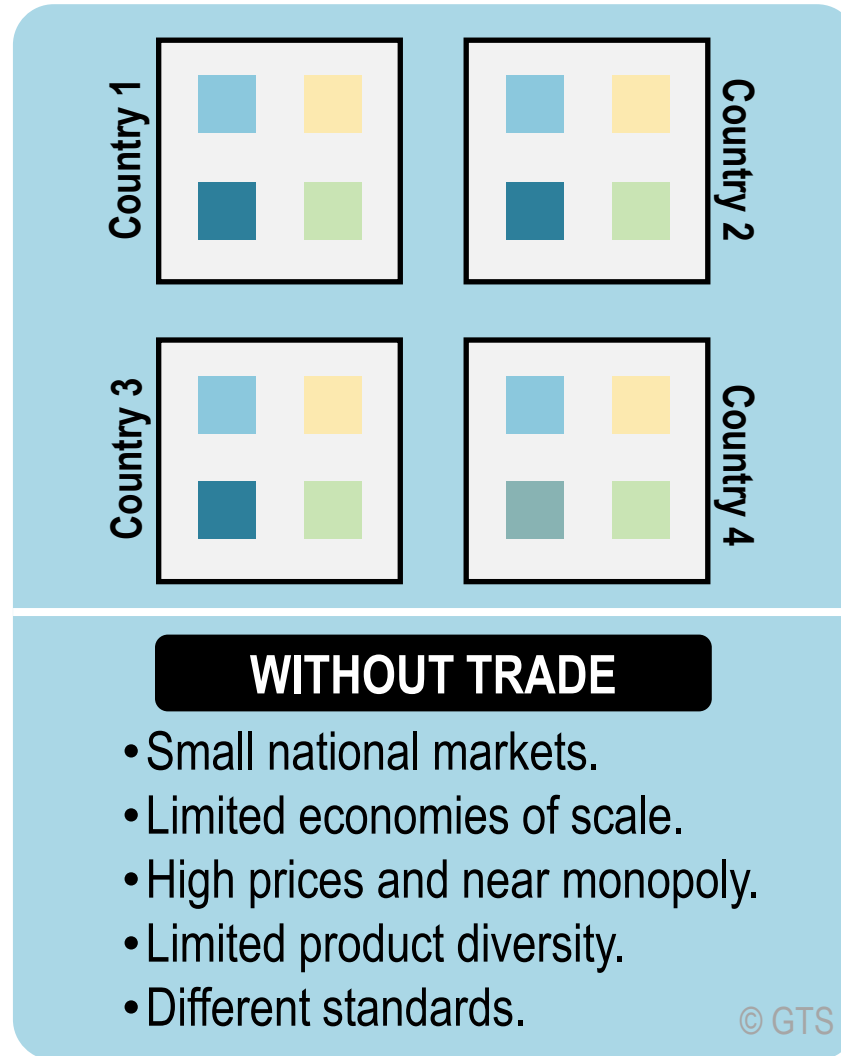
- Spatial interdependencies between elements of the world-system.
- The more integrated economies are, the more they trade.
- Promote harmonious relations / Risk of dependency.

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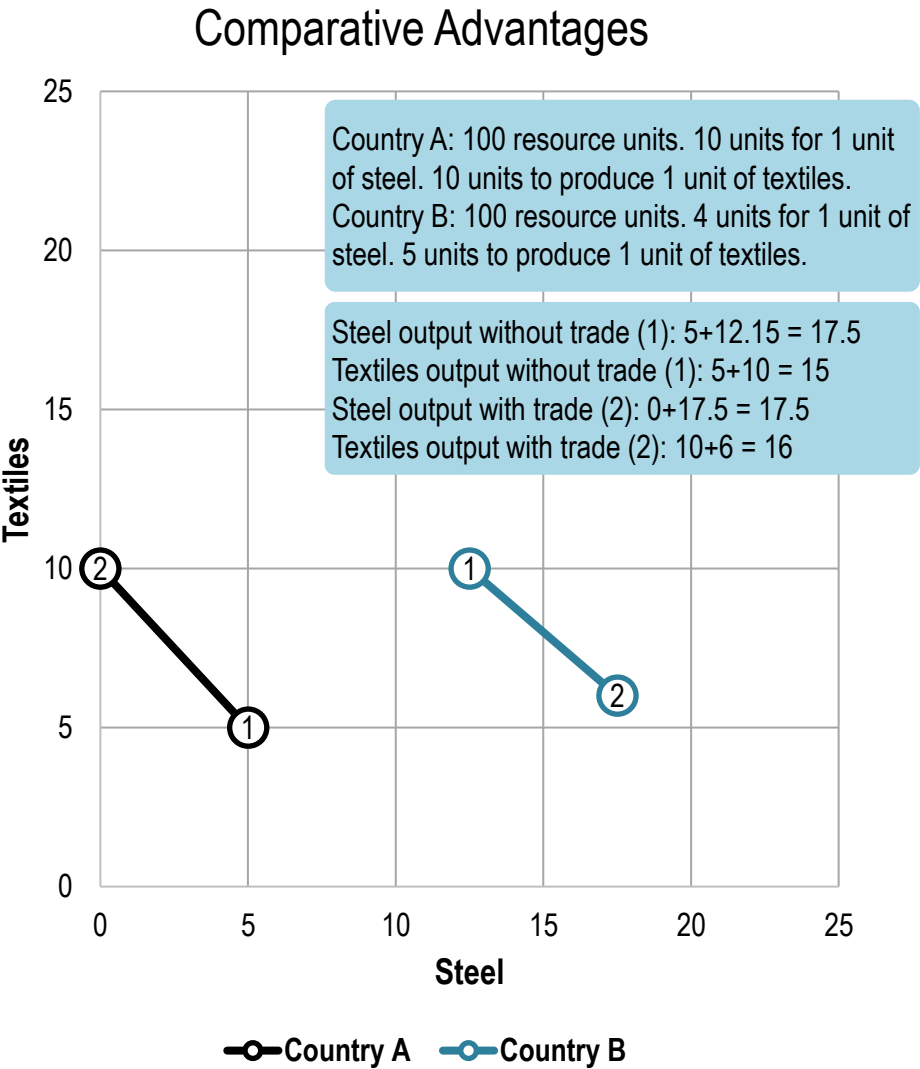
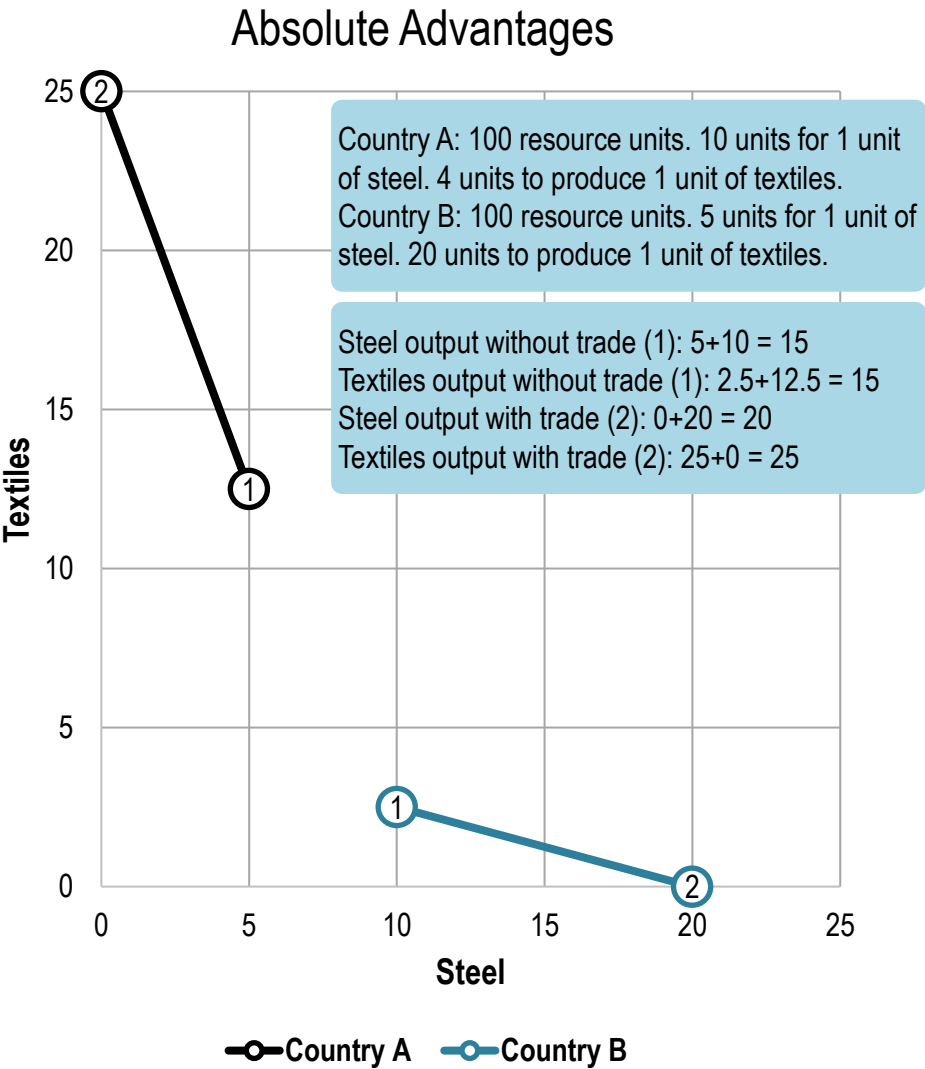
# The Flows of Globalization



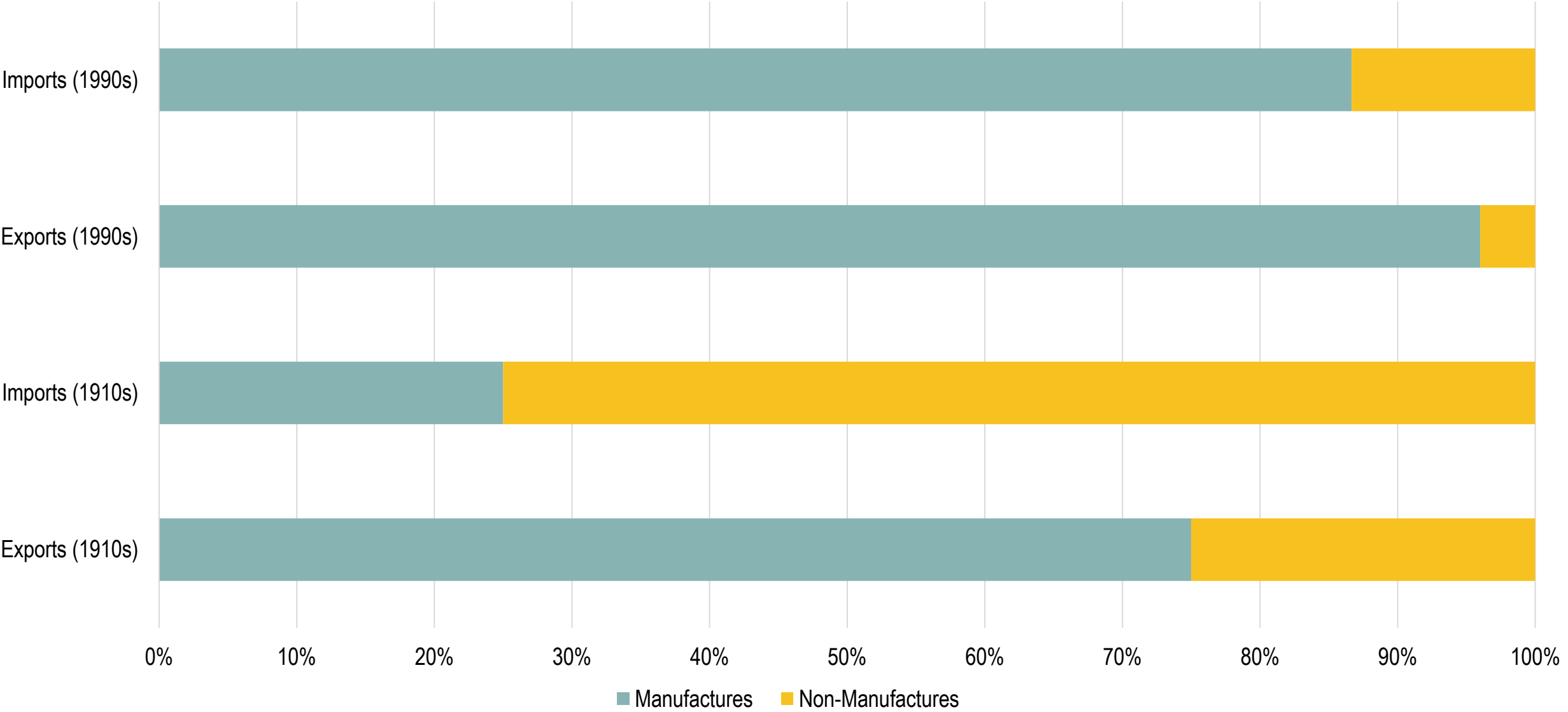
# Economic Rationale of Trade



# Absolute and Comparative Advantages



# Composition of British Trade, 1910s and 1990s



# The Main Theoretical Foundations of International Trade

## **ABSOLUTE ADVANTAGES**

- Produce more effectively in an economic sector while using less resources.
- A nation can focus on its absolute advantages, trade its surplus and import what it lacks.
- Mostly relates to resources such as energy.

## **COMPARATIVE ADVANTAGES**

- A nation can focus on the sectors it has the highest comparative advantages.
- A nation having no absolute advantages can focus on sectors where the total productivity gains are the most significant.
- Mostly relates to the manufacturing sector.

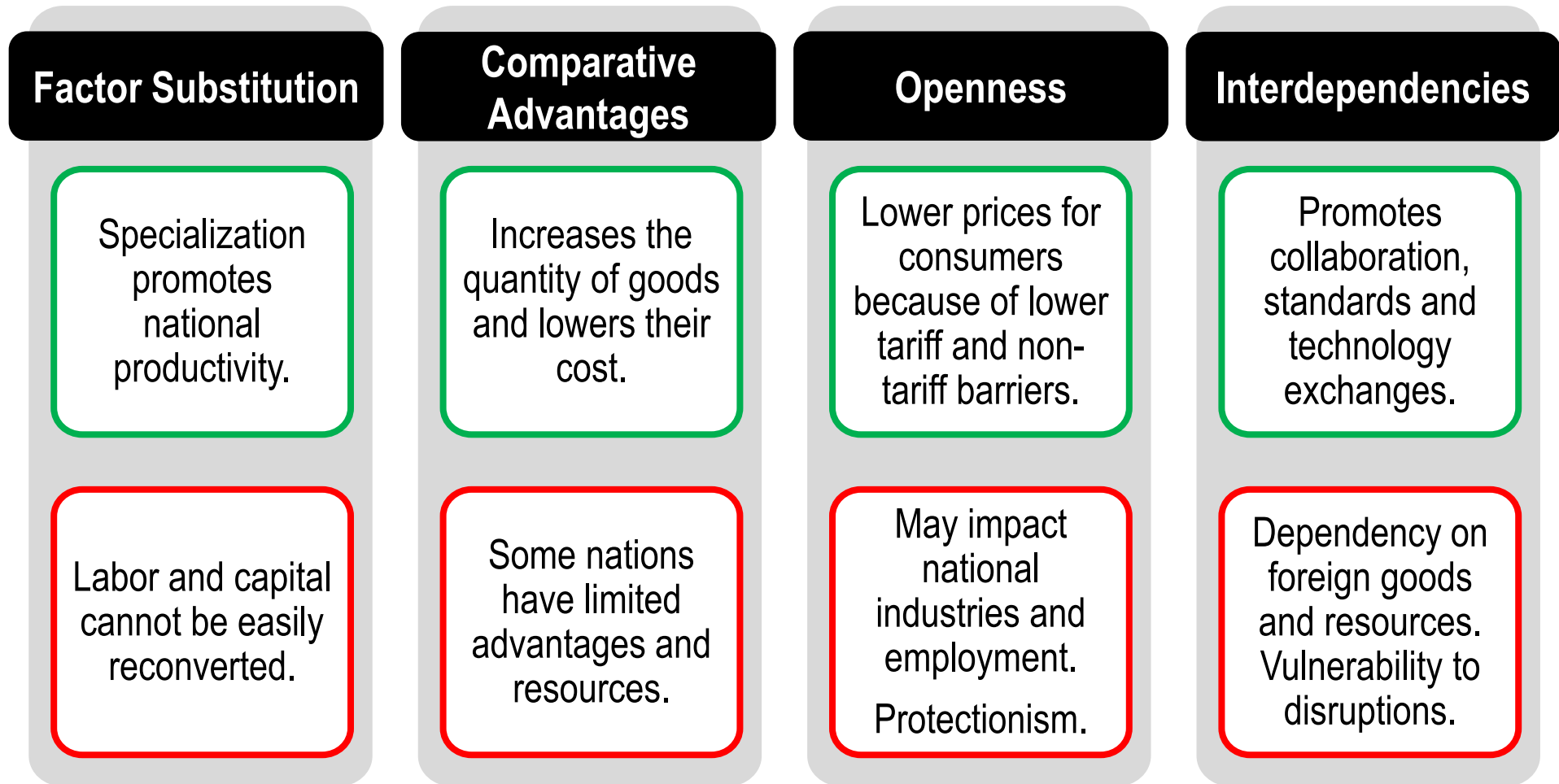
## **FACTORS ENDOWMENTS**

- Trade related to endowments such as capital, land and labor.
- Export goods to which it has notable factor endowments and imports goods in which it has scarce factor endowments.
- Factors can be improved through policy and investments.

## **NEOMERCANTILISM**

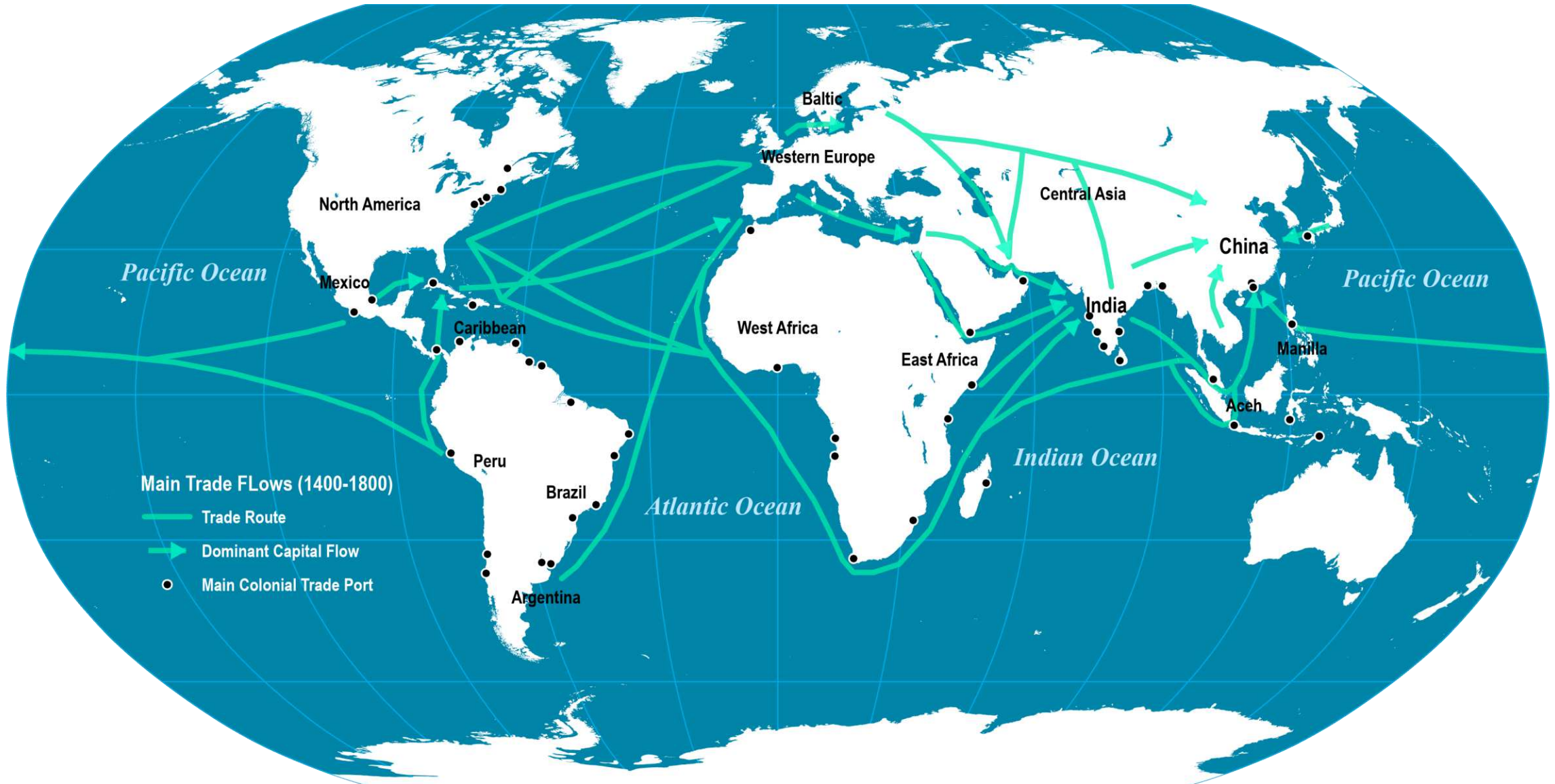
- Controlling trade to meet economic development goals.
- Tariff and non-tariff measures regulating trade and protecting national commercial sectors and enterprises.
- Strategy pursued by several export-oriented economies (Japan, Korea, China).

# Favorable and Contentious Factors in International Trade





# Major Global Trade Routes, 1400-1800



# Standard International Trade Classification (SITC)

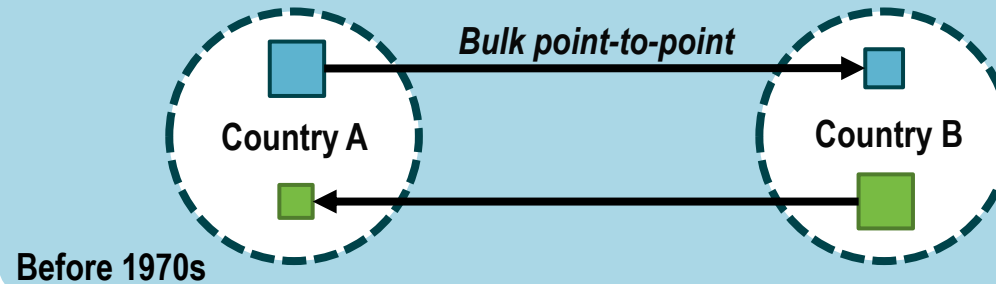
STIC Code	Category	Examples
0	Food & Live Animals	Meat (01), Fish (03), Wheat (041), Rice (042), Corn (044), Orange juice (0591), Sugar (0611), Coffee (071), Cocoa (072), Tea (0741)
1	Beverages & Tobacco	Wine (1121), Beer (1123), Tobacco (12)
2	Raw Materials	Rubber (23), Cotton (263), Iron ore (281)
3	Fuels & Lubricants	Coal (32), Crude oil (333), Kerosene (3342), Natural gas (343)
4	Animal & Vegetable Oils	Olive oil (4214), Corn oil (4216)
5	Chemicals	Salt (52332), Fertilizers (56), Plastics (57)
6	Manufactured Goods	Paper (64), Textiles (65), Cement (661), Iron & Steel (67), Copper (682)
7	Machinery & Transport Equipment	Computer equipment (752), Televisions (761), Cars (781)
8	Miscellaneous Manufactures	Furniture (82), Clothes (84), Footwear (85), Cameras (88111), Books (8921), Toys (894)
9	Others	Postal packets (91)

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# Changes in the Global Trade Environment

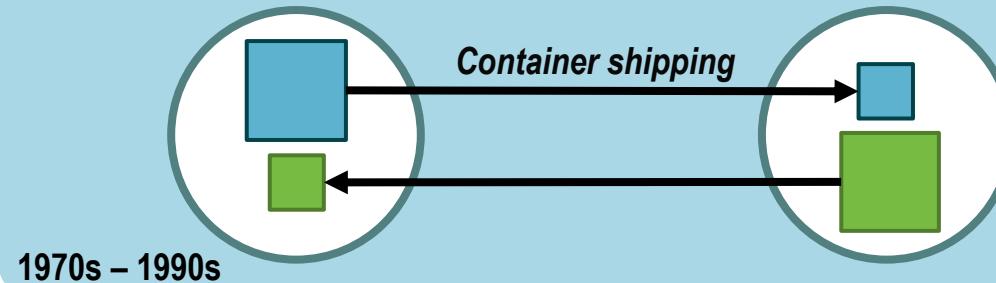
## Immobile Factors of Production

Cope with scarcity



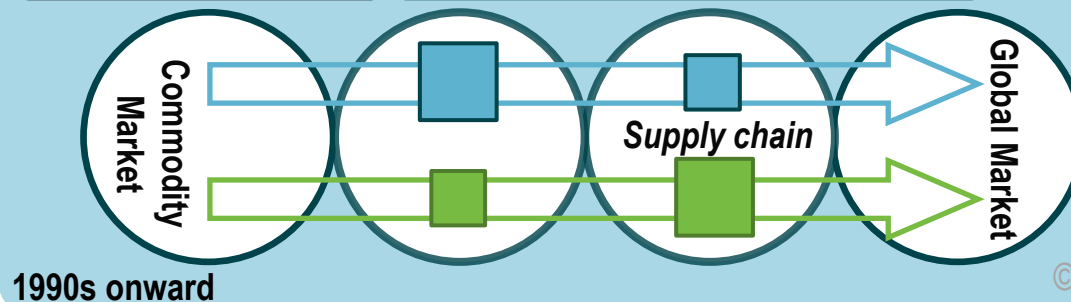
## Mobile Factors of Production

Promote economic efficiency



## Global Value Chains

Added value within supply chains

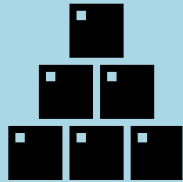


# Main Trends in the Structure of Global Trade



## GLOBAL VALUE CHAINS

- Trade in intermediary goods (parts) increasing.
- Growing share of developing economies.



## MANUFACTURED GOODS

- Growing share of manufactured goods, including parts.
- Trade cycles impacted by recessions.



## REGIONALISM OF TRADE

- The dominance of the “triad” (USA / Western Europe / Japan).
- The rise of China.

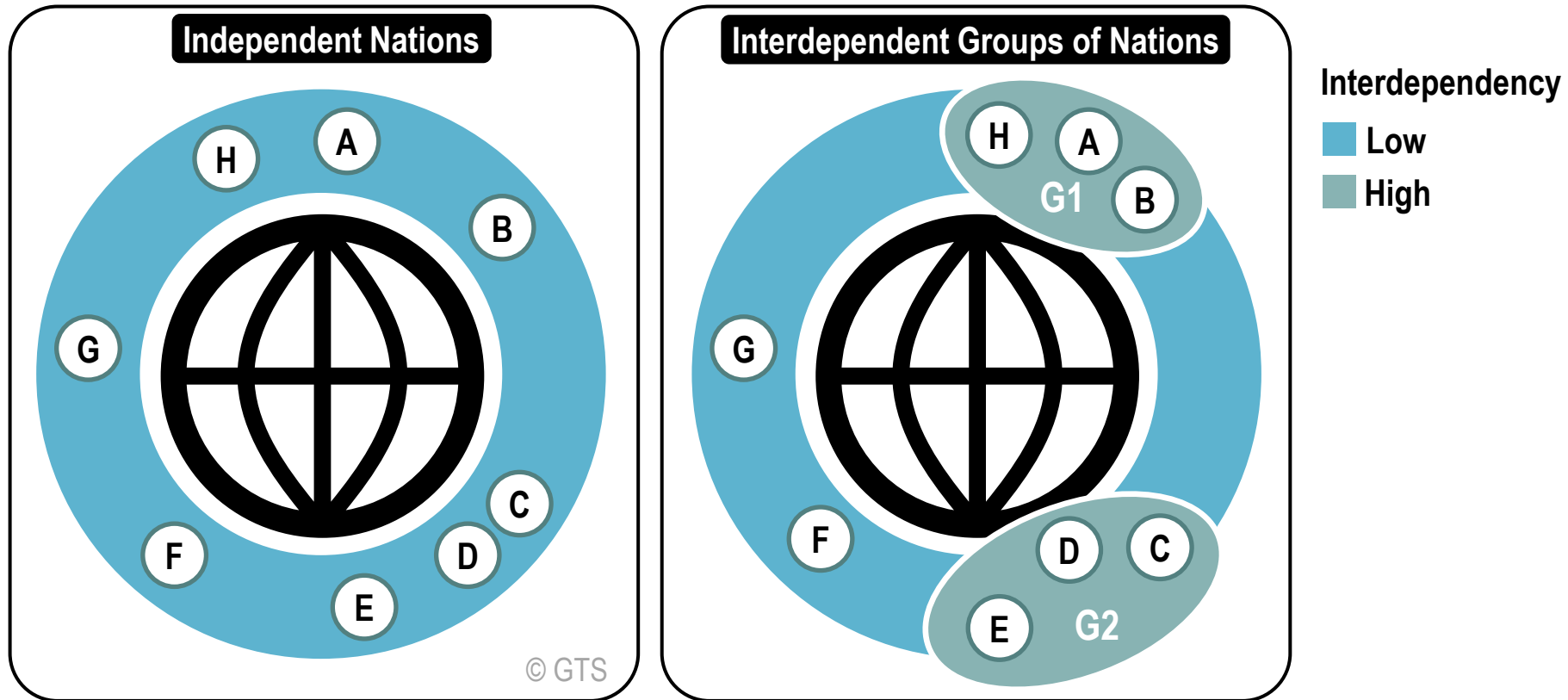


## NEO-MERCANTILISM

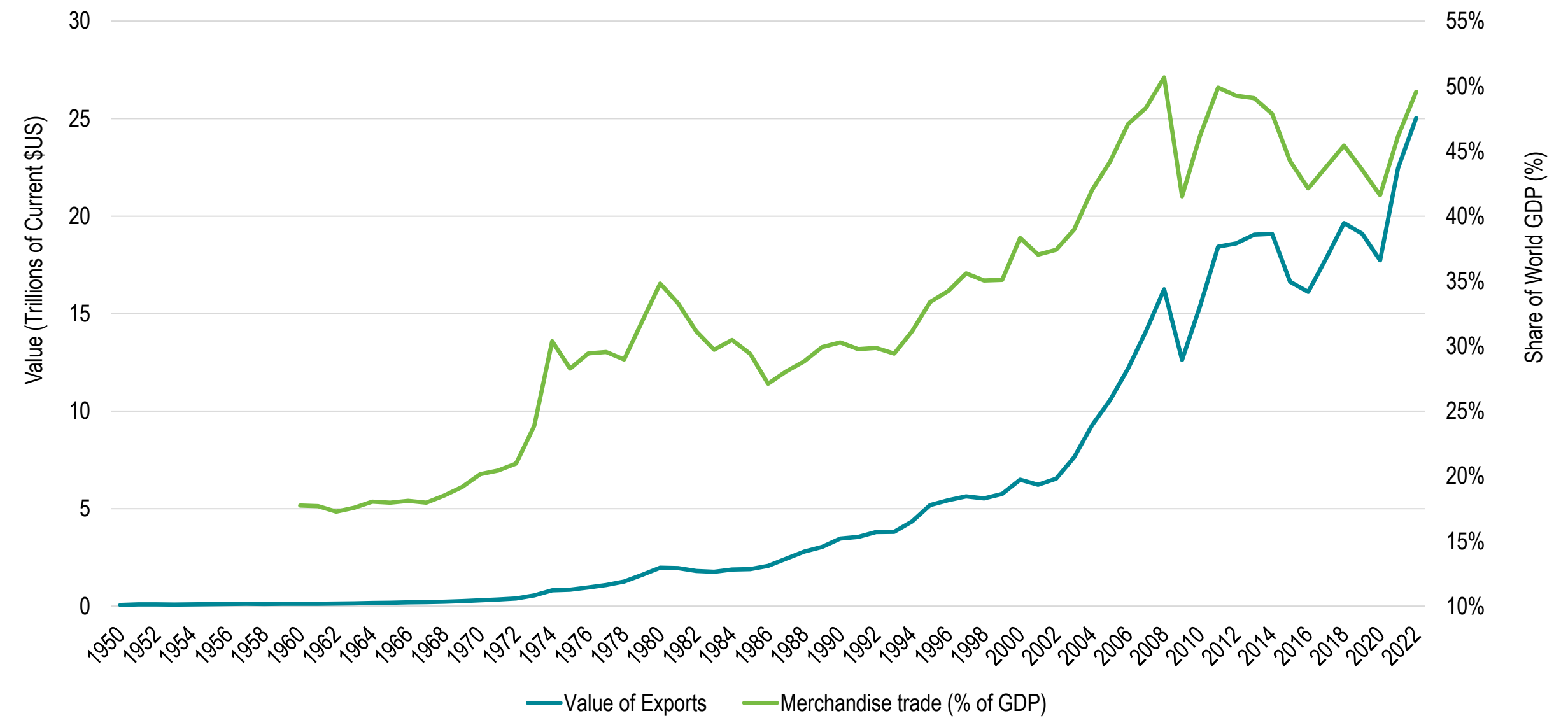
- Export-oriented strategies.
- Trade imbalances.

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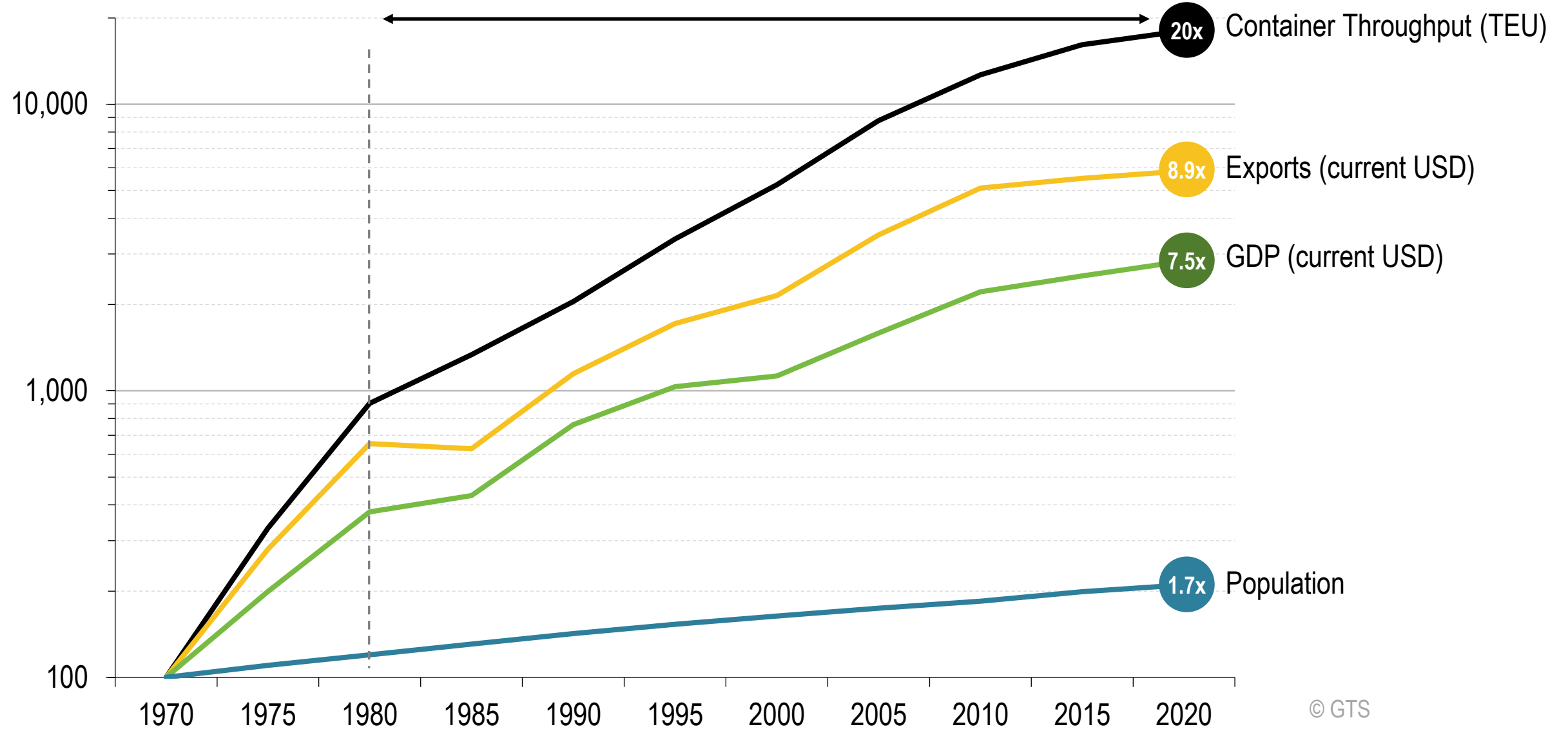
# Economic Integration and Interdependencies



# World Merchandise Trade, 1960-2022



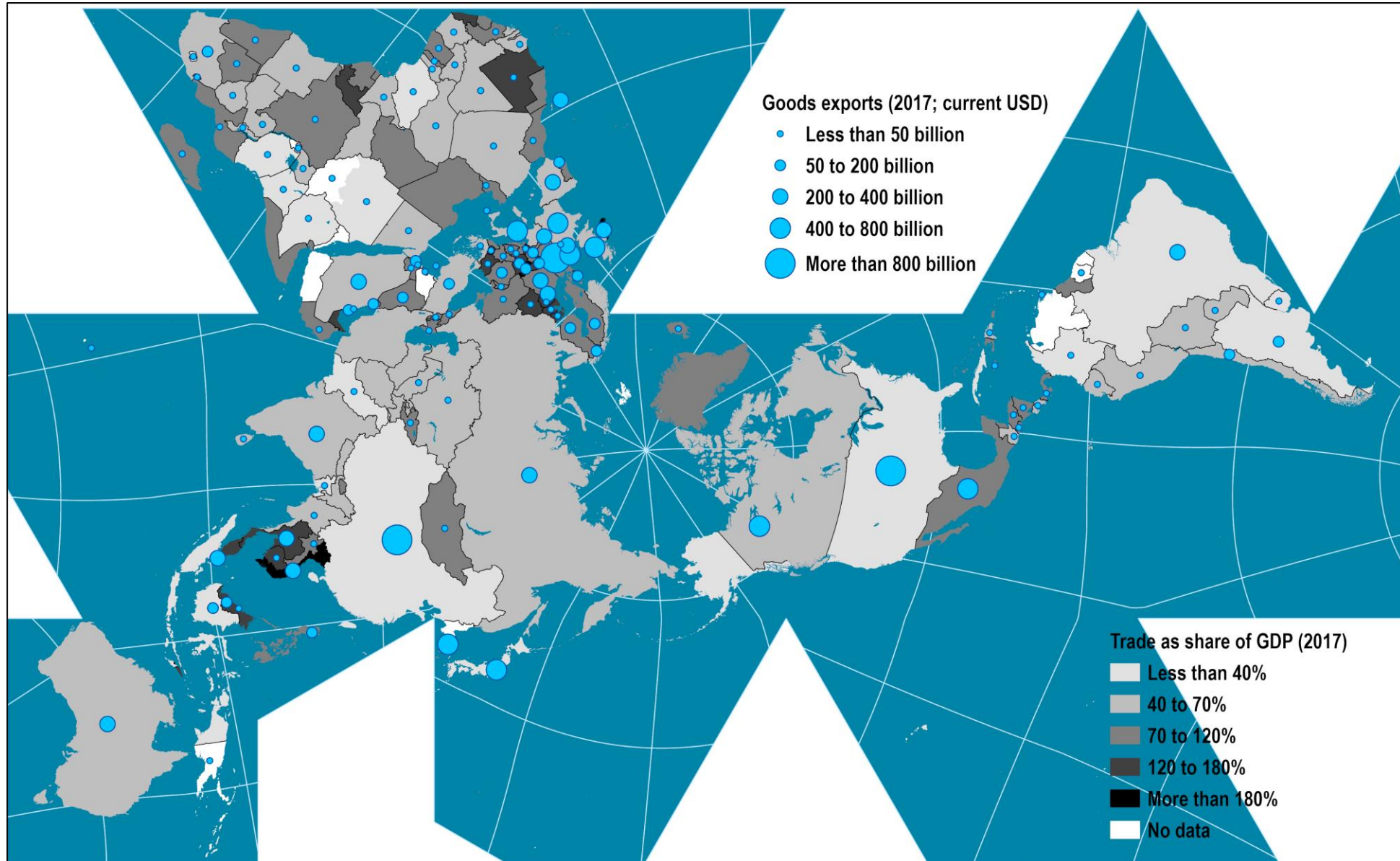
# Global Trade and Container Throughput (1970=100)



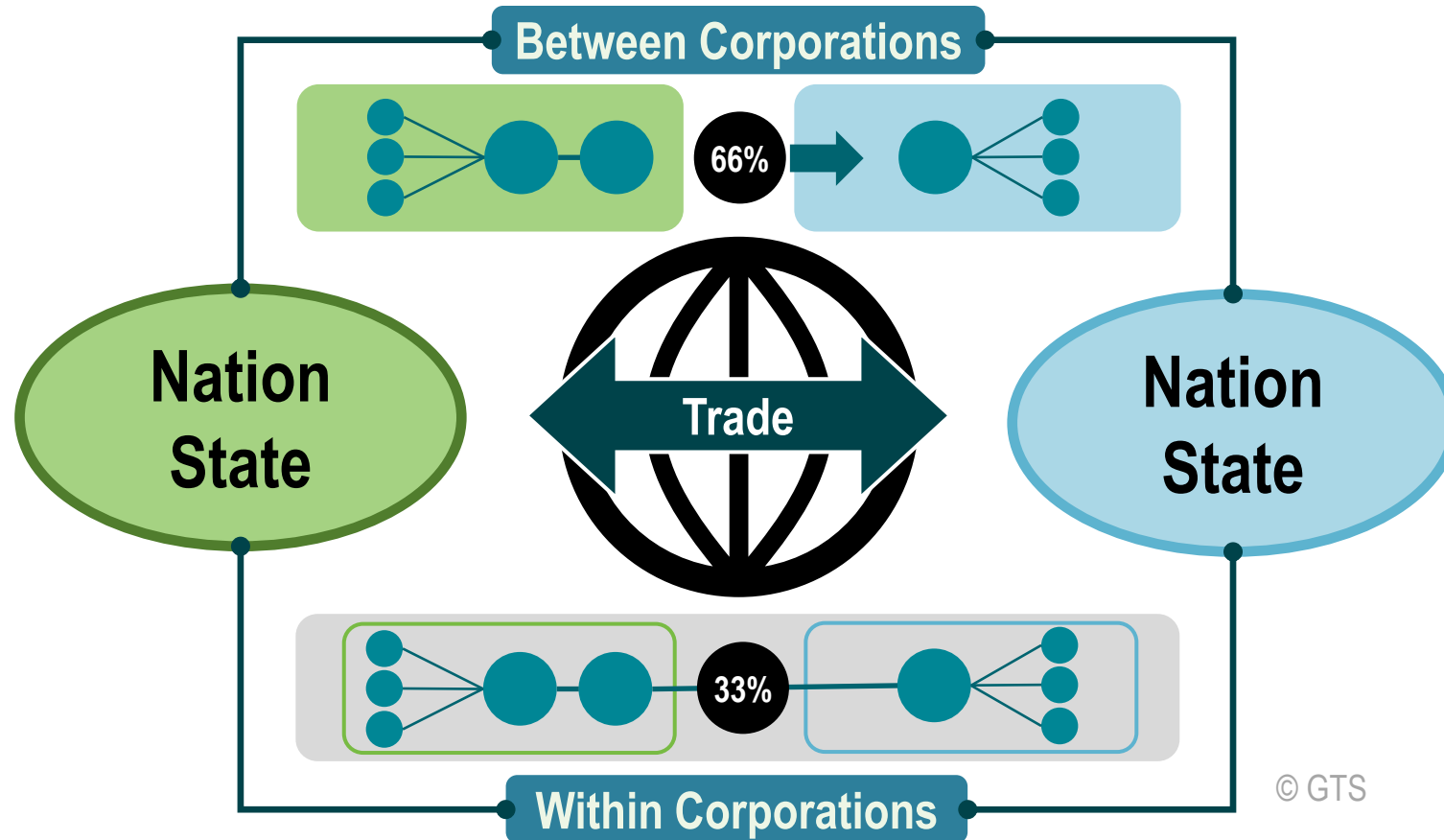
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# Global Trade, 2017



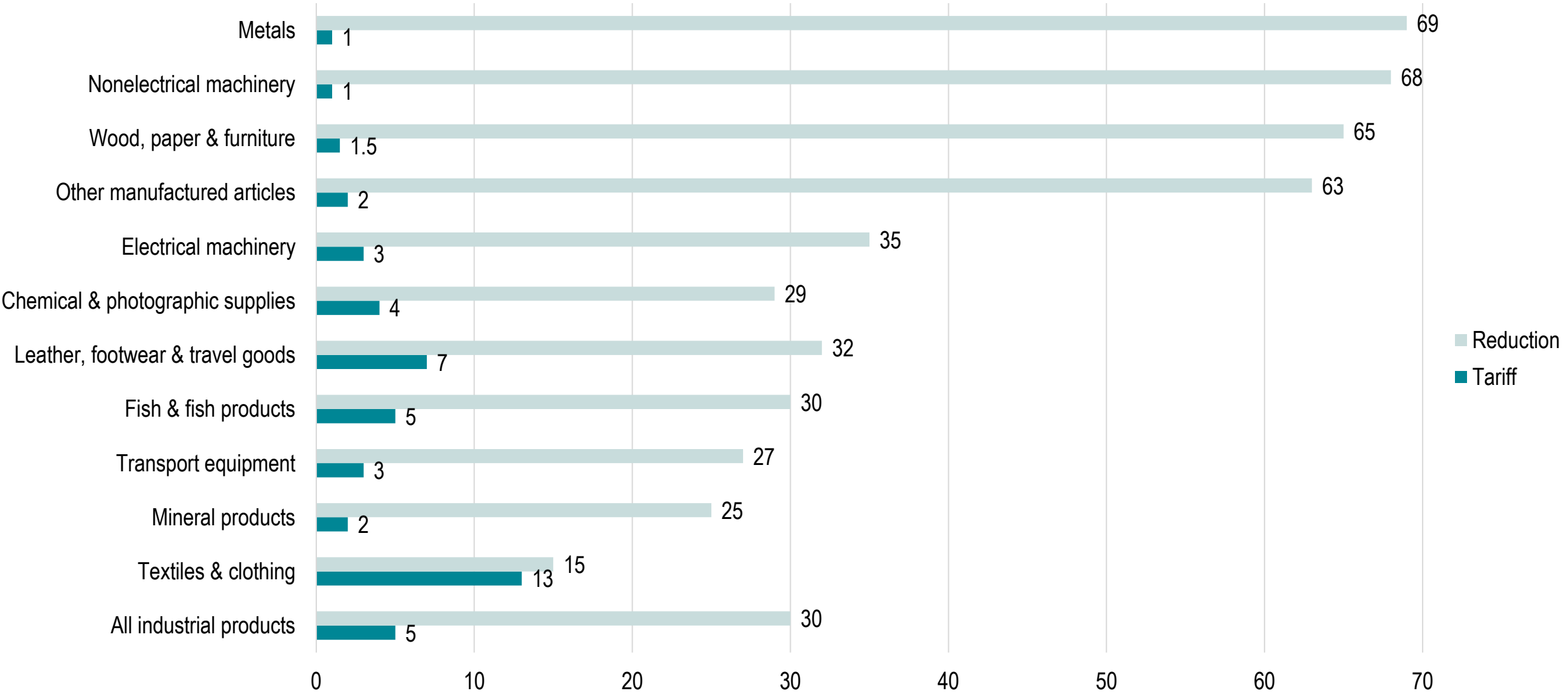
# Trade Within and Between Corporations



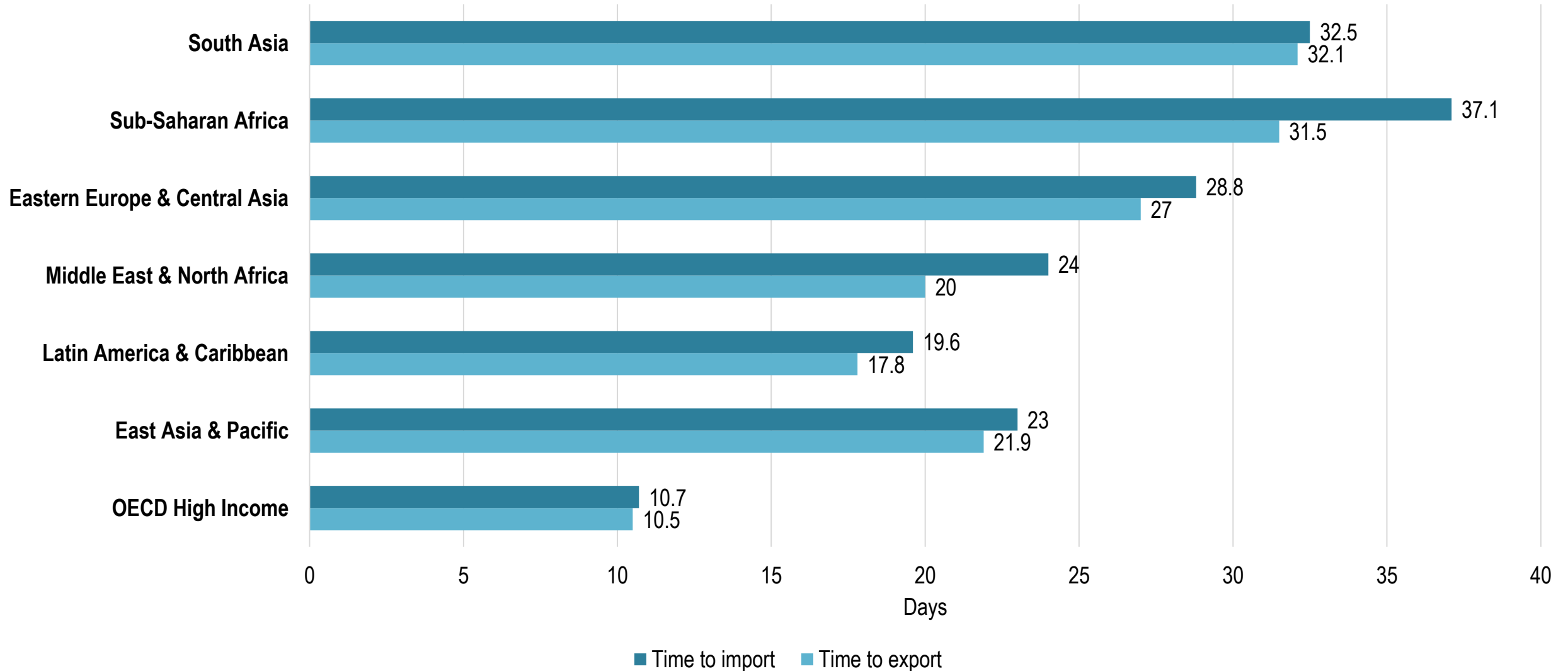
# GATT Rounds

Year	Round	Action
1947	Geneva	45,000 reductions in bilateral tariffs covering 20% of world trade.
1949	Annency, France	5,000 reductions in bilateral tariffs.
1951	Torquay, England	8,700 reductions in bilateral tariffs covering a new range of goods.
1955-56	Geneva	Reductions in bilateral tariffs.
1960-62	Dillon Round	Reductions in bilateral tariffs. EEC talks begin.
1964-67	Kennedy Round	Reductions in bilateral tariffs. Negotiation rules established.
1973-79	Tokyo Round	Reductions in bilateral tariffs. Procedures on dispute resolution, dumping and licensing.
1986-93	Uruguay Round	Additional tariff reductions. Stalemate for agricultural tariffs.
1995	WTO established	WTO replaced the GATT.
2001-08	Doha Round	Divergences between developing and developed countries. Issues over agricultural subsidies.

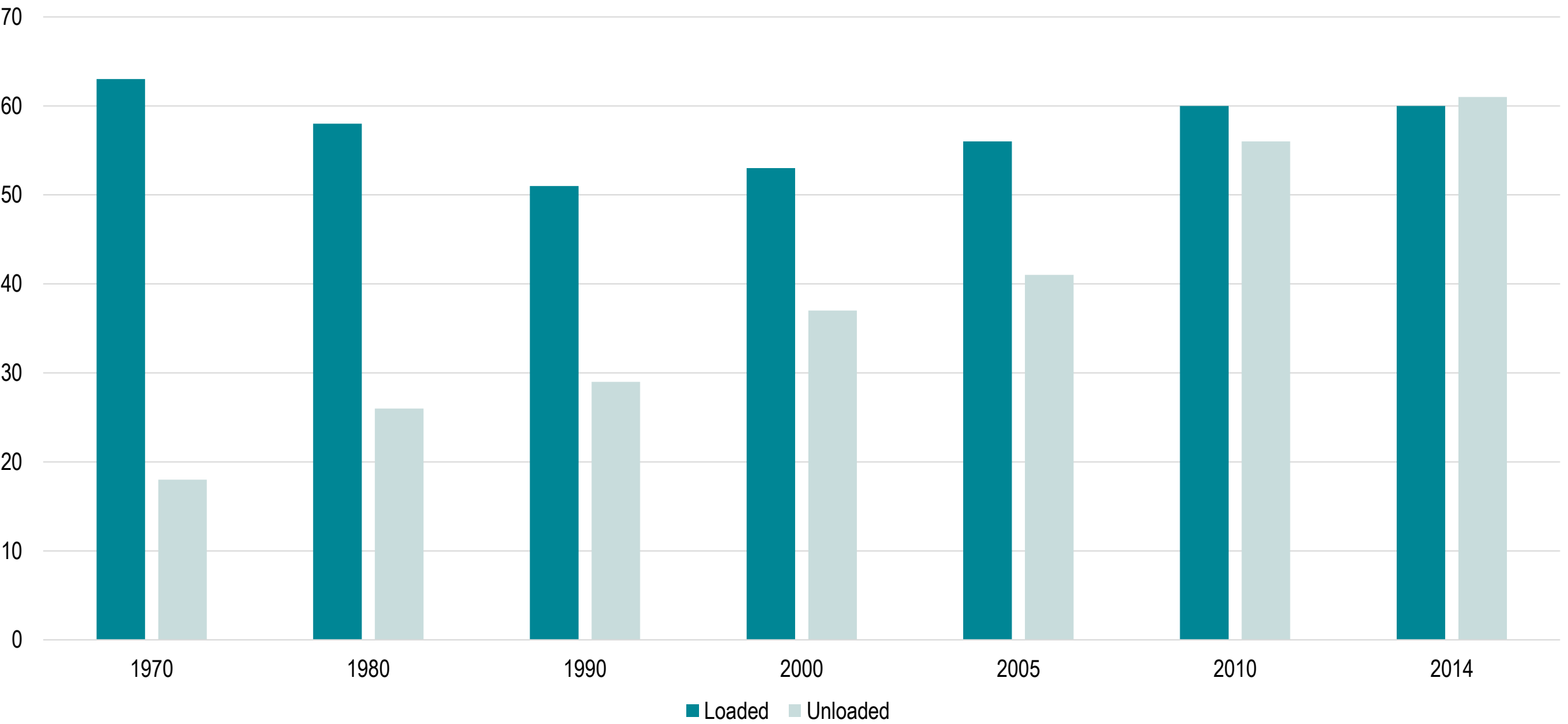
# Average Tariffs after the Uruguay Round (%)



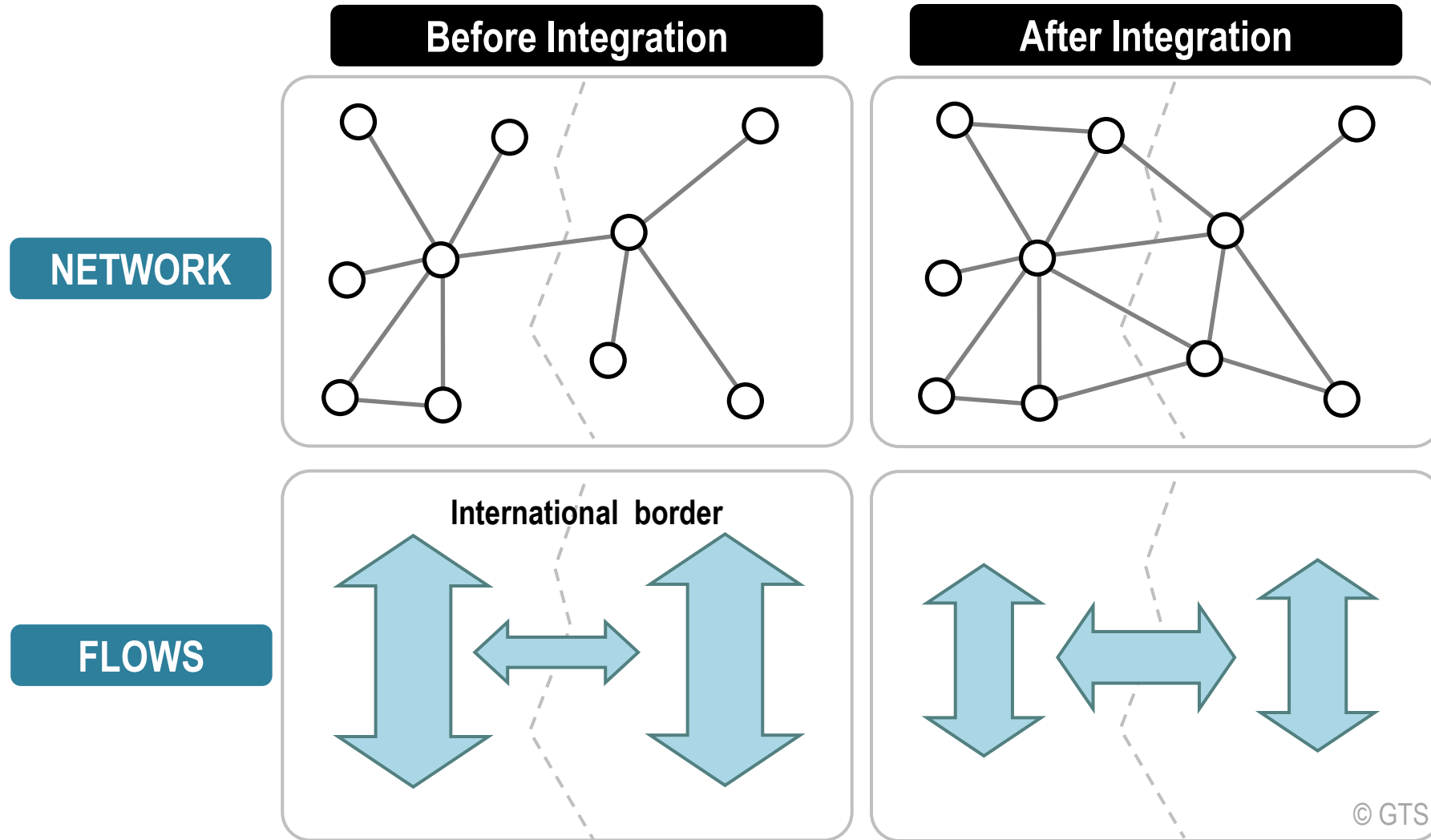
# Regional Averages in Trading Across Borders, 2012



# Participation of Developing Economies in Global Seaborne Trade (% of World Tonnage)



# Impacts of Integration Processes on Networks and Flows

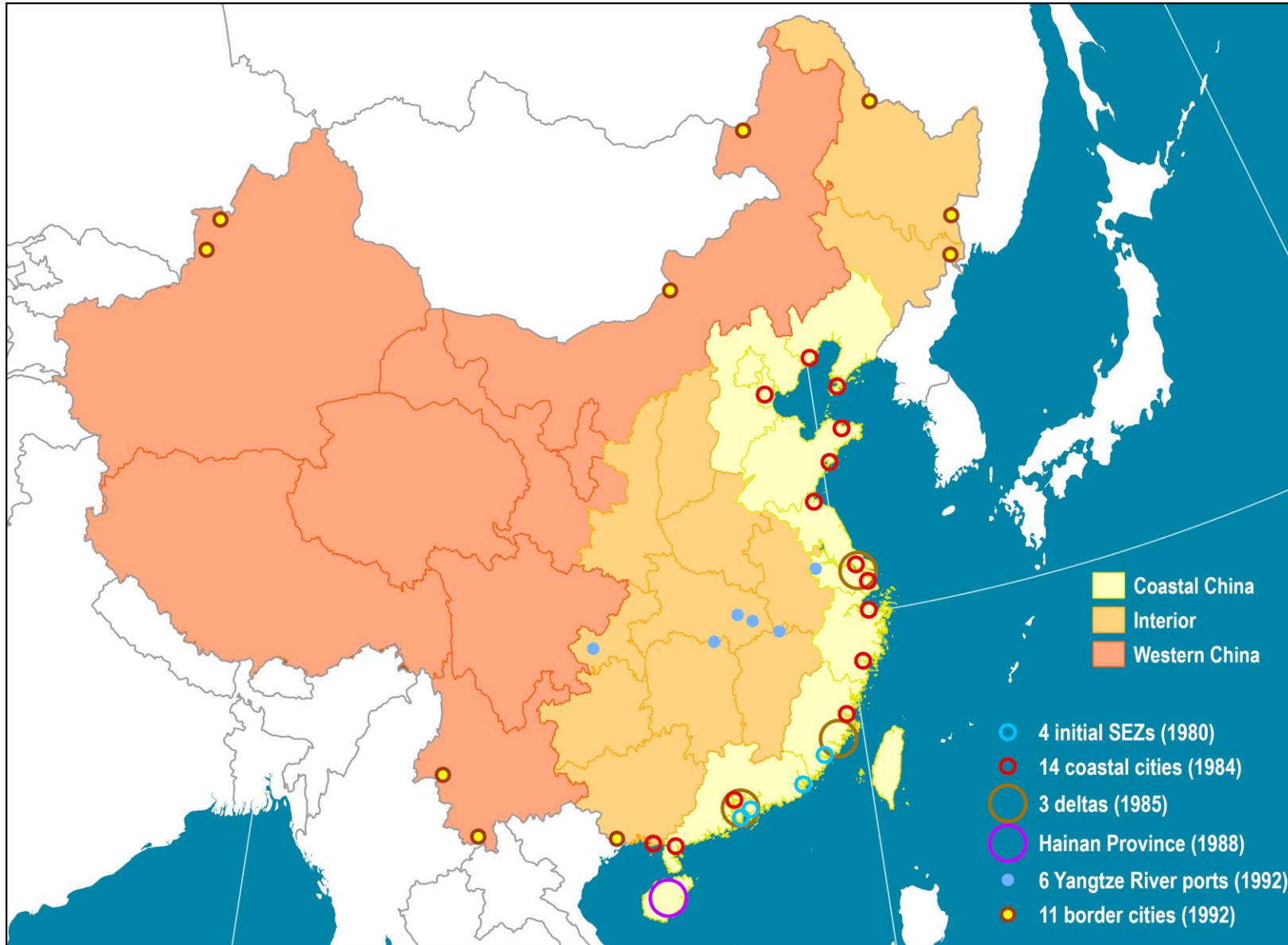


# Characteristics of Free Trade Zones

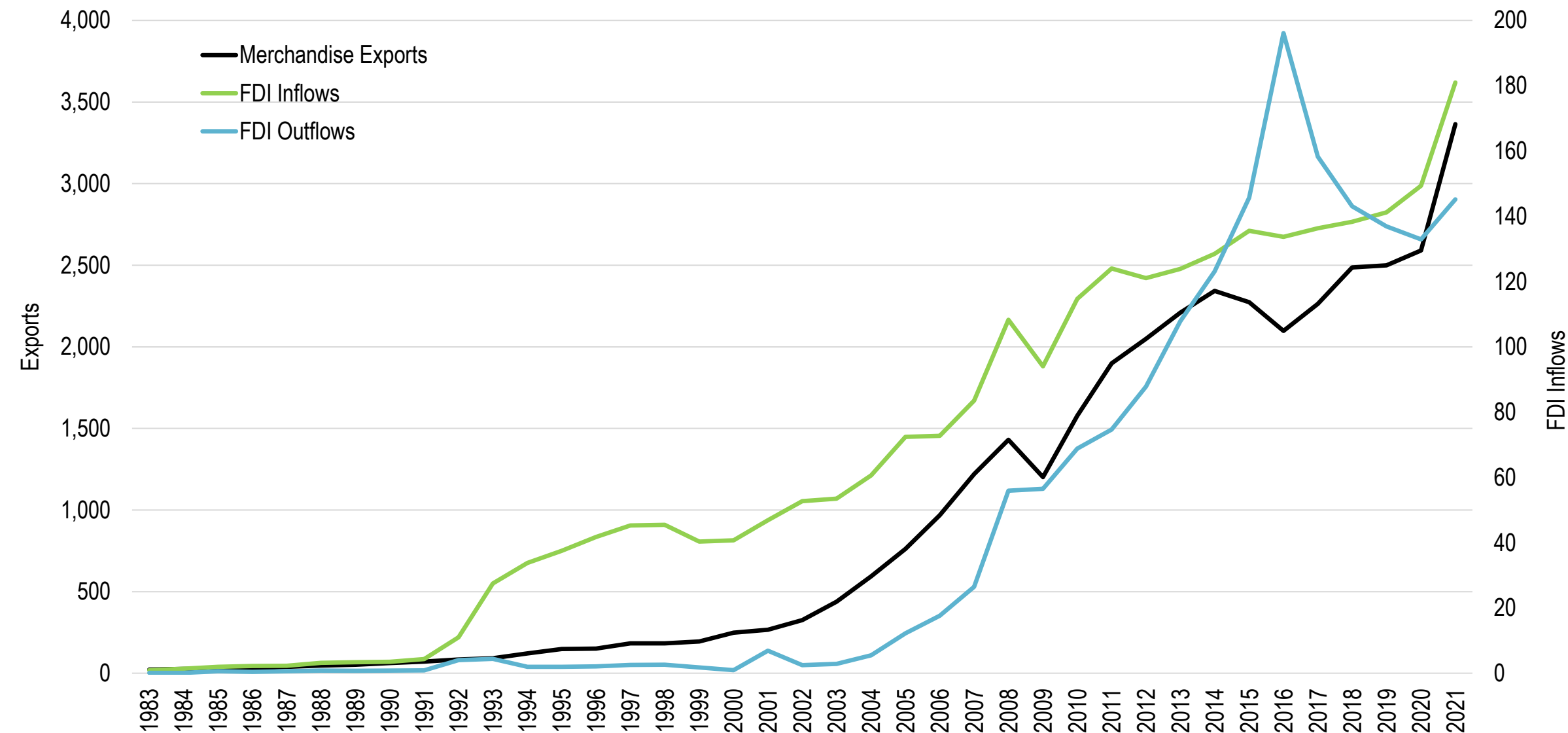
<b>Infrastructures</b>	High level of infrastructure, such as land, transport, office space, utilities, logistics services, business services and other facilities.
<b>Regulations</b>	Streamlined to improve efficiency, including custom services, labor regulation and permits.
<b>Location</b>	High accessibility location, often close to major terminal facilities such as a port, inland terminal or an airport. Location often away from conventional industry.
<b>Export-oriented</b>	Activities operating within the zone produce mainly or exclusively for foreign markets.
<b>Incentives</b>	Variety of incentives, including low cost land, infrastructures, tax and duty exemptions or various subsidies.



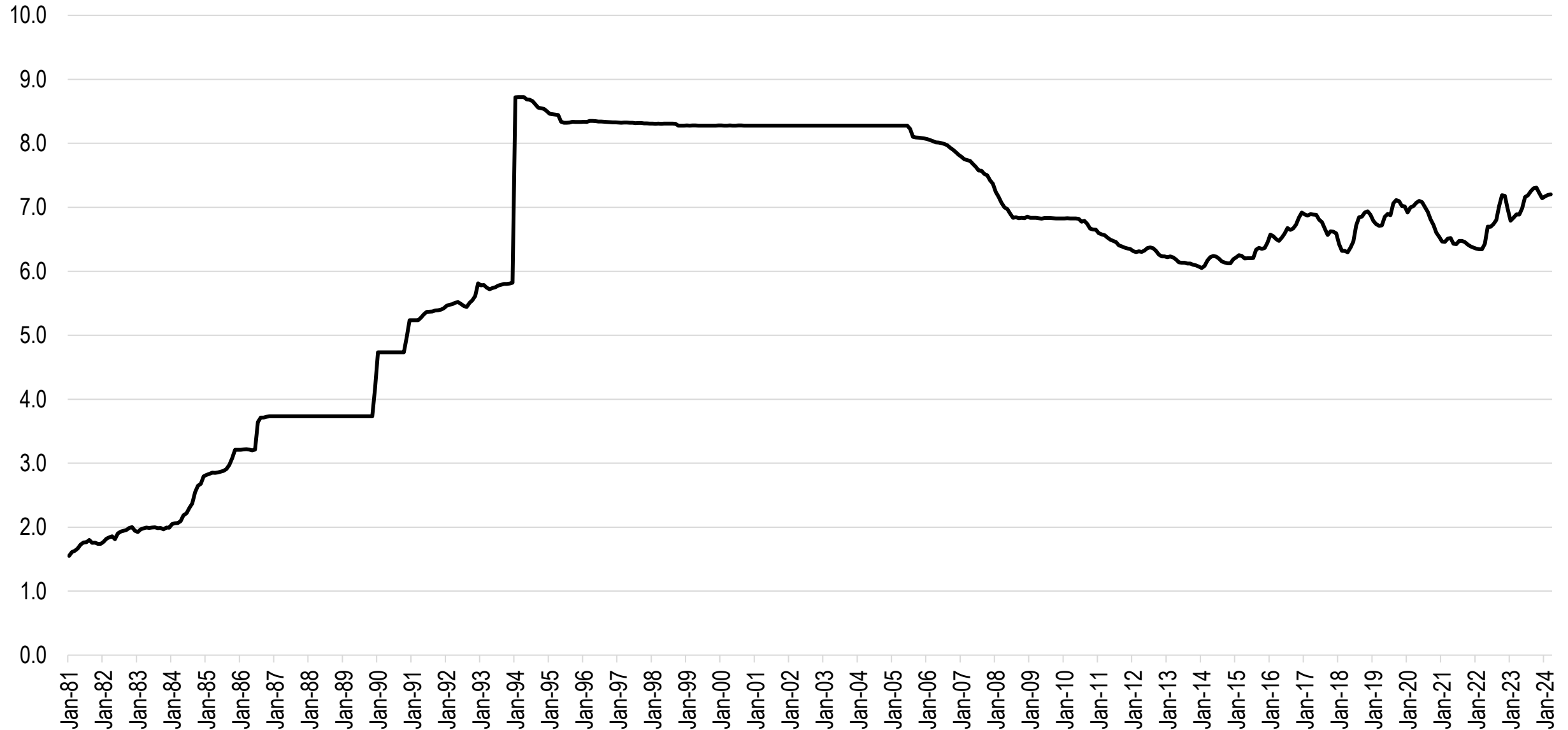
# China's Special Economic Zones



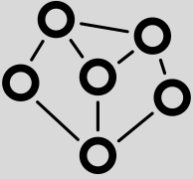

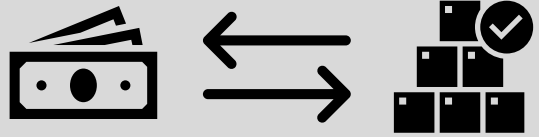
# Value of Chinese Exports and FDI, 1983-2021 (Billions of \$US)



# Yuan Exchange Rate (per USD), 1981-2024 (Monthly)

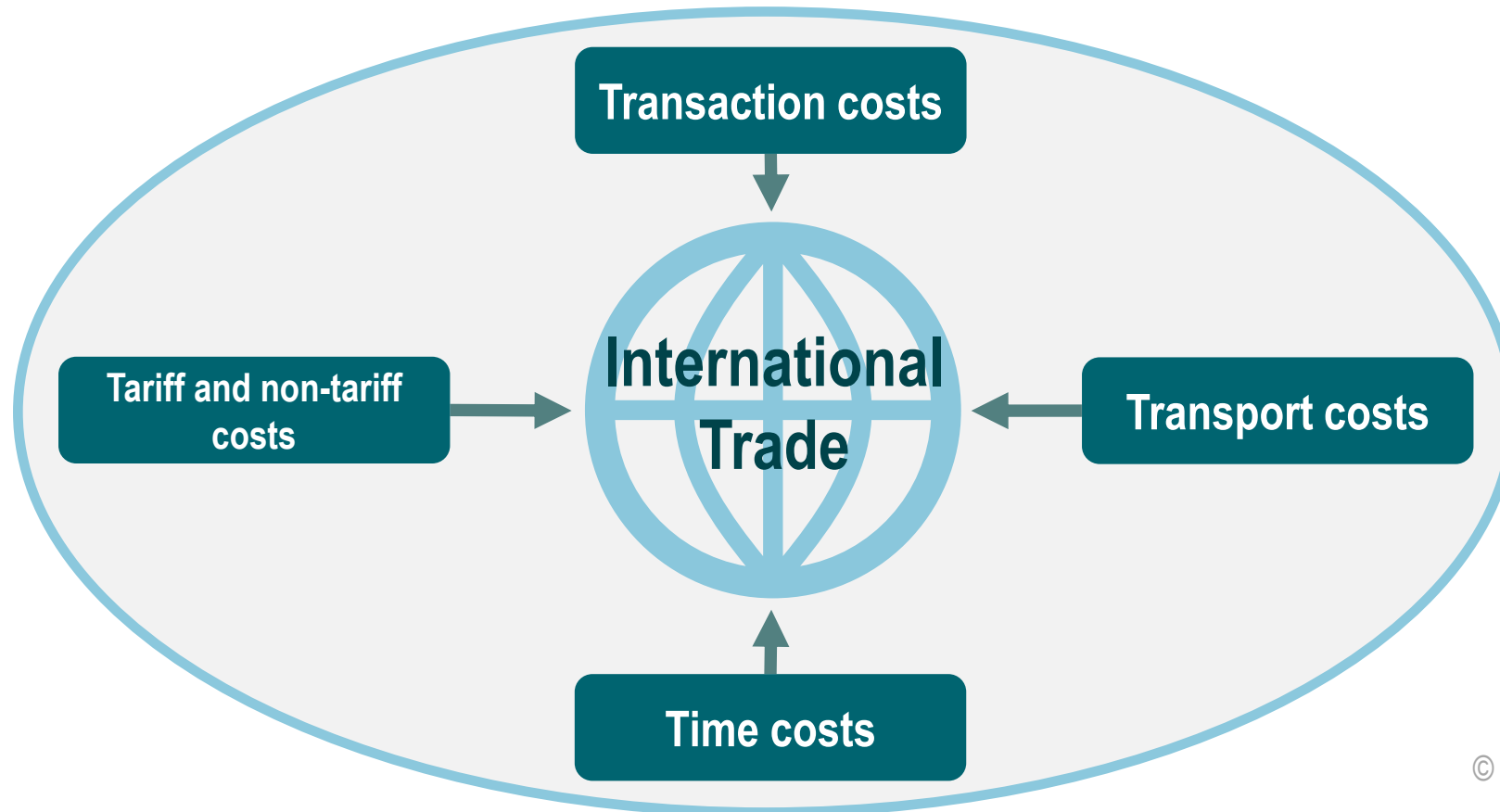


# The Main Dimensions of Trade Facilitation

	INTEGRATION-BASED	DISTRIBUTION-BASED	TRANSACTIONS-BASED
			
<b>Nature</b>	Compliance to rules and regulations.	Physical capacity to support trade.	Setting transactions and receiving compensation.
<b>Activities</b>	Customs procedures, regulations and handling of trade documentation.	Multimodal and intermodal freight transport systems. Modes, infrastructures and terminals.	Banking, finance and insurance activities where accounts can be settled.

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# The “Four Ts” in International Trade



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## Separation Factors

### Exogenous

- Distance, transportation costs, travel time.
- Part of a trade agreement.

## Country Specific Factors

### Endogenous

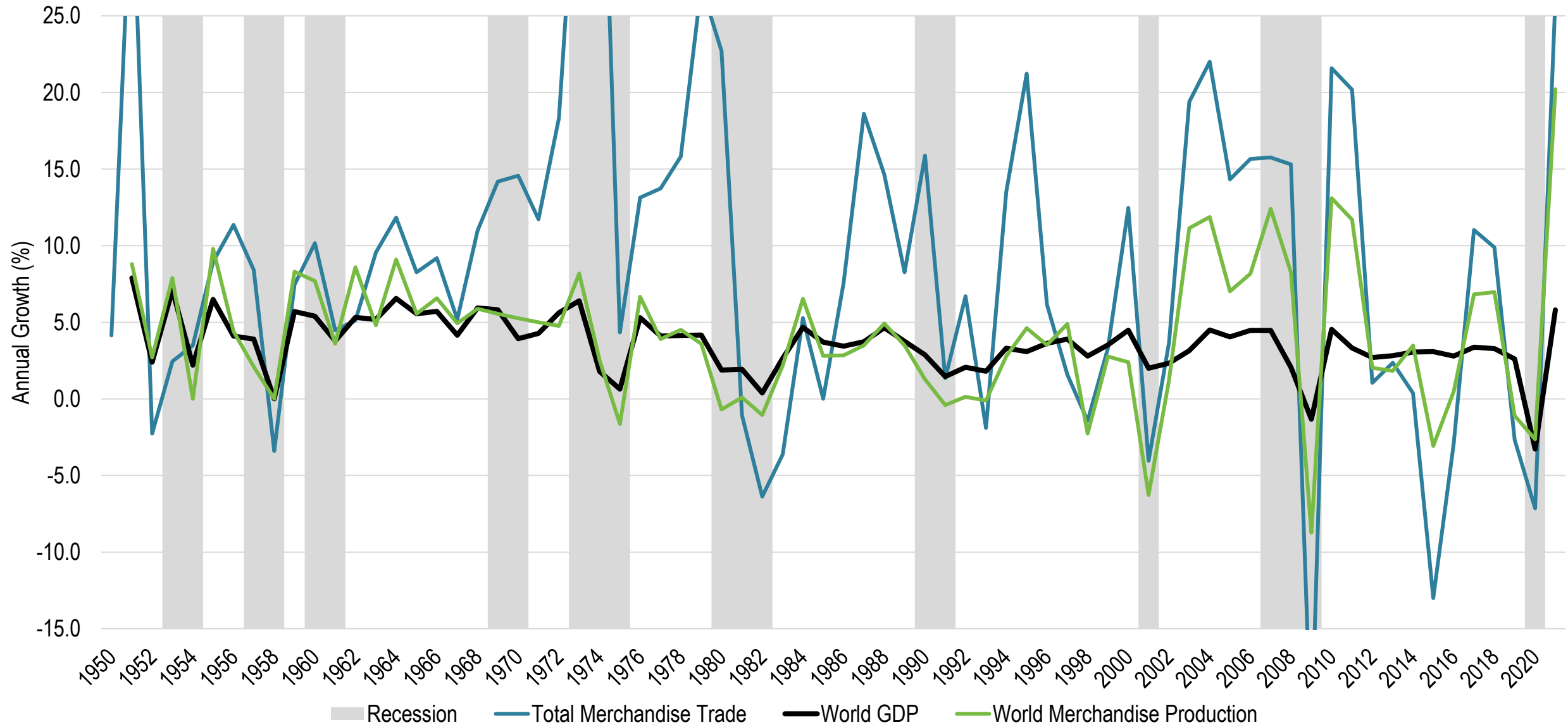
- Customs procedures.
- Performance of national transport and logistics.

# Phases of the Export-Oriented Paradigm

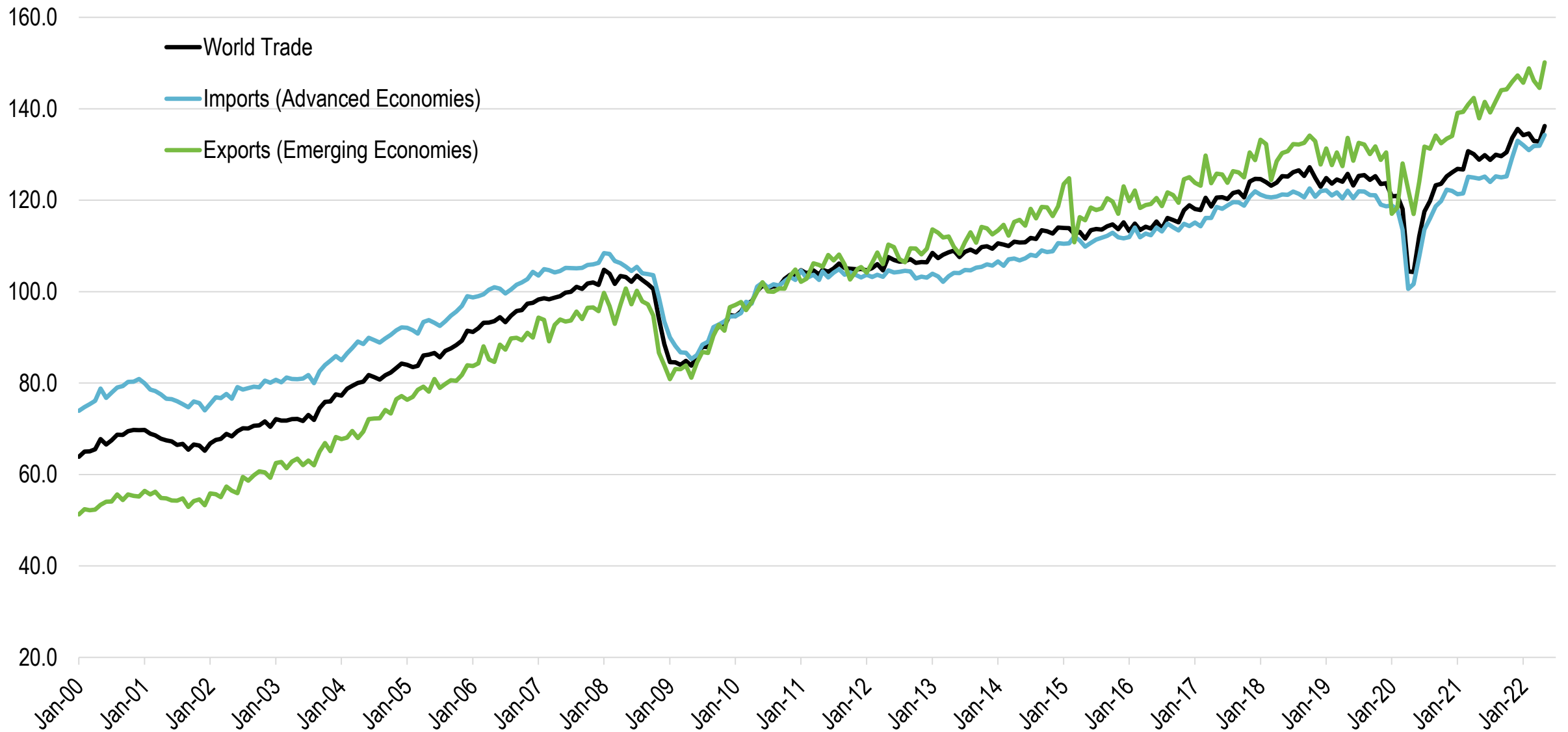
	PHASE I	PHASE II	PHASE III
Capital	<ul style="list-style-type: none"><li>• Currency devaluation.</li><li>• Mostly Foreign Direct Investments (FDI).</li></ul>	<ul style="list-style-type: none"><li>• Surge in FDI.</li><li>• Growing share of national capital.</li></ul>	<ul style="list-style-type: none"><li>• Pressures to revalue currency.</li><li>• Drop in FDI.</li><li>• National capital dominant.</li><li>• Providing FDI to other markets.</li></ul>
Production	<ul style="list-style-type: none"><li>• Several comparative advantages.</li><li>• Focusing on labor-intensive activities.</li></ul>	<ul style="list-style-type: none"><li>• Gradual shift to added value production.</li></ul>	<ul style="list-style-type: none"><li>• Loss of comparative advantages in labor-intensive activities.</li><li>• Growing importance of the national market.</li></ul>
Trade	<ul style="list-style-type: none"><li>• Growth of exports and widening trade balance (imports versus exports).</li></ul>	<ul style="list-style-type: none"><li>• Peak trade growth and imbalances.</li></ul>	<ul style="list-style-type: none"><li>• Re-balancing.</li><li>• Relative decline of the share exports in relation to imports.</li></ul>
Transportation	<ul style="list-style-type: none"><li>• Modernization of existing gateways.</li></ul>	<ul style="list-style-type: none"><li>• Massive investments in new transport terminals, mostly ports and airports.</li></ul>	<ul style="list-style-type: none"><li>• Focus on inland transportation.</li></ul>

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# Changes in the Value World's Merchandise Trade, Manufacturing and GDP, 1950-2021

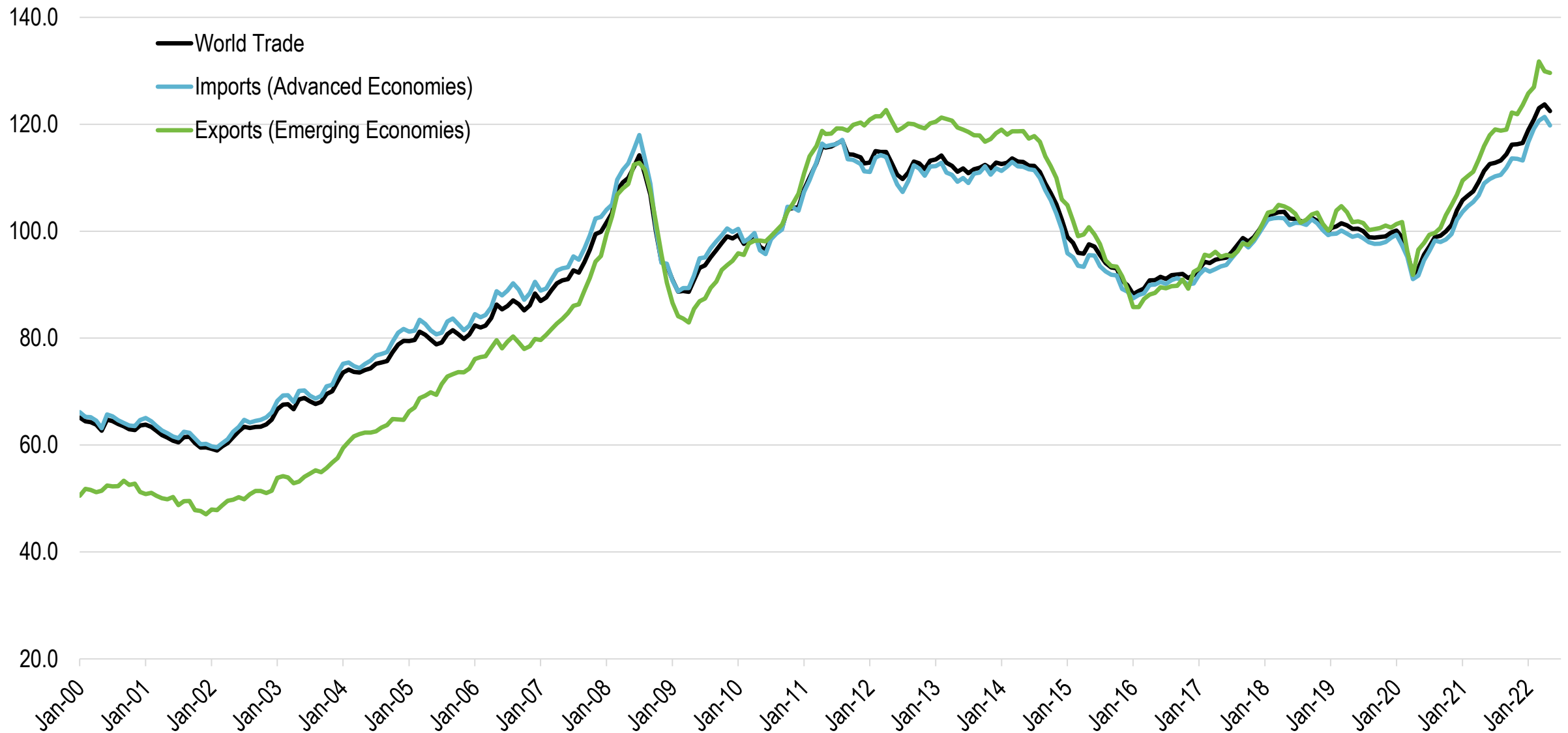


# CPB World Trade Index by Volume, 2000-2022 (2010=100)

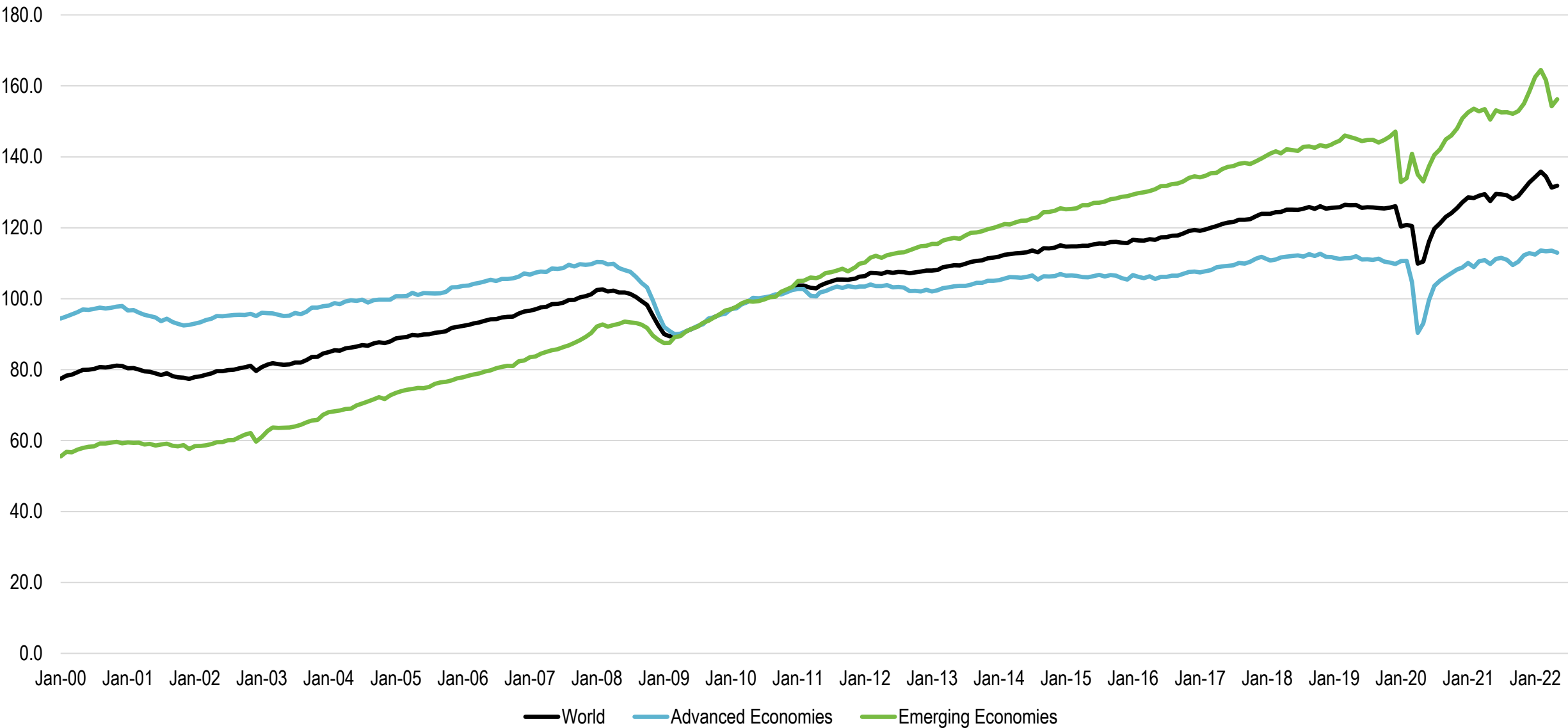




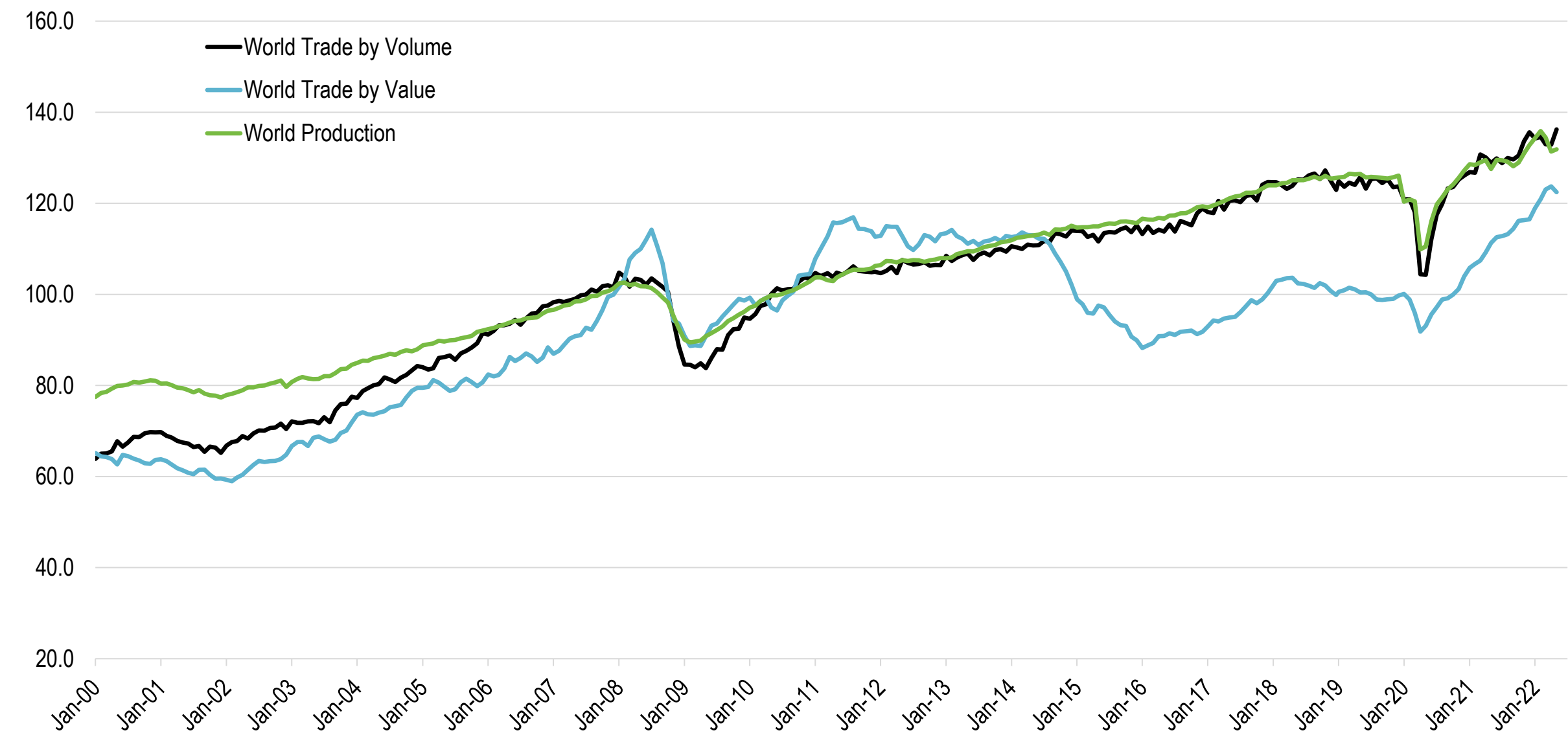
# CPB World Trade Index by Value, 2000-2022 (2010=100)



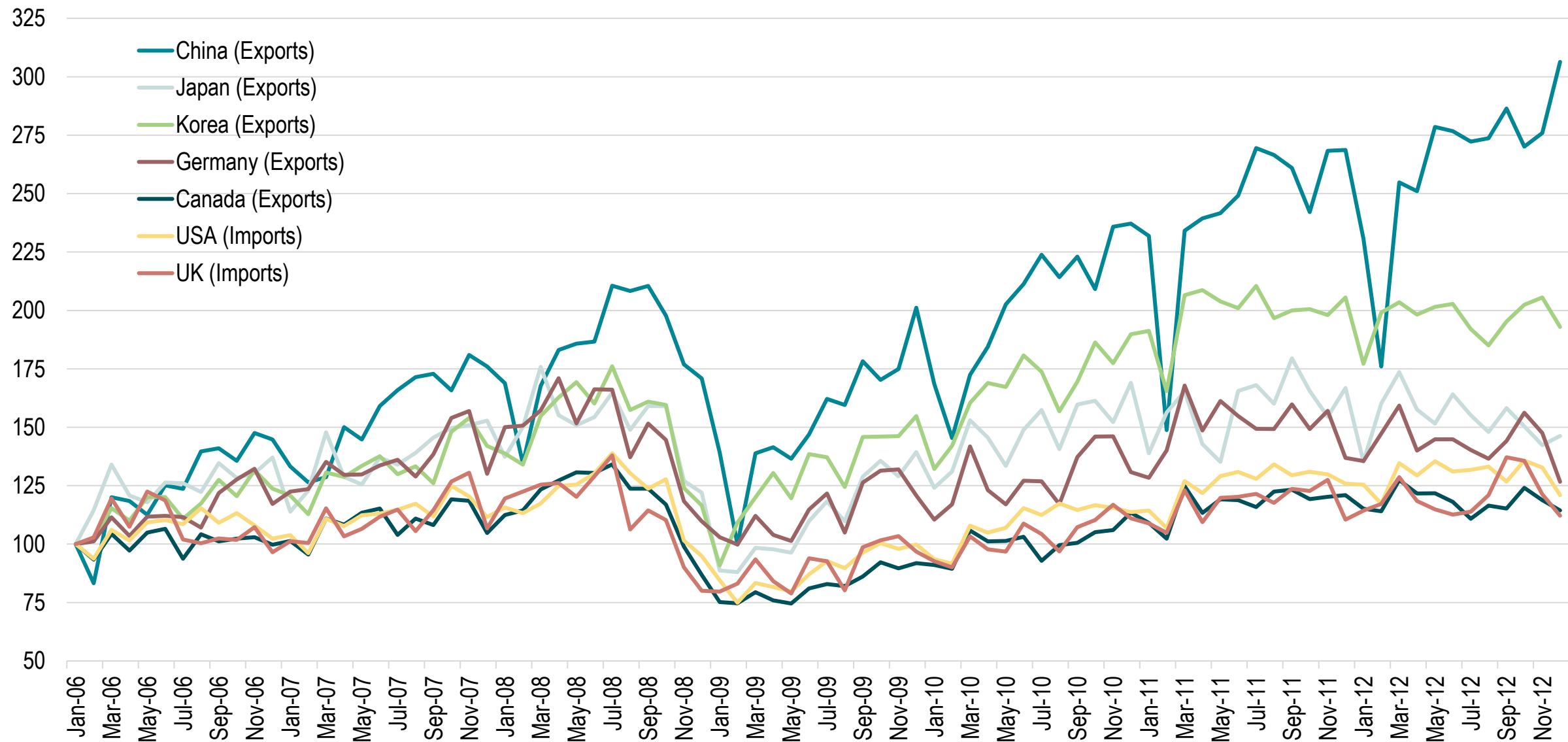
# CPB World Production Index, 2000-2022 (2010=100)



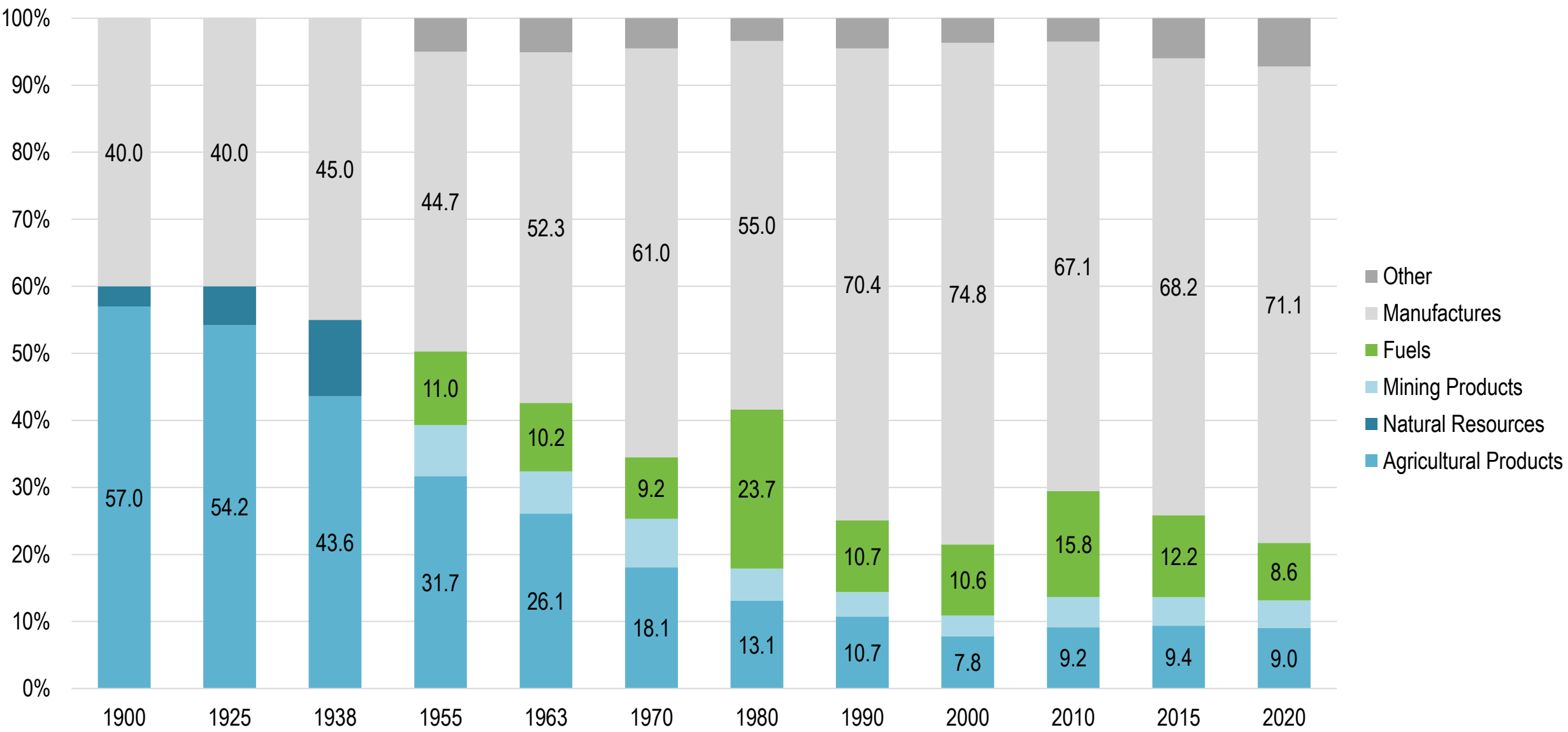
# CPB World Trade Index, 2000-2022 (2010=100)



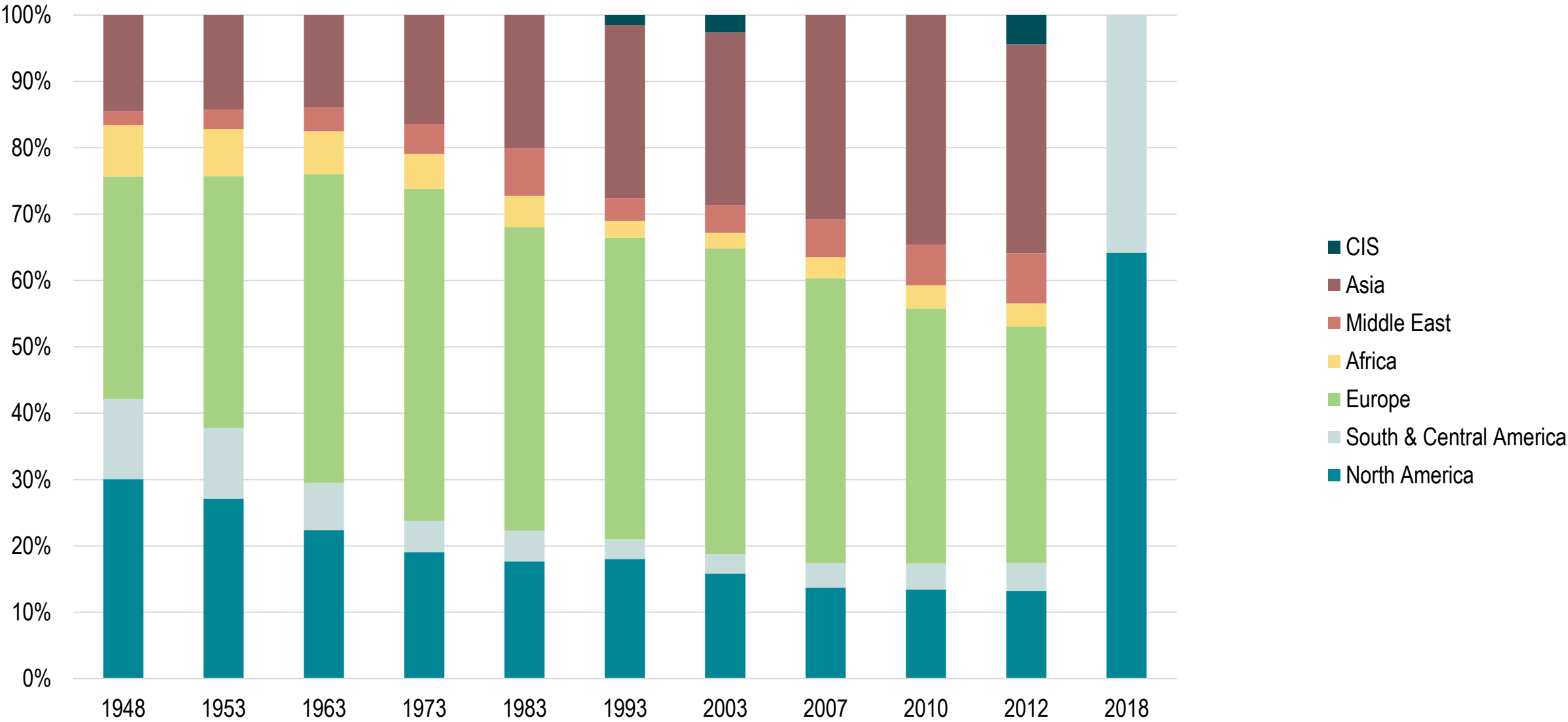
# Monthly Value of Exports or Imports, Selected Traders, 2006-2012 (Jan 2006=100)



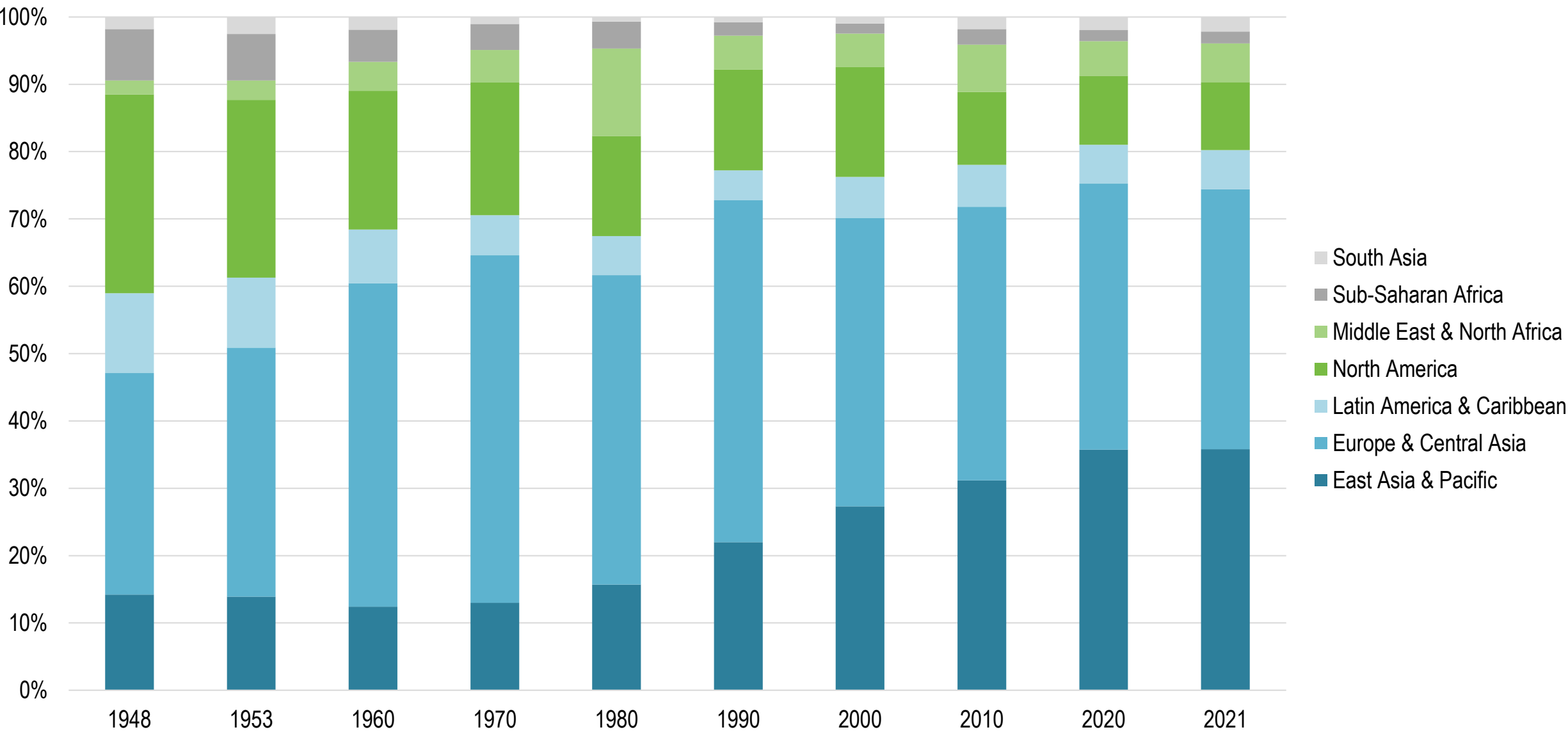
# Share of Product Groups in World Merchandise Trade, 1900-2020



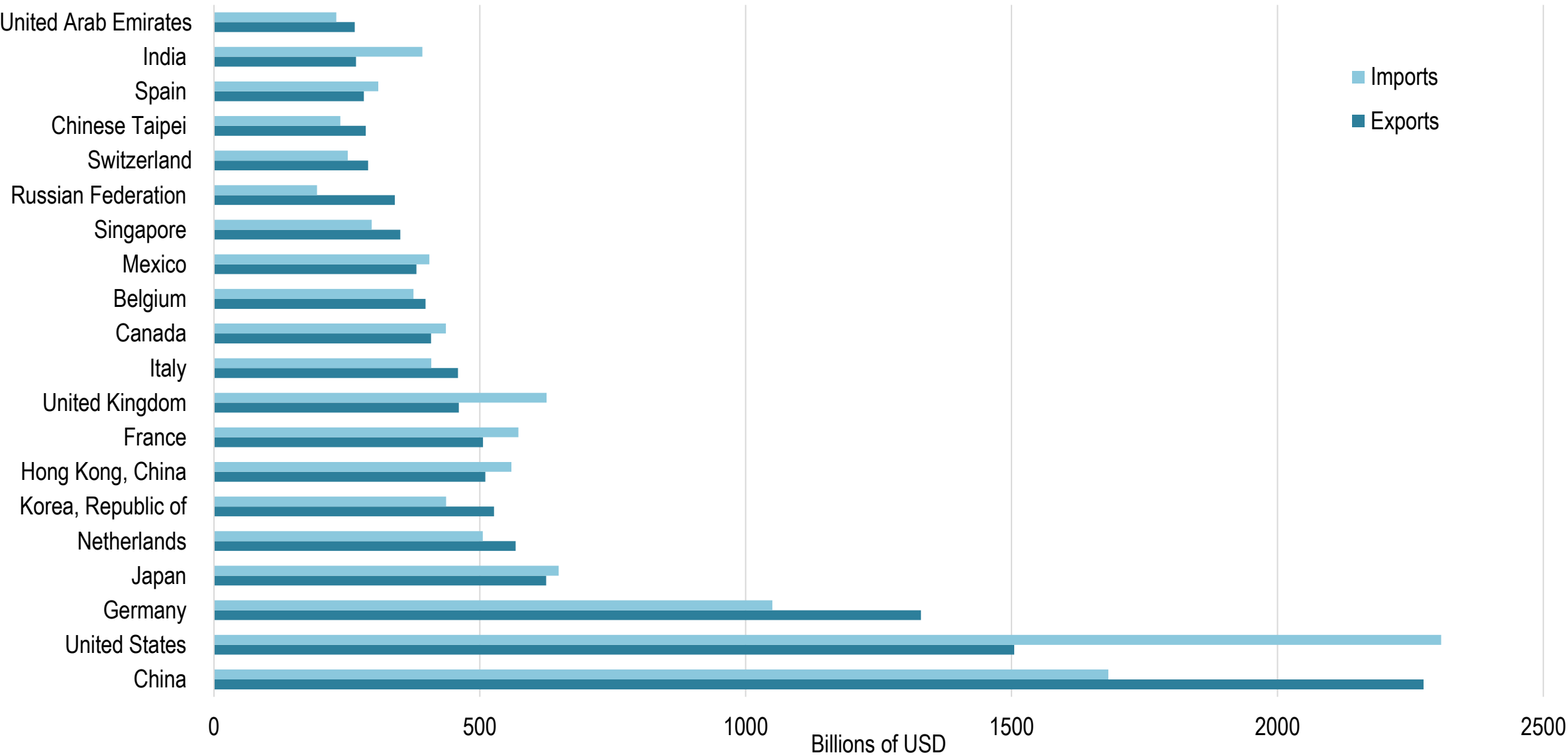
# Share of Merchandise Exports by Region, 1948-2012



# Share of Merchandise Exports by Region, 1948-2021

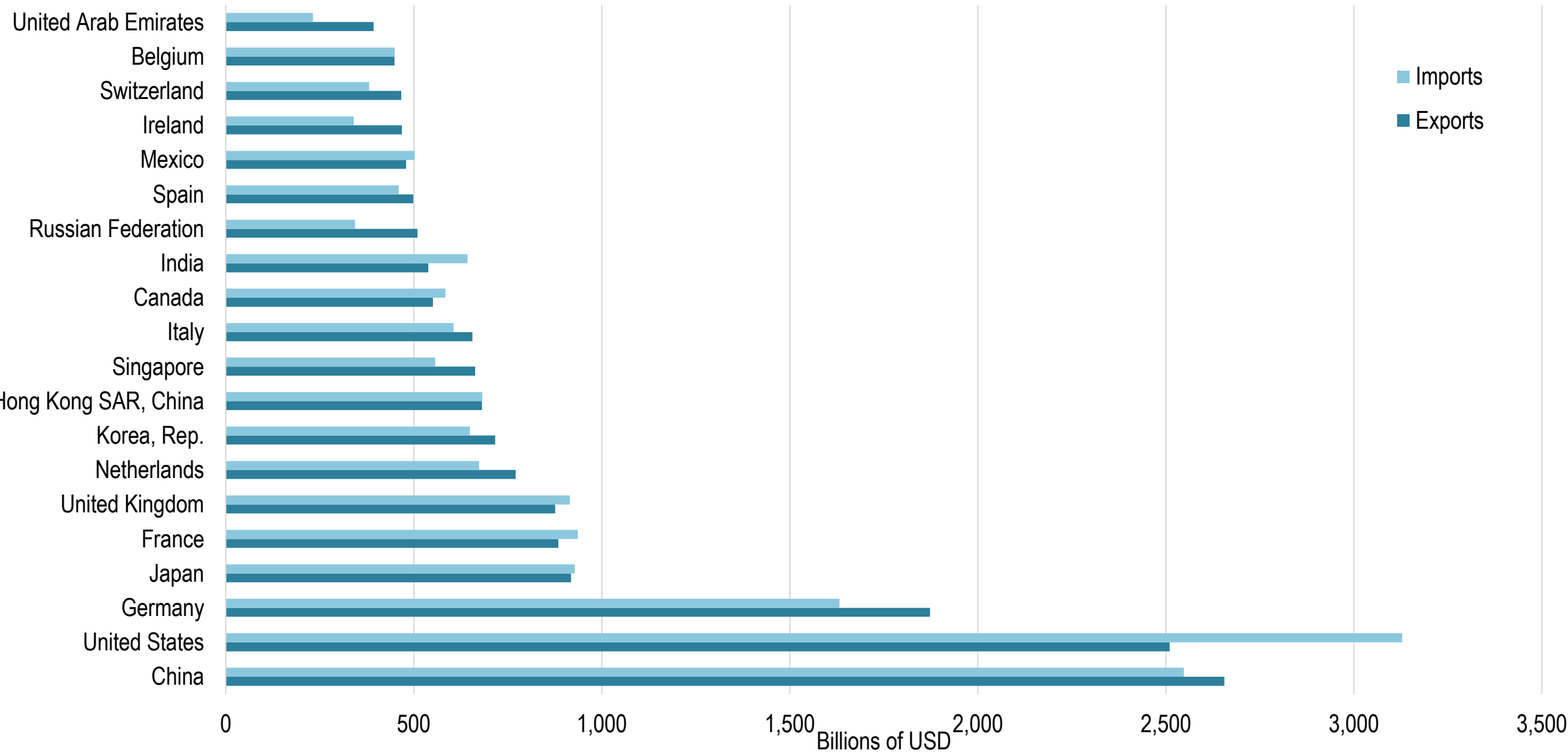


# World's 20 Largest Exporters and Importers, 2015

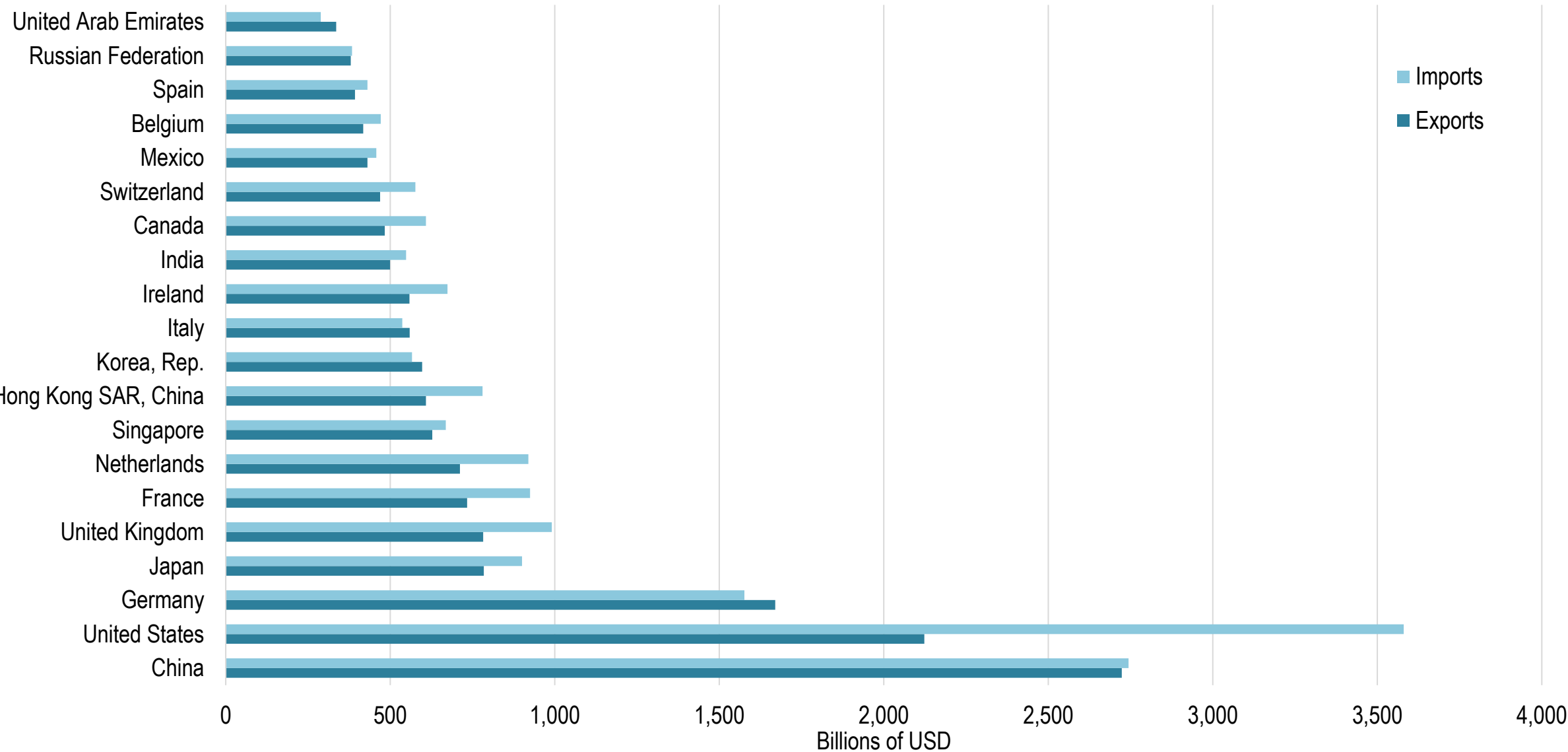




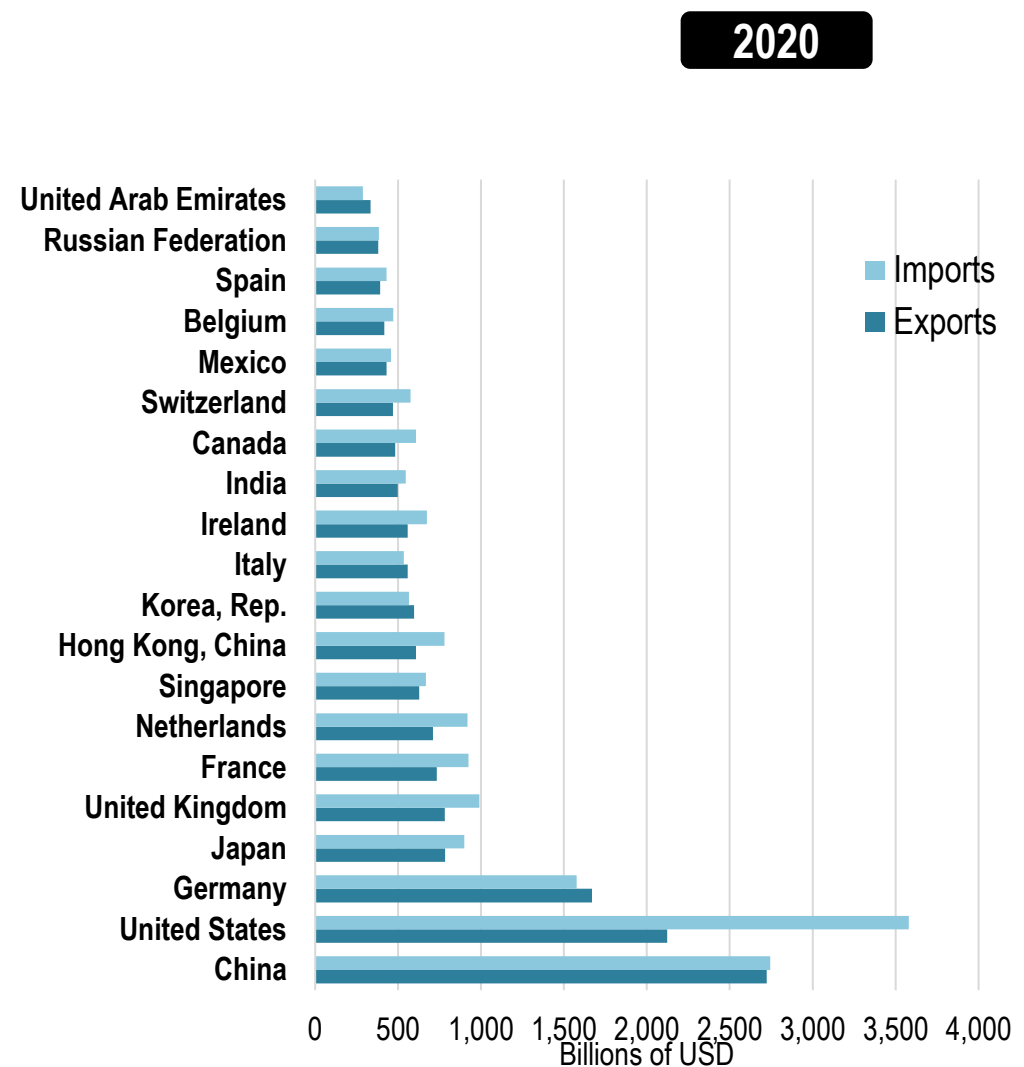
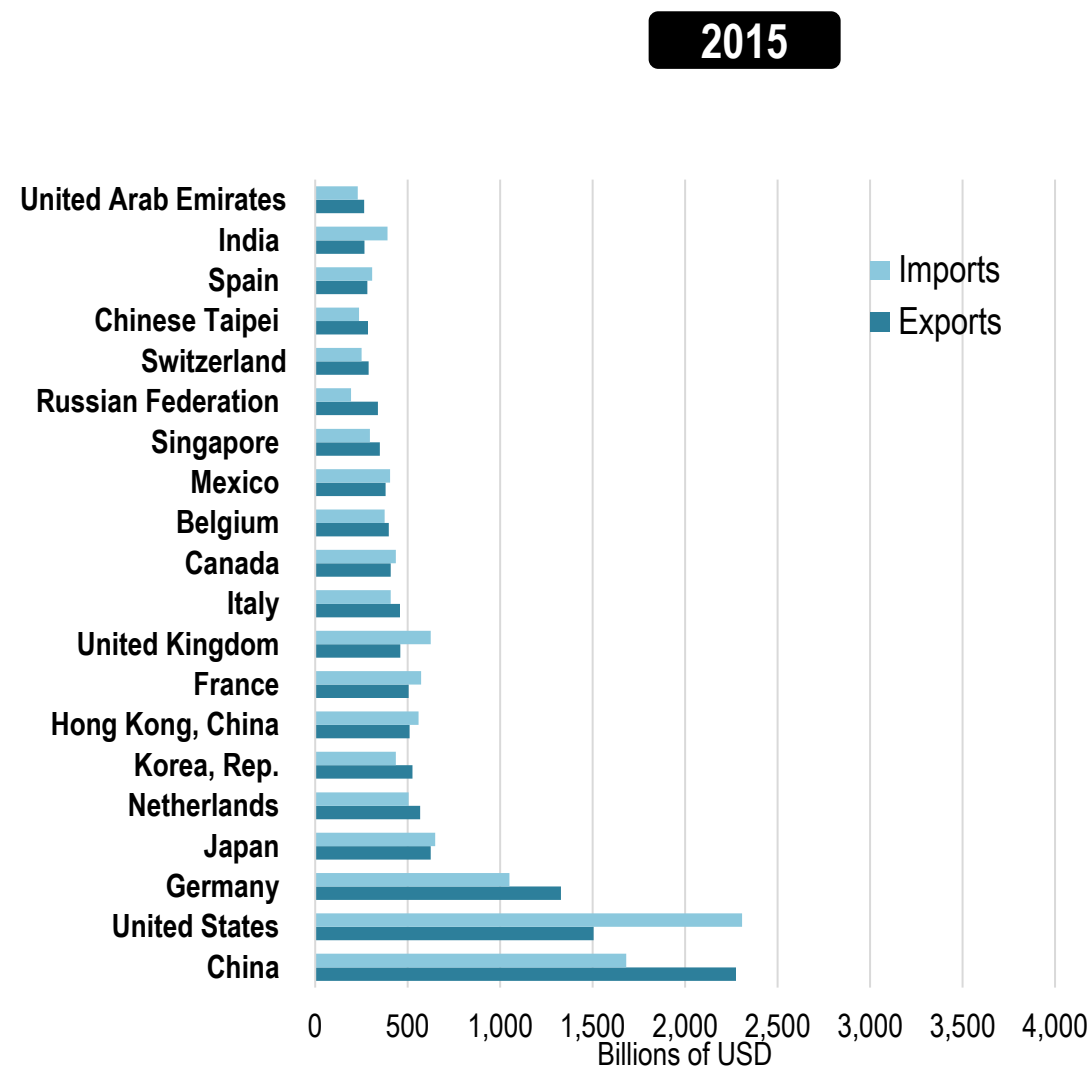
# World's 20 Largest Exporters and Importers of Goods and Services, 2018



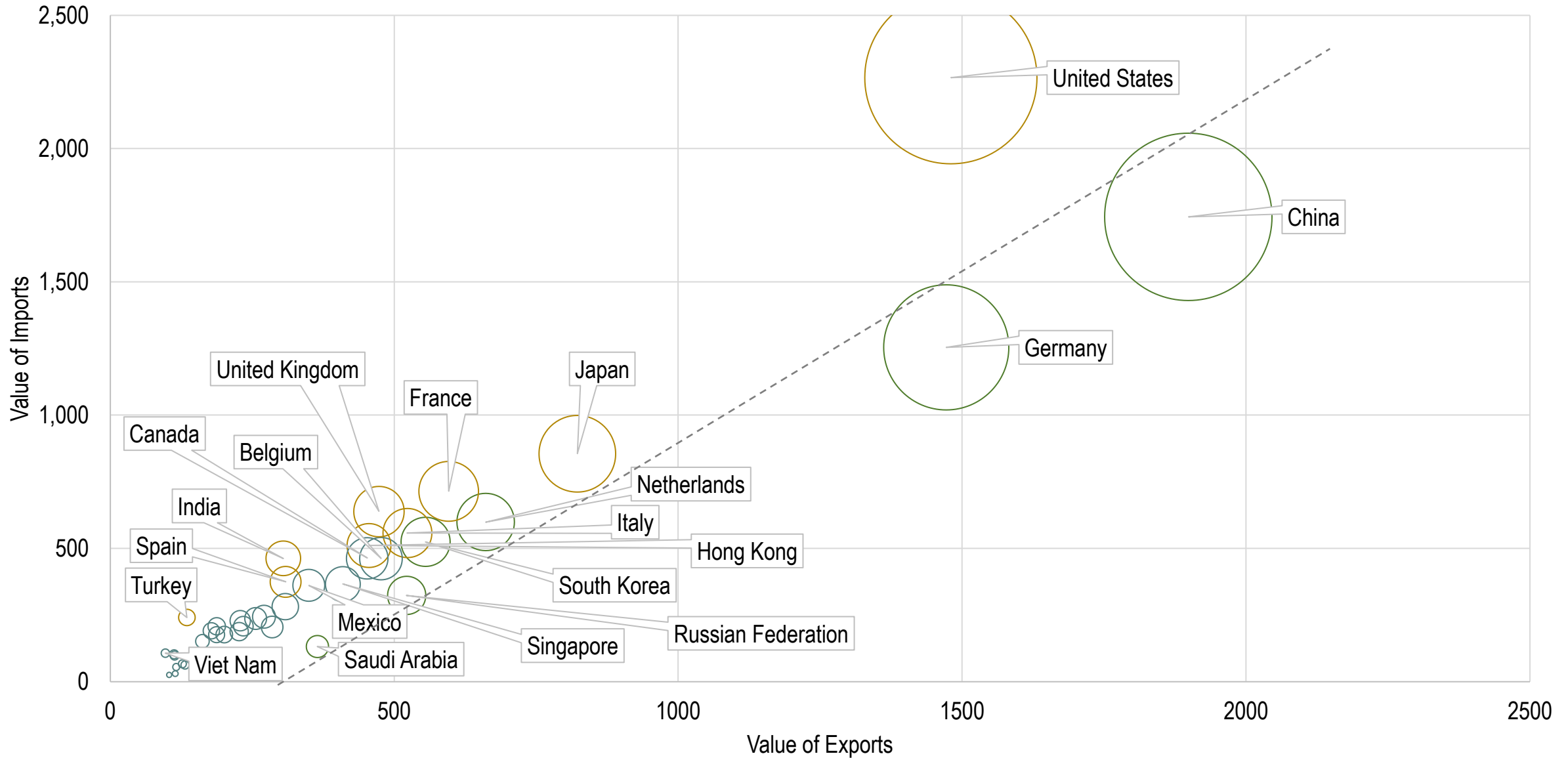
# World's 20 Largest Exporters and Importers of Goods and Services, 2020



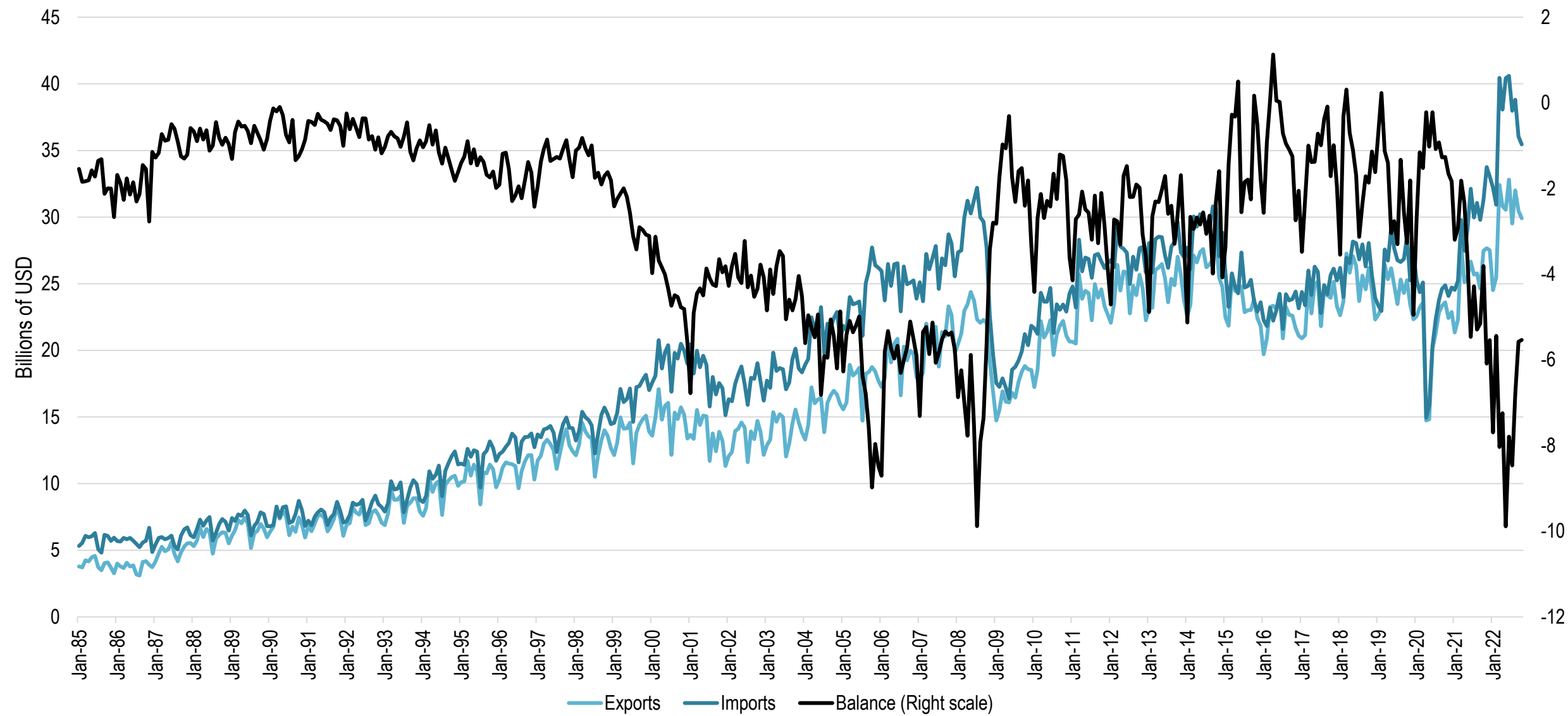
# World's 20 Largest Exporters and Importers of Goods and Services, 2015-2020



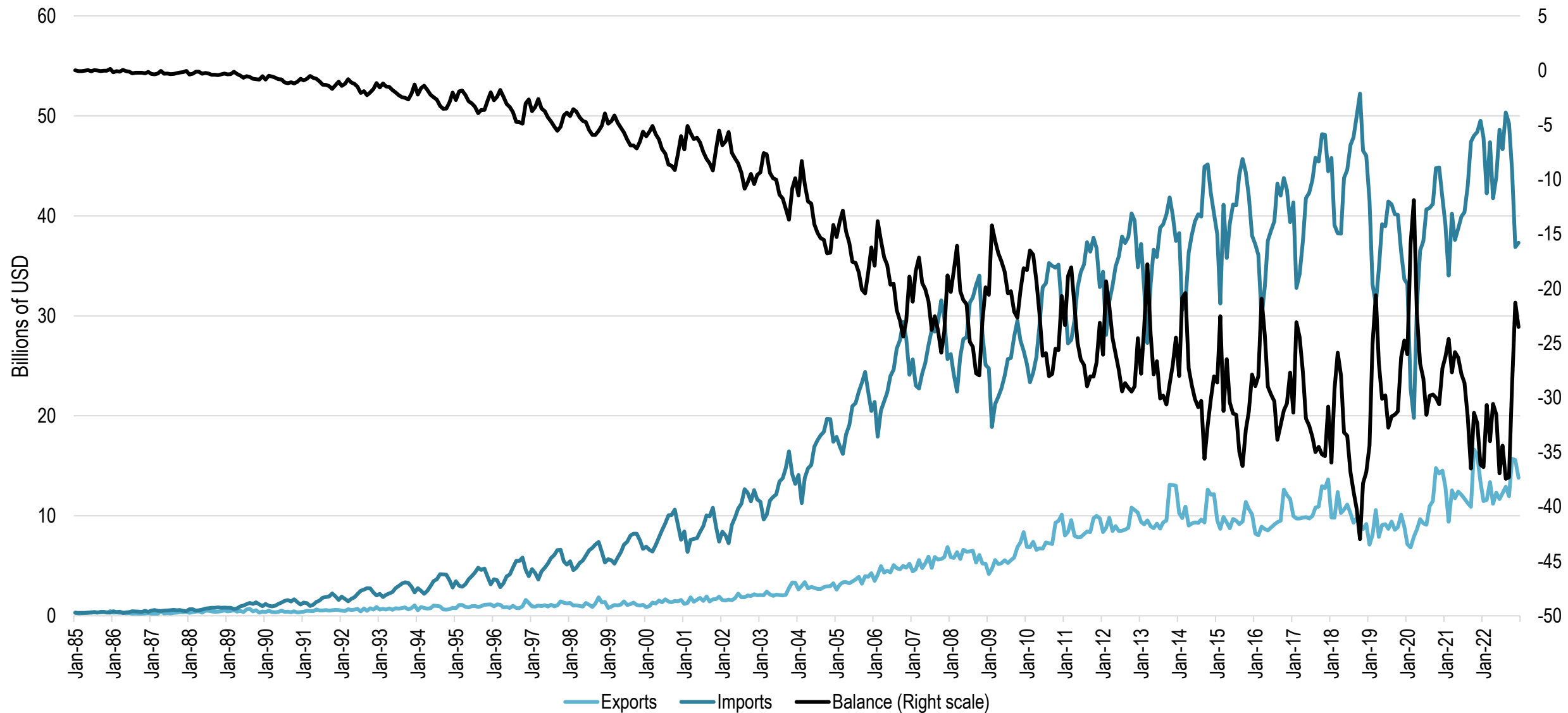
# World's Largest Exporters and Importers, 2011



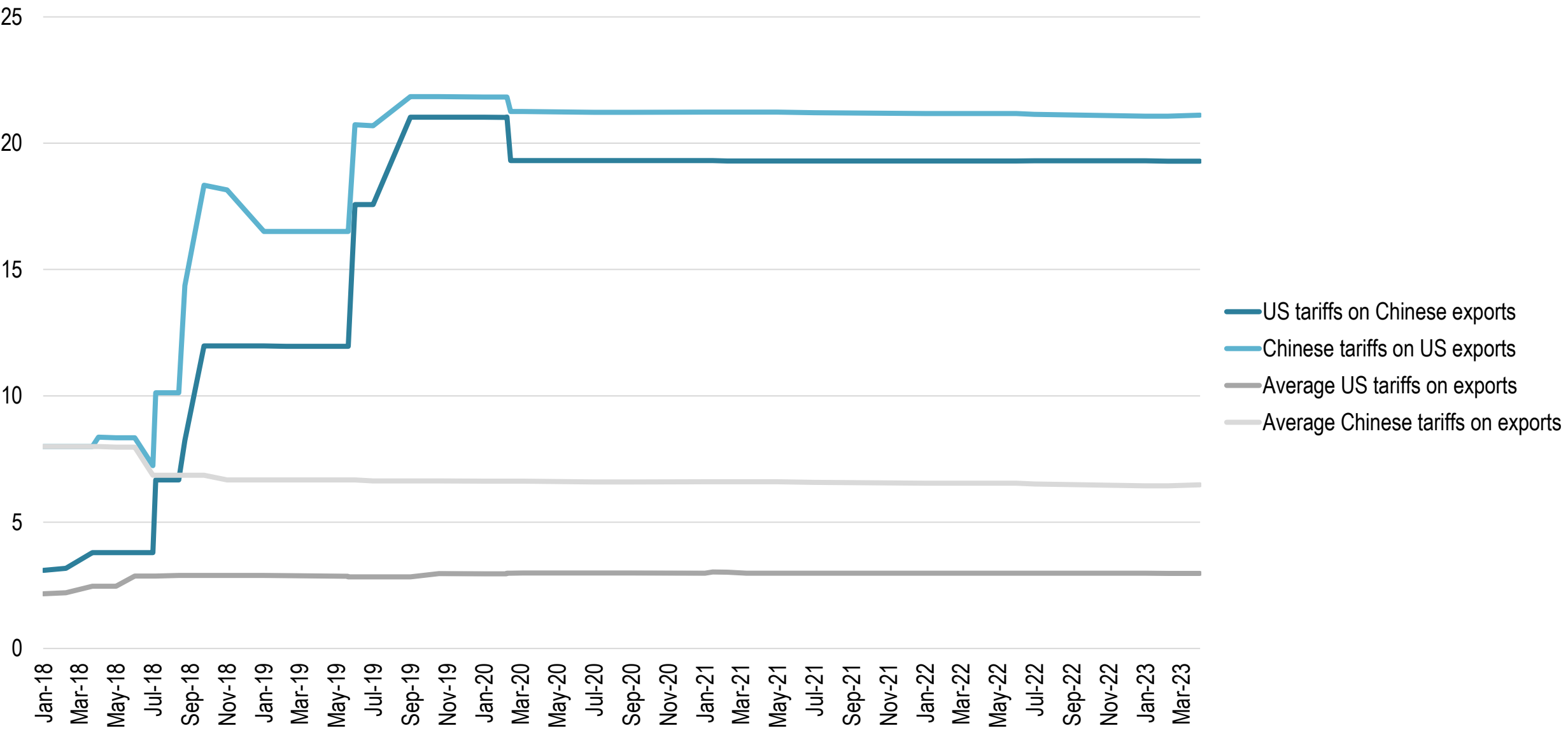
# Monthly Trade between Canada and the United States (1985-2022)



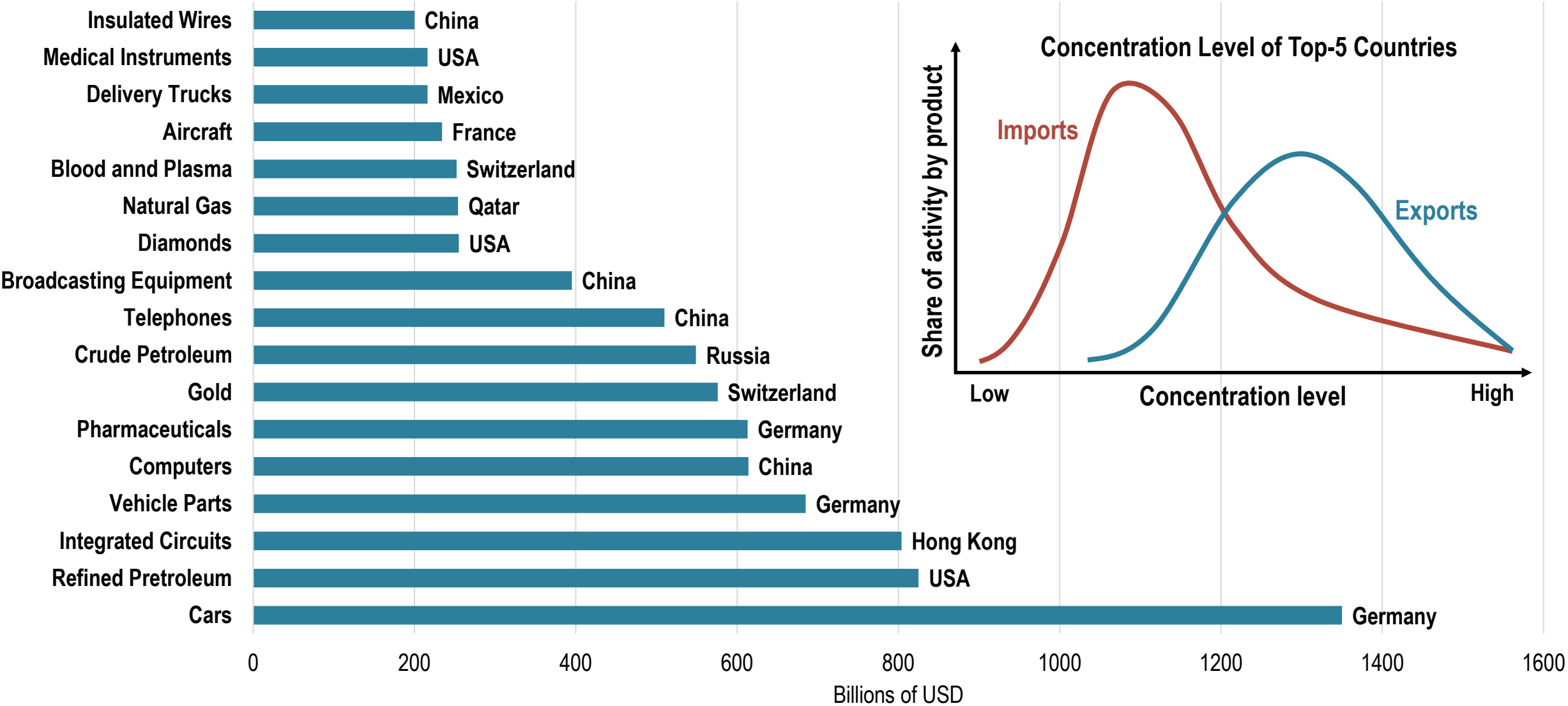
# Monthly Trade between China and the United States (1985-2022)



# US-China Tariffs, 2018-2023

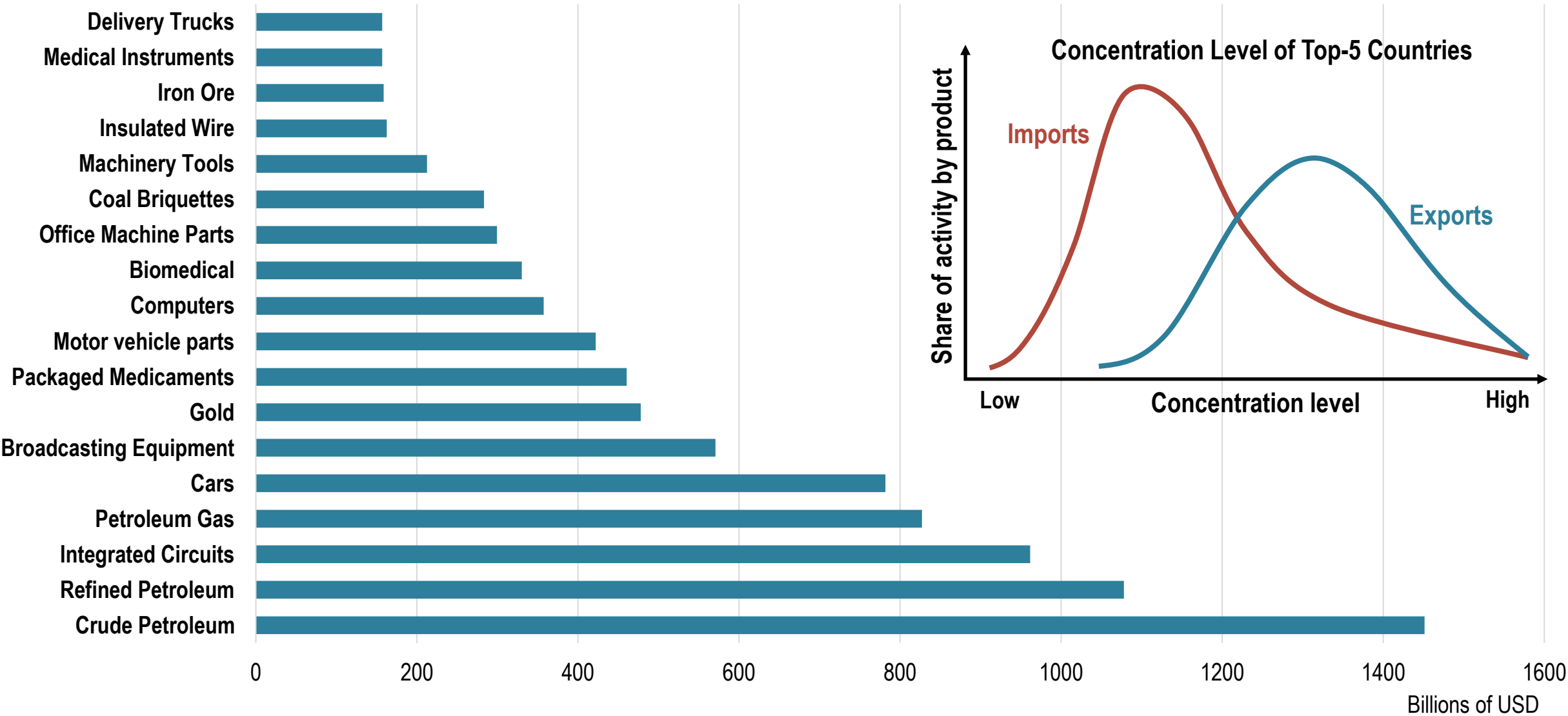


# World's Most Traded Goods, Lead Exporter and Concentration, 2016

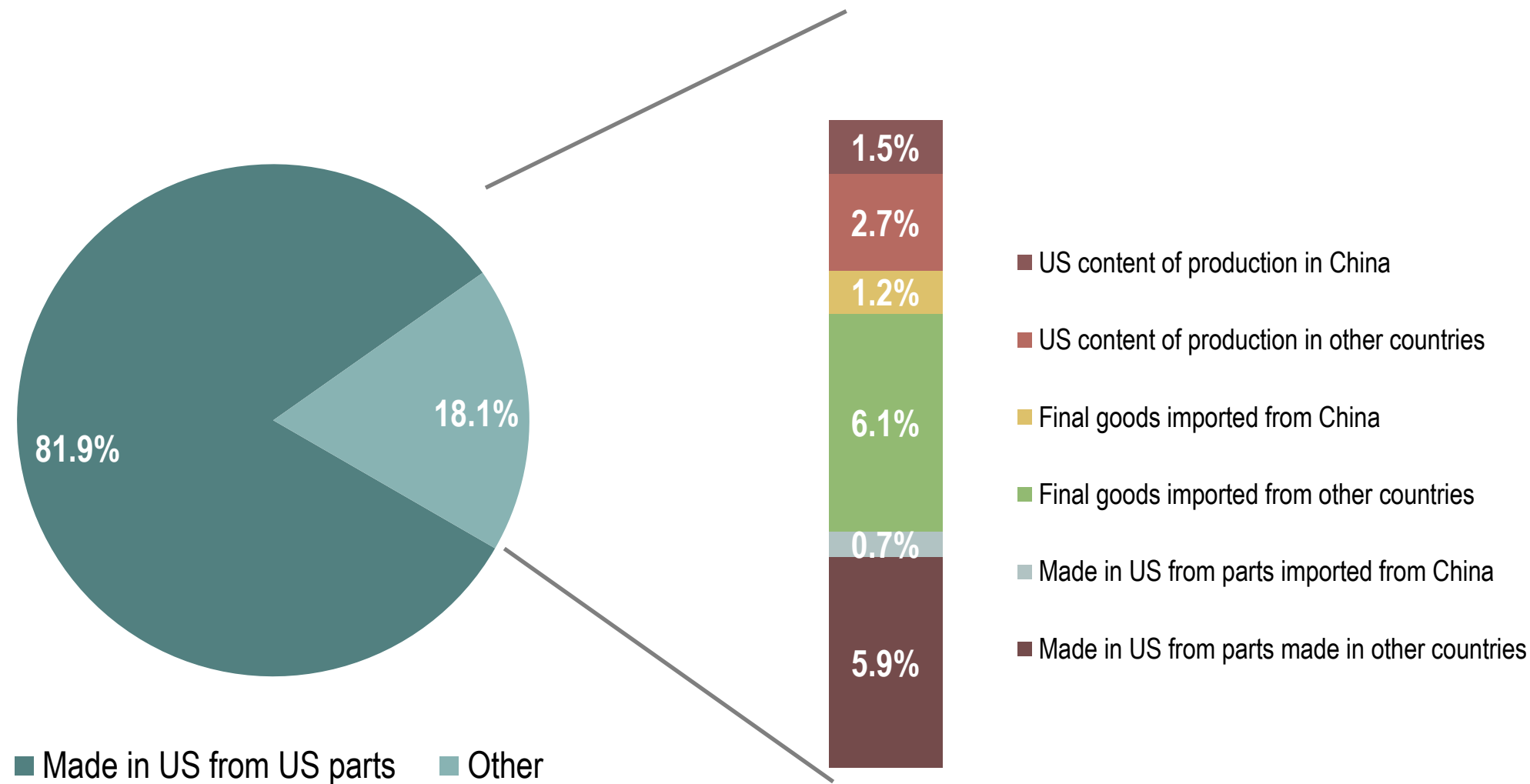




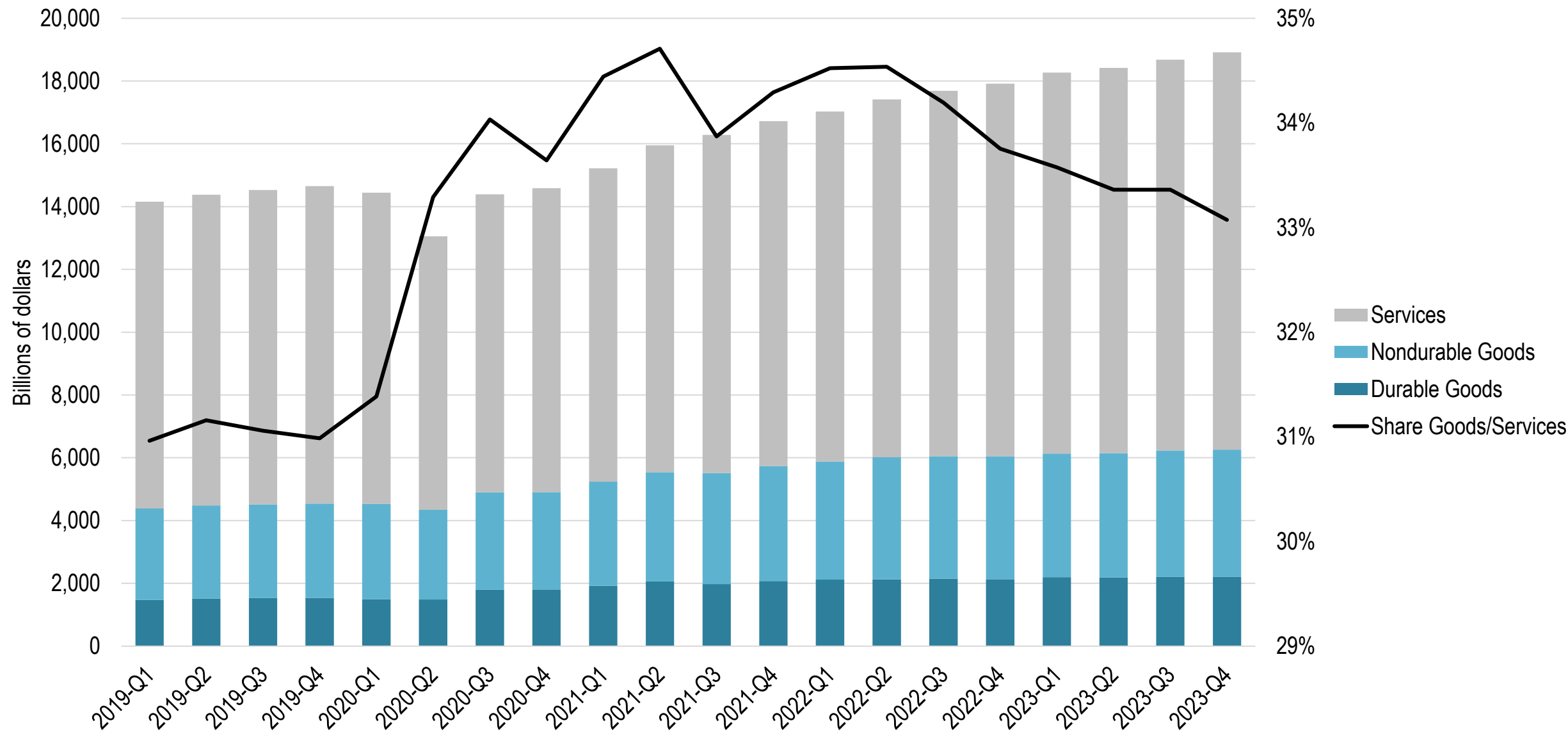
# World's Most Traded Goods and Concentration, 2022



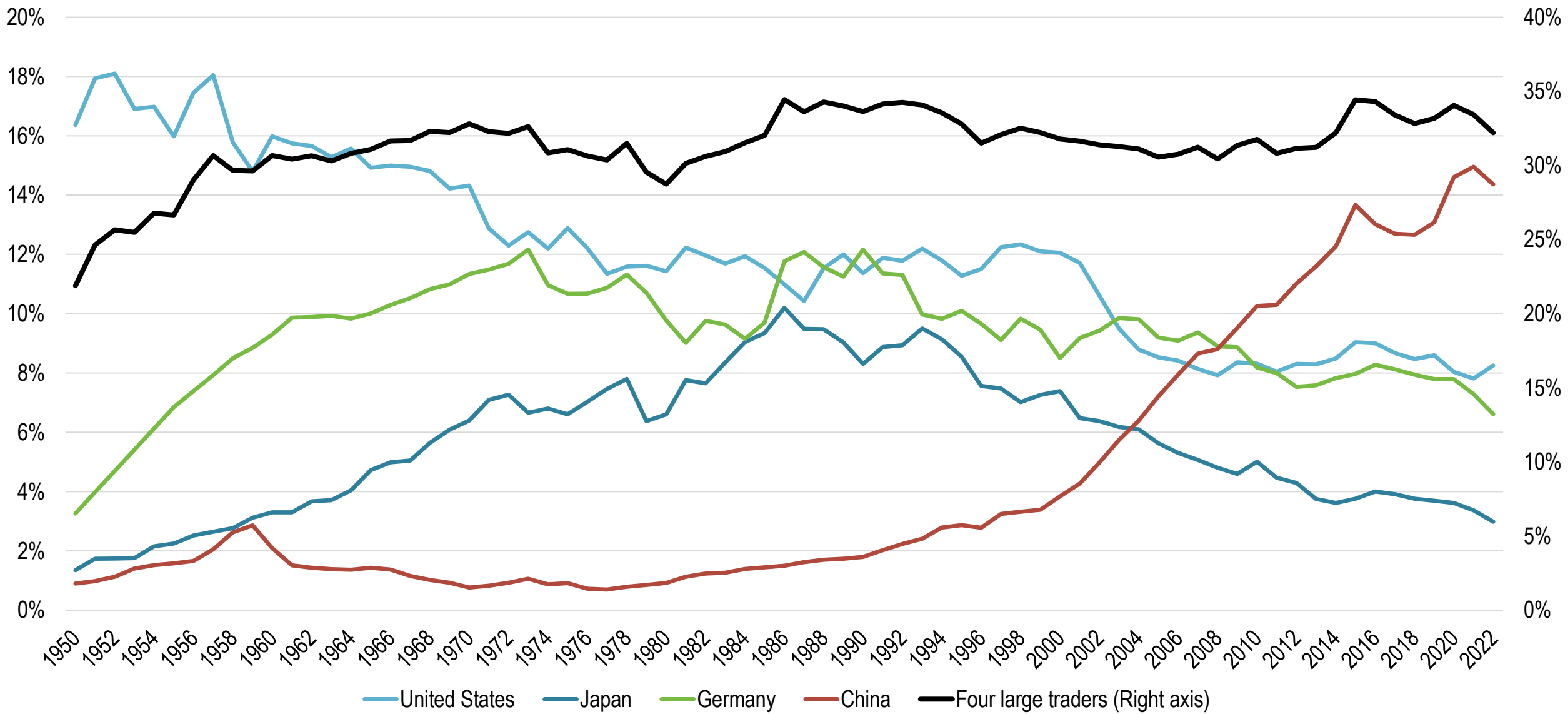
# Personal Consumption Expenditures, United States 2010



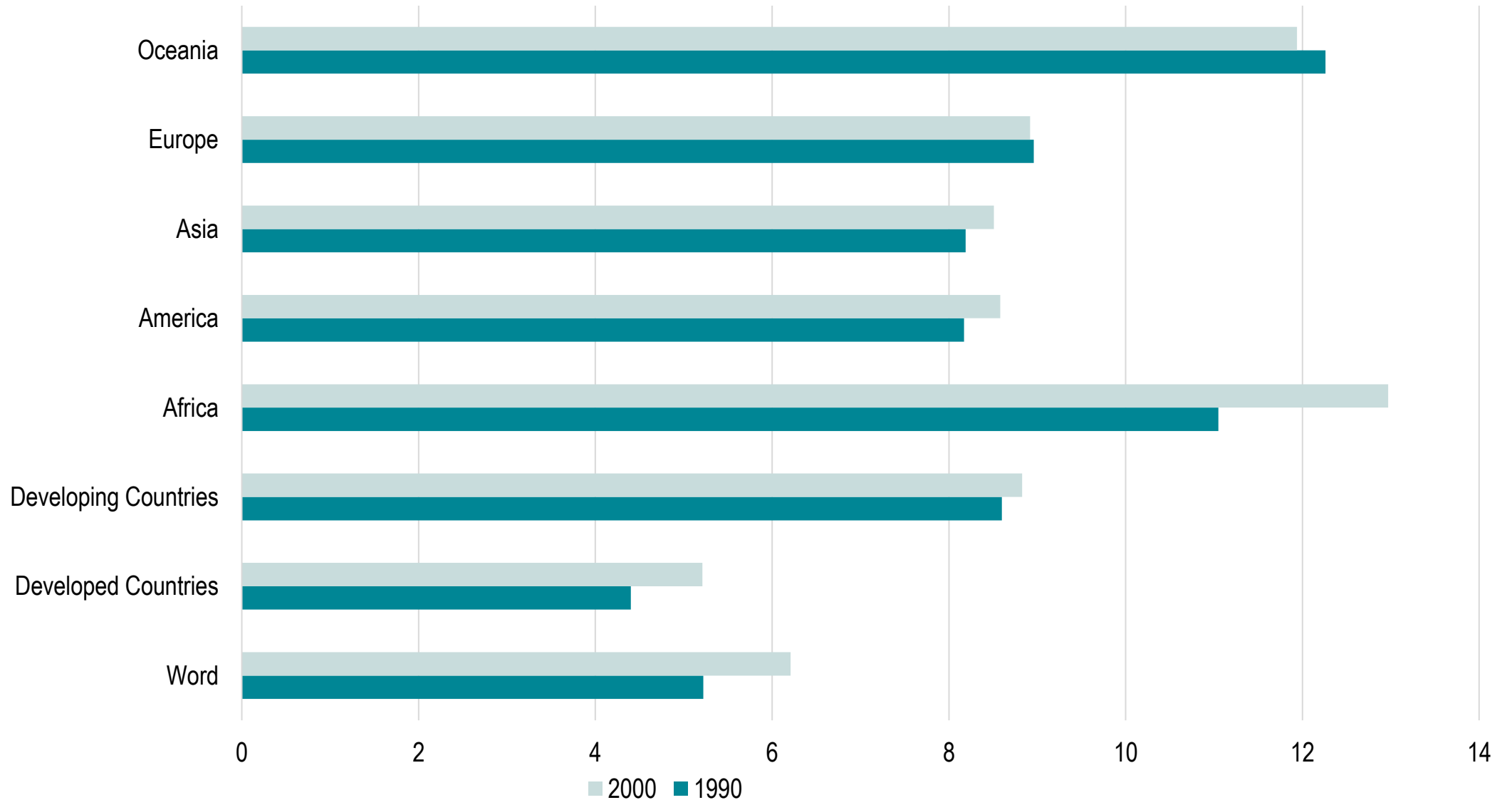
# Personal Consumption Expenditures by Major Type of Product, United States



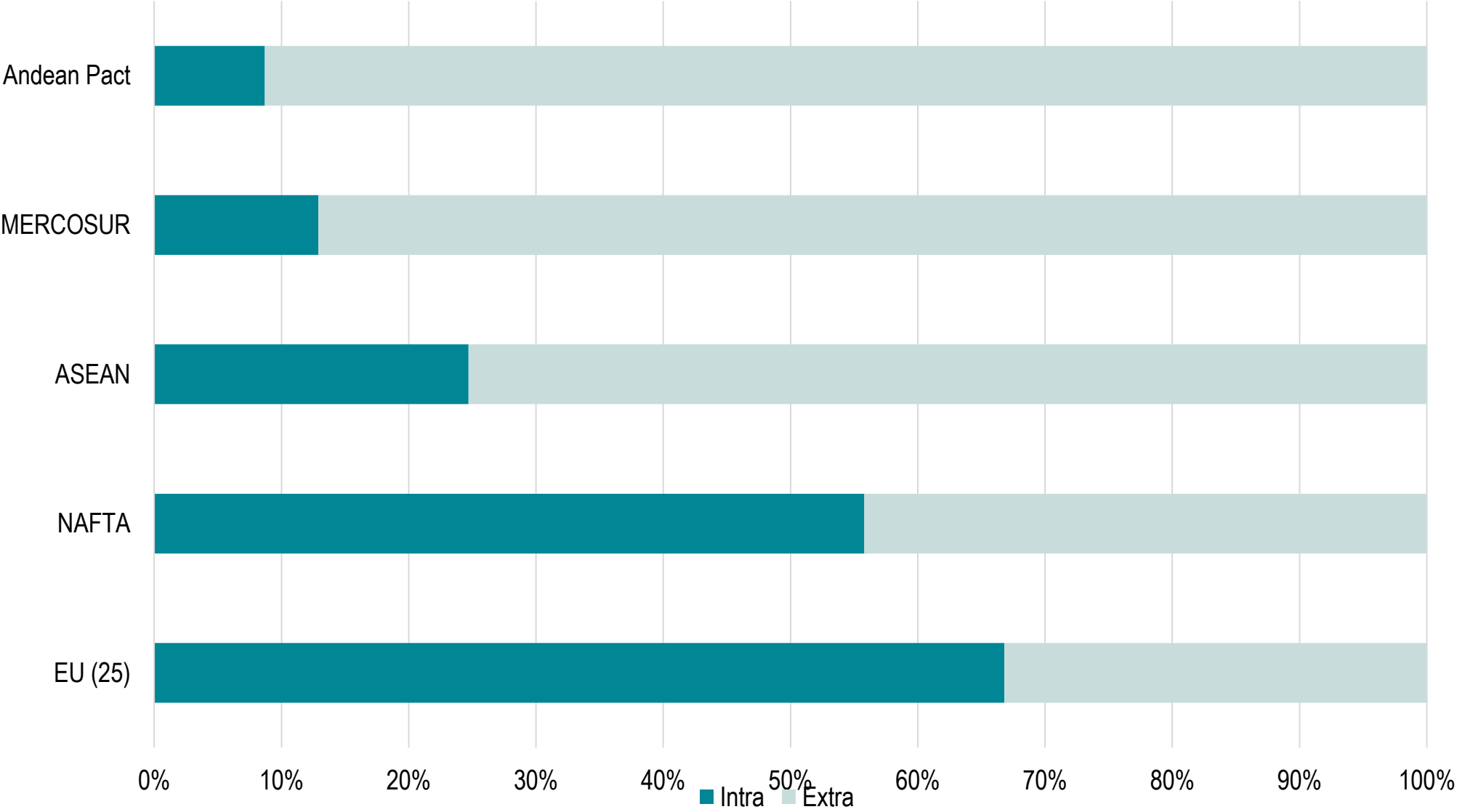
# Share of World Goods Exports, Leading Exporters, 1950-2022



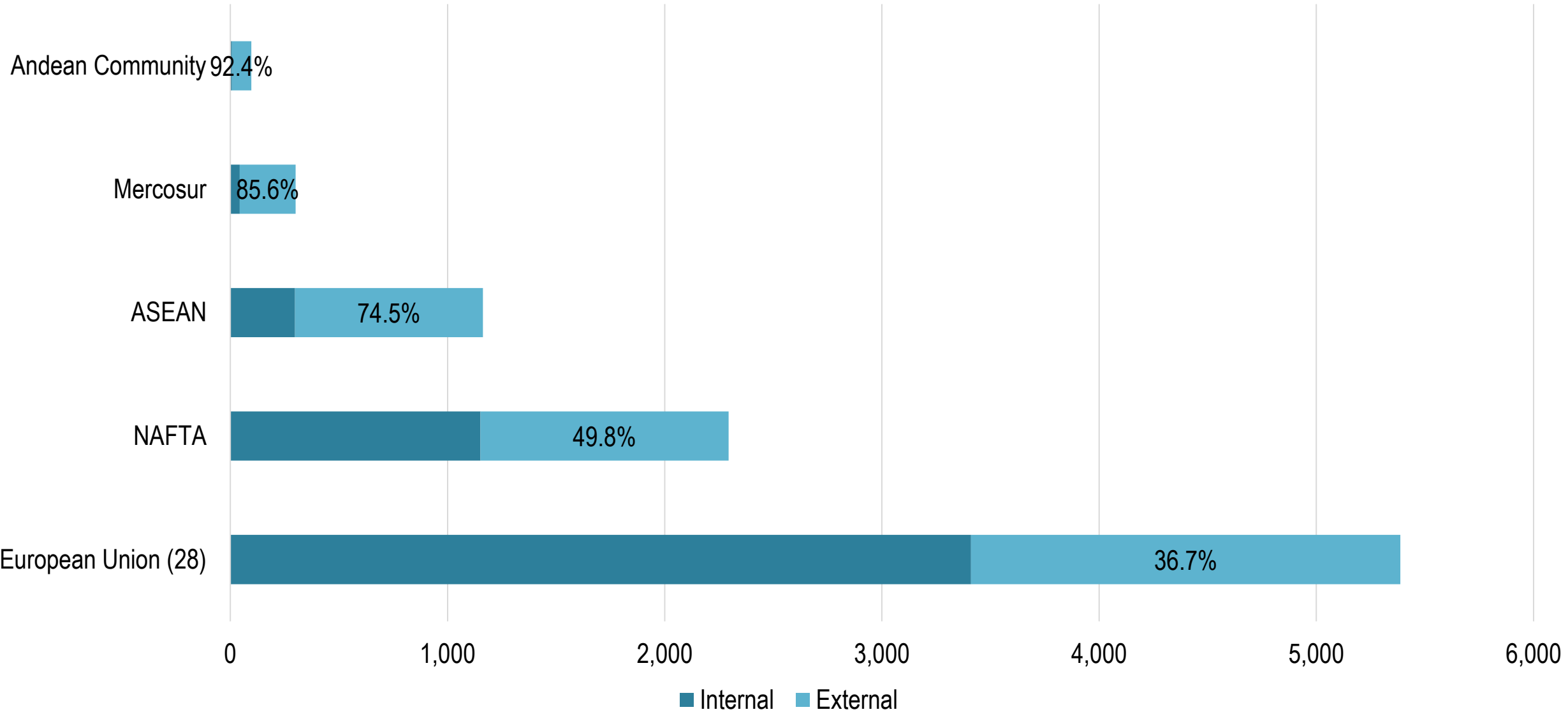
# Total Freight Costs for Imports in World Trade (% of Total Costs)



# Merchandise Exports by Trade Agreement, 2005



# Merchandise Exports by Trade Agreement, 2015 (in billions USD)



# Trends Shaping International Trade

## VOLUME

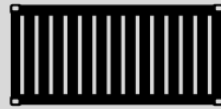


### Peak growth

1980-2020:

- Population: 1.7 times.
- GDP: 7.2 times.
- Exports (value): 8.9 times.
- TEU: 20 times.

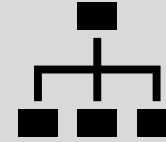
## SUPPORT



### Containerization

- Growing proportion of global trade.
- Intermodal transport chains.

## ACTORS



### Multinational Corporations

- Transnational production networks.
- Outsourcing and offshoring.

## GEOGRAPHY

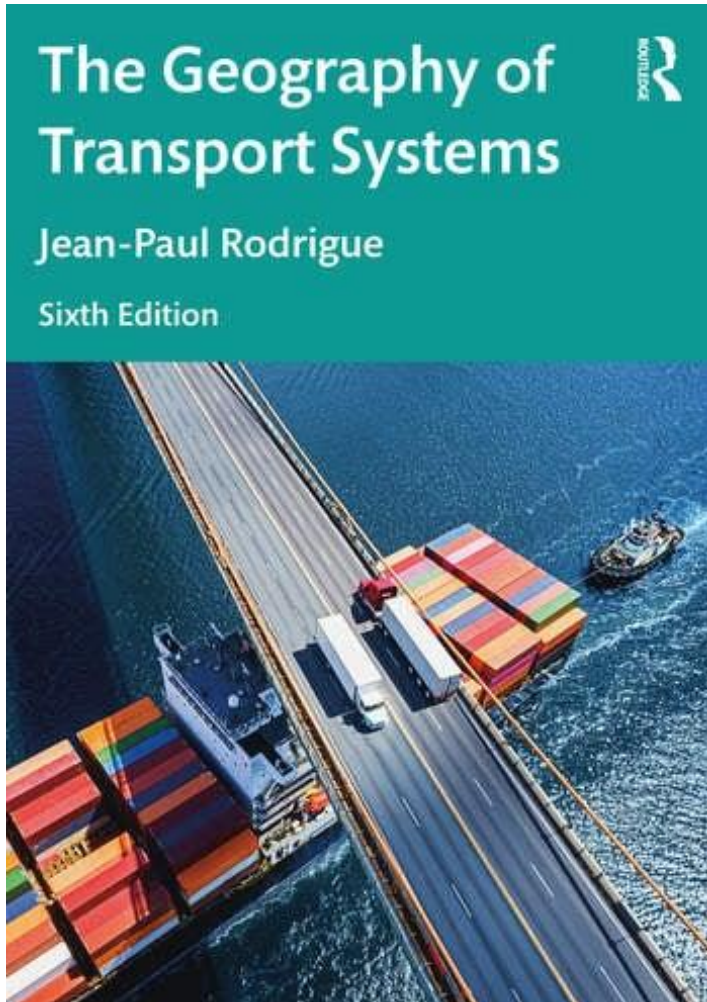


### Export-Oriented Economies

- Focus on exports to promote economic growth.
- Imbalances in trade relations.

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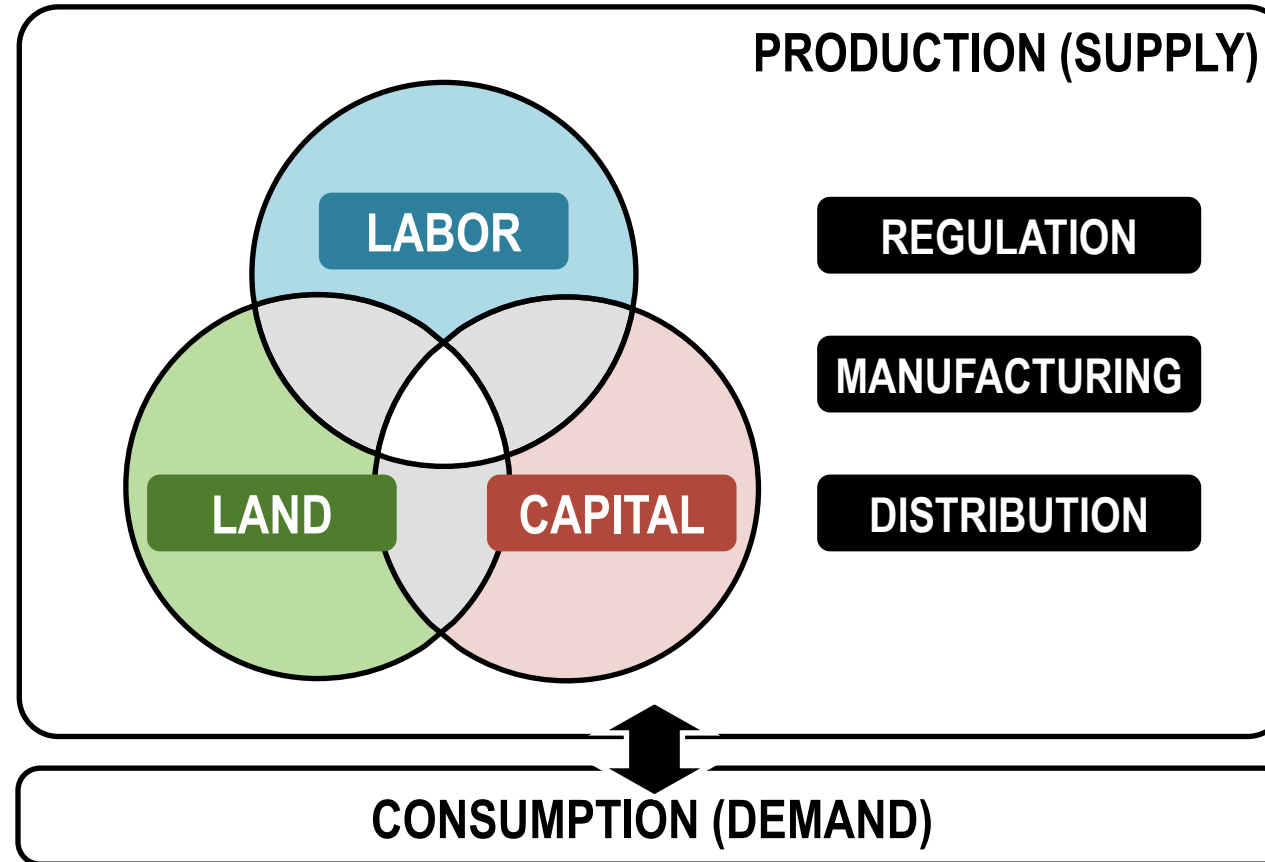
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# Freight Transportation and Value Chains

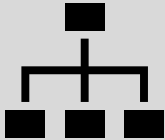
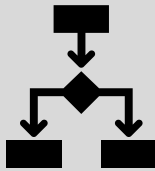
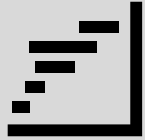
## Chapter 7.3

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# Elements of an Economic System



# The Corporation as a Decision, Management and Planning Unit

	Management Unit	Decision Unit	Planning Unit
			
Nature	Maintain operational conditions.	Decisions about the allocation of resources.	Anticipate market changes and opportunities. Allocate its factors of production.
Scope	Production, sales, marketing, payroll, distribution.	Financial, labor, raw materials, research and development.	Economic, technological, social and political change.
Timeframe	Short term (production cycles).	Short to long term (product cycles).	Medium to long term (business cycles).

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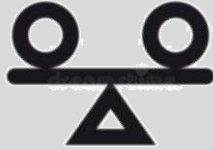
# Competitive Advantages of Multinational Corporations

## Lower Production Costs



- Core goal of a corporation.
- Exploitation of comparative advantages.
- Finding lower costs inputs (land, capital, labor).

## Price Stability



- Low costs rationale take account of price changes in raw materials and parts.
- Risky to relocate (long-term investment) to take advantage of conditions that can change in the short term.

## Product Quality



- Performance, service and maintenance.
- A quantitatively competitive product has limited advantages if not qualitatively competitive.



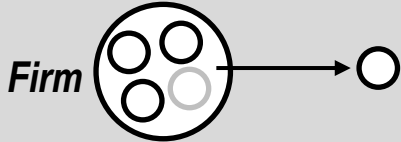
## Logistics Flexibility



- Adapting to changes in the demand confers an advantage.
- Ability to withstand disruptions (resilience).

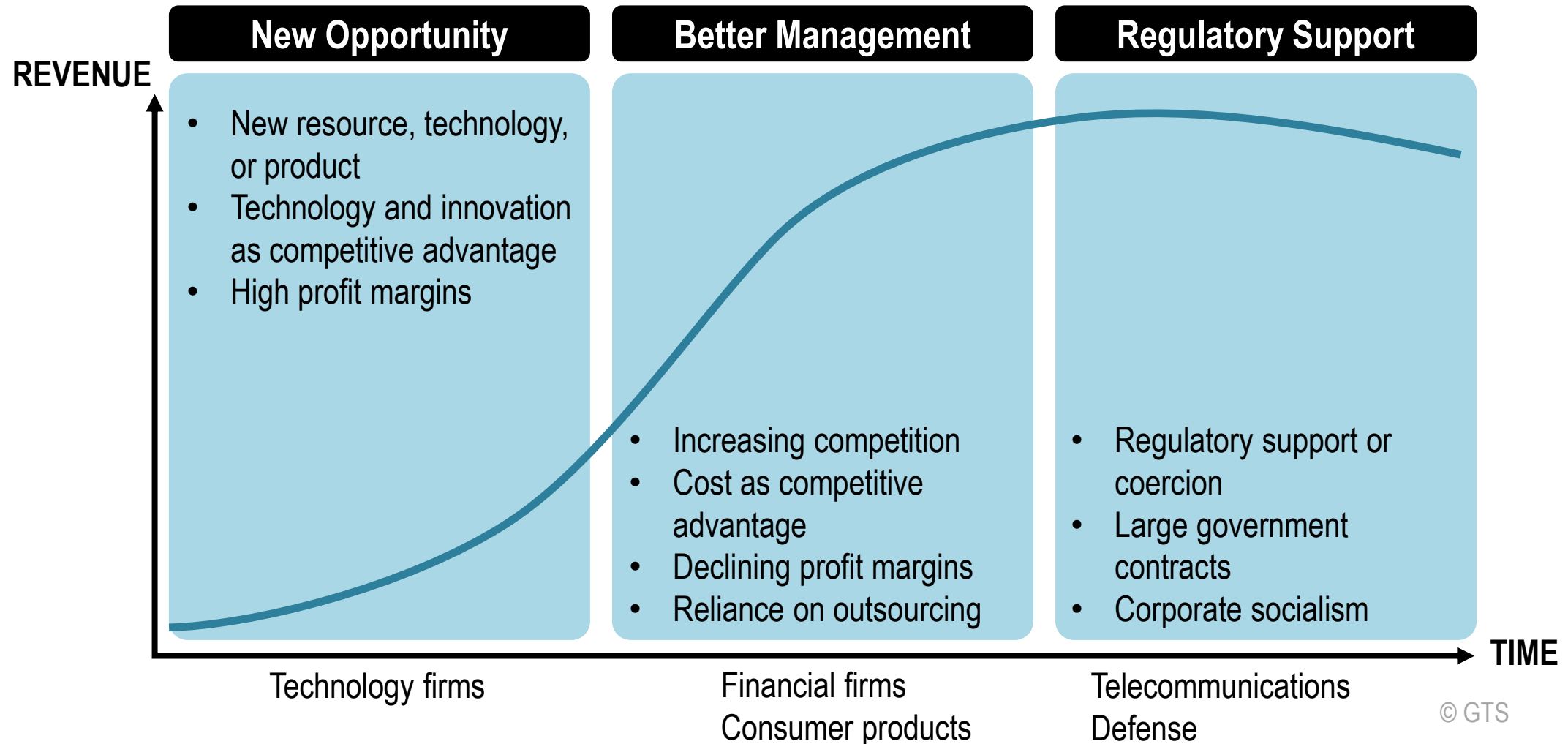
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# The Corporation and its Expansion

	Vertical Integration	Horizontal Integration	Outsourcing
			
<b>Nature</b>	Expand backward (suppliers) or forward (customers) along the supply chain.	Acquiring or merging with competitors.	Some activities performed by another corporation.
<b>Goals</b>	Lower costs. Enhance and protect product quality. Improve supply chain efficiency.	Economies of scale. Product differentiation. Business model replication. Oligopoly.	Reduce costs. Focus on core competencies. Increase output.
<b>Issues</b>	Higher cost structure of suppliers. More difficult to adapt to changes.	Different business cultures. Anti-monopolistic responses.	Dependency. Loss of competency.

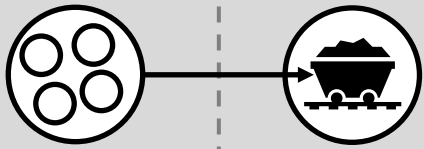
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# The Growth Cycle of Large Multinationals



# Types of Corporations by Multinational Expansion Strategy

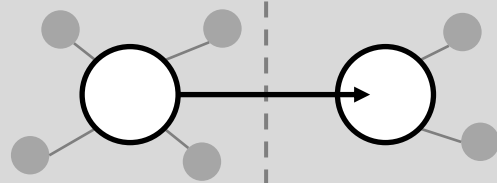
## Raw Material Seekers



- Lower input costs
- Resource acquisition
- First MNCs to emerge

Energy, mining, agricultural, forest

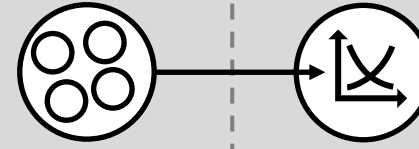
## Market Seekers



- Achieve economies of scale
- Expand market
- Large investors

Retailing, wholesalers

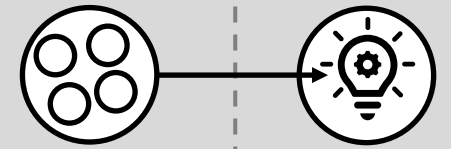
## Low Cost Seekers



- Look for comparative advantages
- Lower production and distribution costs
- Remain competitive

Manufacturing

## Knowledge Seekers

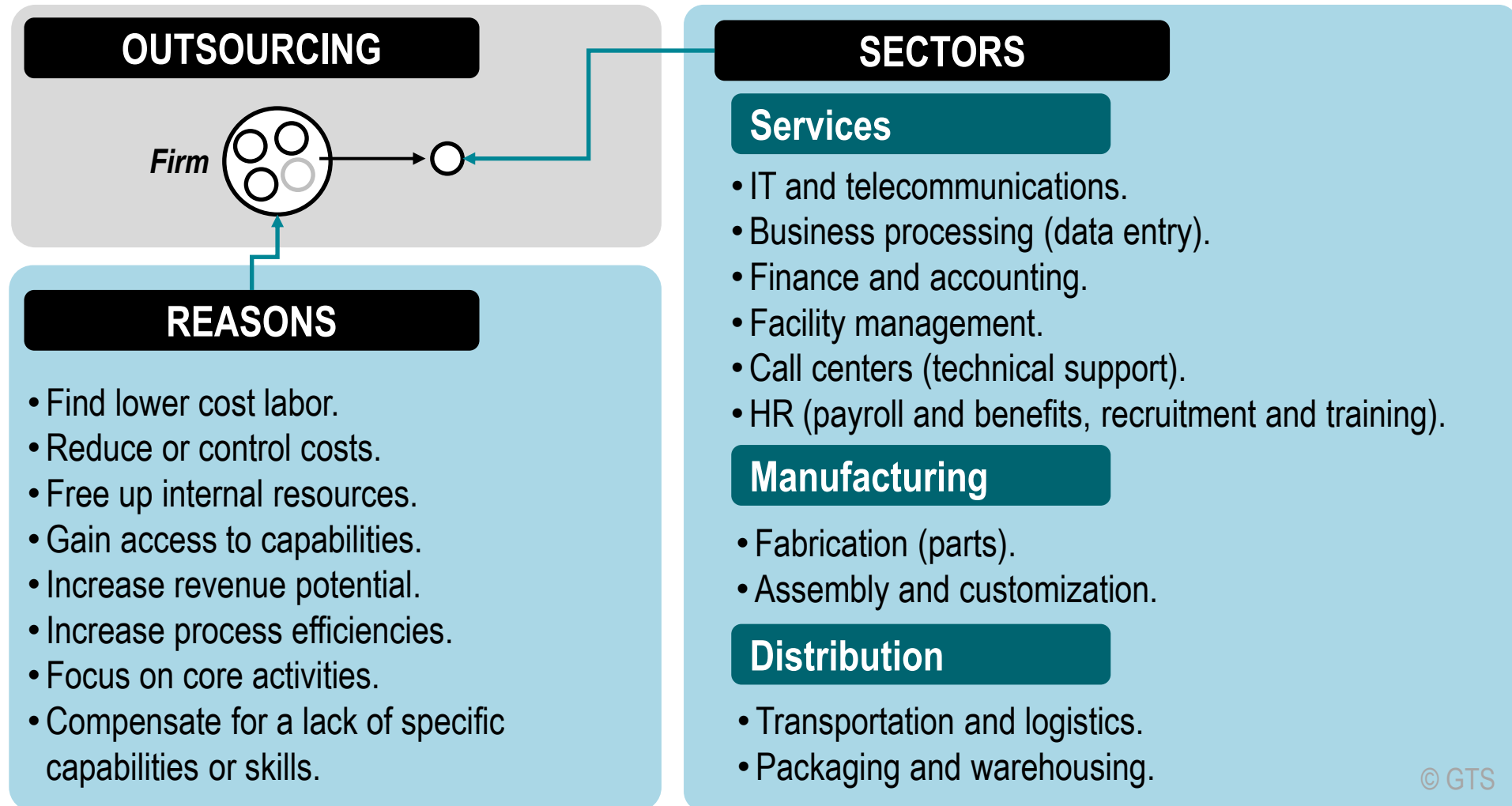


- Look for qualified labor, techniques and processes
- Increase innovative capabilities

Information technologies, pharmaceuticals

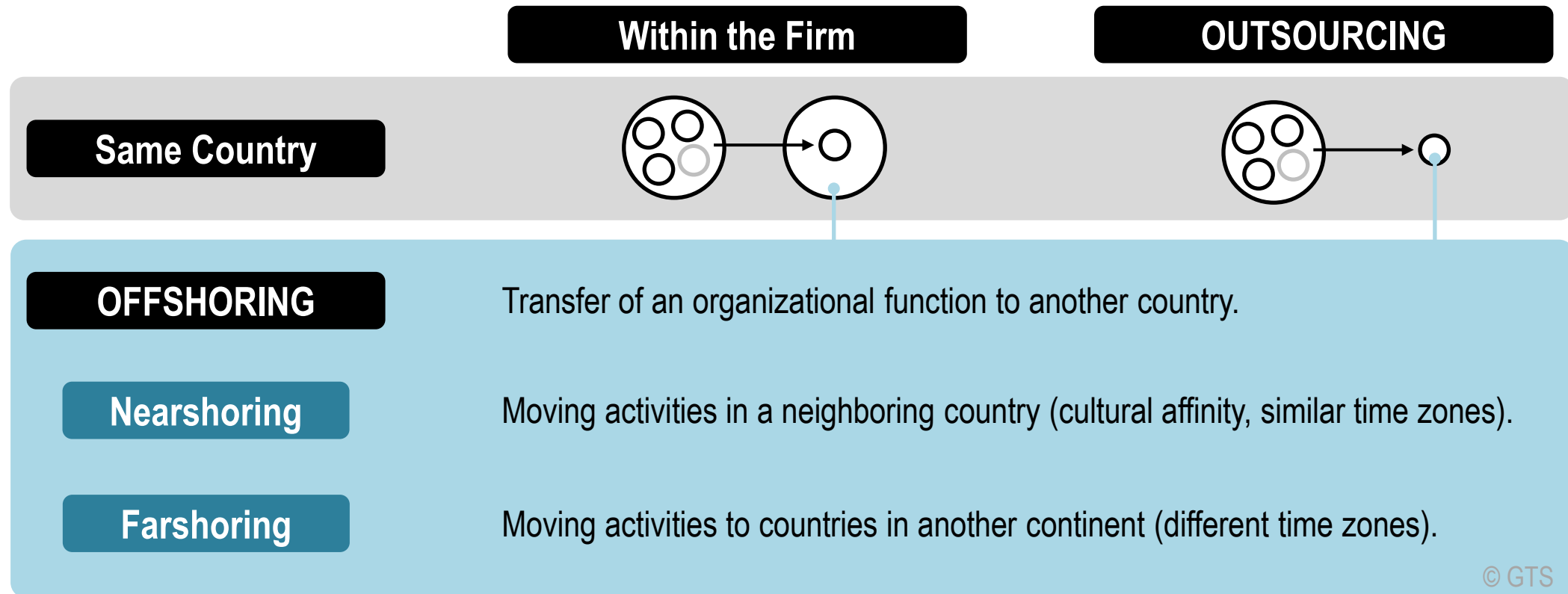
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# Rationale for Outsourcing











# Offshoring, Nearshoring and Farshoring



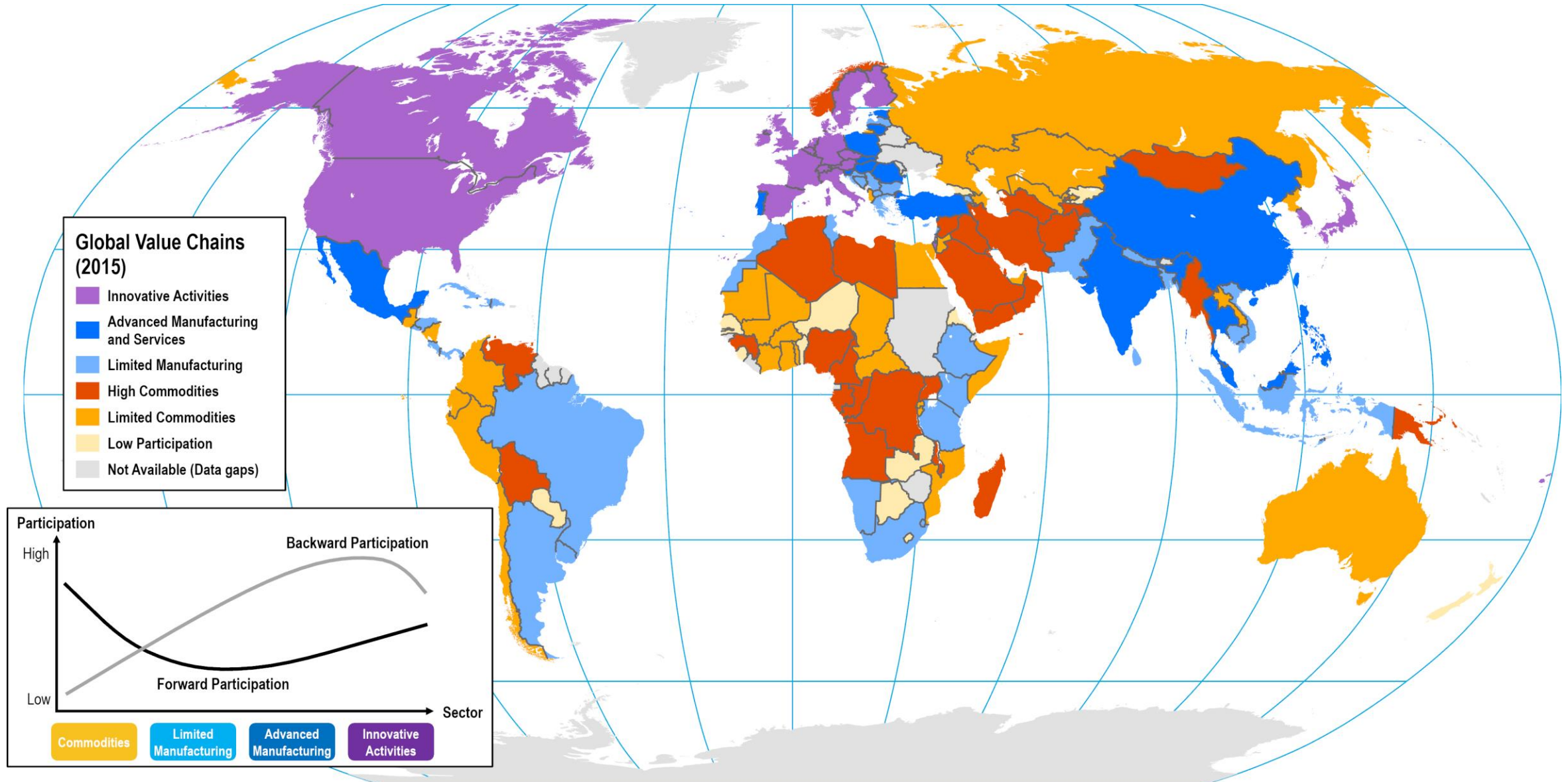
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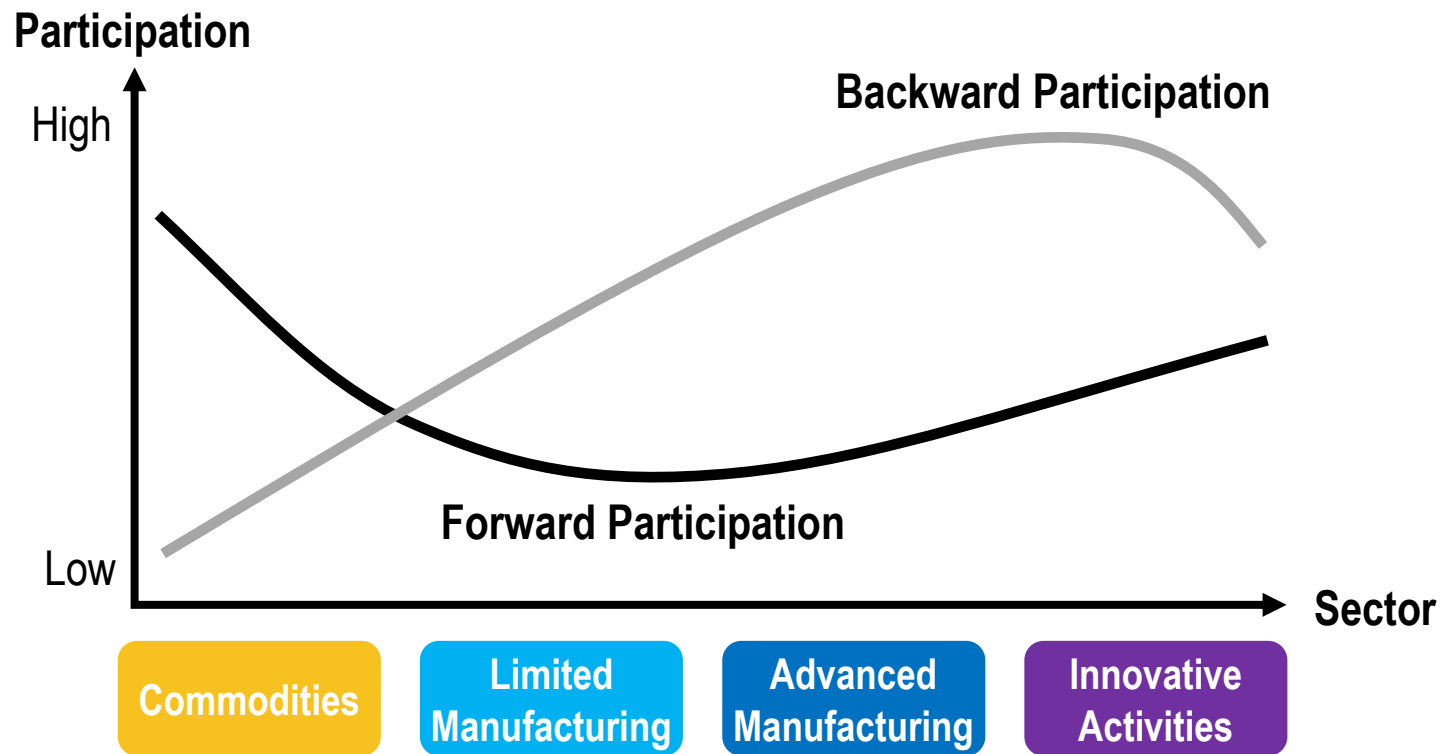
# Savings on Freight and Duties of Nearshoring Alternatives to China

	LOCATION	MODE/DAYS	LANDED PRICE	ΔChina
			For a pair of jeans	
Offshoring	Bangladesh	 30	\$10.68	-11%
	China	 30	\$12.04	0%
Nearshoring	Mexico	 2	\$10.57	-12%
Reshoring	UNITED STATES		\$14.05	+17%
Offshoring	Bangladesh	 30	\$9.94	-20%
	China	 30	\$12.46	0%
Nearshoring	Turkey	 3-6	\$12.08	-3%
Reshoring	GERMANY		\$30.36	+144%

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# Participation Level in Global Value Chains

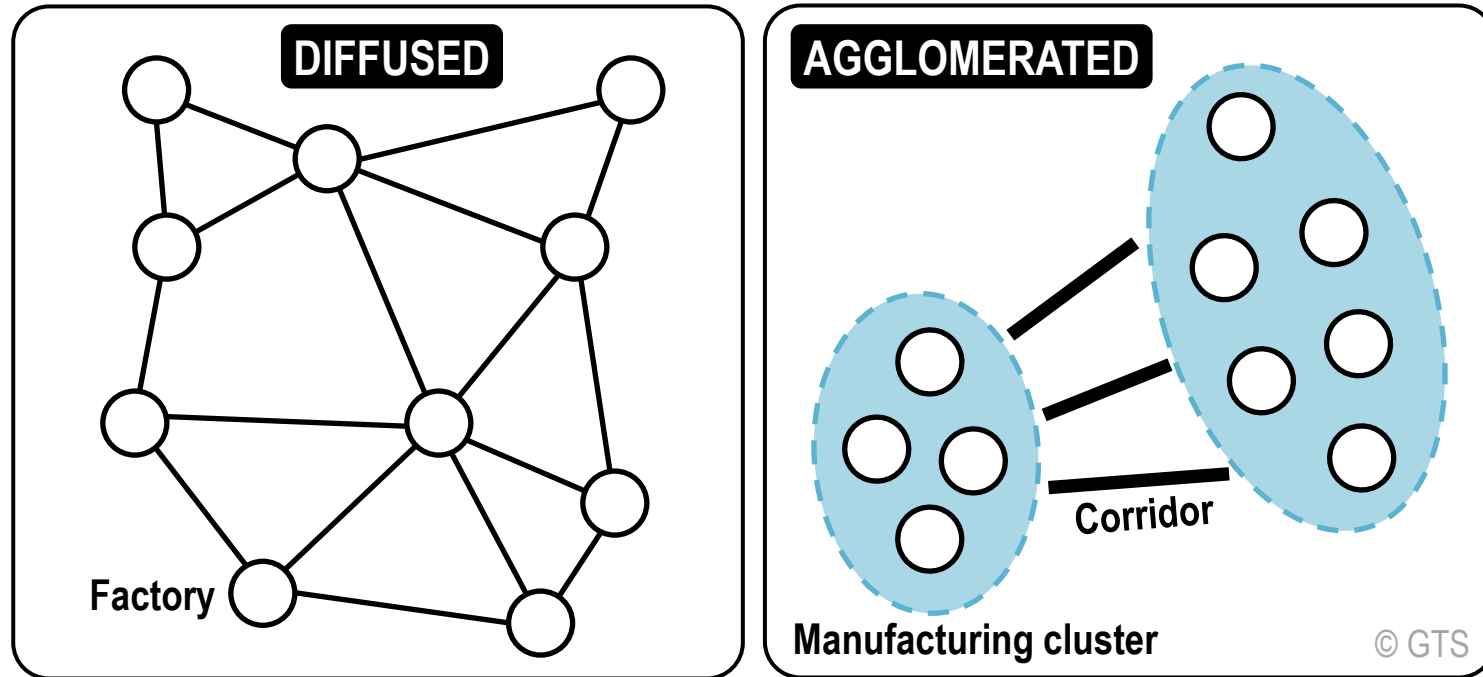




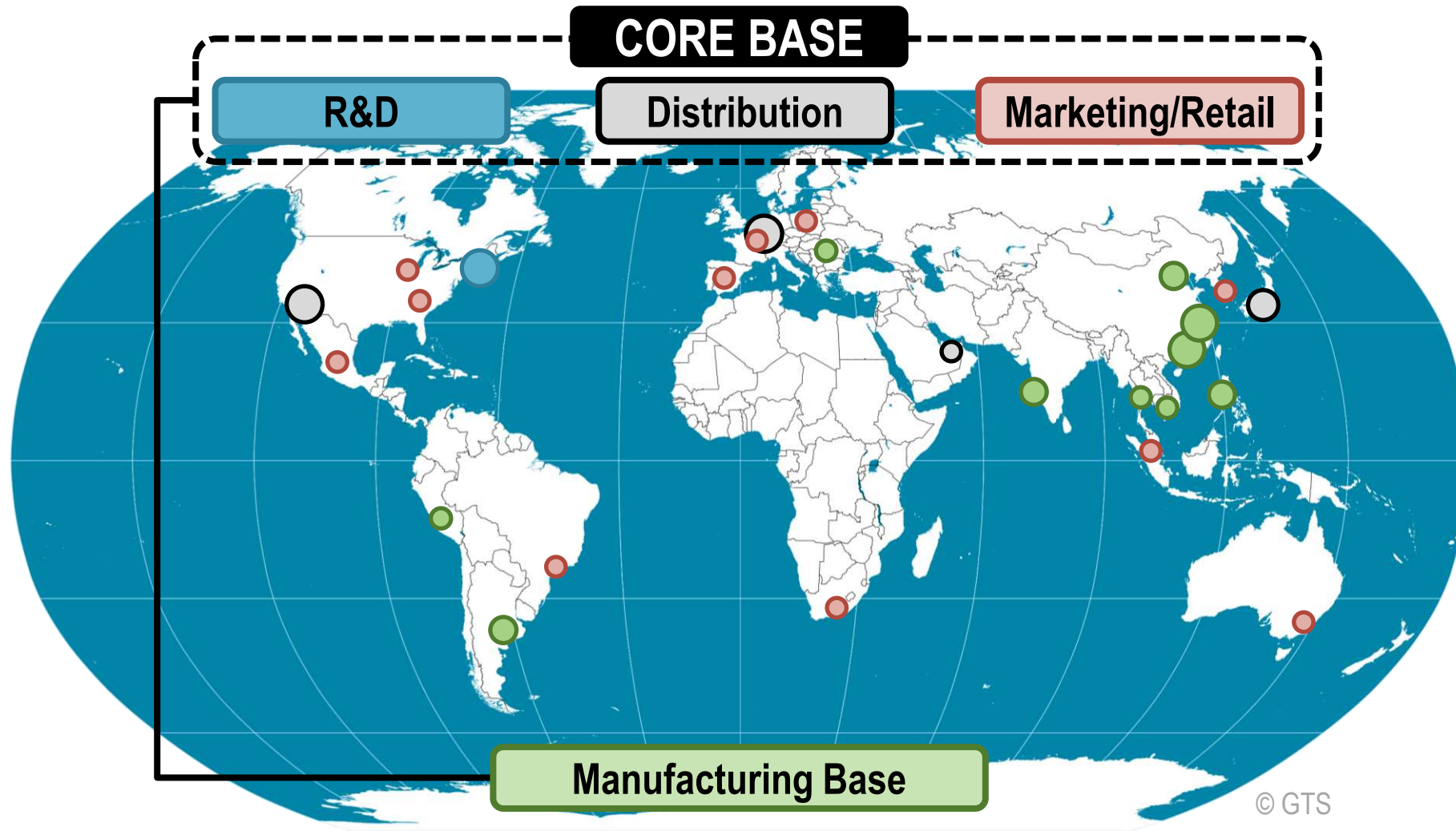
# Private Firms Directly and Indirectly Related to Freight Distribution

	Function	Infrastructure
<b>Carriers</b>	Physical movements of goods	Modes
<b>Terminal operators</b>	Management and operation of terminal assets	Terminal equipment
<b>Logistic service providers (third and fourth party)</b>	Management of transportation physical and information assets	Stakes in transportation assets
<b>Commodity producers</b>	Extraction and transformation of raw materials	Storage facilities and terminal equipment
<b>Manufacturers</b>	Production of intermediate and final goods	Distribution centers
<b>Retailers</b>	Procurement and sale of final consumption goods	Distribution centers and delivery

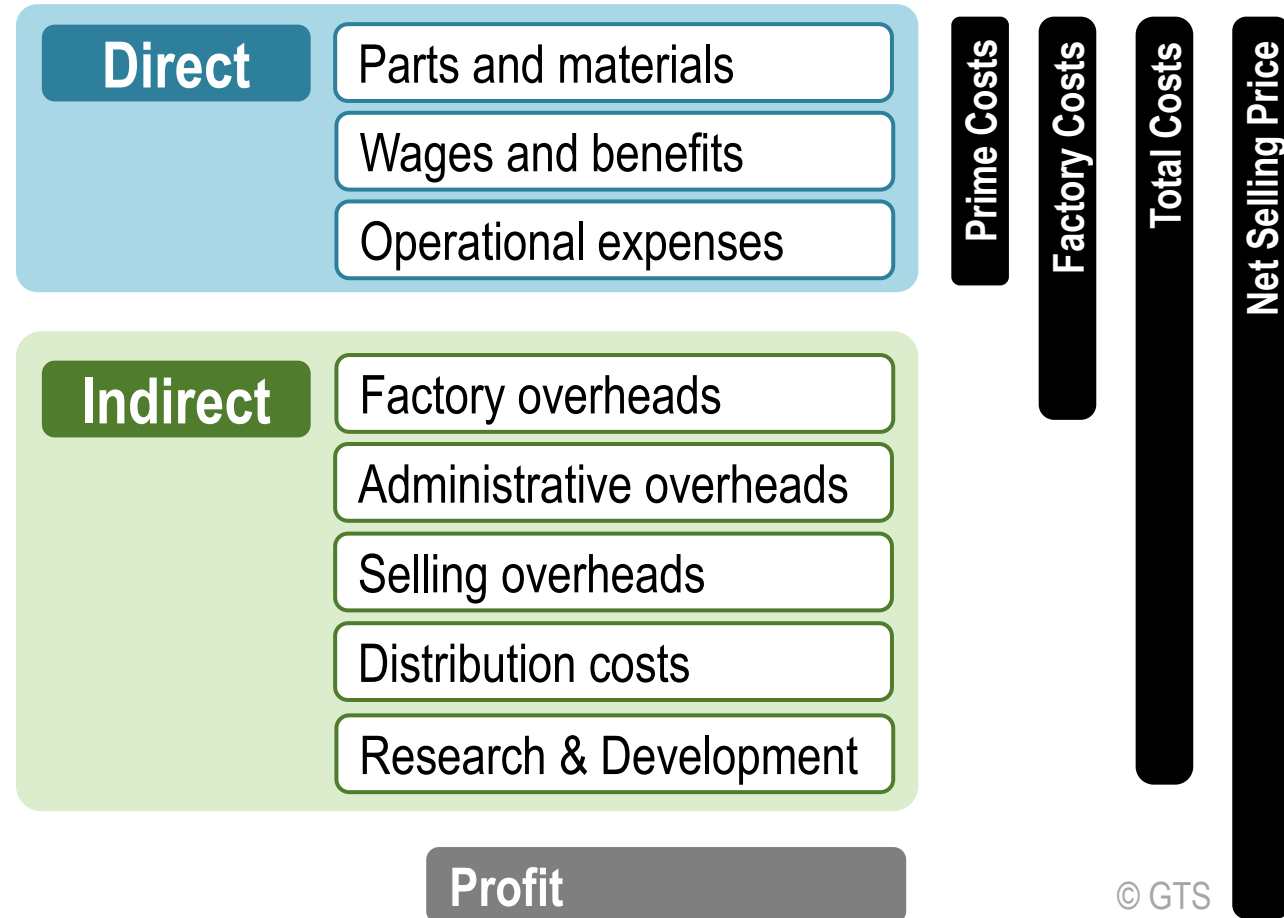
# Industrial Agglomeration and Transportation



# Disconnection of Global Production and Distribution

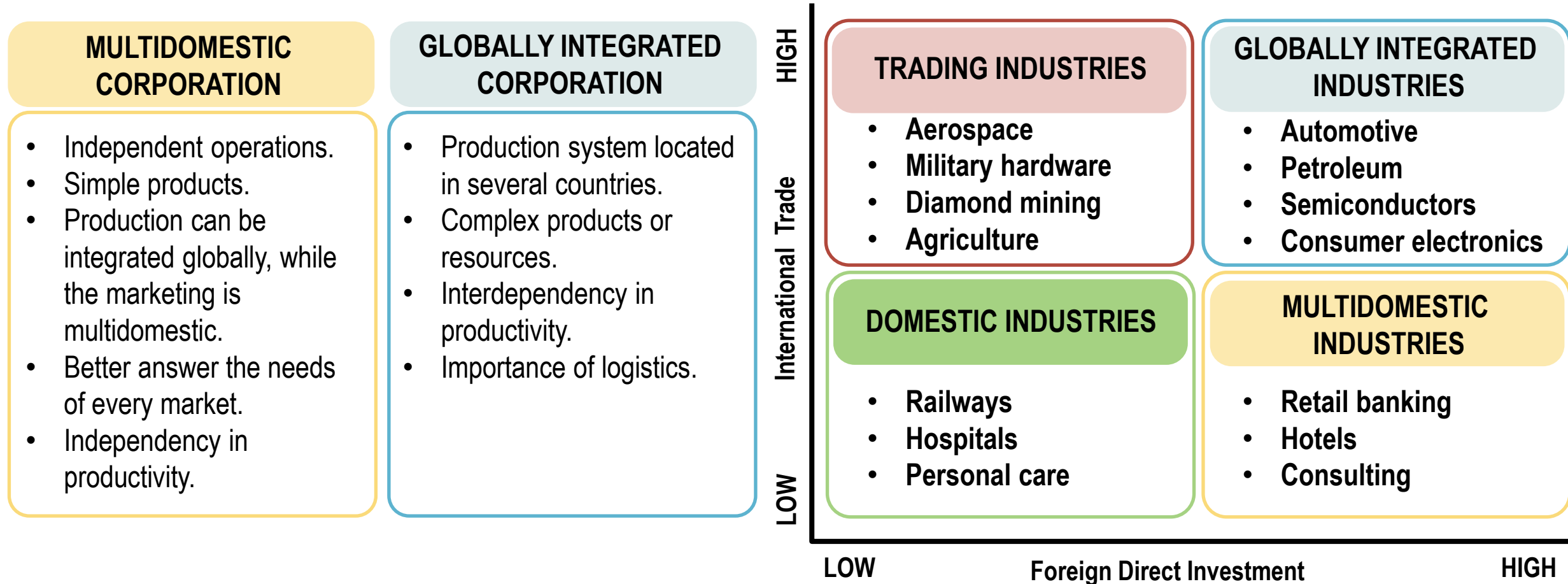


# Manufacturing Cost Structure

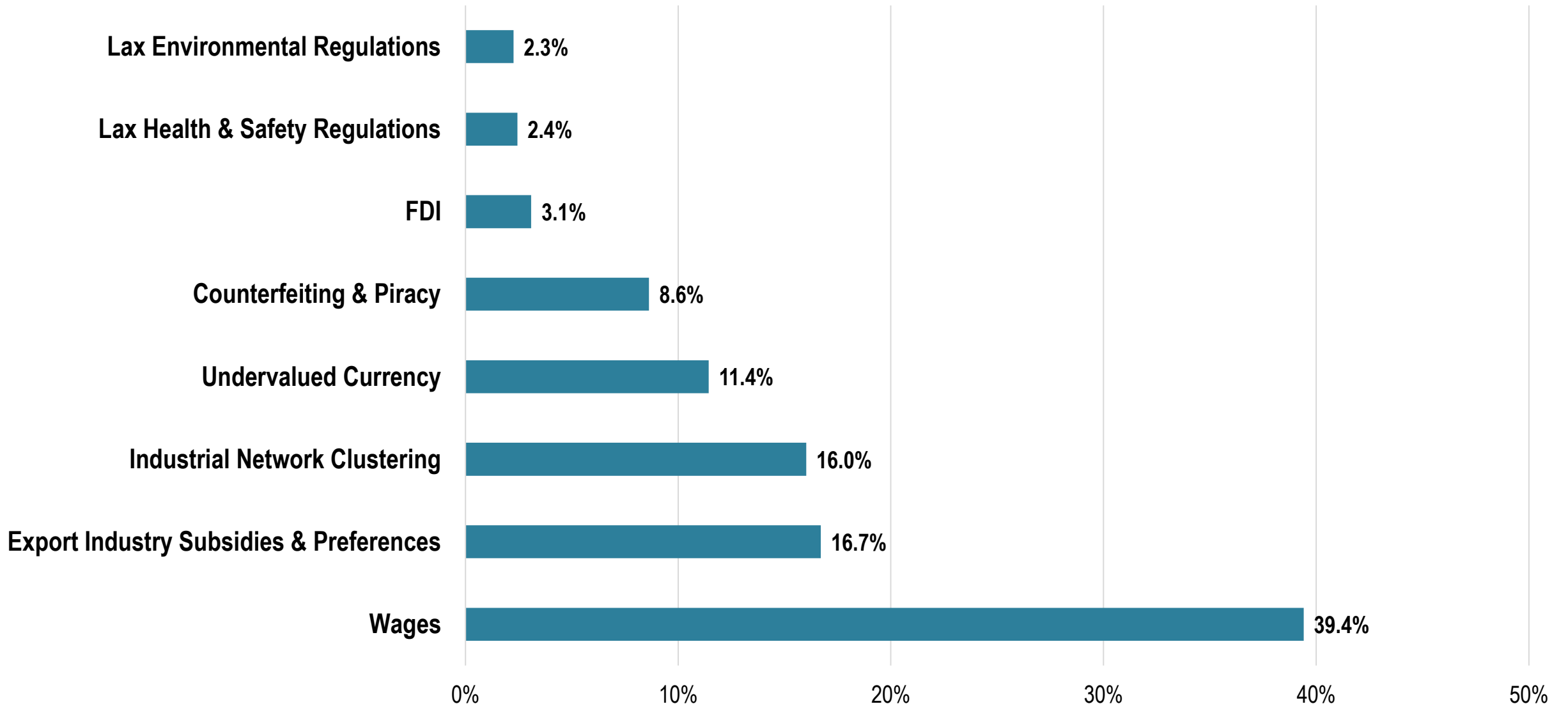




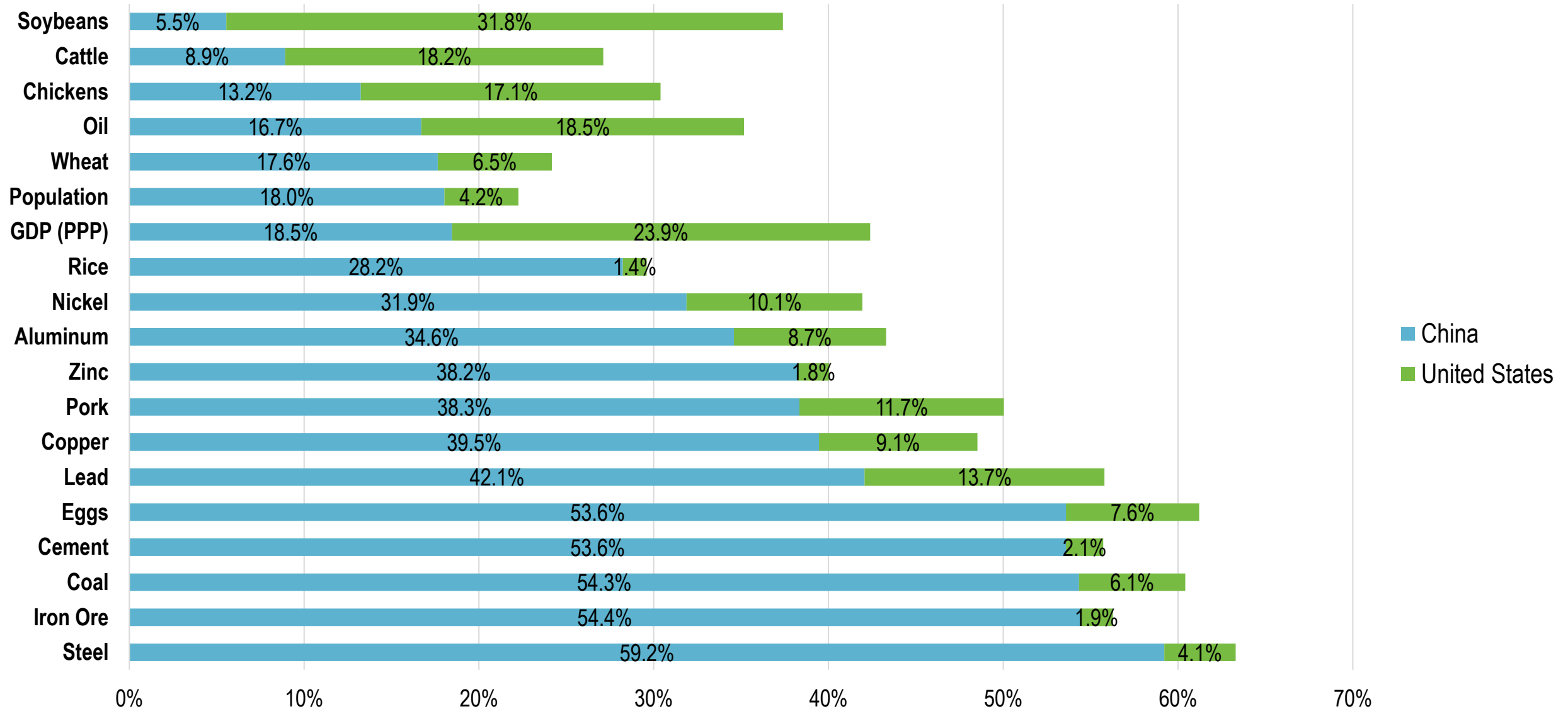
# Types of Internationalization in Manufacturing



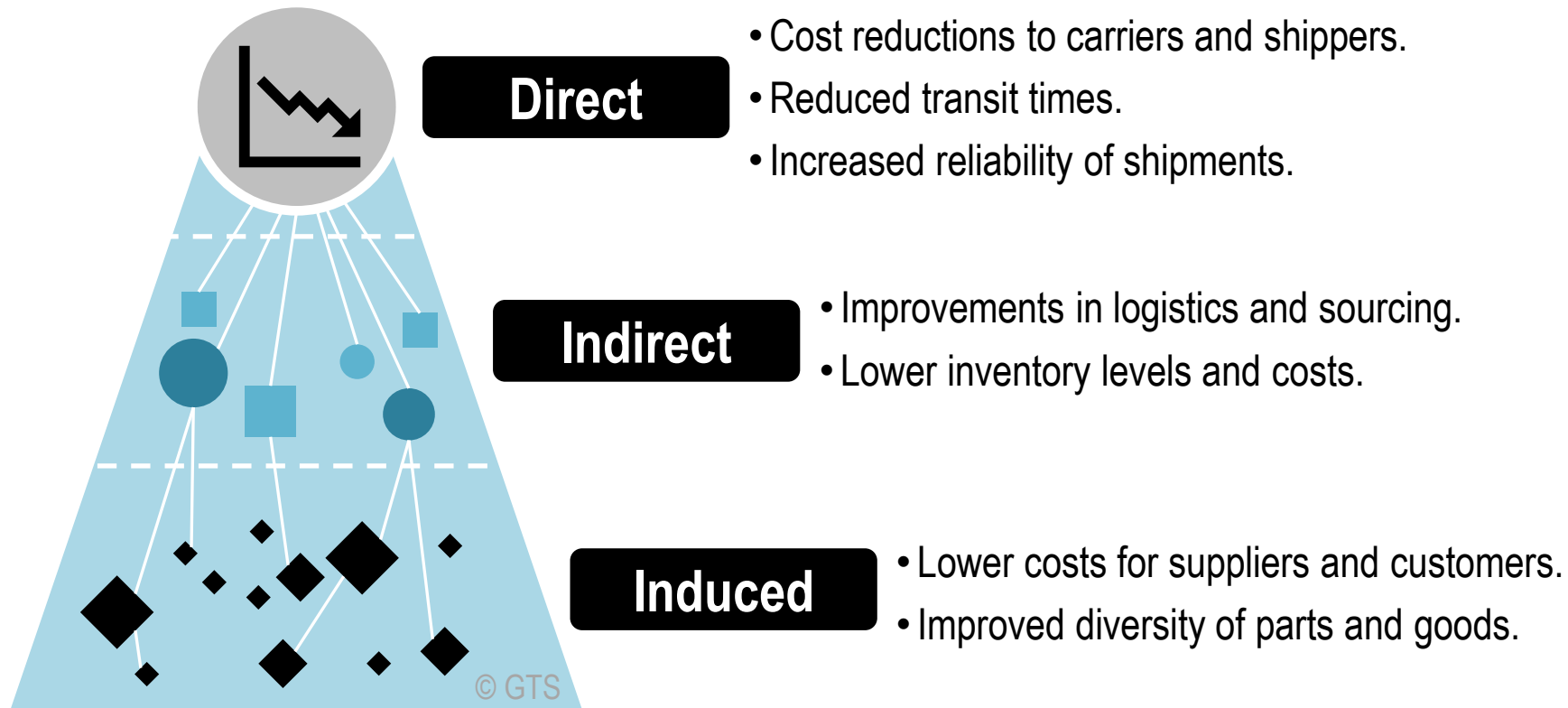
# Major Components to Price Reductions by the Chinese Manufacturing Sector, 2005



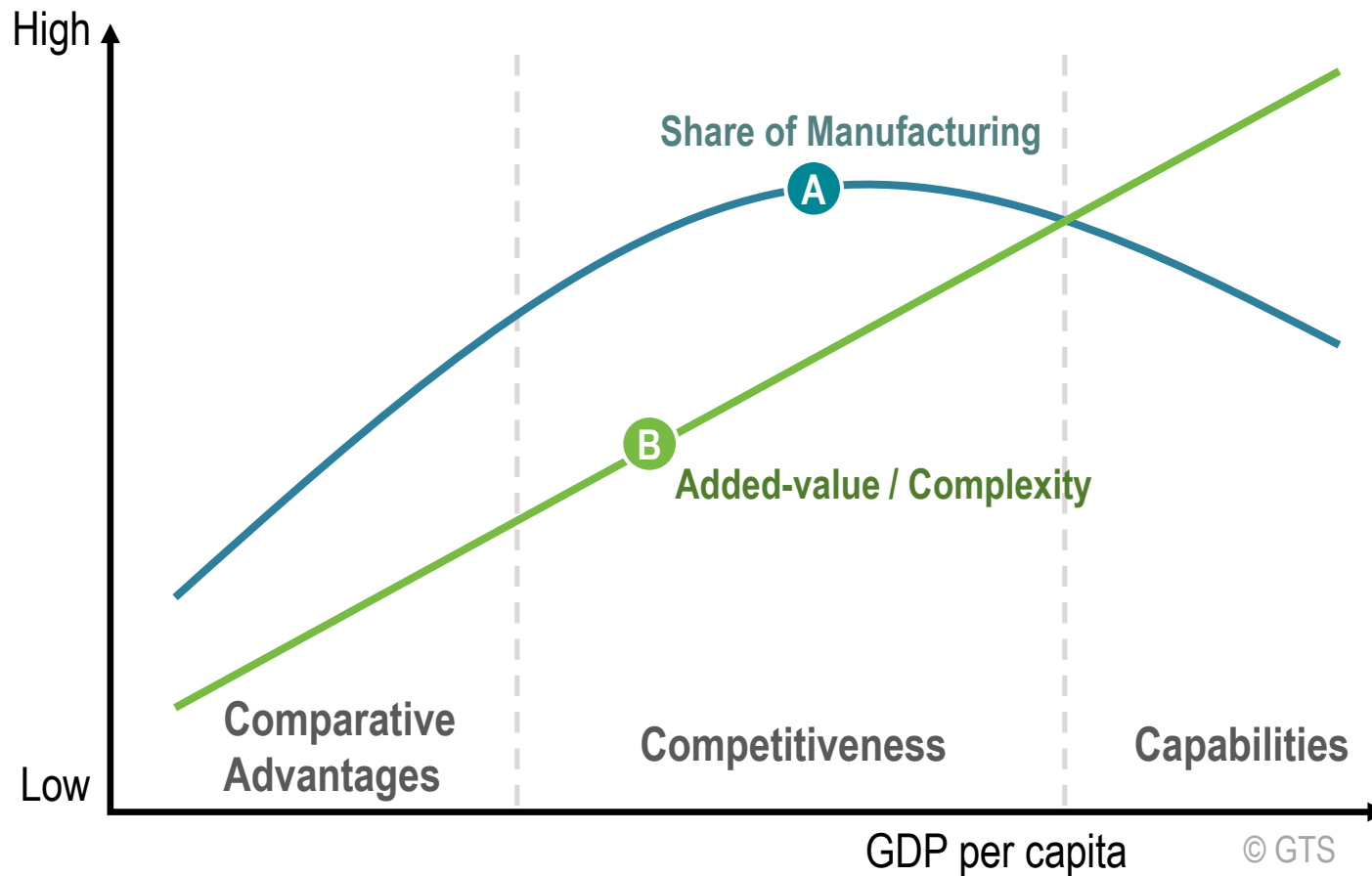
# Share of the World Commodity Consumption, China and United States, c2020



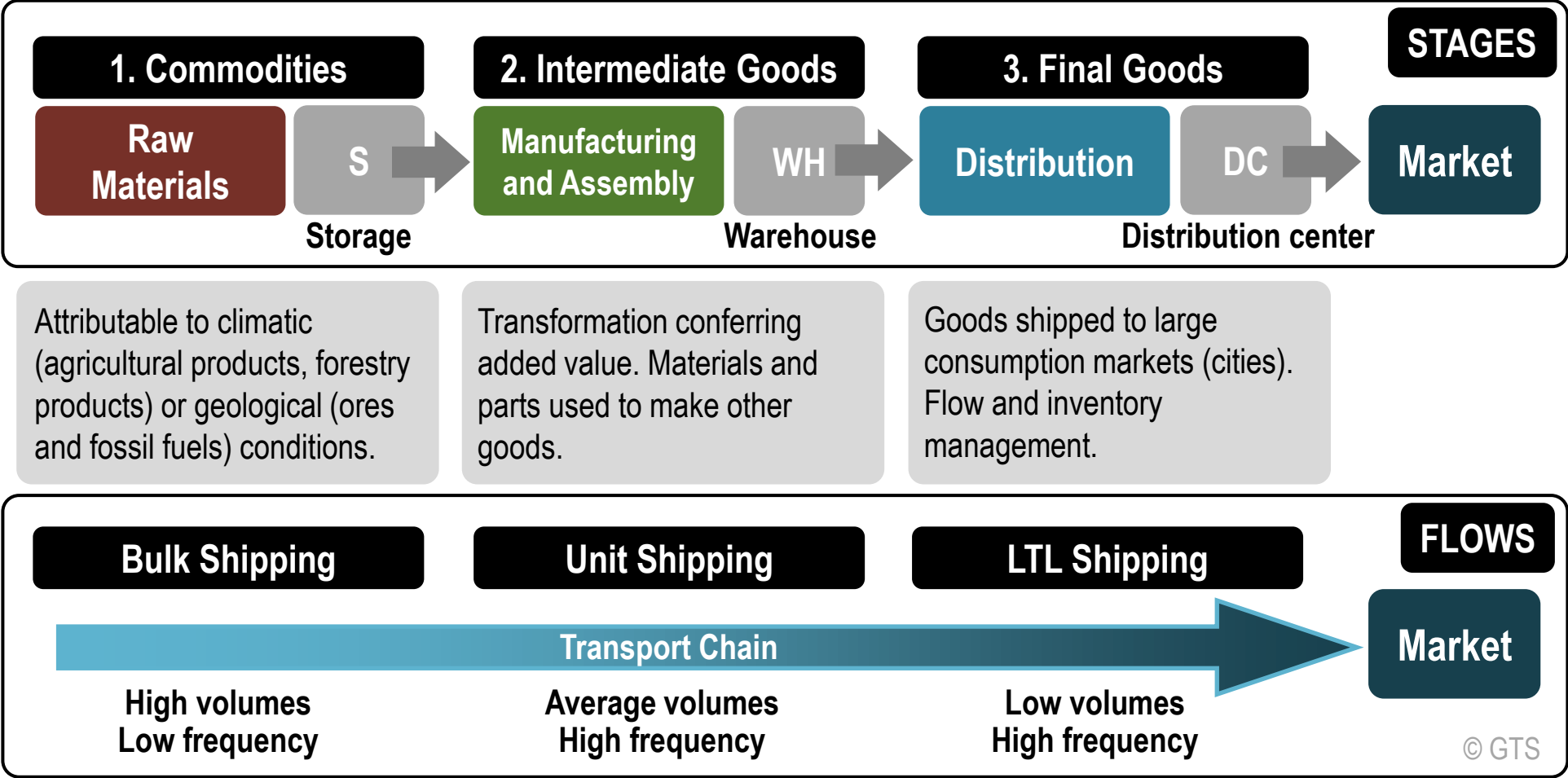
# Benefits of Improved Freight Transportation on Value Chains



# The Transition Towards Manufacturing Capabilities



# The Value Chain (or Commodity Chain)

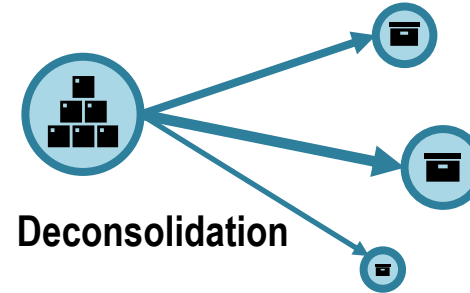


# The Configuration of Value Chains

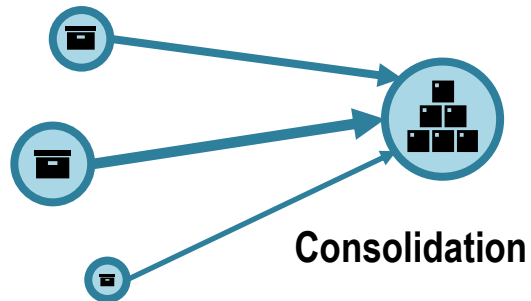
## 1. One-to-one



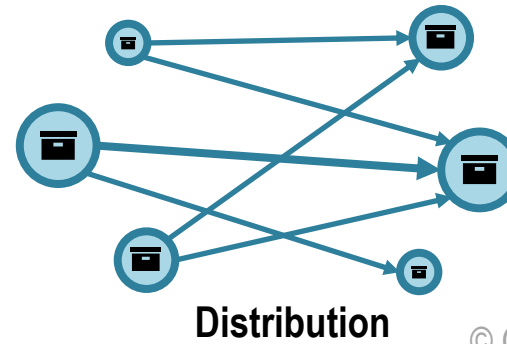
## 2. One-to-many



## 3. Many-to-one

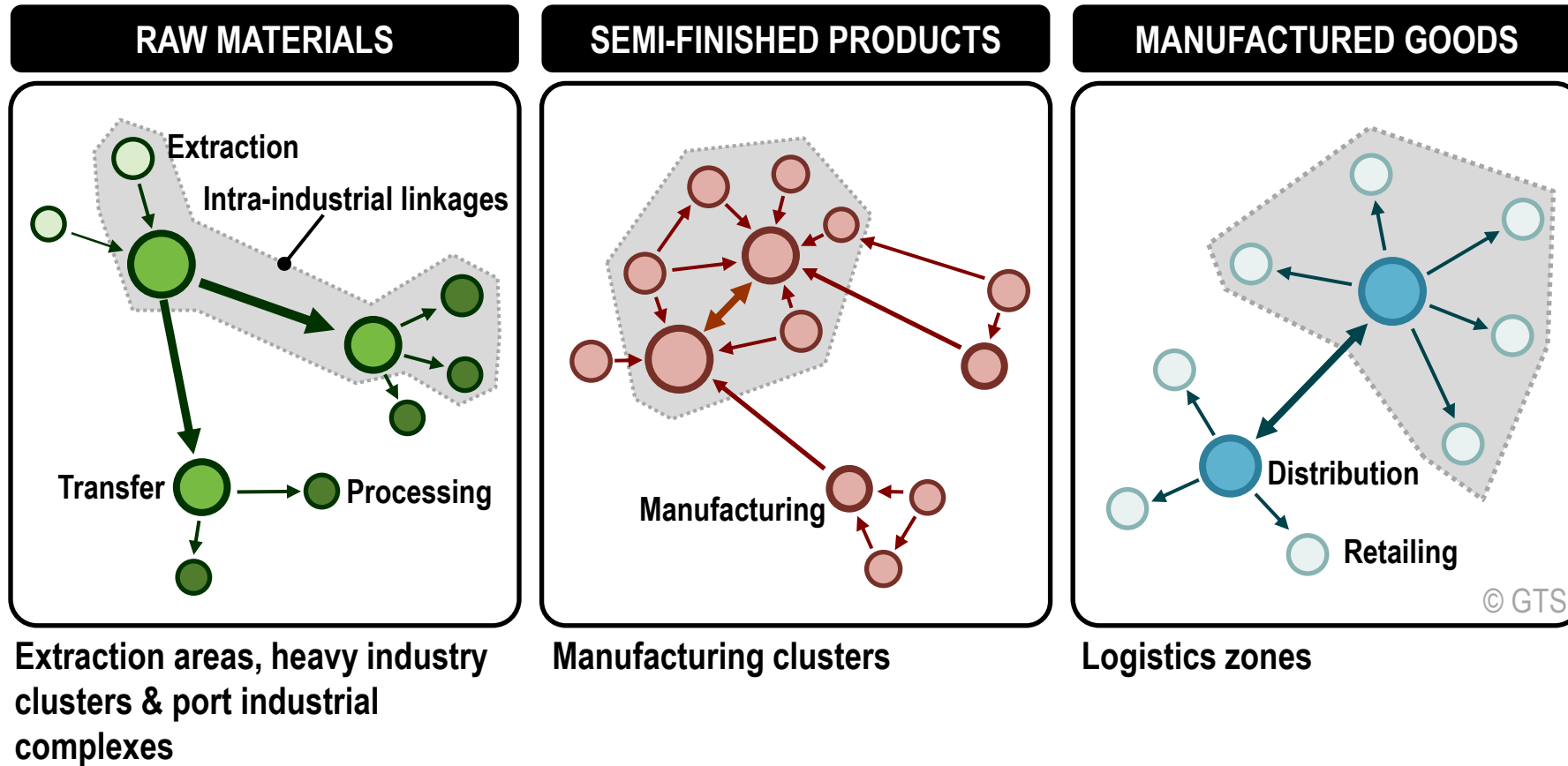


## 4. Many-to-many



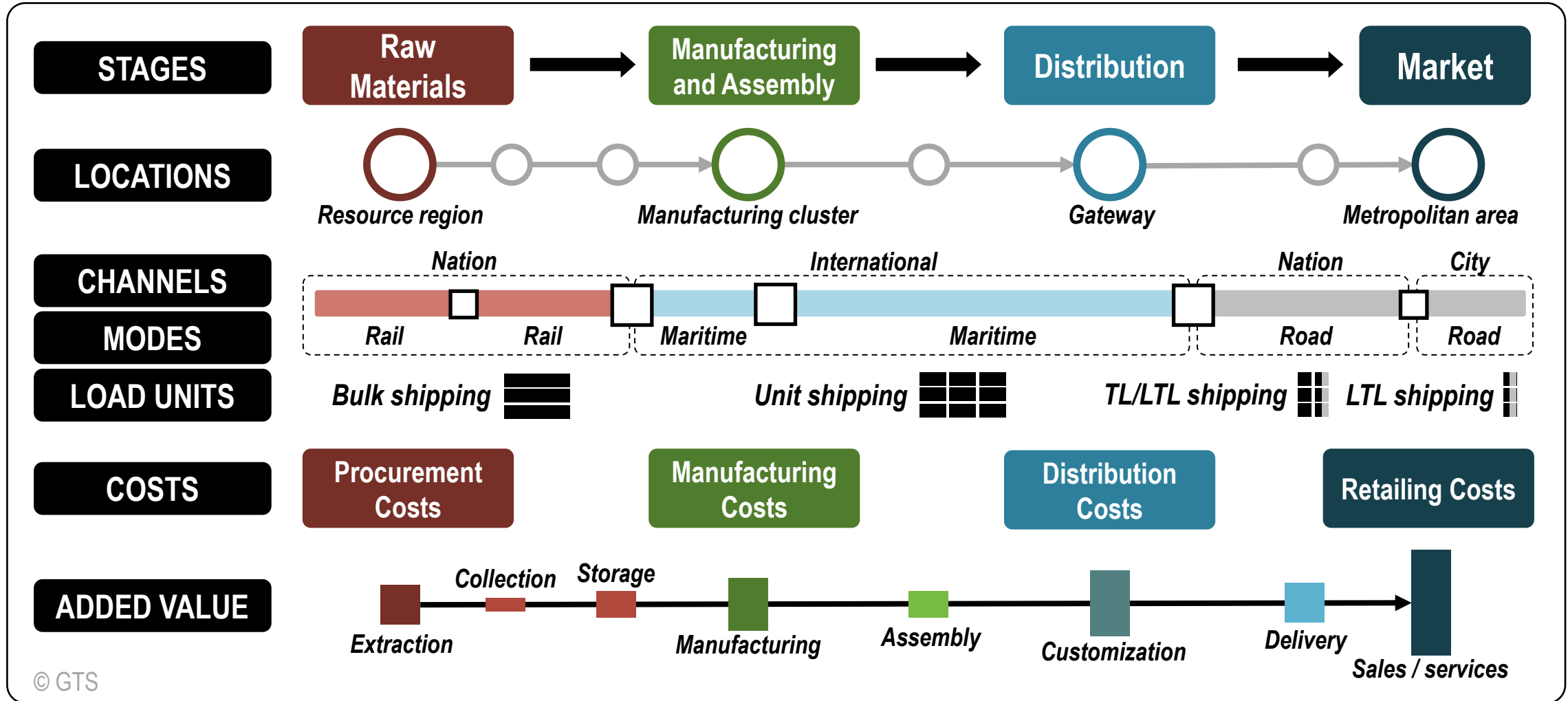
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# Value Chains and Freight Transport Systems

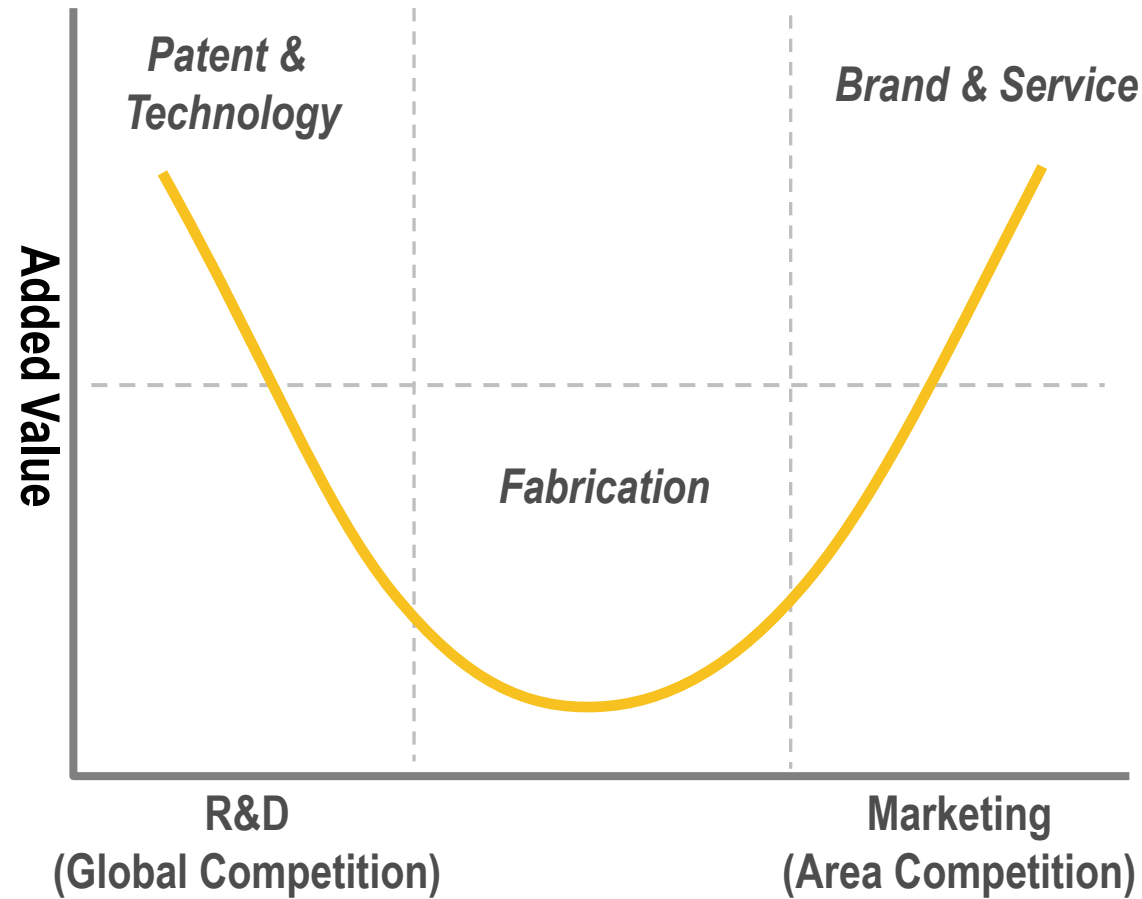




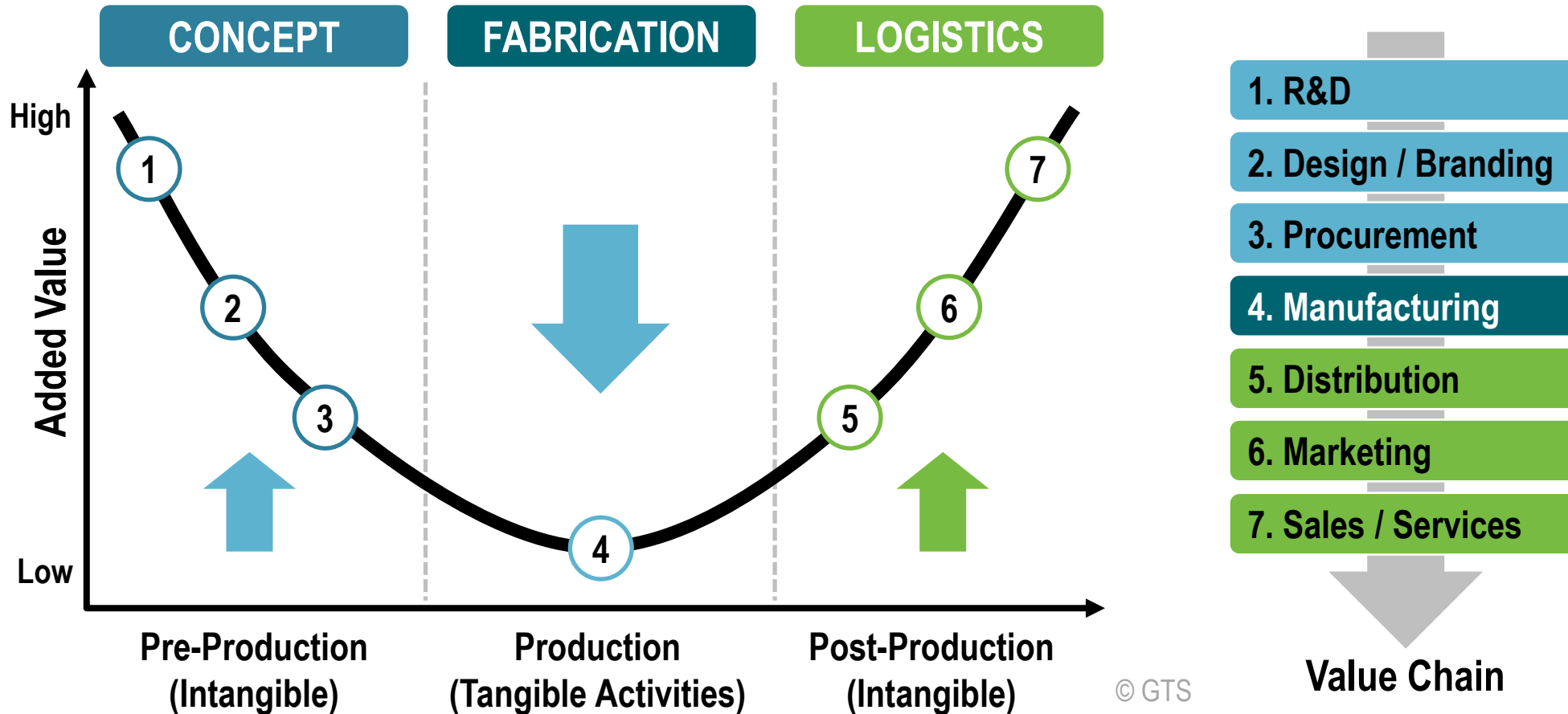
# Supply Chain Analysis



# Generic Smile Curve in a Value Chain



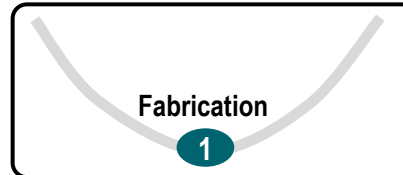
# The Value Chain and its Added Value



# Upgrading the Value Chain

## 1. Fabrication

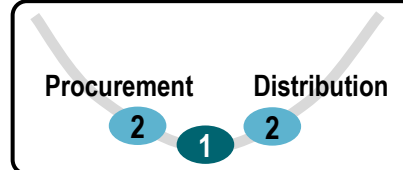
Value chain entry



- Focus on fabrication; suppliers assemble inputs, following buyers' specifications.
- Inputs may be imported due to limited availability and quality concerns over local inputs.
- Product focus may be relatively narrow.

## 2. Supply Chain

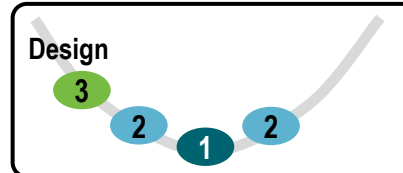
Functional upgrading



- Broader range of manufacturing-related functions, such as sourcing inputs and inbound logistics as well as fabrication.
- The supplier may also take on outbound distribution activities.

## 3. Product Design

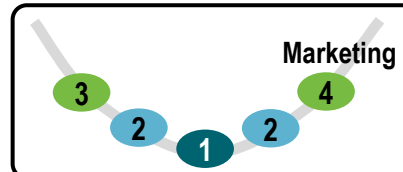
Functional upgrading



- Supplier carries out part of the pre-production processes such as design or product development.
- Design may be in collaboration with the buyer, or the buyer may attach its brand to a product designed by the supplier.

## 4. Product Brand

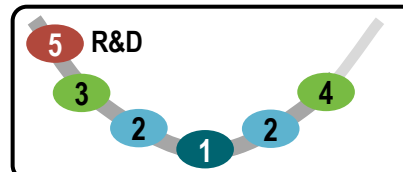
Functional upgrading



- Supplier acquires post-production capabilities and can fully develop products under its own brand names.
- Can be in collaboration with the buyer or by establishing a new market channel.

## 5. R&D

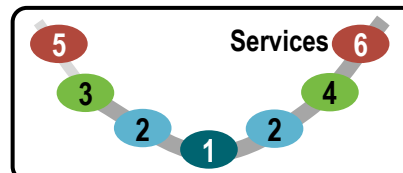
Product upgrading



- Increase unit value by producing more complex products, which requires increasing the capabilities of the firm.
- Countries must move from low-cost commodities to higher value goods that warrant higher returns as labor costs increase.

## 6. Advanced Services

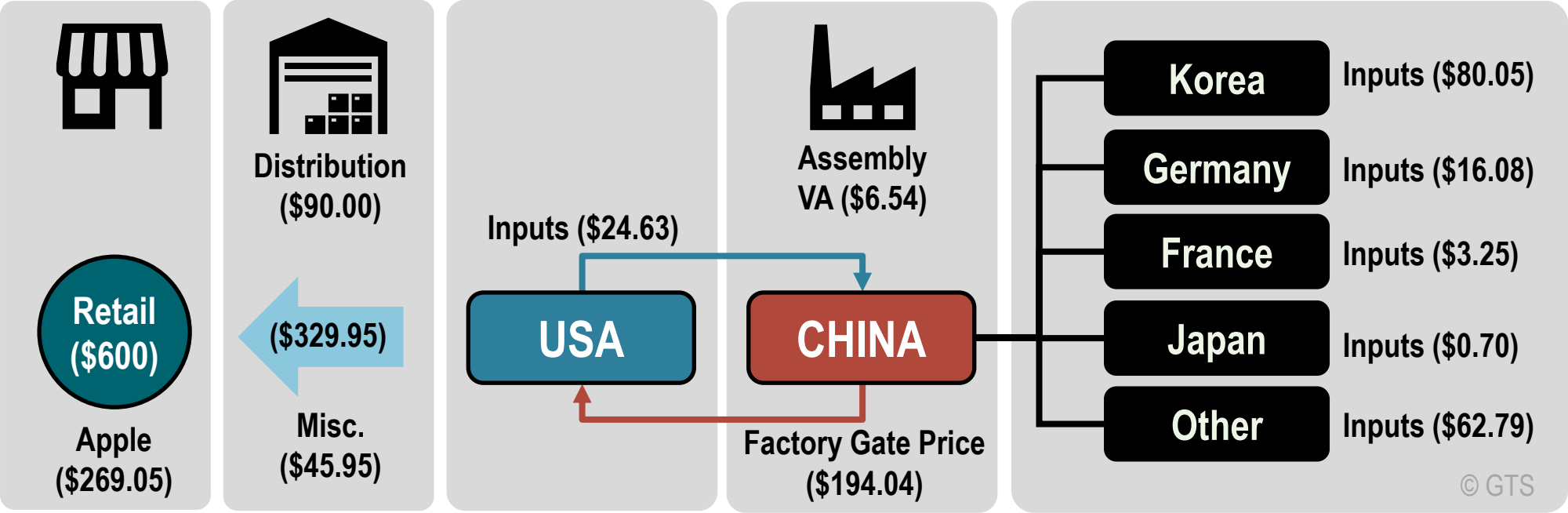
Process upgrading



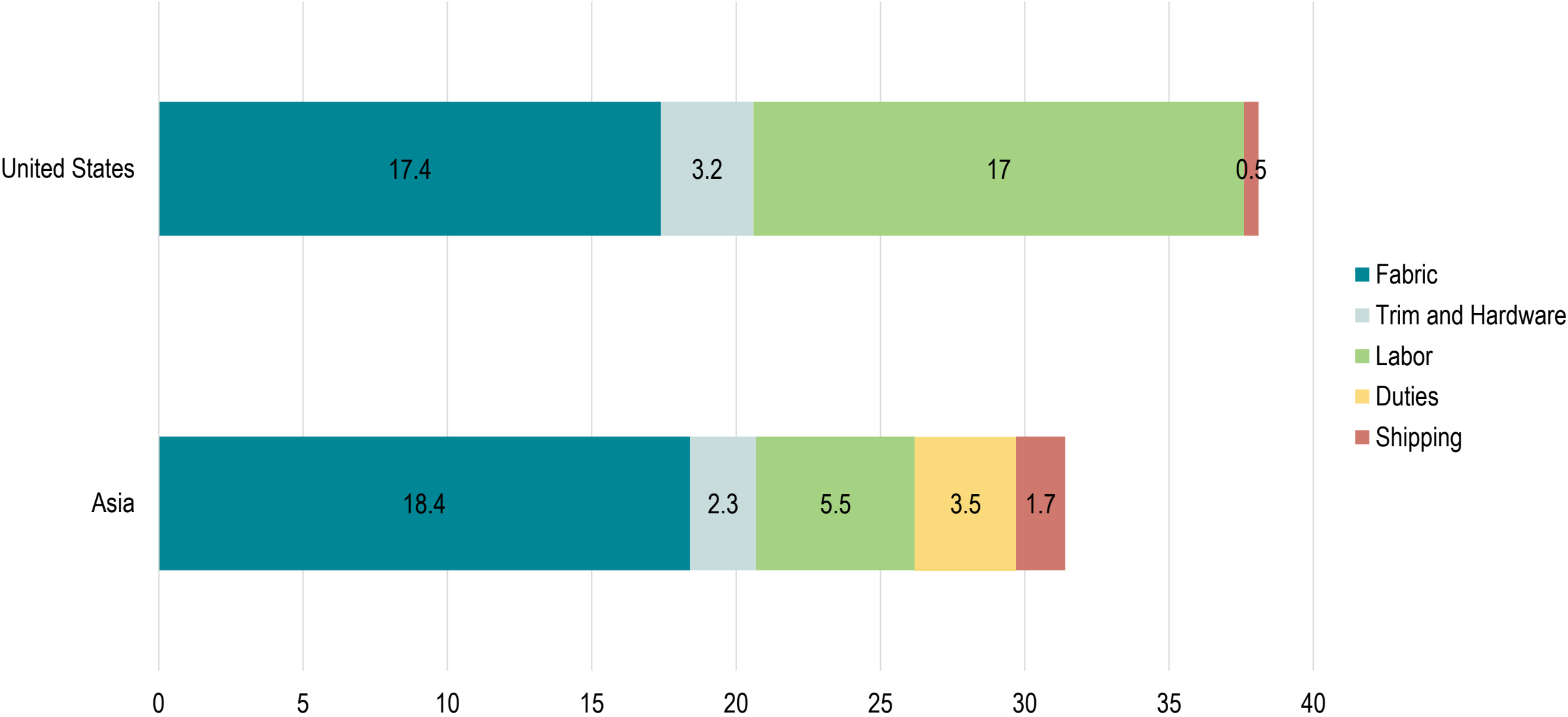
- Improving productivity through new capital investments.
- Improving IT and logistics.
- Reducing lead time and increasing the flexibility of the supply chain process.

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# Value Creation and Capture, iPhone 4 (in USD)



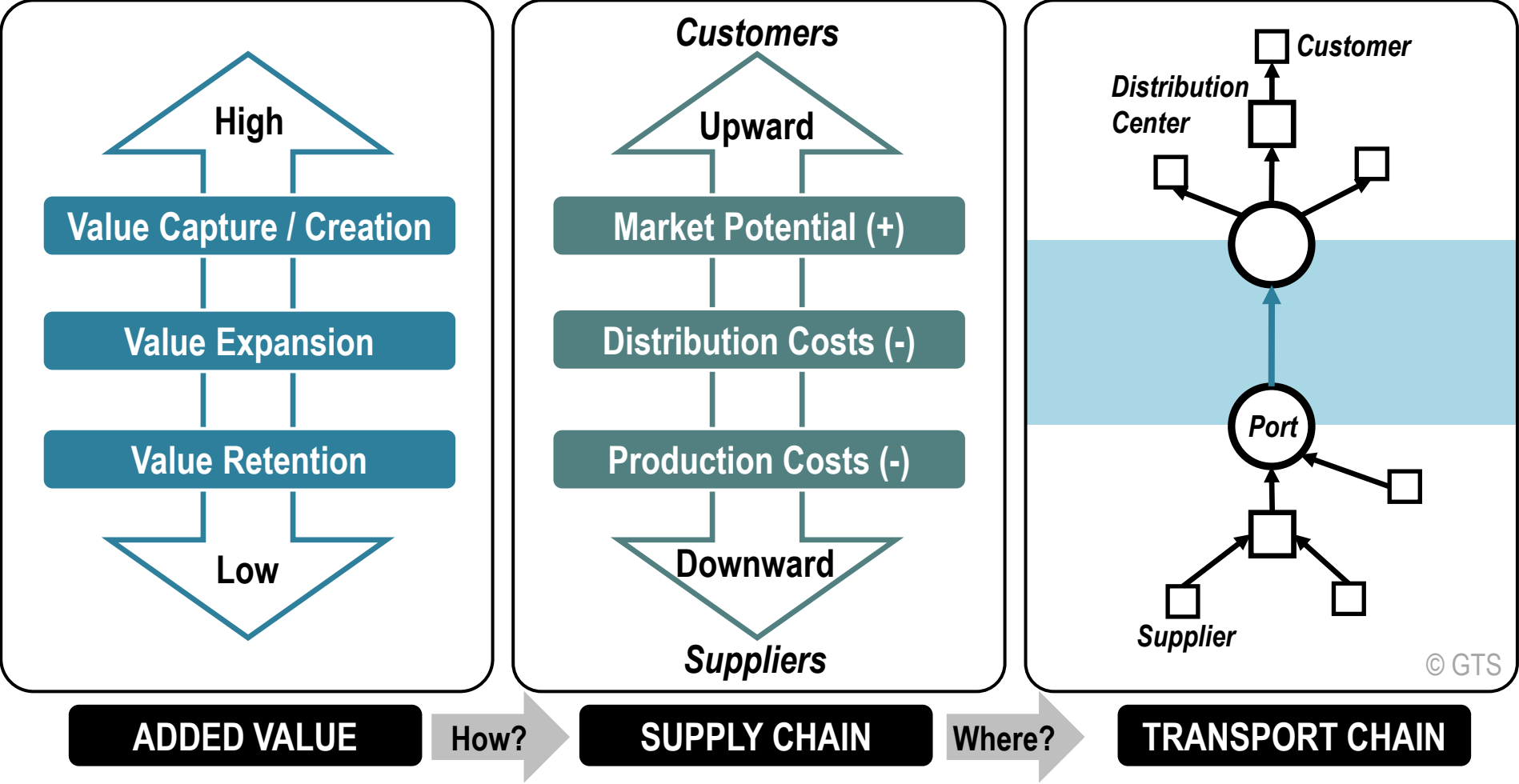
# Cost to Manufacture a Cotton Vest, Asia and United States, 2013



# Freight Transport Costs as Share of Commodity Market Value

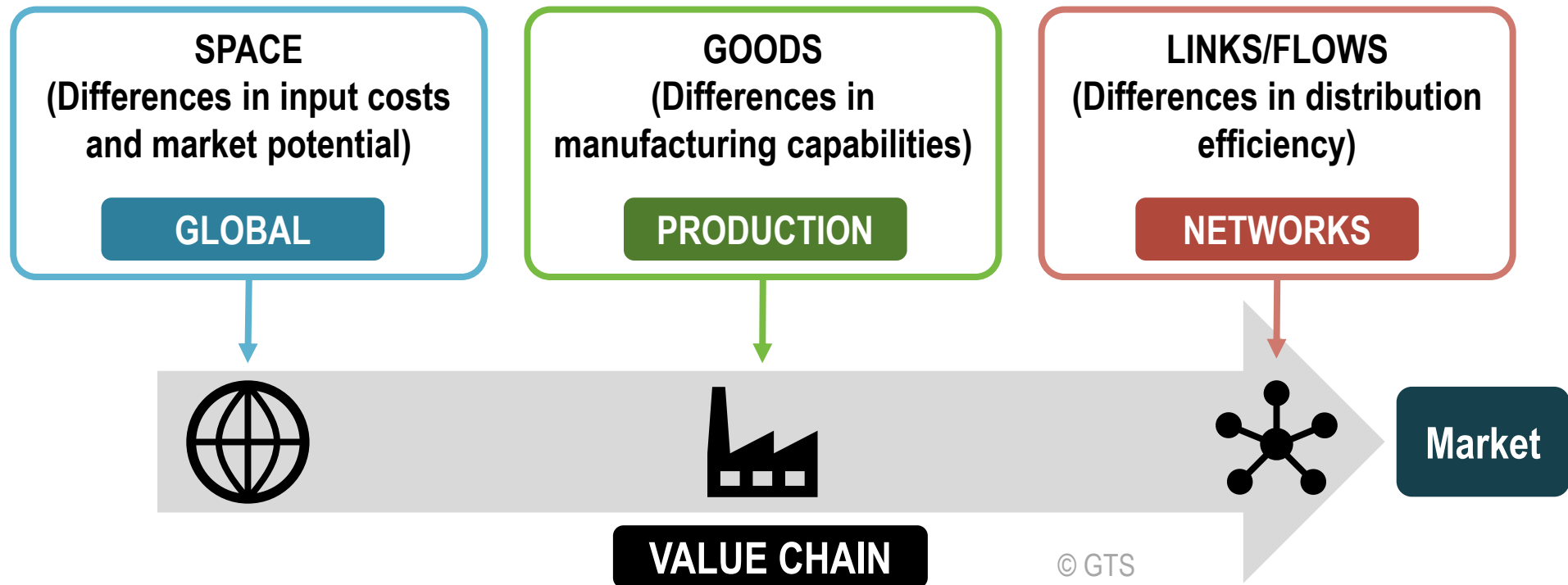
	1970	1980	1990	2007
Jute (Bangladesh)	12.1%	19.8%	21.2%	44.2%
Tea (Sri Lanka)	9.5%	9.9%	10.0%	13.4%
Coffee (Colombia)	4.2%	3.3%	6.8%	2.5%
Cocoa beans (Ghana)	2.4%	2.7%	6.7%	3.5%

# Added Value, Supply Chains and Transport Chains

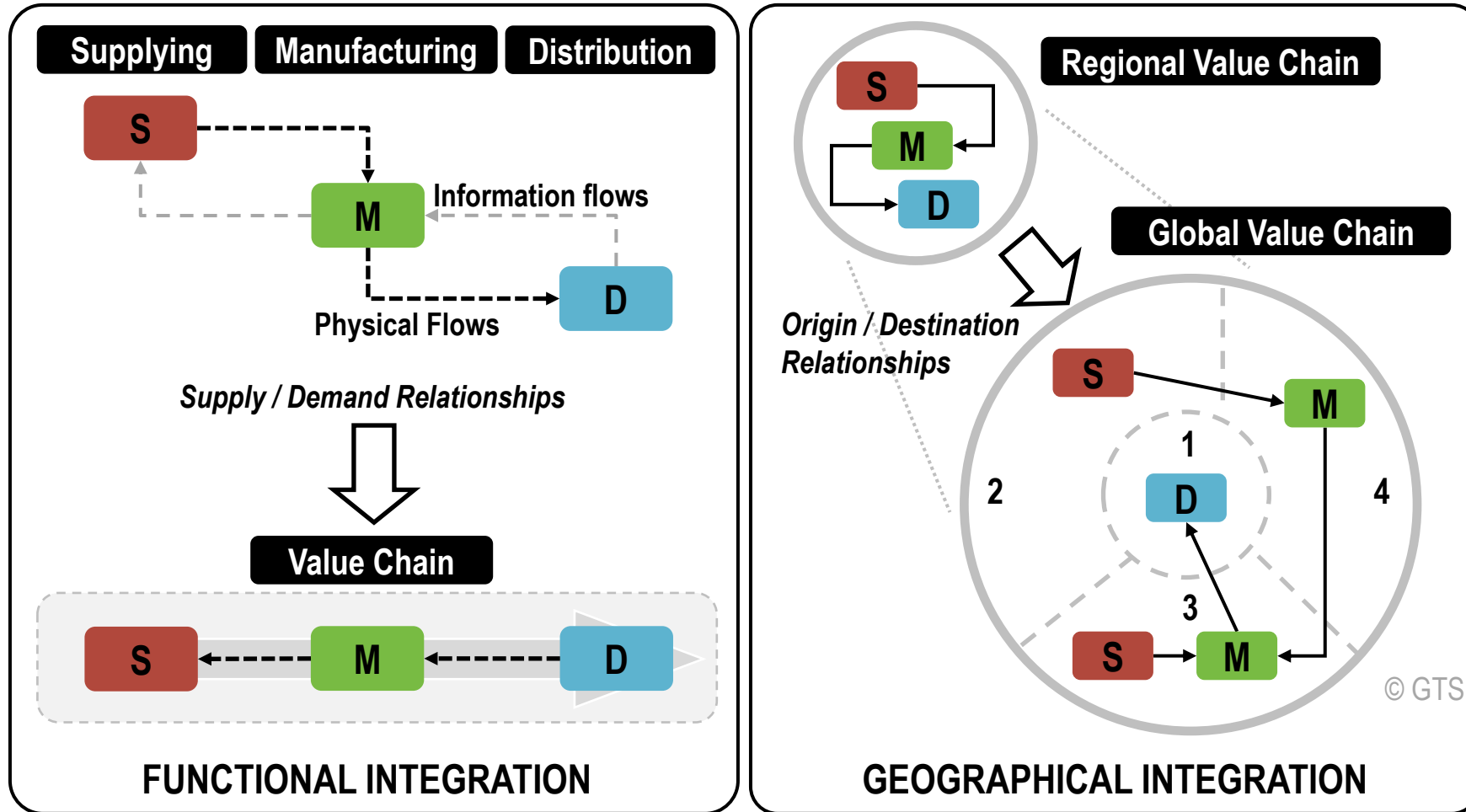




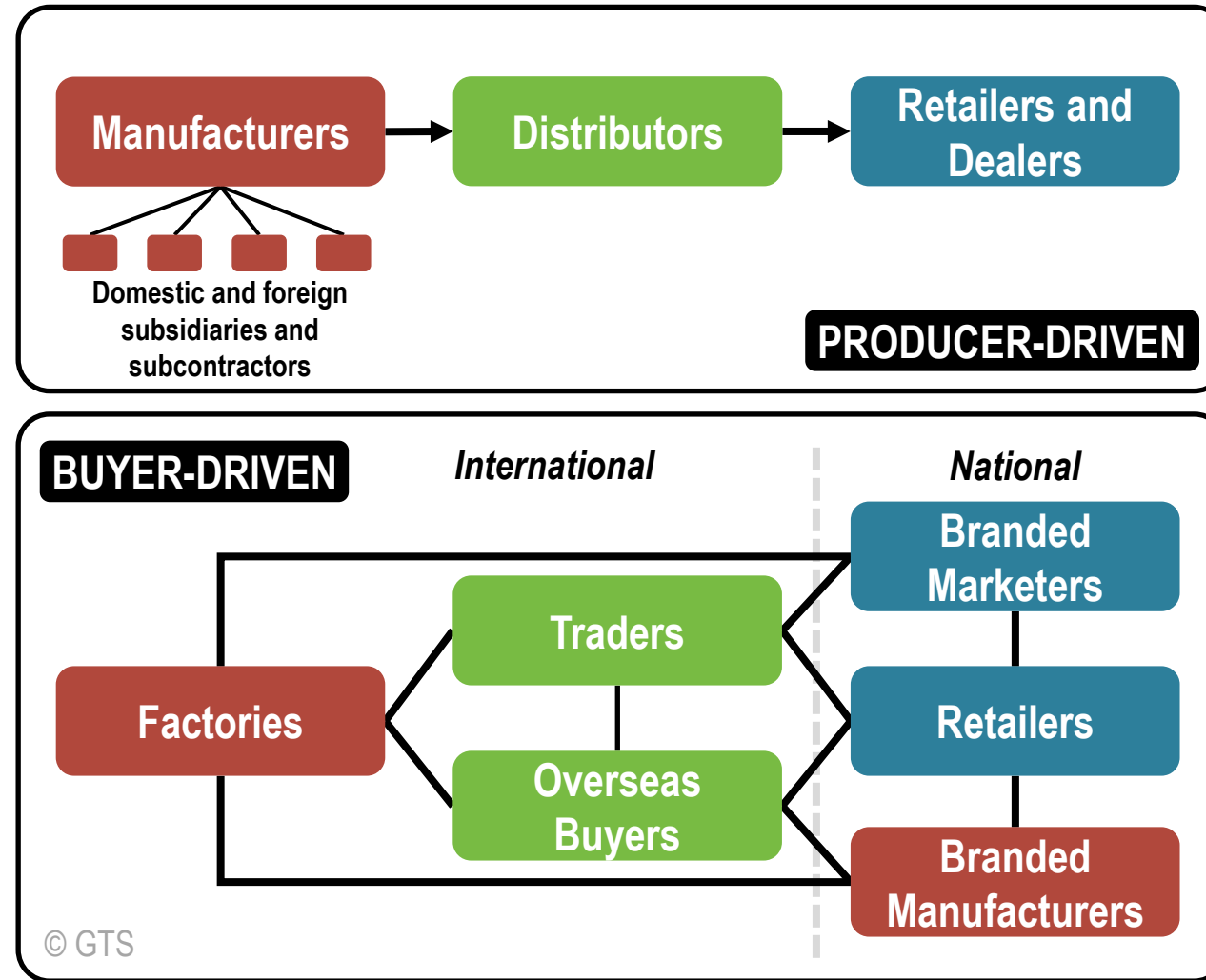
# Global Production Networks



# The Functional and Geographical Integration of Value Chains



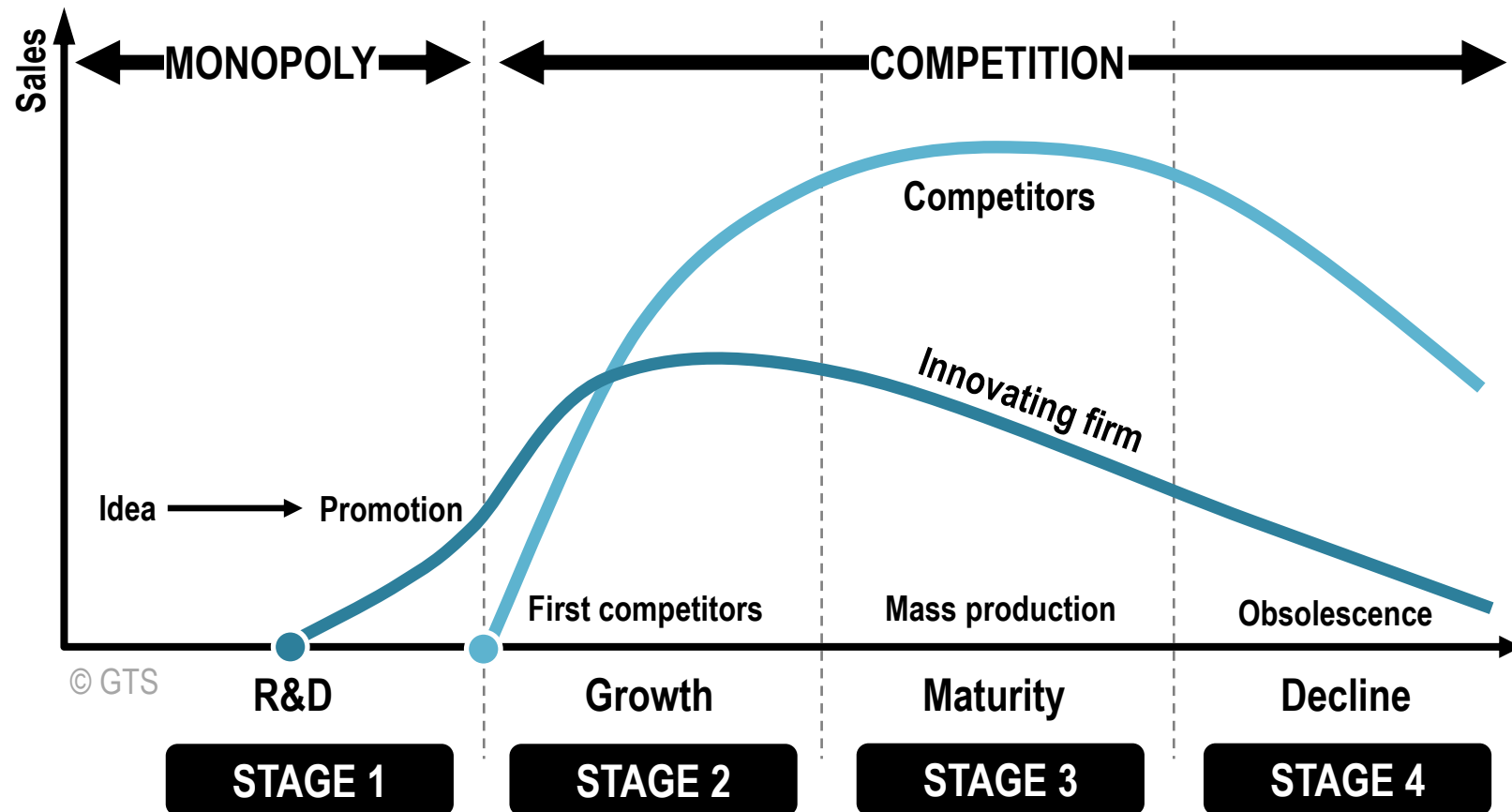
# Producer and Buyer-driven Value Chains



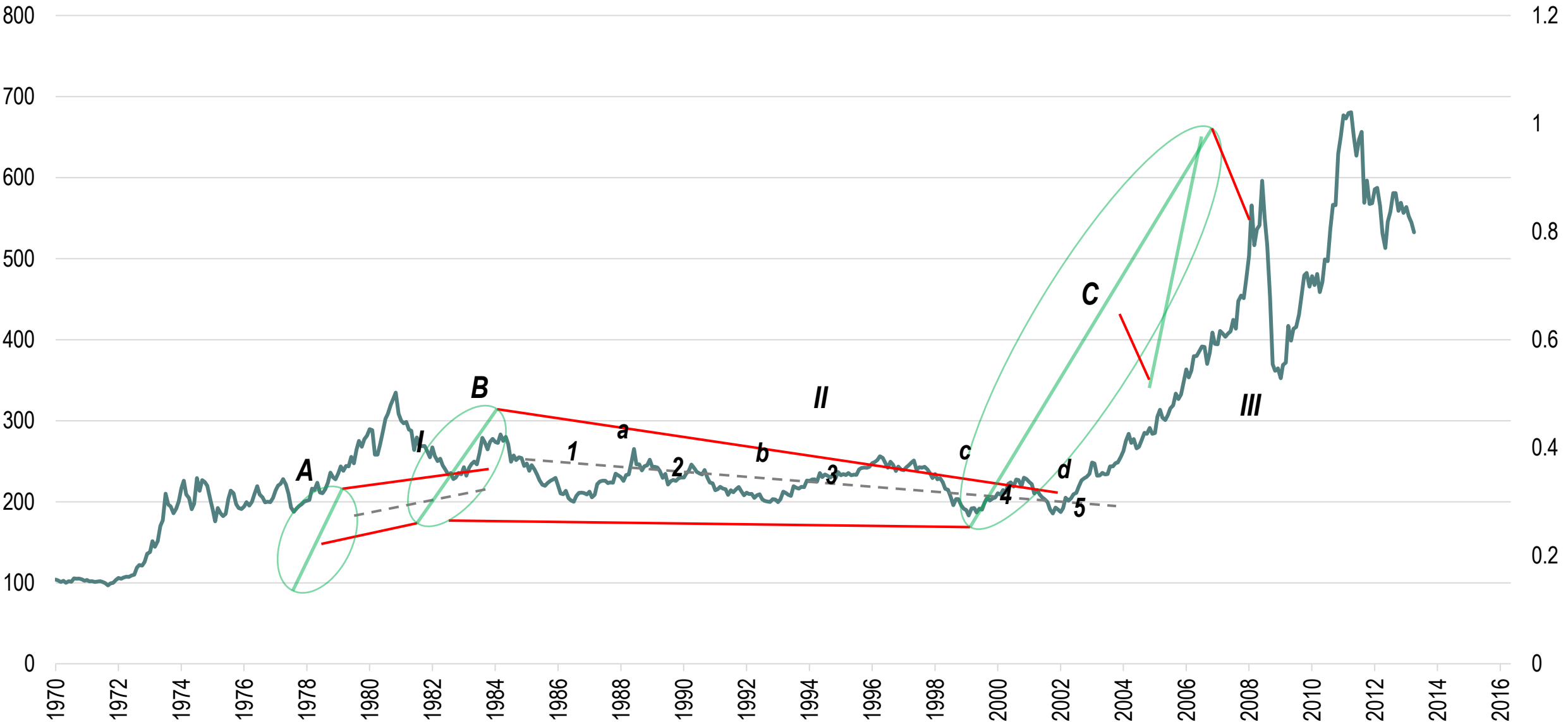
# Characteristics of Producer-Driven and Buyer-Driven Global Commodity Chains

	Producer-Driven Commodity Chains	Buyer-Driven Commodity Chains
Drivers of Global Commodity Chains	Industrial capital	Commercial capital
Core Competencies	Research & Development; Production	Design; Marketing
Barriers to Entry	Economies of Scale	Economies of Scope
Economic Sectors	Consumer Durables; Intermediate Goods; Capital Goods	Consumer Nondurables
Typical Industries	Automobiles; Computers; Aircraft	Apparel; Footwear; Toys
Ownership of Manufacturing Firms	Transnational Firms	Local Firms, predominantly in developing countries
Main Network Links	Investment-based	Trade-based
Predominant Network Structure	Vertical	Horizontal

# Product Life Cycle

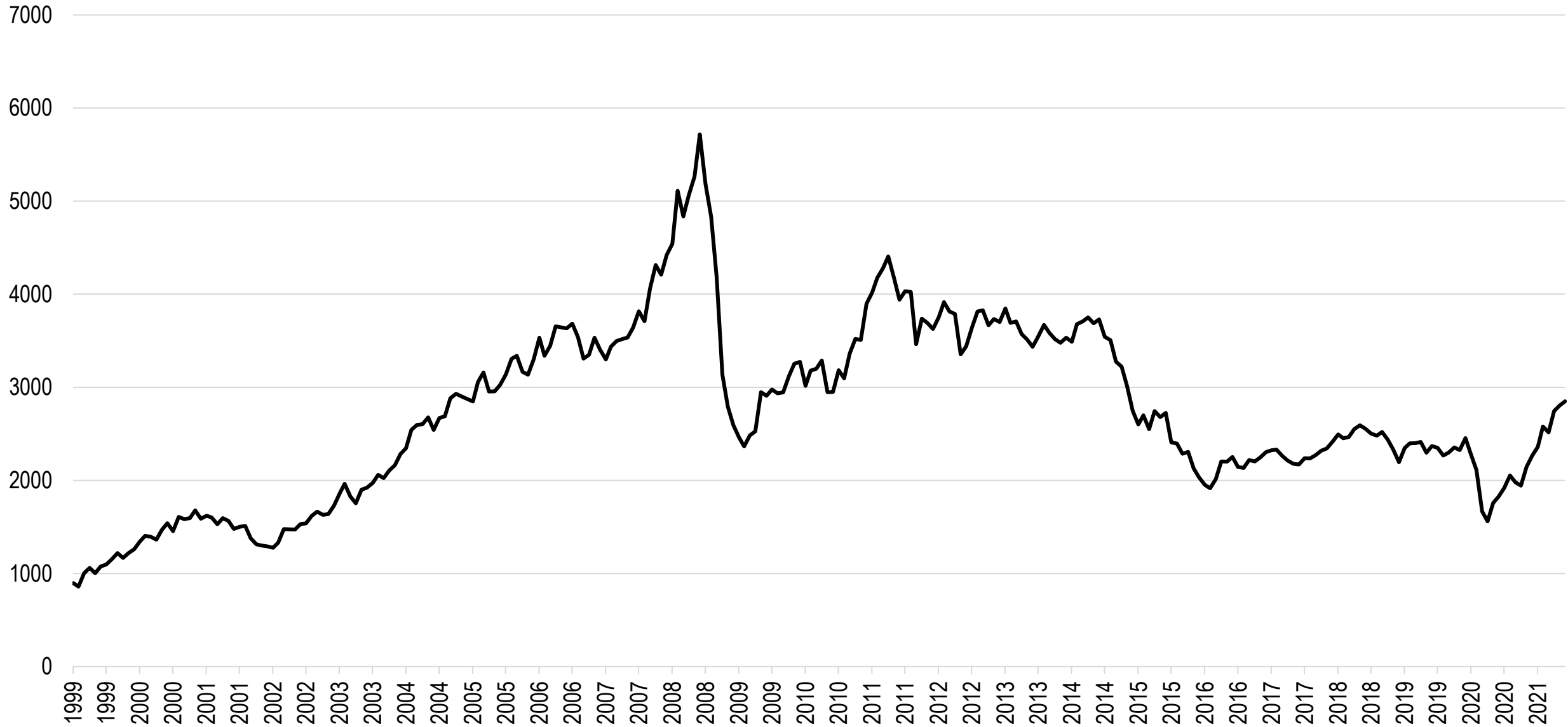


# CRB Index (CCI), Monthly Close, 1970-2013



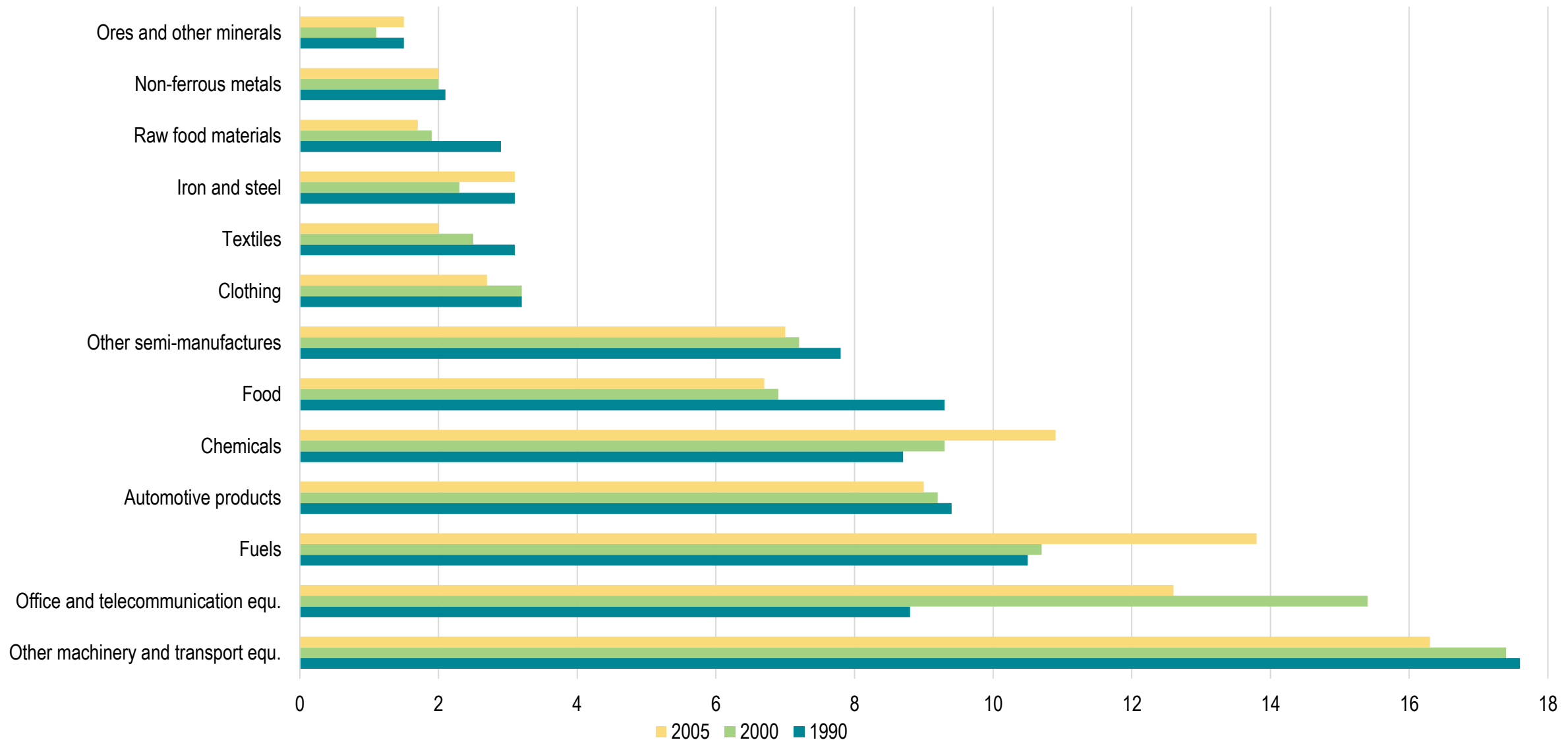
# All Commodity Price Index (2016=100)

# Rogers International Commodity Index 1999-2021

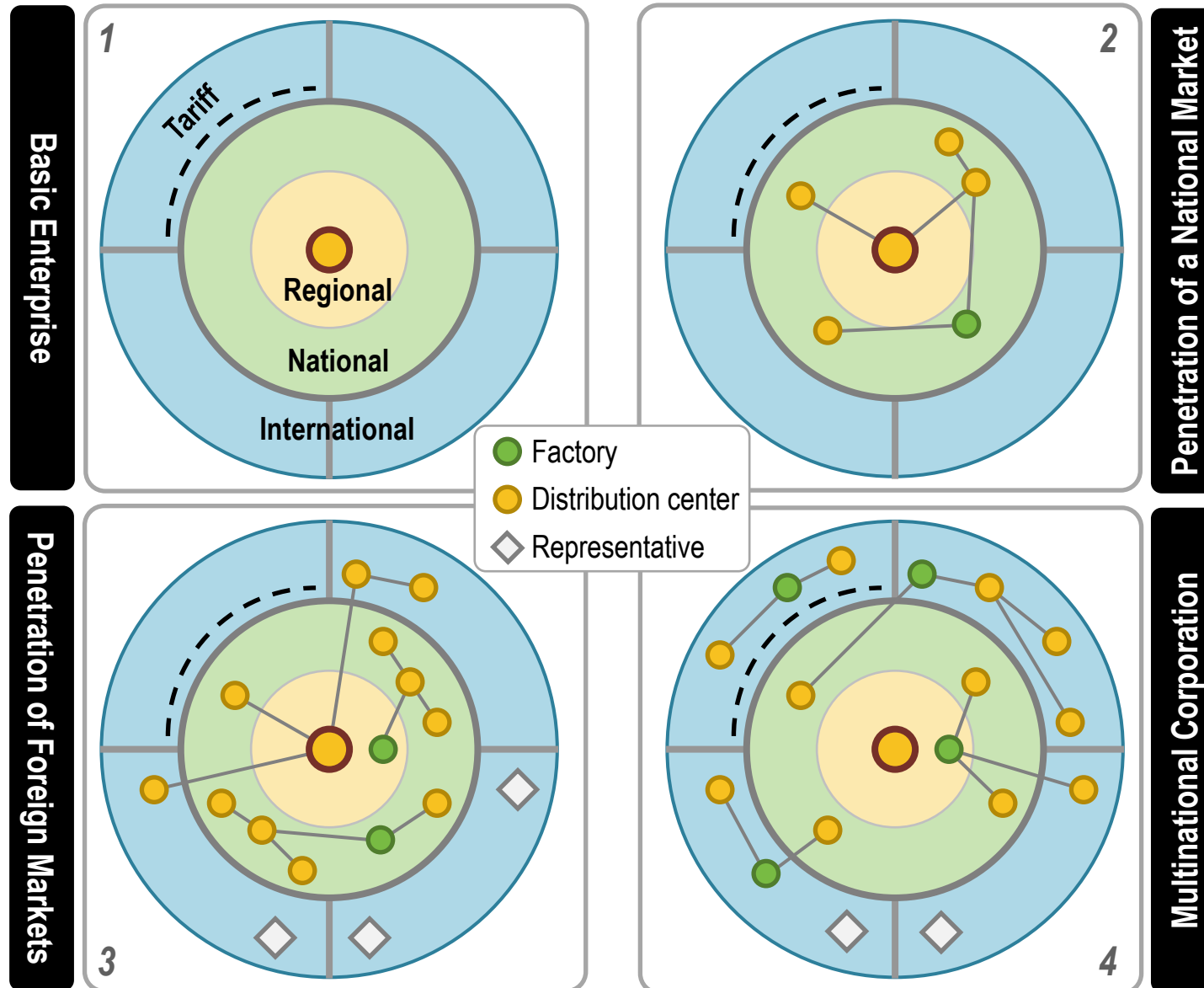




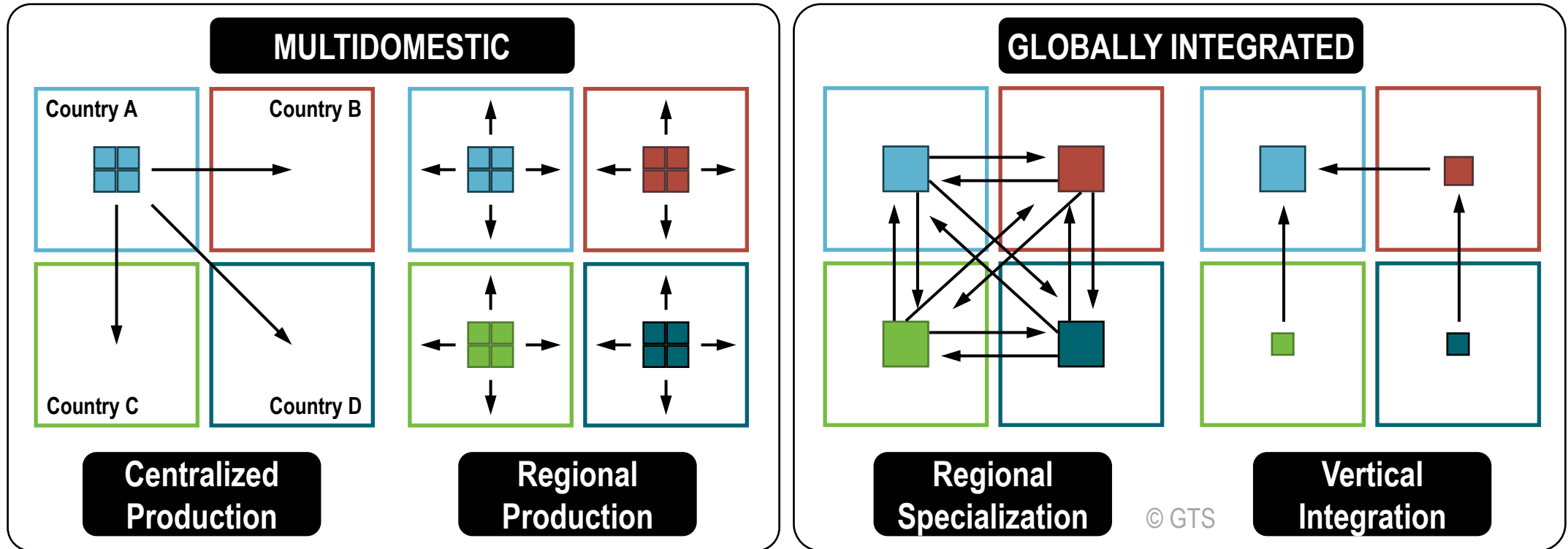
# Global Merchandises Exports by Product, 1990-2005 (in % of value)



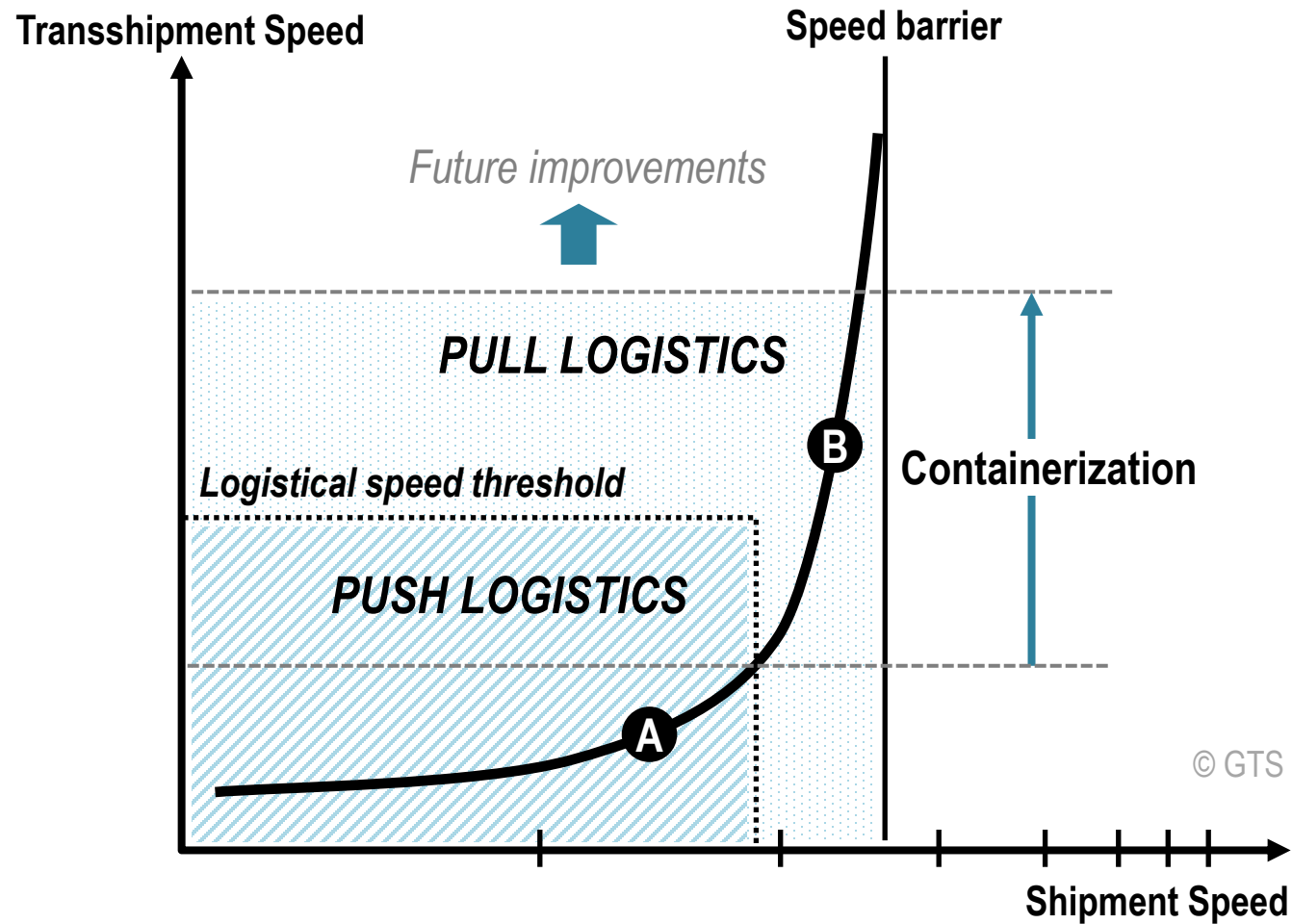
# Geographical Growth of a Multinational Corporation



# Global Production Networks and Location Strategies

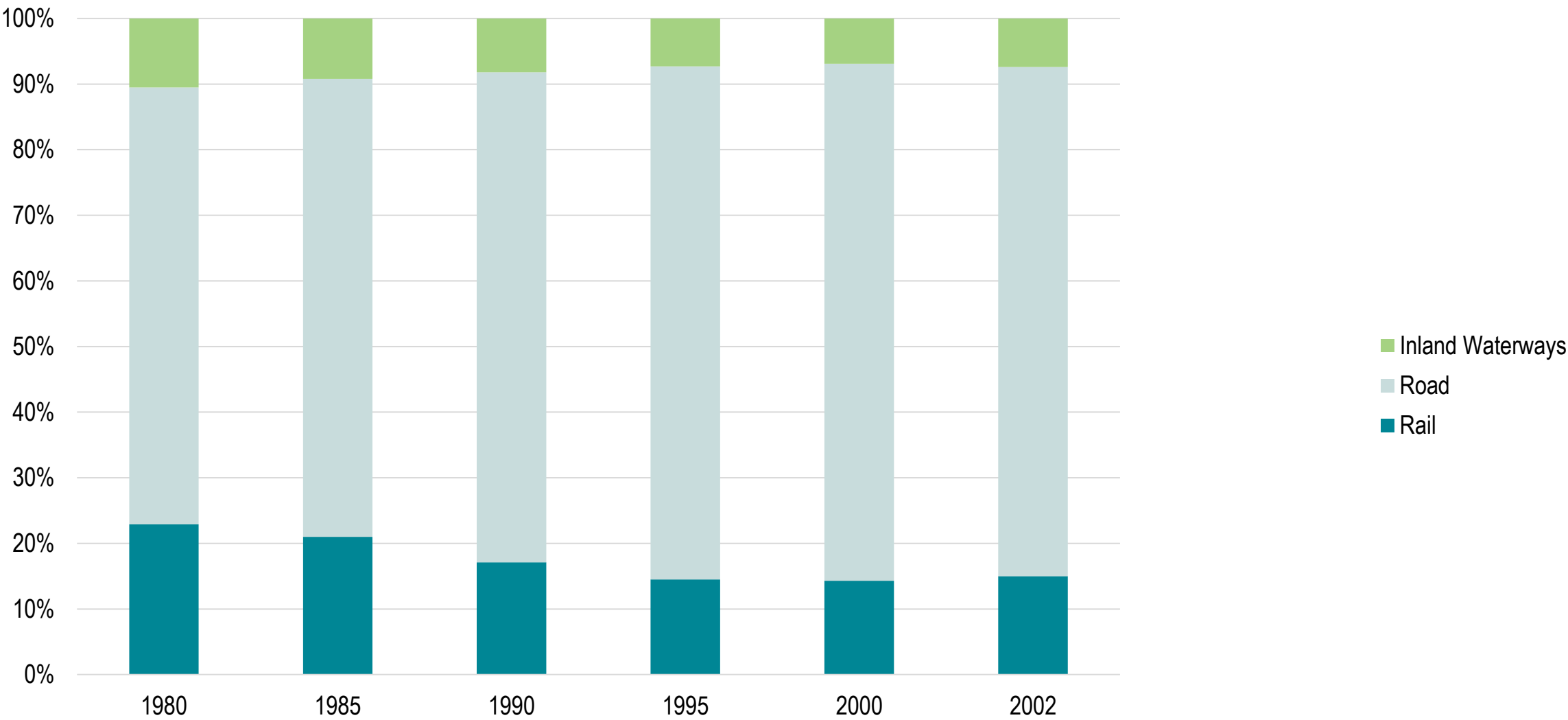


# The Velocity of Freight

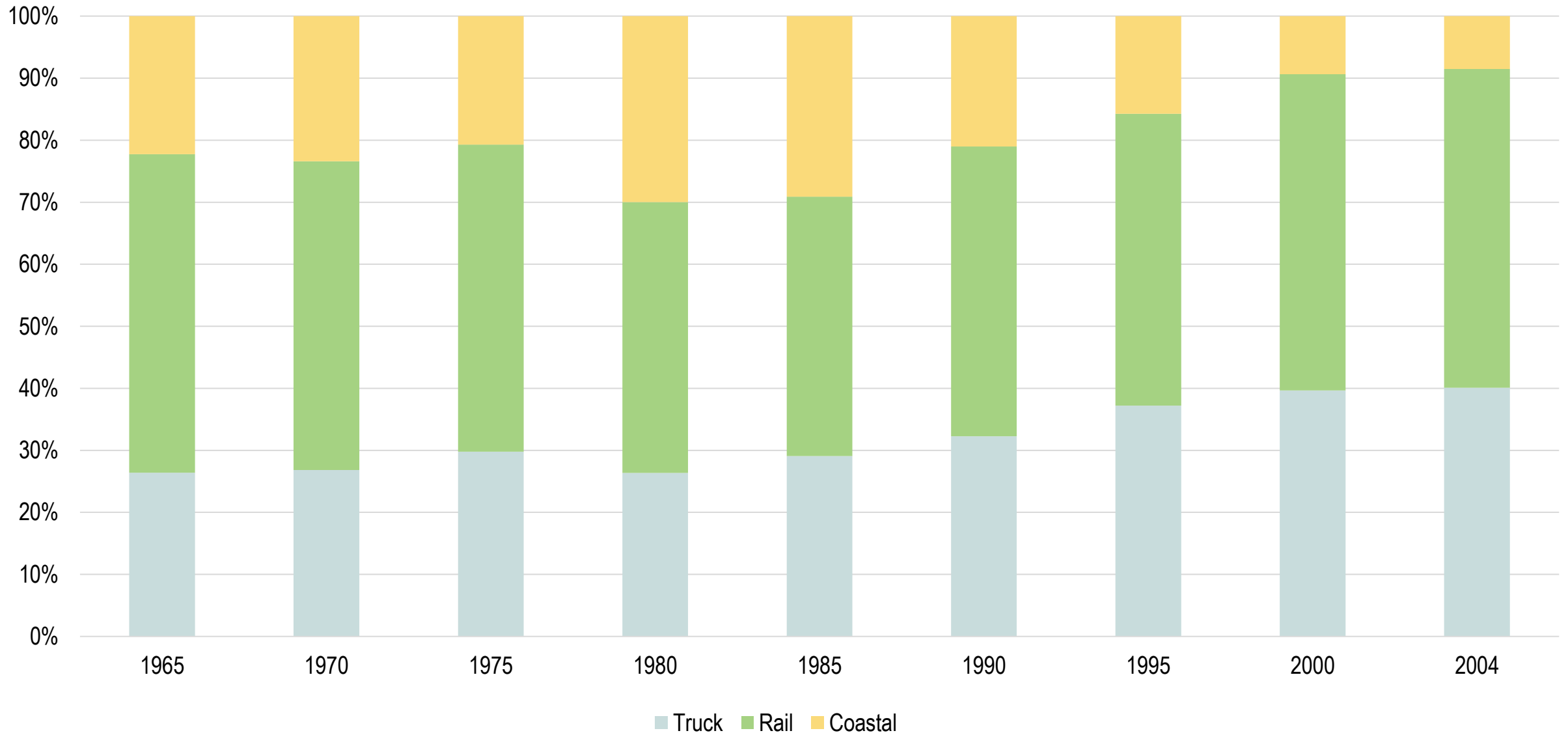


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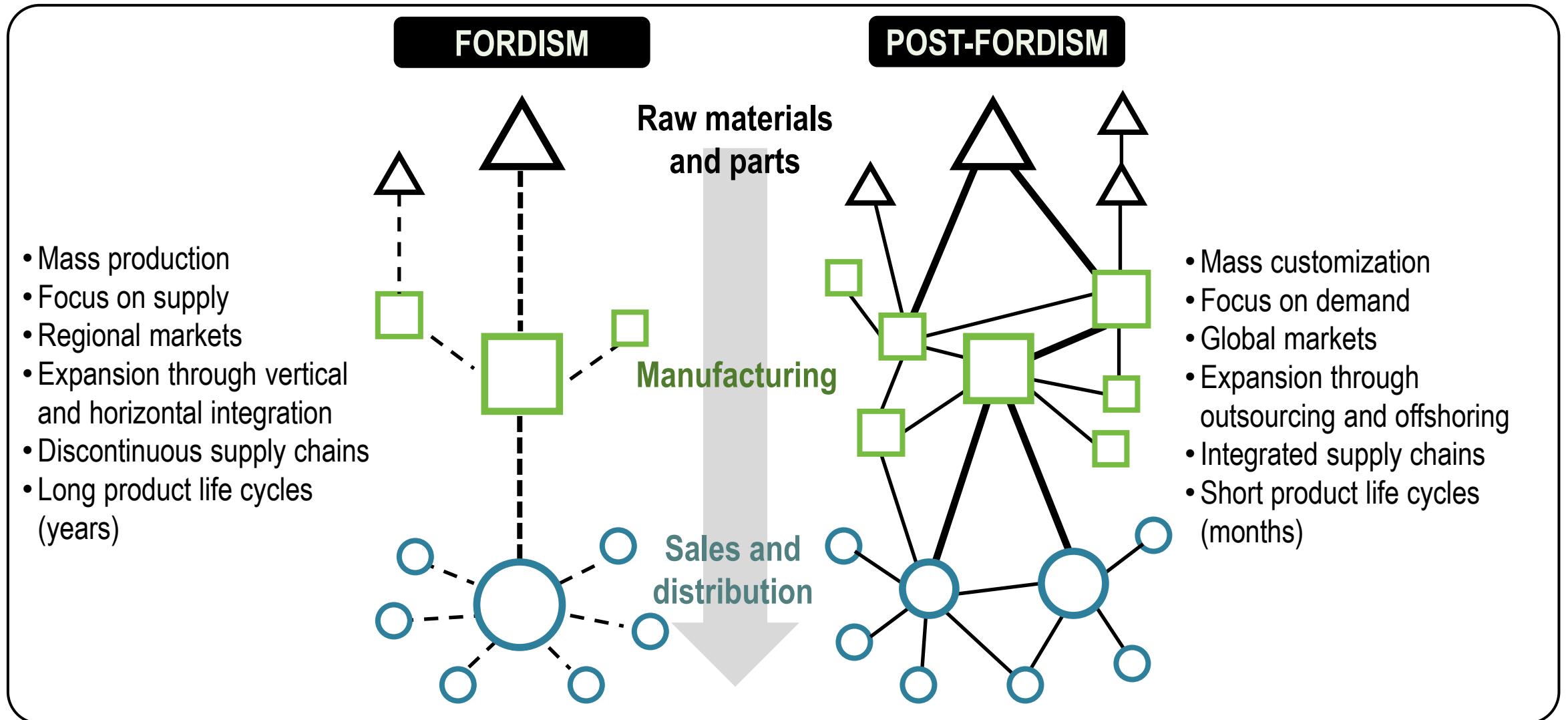
# Market Share by Freight Transport Mode, Western Europe, 1980-2002 (in ton-km)



# Market Share by Freight Transport Mode, United States, 1965-2005 (in ton-miles)



# Fordist and Post-Fordist Production Systems



# Post-Industrial Revolution



## ECONOMIC COMPOSITION

- Relative: shift from manufacturing to services.
- Absolute: growth of manufacturing.



## LABOR

- Declining importance of “blue collar” tasks.
- Increasing importance of technical and creative tasks.



## CAPITAL ACCUMULATION

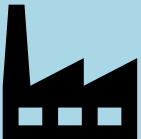
- Knowledge becomes a form of capital.
- High reliance on innovation.



## INFORMATION TECHNOLOGIES

- Global telecommunication networks.
- IT embedded in products and services.

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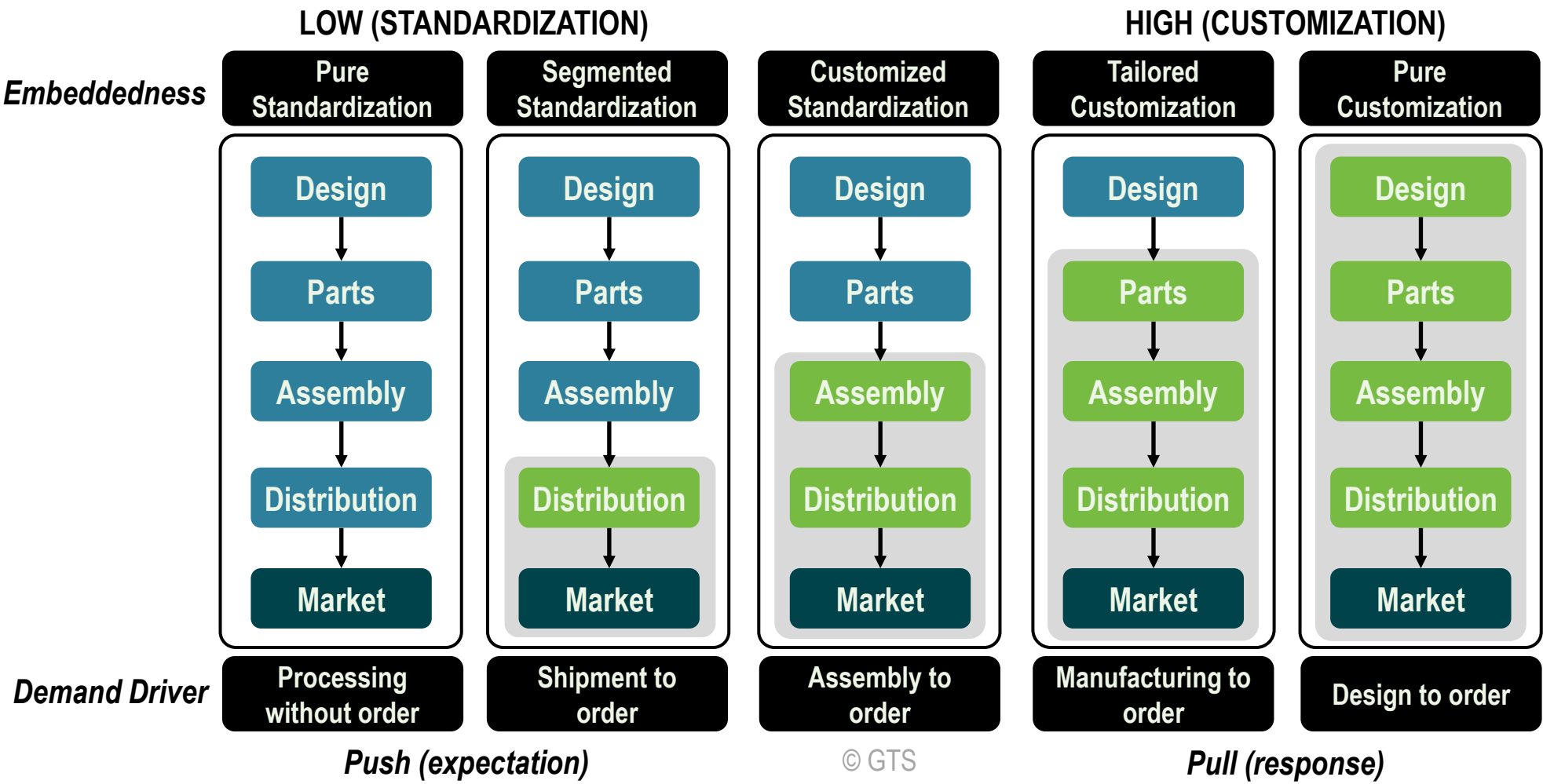


## MANUFACTURING

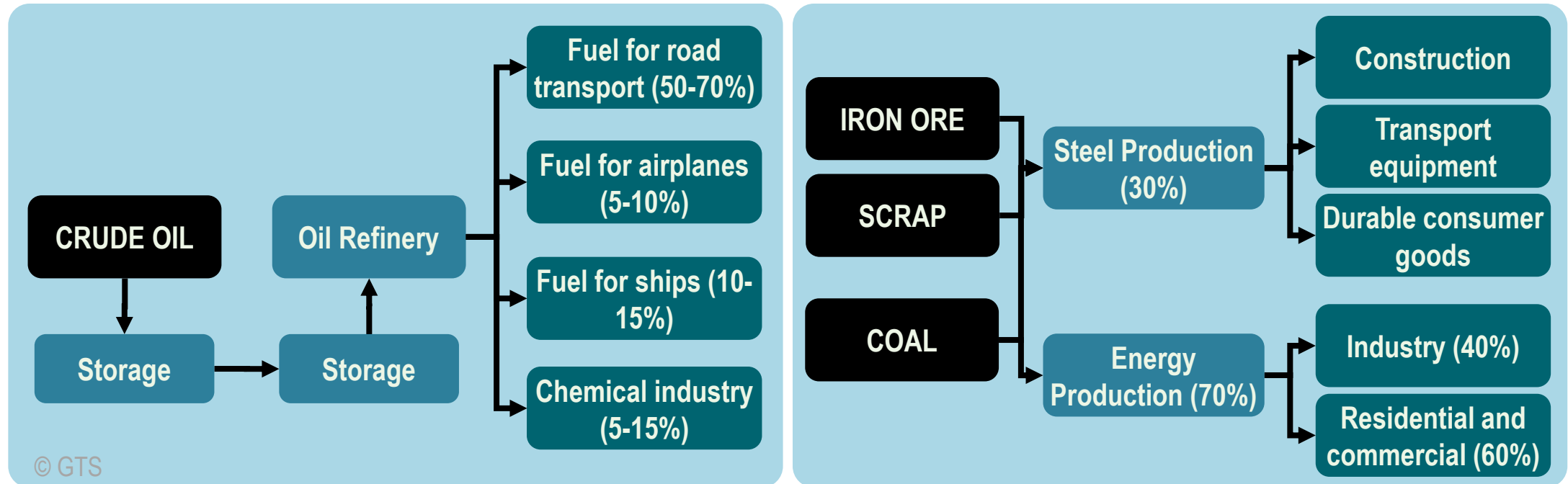
- Flexible manufacturing systems.
- Supply chain management (Just-in-time).
- Diversified trade (from resources to high-value goods).



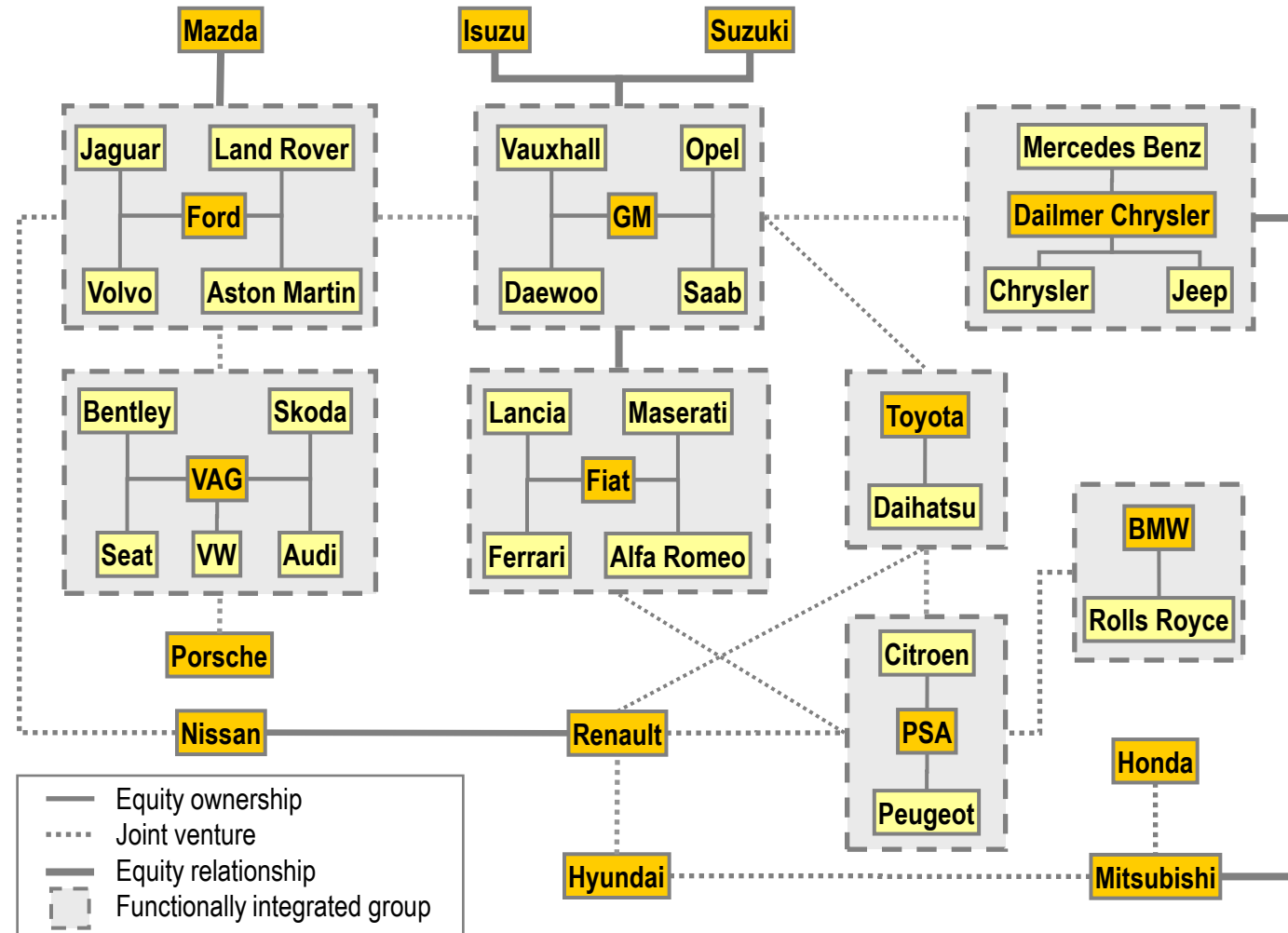
# Level of Embeddedness of Value Chains



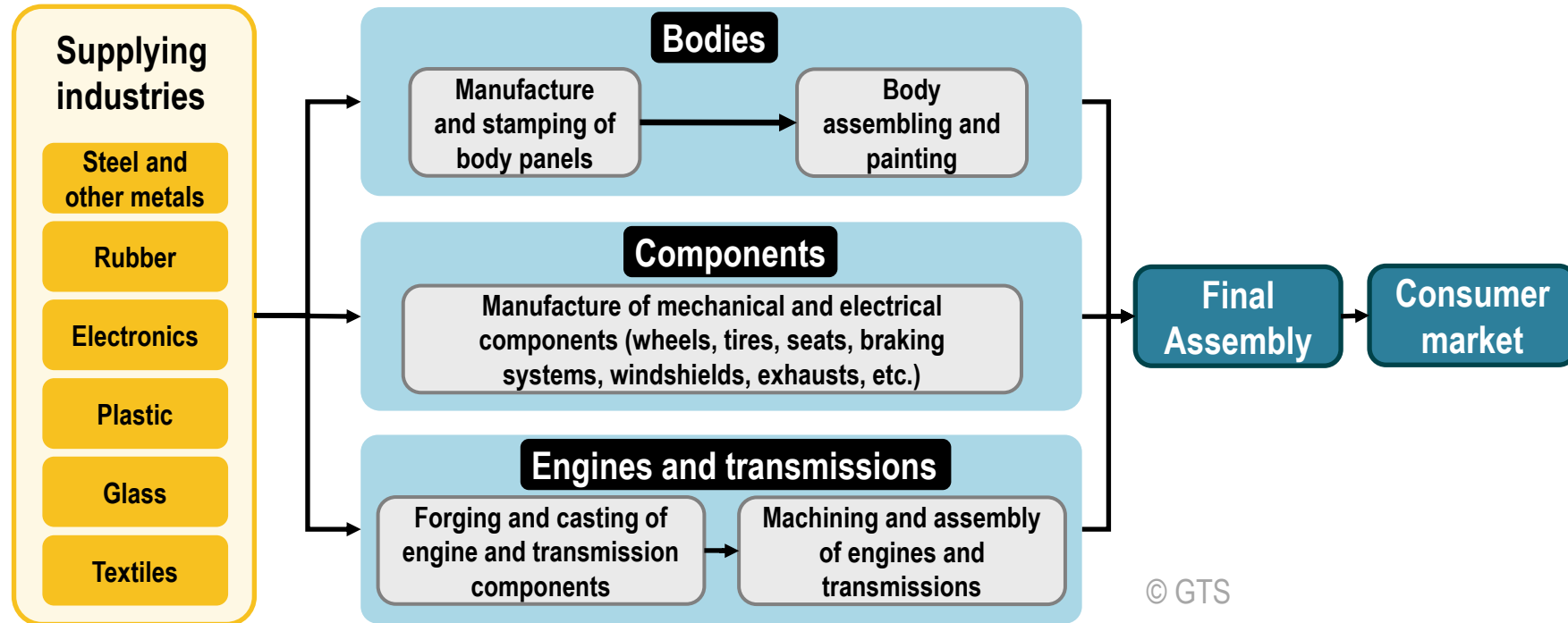
# Energy and Minerals Supply Chains



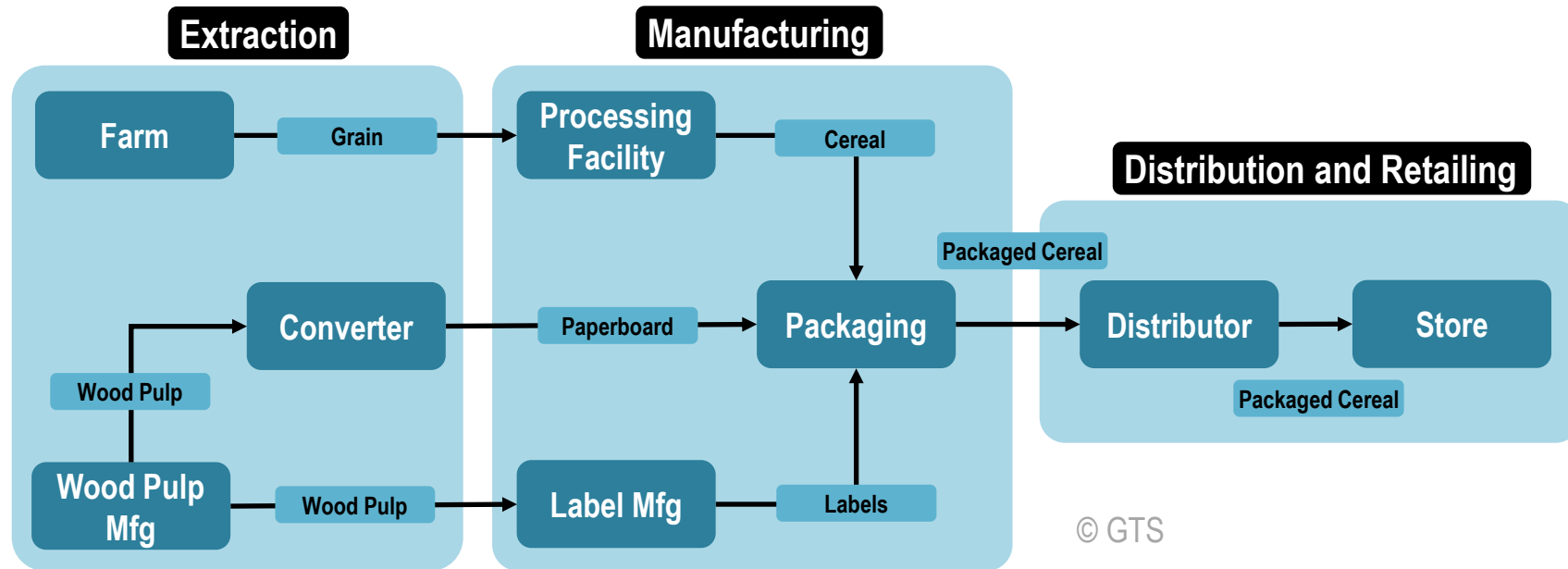
# The Global Car Production Network, 2003



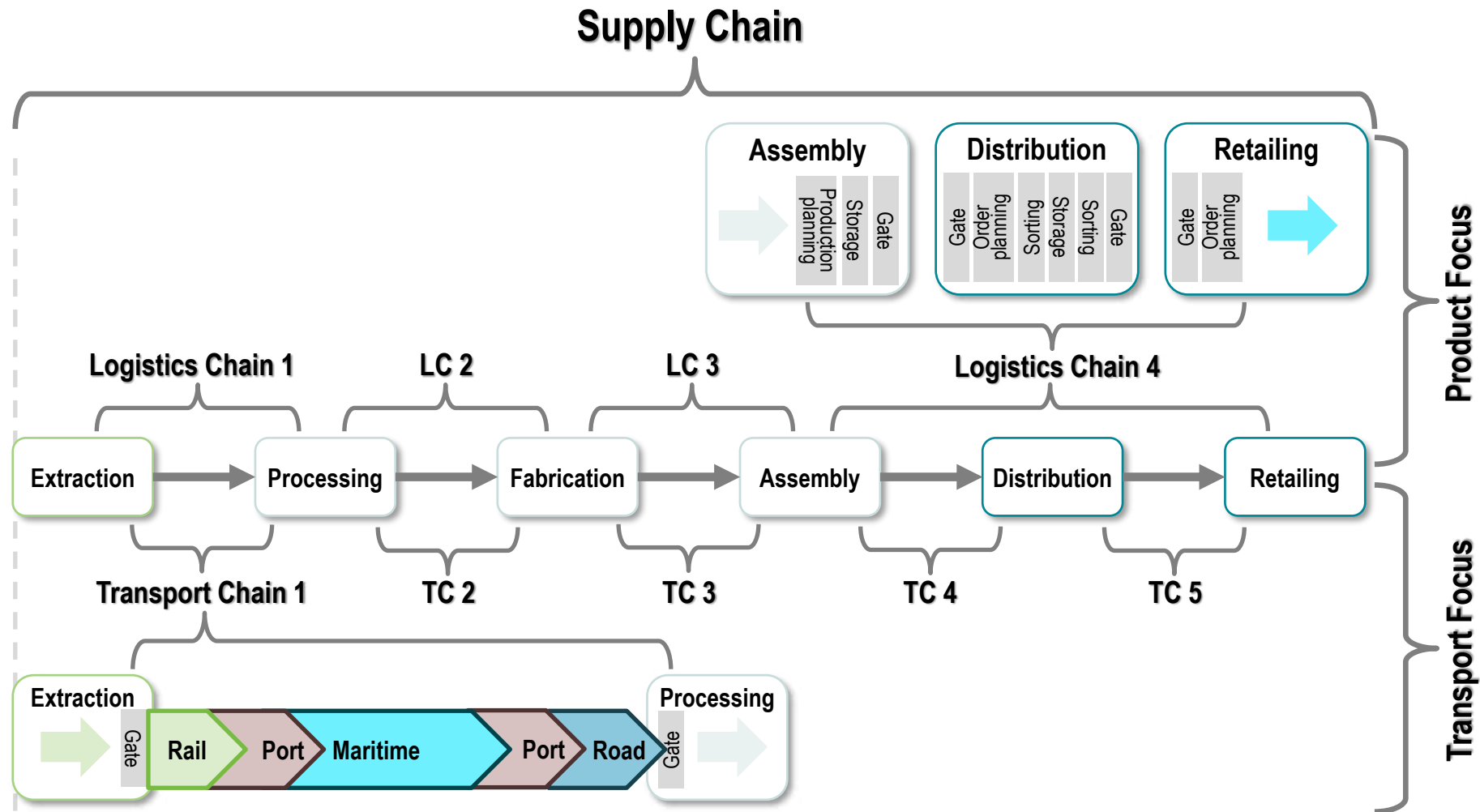
# The Automobile Supply Chain



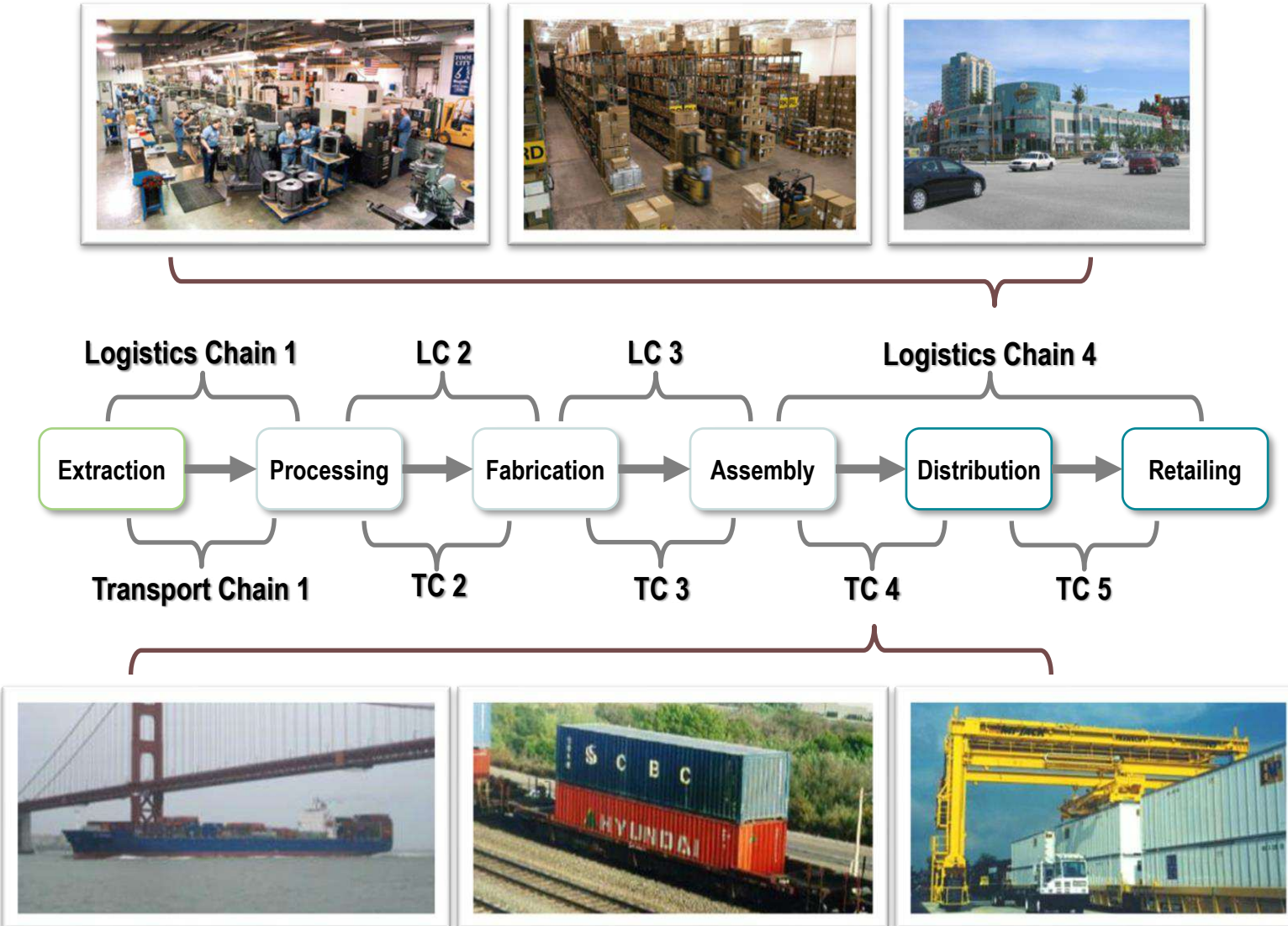
# Cereals Supply Chain

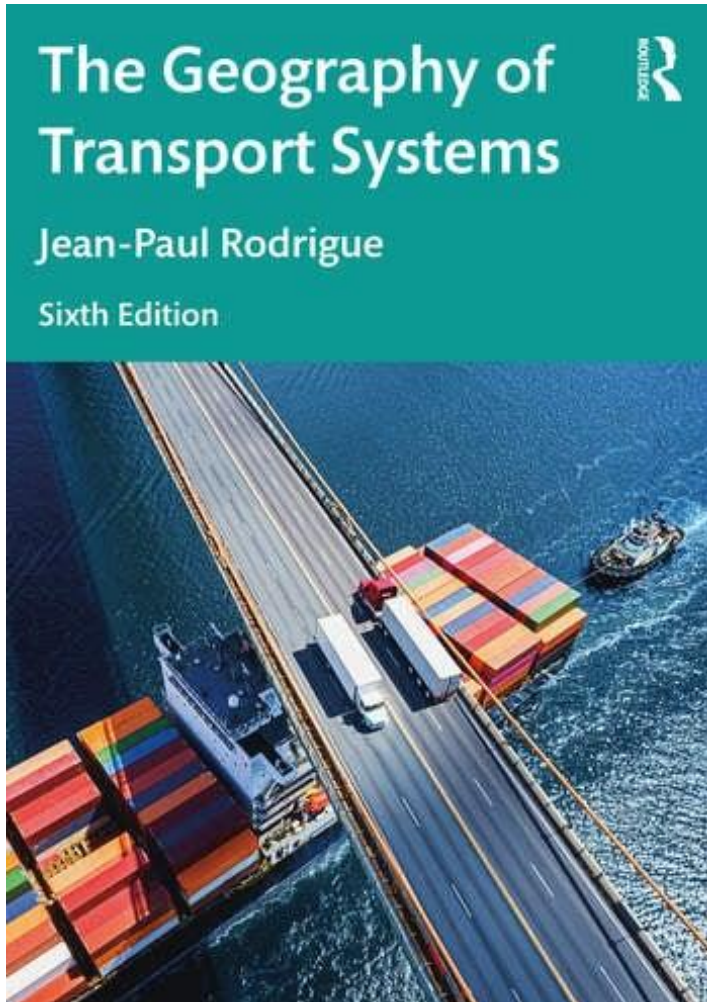


# The Scope of a Supply Chain, Logistics Chains and Transport Chains



# Supply Chains: Alternating First and Last Miles





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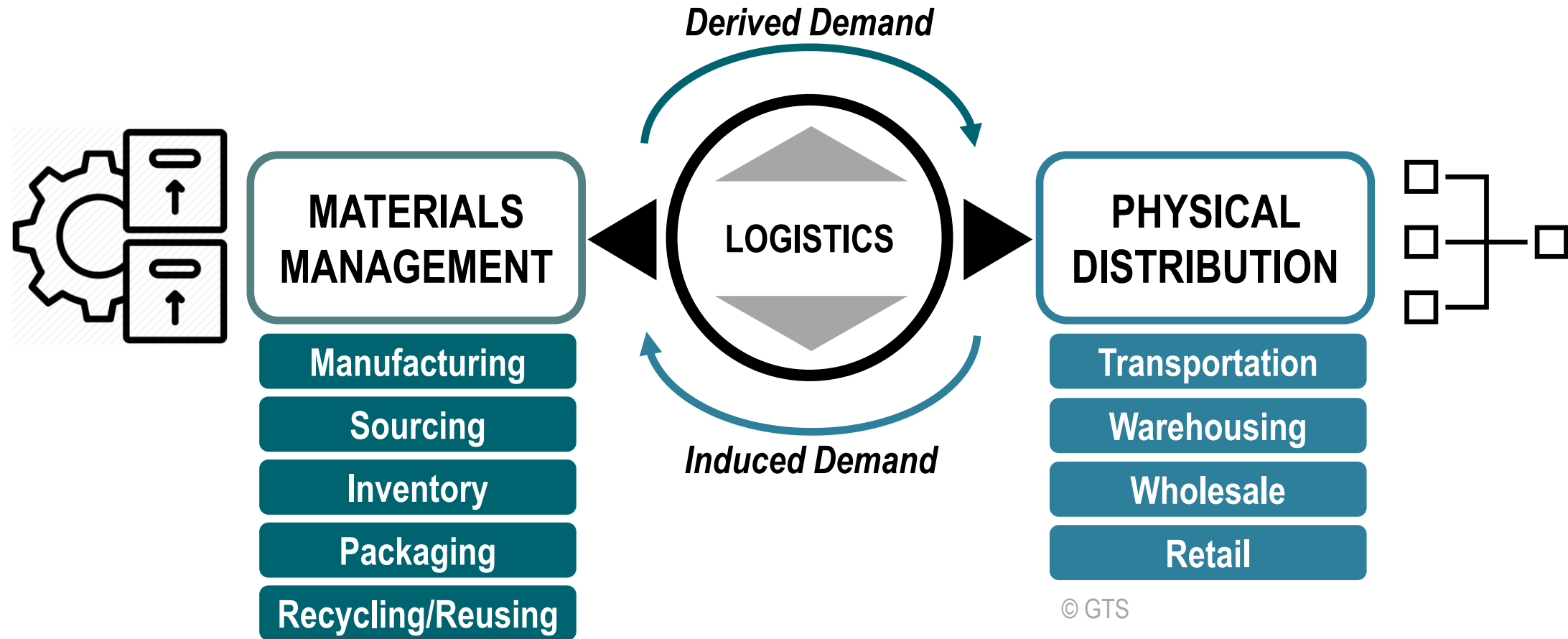
# Logistics and Freight Distribution

## Chapter 7.4

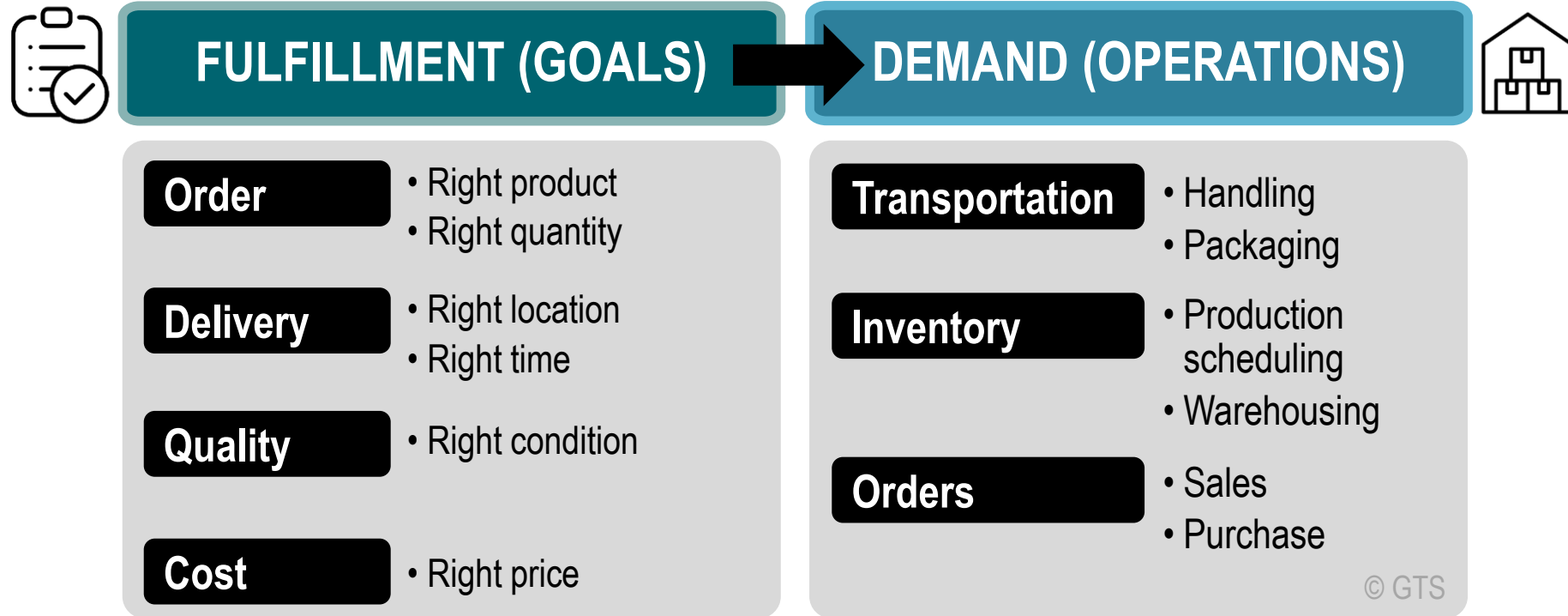
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# The Concept of Logistics



# Logistics Goals and Operations



# Types of Packaging

## PRIMARY PACKAGING

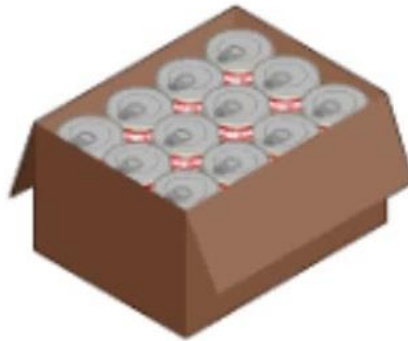
- Packaging touching the product.
- Boxes and wraps.
- Designed for individual items.
- Designed for shelf storage/display of single item.



Primary  
packaging

## SECONDARY PACKAGING

- Packaging bundling items of a product.
- Boxes and wraps.
- Designed for shelf storage/display.



Secondary  
packaging

## TERTIARY PACKAGING

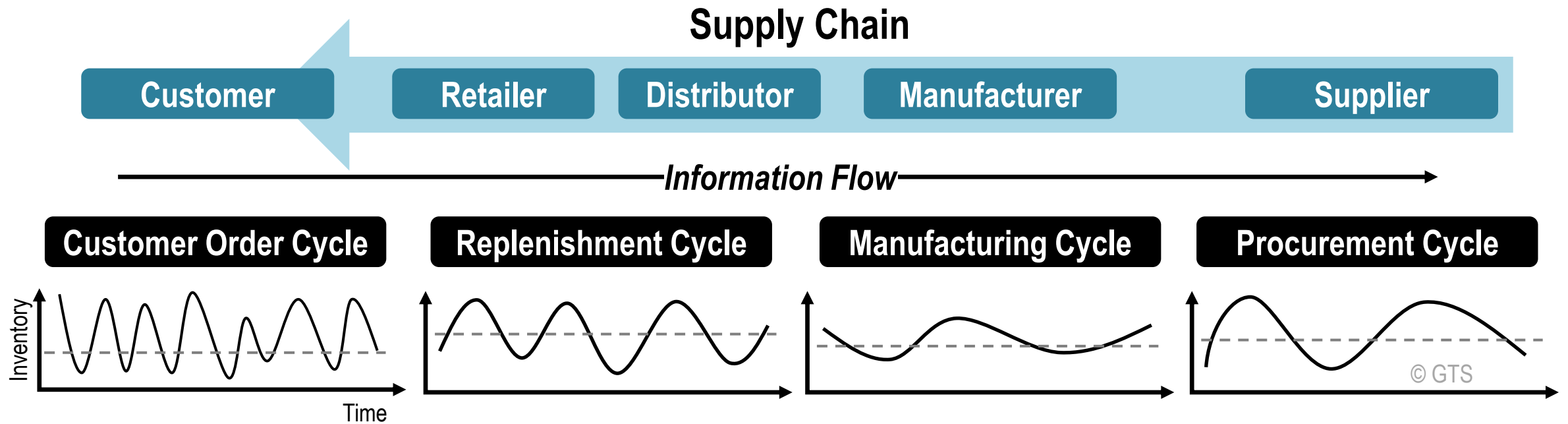
- Packaging bundling products for transport.
- Boxes, pallets and containers.



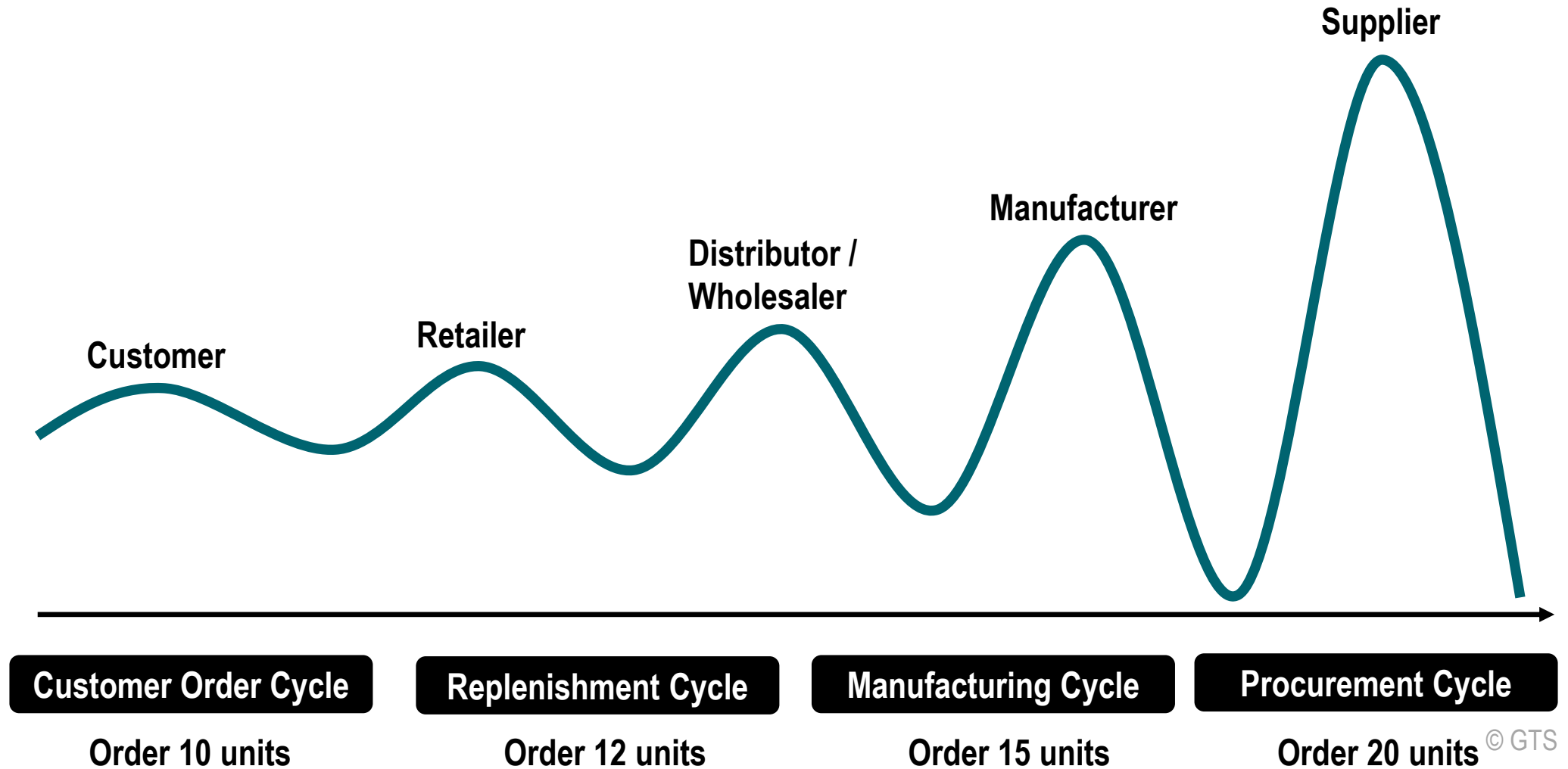
Tertiary  
Packaging

© GTS

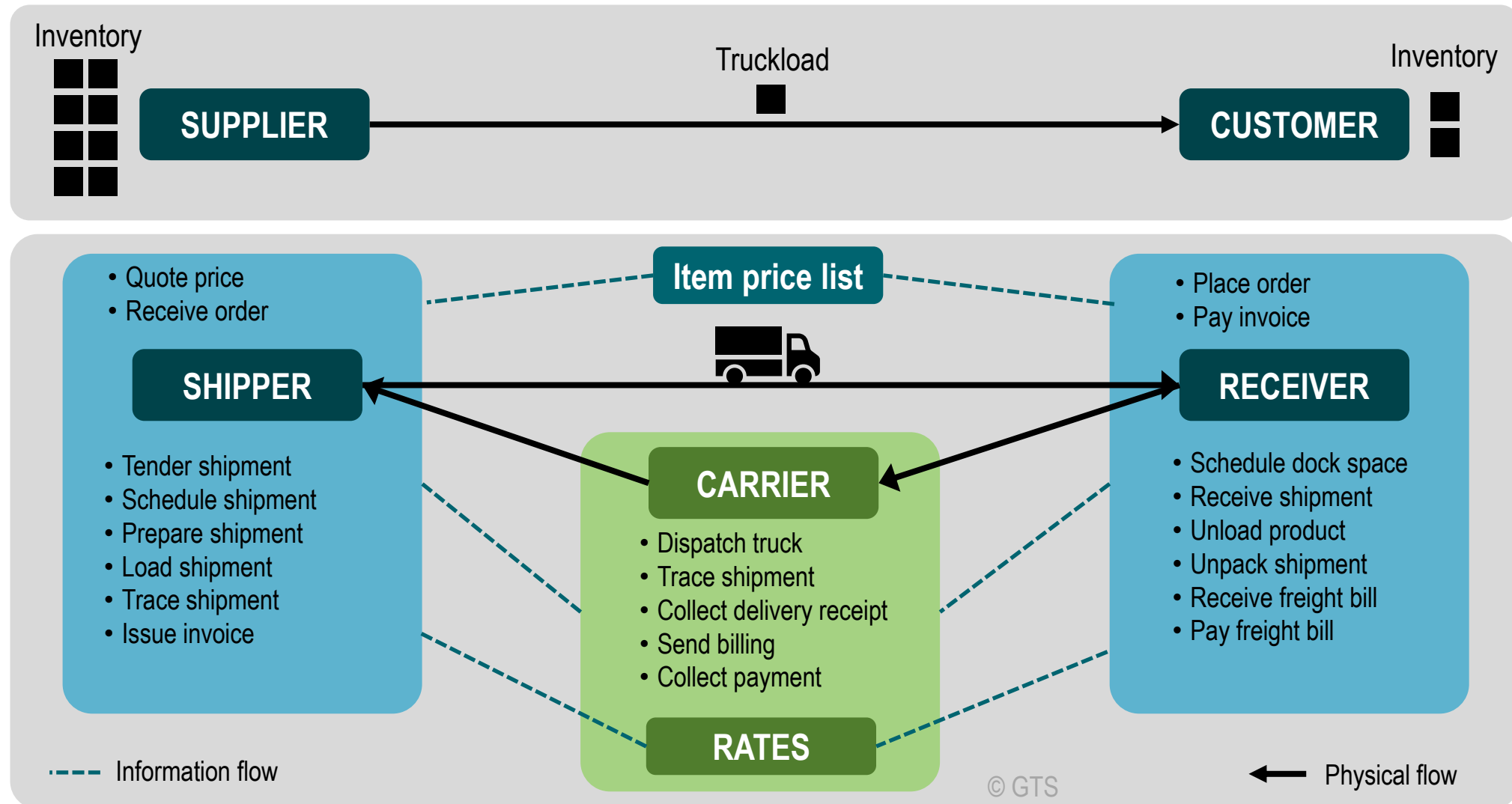
# The Supply Chain and its Cycles



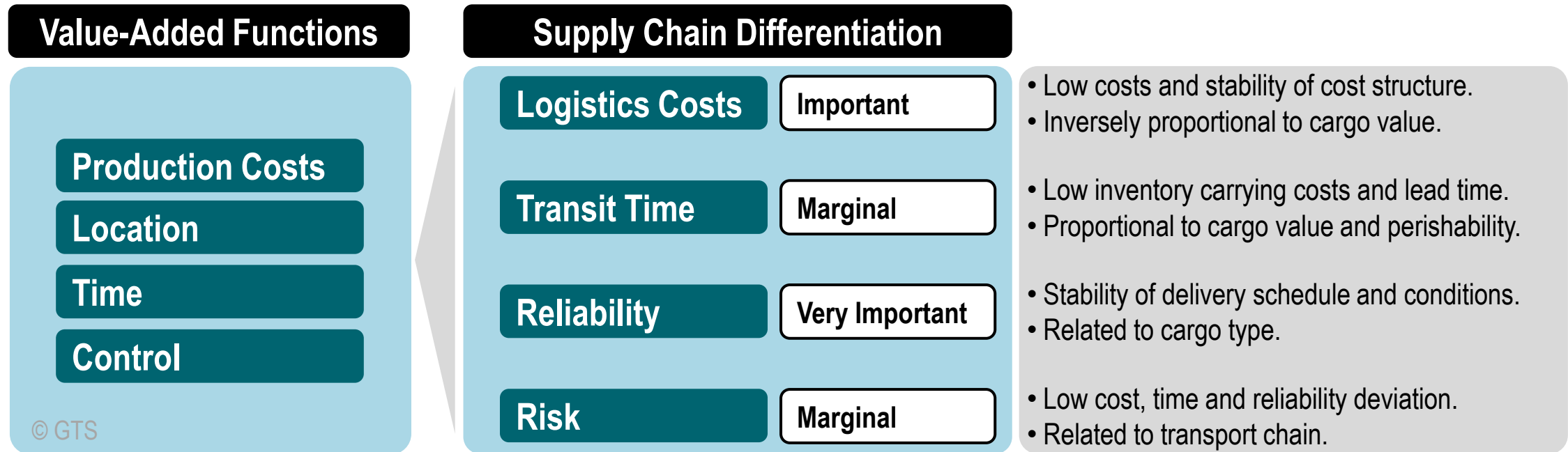
# The Bullwhip Effect on Supply Chains



# Distribution and Related Logistics Activities



# Value-Added Functions and Differentiation of Supply Chains



# Taxonomy of Logistics Decisions

## PRODUCTION STRUCTURES



- Decisions on outsourcing, offshoring and sub-contracting.
- Number, location and capacity of production units.

## DISTRIBUTION STRUCTURES



- The number, location and capacity of distribution centers.
- Frequency and timing of distribution (e.g. just-in-time).

## TRANSPORT STRUCTURES



- Choice of a freight network linking suppliers and customers.
- Choice of modes and terminals on the transport chain.

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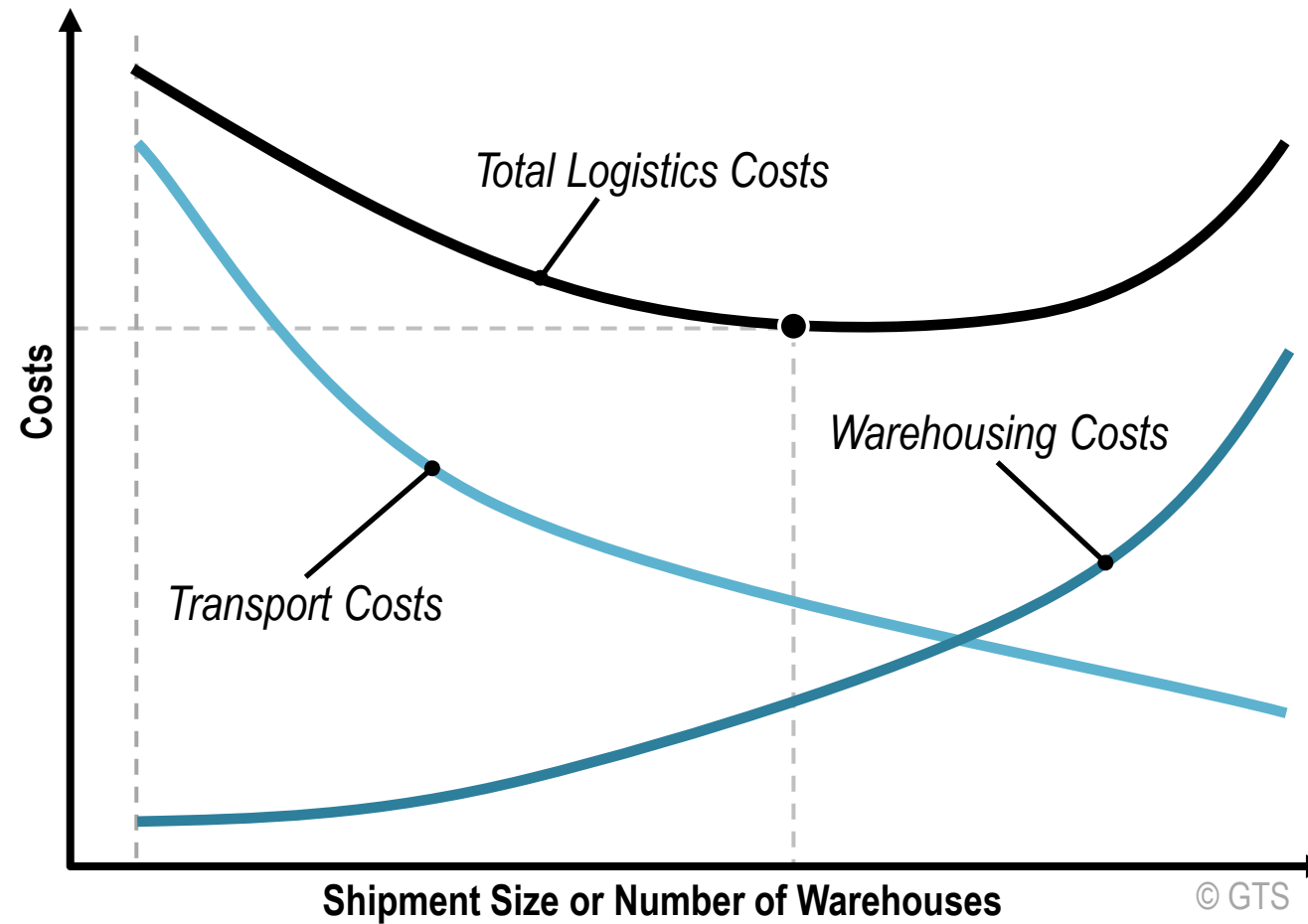
## LOGISTICS STRUCTURES



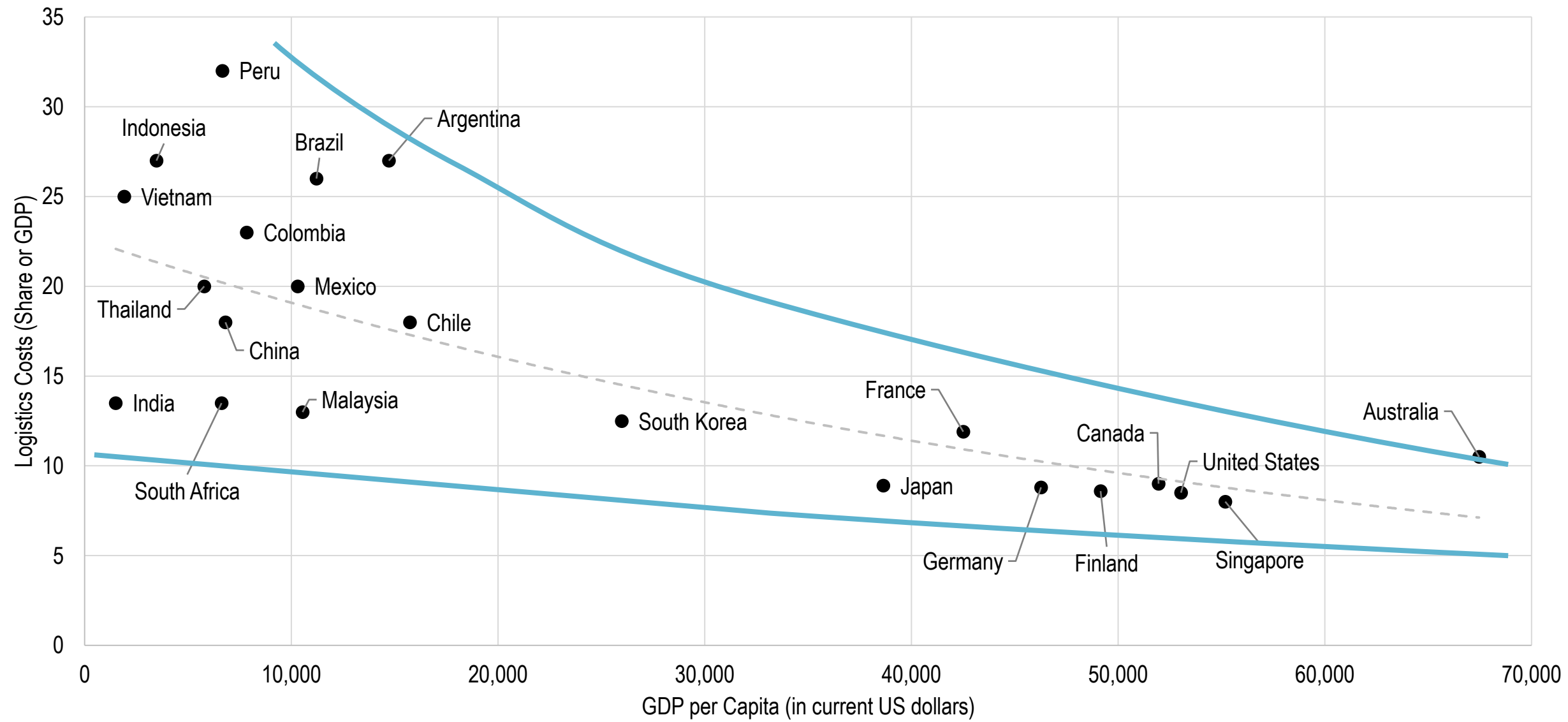
- Production, transport and distribution capabilities to strategies.
- Usage of third-party logistics providers.



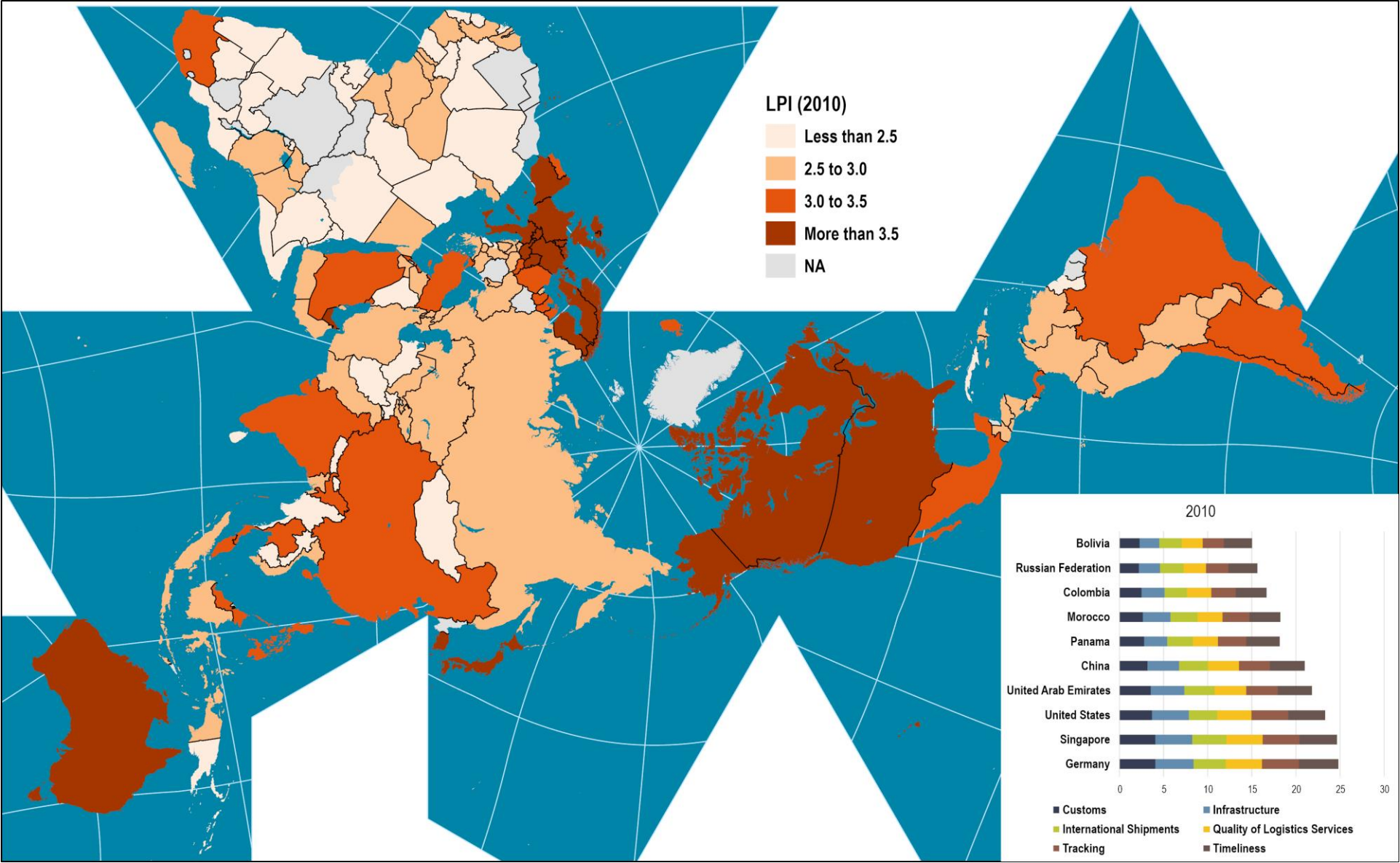
# Total Logistics Costs Tradeoff



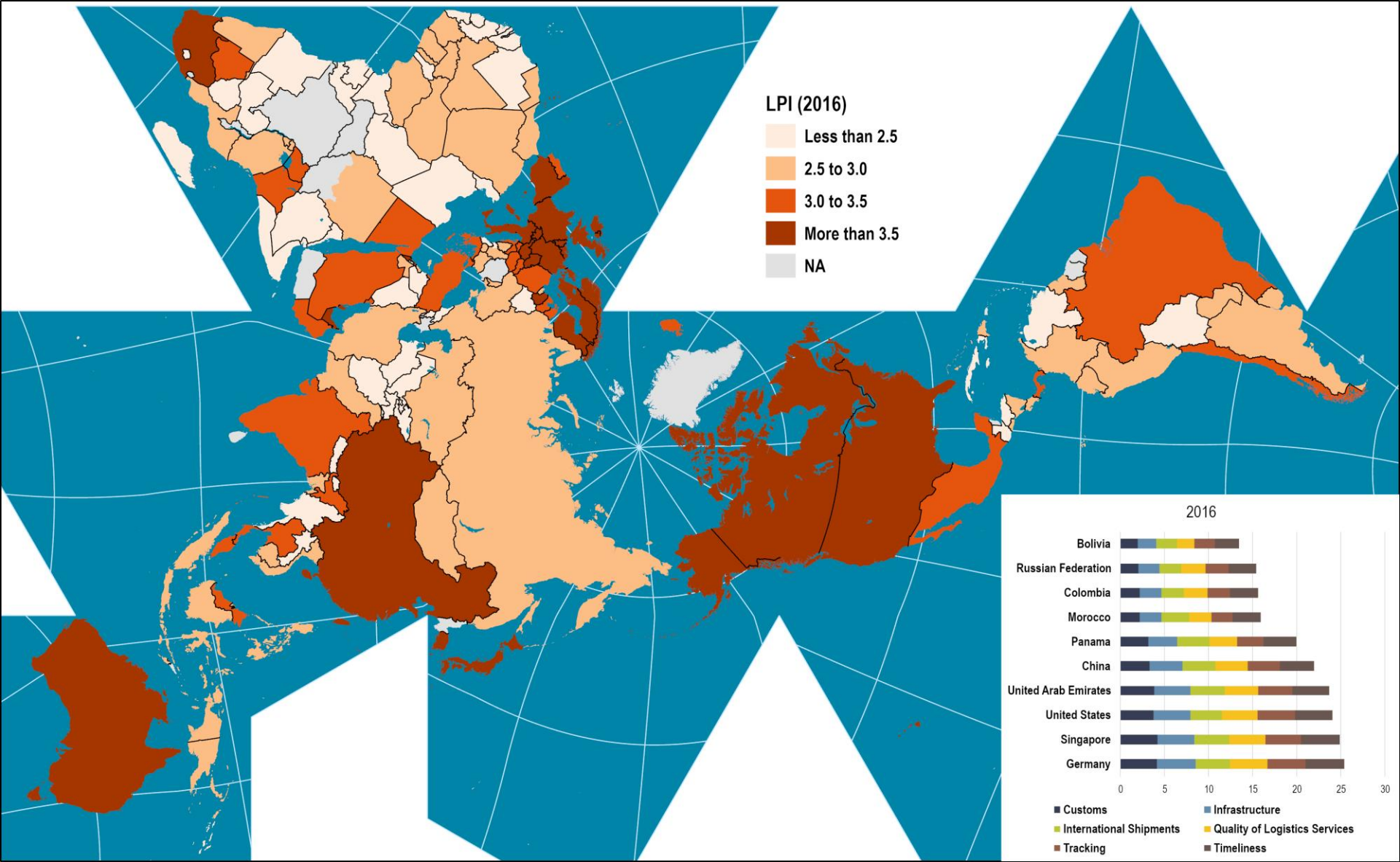
# Logistics Costs and Economic Development



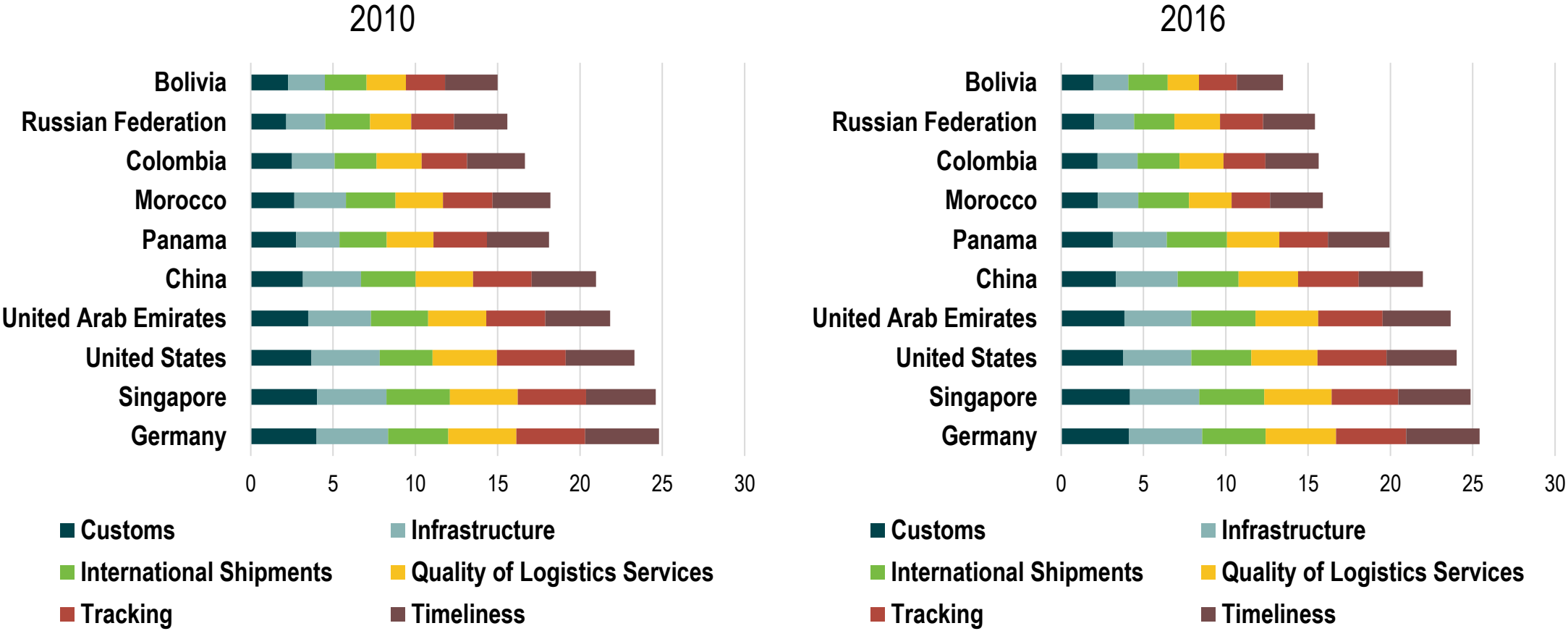
# Logistic Performance Index, 2010



# Logistic Performance Index, 2016

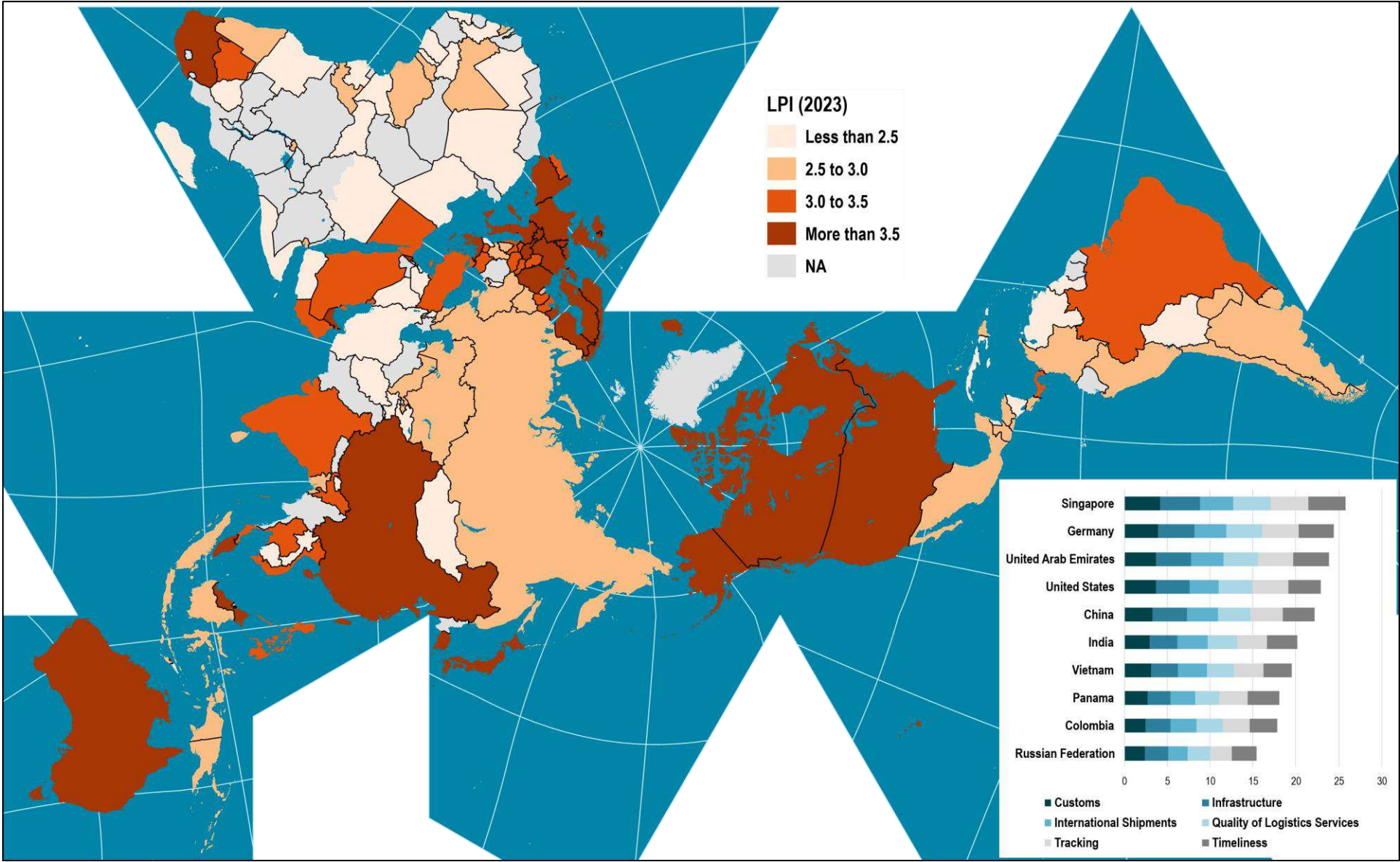


# Composition of the Logistics Performance Index, Selected Countries





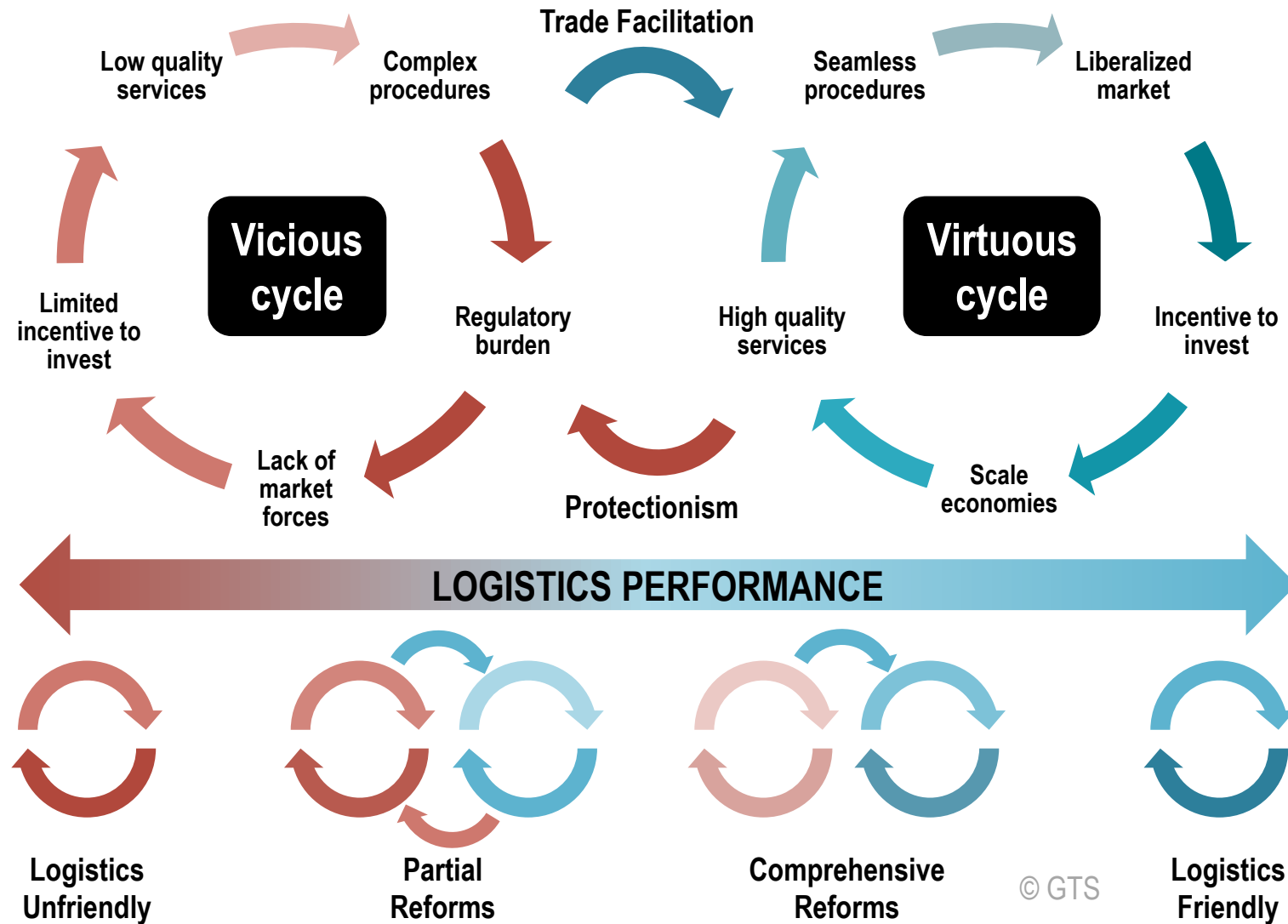
# Logistic Performance Index, 2023



# Composition of the Logistics Performance Index, Selected Countries

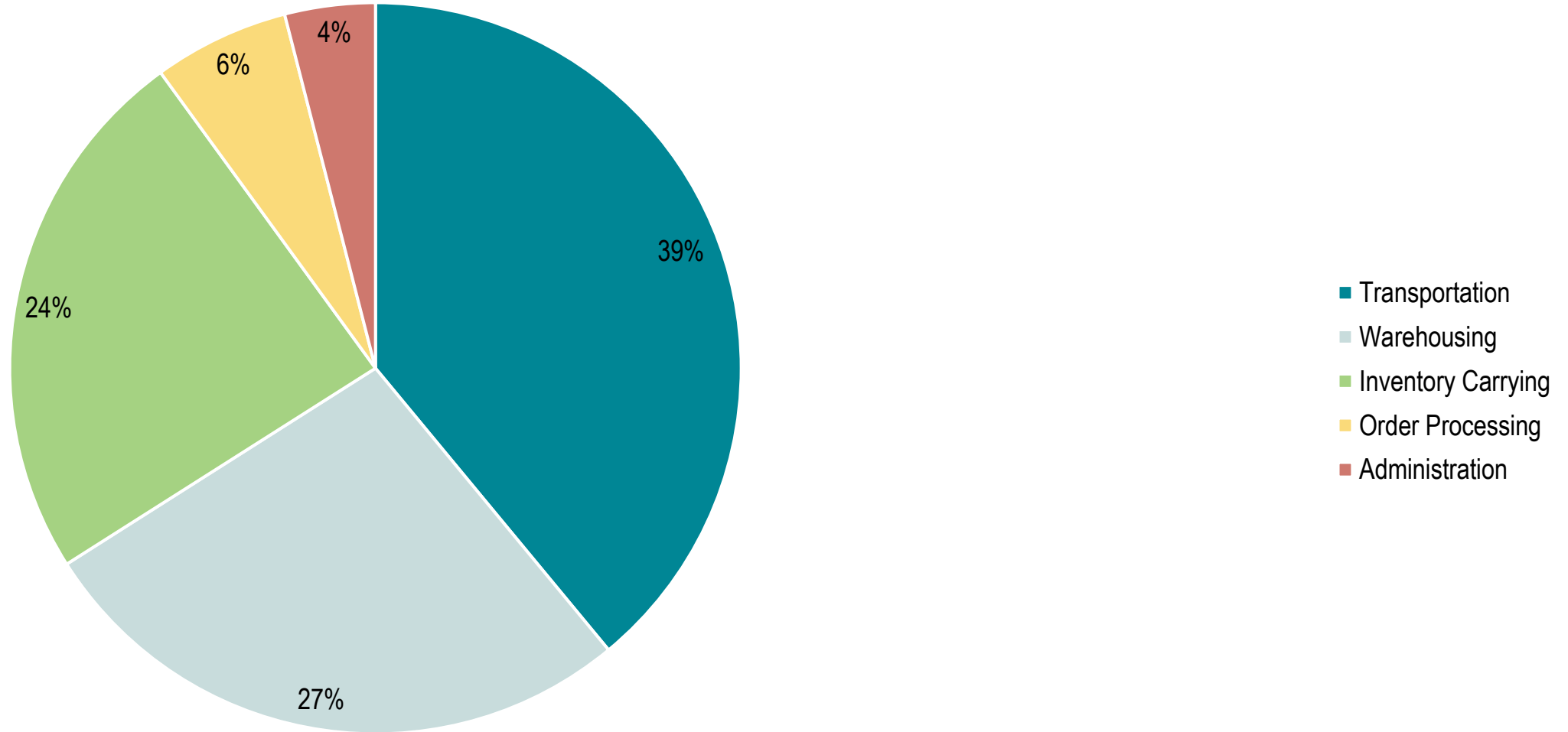


# The Logistics Virtuous and Vicious Cycles

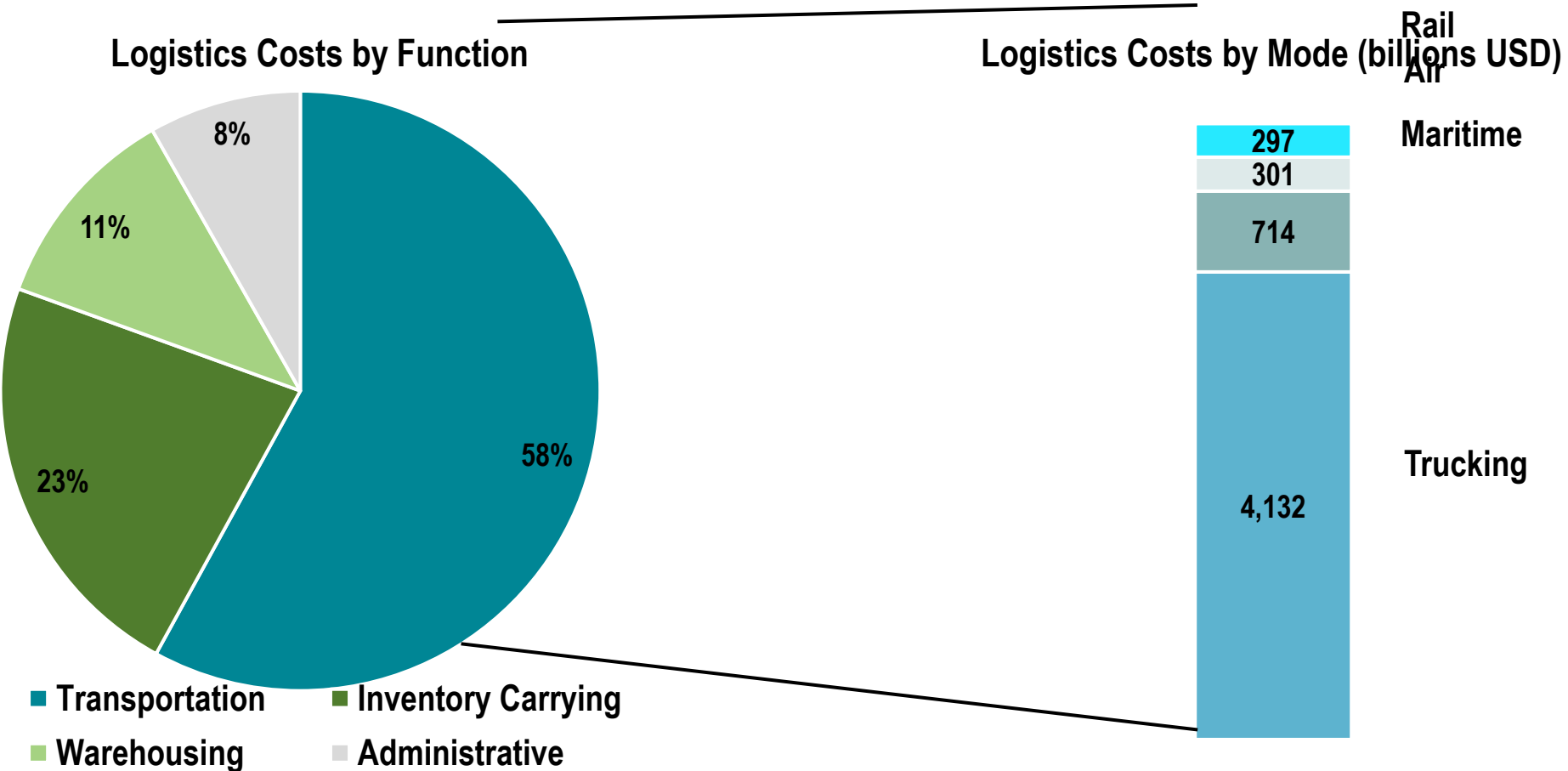




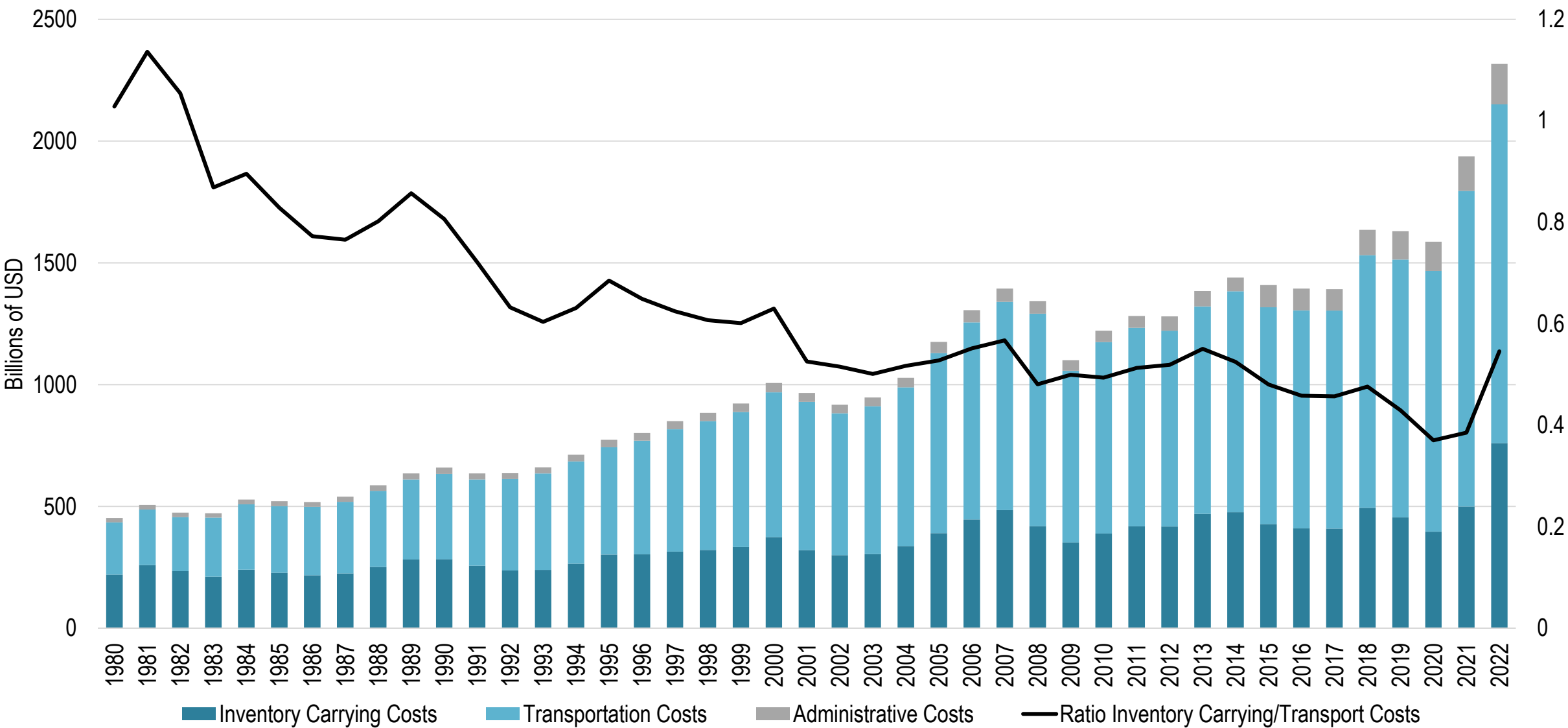
# Worldwide Logistics Costs, 2002



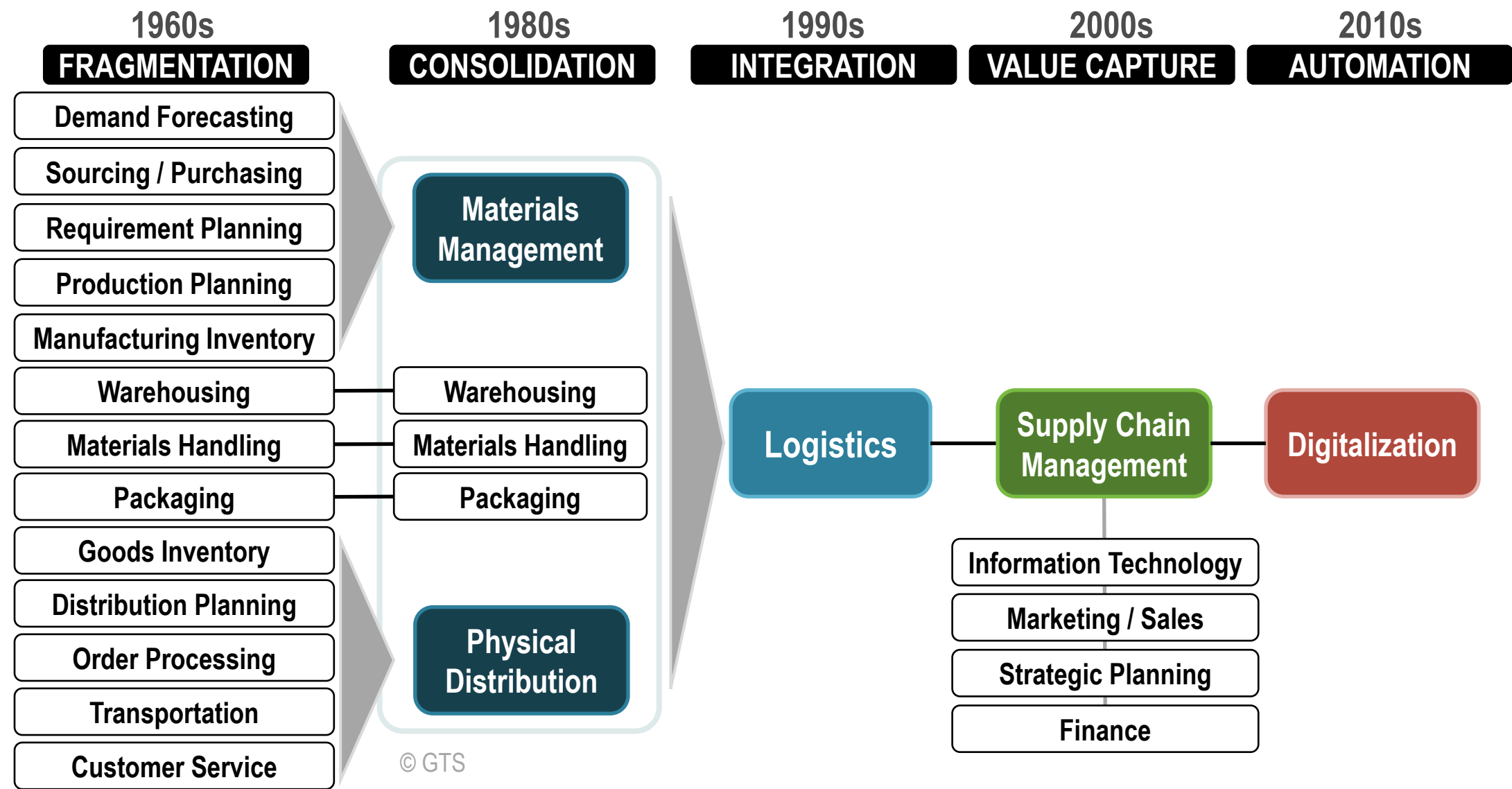
# Global Logistics Costs by Function and Mode, 2018



# Logistics Costs, United States, 1980-2022

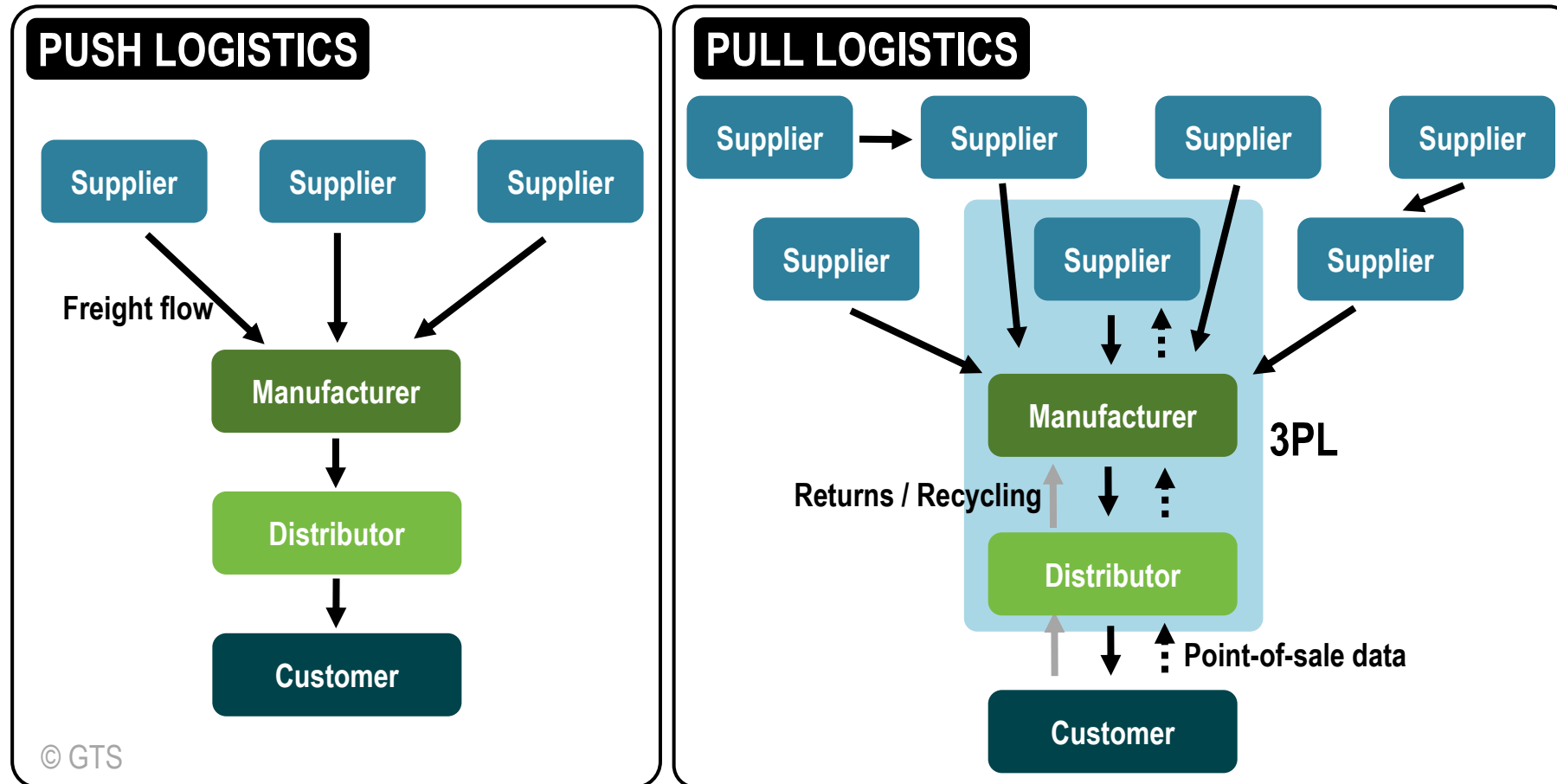


# The Evolution of Logistics



Anticipation Stock • Cycle Stock • Safety Stock • Pipeline Stock •  
Decoupling Stock

# From Push to Pull Logistics



# Warehouses and Distribution Centers



## WAREHOUSE



## Storage

- Supply-driven (storage).
- Buffer related function (inventory holding).
- Inventory stored for weeks or months.
- Cargo ownership usually by supplier / producer.
- Consolidation of cargo.
- Limited added value outside storage.
- Coping with unforeseen demand.

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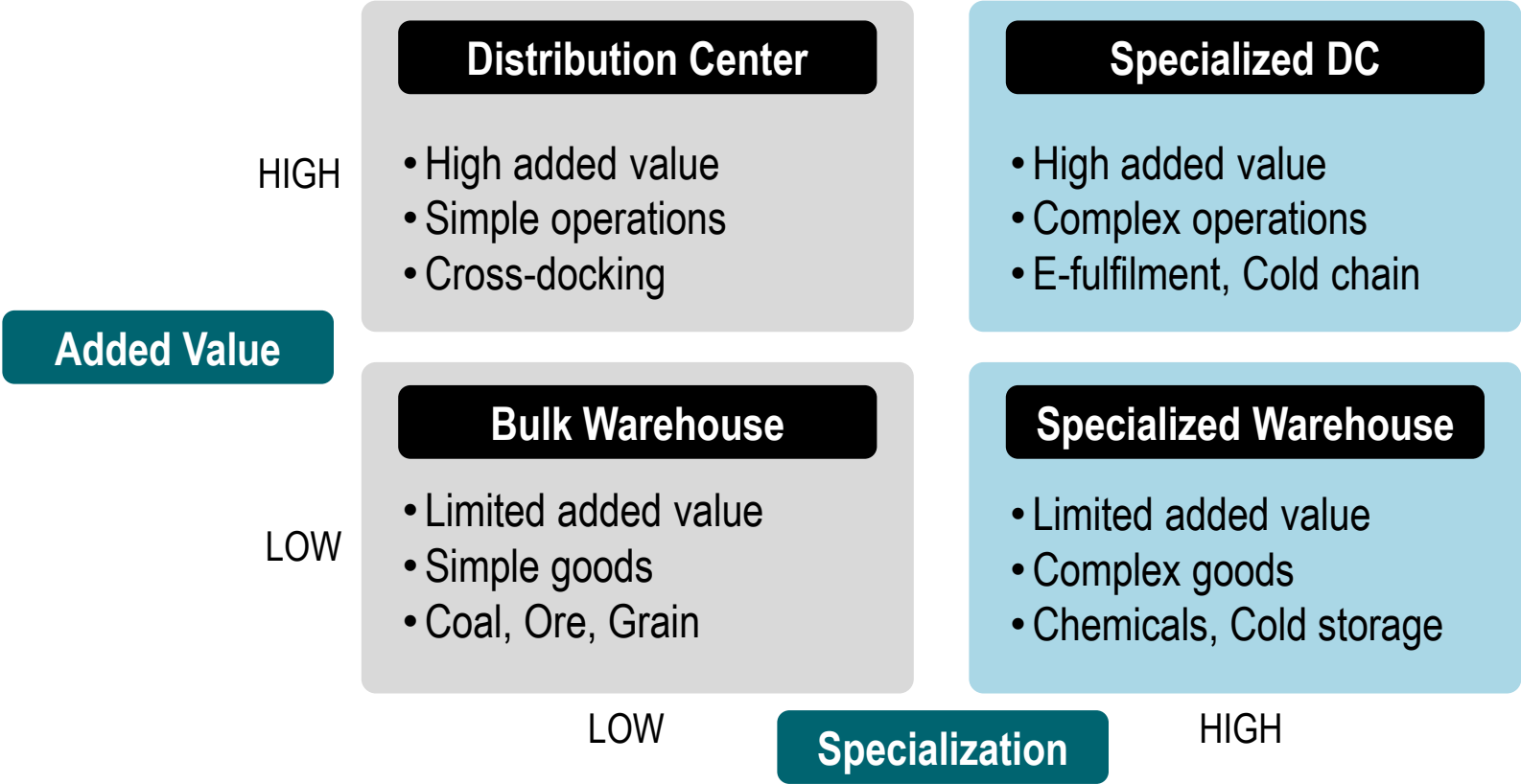
## DISTRIBUTION CENTER



## Throughput

- Demand-driven (throughput).
- Fulfilling orders (processing and fulfillment).
- Inventory stored for days or weeks.
- Cargo ownership usually by distributor/customer.
- Consolidating, deconsolidating, sorting a cargo load or changing the load unit.
- Assembly, packaging and light manufacturing.
- Coping with stable and predictable demand.

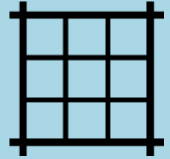
# A Typology of Warehousing





# Advantages of Logistic Zones

## GEOGRAPHICAL ADVANTAGES



### Land

Availability (ownership or zoning).  
Lower acquisition (or renting) costs.  
Preferential taxation.



### Accessibility and Connectivity

Proximity to terminals, suppliers and customers.  
Lower distribution costs (distance).  
Site accessible 24/7.



### Infrastructures

Provision of utilities and roads.  
Leasing of warehousing space and equipment.

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## OPERATIONAL ADVANTAGES



### Planning and Regulations

“Fast track” (construction and operation).  
Incremental development phases.  
Compliance with regulations.  
Foreign trade zone status.



### Economies of Agglomeration

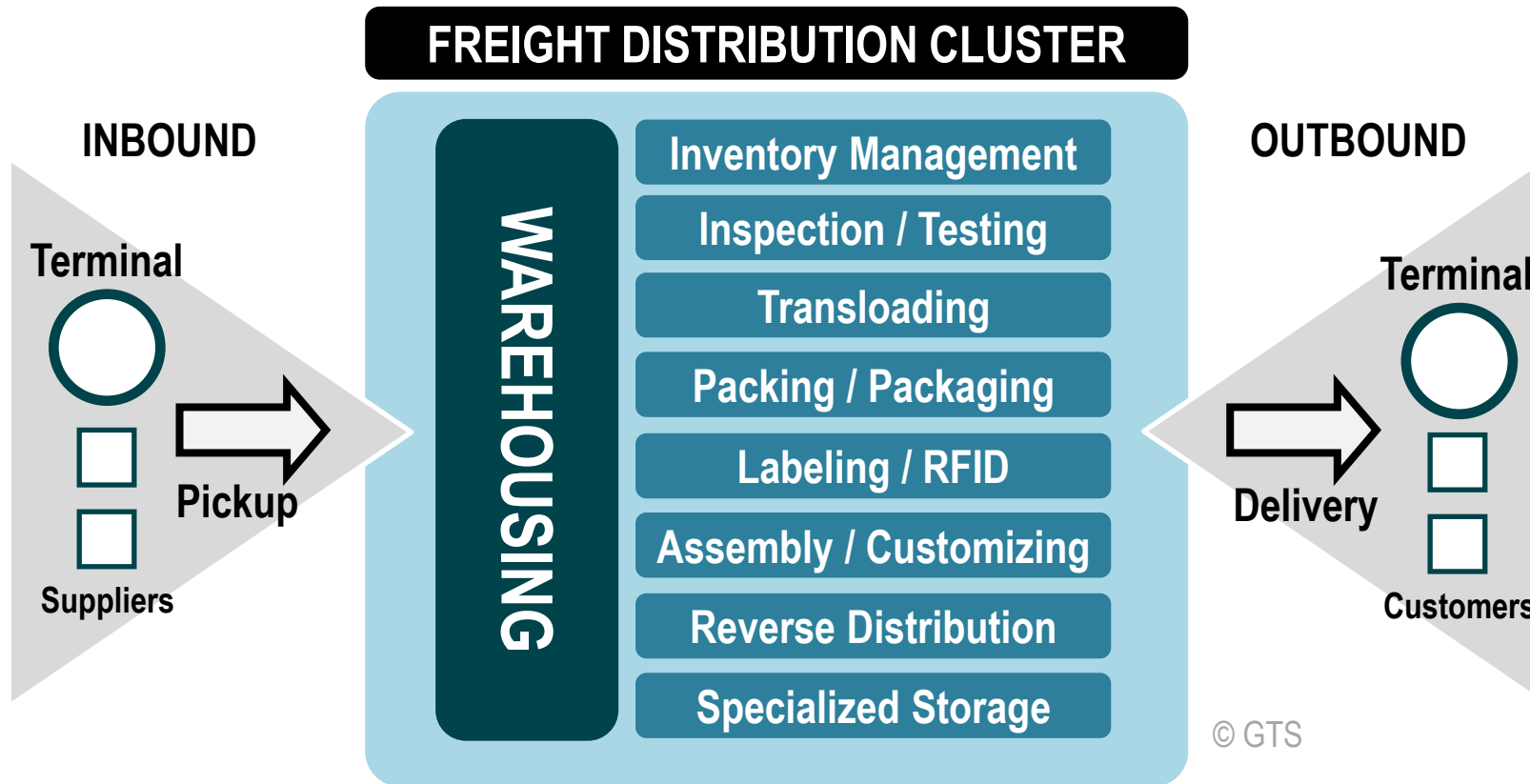
Lower distribution costs (scale).  
More full truck loads.  
Shared services (labor, transloading, telecommunications).



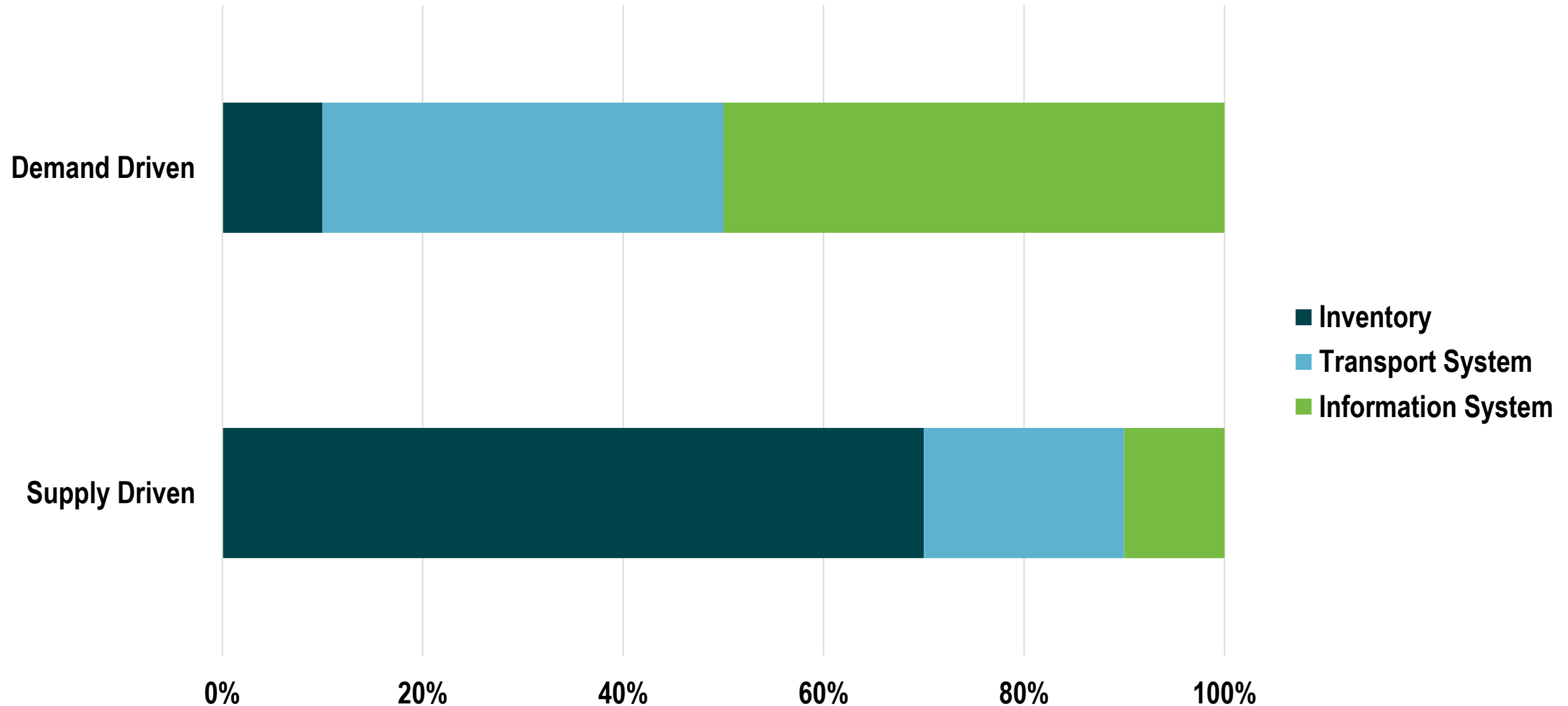
### Multiplying Factors

Anchor tenants (major actors in logistics).  
Diffusion of best practices (managerial, technical).  
Service industries.

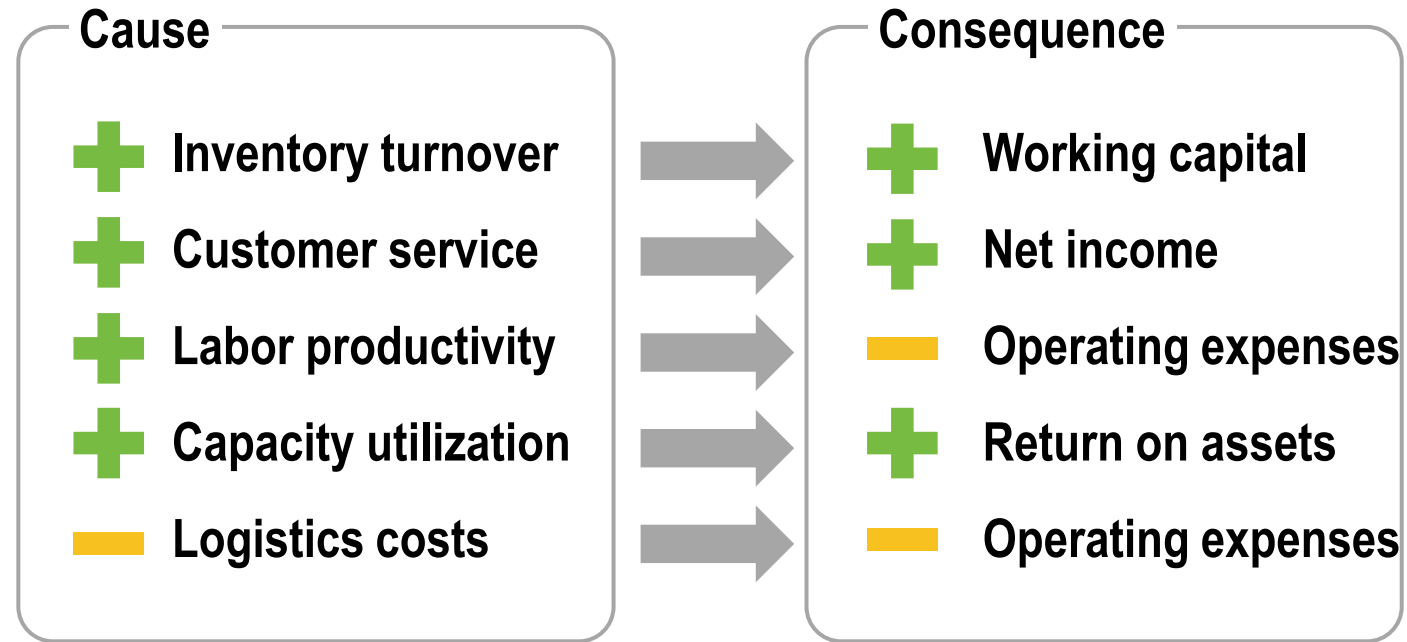
# Value-added Activities Performed at Logistic Zones



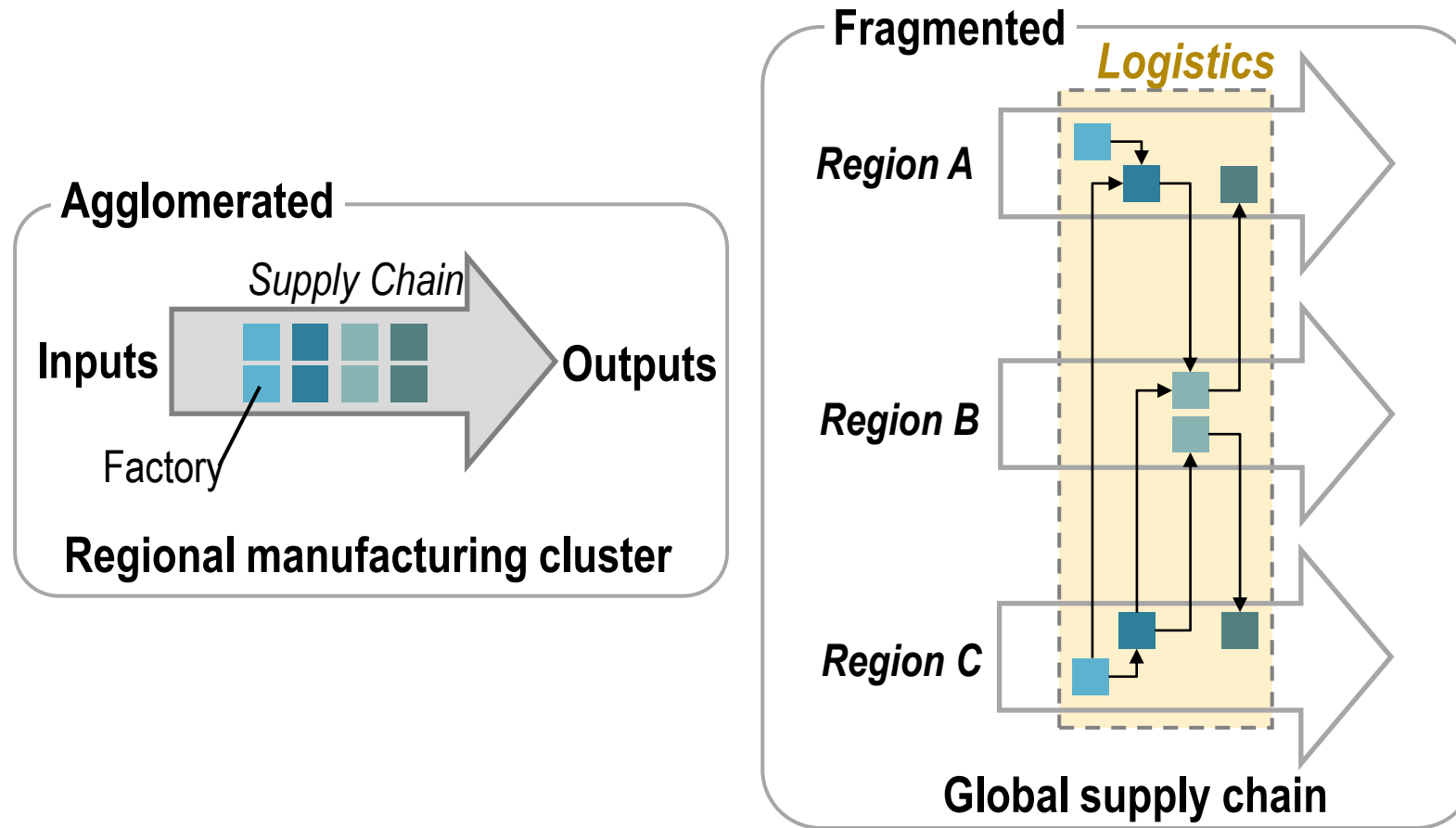
# Changes in the Relative Importance of Logistical Functions in Distribution Systems



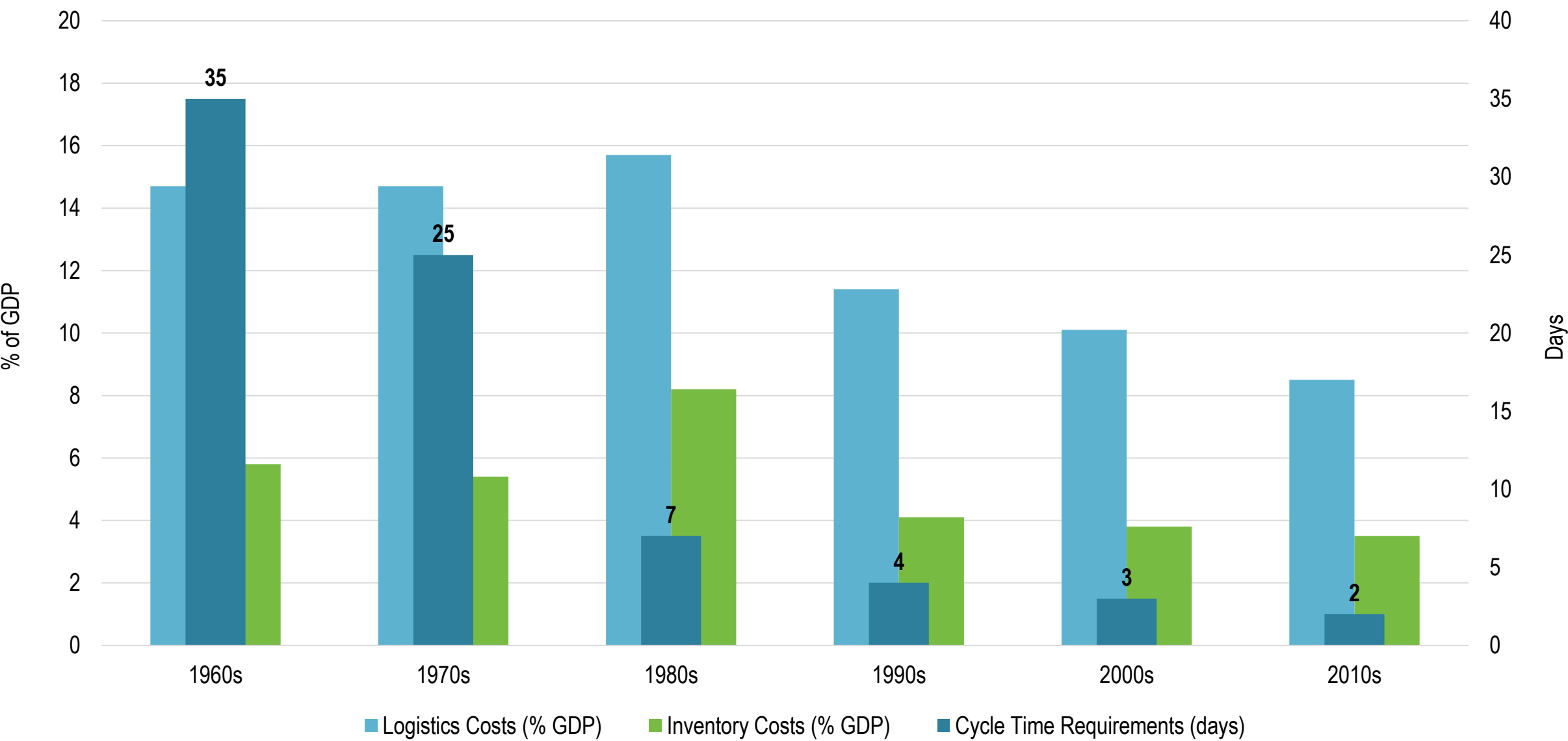
# Benefits of Demand-Driven Supply Systems



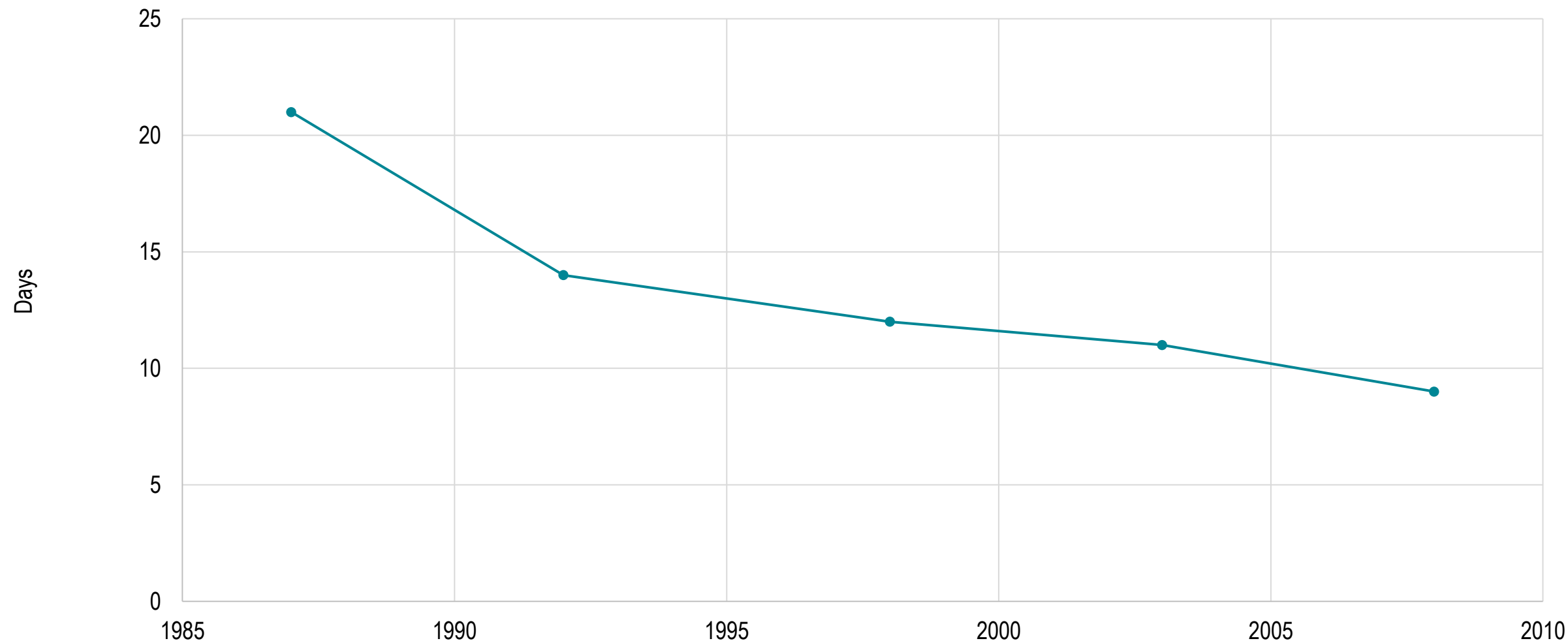
# Fragmentation of the Production System and the Logistics Industry



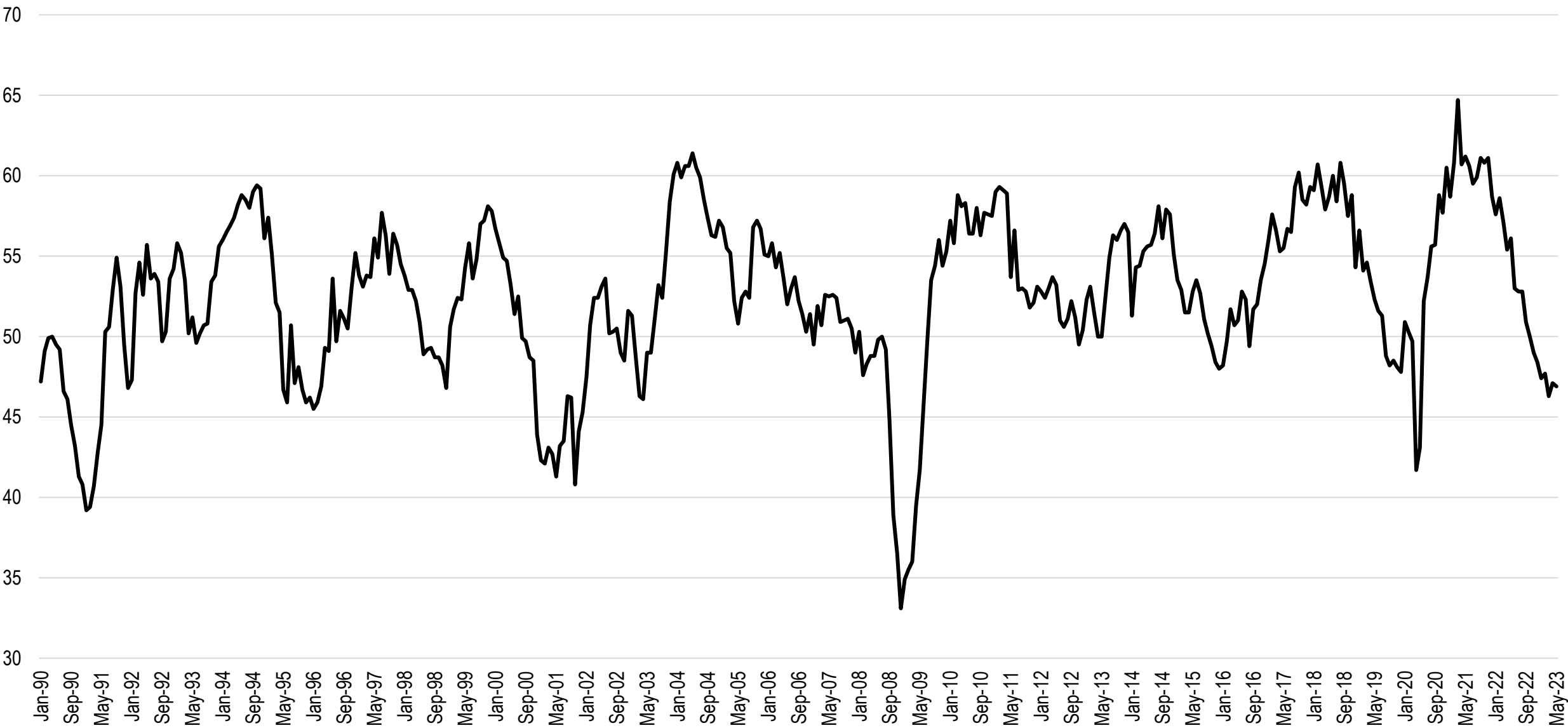
# Logistical Improvements, Manufacturing Sector, 1960s to 2010s



# Average Order Lead Times of European Manufacturers, Wholesalers, and Retailers

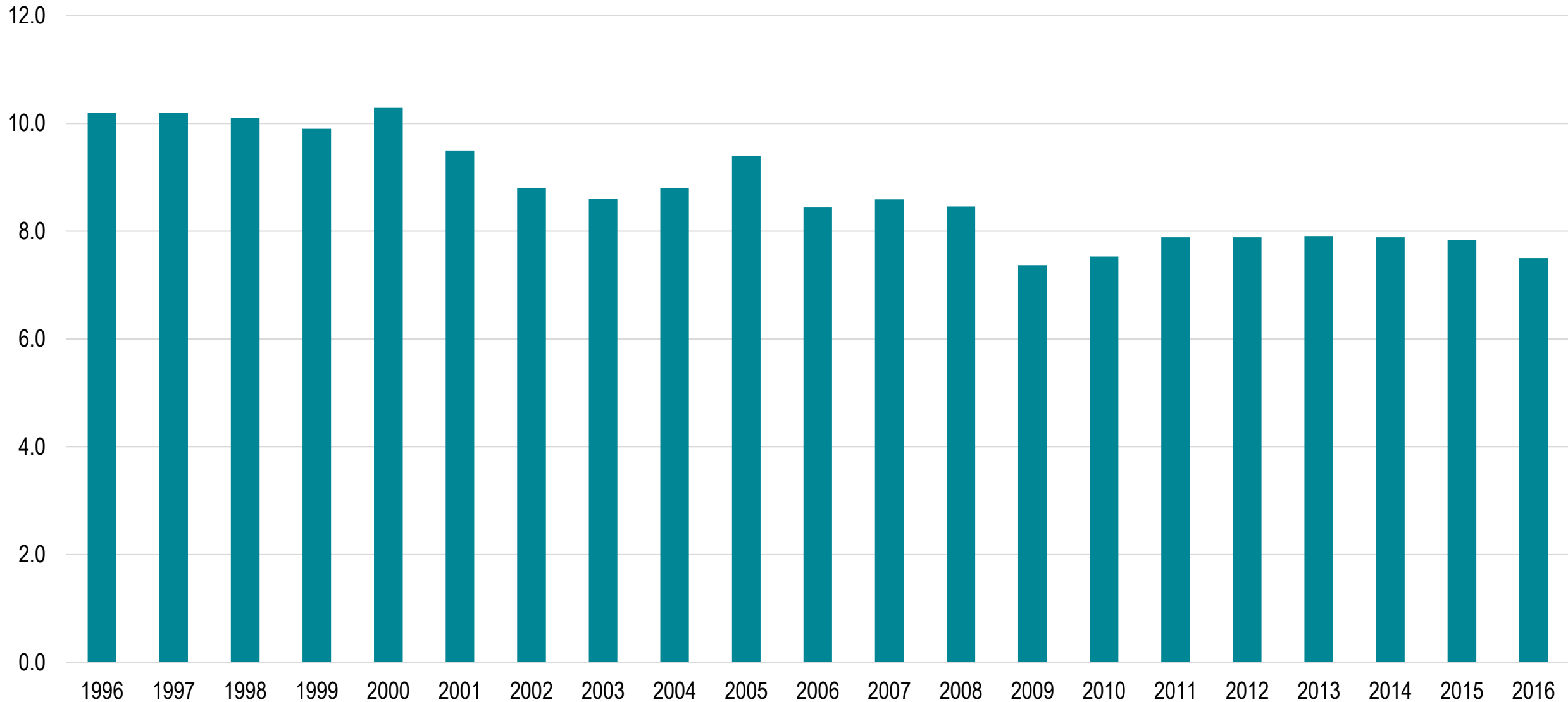


# Purchasing Managers Index, 1990-2023

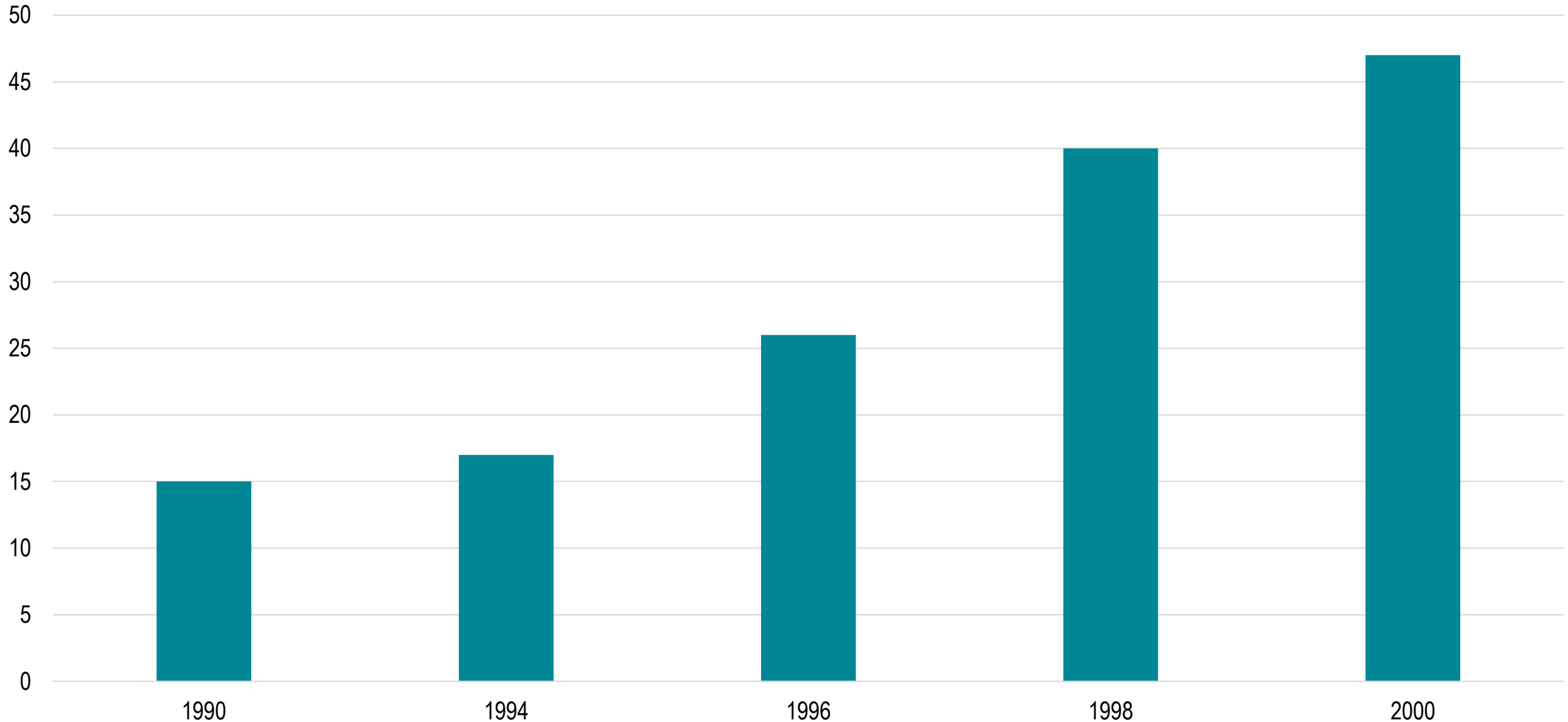




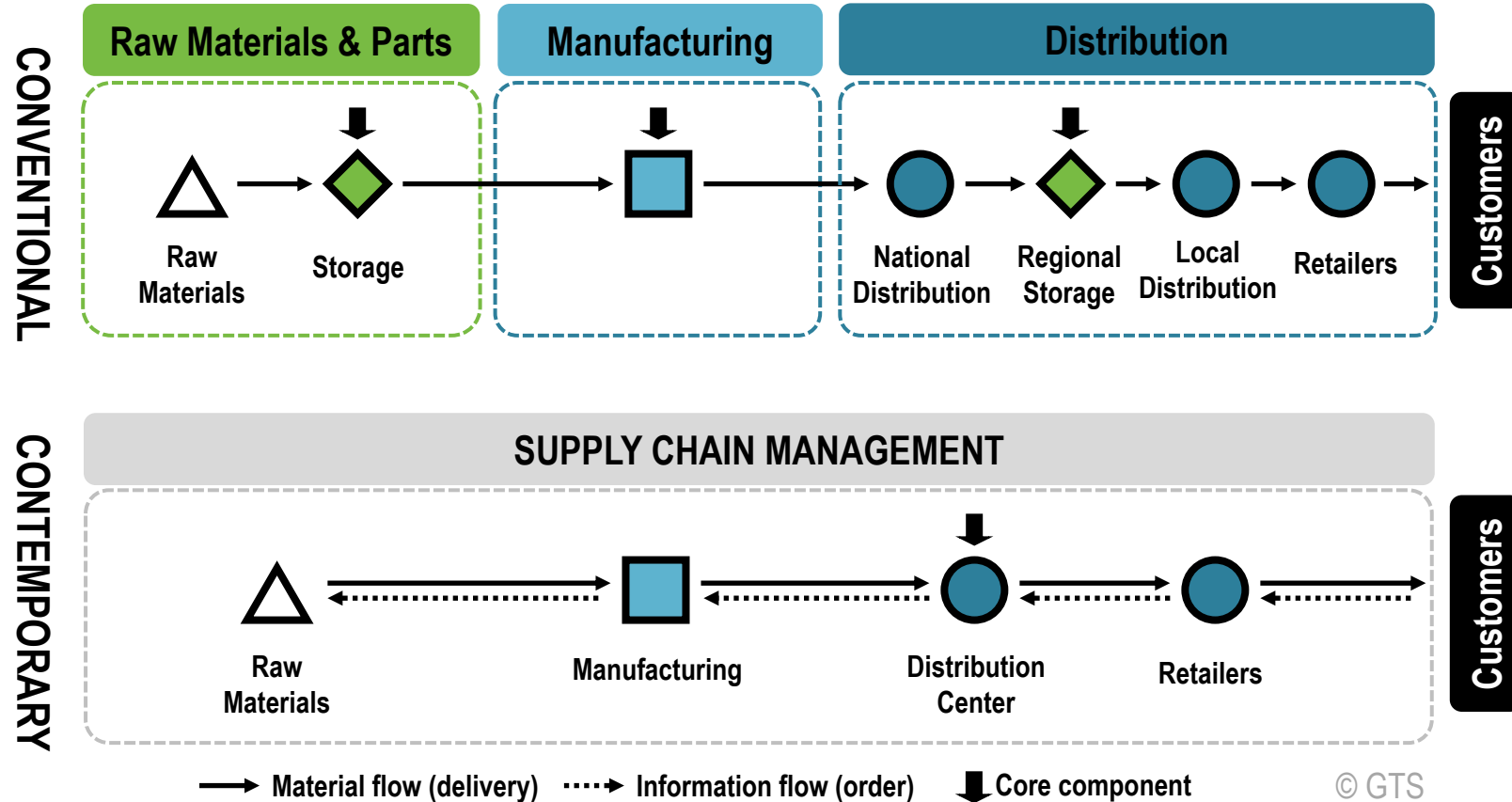
# Logistics Costs as % of GDP



# % of Products Shipped for “Just-in-Time” Manufacturing



# Conventional and Contemporary Arrangement of Freight Flows



# Logistical Activities Related to Containerization

## Container Management



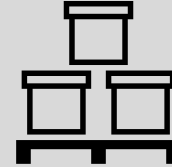
- Broking/Leasing.
- Inventory management.
- Transport routing.
- Container tracking.

## Container Transportation



- Maritime shipping (Routing, Scheduling).
- Terminal operations (Transshipment, Storage/Stacking, Gate access).
- Inland transportation (Rail operations, Drayage, Repositioning).

## Cargo Handling



- Loading (Packing, Palletizing and Bundling).
- Transloading (Re-bundling).
- Unloading (Unbundling, de-palletizing and Unpacking).

## Container Maintenance



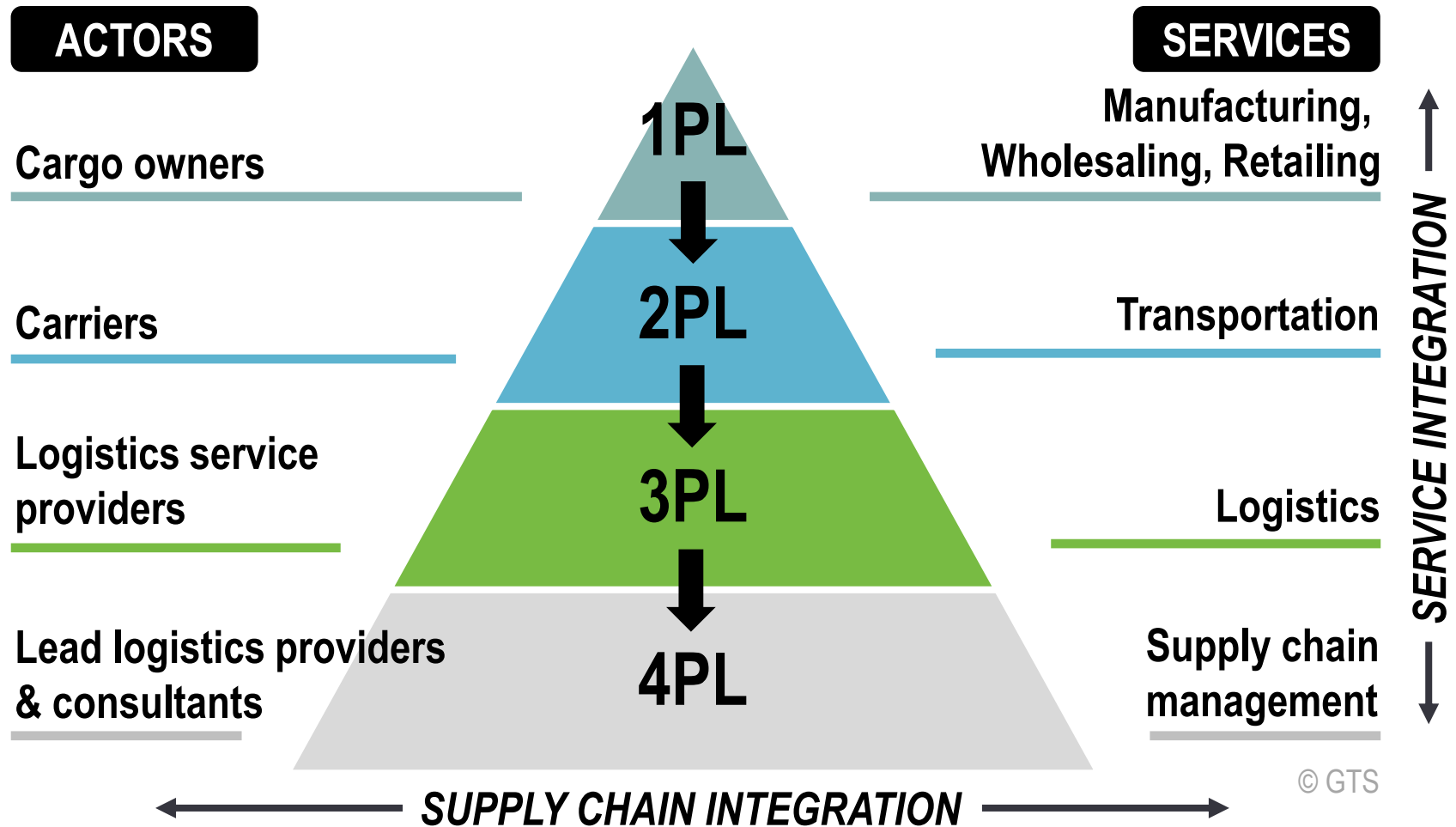
- Empty stacking.
- Inspection.
- Cleaning & Repair.

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# Main Actors of the Logistics Chain



# Layers to Logistics Services



# Key Drivers for Third- and Fourth-Party Logistics Providers

## GLOBALIZATION



Supply chains and manufacturing increasingly global, requiring greater management of supply chains.

## INNOVATION & MANAGEMENT



3PLs becoming increasingly sophisticated in supply chain management, making investments, realizing economies of scale.

## CORE COMPETENCIES



Manufacturers and retailers are focusing on their core business and outsourcing logistics services to specialized firms.

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## ASSET UTILIZATION



3PL model promotes greater asset utilization (e.g. balancing flows, backhaul, within their networks) and asset-sharing alliances.

# Main Core Competencies of Third-Party Logistics Providers





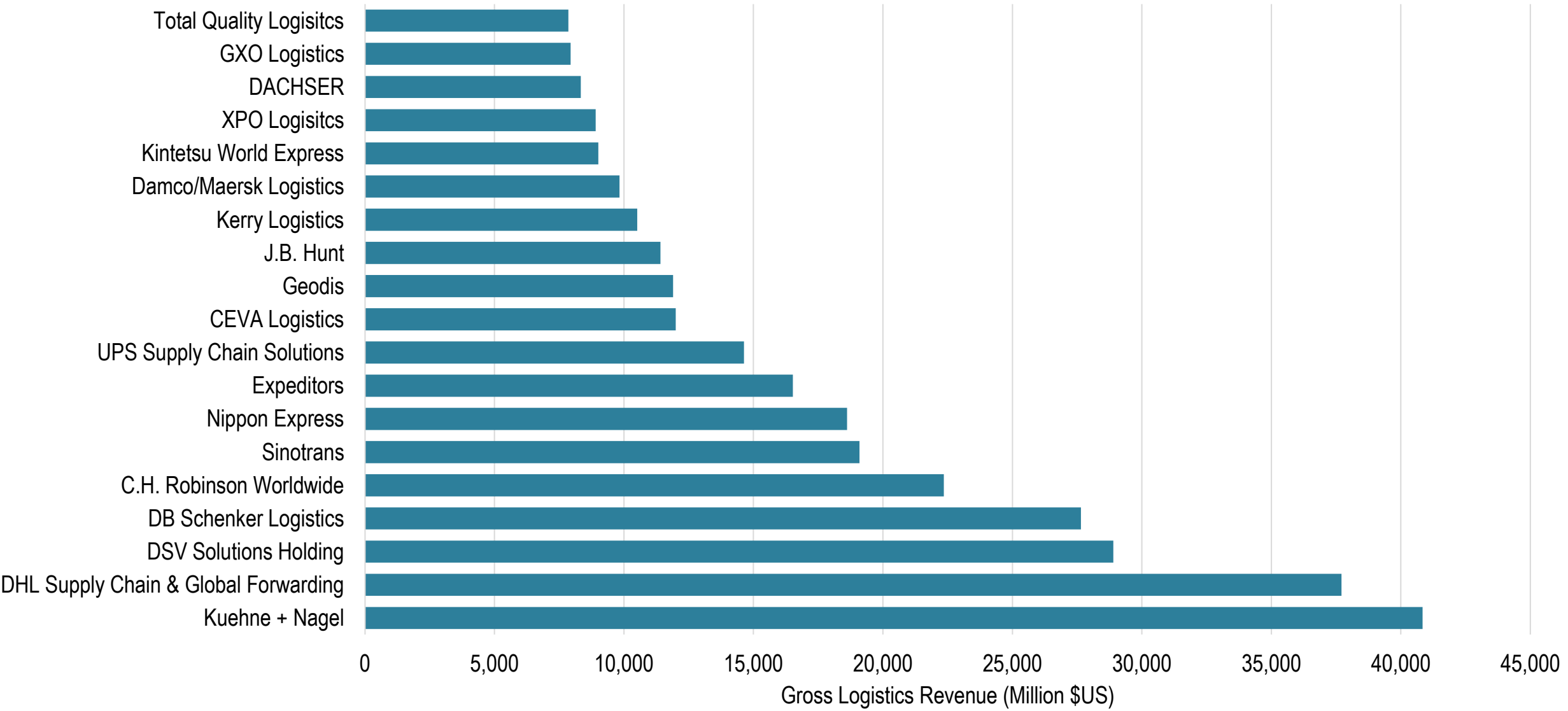
# Services Offered by Third and Fourth Party Logistics Service Providers

3PL ►

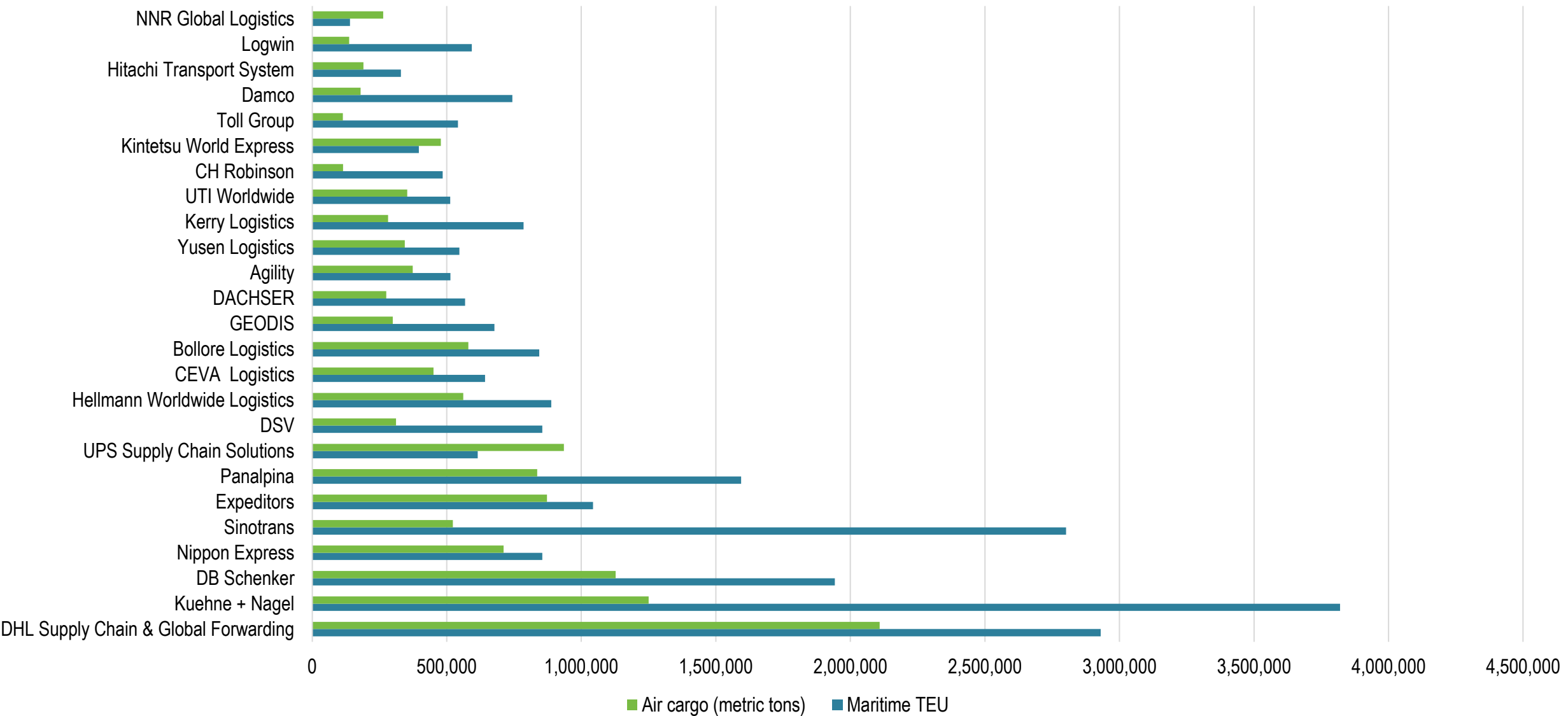
◀ 4PL

Standard	Advanced	Complete	Integrated
Transportation services	Vendor managed inventories	Order planning and processing	Production planning
Carrier selection	Stock accounting	Information and	Global sourcing
Rate negotiation	Customs clearance and	Communications Technologies	Multiple routing options
Fleet management	documentation	(ICT) management	Supply chain consulting
Warehousing	Assembly	Single invoice	Real time supply chain
Cross docking	Packaging and labeling	Landed duty paid cost	monitoring and adjustment
Pick and Pack	Managing product returns	Payment collection	
Distribution (direct to	Financing	Real time inventory updates	
store/home)	Retail delivery, set up and on	Just in Time (JIT) inventory	
Dispatching	site training	management	
Delivery documentation	Inventory tracking		
Shipment consolidation			

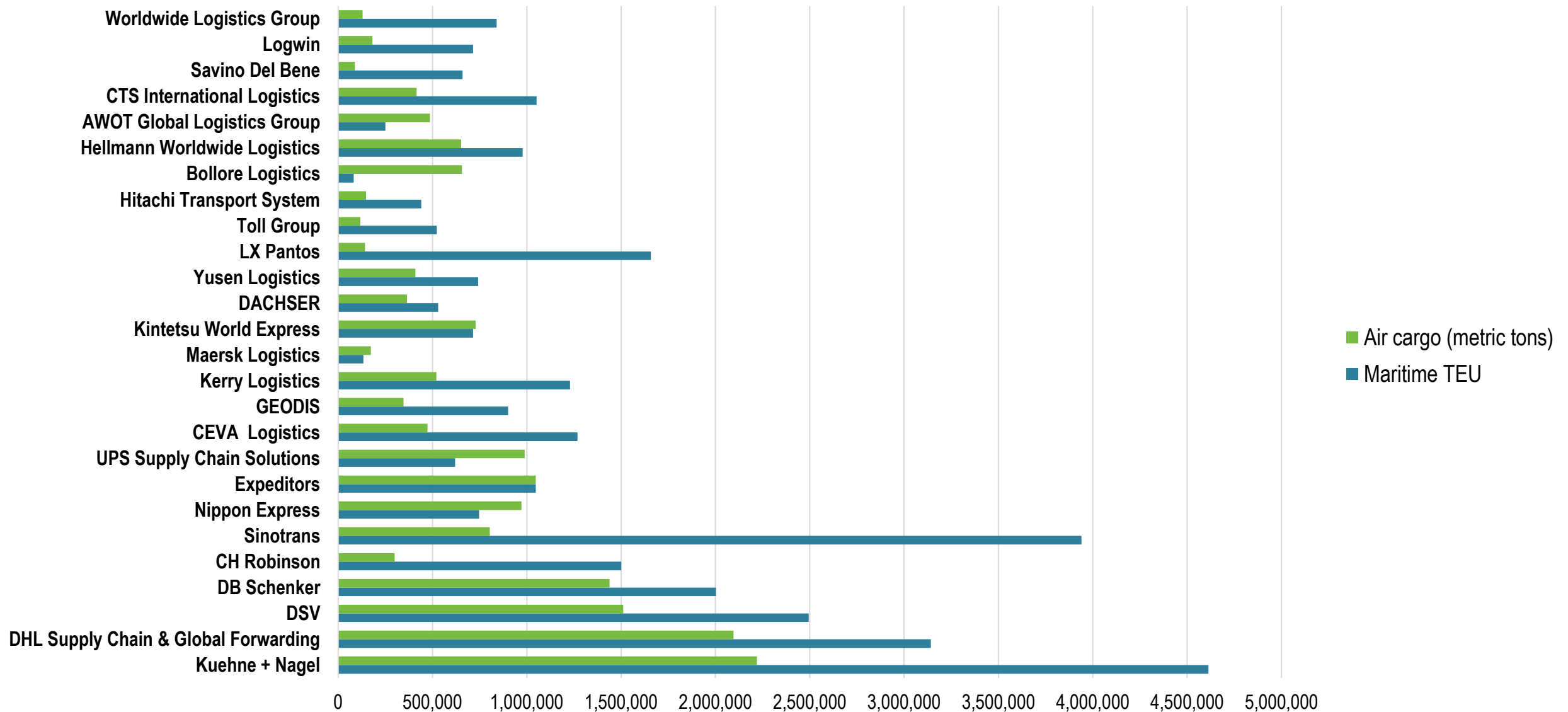
# World's Largest Third-Party Logistics Providers, 2021



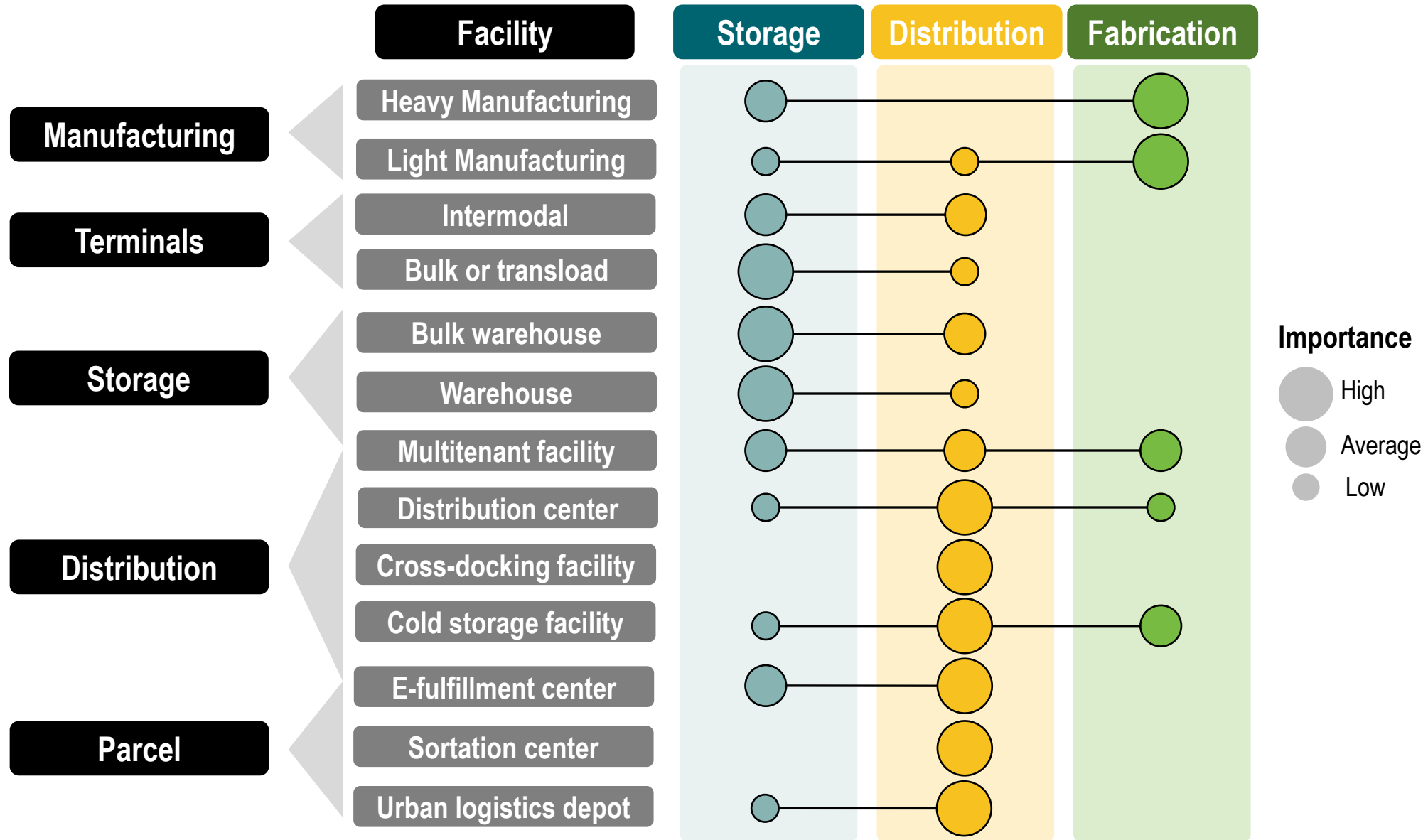
# World's Largest Freight Forwarders, 2015



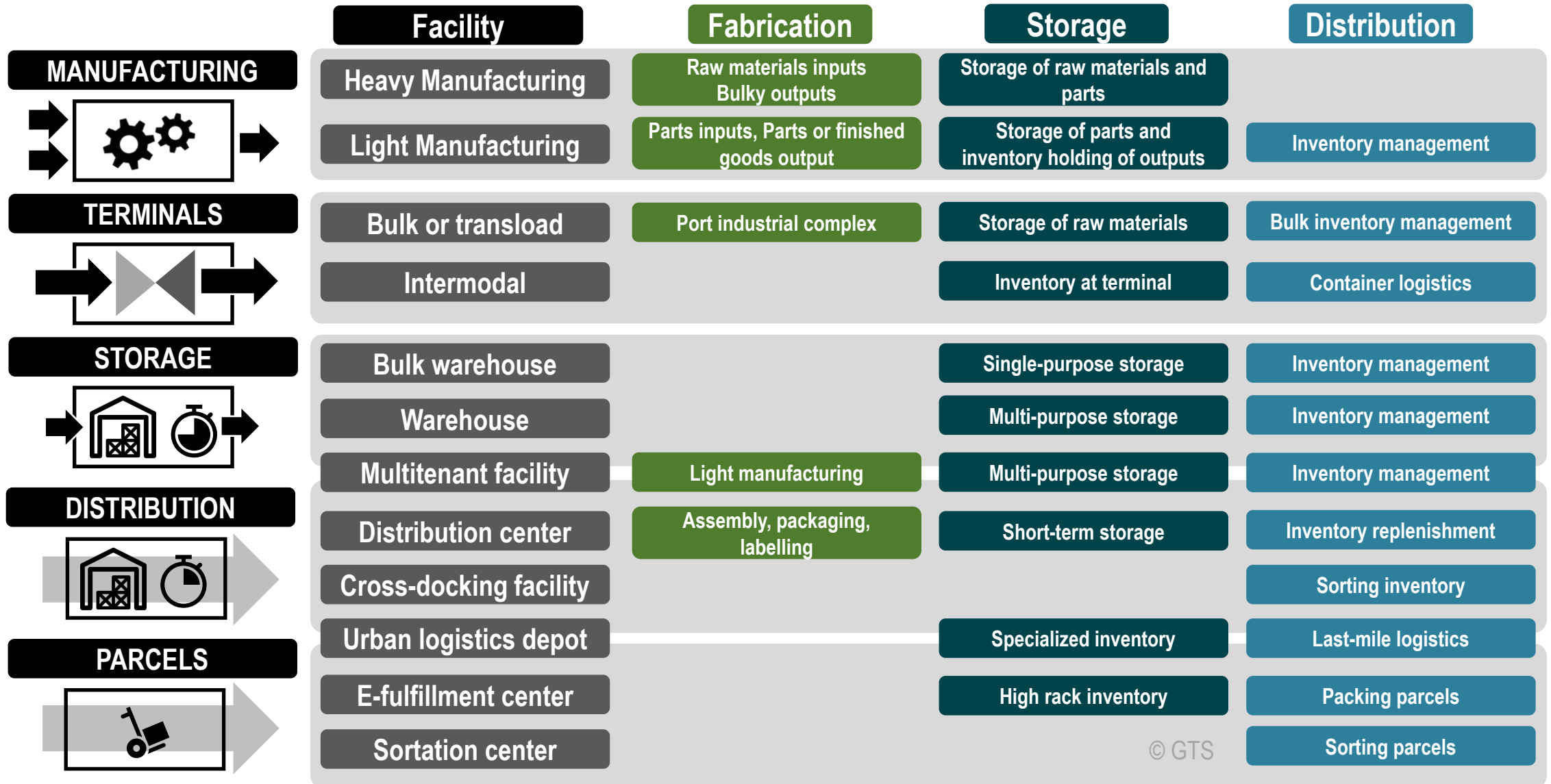
# World's Largest Freight Forwarders, 2021



# Types of Freight Facilities

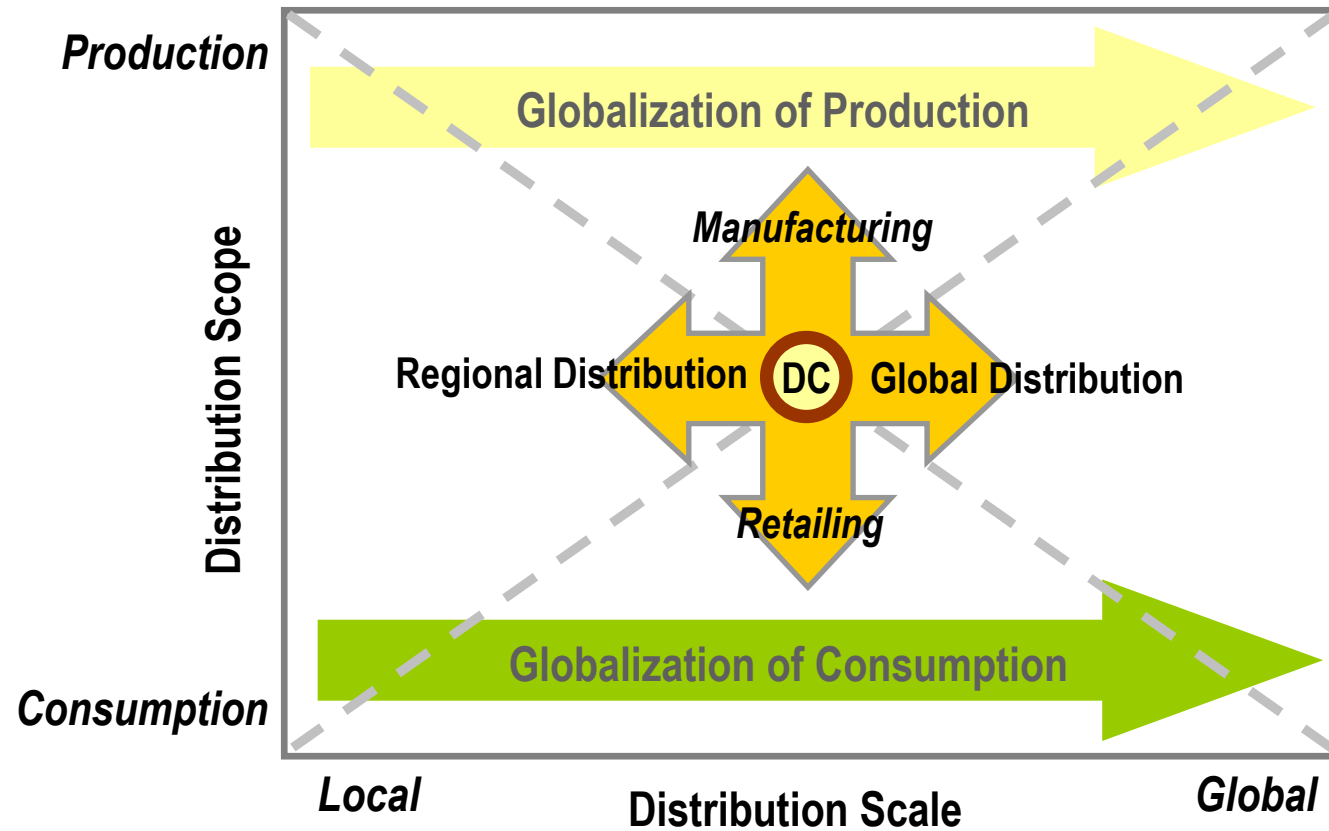


# Types of Freight Facilities

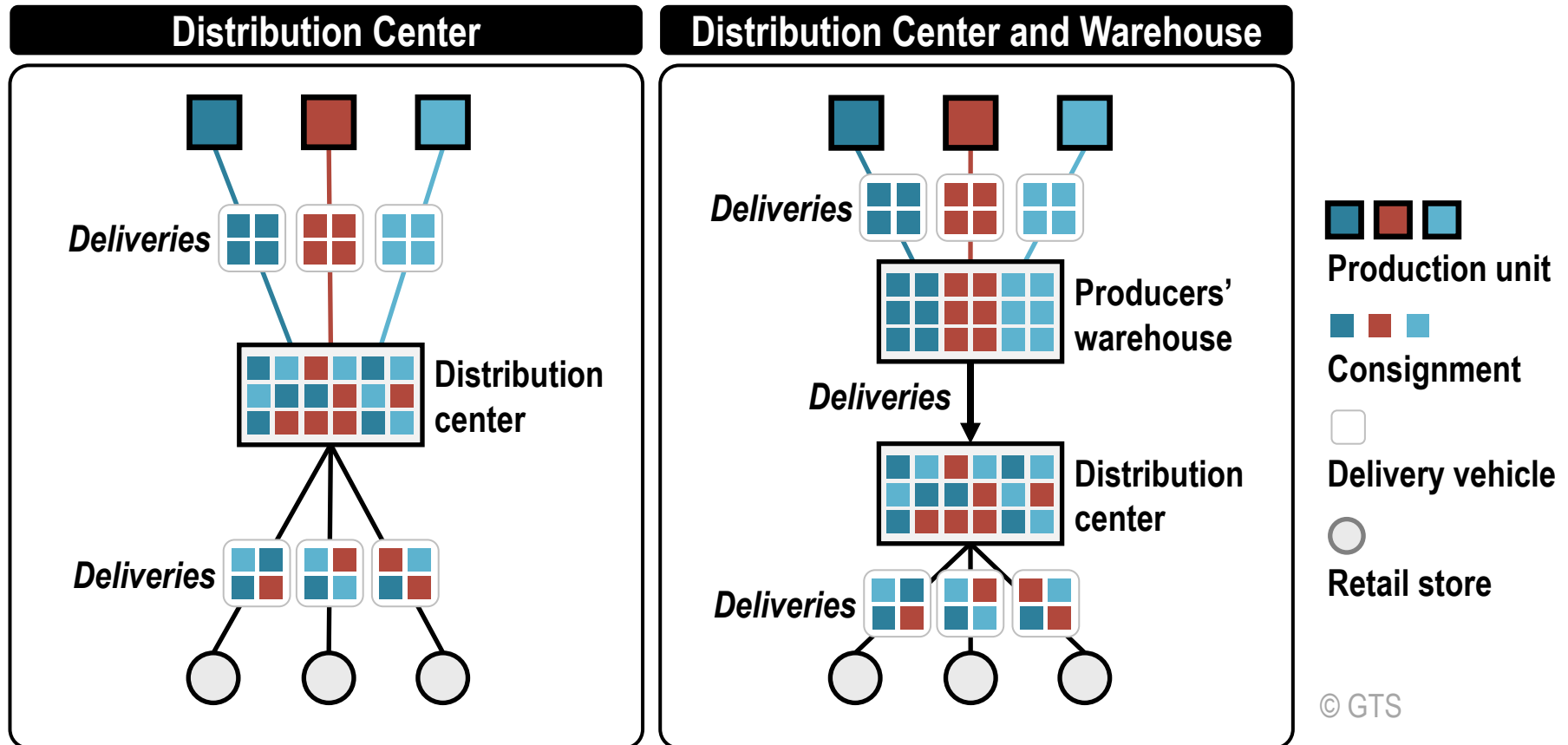


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# Nodes and Freight Distribution

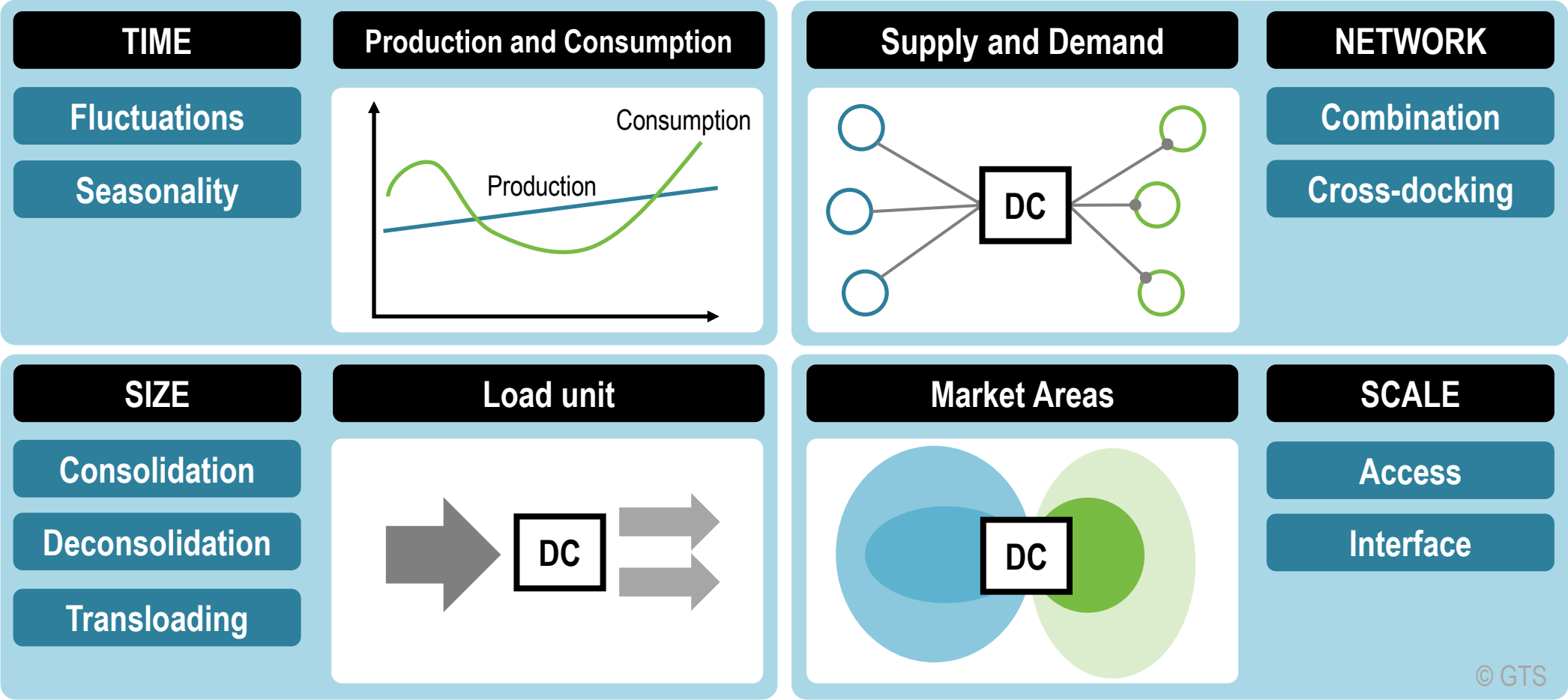


# The Role of Distribution Centers and Warehouses



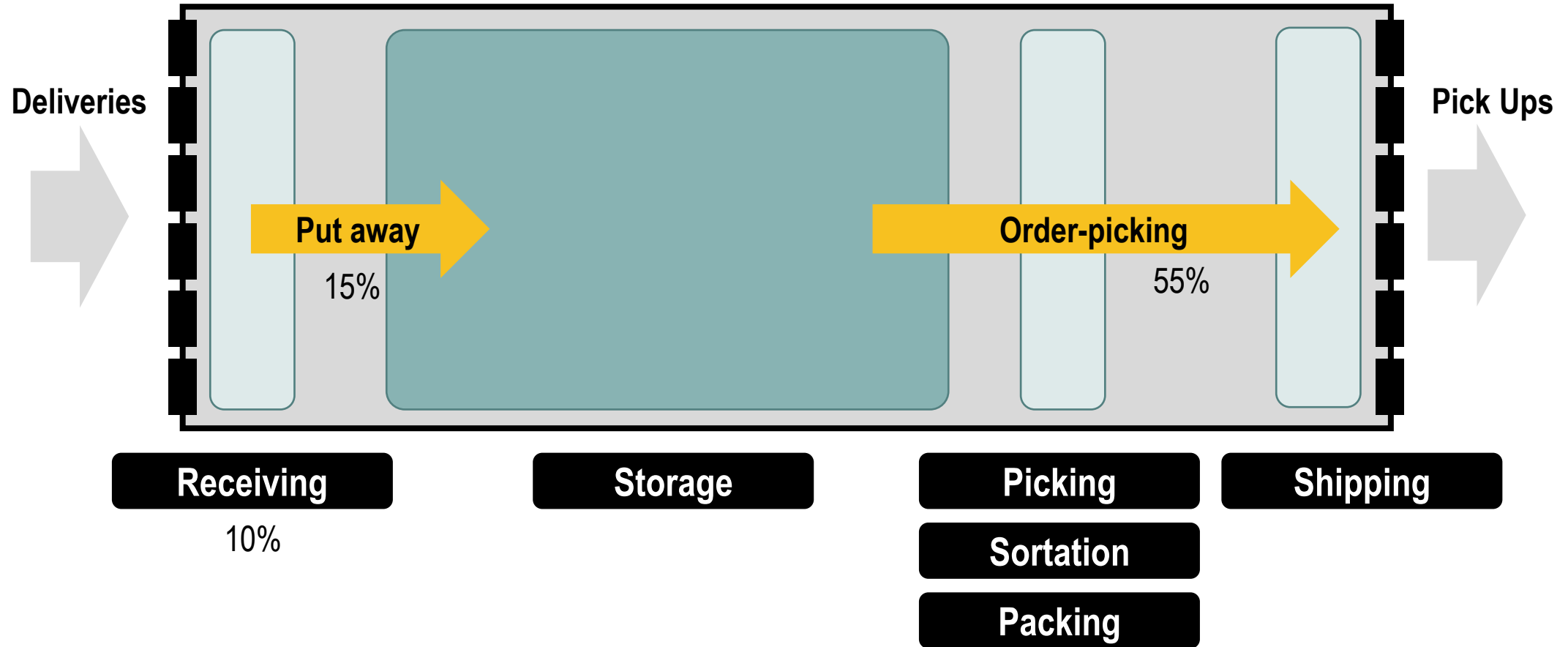


# Asynchronism and Distribution Centers



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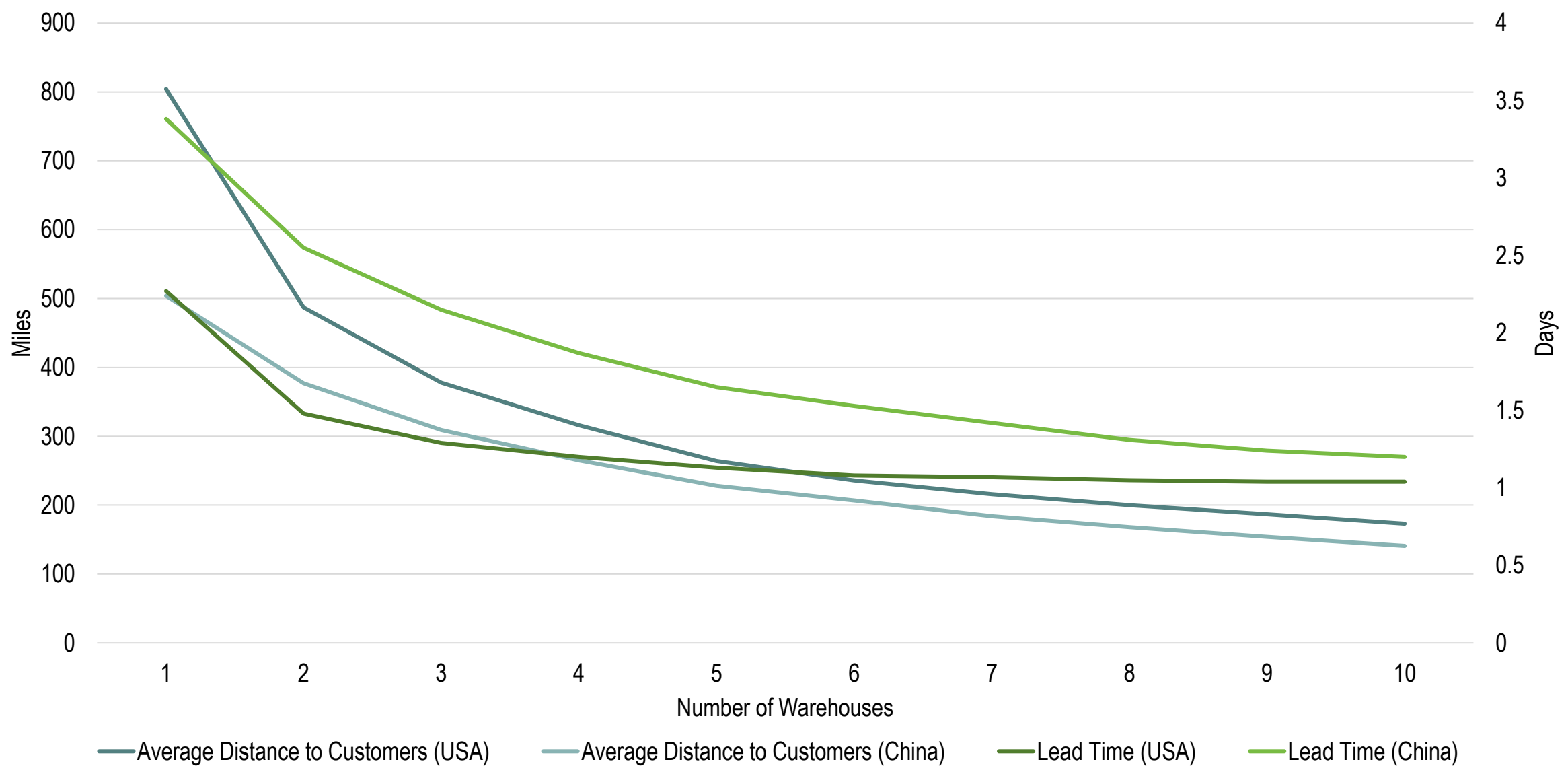
# Main Warehousing Operations



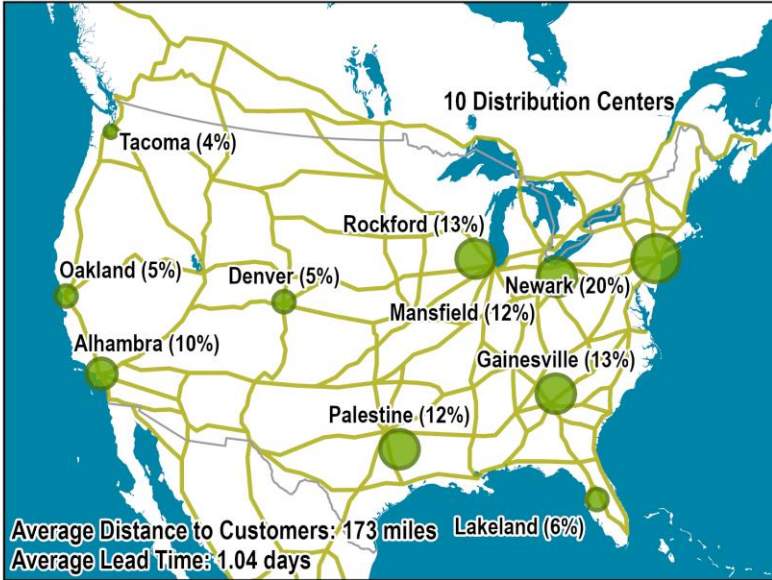
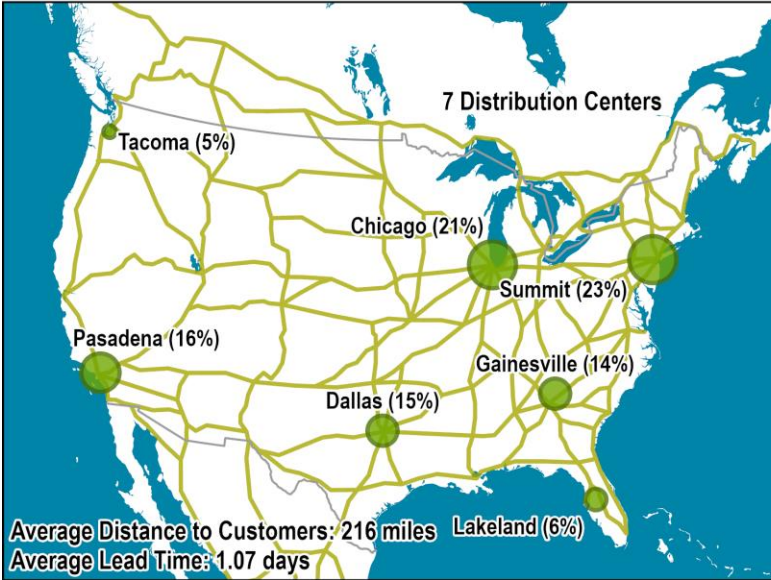
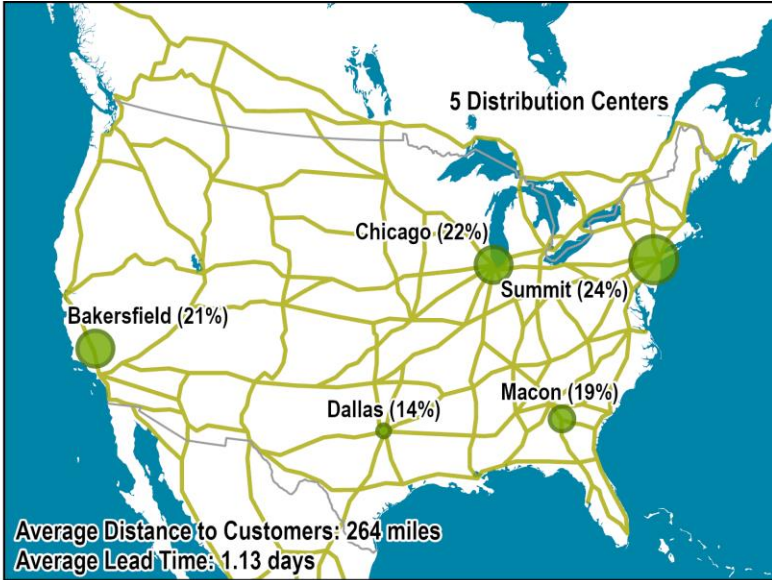
# Location and Design Criteria for Distribution Centers

ATTRIBUTE	DRIVER	
Cost	Price sensitivity	Price per square foot; Operation costs (labor, utilities, taxes).
Footprint	Massification	Large surface; Parking space for trucks; Space for expansion.
Facility	Throughput	High clearance; Separate loading and unloading bays; Improved stacking density (from 20 to 80 feet); Potential for cross-docking.
Connectivity	Co-location	Continuous turnover (pick-up and deliveries often LTL); Access to corridors; Co-location with rail, air and port terminals.
Accessibility	Lead time	Market access; Shorter lead times; Less than 48 hours service window.
Technology	Automation	Sort inventory; Control movements from receiving docks to shipping docks; Management systems controlling transactions.

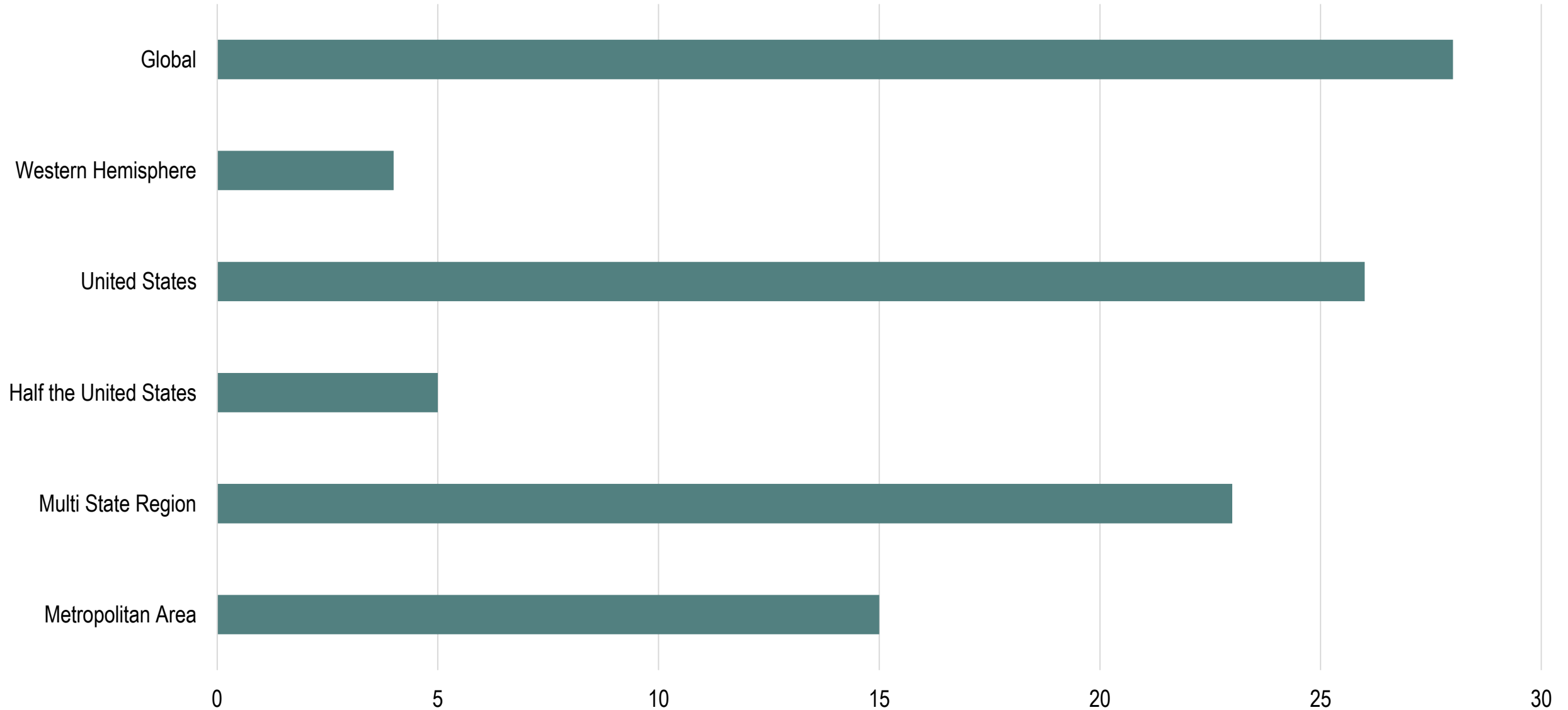
# Basic Operational Characteristics by Number of Warehouses, United States and China, 2009



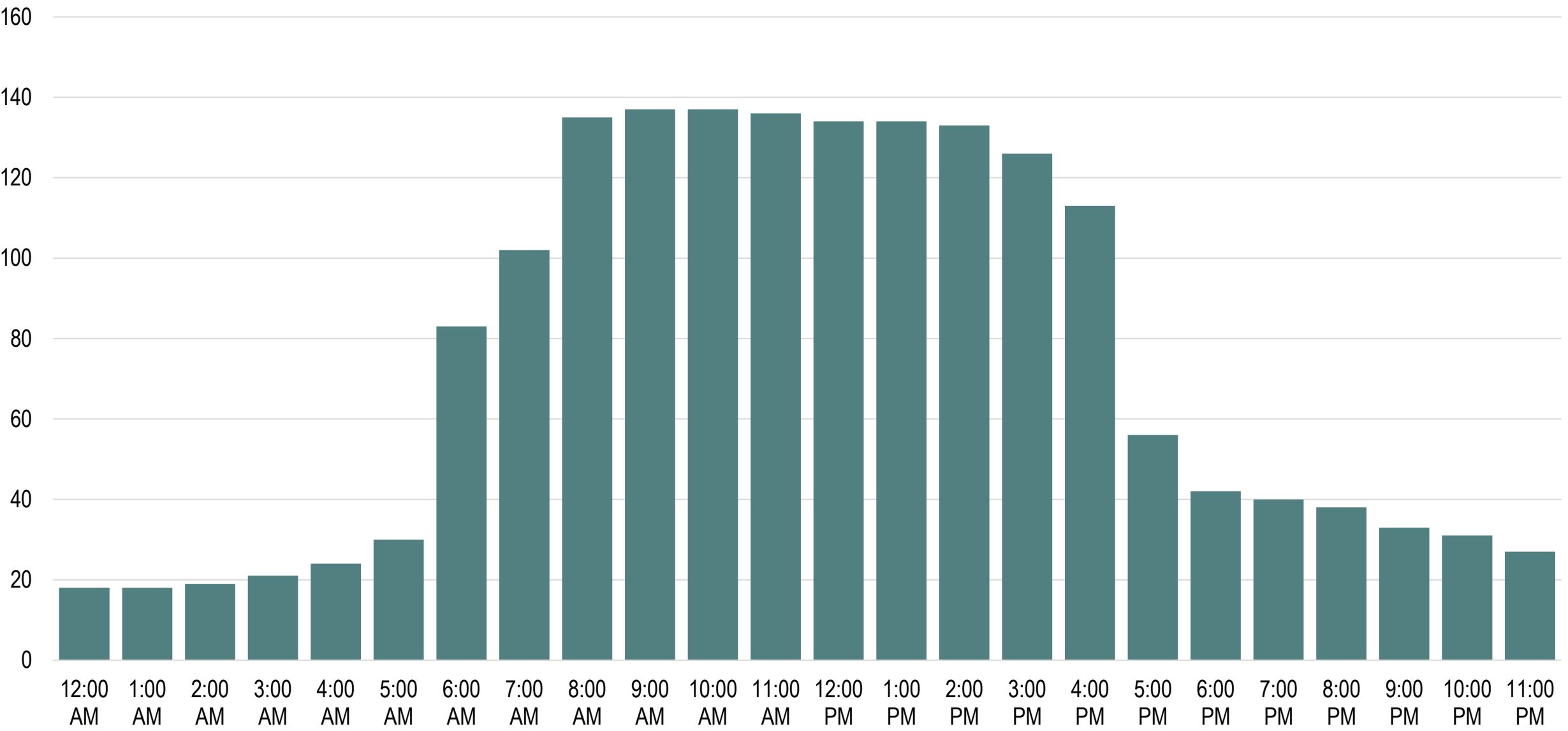
# Optimal Location and Throughput by Number of Freight Distribution Centers



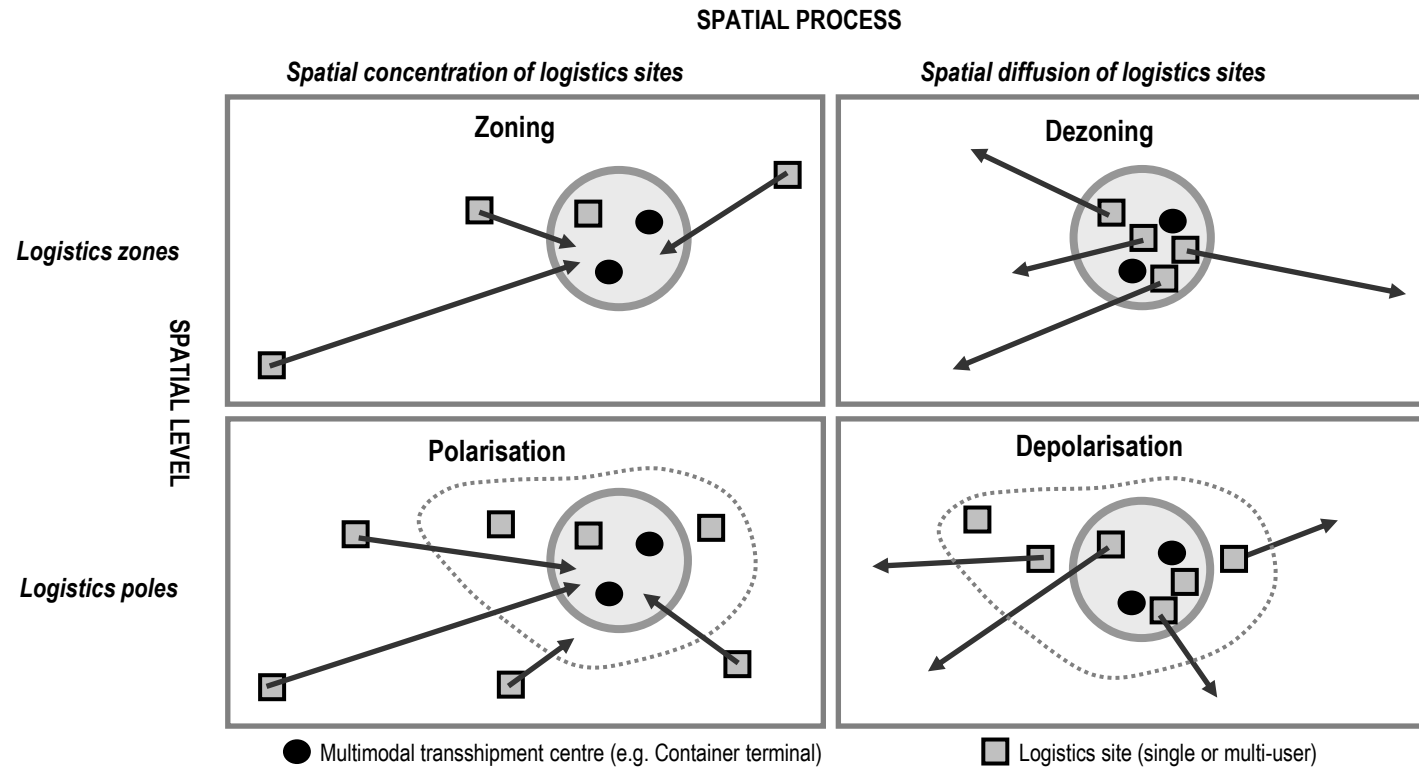
# Market Area of Distribution Centers Located in the United States, 2012



# Operating Hours of Distribution Centers

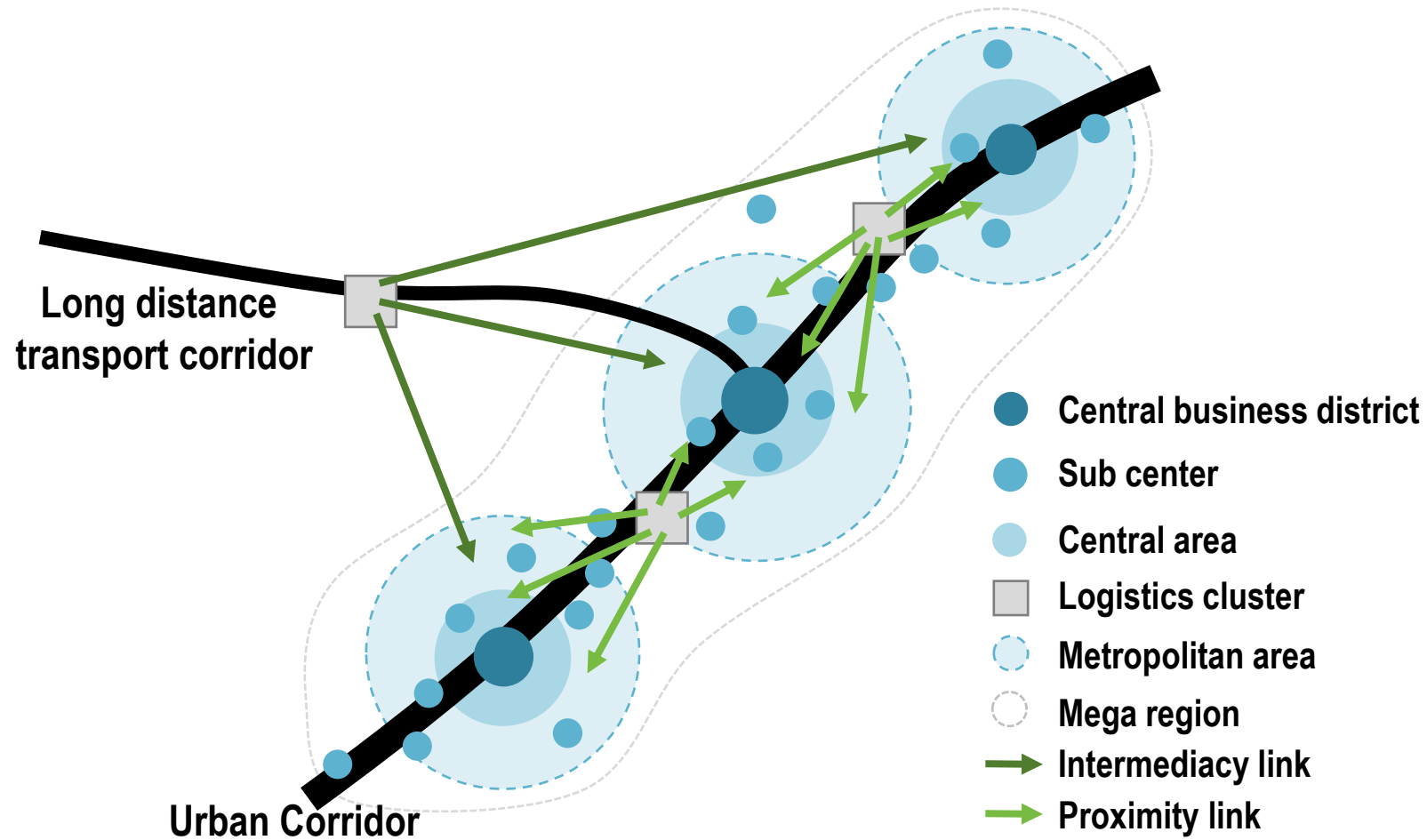


# A Typology of Spatial Dynamics in the Location of Logistics Sites

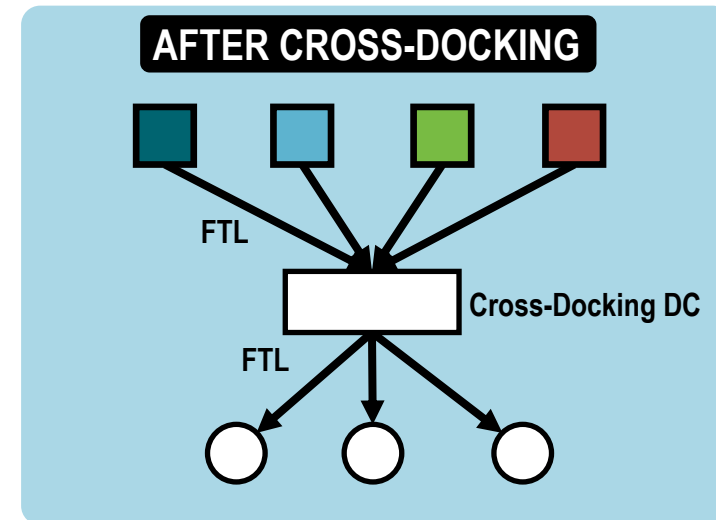
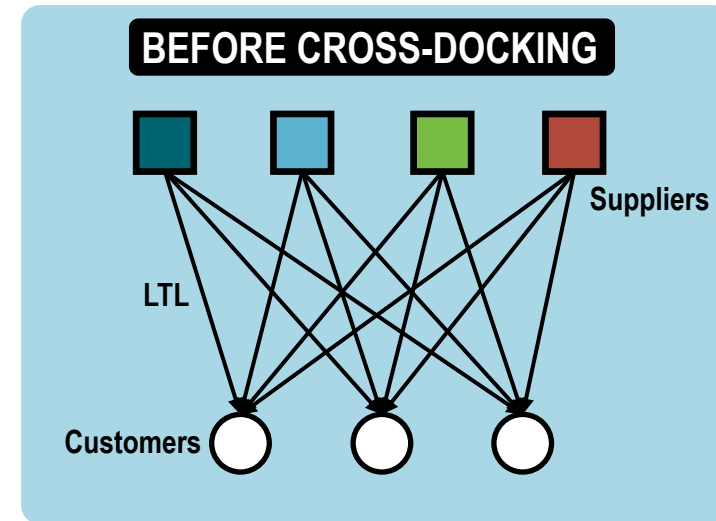
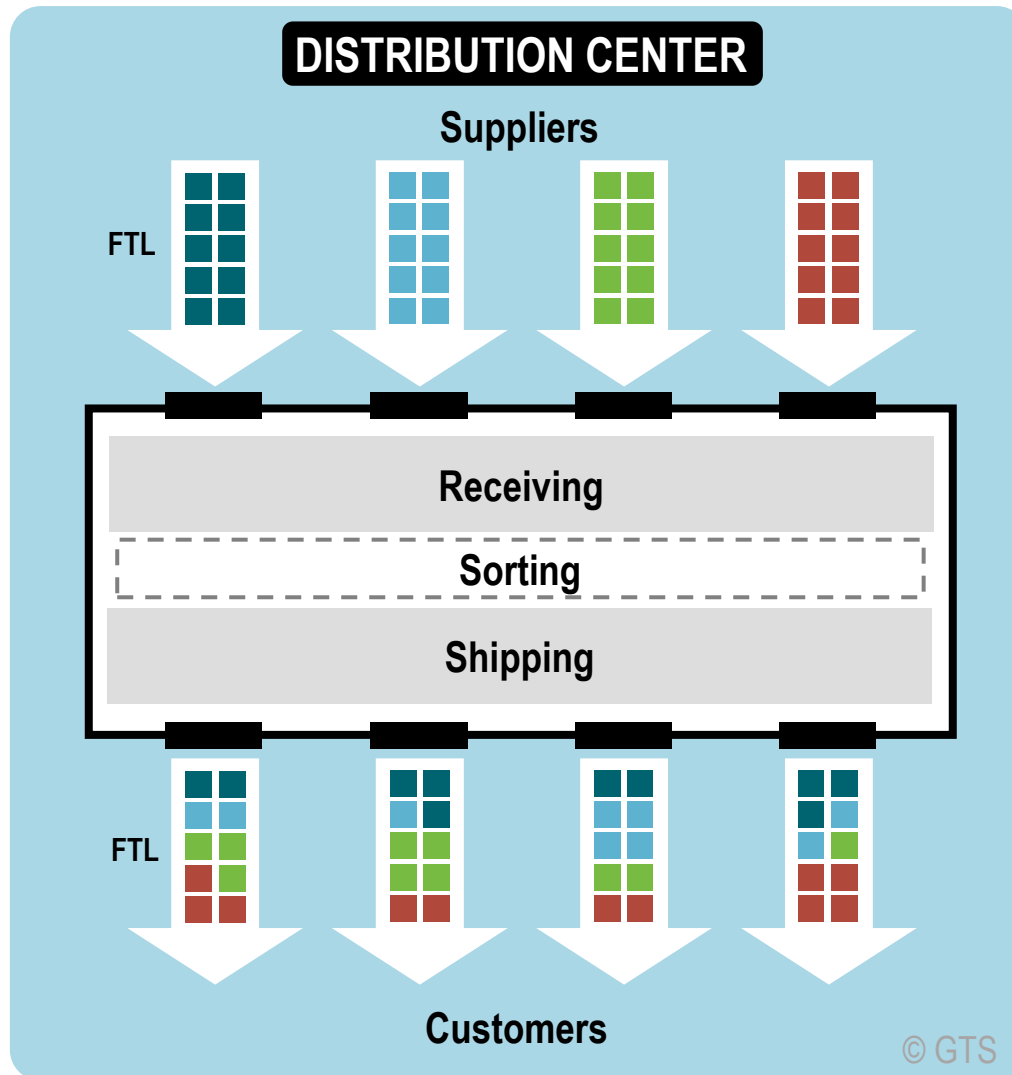




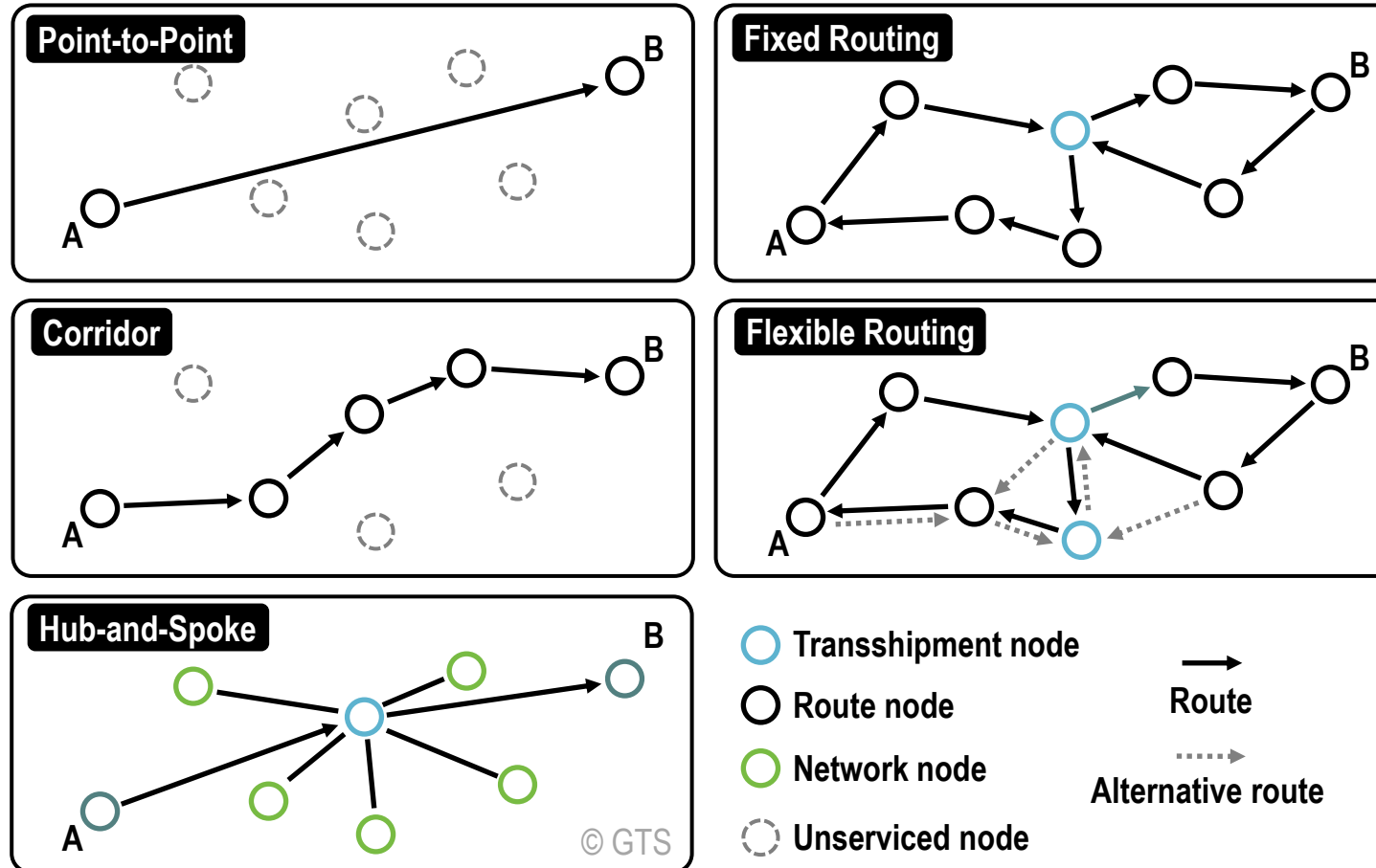
# Proximity and Intermediacy for Distribution Clusters



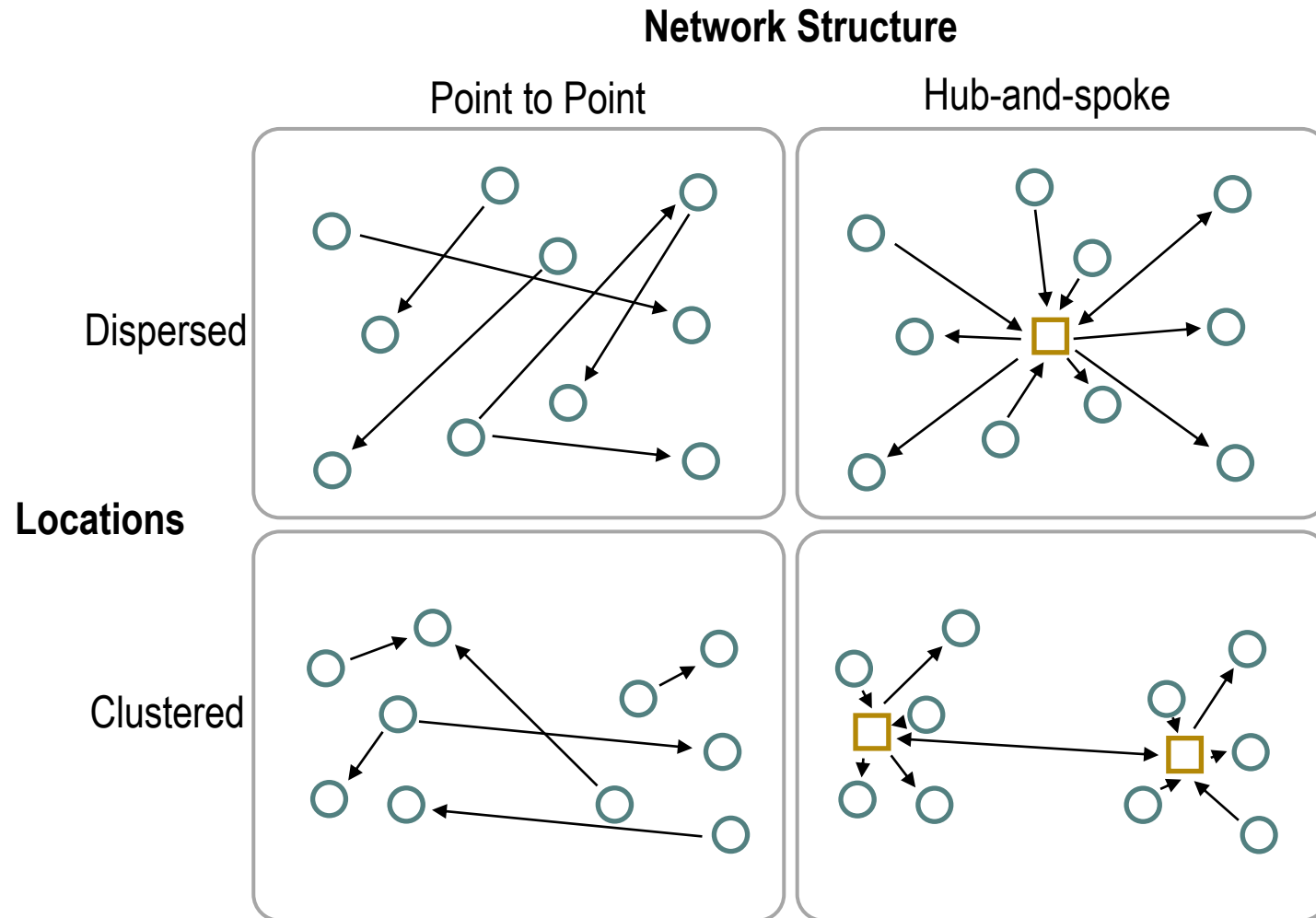
# Cross-Docking Distribution Center



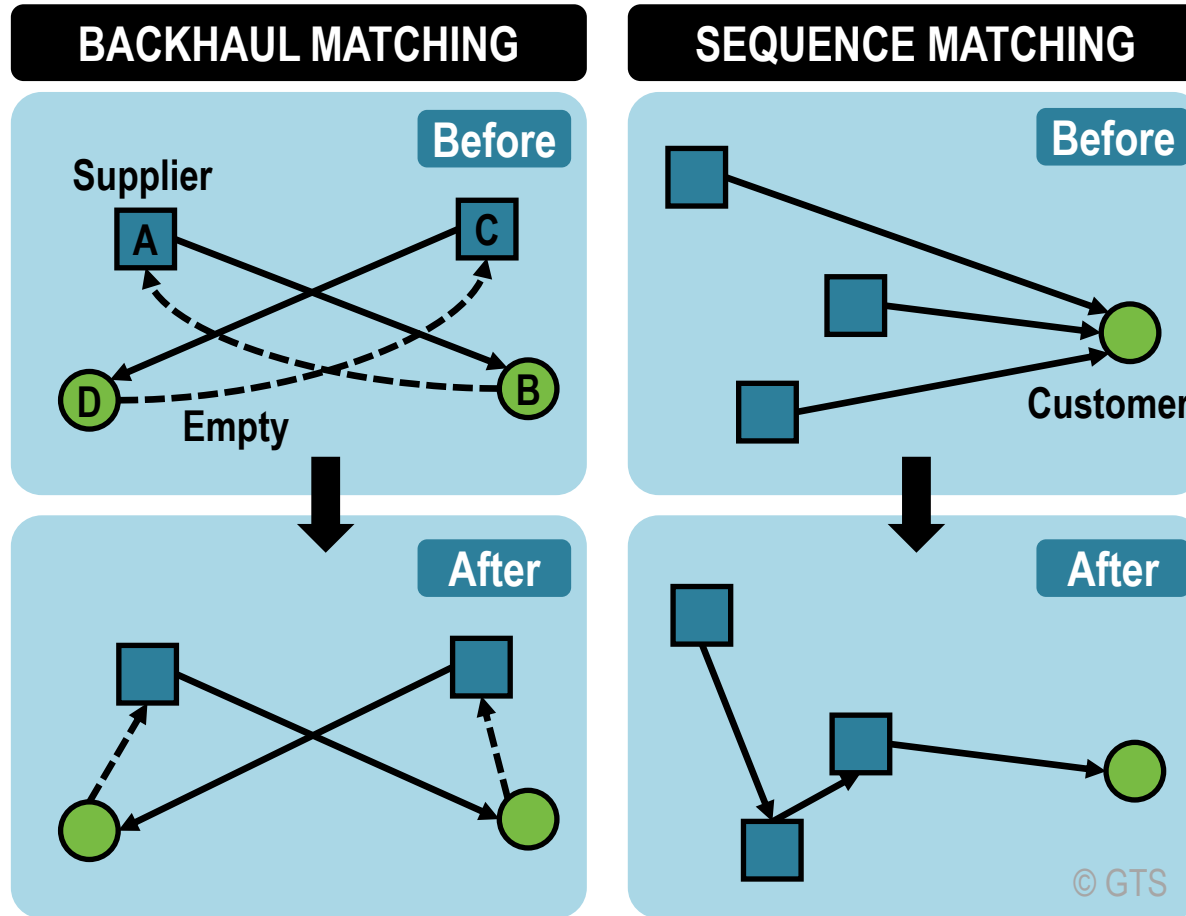
# Freight Distribution and Network Strategies



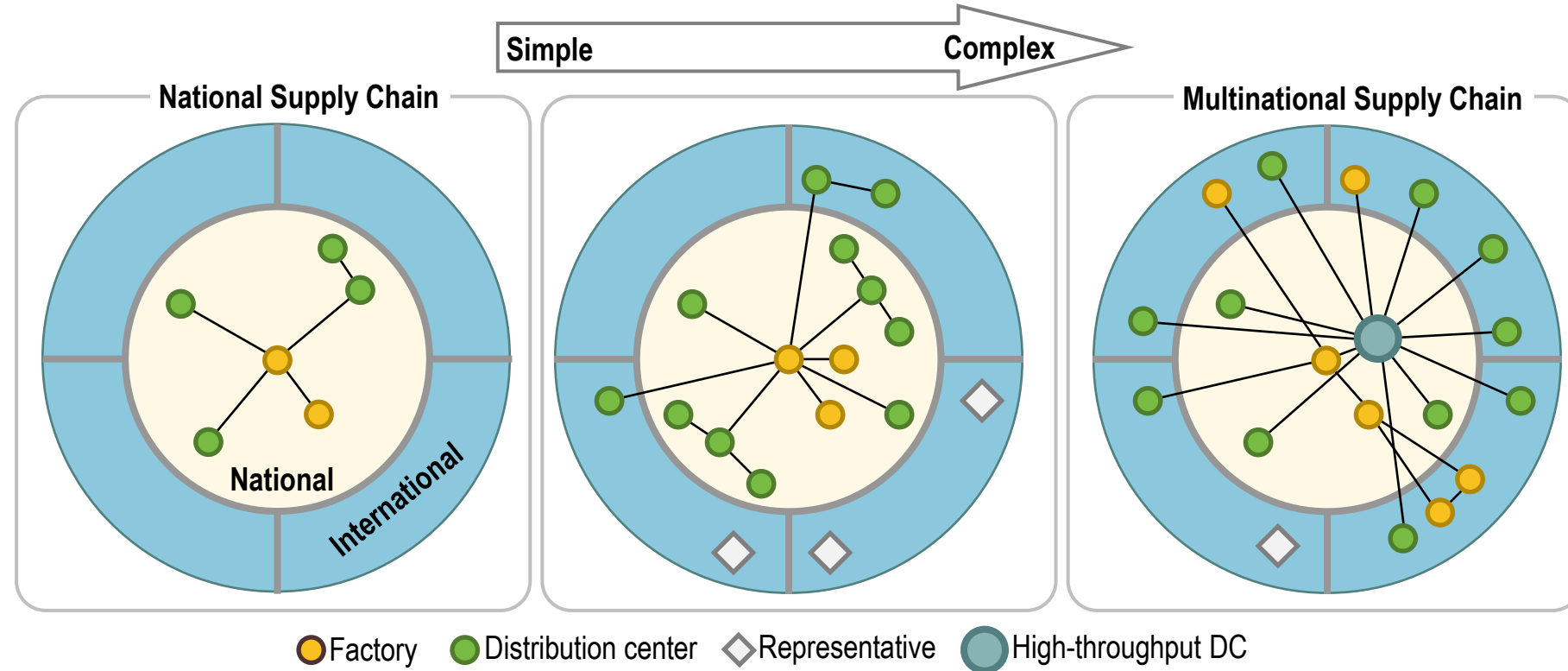
# Logistics Networks



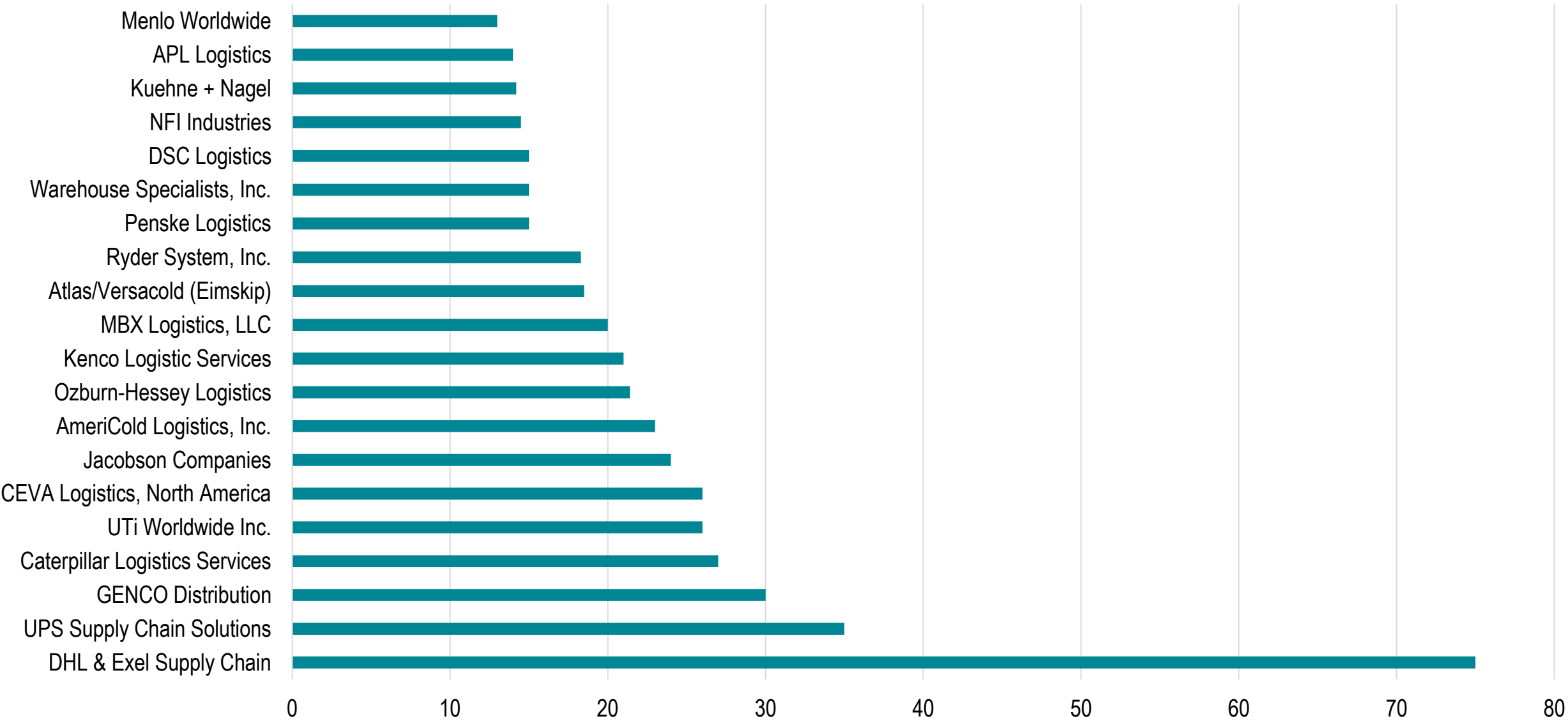
# Collaborative Distribution Strategies



# Complexity of the Supply Chain



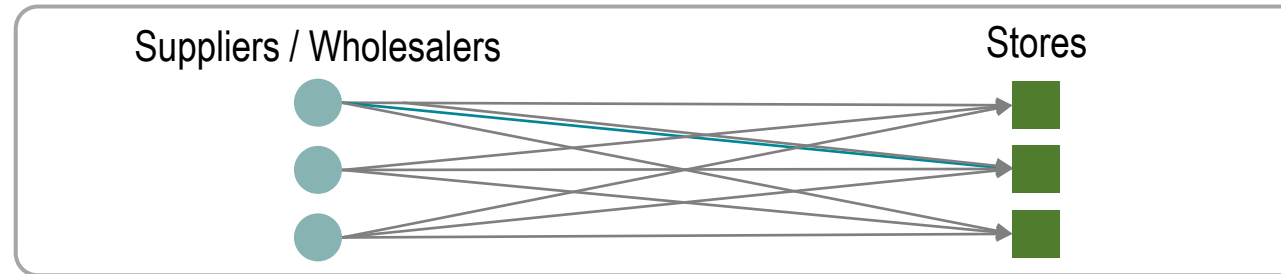
# 20 Largest North American Warehouse Operators, 2007



# The Evolution of Retail Logistics

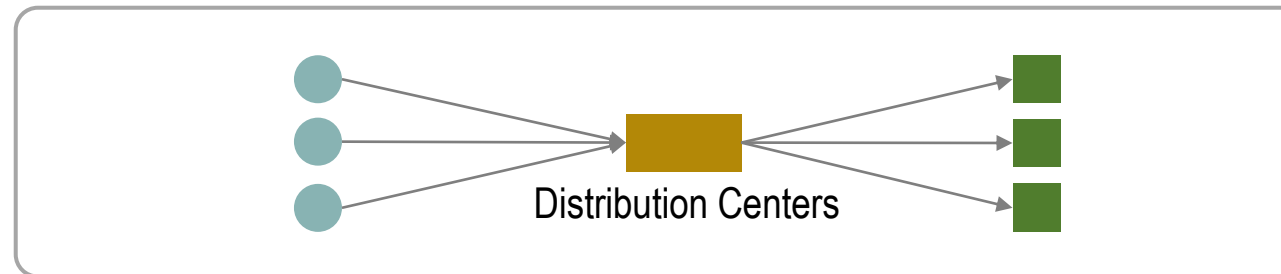
**1970s**

Direct  
replenishment



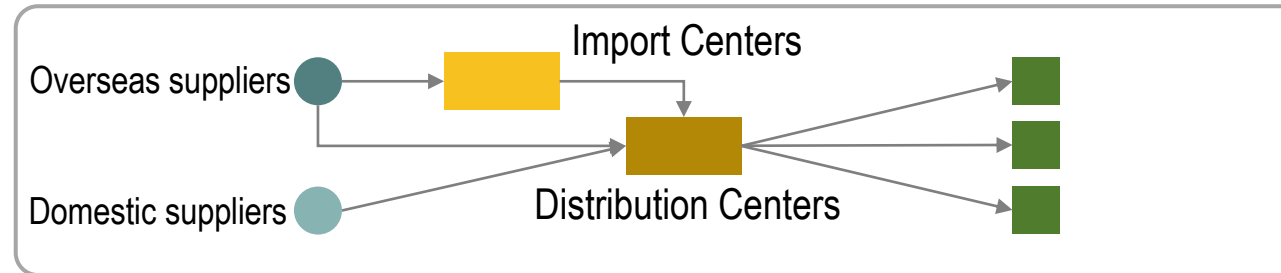
**1980s**

Rationalization



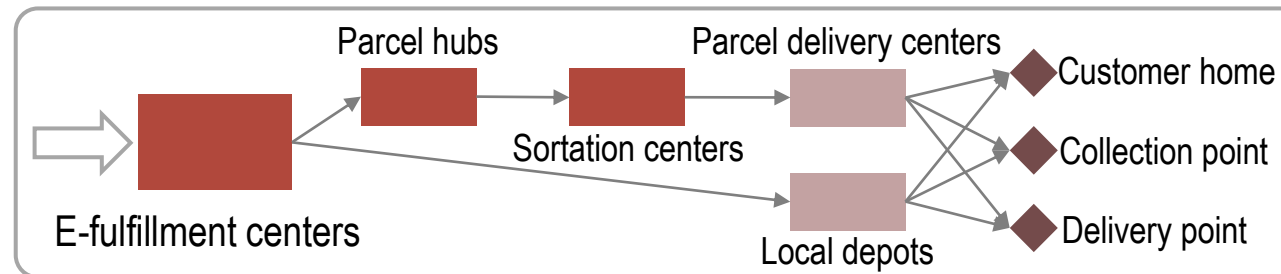
**1990s**

Global sourcing



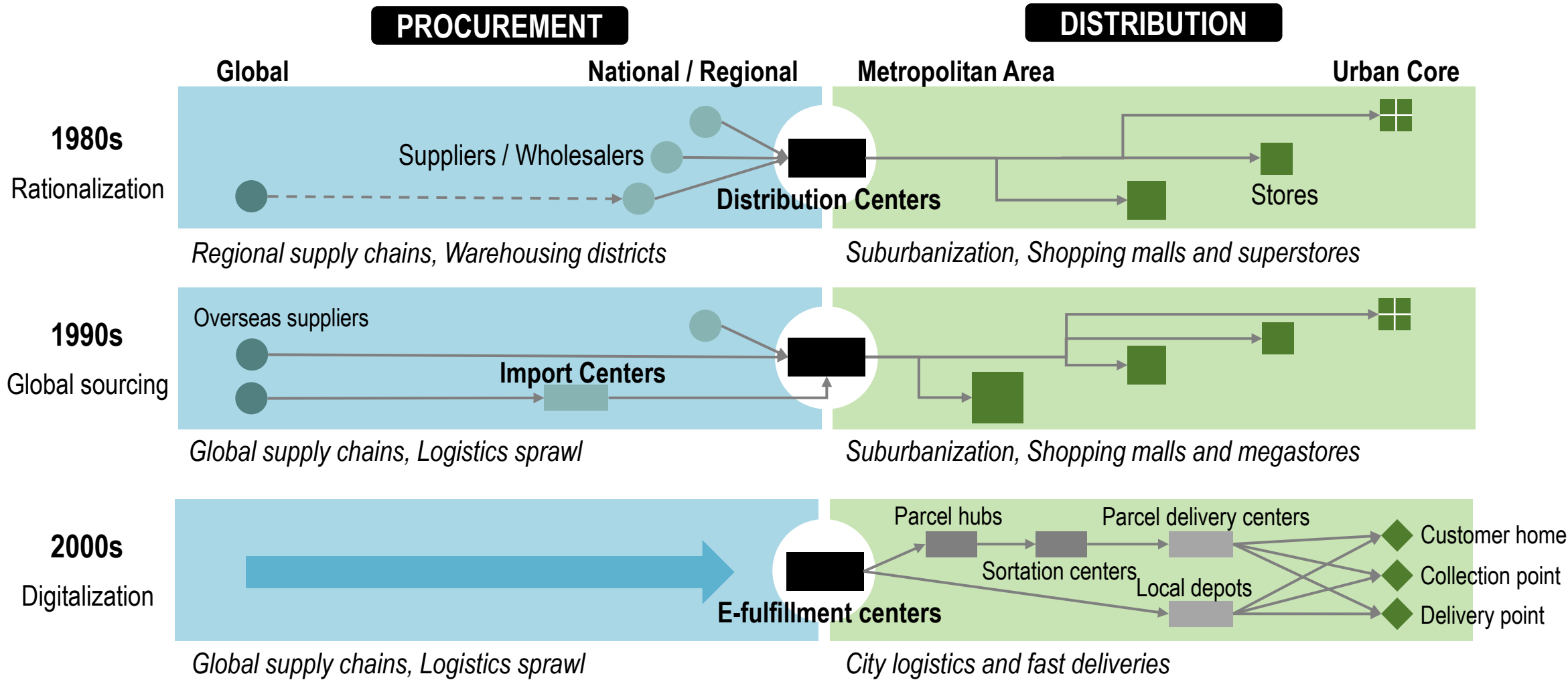
**2000s**

Digitalization

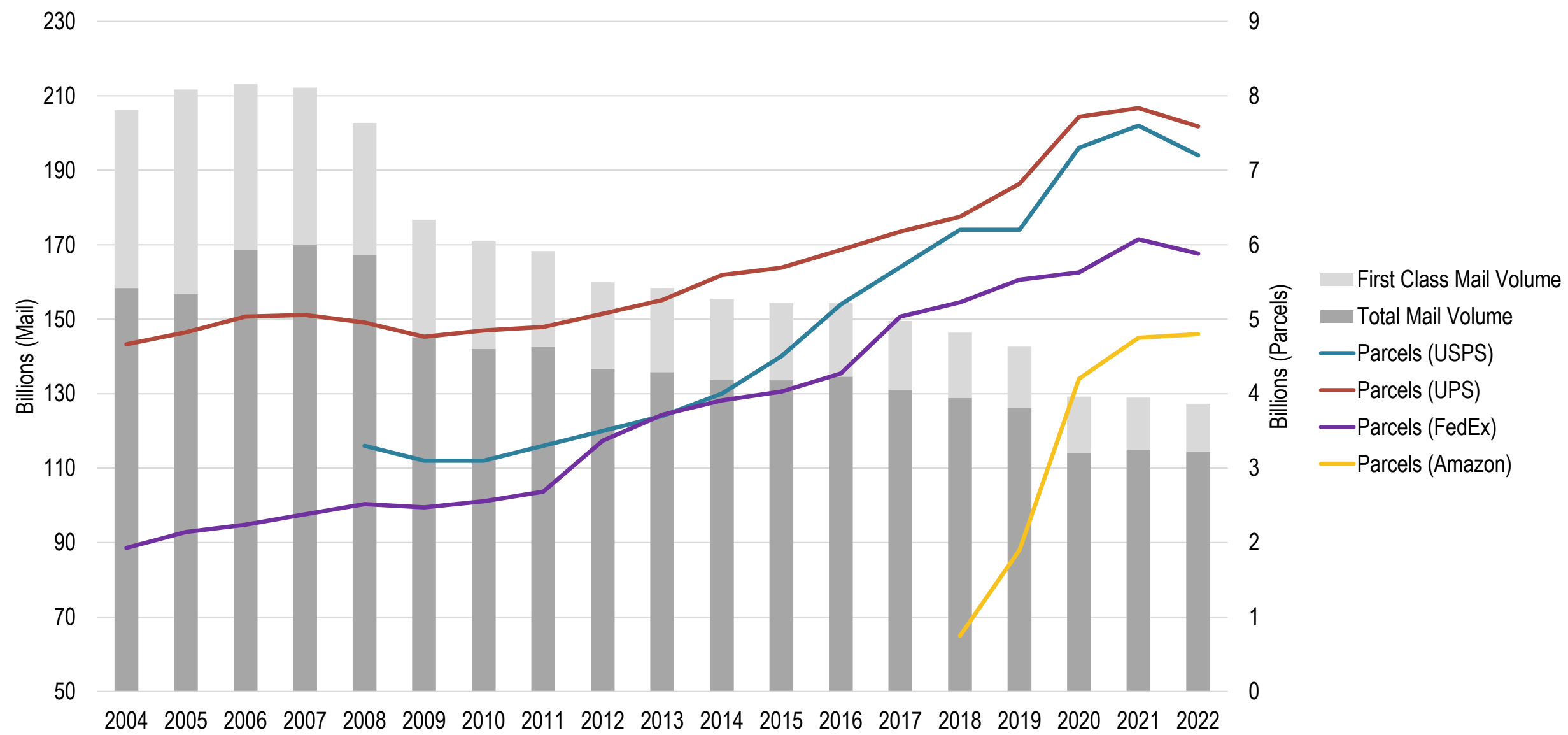




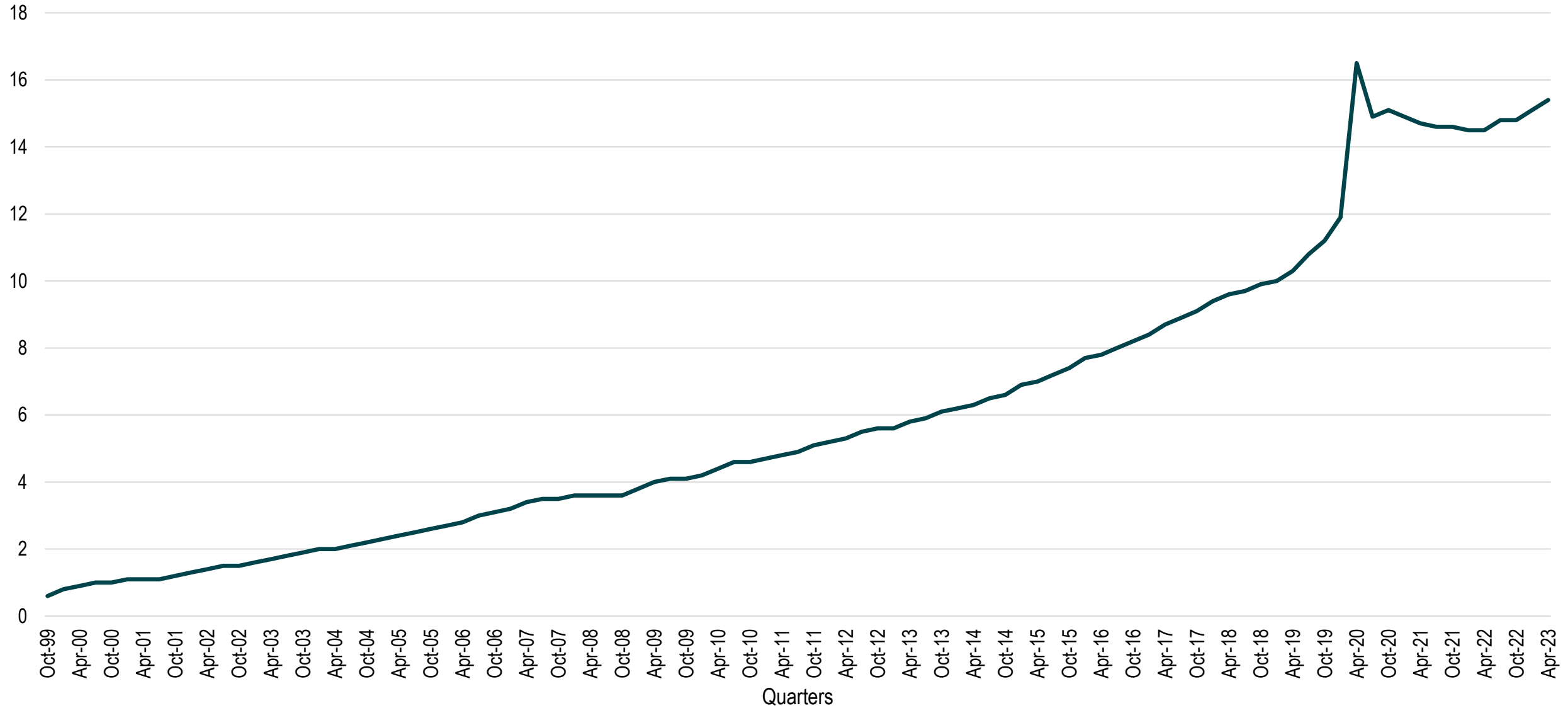
# The Evolution of Retail Logistics



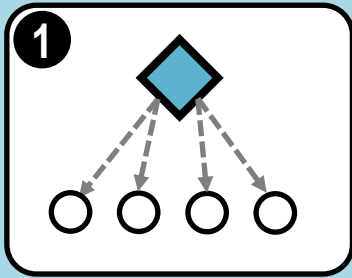
# Mail Carried by USPS and Parcels Carried by Major Carriers, United States, 2004-2022



# E-Commerce Retail Sales as a Percent of Total Sales, United States, 1999-2023

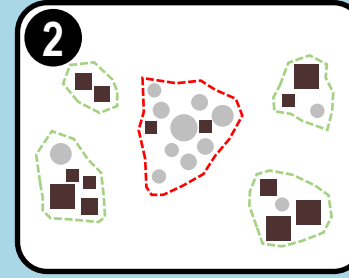


# The Impacts of E-commerce on Freight Distribution



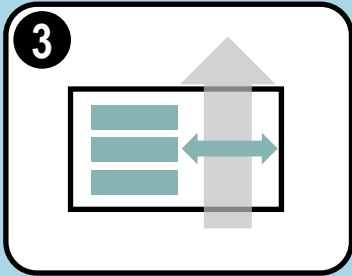
## DISTRIBUTION PATTERN

- Distributional consumption.
- Growth in B2C deliveries.
- Changes in last mile logistics.



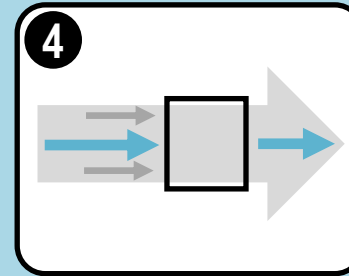
## REAL ESTATE FOOTPRINT

- Shift of the real estate footprint from retail to distribution.
- Changes in locational dynamics.



## LOGISTICAL FACILITIES

- New logistical facilities (E-fulfillment, Sortation center, Urban logistics depot).
- Automation of fulfillment and inventory management.



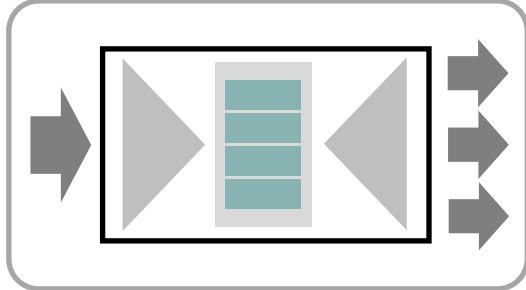
## VERTICAL INTEGRATION

- Development of 3PL and 4PL services.
- Dedicated carrier services (truck, air, non-vessel operating common carrier).

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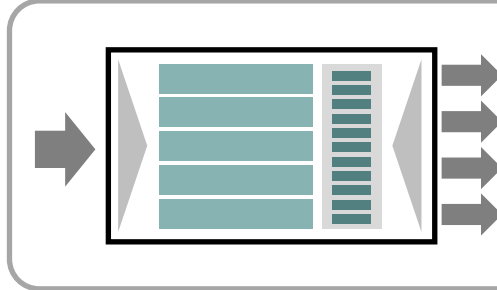
# Logistics Facilities Supporting E-commerce

## Inbound Cross Dock



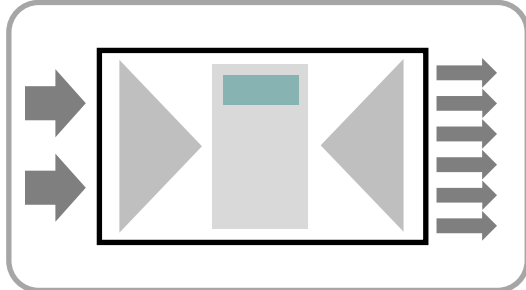
- Large-sized.
- Receiving containers and holding inventory.
- Double-side cross-docking configuration.
- Close to intermodal terminals.

## E-Fulfillment Center



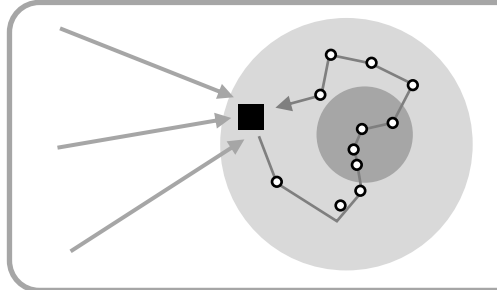
- Large-sized.
- Single-side cross-docking configuration common.
- High racks automated storage.
- Item specialization.
- Access to a major parcel hub.

## Sortation Center



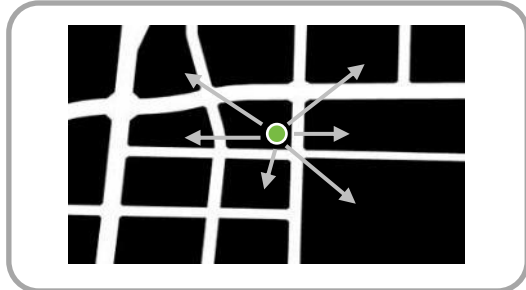
- Medium to large-sized.
- Cross-docking configuration for loading trucks.
- Automated and semi-automated sortation.
- Accessibility to regional distribution.

## Delivery Station



- Medium to small-sized.
- Cross-docking configuration for loading delivery vehicles.
- Periphery or central areas of metropolitan areas.

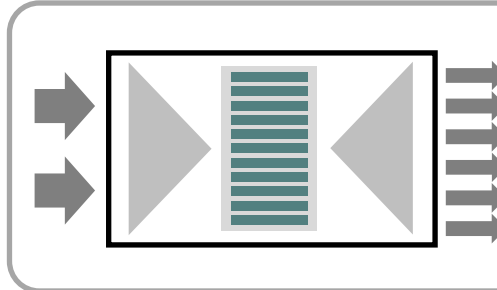
## Local Freight Station



- Small or micro-sized.
- Store-like facility (pickup location).
- Locker banks (freight station).
- High-density neighborhood locations.

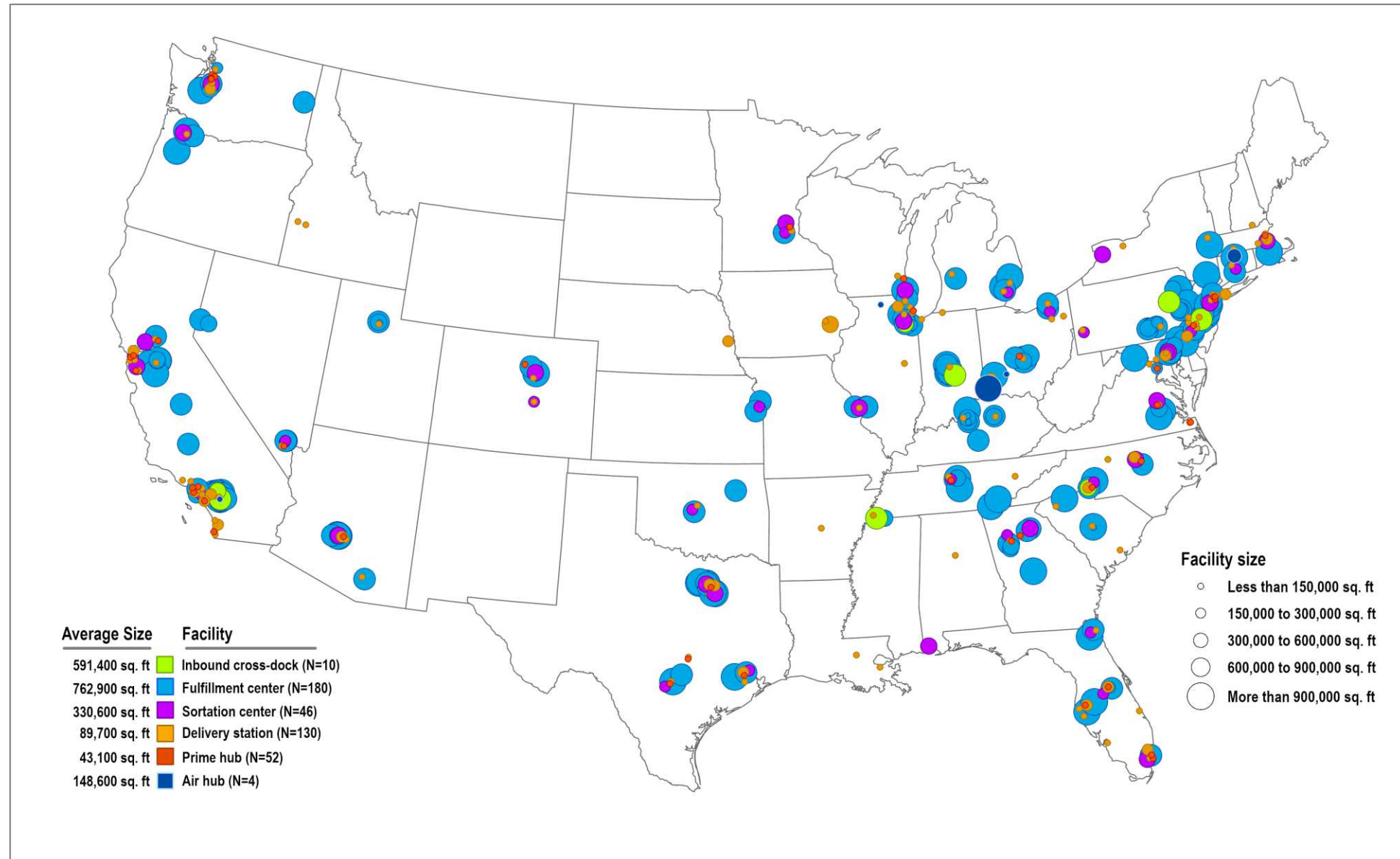
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## Fast Delivery Hub

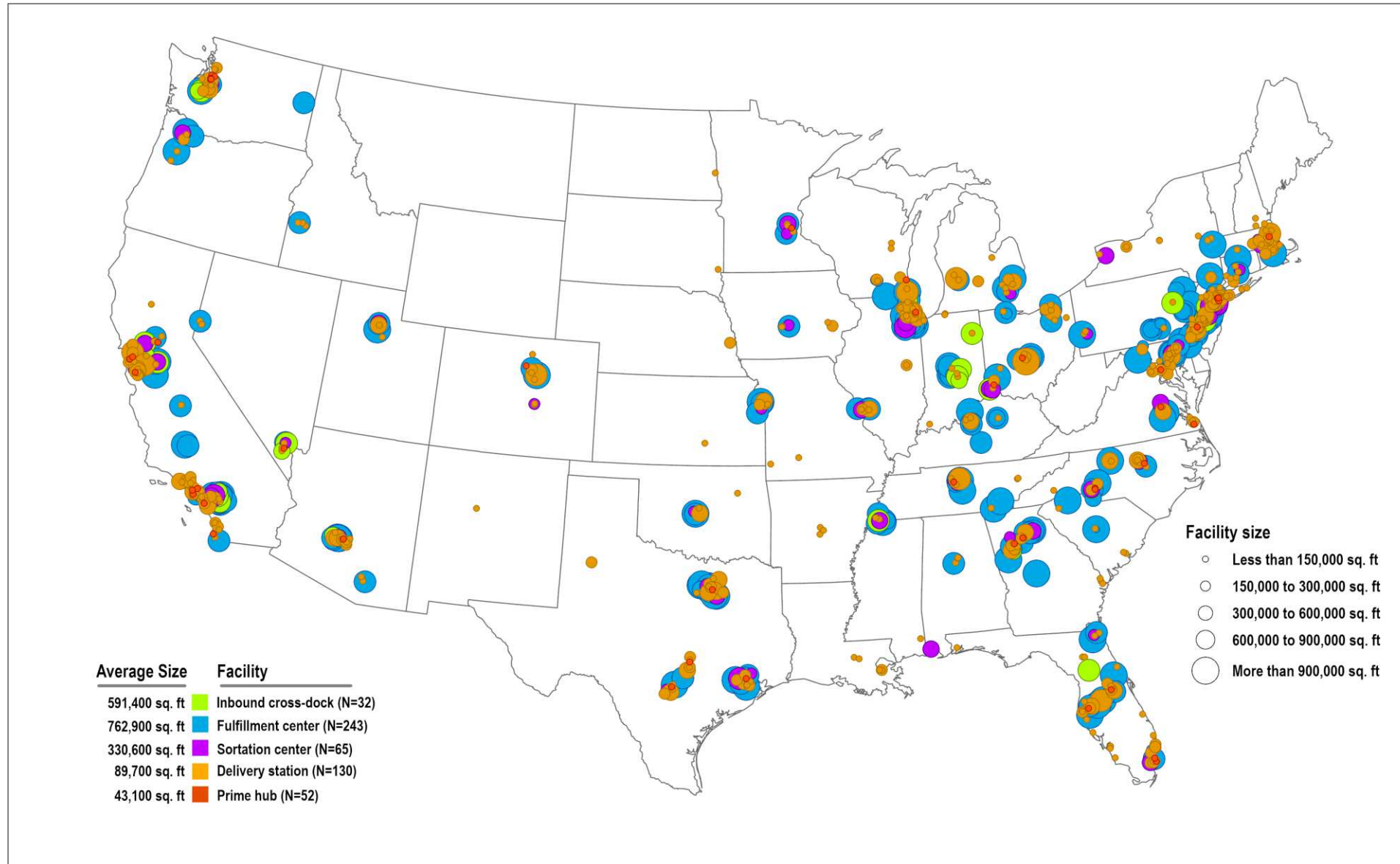


- Small to medium-sized.
- Near large metropolitan areas.
- Limited inventory of high-demand items.
- Some co-location with e-fulfillment centers.

# E-Commerce Facilities Operated by Amazon in the United States, 2019



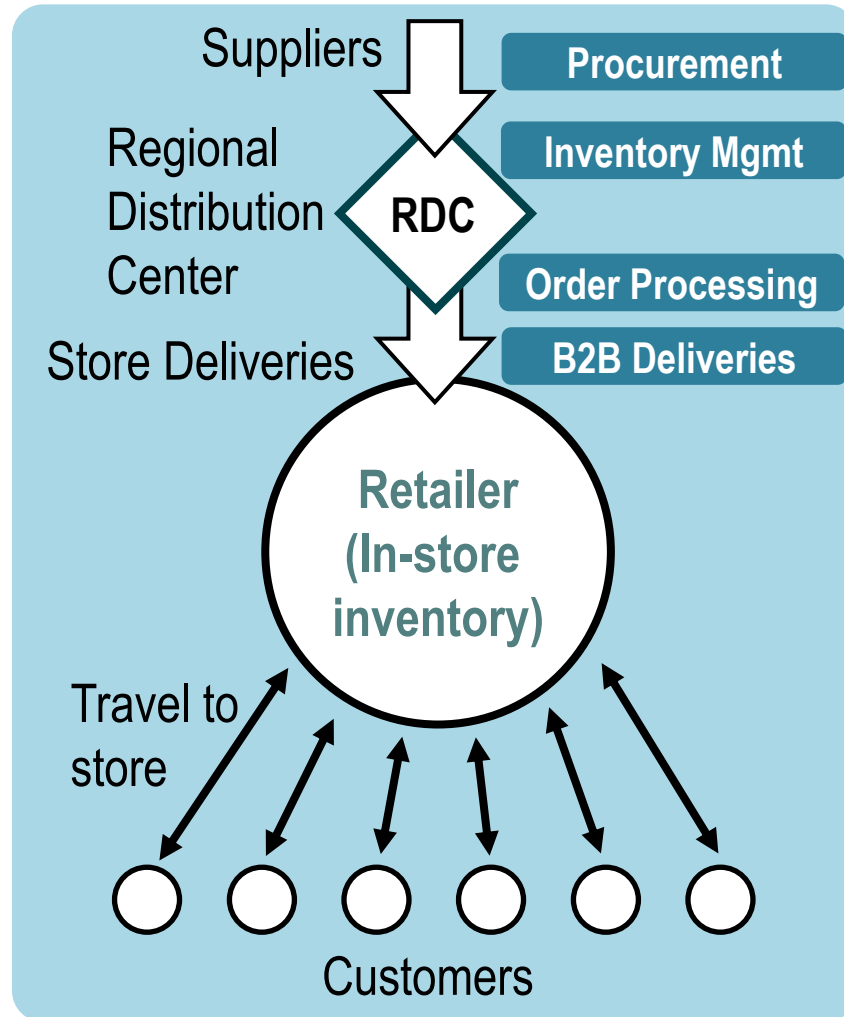
# E-Commerce Facilities Operated by Amazon in the United States, 2021



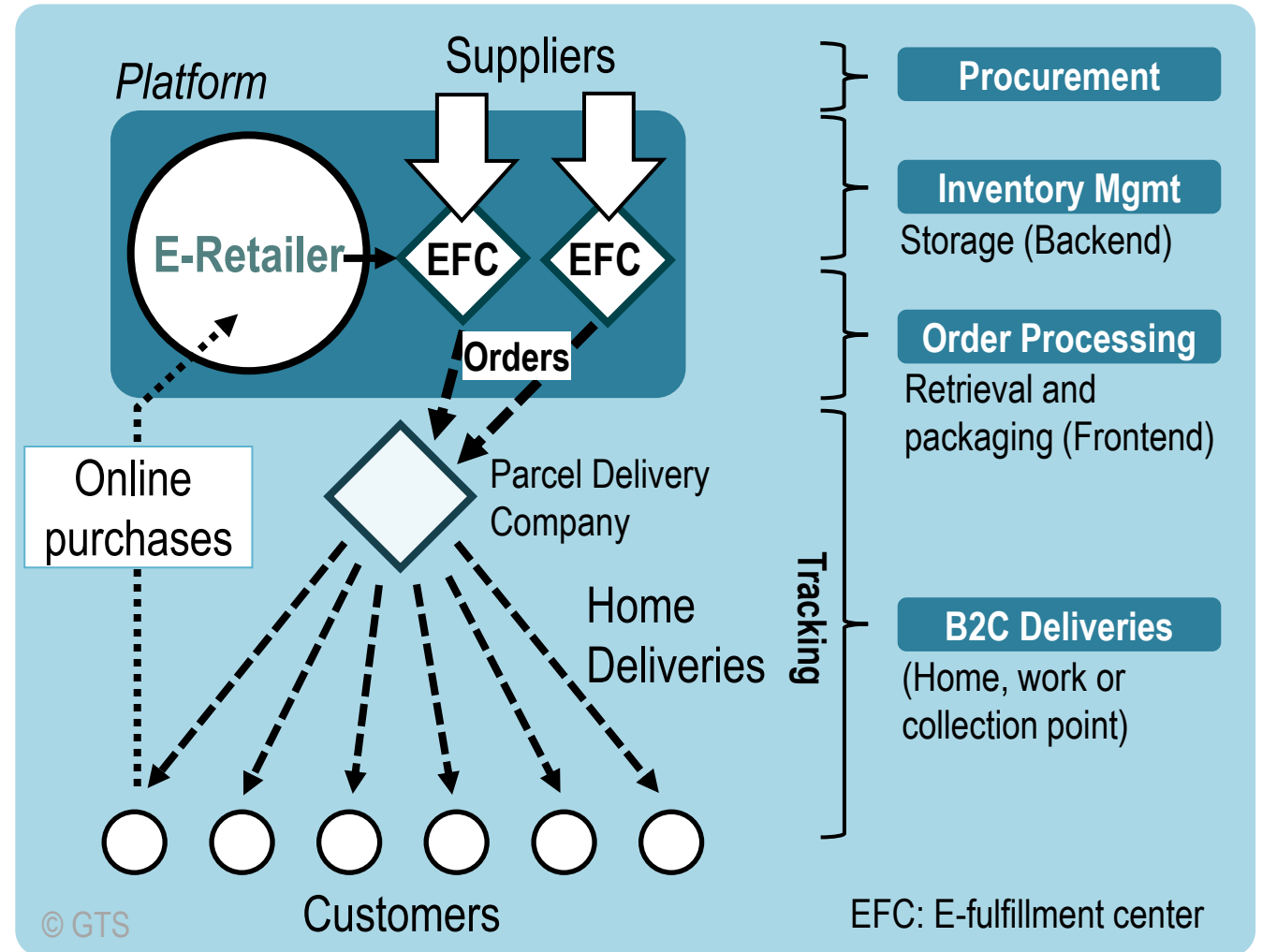


# Retail Logistics and E-commerce

## Conventional Retail Logistics



## E-commerce Retail Logistics





# Comparison Between Retail and E-commerce Cost Structures for a \$150 Apparel Piece



# Shifts of Logistical Operations in the Internet Economy

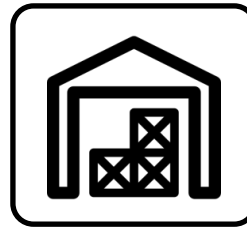
	Traditional logistics	E-logistics
Orders	Predictable	Variable
Order cycle time	Weekly	Daily or hourly
Customer	Strategic	Broader base
Customer service	Reactive, rigid	Responsive, flexible
Replenishment	Scheduled	Real-time
Distribution model	Supply-driven (push)	Demand-driven (pull)
Demand	Stable, consistent	More cyclical
Shipment type	Bulk	Smaller lots
Destinations	Concentrated	More dispersion
Warehouse reconfiguration	Weekly or monthly	Continual, rule-based
International trade compliance	Manual	Automated

# Elements of Last Mile Logistics



## TERMINAL

Capacity; turnover; gate access



## WAREHOUSING

Inventory level; lead time;  
transloading



## DRAYAGE

Congestion; chassis management

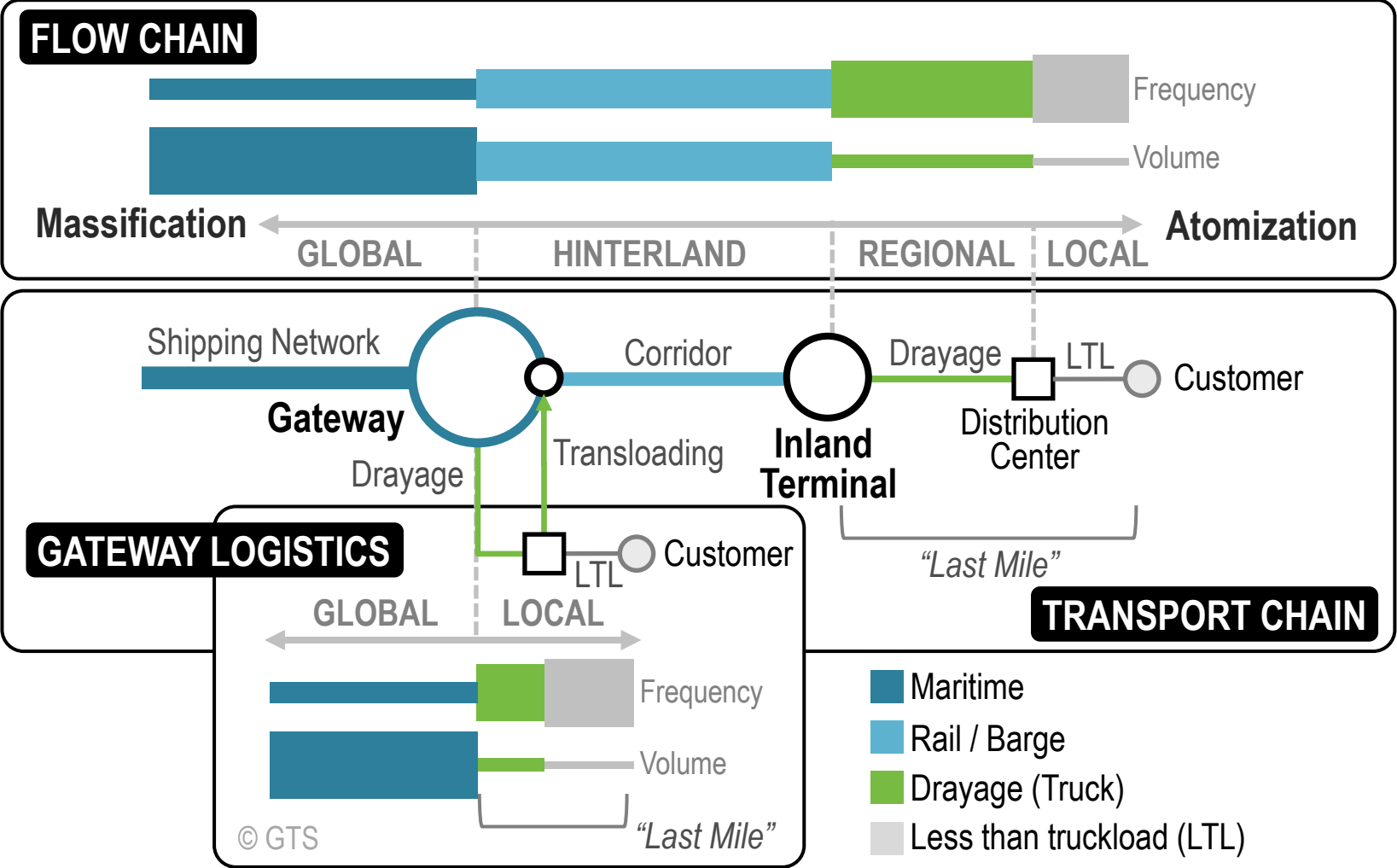


## DELIVERIES

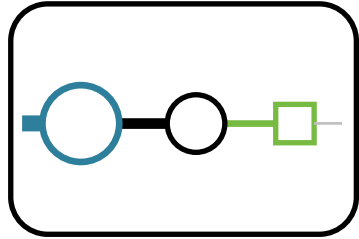
Congestion; parking

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# The Last Mile in Inland Freight Distribution

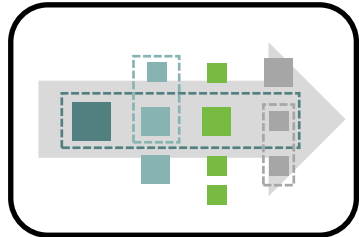


# Elements of Supply Chain Connectivity and Integration



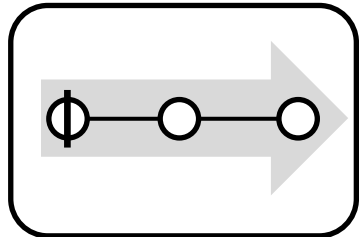
## Transport Connectivity

Improving connectivity and interoperability of modes (intermodalism).  
Infrastructure and superstructure improvements (capacity and throughput).  
Synchronizing terminals and hinterland flows.



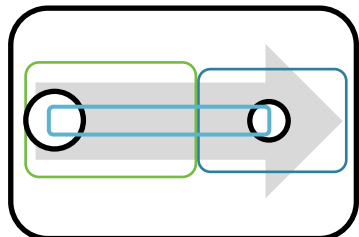
## Commercial Integration

Trade and commercial agreements. Mergers and acquisitions along the supply chain.  
Cost, time and reliability of transport and distribution services.  
Vertical and horizontal integration (e.g. bill of lading).



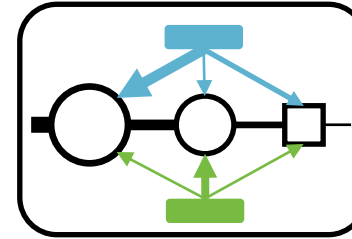
## Customs and Security Integration

Moving cargo more efficiently across borders.  
Harmonization of customs and security procedures.  
Assessments of cargo contents, cargo integrity, route integrity and information integrity.



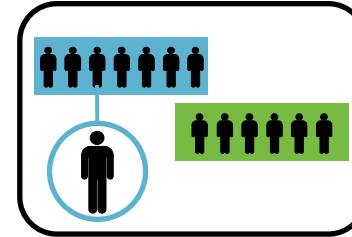
## Regulatory Integration

Promote modal choice and avoid subsidized modal preference.  
Harmonization of regulations across jurisdictions such as for vehicles, goods handling and transport, land use, labor and finance. Promotion of standards and certification.



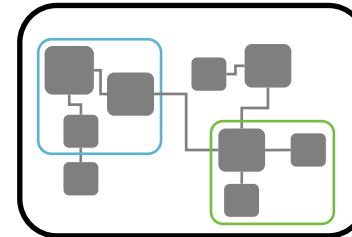
## Planning and Funding Integration

Planning and funding of infrastructure provision from an integrated multi-modal and logistics chain perspective.  
Respective roles and competencies of the public and private actors.



## Work Practices Integration

Organizational (managing labor as a group) and skills (managing individual workers) competencies to move cargo efficiently.  
Operational window (working hours), minimal service levels and essential services.  
Automation of repetitive tasks.

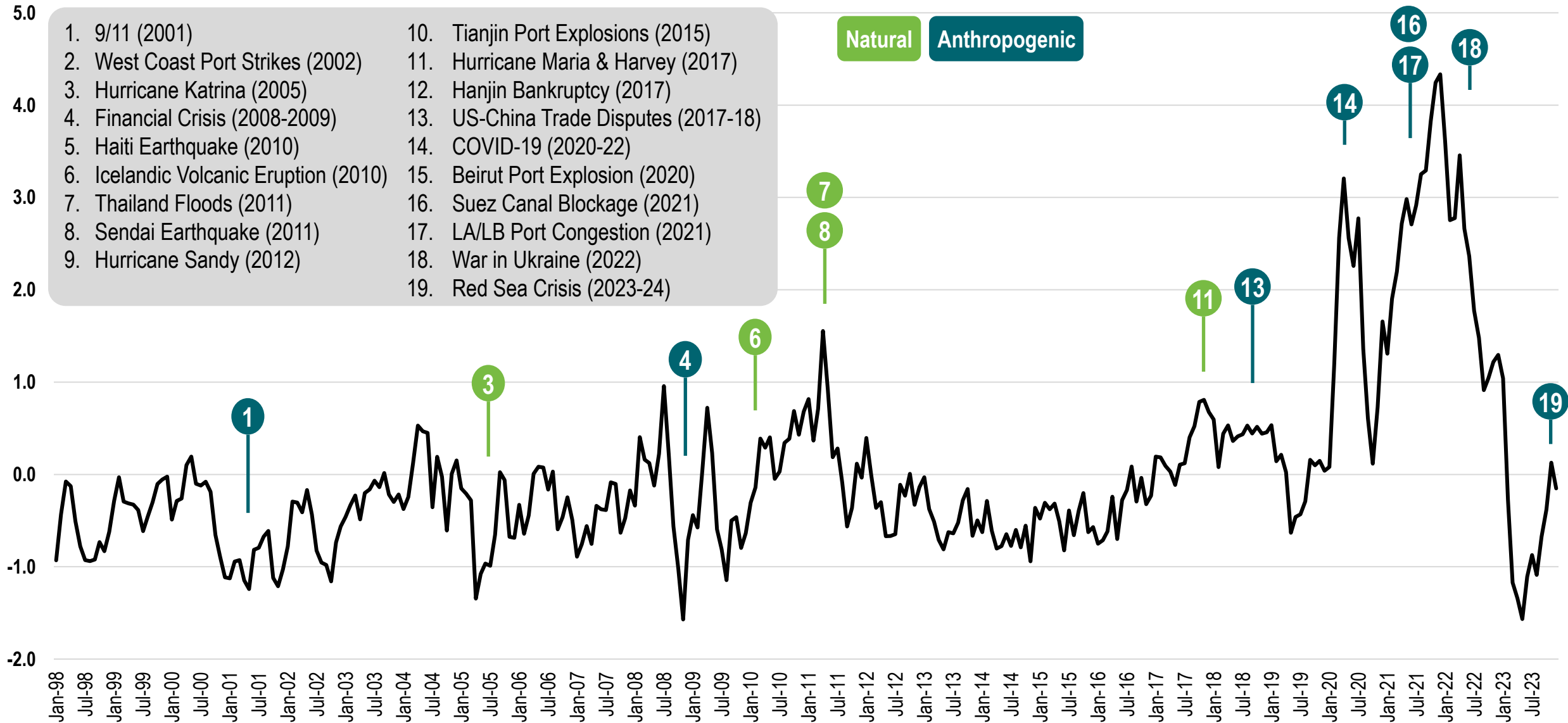


## Information Systems Integration

Interconnectivity of information systems with blockchains.  
Asset tracking, status monitoring, customs facilitation, freight status information and transport network status information.

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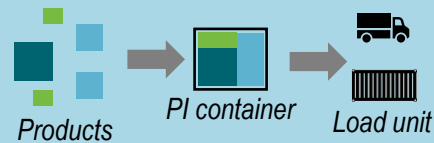
# Global Supply Chain Pressure Index (GSCPI) and Major Supply Chain Disruptions



# Fundamentals of the Physical Internet

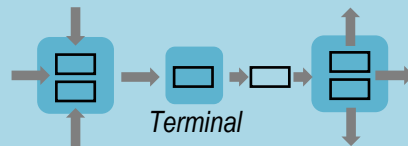
## PHYSICAL INTERNET

### Encapsulation



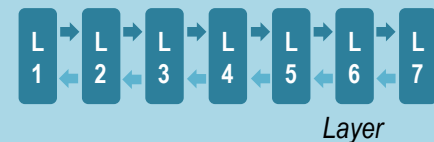
- Encapsulation (consolidation) of products into a modular unit (PI container).
- PI containers to be reconciled with existing load units (e.g. boxes, pallets, ISO containers).

### Interfaces



- Consolidation, deconsolidation and storage of PI containers at distribution facilities.
- Transport and relay PI containers at terminal facilities.
- Physical and digital interfaces.

### Protocols



- Protocols regulating the layers of logistics services (L) along supply chains.
- Layers: Physical (L1), Link (L2), Network (L3), Routing (L4), Shipping (L5), Encapsulation (L6), Logistics (L7).

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