



Croatian Logistics

Opportunities for Sustainable
Competitiveness



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Abbreviations

3PL	Third-Party Logistics Service Provider
4PL	Fourth-Party Logistics Service Provider
AGCT	Adriatic Gate Container Terminal
AGV	Automated Guided Vehicle
BCO	Beneficial Cargo Owner
CO₂	Carbon Dioxide
COVID-19	Coronavirus Disease 2019
CSR	Country Specific Recommendations
DDP	Delivery Duty Paid
EDP	Excessive Deficit Procedure
ERP	Enterprise Resource Planning
EXW	Ex-works
EU	European Union
FCA	Free Carrier
FEU	Forty-foot Equivalent Unit
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GoC	Government of Croatia
HŽ	Hrvatske Željeznice – Croatian Railways
HŽC	HŽ Cargo
HŽI	HŽ Infrastruktura
ICC	Inventory Carrying Costs
Incoterm	International Commercial Term of Contract
IPI	Inland Point Intermodal
IT	Information Technology
KPI	Key Performance Indicator
LDC	Logistics and Distribution Center
LPI	Logistics Performance Index
LSP	Logistics Service Provider
MSTI	Ministry of Sea, Transport and Infrastructure
NO_x	Nitrogen Oxides
NTM	National Transport Model
O-D/OD	Origin-Destination
RH1	Pan-European Corridor X
RH2	Mediterranean Corridor
RO-RO	Roll-on/Roll-off
SOEs	State-owned Enterprises
SPA	Sales and Purchase Agreement
SMEs	Small and Medium Enterprises
TDS	Transport Development Strategy
TEN-T	Trans-European Transport Network
TEU	Twenty-foot Equivalent Unit
ULCV	Ultra Large Container Vessel
WMS	Warehousing Management System
ZCT	Zagreb Deep Sea Container Terminal

Executive Summary

1. Croatia needs to find new sources of economic growth to attain income convergence with the EU; this was true before the onset of the coronavirus disease 2019 (COVID-19) pandemic, and it is an even more urgent challenge now.

By the end of 2019, Croatia's income per capita in constant Purchasing Power Parity terms relative to the EU average stood at roughly the same level it did in 2008, prior to the 2009 global economic crisis. In other words, Croatia attained no further income convergence relative to the EU in the 11 years between 2008 and 2019. The impact of COVID-19 on the Croatian economy is likely to further widen this gap.

2. Improvements in freight logistics, which permeate the tradeable economy and domestic commerce, can become a catalyst of productivity growth, business resilience, and environmentally sustainable economic expansion for Croatia.

Efficient logistics facilitate trade by improving access to markets through connectivity improvements and cost competitiveness. They are a driver of productivity gains across the economy, as Croatian exporting firms are more productive than non-exporting firms. Lower-cost logistics operations, whether through multimodality or within-mode efficiency gains, are linked to reductions in logistics sector emissions of greenhouse gases and local pollutants.

3. Croatia has significant logistics potential—which is yet to be fully realized.

Croatia's potential to deepen the economic impact of the logistics sector is rooted in several factors. Croatia is advantageously located next to 'factory Europe'—the large, dynamic Central European markets that are intense in the generation-attraction of intercontinental trade, particularly between Asia and Europe, via sea freight. It has a well-located, naturally protected deep-water port, the Port of Rijeka in the North Adriatic, that is directly connected to the Central European hinterland and is managed as a landlord port, consistent with European (and global) best practice. In recent years Croatia has considerably strengthened the Port of Rijeka's ability to attract freight volumes through, inter alia, (i) investment in last-mile rail and road connectivity infrastructure in an environment of open competition in rail freight services; (ii) gains in operational efficiency delivered by a capable international terminal operator under a long-term concession agreement; and (iii) expansion in cargo and vessel handling capacity, including the construction of a new container terminal. In the years leading to its 2013 EU accession, Croatia built an international-standard motorway network that enables reliable logistics, including time-definite, expedited, and other types of value-added logistics services.

Yet, persistent challenges have kept a lid on logistics performance at the national level. Available container handling capacity at the Port of Rijeka remains underutilized; and while it has gained significant throughput share in the North Adriatic in recent years, from 7% as early as 2015 to 12% today, Rijeka's current share is the same it held back in 2008, prior to the onset of the 2009 global economic crisis. Urgently needed investment in rail linehaul infrastructure capacity along the primary Rijeka-Zagreb-Hungary border corridor has been considered for years, with little progress to date on account of lengthy investment planning and decision-making processes. There is a lack of coordination across modes, geographies, levels of government, and between the government and the private sector, in support of planning, policy making, and regulatory improvements in multimodal logistics. Establishing

or expanding warehousing operations in Croatia is costly when compared to other Central and Southeastern Europe countries. Croatia's trucking sector, which dominates domestic freight transport, could become greener by renewing a consistently aging national truck fleet. The country's inland waterways remain underutilized and underinvested as a lower-cost, low-carbon transport resource. And there is a need to better understand the freight transport needs of Eastern Croatia as part of an economic development strategy to attract investment and expand job creation in Croatia's lagging regions.

4. The following measures can improve the economic impact of Croatia's logistics sector:

Raise the rail hinterland connectivity and market profile of the Port of Rijeka across Central Europe

The significant physical and operational improvements attained at the Port of Rijeka to date should be matched by (a) expanded rail intermodal services between the port and key Central Europe markets beyond Budapest; and (b) an actively pursued customer acquisition strategy, expansion of market alliances, and improved planning and decision-making processes rooted in competitive benchmarking. The Port of Rijeka offers competitive, though not yet best-in-class, port-to-door transit times between East Asia and Budapest, but the extent of its direct rail intermodal connectivity in Central Europe remains limited to this one market, leaving significant value on the table. Moreover, the Port of Rijeka's logistics offerings are limited in market reach, under-advertised, opaque to many Europe-based logistics operators and freight forwarders, and thus flying under the proverbial radar, while port competition over the Central European containerized hinterland is higher today than at any time in modern European history. Rijeka's success, just like that of Koper, Piraeus, Rotterdam, Hamburg, and other ports serving Central Europe, is tied to the port's hinterland connectivity, and in particular rail intermodal connectivity, in terms of both total logistics cost efficiency and geographic coverage. Over the long term, improvements in the latter will require investment in the trunk rail corridor linking Rijeka with Zagreb as a priority. But more immediately, service delivery improvements can be pursued to increase connections in Central Europe over the existing infrastructure and to further reduce port-to-port transit times for Asia-originated shipments, in collaboration with railway undertakings, container shipping lines, and other supply chain partners.

The Port of Rijeka Authority (PRA) should deepen its integration with its terminal operator(s) to open up new markets and to periodically benchmark Rijeka with other ports from a total logistics costs perspective. This evidence should then be used to inform plans for service improvements aimed at shortening transit times, reducing transport costs, and making port-to-door journeys more predictable.

Adopt an options-based process of investment planning and sequencing to increase the capacity of the Rijeka–Zagreb railway corridor, informed by market dynamics

Addressing the challenge of expanding rail linehaul capacity along the Rijeka–Zagreb corridor—perhaps the single most important infrastructure bottleneck in Croatia's logistics system at present—should consider incremental options sequenced over time, in addition to the transformational investments currently envisaged. This is especially true in the post COVID-19 'new normal' of limited resources, higher uncertainty, and a greater, more urgent need for network resilience. The investment prioritization and sequencing process should reflect integration across government agencies, and be aligned with national goals and aspirations, consulted with end-users and the general public, and informed by Croa-

tia's national risk profile. In particular, consideration of options and eventual interventions should ideally entail closer coordination between freight stakeholders, above all the Ministry of Sea, Transport and Infrastructure (MSTI), Port of Rijeka Authority (PRA), the national rail infrastructure manager HŽ Infrastruktura (HŽI), all (public and private) active railway undertakings, a core community of domestic and international shippers and logistics service providers, and representatives of the subject matter expert academic community.

More broadly, foster collaboration in transport and logistics planning and policy making through institutional integration

Croatia has the opportunity to establish an institutional mechanism to facilitate integrated public sector planning and policy making in logistics across modes, government agencies, levels of government, and geographies. This could take the form of a government logistics committee or council. Integration can strengthen public sector decision making across a host of transport and logistics issues, including infrastructure provision, service delivery, trade competitiveness, environmental sustainability, resilience, and social and labor issues. Such an institution should be empowered to engage across siloed agencies. The institution can have a built-in mechanism for coordination with the private sector, such as an industry advisory board. It can lead Croatia to adopt a national logistics strategy, and it can create the tools to keep track of progress over time towards meeting the strategy's goals, thus promoting accountability.

Introduce incentives to renew the national trucking fleet

The disproportionate impact of trucking operations on local pollutant and GHG emissions, road safety outcomes, road infrastructure maintenance, and logistics costs have made a strong economic case in the international experience for governments to support fleet renewal as a means to address a market failure—insufficient access to credit by carriers, in particular SMEs and owner-operators. These are not simple schemes to run, and the international experience is mixed as to the way they have been implemented. But reversing a trend towards the use of older equipment is an opportunity for Croatia to both stimulate a vital economic sector and making it more environmentally sustainable.

Promote a modern warehousing sector, with better supply-demand balance, as an enabler of Croatia's national aspiration of becoming a regional logistics platform

Available evidence shows that building new warehousing facilities in Croatia entails more onerous administrative compliance requirements, with weaker measures of quality control, than all but one other EU member state, and significantly so compared to neighboring Serbia, which competes with Croatia in the regional warehousing market. These impediments increase the cost of capital, and there is anecdotal evidence to suggest that they are driving existing investors and warehousing operators out of the Croatian market in favor of other countries in the region. The Croatian warehousing sector faces high occupancy rates, comparably unaffordable rental levels per m², and low value-for-money with limited incidence of automation and other modern warehousing technologies. Fostering a competitive real estate market in logistics, with sufficient provision of modern warehousing capacity, should be considered a strategic component of Croatia's effort to become a logistics platform for Central and Southeastern Europe.

Improve the statistical coverage, ease-of-use, and accessibility of the National Transport Model

The current version of the NTM is quickly becoming outdated and MSTI is in the process of refreshing it. This is an opportunity to improve the next version by (i) strengthening the

model's statistical underpinnings through expanded survey inputs; (ii) simplifying the use of the model for analytical purposes; and (iii) making the model freely available to the general public, in alignment with international good practice.

Based on further feasibility studies, invest in inland waterway infrastructure and service delivery improvements

Croatia is blessed with navigable rivers, yet these are underutilized, particularly the Sava. Investments in inland waterways deserve careful viability consideration, which should reflect their contribution to climate change adaptation and mitigation, social cohesion, and regional integration. Croatia's navigable waterways only serve bulk cargo transport at present. But even here shippers could benefit from more effective ways of transporting low-value goods as an alternative to trucks. Importantly, Croatia's navigable waterways are geographically aligned with its lagging regions, which further makes the case for inland waterway transport investments to strengthen basic national multimodal connectivity between lagging and leading regions. The fact that the Sava is also the border between Croatia and Bosnia and Herzegovina means that developing this river is also a way to foster regional integration and cross-border collaboration in the Western Balkans.

Conduct further demand-supply and private sector assessment studies to better understand the operational needs of shippers in Eastern Croatia and the challenges facing carriers and logistics service providers serving this part of the country

To spur economic activity in Eastern Croatia through lower-cost and more efficient access to markets, a more granular analysis of shipper needs to and from this region should be conducted to promote the provision of containerized logistics operations.

Introduction

This report takes stock of Croatia's logistics sector at the national level. It aims to describe the sector's supply-demand composition, identify challenges and opportunities to improve sectoral performance, and recommend public policy measures to address these challenges and meet the opportunities at hand. Logistics is a broad term. On the supply side, it comprises the *provision of infrastructure* for the transportation and storage/handling of goods across modes (trucking, rail freight, air freight, maritime transport, and inland waterway transport) and commodity types (e.g., containerized/non-containerized, refrigerated/non-refrigerated); as well as the delivery of transportation and storage/handling services across a range of providers. On the demand side, it comprises a highly atomized base of cargo owners—"shippers"—with unique needs in terms of the types and quantities of commodities they bring to market, the operational requirements embedded in their supply chains, and the origin-destination profile of their transportation itineraries, among other dimensions of demand. This report assesses the supply and demand sides of Croatian logistics, with particular emphasis on road, rail, maritime, and inland waterway logistics, as these modes account for the majority of national freight volumes transported.

An assessment of Croatia's logistics sector is relevant for several reasons:

- 1. Logistics facilitates economic growth by enabling domestic and international trade—and Croatia needs to find ways to accelerate economic growth.** Croatia's living standards have not converged with those of the EU. By the end of 2019, Croatia's income per capita in constant Purchasing Power Parity terms relative to the EU average stood at roughly the same level it did in 2008, prior to the onset of the global economic crisis of 2008-2009. In other words, Croatia attained no gains in income convergence relative to the EU in the 11 years between 2008 and 2019.¹ The impact of the coronavirus disease 2019 (COVID-19) pandemic on the Croatian economy, which led to economic contraction in 2020 that was both severe in absolute terms and deeper than that of the EU as a whole, will further exacerbate this gap (see Box 1). Meanwhile, the percentage of the Croatian population at risk of poverty and social exclusion—28.4%—is above the EU average. The nominal U.S. dollar value of Croatia's GDP at market exchange rates, which peaked at US\$70.3 billion in 2008, totaled US\$60.4 billion in 2019. And the rate of emigration ("negative net migration") accelerated in the period 2010–2015, roughly coinciding with Croatia's most recent recessionary period, compared to 2005–2010. Today Croatia remains a net source of emigrants—including skilled workers, which particularly reduces economic potential and disproportionately affects lagging regions.

¹ Eurostat; data available at <https://ec.europa.eu/eurostat/databrowser/view/tecoo114/default/table?lang=en>.

BOX 1. CROATIA'S RECENT ECONOMIC CONTEXT: 2008–2020

In 2015 Croatia emerged from a protracted, six-year economic recession that lasted from 2009 to 2014. Between 2008, the last pre-recession year, and 2014, Croatia's GDP shrunk at an average annual rate of -2.0% in real terms and the unemployment rate increased by more than 6 percentage points, from 13.0% to 19.3%, after peaking at 19.8% in 2013. All told, the size of Croatia's GDP was 12% smaller in real terms by year-end 2014 compared to pre-recession levels. The prolonged recession resulted from a combination of corporate and consumer deleveraging after excessive accumulation of debt in the 2000s, further exacerbated by: (a) lackluster growth in Croatia's main commercial partners in Europe, which constrained export growth and reduced tourism demand; (b) feeble consumer spending in the face of increasing unemployment; and (c) a slower-than-hoped pace of adoption of structural reforms by the Government of Croatia (GoC), including on state-owned enterprise (SOE) restructuring, improvements to the ease of doing business as a key driver of foreign direct investment, revamped targeting of social protection benefits, and insufficient infrastructure investment. The general government deficit widened during the recession, as did the level of public debt as a percentage of GDP. This risked further deterioration of Croatia's access to credit in financial markets, and triggered a series of fiscal adjustment measures by the GoC to comply with the EU's excessive deficit procedure (EDP). While undoubtedly beneficial over the medium and long term, Croatia's 2013 EU accession generated short-term headwinds for Croatia in the middle of the recession that further complicated the recovery process, including through adverse changes in trading conditions (e.g., vis-à-vis members of the Central European Free Trade Agreement), EU membership fee payment obligations, and increased policy complexity regarding the planning and execution of EU structural funds and the implementation and enforcement in practice of EU directives and regulatory mandates.

Since 2015 and through the end of 2019 the Croatian economy grew steadily again, although at modest rates—until the COVID-19 pandemic struck in early 2020. After enduring arguably the most protracted period of uninterrupted economic contraction in the EU linked to the 2008 financial crisis (with the possible exceptions of Greece and Italy), Croatia returned to economic growth in 2015. Growth peaked at 3.5% year-on-year in 2016, and averaged 2.9% per year between 2014 and 2019—a period of five consecutive years of sustained growth. The recovery resulted from (i) more favorable external conditions, which facilitated export growth and strengthened tourism demand (tourism accounts, directly and indirectly, for over a quarter of Croatia's GDP); (ii) a gradual but significant improvement in consumer confidence and spending, as unemployment fell steadily and by the end of 2019 reached its lowest level since independence (7.8%); and (iii) progress with structural reforms, including on SOE restructuring, public investment in connecting infrastructure (e.g., maritime ports), labor market reforms, and improvements to the business environment. The recovery underpinned substantial fiscal consolidation. In 2017 Croatia attained its first general government budget surplus since independence; the government budget was expected to remain roughly in balance over the medium term; and the level of public debt relative to GDP—while still elevated at about 71.5% by year-end 2019—had come down from its peak of 86.7% in 2015 and was expected to continue to fall, thus creating fiscal space that could support pro-growth policies going forward—like infrastructure investment and removal of red tape. These developments were ultimately reflected in Croatia earning an investment grade in 2019.

As in much of Europe, the impact of COVID-19 on the Croatian economy in the short term has been severe, and this was further exacerbated by devastating natural disasters. After several years of expansion, the economy is estimated to have shrunk by 8.4% in real terms in 2020,²

² Croatian Bureau of Statistics, First Quarterly Gross Domestic Product Estimate for the Fourth Quarter of 2020, February 26, 2021.

the fourth largest estimated economic contraction in the EU for 2020, after Spain (-11.1%), Italy (-9.2%), and France (-9.0%). Croatia's reliance on tourism as a significant driver of economic activity—prior to the pandemic, the tourism sector's economic contribution was expected to grow to about a third of Croatia's GDP by 2027, up from nearly 20% today—explains much of the decline amid the onset of the COVID-19 pandemic. But the contraction is broad based, affecting consumer spending, gross fixed capital investment, and exports. This is in part a reflection of the fact that the Croatian economy was further disrupted in 2020 by two major earthquakes. The first, in March 2020, struck the capital city of Zagreb—home to 20% of Croatia's population and accounting for 30% of its gross domestic product—and the surrounding Zagreb and Krapina-Zagorje counties. The earthquake resulted in EUR11.3 billion in damage, including thousands of housing buildings and businesses, as well as hundreds of vital health and education facilities amid a global pandemic. There was one fatality, 26 injuries, and thousands of displaced people. The second earthquake, in December 2020, struck the towns of Petrinja and Glina, the city of Sisak, and surrounding areas in Central Croatia. It resulted in at least 7 fatalities and severe damage to local health facilities amid widespread damage to buildings and infrastructure. Despite these setbacks, and assuming a gradual but sustained transition from the pandemic, current expectations are that Croatia's economic growth will rebound sharply in 2021, at a rate of 6.0%, and is expected to average 3.5% per year for the 2022–2025 period. However, this pace of recovery may still be insufficient to achieve Croatia's national aspirations and EU economic convergence potential.

Going forward Croatia faces the challenge of finding new sources of growth that can accelerate income convergence, strengthen economic resilience, and reduce carbon intensity; the impact of COVID-19 has further deepened the urgency of addressing this gap. Long-term recovery will require a combination of further adoption of structural reforms; sectoral revitalization through a more favorable business environment that can boost private investment and incentivize efficiency gains as a driver of both productivity growth and reductions in harmful emissions; and higher, better targeted, and more timely executed growth-oriented public investment.

As a first step towards recovery, the European Union (EU) has prepared a financial package designed to pave the way for an accelerated economic recovery underpinned by a digital and green transformation, to make society and the economy more resilient to future crises. The Multiannual Financial Framework for the period 2021-2027 includes a plan for the recovery of the EU economy after the COVID-19 pandemic, an instrument called Next Generation EU. The Recovery and Resilience Facility (RRF) has been introduced as a part of the Next Generation EU instrument, which will allow Member States to use grants and funds in a total amount of €672.5 billion to finance reforms and related investments to accelerate recovery and increase economic resilience. A prerequisite for the use of RRF funds is the adoption of a National Recovery and Resilience Plan (NRRP) for 2021-2026, which in accordance with the objectives of the RRF includes reforms and investments to be implemented in the coming years, and no later than August 31, 2026.

Reforms and investments within the first component—Economy—of Croatia's National Recovery and Resilience Plan (NRRP) 2021-2026 aim to systematically integrate sustainable development, green and digital transition of the economy, and operationalize them into concrete measures and mechanisms at the national and regional level. Transport policies and strategic goals planned within the NRRP are also consistent with the UN Sustainable Development Agenda 2030 and the European Green Deal. In this sense, the reform of the transport sector is a comprehensive effort aimed at developing a sustainable transport system, including reforms of the railway, road, and air sectors, as well as reform of maritime and inland waterways. Stated reforms, through the development of low-carbon transport systems, will ultimately improve the competitiveness of the economy. Investments that contribute to the implementation of reforms will also have an impact on the development and strengthening of the logistics sector, such as: (i) railway transport reform to increase the competitiveness

and efficiency of the railway sector to provide better services to users in passenger and freight transport and raising the economic competitiveness of the Republic of Croatia; (ii) maritime and inland navigation reform through the modernization of ports open to public traffic and the modernization and renewal of the inland waterway fleet in the context of environmental protection and enhanced safety of navigation; (iii) improvement of the reporting and management system of passenger and freight transport in road transport; (iv) reconstruction and rehabilitation of certain sections of railway infrastructure; and (v) application of green technologies in rail, road, and maritime transport.

Development of a uniform transport network, with expanded and modernized rail infrastructure and infrastructure for public transport and intermodality, is planned in accordance with the Country Specific Recommendations (CSR), resulting in reductions in the share of fossil fuel-powered passenger cars and reductions in greenhouse gas emissions by the transport sector, as well as the elimination of obstacles to the mobility of people and goods.

Source: Authors' research, with data from the IMF World Economic Outlook Database, Eurostat, Croatian Bureau of Statistics, and the Croatia Earthquake Rapid Damage and Needs Assessment Report 2020.

2. Efficient logistics improve firm-level productivity by facilitating access to international markets, as Croatia's exporting firms are more productive than non-exporting firms.

Available evidence shows that within Croatia's manufacturing sector the labor productivity of exporting firms is 35% higher than that of non-exporters.³ Gains in logistics efficiency, through levers like improved and expanded connectivity, more predictable supply chains, and lower logistics costs, can become a catalyst of sustained productivity growth and economic expansion in Croatia.

3. Croatia's logistics performance has room for improvement. By the World Bank's Logistics Performance Index (LPI) standard, Croatia's international logistics performance sits towards the bottom of the EU. While Croatia outperformed EU member states Romania, Bulgaria, the Slovak Republic, Lithuania, Latvia, and Malta in 2018 on the LPI scale, it fell considerably short of the performance of Greece, Slovenia, Poland, Italy, Belgium, the Netherlands, and Germany—all of which are gateway countries competing with Croatia to handle cargo moving to/from the coveted Central European hinterland. Outside the EU, Croatia underperformed upper middle-income countries with similar levels of development and aspirations as Croatia regarding domestic and transit/corridor logistics, such as Malaysia and Turkey; and even lower-middle income countries that have designated freight logistics as a pillar of their economic development trajectory, such as Vietnam and India. Throughout its process of EU accession, and to this day, Croatia has been successful in developing and maintaining a high-capacity motorway network of international standard quality, which has improved domestic and international connectivity and solidified national cohesion.⁴ But no matching push was made to expand rail and inland waterway infrastructure. This has (a) prevented Croatia from fully capitalizing on its geographic location to become a rail-based gateway to Central and Eastern Europe, and (b) kept the logistics and connectivity potential of the Sava River largely untapped, while expanding the logistics impact of the Danube River remains a work in progress.

³ Valdec, M. and J. Zrnc (2018), "Characteristics of Croatian Manufacturing Exporters and the Export Recovery during the Great Recession – the CompNet Trade Module Research Results", Croatian National Bank.

⁴ Between 2001 and 2008, Croatia's motorway network expansion investments totaled EUR7.7 billion.

- 4. There is limited information available on Croatian logistics, particularly from the perspective of informing policy making.** Beyond high-level summary metrics like LPI and basic national infrastructure accounting, relatively little is known about the underlying, disaggregated functioning of Croatia's logistics system, particularly regarding service delivery. Most available assessments of Croatia's logistics performance focus on road, port, and in particular rail infrastructure provision (or gaps thereof). With the partial exception of service provision in the rail sector, where the total number of freight rail operators is limited, the nature of the much more fragmented market of shippers, truck carriers, other non-rail carriers, and logistics service providers moving and handling freight—i.e., the end-users of the trunk infrastructure—remains opaque. The shippers' perspective, for example as to the composition of their logistics needs relative to the quality, demand-supply adequacy, and value-for-money of service provision available in the marketplace, whether in rail or other modes, is seldom discussed in existing literature.

For example, the two most recent installments of the European Commission's Transport in the *European Union* report (April 2018 and March 2019) summarize the "main current [transport] issues" in Croatia as being (i) "outdated and limited" railway infrastructure, (ii) restrictive railway regulations and policies, (iii) insufficient uptake of renewable energy and lower-emission modes in transport, and (iv) Croatia's poor road safety record (fifth worst performer in the EU). The report calls for promoting "modal shift to rail" as a means of reducing transport sector emissions; investing in railway infrastructure, including maritime port linkages (according to the report, Croatia has completed only 5-6% of the core Trans-European rail network within its territory, compared to an average completion rate of 60% for the EU); and further removing barriers to the entry of private operators into the railway sector. These are real and substantive issues, but further clarity will be needed, inter alia, as to the magnitude of the road-to-rail modal shift window, the kinds of interventions that can make such a shift come about in practice, the strategic rationale for rail capacity expansion and the ways in which this should be financed, and the measures that could simultaneously be taken to decarbonize the historically dominant trucking sector.

- 5. Freight transport and logistics generate negative externalities, chiefly including the emission of greenhouse gases (GHGs) and local pollutants, which are not internalized by the emitting parties.** Gains in logistics efficiency, such as through avoidance of unnecessary freight trips or the use of low-carbon transport modes, would directly contribute to meeting Croatia's emissions reduction obligations under the EU's Effort Sharing Regulation through 2030, and to making supply chains more resilient to climate change impacts.

This report will shed light on—and contextualize—the above issues to inform public policy in a way that reflects market supply-demand concerns. Its intended primary audience is public sector decision makers in Croatia, within and beyond the Ministry of Sea, Transport and Infrastructure (MSTI). Private sector firms—shippers, carriers, and logistics service providers—based in Croatia or considering entering the Croatian market are another important audience, as the findings of this report can inform private sector decision making, including with regard to engaging public sector agencies in support of improved logistics outcomes. Scholars and students, who may take this work as a basis for further research; and the general public, which is exposed to logistics operations, directly or indirectly, in myriad ways and should expect Croatian logistics to contribute to its well-being and that of Croatia as a whole, are also part of the report's target audience.

The major questions addressed by the report are:

- 1.** What is the composition of Croatia's logistics system in terms of modal activity, on the supply and demand sides?

2. What is the relative carbon intensity of the different modes of freight transport in Croatia, where are the main opportunities for GHG emission reductions, and what kinds of policy levers could be used to meet them?
3. Where, what, how much, and in what mode does cargo move in Croatia?
4. What is the utilization of the main rail, road, and maritime port trunk infrastructure of Croatia, by comparing installed capacity to demand?
5. How competitive is the Port of Rijeka to serve intercontinental supply chains between Asia and Central Europe compared to other European ports?
6. What are the main operational practices of Croatia-based shippers, carriers, and logistics service providers, and what challenges do they face?

To assess the above questions, the report is organized as follows. Chapter 1 describes the structure of supply and demand in Croatia's logistics system by disaggregating it by mode and other component parts. **Chapter 2** describes the nature of the movement of freight within Croatia and between Croatia and key regional trading partners based on data from Croatia's National Transport Model (NTM). **Chapter 3** assesses Croatia's competitiveness in international logistics relative to other ports of Europe, by quantitatively estimating the logistics cost competitiveness of the Port of Rijeka —Croatia's main maritime port—and associated inland rail freight connections serving cargo moving between East Asia and the Central European hinterland. **Chapter 4** presents the results of a bespoke survey, conducted for this report, of 20 prominent Croatia-based freight stakeholders, to shed light on the nature of their operations, their needs, and their views on policy-relevant issues. **Chapter 5** concludes with policy recommendations to improve sectoral performance.

CHAPTER 1

The Composition of Croatia's Logistics System

CHAPTER 1

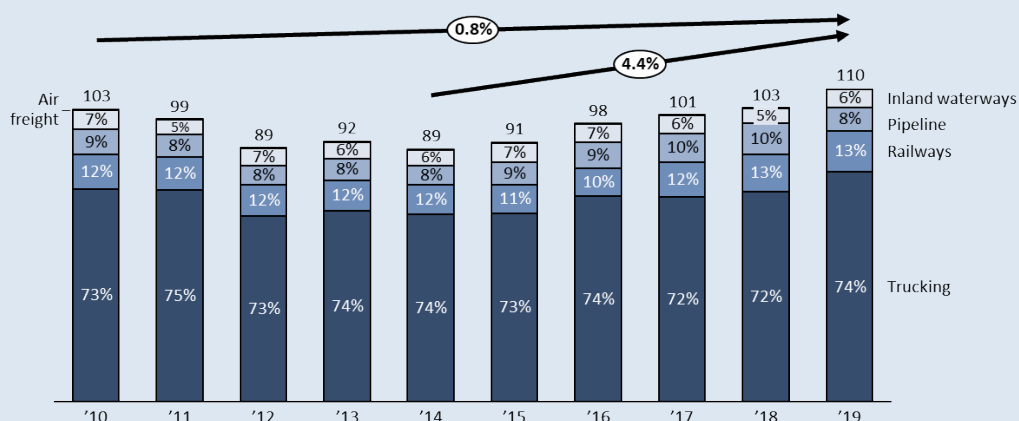
The Composition of Croatia's Logistics System

OVERVIEW

Croatia's logistics system is dominated by truck-based supply chains and closely tracks the overall economy in terms of cyclical growth. In 2019, 110 million tons of freight were transported within Croatia, three quarters of which by truck (Figure 1.1). National freight tonnage saw declines from 2010 through 2012, followed by a flat market through 2014, all associated with the aftermath of the 2008-2009 global economic crisis and related declines in domestic and international economic activity. Freight volumes have recovered since, along with the broader Croatian economy, but only to the point of returning to the 2010 absolute tonnage volumes as of 2018, and then slightly surpassing this mark in 2019. As a result, compared to 2010 overall freight transport activity in Croatia has barely grown, at an average annual growth rate of 0.8% over the 2010–2019 period. Since the 2014 trough, however, national tonnage has grown steadily, at an average annual rate of 4.4%, or about 50% faster than the rate of growth of the Croatian economy over the same period (2.9%).

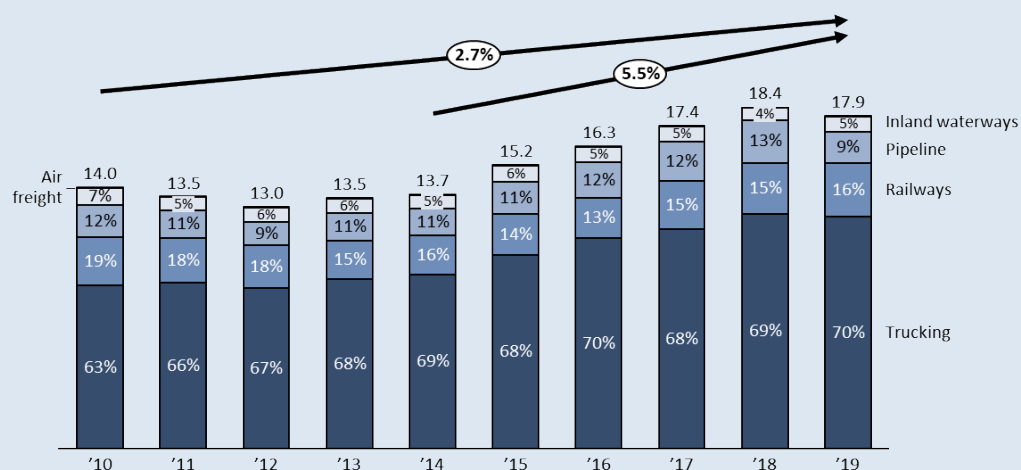
The trucking sector's dominance of Croatia's freight logistics market is both significant and consistent over time. The sector's national tonnage share has remained within the 72–75% range for the past 10 years. The picture does not change much when activity is measured in ton-km, a metric that better accounts for the transportation intensity of the underlying logistics operations, by controlling for distances travelled. Specifically, trucking accounts for 70% of freight ton-km and remains overwhelmingly dominant (Figure 1.2). This is significant

FIGURE 1.1.
Freight Tonnage Transported
in Croatia by Mode,
2010–2019
Millions of metric tons



Source: Source: Croatian Bureau of Statistics; World Bank analysis and estimates.

FIGURE 1.2.
Freight Ton-km
Transported in Croatia by
Mode, 2010-2019
Billions of ton-km



Source: Source: Croatian Bureau of Statistics; World Bank analysis and estimates.

given that truck movements are generally associated with shorter lengths of haul than rail, inland waterway, or pipeline shipments, and is a result of the preponderance of international shipments in Croatia's transport task (i.e., shipments either originated in or destined for points outside Croatia, as well as transit shipments where both origin and destination are outside Croatia). The fact that the railways have lost ton-km market share over time (16% today compared to 19% in 2010) suggests that the trucking sector has further penetrated the long-distance markets where rail transport tends to be more competitive. This further complicates the goal of promoting—and attaining—modal shift from trucks to lower-carbon, lower-cost modes like rail and inland waterways, an important goal for both Croatia and the EU.⁵

Several factors explain the relative attractiveness of Croatia's trucking industry. While Croatia is hardly alone in Europe—and indeed among most upper middle-income and high-income countries globally—regarding the preponderance of trucking in freight logistics (Figure 1.3), the main reasons for this outcome are: (a) the ready availability of high-quality road infrastructure and trucking services nationally compared to rail freight services (Figure 1.4); (b) the high number of road carriers offering their services on the market, which has resulted in competitive transport service prices;⁶ and (c) the lengths of haul of Croatian freight logistics, where the average shipment—across all modes and commodity types—traveled 162 km in 2019 (and as little as 136 km in 2010). In addition to competitive prices, road carriers offer a higher level of flexibility compared to rail carriers in terms of frequency of service and delivery timing and geographic coverage. The structure of export markets is another important element. When it comes to import and export flows, the Croatian economy is strongly linked to its immediate neighboring countries. At these distances for international itineraries, road transport is often highly competitive compared to rail transport.

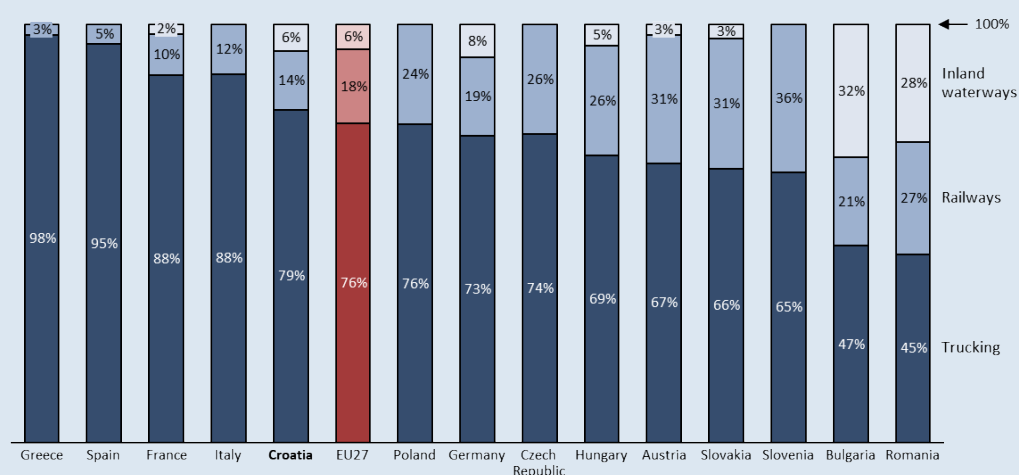
⁵ European Commission, Directorate-General Mobility and Transport (2019), *Transport in the European Union: Current Trends and Issues*, March 2019.

⁶ There are approximately 4,000 trucking and storage companies active in Croatia, employing approximately 60,000 people. In the past, when faced with operating cost increases (for example, increases in fuel prices or border crossing delays), Croatian trucking companies have generally been unable to pass on the increases in costs to their customers due to the highly competitive nature of the sector.

FIGURE 1.3.

Freight Transport Modal Split in Selected European Countries: 2019

In percent of total ton-km transported by inland waterways, trucks, and railways

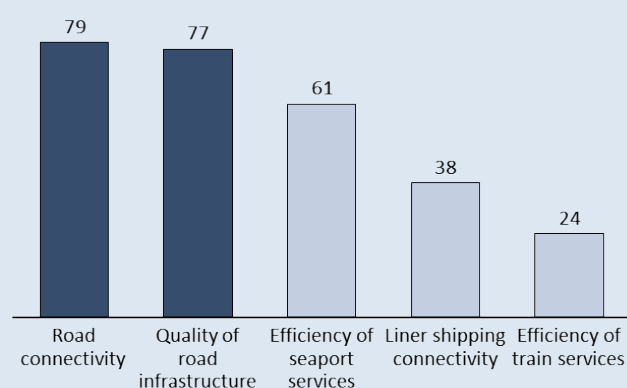


Source: Croatian Bureau of Statistics; Eurostat; World Bank analysis.

FIGURE 1.4.

Croatia's Scores in the 2019 Global Competitiveness Index Values for the Infrastructure Pillar Sub-components

0-100 where 100 = best



Source: World Economic Forum.

There is also, like in other countries, a demand component to this outcome: trucking services are dominant because this is what the shipper base overwhelmingly demands and is familiar with. Supply chains are subject to considerable inertia, and shippers do not always manage explicitly the logistics costs consequences of their own modal and routing choices. As a policy goal, multimodality and modal shift are ultimately exposed to the behavioral aspect of logistics: the need, on the part of shippers and their logistics service providers, for more proactive management of logistics costs at the shipment level, combined with a willingness to operate itineraries that may be more operationally complex than a comparatively simple truck-only load, but which may also result in savings in logistics costs and higher levels of productivity.

On the supply side, greater use of rail transport over the medium term (5-10 years) could be realized if the level of competitiveness of rail carriers were to increase compared to that of road carriers. This could be achieved by intensifying infrastructure investment (e.g., along the Rijeka-Zagreb railway line), and through more robust activity on the part of rail carriers aimed at offering innovative and cost competitive transport services. Protecting investments in railway infrastructure maintenance is another challenge. Rail infrastructure maintenance is not regularly conducted with secured funding, which has an impact on the sector's ability

to capture freight, particularly freight currently moved by trucks. The most promising sectors where larger quantities of freight can be transported by rail within a short period are containerized transport (primarily to/from the Port of Rijeka towards the node of Zagreb and on to the Central European hinterland) and bulk freight transport for major freight generators (e.g., cereals, fertilizers, and oil and derivatives). The transport of secondary raw materials and the distribution of palletized goods are potential expansion markets for the rail transport sector. However, in view of prices and adaptability of delivery deadlines, the current level of supply of rail transport services is not as competitive for the latter commodities as that of road carriers.

FREIGHT TRANSPORT SECTOR EMISSIONS

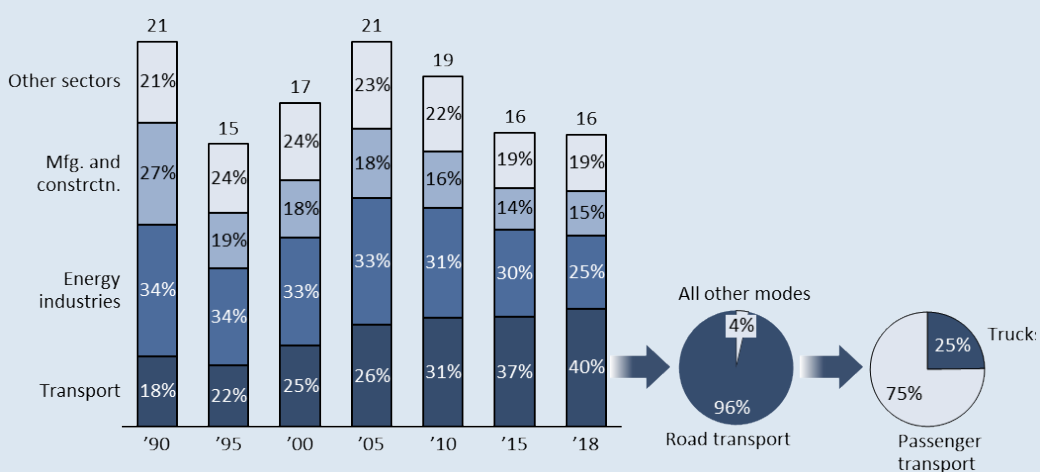
Transport is a major source of CO₂ emissions in Croatia. In 2018, transport sector emissions accounted for a significant 40% of total energy-related CO₂ emissions, more than any other category of energy-consuming economic activity, and about two-thirds larger than the corresponding share globally (24%) (Figure 1.5). The vast majority of Croatia's transport emissions—96%—are accounted for by the roads sector, well above the corresponding global figure of 75%. However, road freight transport (i.e., trucking) accounts for only 25% of total road transport emissions, with the remaining 75% originated from passenger transport, and above all the use of private vehicles. This is just above half the global share of road sector emissions accounted for by trucking (45%). Of all transport sector CO₂ emissions in Croatia, trucking accounts for 24%, compared to a global average of 33%.⁷ Similarly, of all transport sector CO₂ emission in Croatia, freight transport in general (across all modes) accounts for 25% of all transport sector emissions, compared to a global average of 44%.⁸ As a share of Croatia's entire energy-related CO₂ emissions, freight transport accounts for approximately 10%, still below the corresponding global figure of 11%,⁹ but much more in line with global experience compared to its share of transport sector emissions only.

⁷ International Energy Agency (2017), *The Future of Trucks: Implications for Energy and the Environment*.

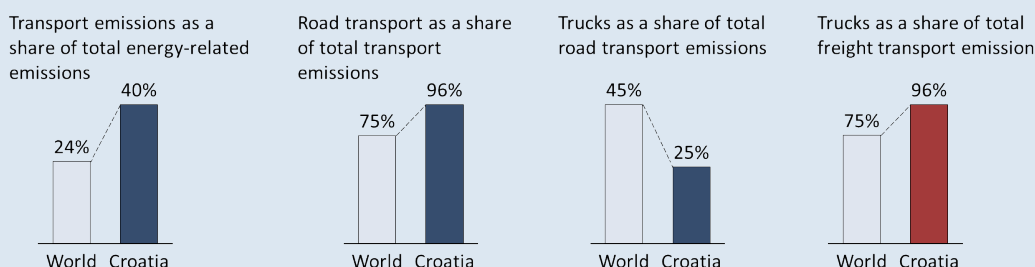
⁸ International Energy Agency (2017), *CO₂ Emissions from Fuel Combustion – Highlights*; World Bank analysis and estimates

⁹ Ibid.

FIGURE 1.5.
Croatia's Energy-related
CO₂ Emissions by Sector and
Disaggregation by Freight
Transport Activity Type,
1990-2018 (selected years)
Millions of tons



CO₂ Emissions: Key shares for Croatia compared to global emission shares¹⁰



Source: Croatian Greenhouse Gas Inventory for the Period 1990-2018 (National Inventory Report 2020); Croatian Bureau of Statistics; International Energy Agency (2017), *The Future of Trucks: Implications for Energy and the Environment*; International Energy Agency (2017), *CO₂ Emissions from Fuel Combustion – Highlights*; World Bank analysis and estimates.

There is a case to be made that, despite the relative dominance of passenger transport in Croatian emissions, the freight transport sector—and above all, and as a matter of prioritization, the trucking sector within it—should nonetheless aim to reduce its carbon footprint. While the transport sector contributes significantly to total energy-related GHG emissions in Croatia, the expected contributions of freight transport in particular—which accounts for a relatively modest 25% of total transport emissions—to overall emission reductions efforts are likely modest compared to reductions in emissions in the dominant passenger transport sector (and in particular the private vehicle subsector). On the other hand, the share of freight transport emissions in Croatia's total energy-related CO₂ emissions (i.e., across sectors beyond transport) is roughly the same as that of the world as a whole. To the extent that there is a global agenda to reduce freight transport emissions at the national level as a means to reduce overall energy-related emissions, Croatia would have roughly the same incentive to join this effort as the “average” country. More concretely, under EU policy Croatia is committed to reducing GHG emissions from sectors not covered by the European Emissions Trading System (ETS), including transport, by 7% compared to 2005 levels, and the freight transport sector can play an important role in meeting this target. This can be done by, inter alia, championing measures to promote modal shift and a greater use of rail and inland waterway logistics in the national freight transport task. Furthermore, Croatia's trucking operations account for a much larger share of national freight transport emissions than the corresponding share globally (lower right-hand panel of Figure 1.5). As such, and building on lessons from the international experience, Croatia's emission reduction efforts should also include, critically, interventions to make the trucking sector more environmentally efficient.

In addition to the goal of reducing GHG emissions as a matter of climate change risk mitigation, the equally important goal of reducing other negative externalities of the freight transport sector should be taken into consideration to make the case for efficiency gains. With respect to the trucking sector, these externalities include local pollutant emissions, road accidents, motorway and local road congestion, and road infrastructure wear and tear. The remaining subsections in this chapter will explore mode-specific, multimodal, and public administration opportunities to reduce GHG emissions from the freight transport sector. This can contribute to meeting Croatia's climate targets. It can also help make Croatia's logistics system more cost-effective and resilient, through multimodalism, greener trucking operations, and the provision of operationally reliable rail and inland waterway infrastructure.

¹⁰ Data for global shares are for 2015; data for Croatia are for 2017; both are the latest for which data are available across all categories as of the time of writing.

CROATIAN TRUCKING SERVICES: SECTORAL PROFILE

As in most competitive, liberalized trucking markets around the world, Croatia's trucking sector is fragmented. Our survey findings suggest that the average profit margin of trucking companies in Croatia is in the order of 3-5% (see Chapter 4), on account of keen competition. These are not abnormally low profitability levels, and are in line with other trucking markets in high-income countries, such as North America. But this gives rise to challenges that are relevant to public policy. For example, despite the high-quality nature of the national motorway network (see Figure 1.4), freight transport still makes up about 50% of total transport volume on Croatia's (lower-capacity) state and county roads, which significantly deteriorates the condition of road infrastructure, increases maintenance costs, and exposes local communities to emissions of local pollutants, road accidents, and congestion. Transit traffic could be partly redirected to motorways and railways, which would reduce the load on the network of state and county roads. A regulation was introduced in 2019 restricting or prohibiting transit traffic on parts of the secondary road infrastructure (state, county, and local roads), but its impact will only be determined over time.¹¹

Unlike other EU member states, Croatia has not introduced measures to encourage the more active inclusion of rail services as a complement to trucking services along the most significant national freight corridors. Austria, for example, has adopted several interventions to encourage freight transport by rail or inland waterways that could serve as an example to Croatia. In addition to liberalizing its rail freight transport market, which Croatia adopted as well, the measures include:

- Development of an intermodal transport masterplan;
- Expansion of the railway network and improvement of inland waterways as environmentally friendly modes of freight transport; this also includes liberalization of specific road corridors for the initial and final road legs on 'rolling road' or 'piggy-back' truck-on-rail (Ro-La) connections between specified rolling road terminals and nearby border stations (i.e., no bilateral road permit for goods transport is necessary on these corridors, provided that the journey is an initial or final road leg on a rolling road connection);
- Optimization of public transport;
- Incentivize demand for freight transport towards environmentally friendly means of transport, such as through financial support of investments in facilities and systems as well as mobile equipment specifically required for the transportation or handling of goods in combined transport. This applies to all forms of combined transport, implying any combination of roads, railways, and inland waterways/coastal shipping and tax policy that stimulates road carriers to use intermodal transportation technologies, such as reinforced road-going trailers for piggy-back trailer-on-flat-car (TOFC) rail-road operations;¹²
- Introduction of a kilometers-travelled-based toll system for heavy vehicles;
- Adoption of limitations to the use of road freight vehicles under certain conditions (night driving, speed limits aimed at noise reduction, EU standards for vehicle engines), which, all else being equal, raise barriers to entry, reduce negative externalities, and make combined transport more attractive; and
- Introduction of an expanded offer of capacities for piggyback rail intermodal transport.

The competitiveness of Croatia's trucking sector is on a long-term trajectory of improvement, which helps explain the sector's ability to grow or maintain market share over time. This is perhaps best illustrated by the increasing rate of outsourcing of trucking services by

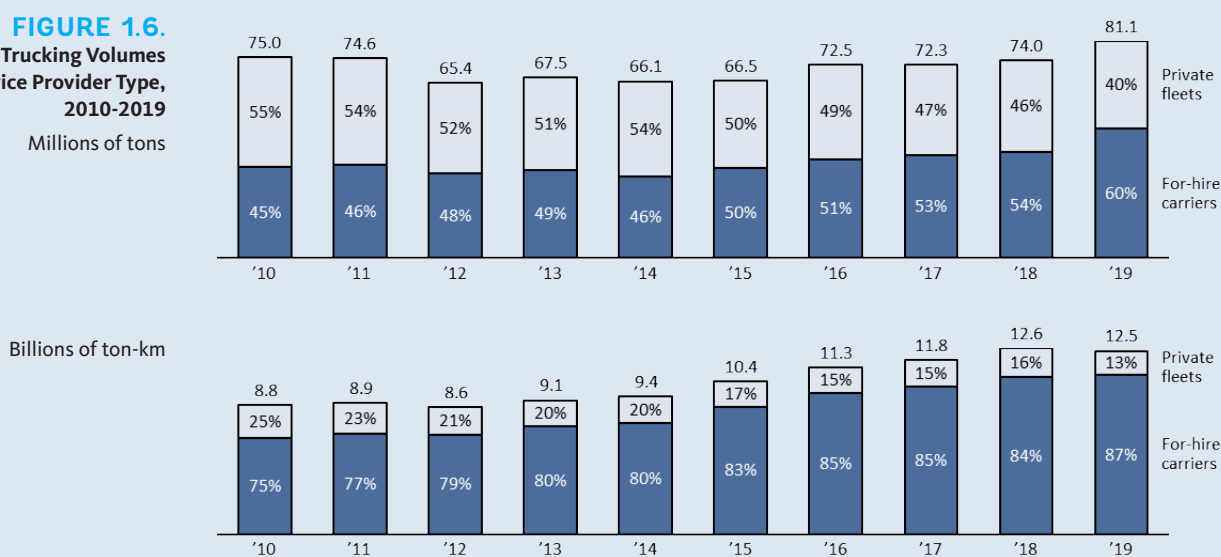
¹¹ Regulation Limiting the Use of Certain Public Roads for Freight Vehicles Whose Highest Permitted Weight Exceeds 7.5 Tonnes, Ministry of the Sea, Transport and Infrastructure, 2019. Due to its recency, the impact of this regulation is yet to be corroborated.

¹² See for example <https://www.bmk.gv.at/en/topics/transportation/combinedtransport.html>.

Croatia-based or Croatia-exposed shippers. Whereas in 2010 45% of all truck tonnage was transported by for-hire carriers, by 2019 the for-hire share had risen to 60% (Figure 1.6). A similar trend is seen in ton-km volumes, which reflect distances travelled, where for-hire carriers account for 87% of all demand, up from 75% back in 2010. This signals an increasing level of comfort by the shipper community with the services of truck carriers, and may also signal an increasing level of comfort with the outsourcing of logistics services in general, beyond trucking.

Improvements attained by the trucking sector over time include key dimensions of environmental—as well as operational—efficiency. A major dimension of environmental and operational efficiency in the for-hire provision of trucking services in Croatia is increasing, in that for-hire carriers' incidence of empty miles driven steadily declined over the 8-year period between 2010 and 2018 (Figure 1.7). While the most current reading of this indicator, 24% in 2019 (latest year for which data is available), partially reversed this positive trend, it is still not far from that of mature markets like the U.S. (21%)¹³. Reductions in empty miles driven have implications beyond trucking firms' profitability and their customers' logistics costs: they accrue significant benefits to society, through reductions in environmental externalities caused by emissions of greenhouses gases and local pollutants, avoidable road congestion, and accidents. Keeping 2019 loaded miles constant, and compared to 2010 levels of empty miles driven as a percentage of total miles driven, in 2019 the Croatian for-hire trucking industry in effect avoided driving 52 million km, which, had they materialized, would have resulted in estimated emissions of 58,000 tons of CO₂, 4.1 tons of PM₁₀, and 407 tons of NO_x, with an estimated aggregate economic value in 2019 of EUR13.3 million at EUR69 per ton of CO₂, EUR42 per kilo of PM₁₀, and EUR22 per kilo of NO_x. The corresponding figures for 2018, when Croatian for-hire truck carriers reached their lowest incidence of empty miles driven since at least 2010, are even higher: avoidance of 81,500 tons of CO₂, 5.7 tons of PM₁₀, and 569 tons of NO_x, with an estimated aggregate economic value in 2018 of EUR18.3 million at EUR68 per ton of CO₂, EUR41 per kilo of PM₁₀, and EUR22 per kilo of NO_x.

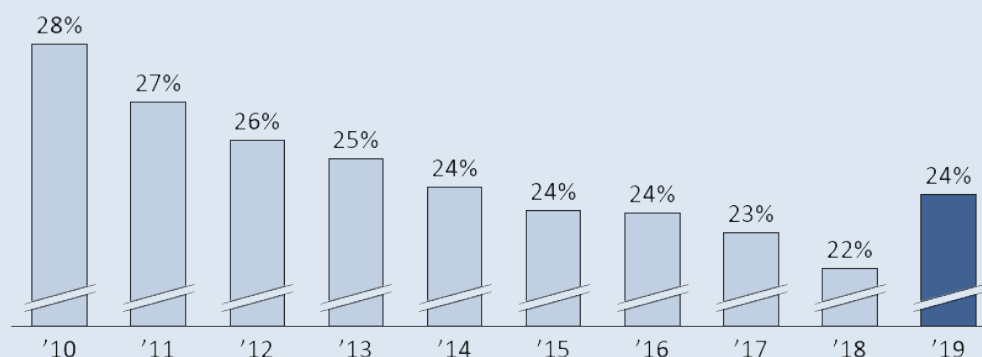
FIGURE 1.6.
Croatia's Trucking Volumes
by Service Provider Type,
2010-2019
Millions of tons



Source: Croatian Bureau of Statistics.

¹³ American Transportation Research Institute (ATRI) (2018), *An Analysis of the Operational Costs of Trucking: 2018 Update*, Arlington, Virginia.

FIGURE 1.7.
Croatia's For-Hire Trucking
Segment Incidence of Empty
Miles Driven, 2010-2019
In % of total miles driven

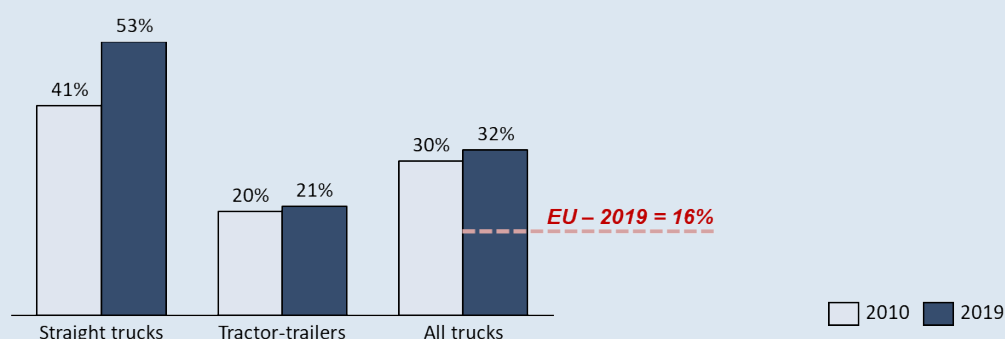


Source: Croatian Bureau of Statistics.

The above gains in environmental and operational efficiency due to reductions in empty miles driven may have been partially offset, however, by the industry's increasing use of older equipment, which tends to be less fuel efficient and more prone to breakdowns. In 2019 Croatia's share of truck km driven by equipment at least 10 years of age—10 years is widely considered a benchmark threshold for reduced environmental and operational performance of heavy-duty equipment—across both the for-hire and private fleet segments was higher than it was in 2010 for both straight trucks and tractor-trailers, and double what it was for the EU as a whole (Figure 1.8). While the use of older equipment tends to increase emissions per ton-km transported, the impact on returns on capital employed of trucking companies is less certain, as this increases some financial costs (e.g., through increased maintenance expenses and reduced miles per tractor per week) but reduces others (e.g., depreciation). Similarly, the logistics costs of beneficial cargo owners may increase or decrease, depending on the net effect between potential savings in transport costs on the one hand (through reduced service quality) and potential increases in inventory carrying costs on the other (through the need to increase safety stock inventories due to exposure to less reliable services). On the whole, Croatia's trend in vehicle fleet usage may signal the need to provide support to truck carriers (and possibly private fleets), particularly small and medium enterprises (SMEs) and owner-operators seeking to renew their fleets. This appears to be most urgent in the case of straight trucks, which tend to be used for shorter length-of-haul shipments, such as in urban logistics operations—a worrying trend given the exposure of local populations to air pollutants in cities.

FIGURE 1.8.
Share of Kilometers Driven
by Trucks over 10 Years Old
in Croatia's Trucking Industry:
2010 vs. 2019
In percent of total km driven by both
private fleets and for-hire carriers

In percent of total km driven by both
private fleets and for-hire carriers



Source: Croatian Bureau of Statistics; World Bank analysis.

Perhaps the most noteworthy feature—both a challenge and an opportunity—of Croatia’s for-hire trucking sector from an environmental and green logistics standpoint is that it still caters to significant amounts of bulk freight for which, in principle, lower-cost modes like rail and inland waterways would have an inherent competitive advantage as regards total logistics costs. For example, in 2019 a full 39% of all tons transported by for-hire truck carriers was accounted for by metal ores and other mining and quarrying products; an additional 13% of for-hire tonnage was accounted for by non-metallic mineral products, and 1% by coal and crude oil. This is already more than half—52%—of all tons transported by for-hire carriers that year, above the 47% share of these commodities in the for-hire tonnage mix in 2010; and it is at an even higher level for private fleets, at 61%. This signals potential opportunities for modal shift. The short lengths of haul involved, however, significantly reduce the modal shift window in Croatia.

CROATIAN RAIL FREIGHT TRANSPORT: SECTORAL PROFILE

Croatia’s current level of railway infrastructure development lags significantly behind the EU average and it is no longer fit for purpose. Specifically, only 5-6% of the national rail network has been upgraded to meet the Trans-European Transport Network (TEN-T) Core Network Standards,¹⁴ compared to up to 60% in the rest of the EU. Croatian railway infrastructure and operations were originally developed for the needs of a nation with an economic structure where agriculture, industry, and manufacturing accounted for 66% of GDP, while tourism accounted for only 4.1% of value added. Today these shares have largely reversed as the economy has gone through significant realignment, placing services as a dominant sector, accounting for 66% of GDP, with 18% of this accounted for by tourism alone, and increasing the relative share of containerized freight, like consumer goods, in the freight mix as maritime connectivity and availability of logistics services have expanded.¹⁵ **These changes have had a significant negative impact on the actual and potential Croatian market for rail freight, as changes in economic structure were not matched by corresponding changes in the orientation of the rail sector as regards infrastructure and service delivery.**

Other structural factors, above all lengths of haul, also determine—and in practice limit—the size of the domestic market ‘catchment’ opportunity for rail freight in Croatia, leaving international transit services as the most promising growth market. The national economy is limited in scope and geography as the distances are short for domestic movements, while the main potential for diversion and more extensive use of intermodal containers and automatized bulk rail is offered by cross-border traffic. When analyzing the countries to which goods are exported, it is evident that the flow of goods in rail transport is largely oriented to neighboring countries: Bosnia and Herzegovina, Hungary, Italy, Austria, Slovenia, and Serbia. This is supported by the fact that most of Croatia’s demand for rail freight traffic (95%), accounting for 75% of all gross ton-kilometers, is situated on two main freight corridors: (i) the Mediterranean Corridor, referred to as RH2, which runs along Rijeka-Zagreb-Koprivnica-Budapest; and (ii) the Pan European Corridor X, referred to as RH1, which runs along Ljubljana-Savski Marof-Zagreb-Tovarnik-Belgrade. However, international (containerized and bulk) movements rely heavily on road transport.

The condition of railway infrastructure is one of the factors limiting improvements to the system of logistics services in Croatia. If the designed technical and functional parameters of the railway network in Croatia (e.g., share of two-track lines, permitted and achieved line

¹⁴ TEN-T comprises two network ‘layers’: (i) the Core Network includes the most important connections, linking the most important nodes, and is to be completed by 2030; and (ii) the Comprehensive Network covers all European regions and is to be completed by 2050.

¹⁵ World Bank (2013), Croatia Railway Policy Note; World Bank research.

speeds, ratio of electrification on rail lines, permitted axle loads, etc.) are compared to the requirements that lines of the trans-European railway network should meet, we observe that, based on this criterion, the current condition of the lines is largely unfavorable (Table 1.1). A further issue lies in the actual technical and functional conditions, which have worsened due to age and deterioration, leading to a reduction of train speed limits.

According to official data, only 9.8% of the national railway network by track length is double-tracked, which greatly limits the absorption and transport capacities of individual lines. In freight transport this track structure also limits transport capabilities in terms of the number of trains and travel times. Given the current situation and the quantities of goods transported by rail, this track structure does not significantly impact railway system performance; however, an increased share of two-track lines would greatly increase absorption capacity, and thus potential train capacities on certain sections.

TABLE 1.1.
Comparison of Railway Network
Characteristics in Croatia and
Neighboring Countries

Country	Double-tracked length of network (%)	Avg Train speed (km/h)	Electrification (%)
Italy	45	170	49
Hungary	17	84	38
Slovenia	28	72	51
Croatia	11	59	37

Source: Croatian Bureau of Statistics; University of Zagreb research.

Despite the above shortcomings, Croatia's freight railways have over the past three years recovered market share lost, in both tons and ton-km, since reaching their lowest point of the past 10 years in 2016. The quantity of goods transported by rail dropped from 15 million tons in 2007 to 10 million tons in 2016, before partially recovering to 14.5 million tons in 2019. The increase in the quantity of goods transported by rail saw the tonnage share of rail transport rise to about 13% in 2019 compared to 10% in 2016. Railway transport market liberalization and improvements in last-mile rail connectivity infrastructure to match rising container volumes at the Port of Rijeka are considered the key reasons for this market share gain. HAKOM, the Croatian Regulatory Authority for Network Industries, reported that as of the first quarter of 2019, new rail freight carriers held a 40% share in ton-km and a 55% share in transported tonnage, a 7% rise over 2018.

Speed limitations do not seem to be a binding constraint on the use of rail freight in Croatia at present, but this could change in the future. Only 7.1% of open lines can sustain train speeds of 160 km/h, 12.2% can sustain speeds of 100 km/h, with 12.4% capable of speeds below 60 km/h. Given the line conditions, the speed of freight trains is significantly lower than the speed achieved by road vehicles. Given the commodity makeup of the cargo carried by railway operators at present, where the largest share comprises raw materials, oil and its derivatives, fertilizers, and agricultural products, commodities that generally do not require high-speed or time-definite transportation services, current available speeds are largely adequate. But this may not be the case in the future as and if the national commodity mix changes, and as other railway systems in neighboring countries may improve performance. This is particularly relevant for containerized services. On the primary Port of Rijeka-Budapest corridor, which currently offers planned transit times of about 24 hours, services appear to be adequate for market needs. This has been sufficient to support gains in rail freight market share to/from the port. But accelerating the port's cargo capture potential in the North Adriatic going forward may need faster and/or more predictable service, and expansions of this service to more destination markets.

The key operational bottlenecks in Croatia's rail freight network comprise gaps in last-mile connectivity, subutilization of inland hubs, and long-standing constraints along the trunk corridor linking the Port of Rijeka with the node of Zagreb. On the primarily domestic bulk market, there is a need for improving last-mile rail infrastructure connectivity to/from cargo generation-attraction nodes such as industrial sites. There are 870 (mostly outdated) industrial tracks covering a total length of 511 km connected to the railway network. In the wake of major shifts in the Croatian economy, the existing network of industrial tracks no longer suits current needs, with inadequate track maintenance being an additional problem.

Second, inland hubs where investment is necessary are Zagreb, Varaždin, Osijek, Rijeka, and Split. These investments would optimize their future technological and logistics function within the transport network. The hubs serve primarily as points of connection for a suburban and regional passenger transport system based on the concept of an integrated regular interval timetable. But they also serve as transit points for freight transport flows and for additional logistics handling at logistics and distribution centers (LDCs). These technical/technological logistics units have not been adequately considered, and Croatia's 2014–2030 Transport Development Strategy underlines their importance.

And third, the main international trunk corridors for bulk and containerized rail freight face capacity bottlenecks, most notably the linehaul network segment linking the Port of Rijeka with Zagreb. Current national and EU-funded infrastructure investments in the sector are focused on corridor lines, with the most intensive works concentrated on the RH2 corridor. Expanding the operational efficiency and capacity of the RH2 corridor is a large-scale, long-term endeavor due to the corridor's complex topography. These transformational investments should be addressed through a process that considers alternative options, the sequencing of investments, the operational needs of the market, and the risk profile, national priorities, and aspirations of the Government of Croatia (see case study presented in Box 2).

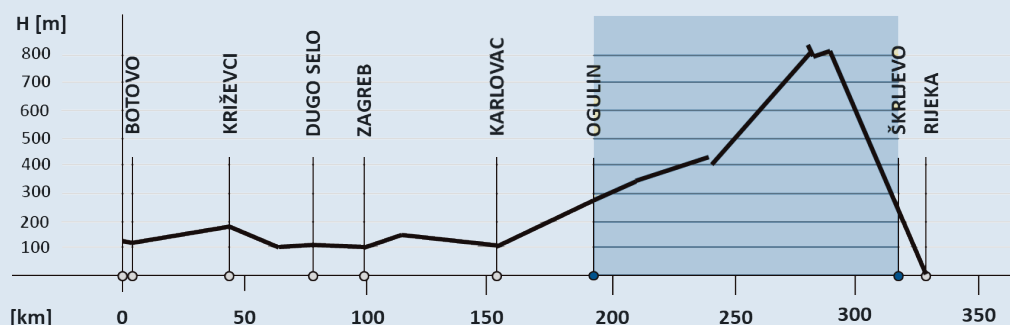
BOX 2. **AN OPTIONS-BASED CASE STUDY OF RAIL FREIGHT CORRIDOR RH2 EXPANSION IN CROATIA**

Rail Freight Corridor 6 of the EU's TEN-T network, known as the Mediterranean Rail Freight Corridor, links Spain, France, Italy, Slovenia, Croatia and Hungary with over 7,000 km of track from Algeciras (Spain) to Záhony (Hungarian-Ukrainian border). The Croatian part of this corridor is divided into a section from Rijeka to Zagreb, which features significant elevation changes, and a relatively flatter section from Zagreb to Botovo (at the Hungarian border). In all, it is a 250-km railway line within Croatia, only 22 km of which, from Zagreb to Dugo Selo, are currently double-tracked and have been electrified. The corridor, and in particular the Rijeka–Zagreb segment, traverses mountainous terrain, making it challenging to develop. Most of the railway is single-track, electrified by a 25 kV 50 Hz system, and open to passenger and freight trains. The track is designed for a maximum load of 22.5 tons per axle and 8.0 tons per meter. The track is equipped with an automatic track block (APB) and traffic flows at a block distance. The existing rail line was built in 1873 as a single-track line for mixed traffic, with small curve radius and steep gradients, which at some sections limit train speeds to 40 km/h.

The cumulative elevation change along this route currently constrains train lengths and requires either advanced locomotives and/or multiple locomotives, as well as the reforming of trains after the ascent (Figure B1.1). Line capacity is about 5 million tons per year. The long, steep gradient from Rijeka inland is the main reason this rail section is one of the most challenging lines in operation in Europe, which translates into reduced competition and higher costs.

On the Botovo–Zagreb–Rijeka corridor RH2 there are no evident capacity bottlenecks considering current levels of traffic (as of 2019), with the exception of its last section, from Škrlevo to the Port of Rijeka, at 101% over the designed parameters (see Figure 2.11 in Chapter 2). However, stations beyond this stretch do not have satisfactory track lengths, and due to the corridor's physical characteristics (mountainous terrain) the number of tracks in some stations is not sufficient. The number of tracks (or lack thereof) at some stations prevents quality train operations, necessary for the configuration of the railway (crossing, multi-part train sharing, connections).

FIGURE B1.1.
Elevation on the
Zagreb–Rijeka Railway Line



Source: University of Zagreb.

Previous Development Attempts (Ongoing Investments)

There are several ongoing/contracted projects along the Rijeka–Zagreb–Hungarian border corridor RH2. Work on the 38.2-km Dugo Selo–Križevci section (north of Zagreb) was underway as of the time of writing, albeit approximately two years behind schedule. The project entails upgrading the existing track and constructing a second track, at a cost of EUR197 million. Similarly, a contract was signed with the Turkish company Cengiz for the upgrading of the existing track and construction of a second track along the Križevci–Koprivnica–Hungarian border section. This section is 42.6 km long and the cost of ongoing upgrades is EUR400 million with a contract duration of 48 months.

As for the corridor RH2 sections south of Zagreb, the idea of a lowland railway that bypasses the current alignment has been under consideration since the early 2000s, with a plan to build a new two-track railway that would allow fast, reliable passenger transport (e.g., Zagreb to Rijeka in 1 hour) and increased freight carrying capacity at lower operating costs. On the southern section there are several ongoing projects, among which the most important is a grant contract signed in 2019 for the reconstruction of the existing track and construction of a second track on the 44 km Hrvatski Leskovac–Karlovac section, worth EUR450 million, of which EUR361 million are EU funds. In addition, seven underpasses and overpasses on the section will be built, all the rail and road crossings modernized, and a modern signaling system installed. This project is part of the envisaged Zagreb–Rijeka lowland line and aims to cut travel times in half.

However, the Karlovac–Škrlevo section is the most difficult stretch on this corridor, where maximum capacity has been reached and no funding for its rehabilitation or redesign has been secured. A location permit was previously obtained for the Škrlevo–Rijeka–Jurdani stretch, a section that comes right after the most difficult section of this line (Karlovac–Škrlevo), for which the location permits are yet to be obtained. This could seriously prolong the implementation period of improvements or realignments.

Several railway stations and tracks are being reconstructed and modernized under the “Port of Rijeka multimodal platform development and interconnection to the Adriatic Gate container terminal” project. The Rijeka Brajdica station has been reconstructed and modernized. Work on

reconstruction and capacity expansion at the Rijeka Brajdica freight station includes a complete reconstruction of the existing nine tracks. The first four tracks, 350-500 meters long, have been reconstructed. Additionally, the Sušak tunnel is being reconstructed, where the existing tunnel is being extended by another track, 423 meters in length. Work has been completed on Brajdica container terminal that saw the construction of four new tracks of about 380 meters.

Work is ongoing at Zagreb Pier on the reconstruction of six existing tracks from the north side of the Rijeka railway station, while the remaining part of the station is used for existing traffic. Once the first phase is completed, rail traffic will be diverted to the newly built northern part, and the work will shift to the remaining six tracks from the south side of the station. In the final stage, an intermodal container transshipment terminal will be built at the southern part of the freight station.

In addition to the reconstruction of the track at the freight section of the station, four new tracks will be built in the area of the Port of Rijeka Authority (PRA), serving container loading and unloading operations, and the reconstruction of the catenary equipment and station lighting will be undertaken, including a new video surveillance system for the entire station and the construction of two crane tracks for portal cranes that will load/unload containers from trains. Upon completion of works the railway station and container terminal will have eight reconstructed tracks, four new tracks at the Zagreb container terminal, and a new track in the tunnel. These projects will improve port connections with the railway corridor.

However, in order to accommodate forecasted cargo operations over the long run (20+ years), improvements to the railway linehaul from Rijeka to Zagreb are necessary.

Possible variants for infrastructure development of the Rijeka–Zagreb RH2 corridor

The capacity problem of this railway line has long been discussed in policy making and market circles, practically from the day of its construction. Recent trends toward shifting investment from roads to the railway sector have led to the development of several design, construction, reconstruction, and upgrade efforts aimed at eventually completing a revamped, more capable RH2 corridor consistent with EU standards and the needs of shippers routing cargo through the Port of Rijeka and the North Adriatic.

Using the case-study approach, we consider 3 available scenarios:

- A ‘do nothing’ scenario;
- An ‘upgrade the existing track’ scenario; and
- Building a new lowland railway line.

‘Do-nothing’ scenario. As noted, the existing railway track is at full capacity on several sections, while utilization levels at other sections exceed 50%. If nothing changes, higher utilization levels will eventually lead to deteriorated track conditions that will require more intensive maintenance, leading to more frequent freight stoppages, poorer itinerary reliability, higher transport and logistics costs and, ultimately, a loss of competitiveness for the Port of Rijeka and Croatia. In addition to hindering the Port of Rijeka’s growth prospects, a do-nothing scenario would divert even more freight flows to trucks. As such, this option would likely represent a missed opportunity to increase Croatia’s overall competitiveness, the competitiveness of its railway sector, and the environmental sustainability of its logistics system.

‘Upgrade the existing track’ scenario. In its ‘Analysis of possibilities to increase the capacity of the M202 Zagreb GK–Rijeka railway line on the Ogulin–Škrljjevo section’ study, the University of Zagreb Faculty of Traffic and Transport Sciences analyzed three main possible design solutions to increase the capacity of the existing Rijeka–Zagreb railway line:

- Option 1: Complete reconstruction of the single-track line to improve its design elements; and
- Options 2 and 3: Upgrade the line by building a second track at the most critical subsections and a partial reconstruction of the existing track.

Based on the geometry and traffic characteristics of the existing railway line and variant solutions, the following track technical and operational parameters necessary for freight capacity calculations were defined: interstation ruling gradient, type of haul (locomotive class), minimal gross weight of freight train, and operating speed. Option 1 presents a complete reconstruction of the existing single track to improve its geometry, increase travel speeds, and expand freight transport capacity. Option 2 involves the construction of a second track and reconstruction of the existing track along the Drivenik–Škrlevo section. Option 3 involves the construction of a new single track, Kupjak–Delnice, the construction of a new double track Delnice–Zlobin section, and construction of a second track and reconstruction of the existing track at the Zlobin–Škrlevo section. Among the analyzed options for improving the existing alignment Option 2 was found to be the most attractive in terms of locomotive utilization, traction effects, and train formation (Table B1.1).

TABLE B1.1.

University of Zagreb Analysis
of the 'Upgrade the Existing
Track' Scenario

Option	'Do nothing'	Option 1	Option 2	Option 3
Design speed (km)	75	100	75	75
Minimal horizontal curvature radius (m)	250	500	250	250
Maximum gradient (%)	27	25	25	27
Single-track section length (km)	107.7	102.5	83.3	58.9
Double-track section length (km)	-	-	23.5	39.6
Total route length (km)	107.7	102.5	106.8	98.5
Number of stations	21	13	15	15
Tunnels (km)	3.2	8.9	3.8	14.5
Bridges (km)	0.1	3.7	3.3	3.6

Source: University of Zagreb Faculty of Transport and Traffic Sciences.

None of these options have a Feasibility Study completed at present, and accordingly the economic calculations are for orientation only. By comparing the estimated investment costs the following conclusions were made in the University of Zagreb study:

- The Option 3 concept requires building many costly new tunnels and bridges;
- In contrast, Option 2 does not entail the complete redirection of the existing line route but only the correction of vertical alignment and critical sections of track with small horizontal curve radii;
- As a result, most of the investment costs of Option 2 pertain to track substructure construction;
- Also, the length of the envisaged double track is two times shorter in Option 2 than in Option 3;
- All this makes Option 2 (estimated investment cost EUR407 million) 30% less expensive than Option 3 (estimated investment cost EUR611 million).

The design approach of Option 2 is to increase track section capacity by constructing a second track on the most critical Drivenik–Škrlevo subsection (23.5 km) and dedicating this line to freight traffic only. It also carries an estimated value of investment that is significantly lower than some of the proposals made for a lowland option, enabling the available rail infrastructure capacity in operation as an implementation of the concept of a targeted network revamp.

Building a Lowland Railway Line

As noted, the concept of a 'lowland' railway on an entirely new alignment has been under consideration for nearly 20 years. The plan entails building a new double-tracked railway that would allow high-speed passenger transport and increase freight carrying capacity to a minimum of 25 million tons, up from the current capacity of approximately 5 million tons.

The first concrete plans were formed in 2008, when the Government requested the development of a Feasibility Study for the lowland line. This study was not finalized. With changes in policy priorities in 2011, the project was deemed unrealistic and was shelved over the following six years. In August of 2017 the Government adopted the Transport Development Strategy of the Republic of Croatia (2017 - 2030), which made building a lowland railway a priority and a key project towards modernizing Croatia's multimodal transport system. The goal was to complete the lowland railway by 2030/2032, with a capacity of more than 20 million net tons per year and ability to meet the total expected traffic volume from the Port of Rijeka maritime hub. The cost of the project, still not exactly determined, is expected to range between EUR4-5 billion.

Two options are considered for the costliest lowland span from Karlovac to Škrlevo, about 150 km in length. Construction costs could reach EUR1.5 billion, but the total cost will depend on whether the Northern or Southern option is selected. Kupska, the Northern option, is 150 km long, of which 61 km involve tunnels and bridges. Drežnička, the Southern option, is 170 km long with 45 km of tunnels and bridges. Several financing options may be available, either through European Commission grant financing, concessions to international investors (including BRI-linked investments), or loan options; however, this decision-making process remains ongoing, awaiting initial formal feasibility study results.

At present, due to global financial uncertainty in the wake of COVID-19, the lowland railway line scenario may seem less of a priority, but development of this project requires a long-term view. Additionally, the current state of planning and implementation of a lowland railway line is progressing slowly and is not fully abreast of market demand and the needs of the Port of Rijeka shipper and carrier base, which are more urgent amid a highly competitive market vying to serve the Central European hinterland (see Chapter 3).

Intermediate solutions as preliminary proposals, such as those set forth under the 'Upgrade the existing track' scenario above, may allow the Government to opt for incremental, phased approaches rather than necessarily binary approaches. By comparing the forecasted and calculated values, the existing single-track rail line will reach full capacity in the medium term. The proposed Options 2 and 3 under the 'Upgrade the existing track' approach would provide sufficient capacity up to the 2030-2035 timeframe based on current (pre-COVID-19) forecasts, which should satisfy current market needs and growth, and, critically, allow HŽ Infrastruktura (HŽI) to prepare and construct a lowland railway line over a longer period of time and in a financially sustainable manner.

If EU grants for the lowland option are to be secured, necessary reforms implemented, and project documentation swiftly completed, implementation of this project would positively impact not just railways and the port but also the overall economic growth and investment climate of Croatia. Securing EU grant funds (85% of total invested cost) would not overly burden fiscal space in Croatia's public finances, while potentially employing thousands of workers (according to some estimates, a EUR1 billion investment in railway infrastructure can bring about 17,000 permanent, semi-permanent, and temporary employment opportunities) and helping improve Croatia's trade competitiveness and spur economic growth in the process.

Investment towards modernizing the line on Corridor X (RH1) towards Serbia is also planned. Among other ongoing projects, the construction of a marshalling yard for container trains at the Port of Rijeka will (and indeed already has) significantly increased the absorption capacity of the Rijeka hub.

In addition to pan-European corridor lines, the Koprivnica–Osijek, Oštarije–Split, and Varaždin–Zagreb lines are important to the development of Croatia's logistics system, because they connect regional and industrial centers of national importance with the trunk network of corridor lines, making railway transport better able to compete with road transport. The current condition of the infrastructure on these lines precludes a significant inclusion of railways in national transport flows, and in some ways hampers the development of these areas. This pertains in particular to the Koprivnica–Osijek and Oštarije–Split lines, which connect several county centers to Zagreb and the Port of Rijeka, and could also serve to link the port terminals in Zadar and Šibenik with neighboring countries.

CROATIAN INLAND WATERWAY FREIGHT TRANSPORT: SECTORAL PROFILE

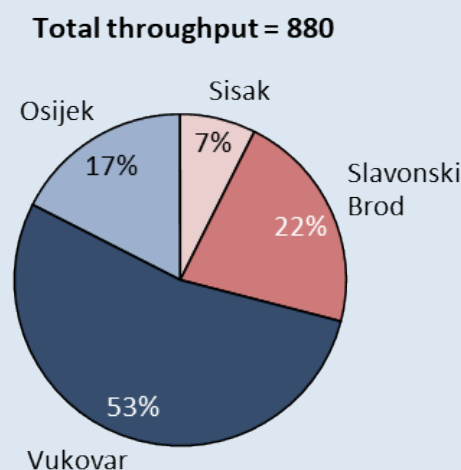
The Croatian inland waterway transport system spans the Danube and Sava River basins. There are four main inland waterway ports: the ports of Vukovar (Danube River) and Osijek (Drava River), and the ports of Slavonski Brod and Sisak (Sava River).¹⁶ These ports handle only bulk cargo at present, and in 2019 they registered total throughput of 815,000 tons (Figure 1.9). This compares to 657,000 tons handled in 2010, for an average annual growth rate of 3.3% over the 2010–2019 period. This moderate growth was attained despite long-standing gaps in inland waterway infrastructure development: the state of inland waterway infrastructure, particularly that along the waterways' fairway, remains largely in the same condition it was thirty years ago. The reasons for this are (i) a lack of potential goods generators that would use inland waterway transport services and thus motivate policies to improve navigation conditions, particularly on the Sava; (ii) the comparatively poor competitiveness of river transport compared to other transport modes in the consumer goods logistics segment—trucking above all; and (iii) the proximity and accessibility of Adriatic ports.

The most significant investments to date have targeted port infrastructure development (e.g., terminal expansion and/or modernization at the ports of Slavonski Brod and Vukovar); Croatia has also championed the demining of the Sava River embankment within its territory. However, the continued presence of mines on the Bosnia and Herzegovina side of the Sava River bank—as the river is the border between these two countries for much of its navigable fairway—remains one of the major impediments to expanding the navigability of this river and thus the connectivity of Sava River ports and communities on both sides of the border, and associated inland waterway logistics services, with regional as well as national implications.¹⁷

¹⁶ Historically, the port of Sisak primarily served an oil refinery which was shut down in 2019. There are ongoing plans to redevelop the refinery land into an industrial park and logistics hub, including production of bitumen and renewable energy (advanced bioethanol and solar). These activities are likely to continue to be served by the port of Sisak in future. In 2018 and 2019 the port of Sisak handled approximately 72,500 tons and 65,000 tons, respectively, of crude oil, petroleum products, and inputs to the refinery process.

¹⁷ The demining of the right bank of the Sava River within Bosnia and Herzegovina is expected to be addressed, for the first time since the conflict of the 1990s, under the World Bank- and multilateral grant-financed Sava and Drina Rivers Corridors Integrated Development Program (SDIP), a regional investment project in the Sava River Basin countries of Serbia, Bosnia and Herzegovina, and Montenegro. Launched in August of 2020, SDIP's objectives are to strengthen transboundary water cooperation and improve navigability and flood protection in the Sava and Drina River corridors.

FIGURE 1.9.
Tonnage Throughput at
Croatia's Main Inland
Waterway Ports, 2019
Thousands of tons



Source: Croatian Bureau of Statistics.

Within Croatia, the Sava River faces greater infrastructure limitations to navigation than the Danube (Figure 1.10). As a Class VI international waterway, navigation along the Danube requires minimal fairway investments such as dredging due to its natural depth and dimensions, which allow this waterway to carry vessels of at least 3,200 DWT capacity. The Sava, on the other hand, is an operational Class III waterway for most of its fairway within Croatia, with water depths below two meters; this limits navigation to vessels less than 1,000 DWT in capacity, a threshold broadly considered necessary to attain minimum reductions in transport costs per ton-km transported that can make inland waterway transport competitive with other modes. And while navigation along the Danube is available year-round, freight transport operations along the Sava are constrained to only 160 days per year at key bottleneck sections that are exposed to shoals, debris, sharp bends, and other impediments to navigation.

The following are among the main challenges keeping the inland waterways from capturing a larger share of the national freight market:

- A lack of freight generators along the waterways of the Sava and Danube rivers: there are no significant industrial capacities in the zones gravitating to the Sava and Danube corridors that would generate significant quantities of freight suitable for transport by inland waterways;
- Underdeveloped waterway infrastructure: sections of the Sava waterway require development to provide easier and speedier transport;
- Constrained port capacities and continued need for port modernization;
- A lack of warehouse capacities at the Port of Vukovar (especially indoor warehouses).

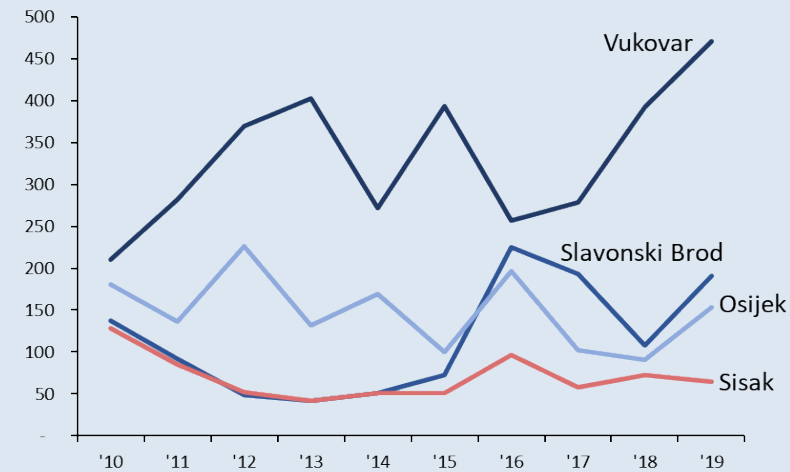
Wheat, soy, metal products, and fertilizer make up the bulk of goods at the Port of Vukovar. There is no transshipment of containers or vehicles (RO-RO transport) at this port. Although the Port of Vukovar handles the highest level of throughput among Croatia's inland waterway ports (470,540 tons in 2019), the volumes overall are still modest, and the port lacks indoor warehouses and larger open transshipment zones to attract greater quantities of goods. The port's current position is such that it enables neither significant spatial expansion nor greater indoor warehouse capacities. The re-evaluation of the port's position and role requires a detailed study proposing possible solutions.

FIGURE 1.10.
Croatia's Waterways by
Navigational Class



Source: Danube Transnational Program, Port Management Models in Inland Cargo Ports, 2017.

FIGURE 1.11.
Throughput Fluctuation at Croatia's
Inland Waterway Ports, 2010-2019
Thousands of tons



Source: Croatian Bureau of Statistics.

Total goods traffic at the Port of Osijek reached 153,731 tons, and that of the Port of Slavonski Brod 190,441 tons, in 2019. These flows were dominated by petroleum and construction material transshipment. Throughput volumes at all inland waterway ports are volatile from year to year (Figure 1.11), which suggests there is a need to better understand the operations of the shippers that own this freight, the reasons for these fluctuations, and the ways in which the ports can better accommodate shipper needs.

CROATIAN MARITIME TRANSPORT: SECTORAL PROFILE

Croatia's maritime port infrastructure is internationally competitive, but the evolving supply and demand landscape in container shipping will require further capacity and modernization investments to improve Croatia's market position. Rijeka and Ploče, the two major ports on Croatia's Adriatic coast, operate terminals for the transshipment of various types of freight, with the Port of Rijeka accounting for the majority of national containerized port throughput. The North Adriatic has become an increasingly important maritime port range for Europe, particularly for the landlocked countries of Central Europe, and the operational complexity of this market has increased as (a) larger vessels have 'cascaded' into this market from the main East-West trade linking Asia with Europe, testing the limits of the ports that comprise it, and (b) delivering efficient multimodal connectivity to/from hinterland destinations, particularly via rail intermodal pre- and on-carriage services, has become a major customer acquisition driver—a competitive requirement more than a discretionary option. Such is the environment in which the Port of Rijeka's container terminal facilities strive to serve container shipping carriers, shippers (importers/exporters), and their logistics service providers.

Ploče is primarily a bulk port of regional importance in the Western Balkans. Container traffic volume at the Port of Ploče is at the level of about 25,000 container units per year, which is about 8% of the Port of Rijeka's traffic, and about 3% of the traffic at Slovenia's Port of Koper. In this respect, the container terminal at the Port of Ploče does not play a significant role in the movement of containers in the North Adriatic. But the port does serve important bulk commodity markets, with more than 3 million tons of goods handled in 2018, and functions as a critical gateway for shippers in Bosnia and Herzegovina and elsewhere in the Western Balkans, via Pan-European Corridor Vc.

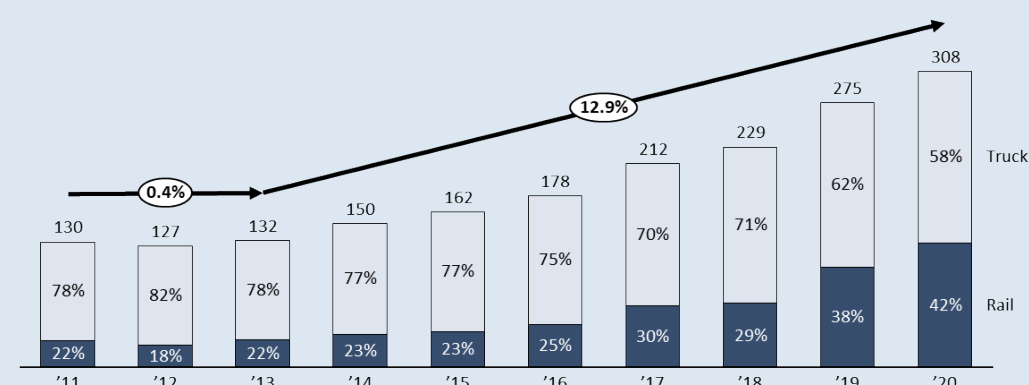
The Port of Rijeka is addressing the challenge of competing in Europe through investment and private sector engagement. Although containerized throughput capacity at the Port of Rijeka—600,000 TEUs as of year-end 2020—is nominally sufficient to handle current volumes, there is a broader need to expand the operational capabilities of this port to serve the ultra large container vessels (15,000+ Twenty-foot Equivalent Units [TEUs] in capacity) that increasingly ply the North Adriatic, as well as to cater to increasingly demanding container shipping carriers, and shippers, operating in Central Europe and the Western Balkans. This includes a need for deeper berthing areas; expanded multimodal connectivity with on-dock rail capabilities that can accommodate demand spikes and shift container movements inland away from trucks and onto rail; and increased use of digital technologies to facilitate collaboration among port users and generation and use of 'big data' to inform long-term decision making, day-to-day port management, and market outreach.

PRA and the GoC have responded to these challenges by: (i) building on-dock rail intermodal terminals adjacent to its container yards, including the opening in December 2019 of a 360,000-TEU capacity rail intermodal yard at its operational container terminal, with the ability to serve two block trains simultaneously; (ii) embarking on the aforementioned infrastructure investment plan to double-track and modernize the Rijeka–Zagreb–Hungary Border RH2 railway corridor (part of Europe's Mediterranean TEN-T corridor), portions of which were underway or in the tendering process as of early 2021; (iii) improving last-mile road connectivity to/from the port to bypass Rijeka's city center and provide faster access to the national motorway network, thus reducing congestion, transport costs, and emissions, and improving road safety; (iv) launching a dredging program to deepen 428 meters of quay at its operational container terminal, to reach 16.5-meter depth at full build-out expected by the first half of 2023, up from 14.9-meter depth across 367 meters of quay and 11.7-meter depth across 300 meters of quay in 2019; (v) adopting a port community system—a digital platform to coordinate and process freight transactions at the port—expected to be operational by year-end 2021; and (vi) building a new deep-water container terminal, 20 meters in depth alongside

berth, to be operated by a concessionaire expected to be competitively selected by year-end 2021, with the concession agreement lasting for a period of 50 years.¹⁸ This new Zagreb Deep Sea Container Terminal (ZCT) is expected to more than double Port of Rijeka's current containerized throughput capacity at full buildout (~2026).

Container traffic at the Port of Rijeka's operational container terminal has been growing at double-digit pace since 2013, with throughput crossing the 300,000 TEU mark for the first time in 2020; volumes grew a remarkable 12% year-on-year in 2020, despite widespread disruption to global trade caused by the COVID-19 pandemic. In 2011, the Philippines-headquartered global container terminal operator ICTSI, in joint venture with the Croatian joint-stock company Luka Rijeka, was awarded a 30-year concession to operate what was then the Port of Rijeka's only container terminal, known as the Adriatic Gate Container Terminal (AGCT). The AGCT concession is managed by PRA under the landlord port model, Europe's dominant container port governance model and widely recognized as international best practice in public sector administration of maritime port assets. Since the concession became effective, AGCT has benefited from a range of public and private capacity expansion and modernization investments, including a more than doubling of the quay wall length, dredging of new berthing areas, and deployment of post-Panamax ship-to-shore cranes, rubber-tired gantry cranes, terminal management systems, and other terminal operation equipment, bringing total throughput capacity to the current 600,000 TEU, up from 250,000 TEU at the time of award. The concession's impact on port performance, as ultimately manifested in throughput growth, was quickly felt (Figure 1.12); equally noteworthy has been PRA's and AGCT's track record of promoting truck-to-rail modal shift and greater use of rail intermodal transport for containers entering and leaving the terminal. This is particularly relevant for countries like Croatia that aspire to serve freight hinterlands well beyond their own borders; in Croatia's case, its geographic location allows it to position the Port of Rijeka as a gateway to/from Central and Southeastern Europe, for which rail connectivity as a complement to international-standard highway connectivity is essential.¹⁹ As of year-end 2020, approximately 70% of AGCT's container throughput was destined for or originated in markets outside Croatia, primarily Serbia, Hungary, Bosnia and Herzegovina, Austria, and the Czech Republic, although only Belgrade, Budapest, and Banja Luka were connected directly to the Port of Rijeka via rail.

FIGURE 1.12.
Port of Rijeka: Adriatic
Gate Container Terminal
Containerized Throughput by
Hinterland Mode, 2011-2020
Thousands of TEU



¹⁸ The tender process to competitively award this concession was underway as of the time of writing. The winning bidder was expected to be announced within calendar year 2021.

¹⁹ The Port of Ploče also serves an international hinterland—particularly the (primarily bulk) freight markets of Bosnia and Herzegovina—via road and rail connections.

The Port of Rijeka illustrates that the confluence of infrastructure investment and improvements in service delivery can incentivize adoption of low-carbon logistics in practice. Beyond terminal management and institutional experience on the part of both the port authority and the terminal operator, AGCT's and PRA's multimodal outcomes are the result of the well-targeted investments in marine-side, terminal-side, and hinterland-side infrastructure enumerated above. These have been conducted by the GoC with support from the EU—via the Connecting Europe Facility (CEF) instrument as well as Cohesion Fund grants—and long-term financing from the World Bank (see Box 3). Although some of these investments, particularly regarding rail linehaul connectivity improvements and the operationalization of ZCT, remain ongoing, the green growth returns on completed investments are already evident in the form of sustained throughput growth coupled with increasing incidence of rail intermodal services to/from AGCT.

BOX 3. **WORLD BANK SUPPORT TO THE PORT OF RIJEKA:** **A LONG-TERM PARTNERSHIP**

The World Bank supported the development of the Port of Rijeka over a span of 15 years, between 2003 and 2018. The engagement took place through two consecutive lending operations: the first Rijeka Gateway Project (2003-2012) and the second Rijeka Gateway Project (2008-2018). Both projects aimed to (i) increase the operational efficiency and improve the financial, social, and environmental conditions of the Port of Rijeka, by rehabilitating infrastructure and replacing equipment; (ii) redevelop part of the port area for urban purposes; and (iii) improve the last-mile road and rail connections linked to the Rijeka gateway. Most notably, the projects financed, inter alia, (a) extension of the infrastructure (berthing and back-up cargo handling areas) of the Brajdica container terminal—now AGCT—and construction of the infrastructure for the greenfield Zagreb Deep Sea Container Terminal (ZCT); (b) expanded last-mile road connectivity to/from the port, to allow heavy-duty vehicles to bypass the Rijeka city center; (c) technical and preparatory documentation to facilitate the construction, with EU funds, of rail intermodal terminals and track connectivity at the last mile to/from both container terminals; (d) construction of a passenger terminal; and (e) technical assistance in support of the implementation of the Port Masterplan, including support for concession planning and transaction advisory, design of a modern Port Community System to enable electronic data exchanges between port stakeholders in real time, and preparatory documentation for potential future investment in logistics clusters adjacent to the port.

The two Rijeka Gateway projects, in combination, ultimately contributed to the transformation of the Port of Rijeka. Specifically, the two projects enabled the port to successfully transition from a “service” port to a “landlord” port with an increased involvement of the private sector in both operations and financing of modern facilities and equipment. This was first achieved in two ways: first, through the increasing privatization over the life of the projects of Luka Rijeka, the incumbent concessionaire and sole operator of dry bulk cargo terminals at the Port of Rijeka (in addition to an off-dock inland cargo terminal at Skrljevo); and second, through the adoption of a long-term (30-year) concession agreement for Rijeka's Brajdica container terminal between the Port of Rijeka Authority and a joint venture (JV) between Luka Rijeka (through its wholly-owned subsidiary Jadranska vrata) and Philippines-based International Container Terminal Services Inc. (ICTSI), an experienced global container terminal operator competitively selected as JV partner based on a well-established operational track record on an international scale. ICTSI acquired a controlling 51% stake in the JV. As such it became the main operator of AGCT, with obligations to meet a minimum amount of infra-

structure investment in the terminal under the concession agreement. The presence of an increasingly privatized incumbent concessionaire (Luka Rijeka) and a fully private concessionaire (ICTSI) effectively established PRA as a landlord port authority, bringing it in line with much of the rest of the EU.

By the time the second project closed, and through mid-2020, the Port of Rijeka Authority intended to solidify its position as a landlord port authority in Europe through the international tender of ZCT for a long-term concession. Although the bidding process, initially launched in 2019, was first delayed in September 2020 amid the COVID-19 pandemic, and later cancelled in December 2020 due to strategic considerations, a new tender process was relaunched in March 2021 and was expected to be completed before year-end 2021.

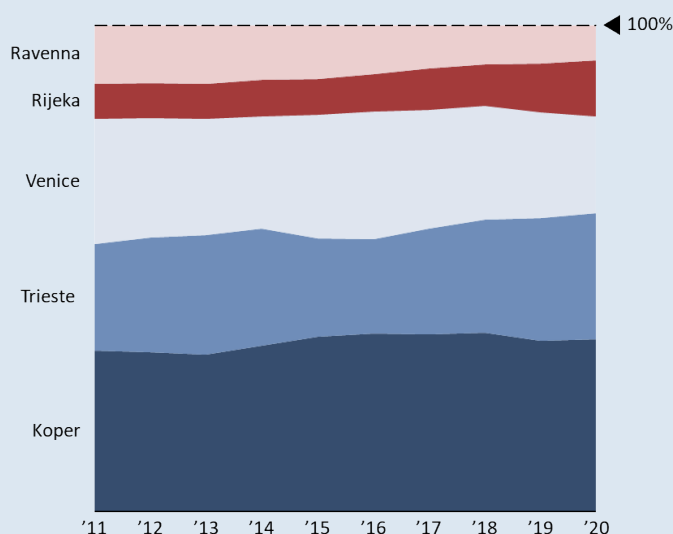
Overall, the two projects allowed the Port of Rijeka to adjust its governance and operating model, increase its physical capacity, and deepen its technical know-how to handle steadily increasing containerized cargo volumes in service of both Croatia and its surrounding region, and to do so through the use of low-carbon logistics solutions like multimodality and promotion of short-sea shipping.

Source: World Bank (2019), Rijeka Gateway II Implementation Completion and Results Report; World Bank analysis and research.

While the Port of Rijeka's container operations have been successful over the past 10 years, they also face several challenges—and risks—going forward. The first is to pursue planning, market outreach, and policy actions that can attract sufficient volumes over the coming years to deepen the port's impact on the Croatian economy and to ensure acceptable levels of installed capacity utilization. This is especially true now, as the port is about to significantly expand capacity when ZCT comes online despite AGCT utilization levels of only 51% in 2020 (and a mere 35% as recently as 2017). Accelerating volume growth is also important from a market positioning point of view, as Rijeka's main competing ports in the North Adriatic port range—specifically, Slovenia's Koper and Italy's Trieste and Venice—have also grown rapidly and are larger than Rijeka by throughput. This impeded the Port of Rijeka from gaining containerized market share in the North Adriatic for much of the 2011-2017 period, although notable gains were attained in 2018, 2019, and especially in 2020 (Figure 1.13). Rijeka's containerized throughput share in the North Adriatic stood at 12% in 2020, compared to 7% in 2011—this is a welcome increase, but Rijeka's market participation in this port range remains modest. This is significant because intercontinental supply chains, and the port routing choices embedded in them, tend to exhibit a great deal of inertia and it can be operationally costly for shippers to rearrange the way their goods are moved. To the extent that other ports succeed in retaining or growing their market shares, it can be challenging for Rijeka to attract greater volumes or recover lost share. On the other hand, as all ports in the North Adriatic grow, invest, and increase their capabilities, the more capable *the port range becomes*—attracting new vessel strings and services as well as new shippers. These developments benefit *all ports* in the range, including Rijeka, and indeed Rijeka has benefited in the past from the increasingly visible profile of the North Adriatic in European (particularly Central European) logistics.

As new capacity comes online, it will be critical for the Port of Rijeka to better utilize its available capacity over the next 5 to 10 years by attracting additional cargo. The construction of ZCT, the ongoing selection of a ZCT concessionaire, and the market's revealed recognition of AGCT—based on throughput growth and market share gains—as a proven gateway are resources that can be leveraged to position the Rijeka gateway route as attractive relative to other gateways in the North Adriatic and elsewhere in Europe (see Chapter 3). International experience shows that the selection of terminal operator at a container terminal plays a key

FIGURE 1.13.
North Adriatic Ports
Containerized Throughput
Share, 2011-2019
In percent of North Adriatic
aggregate TEU throughput



Source: port authority websites; AGCT; World Bank research.

role in attracting shipping lines and additional flows of goods. In addition to Rijeka itself, the ports of Piraeus and Trieste are good examples of this, as their container traffic rose by more than 10% a year upon conclusion of contracts with new terminal operators.

The challenge is that neighboring ports are pursuing similar strategies at the same time in an increasingly dynamic and contestable hinterland market. For example, the port of Koper has already secured construction permits for the expansion of its container terminal—to at least 1.3 million TEU in capacity—by 2021; an agreement has been signed between Italy and China for the expansion of the port of Trieste under China's Belt and Road Initiative (BRI); and additional capacity is planned for container handling at the Port of Venice, where the construction of an offshore terminal is envisaged. Potential complementary improvements in rail intermodal capacity and service delivery at those ports, in addition to the BRI-linked expansion of the Port of Piraeus in Greece—which increasingly competes with the North Adriatic ports in Central Europe, even as it collaborates with the Port of Rijeka on a dedicated Piraeus–Rijeka shuttle service for Asia-originated cargo—and the recent privatizations of the Port of Thessaloniki and the incumbent Greek railway undertaking TrainOSE all further complicate Rijeka's (and Croatia's) transit cargo capture aspirations.

Looking inland, increased container traffic requires the setting up of a network of terminals for container reception, consolidation, and transshipment, ideally in clusters that allow for service co-location. Croatia lacks a network of integrated inland container terminals outside of the Vrapče railway terminal in Zagreb. Increased dry port capacity will be needed if the goal is to boost the importance of logistics hubs in Croatia as points of distribution of goods to/from neighboring countries, and in order for warehousing capacity to meet the requirements of the Port of Rijeka as a cargo generation node. Having a dry port in the Zagreb hub area would attract flows of goods towards Croatia and lead to the strategic repositioning of this hub as a regional logistics hub²⁰ (the Graz Cargo Center in Austria is a good regional example). The application of piggyback transport technology (trucks, trailers, swap bodies) in Croatia is still in its infancy because there has not been evident demand for it to date. There is currently one piggyback terminal in Eastern Croatia (Spačva), but it is out of operation. Insufficient demand for this type of service made it unprofitable and the terminal was closed down after several years of operation.

²⁰ The *Cargo Centre Zagreb study*, University of Zagreb Faculty of Transport and Traffic Sciences, 2011.

OPPORTUNITIES TO STRENGTHEN SUPPLY CHAIN RESILIENCE AND BETTER ADAPT TO CLIMATE CHANGE

Promoting the resilience of supply chains is an increasingly mission-critical policy goal for countries, like Croatia, that seek to strengthen trade competitiveness through improved logistics and connectivity. This stems from increases in the risk of supply chain disruptions due to the impacts of climate change, such as more frequent extreme weather events, as well as from the interconnected nature of production organized as global value chains, which makes them prone to disruption through dependency on weak links. The onset of the COVID-19 pandemic, which led to multiple supply chain disruptions, from border crossing delays to cancelled container shipping services due to factory closures in Asia followed by lockdown mandates in Europe to truck driver shortages linked to inherent virus exposure risks, further underscores the resilience imperative. As Croatia aspires to both improve competitiveness and embed itself more broadly in global value chains, measures to promote climate change adaptation and other resilience enhancements in the supply chain should be considered as equally strategic as measures to reduce private logistics costs and the emission of GHGs and other economic externalities.

The resilience profile of Croatia's transport and logistics infrastructure and service delivery varies across modes. The Port of Rijeka's development has embraced resilience measures, through for example improvements in multimodal last-mile connectivity to provide redundancy in access to market to shippers, as well as by taking advantage of its favorable geographic position, which provides natural protection from the open ocean through islands, with minimal need of breakwaters. The national motorway network has strong levels of infrastructure quality that lend resilience to the network, although it will be important to protect maintenance expenditures in the face of likely revenue shortfalls in the short-term associated with the COVID-19 pandemic. Other modes and service delivery segments should address opportunities for resilience enhancements more forcefully. Rail infrastructure development should take into account climate change adaptation in the design of engineering solutions. Inland waterway infrastructure development, particularly along the less-developed Sava River corridor which is heavily exposed to flood risks, should promote flood protection measures as a matter of freight transport business continuity and social and environmental protection. The warehousing sector faces regulatory inefficiencies that make it difficult for service providers to bring capacity to market, leaving the system vulnerable to price and demand shocks (see Chapter 4). And in the trucking sector, like in other countries in Europe, there is the risk of long-term driver shortages, which should be met through revamped trucking sector regulations that protect driver well-being and safety, as well as through better informed government and private sector decisions towards a more balanced modal split that relies on other modes beyond trucking.

GEOGRAPHIC AND GRAVITATIONAL POTENTIAL OF MAJOR LOGISTICS HUBS IN CROATIA

There are eight major industrial areas and cargo generation-attraction nodes in Croatia (Figure 1.14; see Annex 1 for an analysis of freight flows by node). A region-by-region analysis of production levels in 2017 shows that the Zagreb-Karlovac industrial area has the highest level of production, followed by Northern Croatia, Rijeka, and Eastern Croatia. The data show a marked difference in production levels, with the Zagreb-Karlovac area standing out in relation to other regions; if the size of the populations is taken into consideration, however, productivity in some of the regions is significantly higher.

The industrial processing sector is the top generator of exports. Its share exceeds 50% in nearly all counties and industrial areas, with the exception of the City of Zagreb, where the processing industry is the top export sector, but with a 37% share, and the Lika-Senj and Du-

brovnik-Neretva counties, where industrial production is the second most important export sector, with a share of about 33%. In the context of the impact of the processing industry on the flow of goods, in view of revenue and sector significance, the processing industry is a nationally significant generator of flows of goods in the industrial areas of Zagreb and Northern Croatia, whereas in other industrial areas this sector generates locally significant flows of goods.

Given this structure, the logistics capacity of the Zagreb logistics/transport hub and, to some extent, of the hub in the Varaždin/Čakovec zone in Northern Croatia are of national-level importance to the industrial processing industry.

Wholesale trade, retail trade, and tourism have, in addition to the processing industry, a significant share of the structure of the economy in all regions. Wholesale and retail trade are primarily organized through centralized distribution, with major logistics capacities built in the vicinity of markets with the highest concentration of consumers, e.g. in the Zagreb transport/logistics hub area.

FIGURE 1.14.
Croatia's Major Industrial Regions

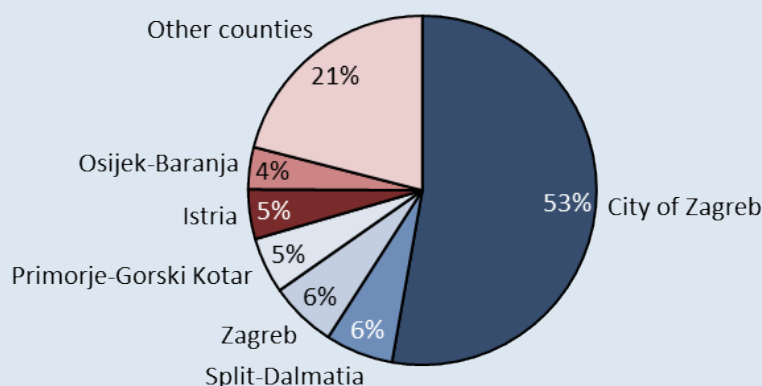


Source: Croatian Chamber of Commerce.

Tourism is a markedly seasonal and significant generator of flows of goods in Croatia. Croatia is also one of the countries in the EU with the greatest difference between the number of permanent residents and tourists (at the national level the ratio is about 30%). In the context of logistics support for the tourism industry, the capacities of most logistics service providers are connected to the Zagreb hub, while smaller volume ancillary capacities are developed locally and characterized by pronounced seasonality (e.g., cross-dock terminals in the coastal areas). The supply of hotel facilities is tied to specialized distribution channels (business-to-business) in which warehouse and other capacities are centralized and largely linked to the Zagreb hub.

In terms of SMEs, an analysis at the county level shows that the City of Zagreb has the greatest share of entrepreneurial income in Croatia. It is followed by Split-Dalmatia County and Zagreb County (Figure 1.15).

FIGURE 1.15.
County Shares in Total
Entrepreneurial Income: 2014



Source: Croatian Chamber of Commerce.

At the national level Italy, Germany, Slovenia, Bosnia and Herzegovina, and Austria are Croatia's top export markets. These countries are also top export markets for the majority of counties. In 2017 there were only six counties in which these countries did not hold the top three spots in terms of value of total exports. The major exceptions were Karlovac County, which saw most exports go to the U.S. (firearms), and Šibenik-Knin County, specifically due to shipyard export activity (Table 1.2).

TABLE 1.2.
Major Export Markets
by County: 2017

Major export markets and their share in total exports			
County	1.	2.	3.
Republic of Croatia	Italy 13.6%	Germany 12.3%	Slovenia 10.7%
Continental Croatia	Germany 13.5%	Slovenia 11.3%	Bosnia and Herzegovina 11.3%
City of Zagreb	Bosnia and Herzegovina	Slovenia	Italy
Varaždin	Austria	Germany	Italy
Zagreb	Slovenia	Germany	Italy
Međimurje	Germany	Austria	Slovenia
Osijek-Baranja	Germany	Hungary	Serbia
Krapina-Zagorje	Slovenia	Germany	Austria
Sisak-Moslavina	Austria	Italy	Germany
Koprivnica-Križevci	Germany	Russia	Bosnia and Herzegovina
Brod-Posavina	Italy	Germany	U.K.
Karlovac	U.S.	Switzerland	Germany
Vukovar-Srijem	Germany	Italy	Bosnia and Herzegovina
Virovitica-Podravina	Germany	Italy	Austria
Bjelovar-Bilogora	Italy	Slovenia	Bosnia and Herzegovina
Požega-Slavonia	Italy	Germany	Bosnia and Herzegovina
Adriatic Croatia	Italy 26.8%	Slovenia 12.9%	Germany 8.1%
Istria	Italy	Slovenia	Cayman Islands
Primorje-Gorski Kotar	Italy	Slovenia	Bosnia and Herzegovina
Split-Dalmatia	Italy	Slovenia	Bosnia and Herzegovina
Zadar	Italy	Slovenia	Germany
Šibenik-Knin	Norway	Germany	Bosnia and Herzegovina
Lika-Senj	Austria	Italy	Germany
Dubrovnik-Neretva	Egypt	Bosnia and Herzegovina	Italy

Source: Croatian Chamber of Commerce.

CROATIA'S PUBLIC SECTOR ADMINISTRATION FOR LOGISTICS AND FREIGHT TRANSPORT

The main public agency in charge of planning, regulation, policy making, and infrastructure investment in transport at the national level is the Ministry of Sea, Transport and Infrastructure (MSTI). MSTI is organized along modal functional lines, with sub-agencies and directorates dedicated to planning, infrastructure provision and maintenance, policy making, and certain aspects of service delivery regulation for roads, railways, inland waterways, air transport, electronic communications (such as broadband), and integrated postal services. As the lead agency for maritime affairs, MSTI comprises all marine port authorities and harbor-master's offices, oversees maritime transport traffic, regulates safety of navigation, and promotes maritime transportation. MSTI has an oversight role over Croatia's main state-owned enterprises (SOEs) of the transport sector, including, among others, the public road and highway companies Croatian Motorways and Croatian Roads; the national railway infrastructure manager HŽ Infrastruktura; the incumbent railway service provider HŽ Cargo; and Croatia Airlines.

Insufficient collaboration across and within modal silos hampers MSTI's ability to deliver interventions—whether in the form of infrastructure, policy making, or regulatory improvements—that can promote multimodality and more efficient logistics. For example, as MSTI's *Transport Development Strategy of the Republic of Croatia 2017-2030* (TDS)—the key public sector document setting the strategic direction for the transport sector in Croatia—points out, “there is a lack of business coordination in the railway sector” and “there is a need of better coordination between HZ Infrastruktura Ltd, HZ Cargo Ltd., and HZPP Ltd. [the state-owned rail passenger service provider]”, and as a result “the freight modal split between rail and road is in favor of road transport”. With regard to maritime multimodal transport, TDS notes that “[the] operations of port authorities are often not harmonized and coordinated”. Among its list of objectives for the transport sector across all modes (railways, roads, inland waterways, maritime transport, and air transport), TDS has adopted the goal of “[improving] the integration of transport modes in Croatia”. Among TDS's key recommendations is that “Croatia should define a national concept for freight logistics involving all modes of transport”, and that “it is very important to define a role for, among others, ports Rijeka and Ploče and Zagreb node.” All of these issues point to a need for a public administration of the transport sector that better balances (a) modal expertise with modal integration, and (b) infrastructure provision with service delivery. Inter-ministerial integration, for example between MSTI and other line ministries or agencies that have an influence on logistics, including those agencies looking after SME competitiveness, regional development, and/or trade, could also be deepened, as well as collaboration between these agencies (including MSTI) and the private sector freight stakeholders on the front lines of the logistics system (shippers, carriers, and logistics service providers). These gaps in coordination in part explain the limited incidence of multimodality in Croatian logistics and the competitiveness shortcomings that will be assessed later in this report (see Chapters 3 and 4).

CHAPTER 2

Croatian Freight Flows: Evidence from Croatia's National Transport Model

CHAPTER 2

Croatian Freight Flows: Evidence from Croatia's National Transport Model

Like in other upper middle-income and high-income countries, disaggregated origin-destination-commodity-mode data to describe the nature of the movement of freight within Croatia has historically not been publicly available. To be sure, government sources, most notably time series transport sector data published periodically by the Croatian Bureau of Statistics, provide a wealth of information on freight transport broken down by mode, commodity type, equipment type, service type, and various other policy-relevant dimensions, consistent with EU-wide good practice. However, the reporting of this information is generally aggregated at the national level, whereas there are numerous instances of policy- and decision-making analysis, such as investment pipeline screening and project viability assessments, that require greater levels of data disaggregation. It is the latter typology of data that had historically been unavailable in Croatia—until the 2014-2016 development of Croatia's first National Transport Model (NTM) by MSTI. This analytical tool is considered essential—and indeed it is a mandatory requirement—by the EU to support EU funding allocation, public investment prioritization, and other policy making decisions in transportation and logistics. Yet MSTI's use of this model for investment and policy making purposes remains limited to date; and since the model has not been publicly released, other stakeholders, such as government entities beyond MSTI, as well as private sector practitioners, have not benefited from its contents as an input into, inter alia, firm-level planning. The use of this model for academic research purposes has also remained limited.

The purpose of this chapter is to discuss the contents of the NTM and assess key model insights regarding the flow of freight in Croatia. Developed with a base year of 2013, the NTM is somewhat dated and as of early 2021 portions of the model were in the process of being refreshed. Nonetheless, it remains, as of the time of writing, the single most detailed, disaggregated, and comprehensive account of the nature of the movement of freight in Croatia. By querying and mapping the contents of the model, this chapter seeks to describe the composition of Croatia's freight markets and to potentially serve as input into better planning and decision making by public and private freight stakeholders.

A discussion of how the NTM was developed is presented in Annex 2.

ANALYSIS OF MODEL OUTPUT

According to the NTM, in 2013 there were 95 million tons of freight transported in Croatia, of which construction materials were the largest commodity by volume. Table 2.1 divides this total into 50 commodity types. The ten most transported commodities in Croatia in tonnage terms (inclusive of transit flows) are 'other construction materials', 'other consumer goods', chemical products, oil products, food products, cereals, raw wood, processed wood, cement, and pebbles and gravel.²¹

The movement of freight in Croatia is concentrated along the East-West corridor across the northern half of the country, linking the coast with Zagreb and, from Zagreb, towards Eastern Croatia, Serbia, and Hungary. Specifically, Croatia's two main freight corridors are Rijeka–Zagreb–Hungarian border (towards Budapest) and Zagreb–Slavonski Brod–Vukovar–Serbian border (towards Belgrade). This is shown in Figure 2.1, which depicts Croatia's overall freight transport on the national road, railway, and maritime networks. For each of Croatia's six regions, total tons of freight stratified by inbound, outbound, and intra-regional freight flows are shown in Figure 2.2. The data confirm that the largest generator of freight is the Central Croatia region, and the smallest is the South Dalmatia region.

TABLE 2.1.
Freight Demand Model
Commodity Classification
2013 millions of metric tons

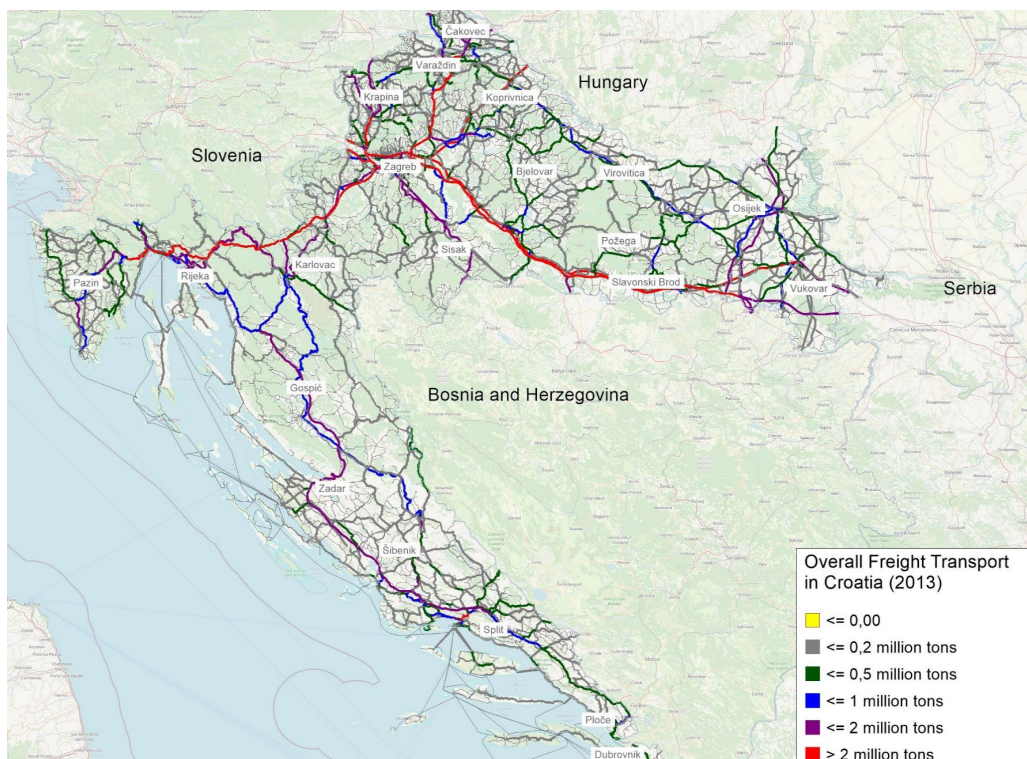
1.	Other Construction Materials	16.0	26.	Other Minerals	0.5
2.	Other Consumer Goods	9.9	27.	Passenger Cars	0.5
3.	Chemical Products	7.5	28.	Salt	0.4
4.	Oil Products	6.5	29.	Metal Products	0.4
5.	Food Products	5.3	30.	Oil Crops	0.4
6.	Cereals	4.5	31.	Vegetable Oil	0.4
7.	Raw Wood	3.5	32.	Crude Steel	0.3
8.	Processed Wood	3.5	33.	Potatoes	0.3
9.	Cement	3.1	34.	Aluminum	0.3
10.	Pebbles And Gravel	3.0	35.	Heavy Vehicles	0.3
11.	Coal	2.7	36.	Steel Tubes	0.3
12.	Machinery	2.3	37.	Cotton	0.3
13.	Paper	1.8	38.	Living Animals	0.2
14.	Luxury Food	1.8	39.	Paper Pulp	0.2
15.	Fertilizer	1.7	40.	Bauxite	0.1
16.	Other Steel Products	1.7	41.	Other Metals	0.1
17.	Marble And Travertine	1.7	42.	Special Vehicles	0.1
18.	Wood Products	1.5	43.	White Goods	0.02
19.	Sugar Beets	1.4	44.	Pulses	0.01
20.	Other Ores	1.3	45.	Copper Ore	0.005
21.	Iron And Steel Waste	1.0	46.	Iron Ore	0.004
22.	Fruits	0.7	47.	Copper	0.003
23.	Textile Products	0.6	48.	Manganese	-
24.	Meat	0.5	49.	Asbestos	-
25.	Vegetables	0.5	50.	Others	5.9
Total		95.3			

Source: Croatia NTM; World Bank analysis.

²¹ It is noted that, as per Table 2.1, the NTM includes no data on the transportation of crude oil. In 2013 the Port of Rijeka handled, through the Omišalj terminal, more than 5 million tons of crude oil.

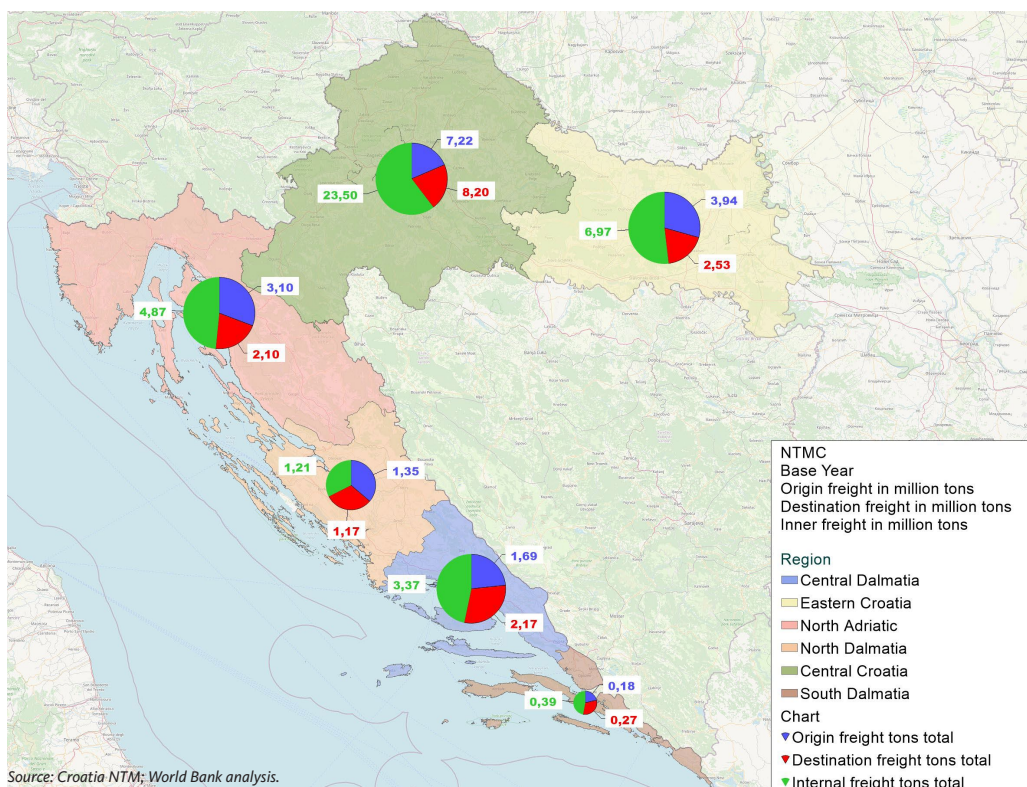
Freight flow links, what we will refer to as ‘desire lines’, help visualize the freight transport linkages between zones. The display of desire lines is useful for illustrating demand matrices in the network, providing an overview of which origin-destination (OD) pairs account for the most significant disaggregated freight flows.

FIGURE 2.1.
Overall Freight Transport
in Croatia, 2013



Source: Croatia NTM; World Bank analysis.

FIGURE 2.2.
Overall Freight Transport
in Croatian Regions by
Directionality of Flow, 2013



Source: Croatia NTM; World Bank analysis.

Figure 2.3 presents desire lines for domestic freight flows between Croatian regions. **The vast majority of domestic freight movements in Croatia comprise shipments between Central Croatia and Eastern Croatia, Central Croatia and the North Adriatic region, and between South Dalmatia and North Dalmatia, in that order.** This pattern of freight movement illustrates the influence of geography on transportation, as illustrated by the low volumes moved between non-adjacent Croatian regions.

FIGURE 2.3.
Total Domestic Tonnage
Flows Between Croatian
Regions

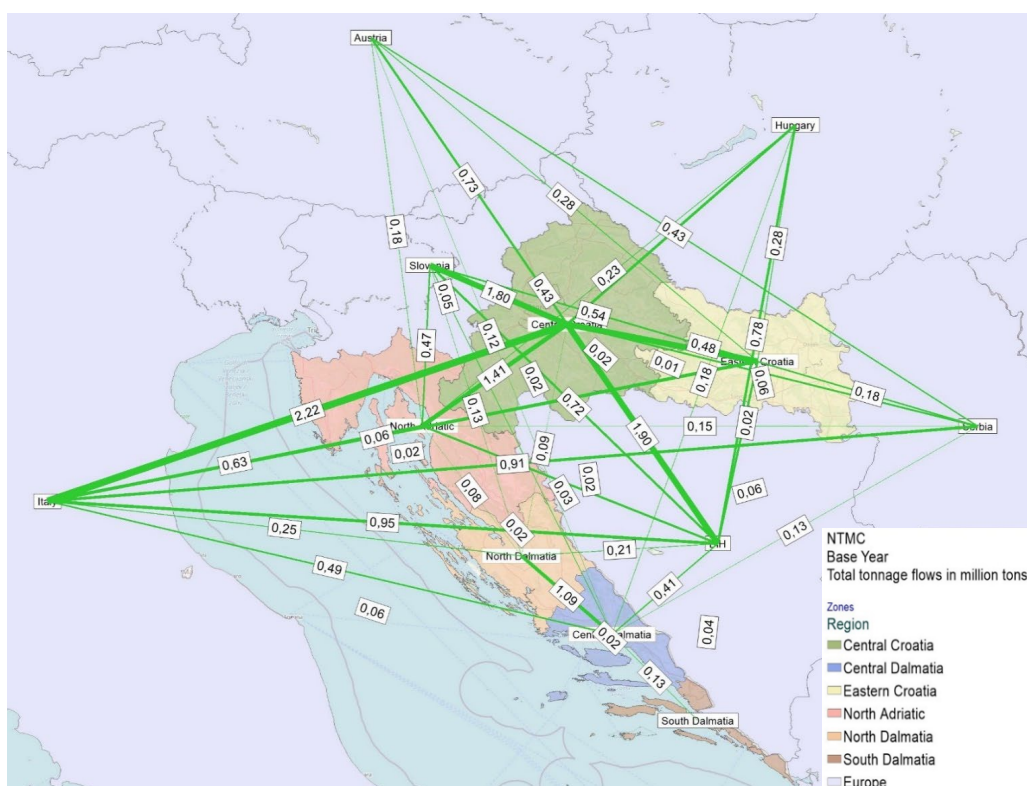


Source: Croatia NTM; World Bank analysis.

Figure 2.4 shows the 100 largest values of international tonnage flows between Croatian regions and neighboring countries.²² **The largest international tonnage flows are between Central Croatia and Italy, Slovenia, Bosnia and Herzegovina, Eastern Croatia, and the North Adriatic region.**

²² The zones in Figure 2.7 represent either subnational Croatian regions or neighboring countries of Croatia. The centroid of each zone represents the entire zone (subnational Croatian region or neighboring country), not the exact location of the origin and destination of freight within each demarcation. The thickness of a link between two regions represents the total volume of freight flowing in both directions.

FIGURE 2.4.
Total Tonnage Flows
Between Croatian
Regions and Neighboring
Countries¹⁾



Source: Croatia NTM; World Bank analysis.

1) Zone centroids represent the entire zone (subnational Croatian region or neighboring country), not the exact location of the origin and destination of freight within each zone. The thickness of links between two regions represents the total volume of freight flowing in both directions.

As the freight model disaggregates data into 50 commodities types, for analytical purposes these were grouped according to the way their transportation is typically conducted, as per the following categories (“commodity groupings”): dry bulk, liquid bulk, containerized, and other cargo. As can be seen from Table 2.2, between all zones in the network **approximately 70% of all cargo transported in Croatia by volume is shipped as bulk. Only about a quarter of all tonnage is transported as containerized cargo.**

TABLE 2.2.
Total Cargo Transported in Croatia
in 2013 by Commodity Grouping
Metric tons

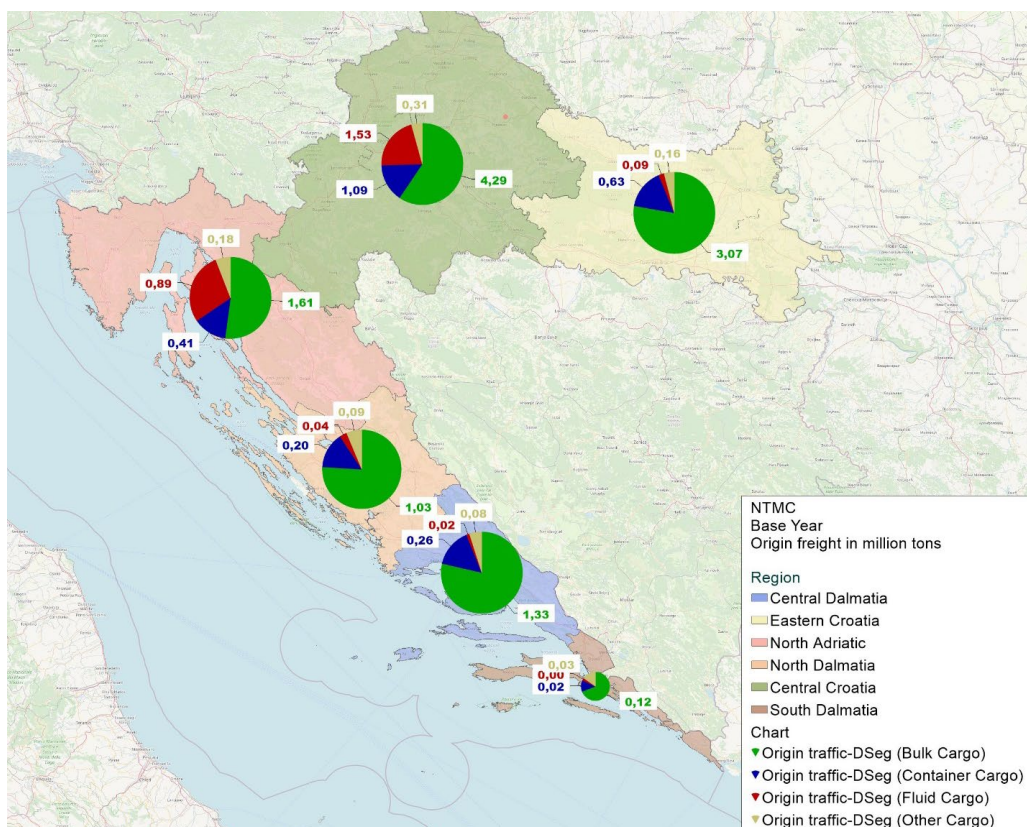
Total Cargo	Dry Bulk	Liquid bulk	Containerized	Other
94,990,884	50,873,869	14,336,916	23,601,233	6,178,866
Share:	54%	15%	25%	7%

Source: Croatia NTM; World Bank analysis.

Figures 2.5 and 2.6 show, respectively, origin and destination freight flows in Croatia’s six regions broken down by commodity grouping. Central Croatia is the largest origin and destination, followed by Eastern Croatia and the North Adriatic region. An important finding from this analysis is the significant amount of containerized freight flows originated in and destined for Eastern Croatia, which in both cases either match or surpass those of the North Adriatic region. While the growth in containerized volumes attained since 2013 at the Port of Rijeka, which is located in the North Adriatic region, may have changed this picture somewhat, it is still noteworthy that as early as 2013 Eastern Croatia generated significant levels of containerized freight transport activity compared to other Croatian regions.

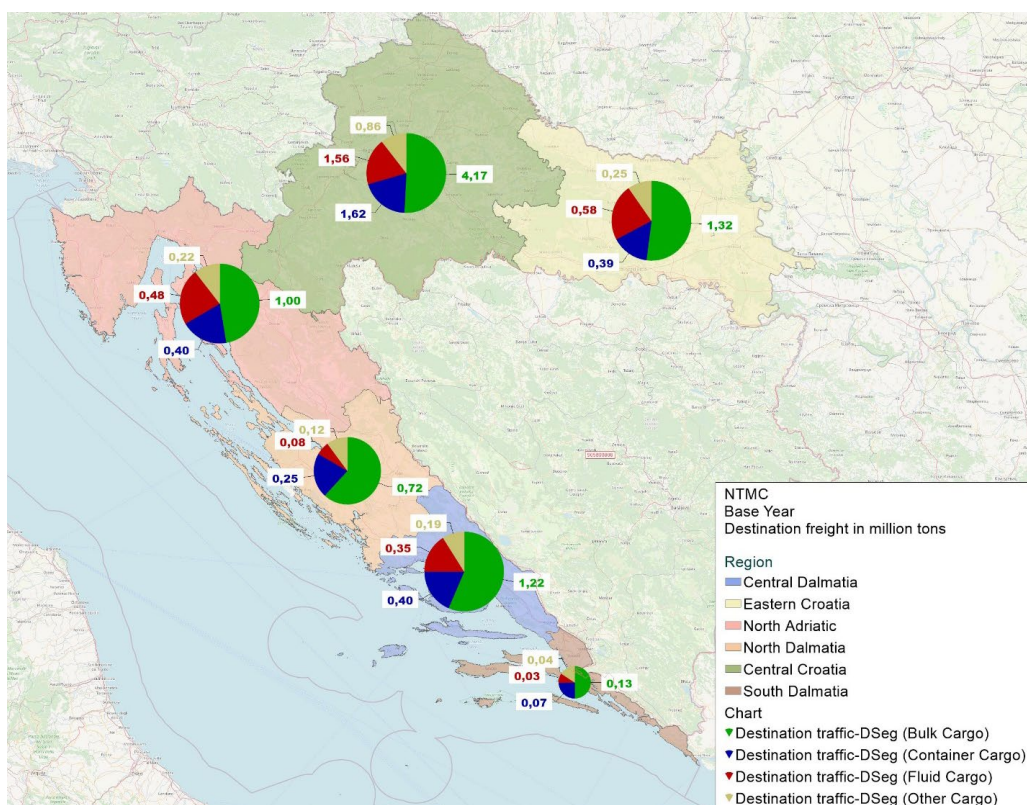
A more granular assessment of domestic and international freight flows by commodity type and origin-destination disaggregation is presented in Annex 3.

FIGURE 2.5.
Origin Flows of Stratified Goods
in Croatian Regions, 2013



Source: Croatia NTM; World Bank analysis.

FIGURE 2.6.
Destination Flows of Stratified
Goods in Croatian Regions, 2013



Source: Croatia NTM; World Bank analysis.

PORT OF RIJEKA TRANSIT FLOWS

Based on the analysis of the National Transport Model, the total freight traffic of the Port of Rijeka is about 3.8 million tons, but it should be noted that the model does not show the transportation of crude oil going to the Omišalj terminal on Krk Island. According to the statistics of the Port of Rijeka, in 2013 the total transshipment load of the Port of Rijeka was about 8.7 million tons, of which about 5.1 million tons were crude oil. According to the model of the total cargo, about 1.1 million tons are transported by rail and the rest by road (Figure 2.7).

ROAD TRAFFIC

Most freight in Croatia is transported on the road network. According to the freight transport model the most saturated roads, with more than 3 million tons per year in both directions, are (see Figure 2.8):

- A3 Motorway (section from Bregana to Slavonski Brod);
- A1/A6 Motorway (section from Zagreb to Rijeka);
- A4 Motorway (section from Zagreb to Varaždin); and
- A2 Motorway (section from Zagreb to Zabok).

Figure 2.9 presents an analysis of utilization levels of the road network. Based on average daily traffic data year-round, the model shows that overall, roads in Croatia are not oversaturated. The degree of saturation over 100% can only be seen in the City of Zagreb.

During the tourist season and summer months the picture is drastically different, with recognizable bottlenecks in the largest cities: Zagreb, Split, Rijeka, Dubrovnik, Pula, and Osijek. Bottlenecks also appear in the cities of Slavonski Brod and Čakovec due to queues at the border with Bosnia and Herzegovina and Hungary.

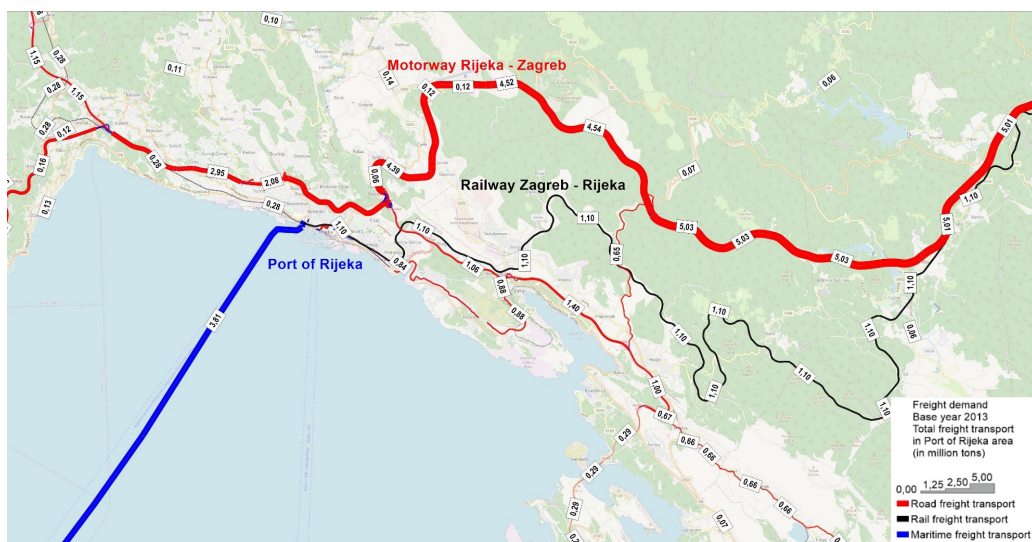
RAILWAY TRAFFIC

According to output data from the model, the most saturated railway tracks in both directions in terms of freight transport tonnage are (Figure 2.10):

- M101, M102 and M201 – Slovenia (Dobova)–Zagreb–Dugo Selo–Koprivnica–Hungary;
- M202 – section from Zagreb to Karlovac;
- M103 and M104 – Dugo Selo–Novska–Vinkovci–Serbia; and
- M304 – Bosnia and Herzegovina to Ploče.

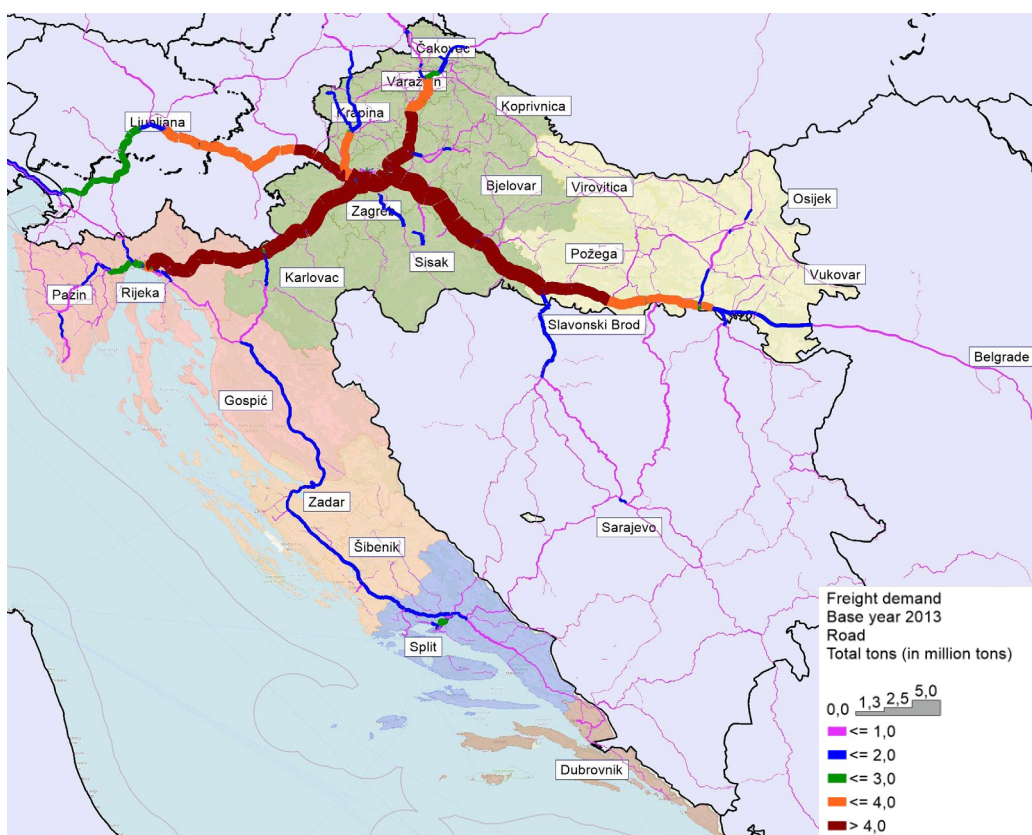
The NTM does not include data on the cargo carrying capacity of the railway network, which prevents analyses of infrastructure bottlenecks based on utilization rates obtained by comparing traffic flows to installed capacity. To close this gap, Figure 2.11 presents current data, for 2019, on utilization levels of the main Botovo–Zagreb–Rijeka railway corridor (RH2). There are no evident capacity bottlenecks considering current levels of traffic, except its last section from Skrljevo to the Port of Rijeka, with 101% over the designed parameters. However, the stations do not have satisfactory track lengths and because of the physical characteristics (mountainous terrain) the number of tracks in some stations is not sufficient. The number of tracks, or lack thereof, at some stations prevents quality train operations, which are necessary to configure the railway itself (crossing, multi-part train sharing, connection).

FIGURE 2.7.
Port of Rijeka:
Total Freight Flows, 2013



Source: Croatia NTM; World Bank analysis.

FIGURE 2.8.
Total Tonnage Flows on
the Road Network, 2013



Source: Croatia NTM; World Bank analysis.

FIGURE 2.9.
Utilization of Croatia's Road
Network for Base Year 2013 (1 of 2)
Year-round average

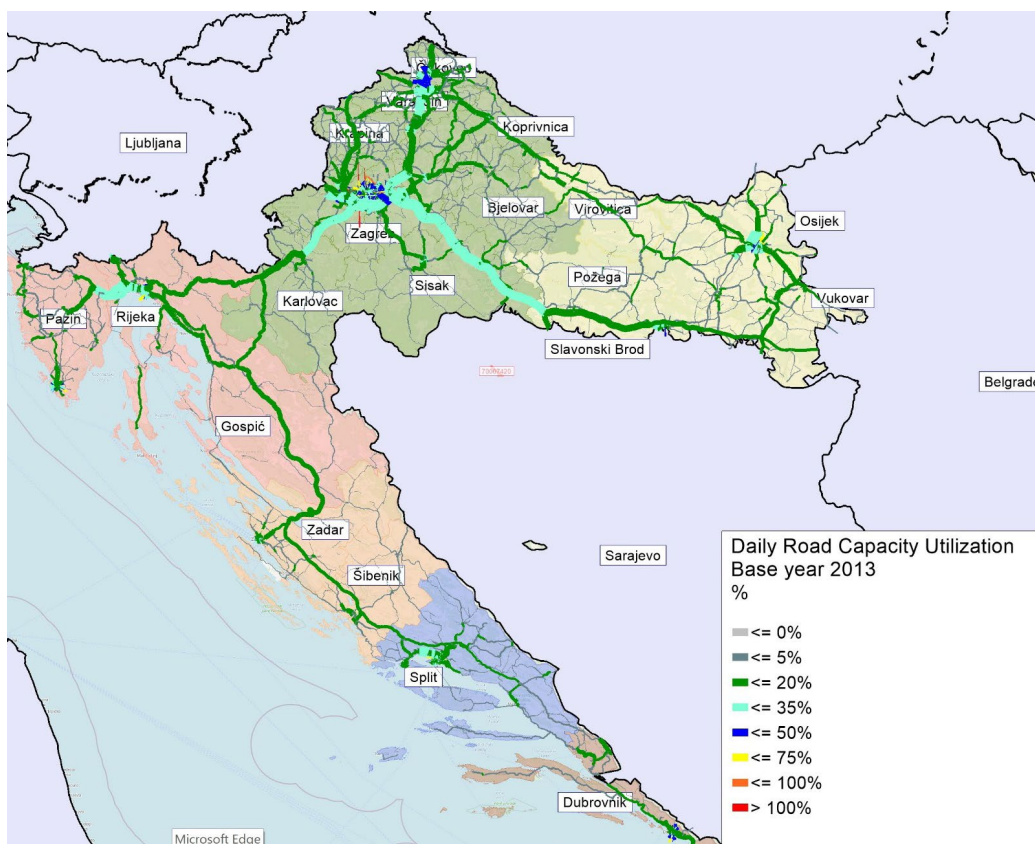
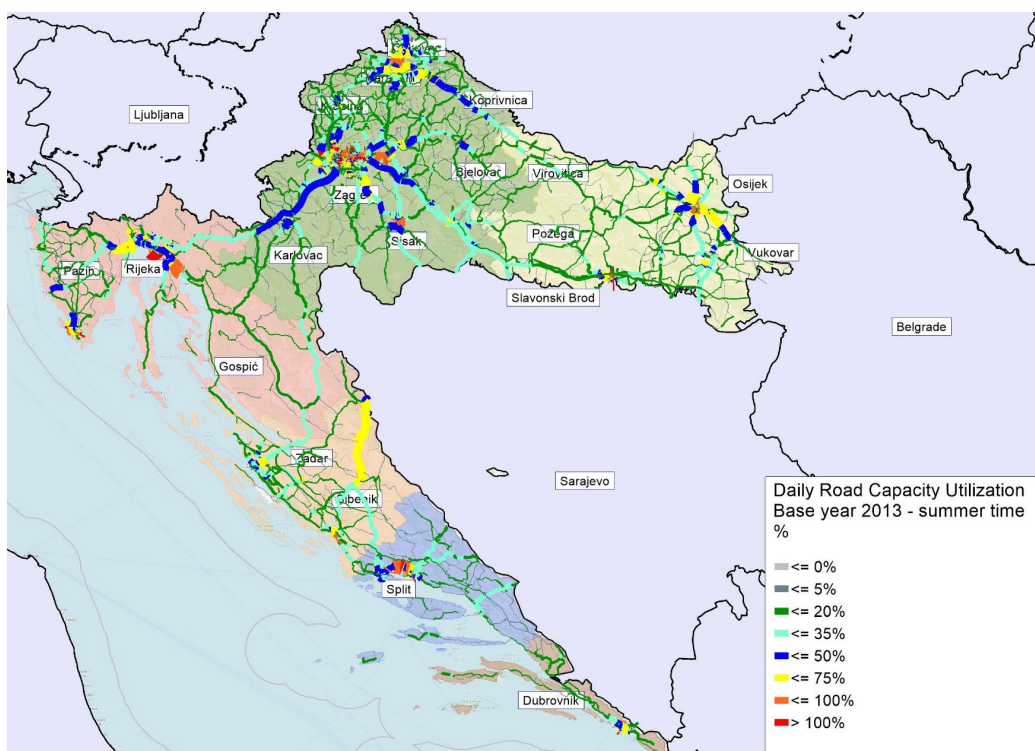


FIGURE 2.9.
Utilization of Croatia's Road
Network for Base Year 2013 (2 of 2)
Summertime



Source: Croatia NTM; World Bank analysis.

FIGURE 2.10.
Total Tonnage Flows on the Rail
Network, 2013 (1 of 2)

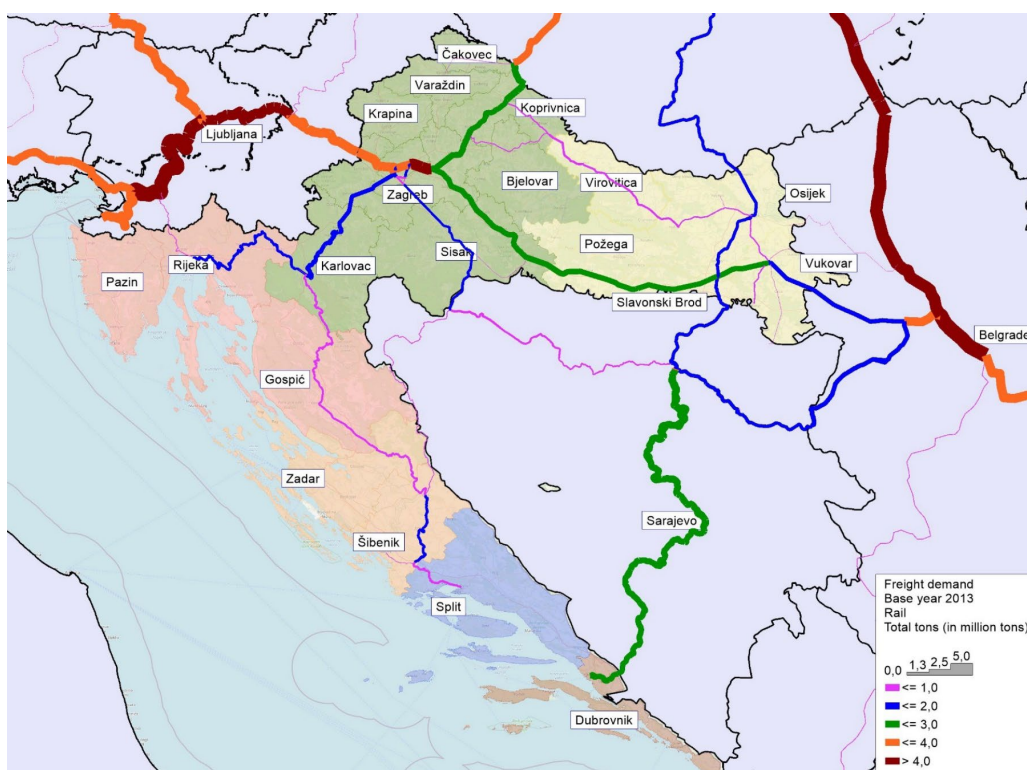
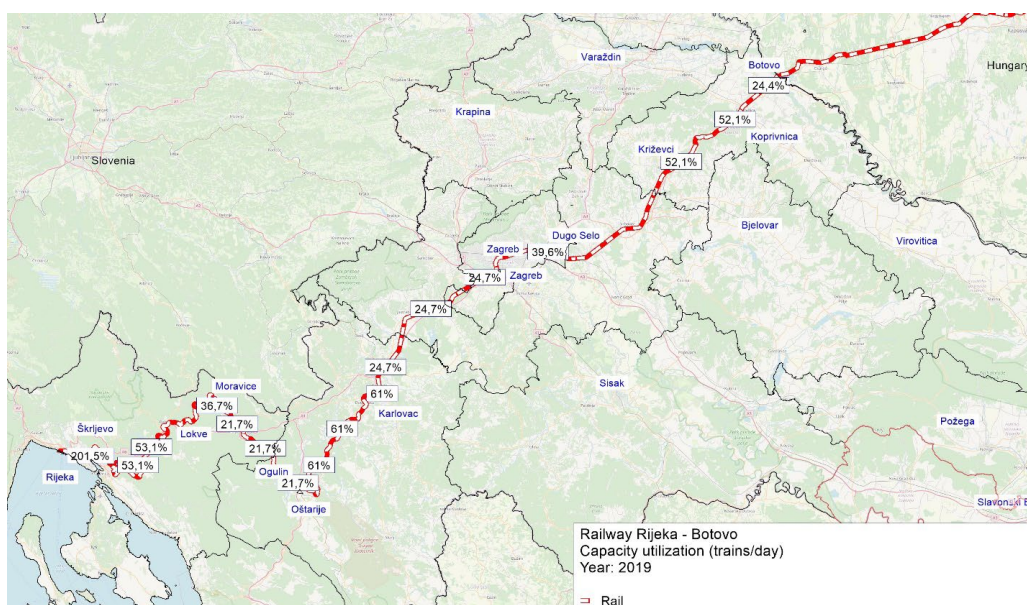


FIGURE 2.10.
Total Tonnage Flows on the Rail
Network, 2013 (2 of 2)



Source: Croatia NTM; World Bank analysis.

FIGURE 2.11.
Capacity Utilization (trains/
day) on the Botovo–Zagreb–
Rijeka Railway Line, 2019



Source: HZ Cargo; World Bank analysis.

FREIGHT FLOWS TO AND FROM EASTERN CROATIA

In terms of total freight transport Eastern Croatia is the second largest freight generation-attraction region in the country, after Central Croatia. Table 2.3 shows the generation and attraction of freight flows, in millions of tons, by region, including domestic, international, and transit flows. In 2013 Eastern Croatia generated about 11 million tons of outbound flows of goods and attracted inbound flows of 9.5 million tons.

TABLE 2.3.
Generation and Attraction of
Freight Flows in Croatian Regions
Millions of tons

Region	Freight generation: outbound flows	Freight attraction: inbound flows
Central Croatia	30.7	31.7
Eastern Croatia	10.9	9.5
North Adriatic	7.8	7.0
North Dalmatia	2.6	2.4
Central Dalmatia	5.6	5.0
South Dalmatia	0.6	0.7

Source: Croatia NTM; World Bank analysis.

Table 2.4 shows Eastern Croatia's largest outbound and inbound flows by commodity type. The largest-volume 'export' (outbound) and 'import' (inbound) commodities for the region are cereals, construction materials, cement, and wood products. It is important to note that consumer products and perishables are also among the largest-volume commodities produced in the region, which makes the case for supporting improvements in containerized logistics and value-added warehousing service delivery to/from Eastern Croatia.

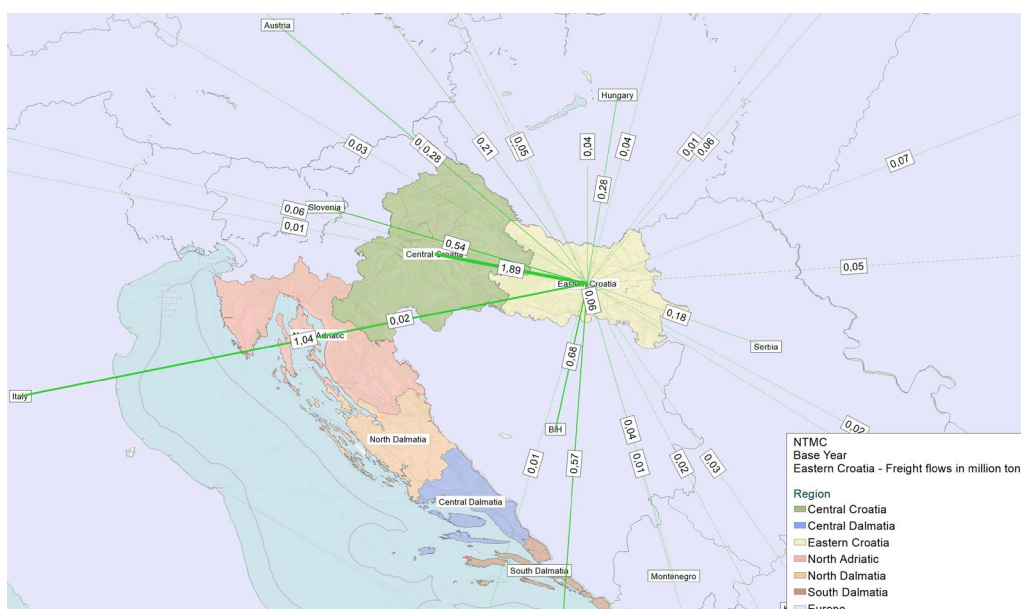
Figure 2.12 shows the 30 largest OD pairs to/from Eastern Croatia. The largest freight flows are between Eastern Croatia and Central Croatia, Italy, Bosnia and Herzegovina, and Slovenia. This underscores the importance of improving connectivity—across infrastructure and service delivery—between Central and Eastern Croatia, and between Eastern Croatia and neighboring countries, particularly Bosnia and Herzegovina.

TABLE 2.4.
Largest Freight Generation
(Outbound) and Attraction
(Inbound) Flows to/from Eastern
Croatia by Commodity Type, 2013
Millions of tons

Commodities	Freight generation: outbound flows	Freight attraction: inbound flows
Cereals	2.79	2.07
Other construction materials	2.26	1.86
Other consumer goods	0.61	0.60
Cement	0.56	0.22
Food products	0.41	0.40
Pebbles and gravel	0.39	0.40
Sugar beets	0.30	0.27
Processed wood	0.46	0.10
Marble and travertine	0.33	0.19
Wood products	0.36	0.14
Luxury food	0.25	0.22
Raw wood	0.14	0.13
Fruits	0.17	0.16
Oil crops	0.26	0.10
Oil products	0.20	0.35
Vegetables	0.06	0.06
Living animals	0.06	0.05

Source: Croatia NTM; World Bank analysis.

FIGURE 2.12.
Largest OD Pairs to/from
Eastern Croatia, 2013

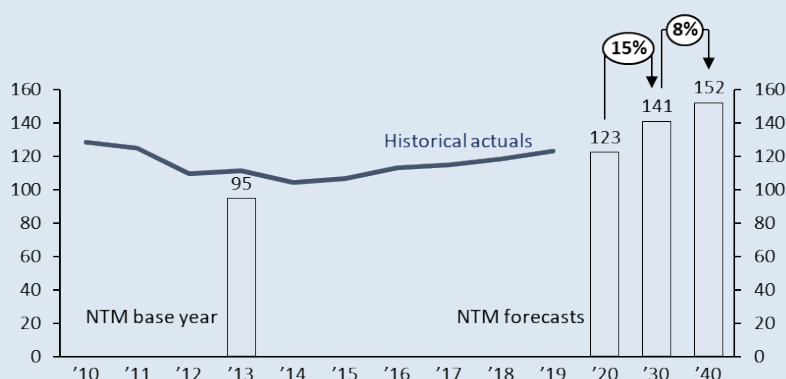


Source: Croatia NTM; World Bank analysis.

FREIGHT DEMAND FORECAST

The model also provides a forecast of freight flows for scenario years 2020, 2030, and 2040. As compared to historical data reported by the Croatian Bureau of Statistics, the model underestimated the base year volumes by about 14%, but the forecasts and overall trajectory of freight demand projected in the out-years appear to fit well with historical actuals (Figure 2.13). From 2020 to 2030 the model projects that demand will rise by about 15% overall, and from 2030 to 2040 by 8%.

FIGURE 2.13.
National Transport Model
Base Year and Freight Demand
Forecast vs. Historical Data
Millions of tons



Source: Croatian Bureau of Statistics; Croatia NTM; World Bank analysis.

KEY OPPORTUNITIES FOR POLICY MAKERS REGARDING THE NTM

Our analysis of Croatia's National Transport Model regarding freight shows that the model is well validated, with a deviation of 8% from actual data in the base year of 2013. Freight flows on the road and rail networks fit well with actual data. However, the model also has limitations. The methodology used for input data collection is not sufficiently explained; in particular, the critical issue of sample representativeness is not elaborated in the model's methodological content. This makes it difficult to update the model with newer data. It is stated in the model description that only 37 companies responded to the key background questionnaire.

The model is complex, making deep technical expertise necessary to conduct queries, analysis, updates or changes. As a result, the model does not lend itself to regular upkeep and ongoing analysis of output data by MSTI (and others) in response to changes in the transport network or as an input into decision and policy making. By way of example, the model has 1,206 procedures before it is possible to assign freight flows onto the network.

Seven years since its development, and without regular upkeep and updates, the model was allowed to become dated. This has reduced (although, in an environment of limited availability of disaggregated freight flow data at the national level, by no means entirely removed) its relevance as a decision-making support tool. MSTI has indicated that the methodology for the model's update is under discussion. MSTI has the opportunity to reach out to Croatia's academic and research institutions to address some of the above-mentioned limitations, such as through more representative data sampling. A detailed analysis of the existing model should be conducted as well, so that any errors or overly complex design structures can be internalized as lessons learned towards improving the model's next iteration. Going forward, consideration should be given to provide the model with ongoing maintenance and a predictable updating schedule (e.g., every 3-5 years) to maintain relevance through accuracy and usability. Germany, where the national transport model is updated, as a rule, every five years, offers a good example of this approach.

CHAPTER 3

Croatia's Competitiveness as a Maritime Gateway in European Intercontinental Logistics

CHAPTER 3

Croatia's Competitiveness as a Maritime Gateway in European Intercontinental Logistics

One of the inherent strengths of Croatia's logistics sector is the country's geographic position. Even though the Croatian domestic freight market is relatively small per se, Croatia is adjacent to the core of what the IMF once called the 'German-Central European Supply Chain'²³—the dynamic, high-volume, manufacturing- and distribution-intense Central European hinterland. This creates the opportunity for Croatia to more solidly establish itself as a logistics platform to serve this hinterland, particularly as it relates to intercontinental—and above all, Asia-Europe—logistics. Specifically, Croatia has the opportunity to strengthen its position as (i) a maritime gateway for containerized shipments; (ii) a geographic base to locate warehousing, distribution, cross-docking, and other cargo handling facilities to provide regional value-added logistics services; (iii) a multimodal network of road, rail, and inland waterway infrastructure; and (iv) a transport service delivery market for trucking, rail intermodal, and barge multimodal itineraries. These activities can contribute to improvements in firm-level productivity for Croatian and European firms, as well as job creation, foreign direct investment, and economic growth in Croatia.

While there are multiple components underpinning the realization of this vision, none is more important than the market competitiveness of the Port of Rijeka and its rail-based hinterland connectivity to/from Central Europe. The Central European hinterland has been and will continue to be competitively served by numerous European ports and rail intermodal corridors, including the historically dominant northern European ports of the Hamburg-Le Havre port range; the relatively smaller but strategically located ports of the North Adriatic range, including Rijeka and several neighboring 'competing' ports,²⁴ such as Slovenia's port of Koper; formidable ports farther afield, such as Greece's port of Piraeus; and ports that are

²³ International Monetary Fund (2013), "German-Central European Supply Chain—Cluster Report", *IMF Multi-Country Report*, Report No. 13/263, Washington DC.

²⁴ We use the term 'competing' deliberately but with caution. Maritime ports serving a partially or fully overlapping hinterland—such as the ports of Rijeka, Koper, Venice, Trieste, and Ravenna in the North Adriatic—are not necessarily involved in zero-sum competition where one port's volume gains are necessarily another port's loss. International experience shows that international integration and openness to trade at the regional level typically brings broad-based economic benefits to neighboring countries in the region, because economic activity in one portion of the region is likely to spur economic activity in well-connected portions elsewhere. For example, in the North Adriatic over the past 15 years improvements in port efficiency and hinterland connectivity in a port like Koper have elevated the visibility of the North Adriatic port range across Central Europe, which in turn prompted realignment of supply chains towards gateways in this range, as well as realignment of shipping and logistics services and regional infrastructure investment to/from these gateways—from which Rijeka, and all ports in the range, have benefited. It is based on effects like these that the North Adriatic ports—like other ports serving common hinterlands—routinely collaborate. This is done most notably through the North Adriatic Ports Association (NAPA), a regional entity devoted to promoting the Adriatic Sea as a corridor to/from Europe, and to combining efforts across NAPA ports to coordinate infrastructure planning and investment, harmonization of regulations, digitalization and technology adoption, and safety practices, among other areas of collaboration. The benchmark analysis presented in this chapter assesses the comparative attractiveness of the Port of Rijeka as a gateway—more than as 'just' a maritime port—in intercontinental logistics; that is, it assesses Rijeka's *competitiveness* more so than its level of competition, with the intention of illustrating opportunities for the Port of Rijeka and Croatia to become a *more capable gateway* than it has been in the past.

investing to reposition themselves in this highly coveted market, like Poland's port of Gdansk. In other words, competition for the market is not only keen, but it is arguably keener now than it has ever been in modern European history, including with significant private and EU-led investments. And the latter are expected to intensify going forward in the context of the European Green Deal and its commitment to decarbonization—per the ports' vital role in facilitating multimodalism—and in the context the COVID-19 recovery effort to 'build back better'. Furthermore, factors external to Europe exert influence over the organization of intercontinental supply chains connecting the continent and the infrastructure that underpins them, such as China's Belt and Road Initiative (BRI).

In this context, it is important to assess Croatia's comparative competitiveness as a logistics platform for Central Europe vis-à-vis other countries. It is also important for such assessment to be specific so that it can be actionable. For example, how should the Central European hinterland be defined? What kinds of commodities are being moved to/from this hinterland? What are the different routings to move containerized cargo between Asia and Central Europe, and which routings minimize shipper-level logistics costs? Are some of those routings anchored in Croatia? These are some of the critical questions that this chapter will attempt to address. Their policy and market implications will be discussed in Chapter 5 on recommendations for action.

KEY ROLES IN THE CONTAINER SHIPPING ECOSYSTEM

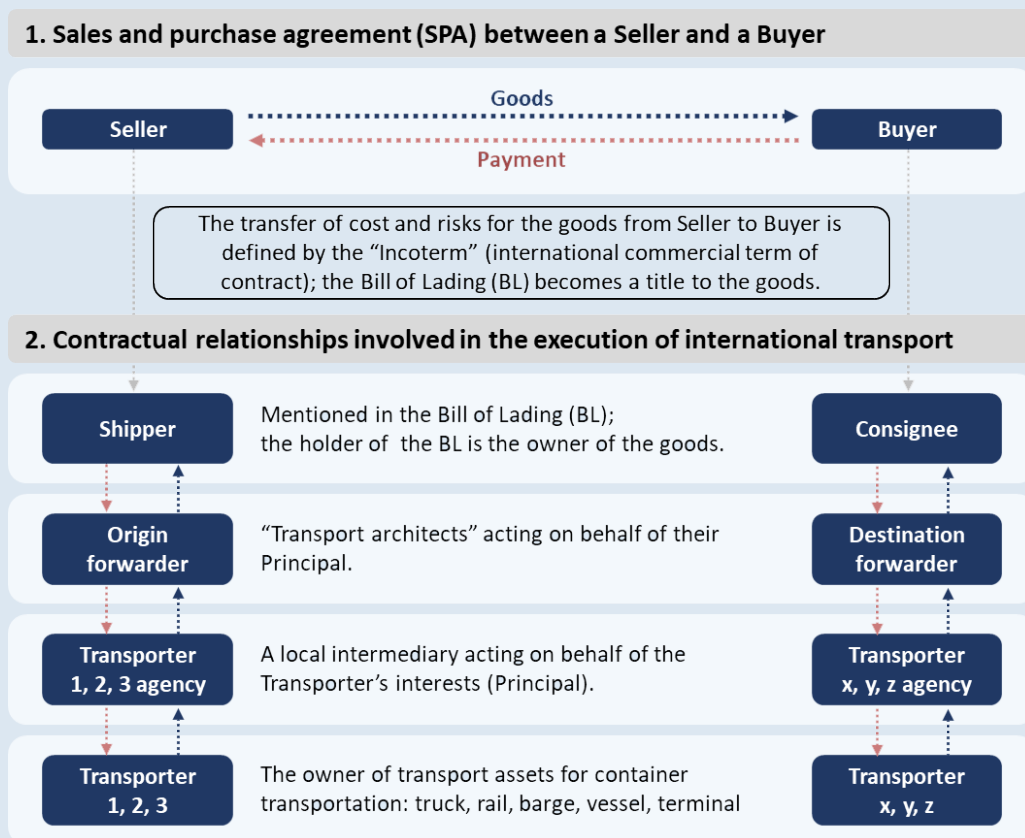
Traditionally, a sales and purchase agreement (SPA) between a buyer and a seller of goods gives rise to the need for transportation (see Figure 3.1). Good practice requires the SPA to contain an "Incoterm" (international commercial term of contract) which stipulates the point at which the costs and risks for the underlying goods are legally transferred from the seller to the buyer. In practical terms, the Incoterm defines when the cargo can be considered 'delivered', and consequently it stipulates which part of the transport chain falls under the responsibility of the seller versus that of the buyer. In containerized logistics, the transportation contracts that ensue from international SPAs requiring ocean transport—most notably the Bill of Lading—refer to the seller of the goods as the 'shipper' and the buyer of the goods as the 'consignee'.²⁵

While containerized shipping services can be arranged by the seller's or buyer's in-house logistics teams, usually, and particularly in international itineraries, both parties will rely on non-asset based intermediaries to arrange and/or execute transport services and formalities on their behalf. In international, and especially intercontinental, shipments these intermediaries are typically freight forwarders.²⁶ The shipper's forwarder is referred to as the origin forwarder and the consignee's forwarder as the destination forwarder. Box 4 illustrates the most frequent setups and scopes of forwarder activities in a selection of Incoterms for intercontinental containerized sea freight supply chains.

²⁵ Beyond the particular terminology of documents like bills of lading, where distinguishing between shipper and consignee is an essential component of the transaction for legal, financial, and operational reasons, in general logistics parlance the term "shipper" is typically used as shorthand for the ultimate owner of the cargo being transported (referred to in the jargon as a "Beneficial Cargo Owner", or BCO). For example, in the case of a retail supply chain of a 'big box' retailer (e.g., Tesco, Target, or Wal-Mart) importing goods from the Far East into, say, North America, the retailer is the BCO and would typically be referred to as the shipper, even though in the underlying documentation the BCO may be designated, for legal and other reasons, as the consignee of a given shipment.

²⁶ Freight forwarders are a subset of a broader typology of non-asset based or "asset light" logistics intermediaries under the overall rubric of third-party logistics service providers, or 3PLs, where the latter also include non-vessel operating common carriers (NVOCCs), truck brokers, intermodal marketing companies, warehousing and distribution operators, dedicated contract carriage operators, and supply chain management planning and execution service providers.

FIGURE 3.1.
The Container
Shipping Ecosystem



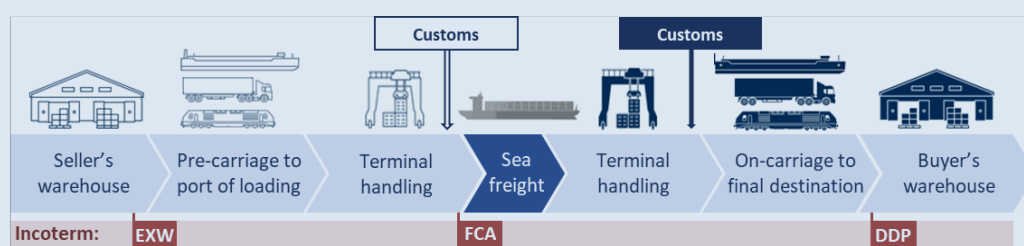
Source: Drewry Supply Chain Advisors; World Bank analysis.

Similar to shippers and consignees utilizing intermediaries to act on their behalf, large (asset-based) transport carriers with international activities also often work through local agents, sometimes referred to as Transporter Agencies, which deploy operational, commercial, and customer service activities in local markets.

BOX 4. THE SETUP OF INTERCONTINENTAL CONTAINERIZED SEA FREIGHT SUPPLY CHAINS

Intercontinental door-to-door containerized supply chains typically move cargo between the seller's and the buyer's warehouse as illustrated in Figure 3.2. The maritime journey is preceded and followed by inland transportation: the pre- and on-carriage. Pre- and on-carriage may be optimized through rail intermodal transportation—the movement of containers or trailers by rail for the linehaul portion of the journey, with short-haul “drayage” trucking services at either end (the “first” and “last” miles of each inland leg). In the intermodal case, multiple parties get involved instead of just the trucker. In the absence of special arrangements, cargo is cleared through customs at origin (before loading on board the vessel) and at destination (before leaving the maritime port gateway container terminal).

FIGURE 3.2.
Representative
Operational Setup of
an Intercontinental
Containerized Supply Chain



Note: EXW= Ex-works; FCA = Free Carrier; DDP = Delivery Duty Paid.
Source: Drewry Supply Chain Advisors; World Bank analysis.

The incoterm settles the point in the supply chain at which cargo transport costs and risks transfer from seller to buyer. For example:

- Ex-works (EXW) ‘named place’: costs and risks for goods are transferred to the buyer as the goods are loaded in the container at the named place, usually the seller’s premises;
- Free Carrier (FCA) ‘named place’: costs and risks for goods sold on this basis are transferred onto the buyer as the goods arrive at the named place;
- Delivered Duty Paid (DDP): when goods are sold on DDP terms, the seller bears all costs and risks to get the cargo delivered to the destination warehouse; only destination unloading falls under the account of the buyer.

The incoterm choice has important repercussions for the scope of involvement of the respective origin and destination forwarders. At one end of the spectrum, under EXW the shipper’s liabilities and exposure are minimized and all customs formalities and transport arrangements are made by the consignee or the consignee’s destination forwarder. At the other end, under DDP incoterms, the origin forwarder handles all export and import formalities as well as transport arrangements, and the liabilities and exposure for the consignee are minimized. Between these two extremes there are several viable options, such as FCA and others, to suit the size and experience of the shipper and consignee or their respective forwarders.

An important evolution of the ecosystem of the intercontinental containerized supply chains as described above occurred with the emergence of large, global forwarders. These intermediaries often lease warehouse space around the globe, and also offer distribution services from the warehouse to the final customer/point of consumption. These integrated forwarders offer both origin and destination services within a single company as part of a wider supply chain proposition, which goes beyond the historically traditional ‘warehouse to warehouse’ scope.

Source: Drewry Supply Chain Advisors; World Bank analysis.

THE 'BEST ROUTE' CONCEPT

The 'best route' concept is a benchmarking technique that has been widely used in the international experience—by shippers, carriers, logistics service providers, government agencies, and academics alike—to compare the competitive position of a given country, a given port, or a given routing relative to other countries, ports, or routings vying to serve a common hinterland or available to fulfill a given freight itinerary. It is based on the premise that for every origin-destination shipment the 'rational shipper' will seek, explicitly or implicitly, to minimize the total logistics costs associated with that shipment. For any given shipment, the 'best route' is the *routing option*—defined as the combination of modal choice, service type choice, service provider choice, and the incidence of connections and 'touch points' along the way—that minimizes total logistics costs among all available routes. In this chapter we will assess Croatia's—and, in particular, the Port of Rijeka's—competitive position vis-à-vis an array of European ports serving the Central European hinterland for the Asia-Europe trade, with China—and specifically, the port of Shanghai, the world's largest container port by volume—as the most representative origin, based on best-route benchmarking.

A key corollary of the best route concept is that maritime ports, particularly gateway ports (as opposed to transshipment ports), do not compete purely on the basis of what happens within the four walls of their container terminals—factors like port productivity (e.g., container moves per crane per hour, throughput per meter of quay, etc.) and terminal handling charges (i.e., unit price). Rather, maritime ports are nodes within broader routes, or supply chains, and it is the competitiveness of these routes as a whole, from origin to destination, which are enabled by maritime ports as gateways but also by factors like hinterland connectivity to/from the port, that elevate or constrain the attractiveness of a port from the perspective of shippers and logistics service providers. This is why routing options are often at the core of supply chain management, more so than port choice per se.

The different routing options available to move cargo between a given origin-destination pair each entail their own specific cost-service tradeoffs, which can be quantified in a total logistics costs (sometimes also referred to as 'total landed cost' or 'total distribution cost') calculation. For the purposes of this analysis, our definition of **total logistics costs** will comprise:

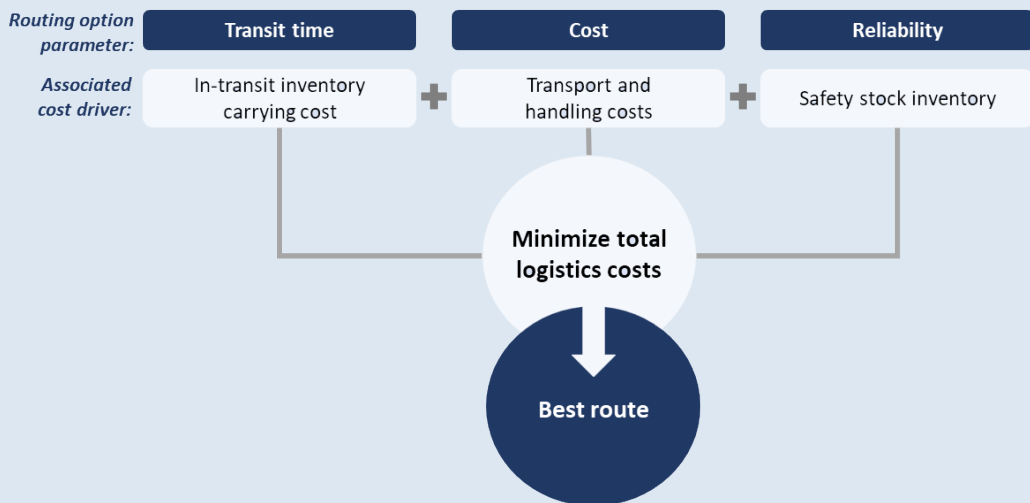
- **Transport and handling costs.** All route-specific expenses involved in physically moving and handling cargo from origin to destination, the bulk of which is typically accounted for by door-to-door transport costs and handling costs such as marine terminal operation charges.²⁷
- **In-transit inventory carrying costs.** All cargo kept on hand generates an opportunity cost of capital, including during the time it transits between origin and destination while bringing it to market. In addition to incurring an opportunity cost of capital, cargo in transit is exposed to damage, pilferage, loss, diversion, and other forms of inventory 'shrinkage', as well as to obsolescence costs. These costs will typically vary by commodity type and may also vary by routing option. Irrespective of commodity type and routing option, however, these costs are directly dependent upon the length of time cargo remains in transit—the longer the transit time, the greater the risk exposure of the underlying cargo and the higher the opportunity cost of capital tied up in inventory, and therefore the higher the in-transit inventory carrying costs incurred. Since the average length of transit time—formally referred to as the *delivery lead time*—will change based on route choice, transit time and the associated in-transit inventory-carrying cost implications are an important element of the total logistics costs calculation.

²⁷ To the extent that the cost of customs formalities and documentary requirements is the same across routes for a given origin-destination pair (which they typically are), customs clearance costs are irrelevant to route choice and therefore should not be part of the definition of 'landed cost' for best-route benchmarking purposes.

- **Safety stock inventory carrying costs.** *The reliability or predictability*²⁸ of any given routing option, as well as the predictability of demand for the underlying cargo, have important repercussions as to the minimal safety stock inventory levels that are required to avoid stock-out situations during the delivery lead time at a given (shipper-determined) level of statistical confidence, referred to as *service level* (say, 97% of the time). Reliability in supply chains is a measure of risk. It encompasses several route-specific dimensions, most notably the predictability of demand during the delivery lead time, which is in principle quantifiable (typically measured through such metrics as the standard deviation or the coefficient of variation of demand during the lead time). But it also includes less tangible factors, like the availability (and cost) of backup solutions in case the preferred itinerary is disrupted by unforeseen circumstances, such as strikes, equipment failure, or accidents. For the purposes of this chapter we will use estimates of demand and lead time variability based on (a) previous findings in the academic literature in logistics, and (b) current data on *service frequency* as a proxy for itinerary reliability, the rationale being that more frequent services provide shippers with quicker access to backup options in case of disruption compared to less frequent services.

The rational shipper can be assumed to opt for the cargo routing option that offers the lowest total logistics costs resulting from the combination (i.e., the summation) of the above three dimensions of cost (see Figure 3.3). The route with the lowest logistics costs is the route we will define as ‘best route’ for the purposes of this chapter. A maritime port and port hinterland connectivity combination that delivers the ‘best route’ (or ‘better’ route) relative to other port and port hinterland combinations for a given origin-destination itinerary can be considered to be more competitive in the market place, and therefore in principle better able to attract freight demand and associated investment and economic activity.

FIGURE 3.3.
Representative Operational
Setup of an Intercontinental
Containerized Supply Chain



Source: Drewry Supply Chain Advisors; World Bank analysis.

Best routes are not static—they can change in the short term due to fluctuations in relative freight rates, or over the long run due to more fundamental changes in the wider transport context, such as improvements in infrastructure and associated service connectivity. For Central Europe, both are happening now: not only are ocean transport prices highly volatile, but

²⁸ These terms will be used interchangeably for the purposes of this chapter.

due to recent developments in the liner shipping, terminal operations, and intermodal transport²⁹ industries, exporters and importers handling cargo flows into Central Europe can use new port and routing options that take advantage of increased infrastructure investment and greater *route-level* competition between ports, container shipping carriers, and intermodal transport operators. This chapter intends to shed some light as to the balance of these issues in the contemporary European supply chain, using market information as of year-end 2018.

THE CENTRAL EUROPEAN INLAND HAULAGE MARKET FOR CONTAINERIZED SHIPMENTS

The Central European hinterland market is particularly suited for transporting containers by rail/road combined transport—which henceforth we will refer to as ‘rail intermodal’ transport. Certain container shipping lines have developed strong ‘in-house’ on-carriage transportation services based on rail intermodal transportation and are now a dominant force in the Central European market with a profound impact on the routing options that are available to shippers.

Traditionally, the inland transportation of the on-carriage services is organized by the destination freight forwarder working on behalf of the consignee. This setup is referred to as *merchant haulage*, and it remains prevalent particularly in markets with strong freight forwarder communities. When the on-carriage is organized by the destination forwarder, the container shipping lines’ involvement in the transport chain is limited to the port-to-port portion of the international/inter-continental journey.

But for shipments from Asia to the main cargo hinterlands of Central Europe, some asset-based shipping lines have developed competitive products to organize the inland transportation themselves. This setup is referred to as *carrier haulage*. When the on-carriage is organized by the shipping line, the shipping line’s involvement in the transport chain is expanded, from its traditional port-to-port scope to a port-to-ramp or port-to-door scope.

In the port-to-ramp scope, the involvement of the shipping line ends at the desired rail (or barge) terminal, usually the one closest to the end-customer’s warehouse. In the port-to-door scope, the shipping line is responsible for the full inland transportation itinerary, inclusive of final delivery to the end-customer’s warehouse.

The Central European market is particularly well-suited for rail intermodal transportation. This is due to two main factors:

- 1. The distances involved.** Although train shuttles can be cost-effective on shorter distances, the traditional rule of thumb is that rail becomes cost effective compared to truck in the European market for lengths of haul of at least 300 km (round-trip) or 700 km (one-way), depending on how close the rail terminal is located to the final destination of the cargo. The reason is that, depending on the local driving time/hours-of-service regulations, longer distances are impossible to cover by truck in a single day (i.e., 300 km round trip or 700 km one-way) and the overnight charges for the driver make the truck leg suddenly a lot more expensive once these distances are exceeded. This long-distance work for truckers also has implications for the driver’s quality of life and work/life balance, and therefore for the attractiveness of trucking as a profession and the availability of truck drivers and ‘seated trucks’ (or lack thereof). As shown in the distance matrix in Table 3.1, none of the listed origin-destination pairs—which are representative of the Central European hinter-

²⁹ Also referred to in the Western European context, particularly in policy circles, as rail/road ‘combined transport’.

land (see Market Sizing section below)—fall within the 300 km bracket, and only a limited number fall within the 700 km bracket, which positions these markets as within the inter-modal-competitive window.

TABLE 3.1.
Distance Matrix for Main
Central European Hinterland
Markets to/from Key Ports
Competing in these Markets
Km

	Koper	Rijeka	Trieste	Gdansk	Antwerp	Hamburg	Rotterdam	Tessaloniki	Piraeus
Munich	507	515	488	1.148	780	791	838	1.565	2.033
Katowice	877	907	858	514	1.182	804	1.176	1.573	2.040
Prague	813	843	795	887	902	604	907	1.522	1.990
Bratislava	536	566	517	899	1.188	966	1.233	1.199	1.666
Vienna	490	520	417	907	1.102	970	1.161	1.240	1.708
Budapest	568	506	550	1.095	1.351	1.163	1.409	1.005	1.473

Source: Drewry Supply Chain Advisors.

2. Containerization. The single conveyance—the marine ISO container—that is used across different modes of transport in inland point intermodal (IPI) services, in which cargo is delivered through its final destination in the same container it was loaded into at origin, makes it easier to organize rail intermodal transportation moves by minimizing cargo transfers and touch points. Transloading services, a variant of rail intermodal services in which cargo is transferred from marine ISO containers to domestic containers at or in the vicinity of the destination port, increase the number of touch points by virtue of the transloading operation. However, domestic containers have larger volumetric capacity, which reduces transportation costs,³⁰ and the nature of transloading operations can reduce inventory carrying costs by enabling inventory postponement strategies.³¹ Due to their being the most common typology of rail intermodal services to/from the Central European hinterland, IPI services will be the focus of this chapter's 'Best Route' analysis.

Initially, shipping lines usually buy part of a train connection's rail capacity on a relatively flexible basis, on terms that are subject to review usually quarterly, sometimes annually. For smaller-volume cargo flows, this is the shipping lines' main rail capacity procurement setup. However, wherever possible shipping lines will strive to enter into long-term contracts for full-train (block train/unit train) loads, as these provide a lower per-unit rate. These contracts typically last two to three years, whereby the rail operator commits to running the agreed number of trains while the shipping line will pay the rail operator for running the trains on a 'used or not used' basis, thereby assuming the commercial risk of actually filling the trains.

Organizing rail products cost effectively requires the trains to consistently run with high utilization rates. Generally, train products reach their breakeven point at utilizations levels of around 80%. Due to the volatility of transport demand volumes, optimal train utilization requires:

1. Sufficient pre-notice of when the containers become available for transport at the port and when they are required to arrive at their destination, so that any leeway can be used to swap containers between different train departures; and
2. A sufficiently large pool of containers available to optimally fill trains (taking into account container sizes, weight, and gauge limitations).

³⁰ In North America, for example, roughly the contents of three 40-foot high-cube marine ISO containers can fit into two domestic 53-foot containers, and therefore fewer transload shipments inland are needed to move the same amount of cargo.

³¹ Specifically, by allowing shippers to delay the inventory positioning decision until the time of on-shore transloading, rather than at origin in Asia several weeks earlier.

Shipping lines are often able to identify the final destination of a container when it is booked at origin, which provides them with sufficient pre-notice. Large shipping lines generate enough Asia->Central Europe volumes to operate as a multimodal transport operator for their inland operations: using a base section of the volumes to fill their trains, while being able to move by truck the balance of containers that do not fit within the optimal train profile. Hence several of the top asset-based container shipping lines in this trade have managed to overcome the difficulties encountered in running trains cost effectively. Specifically, they have leveraged their strong position vis-à-vis the inland transportation operators due to the large volumes they bring to the table, to develop conveyor belt like carrier haulage products that connect seamlessly to their vessel arrivals and deliver on-carriage services at lowest cost, optimal reliability, and minimal environmental impact.

Indeed, in several Central European markets shipping lines emphasize their strong carrier haulage proposition by imposing additional costs onto the merchant haulage market, while absorbing those same costs for their carrier haulage products. Examples of this include the following:

- **Increasing the cost of container hire (detention).** By limiting the free time period for detention to a few days, shipping lines can make it difficult for the merchants to return empty containers within the free time period. The merchant haulage market is then pushed towards using road transportation, which is the most expensive transport mode.
- **Charging drop-off fees for accepting empty containers at inland container depots.** Shipping lines set up inland container depots close to areas of large demand in order to have a buffer stock location for empty containers so that the import containers can be reloaded with an export load after the import journey. This way, the operating model for carrier haulage products can move from the default 'round trip' model to a 'one-way' model. This changes the distance assumptions used for pricing transportation services. In the round-trip model, the distance assumption for a simple load is twice the point-to-point distance between origin and destination. The assumption is that the transport asset will start and end its journey at the same location, so the import leg will be followed by an empty return leg to the port; while the export leg will be preceded by an empty leg from the port. In the one-way model the distance assumption for a simple load is the point-to-point distance between origin and destination, plus the distance to the nearest depot. This is considerably shorter than the distance for the round-trip model, and so are the cost and price. By charging high drop-off fees to the merchant haulage market, shipping lines can in effect force this market to stay on the round-trip model, while pricing their own carrier haulage product on a one-way model basis.³²
- **Absorbing demurrage and storage charges.** Importers and exporters will at some point face a situation that causes their container to remain on the terminal longer than anticipated. This could be due to congestion at the inbound warehouse; or delays on the export inland movement that causes a container to miss the closing date of the intended vessel, thus requiring the container to sit idle on the terminal until the next vessel's departure. These delays will cause costly storage and demurrage charges for merchant haulage customers that can be absorbed by the shipping lines 'for free' for containers moved under carrier haulage.

These competitive carrier haulage products enable shipping lines to sell combined ocean + inland transportation services under so-called 'through rates', rather than the traditional 'port-to-port' rates. These 'through rates' cover the maritime journey as well as the inland move, which can be port-to-ramp (rail only) or port-to-door (rail/road combined). In developing this chapter, the success of these carrier haulage products in the Central European market was made clear to us repeatedly during our interactions with market participants. Indeed, several forwarders based in Central Europe explained that they are no longer interested in organizing the destination inland transportation (on-carriage) under merchant haulage terms because they are not

³² The fact that shipping lines control the inland depots and the container assets implies that the trucker, whose default operating model is based on round trip execution, has very limited influence in deciding whether a haulage job can be executed on a one-way basis.

able to compete on price. Instead, they would guide their clients (shippers) towards shipping line 'through services' from, say, Shanghai to Central Europe either on a 'ramp basis', where the forwarder stays in control of the last mile delivery from the rail ramp, or on a 'door basis', where the shipping line will execute the last mile delivery from the rail ramp as well.

The success of carrier haulage products in Central Europe has important repercussions on the routing options available to shippers. For example, this important market segment no longer provides freight rates for every routing option that is theoretically feasible. Instead, carriers will often steer volumes through certain gateway ports in order to optimize their inland setups, an important part of which is their train utilization. This steering will be directed based on a carrier's own internal 'best route' calculations on how to best serve a particular market. An example of this is Maersk, which offers Shanghai to Bratislava either via Koper or via Hamburg/Bremerhaven but not via Antwerp, Gdansk, or Piraeus.

In this regard it is important to note that the shipping lines' best route calculations include, besides the criteria we use in our definition:

- Customer contracts and volume forecasts;
- Vendor relationships and joint network development opportunities;
- Trade and equipment imbalances;
- Vessel schedules; and
- Strategic considerations.

COSCO, for example, offers a rail/road product from Piraeus to Munich, spanning some 2,000 km overland, while solutions are available that only require 500 km (via Koper) or 800 km (via Hamburg) overland transportation. Clearly then, the decision to market a rail service via Piraeus is not simply based on a narrow economic calculation but may also serve broader strategic interests.

Although a detailed analysis of the market shares of carrier haulage versus merchant haulage is beyond the scope of this chapter, we repeatedly received market feedback from forwarders in Central Europe that almost exclusively rely on these carrier haulage products by combined rail/road transportation. It is therefore important to note that these carrier haulage services are not 'open access', and hence have to be linked to the ocean transportation service, and cost, of the shipping line. Hence, in order to accurately represent the routing options that are available to the market, one can no longer simply add the different cost elements for each permutation between ocean and inland transportation routing, as would have been the case in the traditional merchant haulage market.

MARKET SIZING OF THE CENTRAL EUROPEAN HINTERLAND

For the purposes of this chapter, we define the Central European hinterland at three different levels. The country/region level defines the geographical boundaries of the area we want to study. Then proxy locations provide focus onto the logistical centers of gravity in those countries/regions. And at the most granular level, the nearest rail terminals to these logistical centers are the rail transport nodes used in the detailed logistics cost calculations.

In terms of countries/regions, our analysis defines the Central European hinterland as comprising:

- Germany: Southern Germany subregion;
- Poland: Southern Poland subregion;
- Czech Republic;
- Slovakia;
- Austria; and
- Hungary.

In order to focus our analysis, in each country we have defined a proxy location. These locations are strategically chosen to represent the freight center of gravity of the relevant trade flows:

- Southern Germany: Munich;
- Southern Poland: Katowice;
- the Czech Republic: Prague;
- Slovakia: Bratislava;
- Austria: Vienna; and
- Hungary: Budapest.

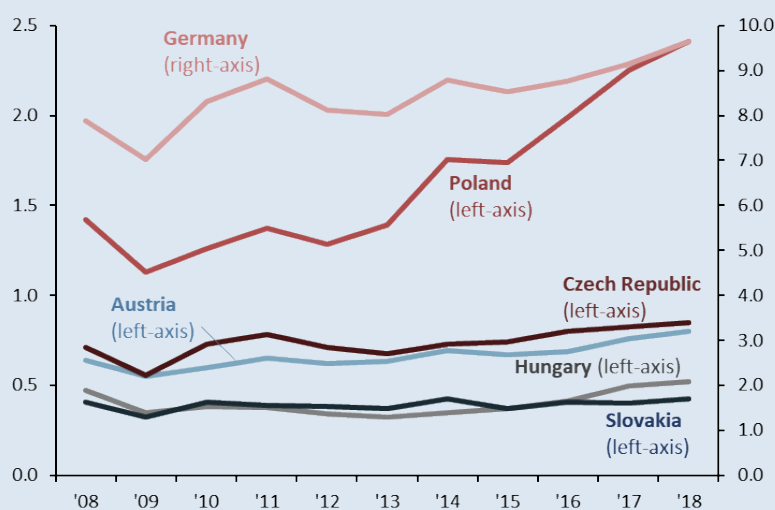
Lastly, for each proxy location we identified the most logical (set of) rail terminal(s), usually the nearest rail terminal, and have assumed, for the detailed cost calculations, that a “virtual warehouse” is located 30 km from the inland rail terminal. The relevant rail terminals are:

- Munich: Muenchen Riem;
- Katowice: Gliwice;
- Prague: Rail Terminal Prague (Metrans);
- Bratislava: SPaP Terminal or Dunajska Streda (Mettrans);
- Vienna: Dunajska Streda (Mettrans); and
- Budapest: BILK Terminal (RCT) or Budapest Freeport (MCC Terminal).

Westbound (Headhaul) Market Sizing: Asia to Central Europe

The total westbound trade from the Far East³³ to the six Central European countries in our sample grew from 11.5 million TEU in 2008 to 14.7 million TEU in 2018, at a compounded annual growth rate (CAGR) of 2.4%. Germany takes 69% of the total cargo flow but has grown at a CAGR of 2.0% over the last 10 years. The fastest growing trade flow is to Poland: with a 10-year CAGR of 5.4%, this is the only flow growing faster than the average. It is also the second most important flow by size, accounting for 13% of the total, after Germany, which overwhelmingly dominates this trade (Figure 3.4).

FIGURE 3.4.
Containerized Flows from
the Far East to Six Central
European Countries: 2008-18
Millions of laden TEU



Source: IHS; World Bank analysis

³³ The definition of Far East includes the following countries: Brunei Darussalam, Cambodia, China, East Timor, Hong Kong, Indonesia, Japan, Laos, Macao, Malaysia, Mongolia, Myanmar, North Korea, Papua New Guinea, Philippines, Singapore, South Korea, Taiwan, Thailand, and Vietnam.

The commodity composition of this trade for 2018 is shown in Table 3.2, which lists the 13 top commodity flow groupings, covering 50% of total imports to the six Central European countries in our sample from the Far East. 'Machinery and electrical equipment', which makes up 1.4 million TEU, is the largest commodity grouping, followed by 'Miscellaneous' (which includes furniture and toys), 'Chemicals and related products', and 'Textiles, leather and apparel', each worth about 1 million TEU.

In 2018, Germany imported 66% of all commodities imported from the Far East to the six countries in our sample. But it imported 88% of the entire commodity group 'Beverages and oils' and 87% of the group 'Animal products', revealing relative import intensity in those commodity groups. Similar import intensities across commodity types for all countries in our sample are highlighted in green in Figure 3.5. On the other hand, Germany 'only' imports 48% of all transportation equipment and parts on this trade, which indicates a relative lower intensity in the importation of these kinds of commodities compared to other commodity groupings. Relative under-intensity is highlighted in red in Figure 3.5.

TABLE 3.2.
Main Commodity Flows from
the Far East to Six Central
European Countries: 2018
Laden TEU

Commodity group	Czech						Total
	Germany	Poland	Republic	Austria	Hungary	Slovakia	
Machinery and Electrical Equipment	900,108	218,818	103,593	93,477	68,960	48,007	1,432,961
Miscellaneous ¹	809,207	212,344	48,771	79,896	21,891	14,647	1,186,755
Chemicals and Related Products	782,150	205,758	58,228	49,091	50,915	24,867	1,171,009
Textiles, Leather, and Apparel	672,785	138,675	29,246	62,673	19,746	14,083	937,207
Metals and Metal Products	391,783	107,681	39,495	30,955	16,659	22,708	609,281
Computers and Professional Equipment	335,373	80,932	45,540	14,052	24,953	43,357	544,205
Transportation Equipment and Parts	247,385	102,701	73,046	18,301	40,981	37,117	519,531
Glass and Non-Metallic Products	272,537	77,128	11,291	28,816	8,138	4,327	402,237
Vegetable Products ²	166,221	21,306	7,511	10,809	3,484	1,062	210,395
Wood, Paper and Related Products	135,133	31,695	5,731	9,265	4,848	1,604	188,276
Beverages and Oils	48,071	3,474	1,367	726	662	284	54,585
Animal Products	36,637	1,949	1,344	1,366	378	405	42,080
Energy and Mining	22,262	3,106	331	2,515	53	265	28,531
Total	4,819,651	1,205,565	425,493	401,941	261,668	212,735	7,327,053

¹ Miscellaneous includes, inter alia, arms, ammunition and explosives, baby carriages, cigarettes and cigars, furniture, miscellaneous manufactured goods, musical instruments, toys, umbrellas, and works of art.

² Vegetable products include, inter alia, fruits and vegetables, coffee, corn, cotton, flowers, food preparations, honey, oil seeds, rice, sugar confectionery, tea, tobacco, vegetable textile fibers, frozen vegetables, and wheat.

Source: IHS.

FIGURE 3.5.
Shares of Commodity Groups
in Each Country's Far East
Import Commodity Baskets,
and Relative Intensity
Compared to Each Country's
Average Share

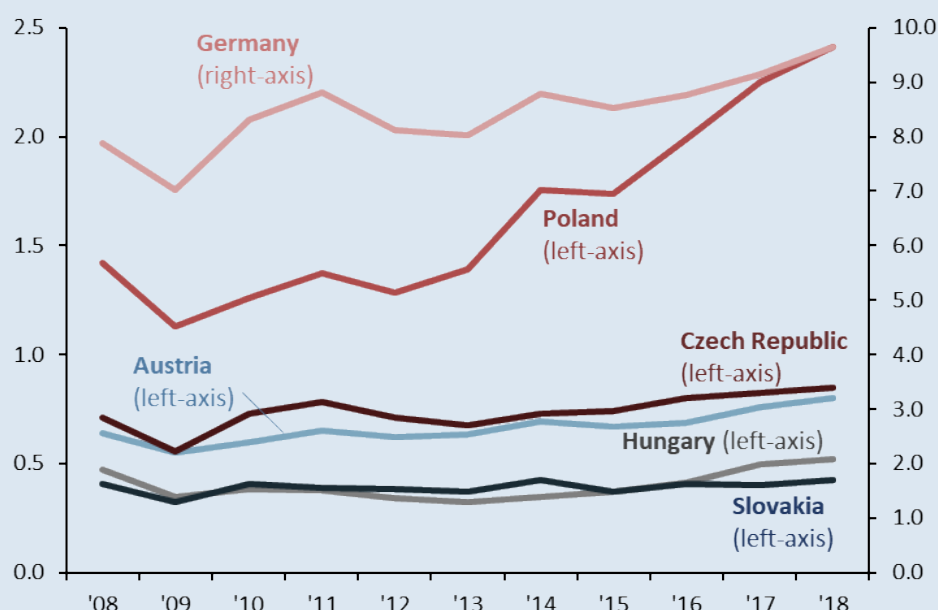
	Germany	Poland	Czech Republic	Austria	Hungary	Slovakia	Total
Machinery and Electrical Equipment	63%	15%	7%	7%	5%	3%	100%
Miscellaneous	68%	18%	4%	7%	2%	1%	100%
Chemicals and Related Products	67%	18%	5%	4%	4%	2%	100%
Textiles, Leather, and Apparel	72%	15%	3%	7%	2%	2%	100%
Metals and Metal Products	64%	18%	6%	5%	3%	4%	100%
Computers and Professional Equipment	62%	15%	8%	3%	5%	8%	100%
Transportation Equipment and Parts	48%	20%	14%	4%	8%	7%	100%
Glass and Non-Metallic Products	68%	19%	3%	7%	2%	1%	100%
Vegetable Products	79%	10%	4%	5%	2%	1%	100%
Wood, Paper and Related Products	72%	17%	3%	5%	3%	1%	100%
Beverages and Oils	88%	6%	3%	1%	1%	1%	100%
Animal Products	87%	5%	3%	3%	1%	1%	100%
Energy and Mining	78%	11%	1%	9%	0%	1%	100%
Country Average	66%	16%	6%	5%	4%	3%	100%

Source: IHS.

Eastbound (Backhaul) Market Sizing: Central Europe to Asia

The total eastbound trade from the 6 Central European countries in our sample to the Far East grew from 4.7 million TEU in 2008 to 7.6 million TEU in 2018, at a CAGR of 4.9% per annum. Germany contributes 80% of the total cargo flow but has grown at a below-average CAGR of 4.3% over the last 10 years (Figure 3.6). The fastest growing trade flows over this period originated in Slovakia, Czech Republic, and Poland. Together they make up 9% of the total trade flow, but their respective 10-year CAGRs were 12.0%, 11.6%, and 10.3%.

FIGURE 3.6.
Containerized Flows from Six
Central European Countries to
the Far East: 2008-18
Millions of laden TEU



Source: IHS; World Bank analysis.

In 2018, the main commodity groups that were exported in containers from the 6 Central European countries in our sample to the Far East was 'Chemicals and related products', which makes up 772,000 TEU, followed by 'Transport equipment and parts' (646,000 TEU), 'Wood, paper and related products', and 'Machinery and electrical equipment' each with over 500,000 TEU (Table 3.3).

In 2018, Germany exported 80% of all commodities exported from the 6 countries in our sample to the Far East. But it exports 91% of the entire commodity group 'Energy and mining' and 89% of the group 'Transportation equipment and parts', denoting relative intensity or specialization in the production and exportation of those commodity groupings. These specializations are highlighted in green in Figure 3.7. On the other hand, Germany 'only' exports 67% of all 'Wood, paper and related products' and hence shows relative under-intensity for that commodity group. Commodities with lower levels of relative export intensity by country are highlighted in red in Figure 3.7.

TABLE 3.3.

**Main Commodity Flows from
Six Central European Countries
to the Far East: 2018**

Laden TEU

Commodity group	Germany	Poland	Austria	Czech Republic	Hungary	Slovakia	Total
Machinery and Electrical Equipment	640,354	43,571	52,367	21,595	7,475	6,858	772,222
Miscellaneous ¹	575,657	8,630	15,529	10,672	14,120	21,212	645,819
Chemicals and Related Products	384,613	32,110	97,427	48,576	1,947	5,589	570,263
Textiles, Leather, and Apparel	424,649	24,645	26,608	19,944	17,034	11,433	524,312
Metals and Metal Products	319,225	44,010	3,863	13,038	7,580	9,221	396,939
Computers and Professional Equipment	227,445	47,872	9,033	3,364	9,981	34	297,730
Transportation Equipment and Parts	146,418	16,015	20,241	4,775	1,718	912	190,078
Glass and Non-Metallic Products	109,775	22,412	5,017	4,694	1,813	155	143,867
Vegetable Products ²	63,973	1,566	5,253	4,171	1,078	220	76,261
Wood, Paper and Related Products	55,529	5,774	6,317	5,433	1,042	374	74,469
Beverages and Oils	50,571	1,926	2,777	2,419	2,404	335	60,430
Animal Products	22,024	1,953	1,366	2,832	1,141	671	29,988
Energy and Mining	5,943	460	67	19	9	11	6,509
Total	3,026,177	250,945	245,866	141,532	67,342	57,025	3,788,887

¹ Miscellaneous includes, inter alia, arms, ammunition and explosives, baby carriages, cigarettes and cigars, furniture, miscellaneous manufactured goods, musical instruments, toys, umbrellas, and works of art.

² Vegetable products include, inter alia, fruits and vegetables, coffee, corn, cotton, flowers, food preparations, honey, oil seeds, rice, sugar confectionery, tea, tobacco, vegetable textile fibers, frozen vegetables, and wheat.

Source: IHS.

FIGURE 3.7.

**Shares of Commodity Groups
in Each Country's Far East
Export Commodity Baskets,
and Relative Intensity
Compared to Each Country's
Average Share**

	Germany	Poland	Austria	Czech Republic	Hungary	Slovakia	Total
Machinery and Electrical Equipment	83%	6%	7%	3%	1%	1%	100%
Miscellaneous	89%	1%	2%	2%	2%	3%	100%
Chemicals and Related Products	67%	6%	17%	9%	0%	1%	100%
Textiles, Leather, and Apparel	81%	5%	5%	4%	3%	2%	100%
Metals and Metal Products	80%	11%	1%	3%	2%	2%	100%
Computers and Professional Equipment	76%	16%	3%	1%	3%	0%	100%
Transportation Equipment and Parts	77%	8%	11%	3%	1%	0%	100%
Glass and Non-Metallic Products	76%	16%	3%	3%	1%	0%	100%
Vegetable Products	84%	2%	7%	5%	1%	0%	100%
Wood, Paper and Related Products	75%	8%	8%	7%	1%	1%	100%
Beverages and Oils	84%	3%	5%	4%	4%	1%	100%
Animal Products	73%	7%	5%	9%	4%	2%	100%
Energy and Mining	91%	7%	1%	0%	0%	0%	100%
Country Average	80%	7%	6%	4%	2%	2%	100%

Source: IHS.

TABLE 3.4.

**Economic Summary of
Countries in Sample**

Country	Population (mil.)	GDP per capita 2018 (current US\$)	Real GDP growth 2010–2019	Main industries
Germany	83.0	47,603	1.7%	Iron, steel, coal, cement, chemicals, machinery, vehicles, machine tools, electronics, food and beverage
Poland	38.0	15,421	3.6%	Machinery, iron and steel, coal mining, chemicals, shipbuilding, food processing, glass, textiles, beverages
Czech Republic	10.7	23,079	2.3%	Vehicles, metallurgy, machinery and equipment, glass products
Hungary	9.8	16,162	3.0%	Mining, metallurgy, construction materials, processed foods, textiles, chemicals, pharmaceuticals, vehicles
Austria	8.8	51,462	1.5%	Construction, machinery, vehicles and vehicle parts, food, metals, chemicals, lumber, paper, electronics
Slovakia	5.4	19,443	2.7%	Vehicles, metals and metal products, chemicals, synthetic fibers, wood and paper products, fuels

Source: Eurostat; World Development Indicators; IMF World Economic Outlook; Drewry Supply Chain Advisors; World Bank analysis and research.

EUROPEAN PORTS AND THEIR MARITIME CONNECTIVITY WITH SHANGHAI

Liner Services and Vessel Draught Requirements

As of June 2019, there were 23 liner services (loops) connecting the Far East with Europe (Table 3.5). Northern Europe was served by 14, the Mediterranean by eight, and one service connects both (calling Piraeus on the way to Northern Europe). On the Asia–North Europe trade, each of the three global container shipping alliances has at least one loop operated by ultra-large container vessels (ULCVs) of more than 20,000 TEU in capacity. These ships have a draught of 16.5 m and require a berth draught of at least 17.0 m. On the Asia–Mediterranean trade, only two loops are operated by ULCVs; the majority of loops are operated by vessels with a nominal capacity of between 14,000 and 16,000 TEU, which require a berth draught of 16.5 m. The Ocean Alliance's ULCV-operated FAL2 loop calls Piraeus on its westbound voyage, then proceeds to Northern Europe.

To judge the suitability of a terminal's berth depth, we used the criteria outlined in Table 3.6. In doing so, we adopt the strictest possible position regarding berth depth as a criterion. First, we used the global fleet's vessel with the maximum vessel draught for each vessel size segment. Clearly there will be vessels of that size range that have a lower draught requirement. Equally, we are using the draught requirement of the fully-loaded vessel. This is where shipping lines can get creative by playing the tidal windows, not using the constrained port terminal as the 'first port of discharge' (i.e., when the vessel is at its fullest), or simply not loading the vessel to its fullest capacity. We recognize that these workarounds exist, but prefer to highlight in green only those terminals that are able to offer 24h access to each vessel in that particular size range, and in red those terminals that clearly struggle to accommodate the vessels that are deployed by the shipping lines on the relevant trades.

TABLE 3.5.
Overview of Asia-Europe Liner
Services as of June 2019

Trade Route	Service name	Max vessel size (TEU)	Max. vessel draught (m)	Min. depth required (m)
Asia-North Europe	Ocean Alliance - FAL5/NE1/AEU1/LL1	21,413	16.0	16.5
	Ocean Alliance/APL - FAL1/AEU2/LL4	20,600	16.5	17.0
	2M - AE2/Swan	20,568	16.5	17.0
	2M - AE10/Silk	20,568	16.5	17.0
	2M - AE5/Albatross	20,568	16.5	17.0
	Ocean Alliance - FAL6/CEM/AEU5/LL6	20,150	16.5	17.0
	THE Alliance - FE2	20,150	16.5	17.0
	2M - AE7/Condor	17,816	16.0	16.5
	Ocean Alliance/APL - FAL3/AEU6/LL5	17,292	16.0	16.5
	THE Alliance - FE4	14,993	16.0	16.5
	Ocean Alliance - FAL8/CES/AEU8	14,424	16.0	16.5
	2M - AE6/Lion-TP2/Jaguar	14,000	16.0	16.5
	2M - AE1/Shogun-TP6/Pearl PDM	14,000	16.0	16.5
	HMM - AEX-PN2 PDM	5,700	14.5	15.0
Asia-Med	2M - AE11/Jade	19,224	16.5	17.0
	2M/Zim - AE15/Tiger/ZMS	15,908	16.0	16.5
	2M/Zim - AE12/Phoenix/ZAS	15,226	16.0	16.5
	THE Alliance - MD2	14,100	16.0	16.5
	Ocean Alliance - MEX2/AMX1/WM2	14,074	16.0	16.5
	Ocean Alliance/APL - BEX/EM1	10,622	15.5	16.0
	Ocean Alliance/APL - PHEX/BEX2	7,024	14.5	15.0
	Ocean Alliance - FEM/EM2	5,652	14.5	15.0
Asia-Med, Asia-North Europe	Ocean Alliance - FAL2/NE3/AEU3/LL2	20,988	16.5	17.0

Source: Drewry Maritime Research.

TABLE 3.6.
Terminal Vessel Call Capacity
Assessment Criteria

Asia-North Europe trade		Asia-Mediterranean trade	
Max.berth depth ≥ 17 m	Green	Max.berth depth ≥ 17 m	Green
Max.berth depth $16.5 < x < 17$ m	Amber	Max.berth depth $15 < x < 17$ m	Amber
Max.berth depth < 16.5 m	Red	Max.berth depth < 15 m	Red

Source: Drewry Supply Chain Advisors; World Bank analysis.

Port Sample and Relative Sizes by Throughput

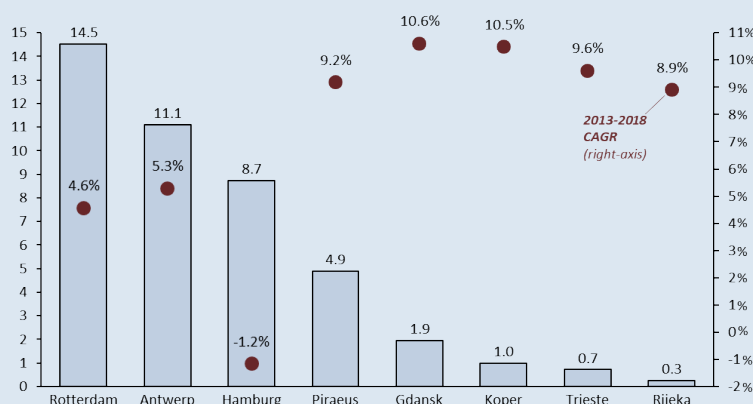
A sample of eight ports was chosen to assess the best-route maritime connectivity of our chosen Central European markets: Rotterdam (the Netherlands), Antwerp (Belgium), Hamburg (Germany), Piraeus (Greece), Gdansk (Poland), Koper (Slovenia), Trieste (Italy), and Rijeka (Croatia).

The above list is representative, in that it includes the established, historically-dominant ports of Northern Europe (Rotterdam, Antwerp, and Hamburg) in the Hamburg-Le Havre port range; three out of five Northern Adriatic ports, which in many cases are geographically closest to the Central European hinterland and as such play an increasingly important role in the connectivity of this region (Slovenia's Koper, Italy's Trieste, and Croatia's Rijeka); the global transshipment hub port of Piraeus (Greece), which as of 2019 overtook Valencia as the largest port in the Mediterranean by throughput and which is increasingly connected to Central Europe via rail, road, and maritime connections, with BRI backing; and Poland's Gdansk, where PSA International, the operator of the port of Singapore and one of the most capable global terminal operators in the world, now co-owns and operates Poland's largest container terminal. All ports in our sample have stated plans to serve or continue to serve the Central European hinterland. Several of them, including Rijeka, Gdansk, Koper, Piraeus, and Thessaloniki, have announced plans (some of which ongoing) to increase throughput and vessel handling capacity through the medium term (see next section).

In 2018, container port throughput of the Northern European ports (Rotterdam, Antwerp, and Hamburg) was higher (in most cases, significantly so) than all other ports in our sample. However, the smaller ports have realized much higher growth rates over the last five years compared to those of the Northern European throughput leaders, and are hence gaining market share (Figure 3.8).

The following section delves deeper into the current status and development plans of our sample ports.

FIGURE 3.8.
Port Throughput in our
Sample Ports: 2018
Millions of TEU



Source: Drewry Maritime Research.

PORT OF ROTTERDAM: Infrastructure and Investment Plans

The port of Rotterdam theoretically has 12 container terminals. However, in 2018 only 10 were operational (see Table 3.7 for a summary of Rotterdam's operating capacity). These 10 terminals provide the port with a total capacity 19.8 million TEU. With a throughput of 14.5 million TEU, the overall utilization of the port was 73% in 2018. Of the total capacity, 4.3 million TEU (22%) is accessible 24/7 by the largest ships that are currently deployed on the Asia–North Europe trade and have a draught of up to 16.5 m, requiring a berth draught of 17.0 m. With the Maasvlakte 2 terminal completed in 2013, the Port of Rotterdam's investment focus is currently not on terminal capacity, although some terminal upgrades are still ongoing, like the Euromax Terminal. Instead, the port is currently focused on digitizing its operations, supporting its hinterland connections, and investing in public and client infrastructure.

TABLE 3.7.
Terminal Infrastructure and
Investment Plans at the
Port of Rotterdam

Terminal name	Terminal status (2018)	TEU capacity (2018)	Max. berth depth (m) (*)	Expansion plans (TEU capacity 2023)
APM Terminali (Maasvlakte I)	operational	3,570,000	16.6	-
APM Terminali (Maasvlakte II)	operational	2,000,000	20	2,700,000
Delta Barge Feeder Terminal (ETC)	operational	700,000	11	-
Delta Container Service (DCS)	operational	50,000	12	-
Delta Dedicated East & West Terminals (ECT)	operational	4,630,000	16.6	-
Delta Dedicated North Terminal (ECT/TIL)	operational	1,140,000	16	-
ECT Home - City Terminal	inactive			-
Euromax Terminal	operational	2,550,000	16.5	3,200,000
Hanno Terminal (Waalhaven Pier 6)	inactive			-
Rotterdam Shortsea Terminal	operational	1,600,000	11.7	-
Rotterdam World Gateway Terminal	operational	2,350,000	20	-
Uniport (Waalhaven Piers 5-7)	operational	1,200,000	14.5	-

Note: Only includes capacity increases > 200,000 TEU.

(*) berth depth measured at low tide.

Source: Drewry Maritime Research.

PORT OF ANTWERP: Infrastructure and Investment Plans

The port of Antwerp theoretically has nine container terminals; however, in 2018 only five were operational. These five terminals provide the port with a total capacity 15.2 million TEU (Table 3.8). With a throughput of 11.1 million TEU, the overall utilization of the port was 73% in 2018. Of the total capacity, 12.9 million TEU (85%) is accessible 24/7 by the largest ships that are currently deployed on the Asia–North Europe trade, and have a draught of up to 16.5 m requiring a berth draught of 17.0 m. Although there has recently been a political decision to expand the port's container handling capacity by 7 million TEU by 2025, these plans are still in their infancy; in the short term, the Port of Antwerp's primary investment lies in digitizing its operations and supporting its hinterland connections.

TABLE 3.8.
Terminal Infrastructure and
Investment Plans at the
Port of Antwerp

Terminal name	Terminal status (2018)	TEU capacity (2018)	Max. berth depth (m) (*)	Expansion plans (TEU capacity 2023)
Antwerp Container Terminal	operational	500,000	0	-
Antwerp Gateway	operational	2,800,000	17	3,400,000
Antwerp International Terminal - PSA	inactive			-
Delwaide Dock (Berths 742-748)	inactive			-
Europa Terminal (Quays 851-869)	operational	1,800,000	14.5	-
Euroports Containers Right Bank (Manuport)	inactive			-
MSC Home Terminal (Quays 702-738) - PSA/TIL	closed			-
MSC PSA European Terminal (MPET)	operational	8,311,000	17	9,000,000
Noordzee Terminal (Quays 901-913)	operational	1,800,000	17	-

Note: Only includes capacity increases > 200,000 TEU.
(*) berth depth measured at low tide.
Source: Drewry Maritime Research.

PORT OF HAMBURG: Infrastructure and Investment Plans

The port of Hamburg has four container terminals, all of which were operational in 2018. Together they provide the port with a total capacity 12.8 million TEU (Table 3.9). With a throughput of 8.7 million TEU, the overall utilization of the port was 70% in 2018. None of the total capacity is 24/7 accessible by the largest ships that are currently deployed on the Asia–North Europe trade. In view of the idle capacity available at Wilhelmshaven, there are no terminal capacity investments currently planned in the Port of Hamburg.

TABLE 3.9.
Terminal Infrastructure and
Investment Plans at the
Port of Hamburg

Terminal name	Terminal status (2018)	TEU capacity (2018)	Max. berth depth (m) (*)	Expansion plans (TEU capacity 2023)
Altenwerder Container Terminal (CTA)	operational	3,000,000	16.7	-
Burchardkai Terminal (CTB)	operational	3,500,000	16.5	-
Eurogate Container Terminal Hamburg	operational	4,100,000	16.1	-
Tollerort Terminal	operational	2,200,000	15.2	-

Note: Only includes capacity increases > 200,000 TEU.
(*) berth depth measured at low tide.
Source: Drewry Maritime Research.

PORT OF PIRAEUS: Infrastructure and Investment Plans

The port of Piraeus has three container terminals, all of which were operational in 2018. Together they provided the port that year with a total capacity 6.6 million TEU (Table 3.10). With a throughput of 4.9 million TEU (approximately 85% of which are transshipment flows), the overall utilization of the port was 74% in 2018. All of the terminal capacity is 24/7 accessible by the largest ships that are currently deployed on the Asia-Mediterranean trade, and only Pier 2 would struggle to accommodate the largest vessels currently deployed on the Asia–North Europe trade. China COSCO Shipping (COSCO), through its terminal operator subsidiary COSCO Shipping Ports, gained a 30-year concession right to operate piers 2 and 3 back in

2009 and is aiming to develop capacity of about 8,000,000 TEU by year-end 2021, while at the same time running the port's hinterland rail connections, aiming to grow the port's gateway function for cargo destined for the Western Balkans and Central and Eastern Europe.

TABLE 3.10.
Terminal Infrastructure and
Investment Plans at the
Port of Piraeus

Terminal name	Terminal status (2018)	TEU capacity (2018)	Max. berth depth (m) (*)	Expansion plans (TEU capacity 2023)
Piraeus Container Terminal (Pier II)	operational	3,200,000	16.5	-
Piraeus Container Terminal (Pier III)	operational	2,300,000	19.5	1,400,000
St George Terminal (Pier I)	operational	1,100,000	18.0	-

Note: Only includes capacity increases > 200,000 TEU.

(*) berth depth measured at low tide.

Source: Drewry Maritime Research and World Bank research.

PORT OF GDANSK: Infrastructure and Investment Plans

The port of Gdansk has three container terminals, all of which were operational in 2018. Together they provide the port with a total capacity 3.1 million TEU (Table 3.11). With a throughput of 1.95 million TEU, the overall utilization of the port was 63% in 2018. Only the port's main terminal (DCT2) is 24/7 accessible for vessels that require a max berth depth of 17 m. With DCT1 operational since 2007 and DCT2 since 2016, the port of Gdansk has ample terminal capacity for the medium term, and is focused on upgrading its landside infrastructure. In particular, the state of the infrastructure on several stretches of the Polish rail network does not allow trains to compete with trucks. Poland's National Railway Program, which runs through 2023, promises to invest EUR15.5 billion in the railway network. PSA International, together with the Polish Development Fund (PFR) and the IFM Global Infrastructure Fund (GIF), jointly acquired DCT2 in May 2019.

TABLE 3.11.
Terminal Infrastructure and
Investment Plans at the
Port of Gdansk

Terminal name	Terminal status (2018)	TEU capacity (2018)	Max. berth depth (m) (*)	Expansion plans (TEU capacity 2023)
Deepwater Container Terminal (DCT1)	operational	1,400,000	16.5	-
Deepwater Container Terminal (DCT2)	operational	1,600,000	17	-
Gdansk Container Terminal (Szczecinskie Warf-inner harbour)	operational	100,000	9.8	-

Note: Only includes capacity increases > 200,000 TEU.

(*) berth depth measured at low tide.

Source: Drewry Maritime Research.

PORT OF KOPER: Infrastructure and Investment Plans

The port of Koper has one container terminal, which was operational in 2018. It provided the port with a total capacity 0.85 million TEU (Table 3.12). With a throughput of 988,499 TEU, the overall utilization of the port was 116% (i.e., at-capacity) in 2018. At the beginning of November 2018, Luka Koper, the company that operates the Port of Koper, received the political green light to proceed with its plans to extend Pier I. This expansion is expected to be completed by 2021 and would increase the terminal's capacity to 1.3 million TEU. Yet the berth depth might be a bottleneck, as it is unable to provide 24/7 access to the largest ships currently deployed on the Asia-Mediterranean trade.

TABLE 3.12.

Terminal Infrastructure and
Investment Plans at the
Port of Koper

Terminal name	Terminal status (2018)	TEU capacity (2018)	Max. berth depth (m) (*)	Expansion plans (TEU capacity 2023)
Koper Container and Ro-Ro Terminal	operational	850,000	14.5	1,300,000

Note: Only includes capacity increases > 200,000 TEU.

(*) berth depth measured at low tide.

Source: Drewry Maritime Research.

PORT OF TRIESTE: Infrastructure and Investment Plans

The port of Trieste has one container terminal, which was operational in 2018. It provided the port with a total capacity 0.75 million TEU (Table 3.13). With a throughput of 0.73 million TEU, the overall utilization of the port was 97% in 2018. The Trieste Marine Terminal is accessible by the largest ships that are currently deployed on the Asia-Mediterranean trades, requiring a max berth depth of 17.5 m. The port has drawn up plans for the enlargement of the existing container terminal and the construction of a new container terminal (Pier VIII), but these had not yet been confirmed as of the time of writing.

TABLE 3.13.

Terminal Infrastructure and
Investment Plans at the
Port of Trieste

Terminal name	Terminal status (2018)	TEU capacity (2018)	Max. berth depth (m) (*)	Expansion plans (TEU capacity 2023)
Trieste Marine Terminal	operational	750,000	18	-

Note: Only includes capacity increases > 200,000 TEU.

(*) berth depth measured at low tide.

Source: Drewry Maritime Research.

PORT OF RIJEKA: Infrastructure and Investment Plans

The Port of Rijeka has one operational container terminal, the Adriatic Gate Container Terminal (AGCT) at Brajdica, operated by the Philippines-headquartered ICTSI Group, a global container terminal operator. AGCT was fully operational in 2018. It provided the port with a total capacity 0.6 million TEU (Table 3.14). With a throughput of 0.23 million TEU, the overall utilization of the port was 38% in 2018. The terminal's maximum berth depth of 14.9 m allows access to fully loaded vessels of up to between 6,000 and 14,000 TEU. As this could be a bottleneck towards providing 24/7 access to some of the larger ships currently deployed on the Asia-Mediterranean trade, AGCT is in the process of deepening its berthing depth to 16.5 m. Construction of the infrastructure for the greenfield Zagreb Deep Sea Container Terminal (ZCT)—Rijeka's second container terminal—was completed in May 2019. With a quay length of 400 m and berth depth of 20 meters, this terminal would remove potential depth-related bottlenecks that could affect the Port of Rijeka in the future. With the concession process for the super structure and terminal operations currently underway, this new development does not yet affect the routing options via the Port of Rijeka that are currently available in the market. When operational in 2023, it is expected that ZCT will increase the throughput capacity of the port of Rijeka by approximately 400,000 TEUs in its first phase, and eventually by 700,000 TEUs, for a total of approximately 1.3 million TEUs by the 2026 timeframe.

TABLE 3.14.

Terminal Infrastructure and
Investment Plans at the
Port of Rijeka

Terminal name	Terminal status (2018)	TEU capacity (2018)	Max. berth depth (m) (*)	Expansion plans (TEU capacity 2023)
Adriatic Gate Container Terminal (AGCT)	operational	600,000	14.9	-
Zagreb Deep Sea Container Terminal	not yet operational	-	20	400,000

Note: Only includes capacity increases > 200,000 TEU.

(*) berth depth measured at low tide.

Source: Drewry Maritime Research.

Maritime Connectivity: Service Frequency

In June 2019 a total of 45 weekly liner services provided connections between Shanghai and the eight ports in our sample (Table 3.15). Rotterdam had the highest number of weekly calls (13) followed by Hamburg (nine) and Piraeus (eight). These are also the only ports that receive five weekly loops, i.e. almost daily connections, by the 2M and Ocean alliance, albeit 2M only provides this frequency for Rotterdam while Ocean provides it for Rotterdam, Hamburg, and Piraeus. In addition, as of July 2019 COSCO introduced a shuttle service between Piraeus and Rijeka, called the Piraeus Rijeka Express Service (PRS). This feeder service provides another link between Rijeka and the Far East, via Piraeus, with the operational backing of COSCO, one of the world's largest shipping lines and terminal operators. PRS operates once per week and has a 2.5-day non-stop transit time between the two ports.

TABLE 3.15.
Service Frequency Between
Shanghai and our Sample
Ports: June 2019
Services per week

Port Pair	2M	HMM	OCEAN	THE	COSCO PRS ¹	Total
Shanghai-Rotterdam	5	1	5	2		13
Shanghai-Hamburg	1	1	5	2		9
Shanghai-Antwerp	3		3	1		7
Shanghai-Gdansk	1		1			2
Shanghai-Piraeus	2		5	1		8
Shanghai-Koper	1		1			2
Shanghai-Trieste	1		1			2
Shanghai-Rijeka	1		1		1	3
Total	15	2	22	6	1	46

¹ Introduced in July 2019.

Source: Drewry Maritime Research; Dragon Maritime/COSCO; World Bank analysis.

The data on frequencies of liner connections confirms several market trends:

1. The pole position for the Port of Rotterdam in the European port landscape: it receives the highest frequency of calls, and it receives calls from every operator or operating alliance. The implication is that Rotterdam is widely considered indispensable when serving this trade;
2. The continued importance of Hamburg, which is also served by each operator or operating alliance but receives overall four fewer weekly calls than Rotterdam, due to 2M's single weekly call compared to five weekly calls in Rotterdam;
3. The stellar rise of Piraeus, to become the third best-connected port within our sample within just a few years;
4. Antwerp remains an important port, served by all three operating alliances but at lower frequencies than Hamburg by the Ocean and THE alliances. For 2M the frequency is higher, which is probably due to MSC's uniquely strong position in the Port of Antwerp; and
5. The ports of Gdansk, Trieste, Rijeka, and Koper each receive one weekly call from the 2M and OCEAN alliances. Rijeka in addition developed a capable shuttle service with COSCO via Piraeus. This shows on the one hand Rijeka's interest in finding partners to expand markets and gain market share; and on the other COSCO's interest in exploring alternative ways to serve Central Europe beyond land connections through Corridor X in the Western Balkans.

Maritime Connectivity: Transit Time

Transit times on the services connecting Shanghai with the ports in our sample are exposed to significant competition in the Northern European port range, but less so in the Adriatic port range, where both alliances serving it, 2M and OCEAN, follow the same port rotation: first Koper, then Trieste, and finally Rijeka (Table 3.16).

TABLE 3.16.
Port-to-Port Shortest / Longest
/ Average Transit Times by Port
Pair and Operator or Alliance:
June 2019
Days

Port Pair	2M	HMM	OCEAN	THE	COSCO PRS ¹⁾
Shanghai-Rotterdam	30/43/36	33/33/33	31/37/34	28/43/36	
Shanghai-Hamburg	32/32/32	35/35/35	33/37/34	31/41/36	
Shanghai-Antwerp	30/42/36		30/37/35	34/34/34	
Shanghai-Gdansk	34/34/34		36/36/36		
Shanghai-Piraeus	34/38/36		23/49/34	28/28/28	
Shanghai-Koper	26/26/26		30/30/30		
Shanghai-Trieste	29/29/29		32/32/32		
Shanghai-Rijeka	33/33/33		32/32/32		30/30/30

¹⁾ Introduced in July 2019.

Source: Drewry Maritime Research; Dragon Maritime/COSCO; World Bank analysis.

Key observations regarding the port-to-port transit times:

1. For the three base ports in the Northern European port range, average transit times are competitive: all three operator alliances have loops that serve the three base ports in between 30 and 33 days. THE Alliance is making a point with their FE-4 loop, which ships to Rotterdam in 28 days;
2. Gdansk is a relatively new addition to the liner schedules and sits at the end of the port rotation, with the highest values for shortest transit time in the Northern European range;
3. Ports in the North Adriatic have a clear ocean transit time advantage over the Northern gateway ports (Table 3.17), ranging from 2.8 days (Rijeka vs. Hamburg) to seven days (Koper vs. Antwerp); and
4. Even though Piraeus is used primarily as a transshipment hub by most operators, its average transit time from the Far East is highly competitive, indeed the shortest port-to-port average transit time in our sample (Table 3.17), driven by the OCEAN alliance product explicitly introduced to develop gateway volumes.

TABLE 3.17.
Fastest and Average Port-to-
Port Transit Times by Port Pair:
June 2019
Days

Port Pair	Fastest transit time	Average transit time	Std. dev. of transit time
Shanghai-Piraeus	23	27	1.4
Shanghai-Koper	26	28	1.4
Shanghai-Trieste	29	31	1.5
Shanghai-Rijeka	30	32	1.6
Shanghai-Hamburg	31	34	1.7
Shanghai-Rotterdam	28	35	1.7
Shanghai-Antwerp	30	35	1.8
Shanghai-Gdansk	34	35	1.8

Source: Drewry Maritime Research; World Bank analysis and estimates.

Maritime Connectivity: Ocean Freight Rates

Changing market dynamics that were unleashed by the prohibition of liner conferences within the EU at the end of 2008 ushered in an era in which ocean freight rates have become much more volatile, both in terms of absolute freight rate variations as well as the increased frequency of rate changes. Prior to 2008, spot market rates changed quarterly or sometimes monthly. Currently, on key East–West trades rates change bi-weekly, weekly, or at certain periods even more than once per week. The associated increase in operational workload and administration has led to an industry practice among shipping lines that is referred to as ‘common rating’, whereby a single freight rate applies to several port pairs where the loading and discharge ports are considered as belonging to the same market or market zone definition by the shipping line. The practice of common rating usually covers the basic ocean freight rate, bunker surcharge and other ocean-related surcharges, but does not extend to the terminal handling charges (THC). Hence there remain variations in the total all-in cost of common rated port pairs, which are largely due to differences in THC.

The ocean freight rates which we collected were valid during the month of July 2019 (see a sub-sample of the freight rate market information collected for this analysis in Table 3.18). For this analysis, ‘common rating’ can be witnessed for example on Shanghai to Antwerp and Rotterdam, or also on Shanghai to Koper, Rijeka, and Trieste.

TABLE 3.18.
Sample Port-to-Port Freight
Rates in July 2019

Port of loading	Port of discharge	Carrier	Origin THC	Freight rate	Applicable surcharges	Destination THC	All-in port-to-port rate	Validity period
Shanghai	Rotterdam	Hapag-Lloyd	\$ 168	\$ 704	\$ 802	\$ 261	\$ 1,936	1-14/07/2019
Shanghai	Antwerp	Hapag-Lloyd	\$ 168	\$ 704	\$ 802	\$ 239	\$ 1,913	1-14/07/2019
Shanghai	Hamburg	Hapag-Lloyd	\$ 168	\$ 704	\$ 802	\$ 298	\$ 1,972	1-14/07/2019
Shanghai	Koper	Hapag-Lloyd	\$ 168	\$ 830	\$ 770	\$ 207	\$ 1,976	1-14/07/2019
Shanghai	Trieste	Hapag-Lloyd	\$ 168	\$ 730	\$ 1,120	\$ 248	\$ 2,266	1-14/07/2019
Shanghai	Rijeka	Hapag-Lloyd	\$ 168	\$ 830	\$ 770	\$ 171	\$ 1,939	1-14/07/2019
Shanghai	Piraeus	Hapag-Lloyd	\$ 168	\$ 730	\$ 770	\$ 152	\$ 1,821	1-14/07/2019
Shanghai	Thessaloniki	Hapag-Lloyd	\$ 168	\$ 930	\$ 770	\$ 150	\$ 2,018	1-14/07/2019
Shanghai	Rotterdam	Maersk	\$ 191	\$ 1,350	\$ 54	\$ 256	\$ 1,850	1-14/07/2019
Shanghai	Antwerp	Maersk	\$ 191	\$ 1,350	\$ 54	\$ 228	\$ 1,822	1-14/07/2019
Shanghai	Hamburg	Maersk	\$ 191	\$ 1,350	\$ 54	\$ 272	\$ 1,867	1-14/07/2019
Shanghai	Gdansk	Maersk	\$ 191	\$ 1,300	\$ 54	\$ 139	\$ 1,684	1-14/07/2019
Shanghai	Koper	Maersk	\$ 191	\$ 1,400	\$ 24	\$ 178	\$ 1,792	1-14/07/2019
Shanghai	Trieste	Maersk	\$ 191	\$ 1,400	\$ 24	\$ 250	\$ 1,865	1-14/07/2019
Shanghai	Rijeka	Maersk	\$ 191	\$ 1,400	\$ 24	\$ 167	\$ 1,781	1-14/07/2019
Shanghai	Piraeus	Maersk	\$ 191	\$ 1,450	\$ 24	\$ 256	\$ 1,920	1-14/07/2019
Shanghai	Thessaloniki	Maersk	\$ 191	\$ 1,550	\$ 24	\$ 298	\$ 2,062	1-14/07/2019
Shanghai	Piraeus	Cosco	\$ 147	\$ 1,650	\$ 188	\$ 256	\$ 2,241	7/31/2019
Shanghai	Thessaloniki	Cosco	\$ 147	\$ 1,750	\$ 188	\$ 298	\$ 2,383	7/31/2019
Shanghai	Koper	Cosco	\$ 147	\$ 1,600	\$ 188	\$ 178	\$ 2,113	7/31/2019
Shanghai	Rijeka	Cosco	\$ 147	\$ 1,600	\$ 188	\$ 167	\$ 2,102	7/31/2019
Shanghai	Trieste	Cosco	\$ 147	\$ 1,650	\$ 188	\$ 250	\$ 2,235	7/31/2019
Shanghai	Dunajska CY	Cosco	\$ 147	\$ 2,527	\$ 188 incl		\$ 2,862	7/31/2019
Shanghai	Antwerp	Cosco	\$ 147	\$ 1,600	\$ 188	\$ 228	\$ 2,163	7/31/2019
Shanghai	Rotterdam	Cosco	\$ 147	\$ 1,600	\$ 188	\$ 256	\$ 2,191	7/31/2019
Shanghai	Hamburg	Cosco	\$ 147	\$ 1,500	\$ 188	\$ 272	\$ 2,108	7/31/2019
Shanghai	Gdansk	Cosco	\$ 147	\$ 1,600	\$ 188	\$ 139	\$ 2,074	7/31/2019

Source: Drewry Maritime Research.

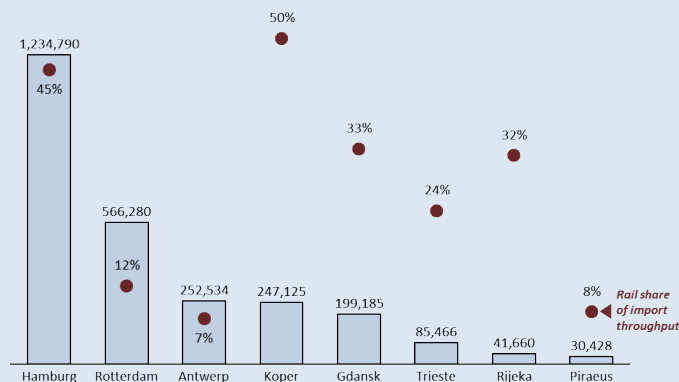
EUROPEAN PORTS AND THEIR RAIL INTERMODAL CONNECTIVITY WITH CENTRAL EUROPE

In contrast to port throughput and port infrastructure data, which were obtained from proprietary industry databases, data for intermodal connectivity was obtained through a three-pronged combination of primary and secondary research:

- For primary research, we engaged directly with several local forwarders, including one that specializes in imports to and across Central Europe. Through the latter, we were able to interrogate yet more local market participants, focusing mainly on obtaining service and price proposals from local freight forwarders and shipping line agencies, as well as on gathering direct market feedback about the performance of different routing options;
- This research yielded mostly ‘through rates’ from Shanghai to the final place of delivery at destination, based on carriers’ carrier haulage products. It was also in this stage of research that we received feedback about the strength of several carrier haulage products, and the difficulty local forwarders face when trying to compete with such ‘mass volume’ setups when serving small- and medium-sized shippers in merchant haulage situations;
- Our secondary research consisted of internet research and web page scraping. One component of the research was aimed at examining the websites of relevant port authorities and rail operators. This yielded most of the ‘operational data’ used to build the picture of the available intermodal connections’ service frequency and lead times that were available to service the merchant haulage market. A second component was aimed at examining the websites of the key shipping lines in order to better understand the full extent of their carrier haulage products, as well as the routing decisions they have made in order to serve the Central European hinterland at best possible cost. A third and final component of internet research was dedicated to examining ‘intermodal portal’ websites that consolidate routing information from different intermodal operators. We used this third option mainly to fill-in any gaps from the previously described research efforts.

Figure 3.9 shows, for each port in our sample, the rail share in its modal split and the resulting annual import rail cargo flow, in TEU. The rail volumes are an important indicator of a port’s intermodal connectivity because volumes are critical to a successful train operation. Europe’s so-called Northern Gateway holds a dominant position when it comes to developing high-frequency train connections. This is particularly true of Hamburg, which is the only port to have an inbound rail flow of more than 1 million TEU and makes up almost half of the total inbound rail volumes in this analysis. Clearly in second place is Rotterdam, with 566,000 import rail TEU. Antwerp has a rail ratio of just 7%, which limits the import cargo flow available to rail to about 250,000 TEU, comparable to that of Koper even though the latter only has one tenth of Antwerp’s port throughput. Gdansk has the third highest rail share at 33%.

FIGURE 3.9.
Annual Import Rail Volumes
and Rail Share in Imports’
Modal Split by Port: 2018
TEU



Source: Drewry Supply Chain Advisors; World Bank analysis and estimates.

In order to gauge the suitability of a port's inland container flows to set up rail connections, the level of container volumes is of utmost importance. As a rule of thumb, we assume that a minimal annual volume of about 10,000 TEU is required per train connection. This is based on the calculations shown in Table 13.19, which work as follows—every train route requires:

- Freight trains that provide space for 75 TEU, which is the industry average in most of Europe;
- Train utilization levels below 80% are usually not profitable, so we assume a profitable train utilization level of 85% on average;
- The minimum frequency for a viable 'open access' train product is three departures per week; and
- The train operates 51 weeks per year.

TABLE 3.19.
Critical Assumptions on
Minimum Annual Volume
Requirements per Train
Connection

TEU per train	75
Train utilization	85%
Min. train frequency per week	3
Weeks per year	51
Min. annual container flow (TEU) per train connection	9,754

Source: Drewry Supply Chain Advisors.

It is common to express freight train schedules' transit times by 'lettering' the day of departure at the departure terminal and day of arrival at the destination terminal. The day of departure is referred to as 'Day A' and the day of arrival is B in case of an 'overnight' train arrival, Day C when it takes two nights to reach destination, and so on. Table 3.20 shows transit times of the rail services by route that are currently available in the market. Table 3.21 shows the frequency of those rail services. Most of this information is derived from 'open access' rail services operated by neutral rail operators that accept cargo from any third party. However, on a few routes the only rail services provided are dedicated to a single shipping line. This is the case on the connections via Piraeus for example. In such cases, we used the transit time and frequency from those dedicated services. Table 3.22 presents summary commentary on the state of rail intermodal services to Central Europe by port.

TABLE 3.20.
Rail Intermodal Service
Port-to-Destination Terminal
Transit Times by Route

Discharge port→ Inland hub↓	Hamburg	Rotterdam	Antwerp	Gdansk	Piraeus	Koper	Trieste	Rijeka
Bratislava	A-C	A-E	A-D	n/a	A-F	A-B	n/a	n/a
Budapest	A-C	A-D	A-D	A-F	A-E	A-B	A-B	A-B
Katowice	A-C	A-D	A-D	A-B	n/a	A-C	n/a	n/a
Munich	A-B	A-B	A-C	n/a	n/a	A-B	A-B	n/a
Prague	A-B	A-B	A-C	n/a	A-G	A-E	A-E	n/a
Vienna	A-C	A-C	A-C	A-G	A-F	A-B	A-C	n/a

Source: Drewry Supply Chain Advisors; World Bank analysis and research.

TABLE 3.21.
Rail Intermodal Service
Port-to-Destination Terminal
Frequency by Route
Services per week

Discharge port→ Inland hub↓	Hamburg	Rotterdam	Antwerp	Gdansk	Piraeus	Koper	Trieste	Rijeka
Bratislava	3	5	5	n/a	2	5	n/a	n/a
Budapest	5	5	4	2	3	5	5	5
Katowice	5	5	2	5	n/a	4	n/a	n/a
Munich	5	3	3	n/a	n/a	3	5	n/a
Prague	5	5	3	n/a	1	3	3	n/a
Vienna	5	5	5	2	n/a	3	5	n/a

Source: Drewry Supply Chain Advisors; World Bank analysis and research.

TABLE 3.22.
Summary Analysis of Rail
Intermodal Connectivity to
Central Europe by Port

Rotterdam	Antwerp	Hamburg
Port of Rotterdam reports a 12% rail share in its hinterland container traffic. That results in an import flow of 566,000 TEU, which is more than enough to develop intermodal rail products. Rotterdam's large container throughput facilitates the setting up of block trains. From Rotterdam, direct connections are available to all hinterland hubs in our sample except Bratislava. Cargo for Bratislava is better routed via Antwerp, but if cargo discharges in Rotterdam it can be barged to Antwerp for about EUR100 per container. This would increase the lead time by 1 day. For the other logistics clusters, several rail operators offer competitive transit times and, generally, high service frequencies.	The port of Antwerp is connected to all inland hubs in our sample. However, several connections are indirect, which results in relatively few short transit times. Also the service frequency is relatively low, with 'daily departures' only available to Bratislava and Vienna.	Hamburg is traditionally the strongest port for connecting into the Central European hinterland via rail. It is connected through direct rail links that offer daily departures, usually offered by several operators, to all inland hubs in our sample except Bratislava, where there are only three departures per week.
Piraeus	Gdansk	Koper
Cosco offers several rail connections through the Western Balkans into Central Europe, albeit with relatively long transit times and, as of June-July 2019, low rail frequencies. These rail products are not open access, which means only cargo that was shipped on Cosco vessels can use these intermodal connections. For other lines, Piraeus is mainly a transshipment hub.	The rail connections to Central Europe via Gdansk are very strong within Poland, but the international network is as yet patchy and several locations are not served with direct trains. But towards the Katowice hub, there are daily departures with cargo arriving overnight.	In the North Adriatic, Koper has positioned itself as the best rail connected port over the past decade or so, with fast and direct, overnight train setups to 4 of the 6 inland hubs in our sample. For Bratislava and Budapest the connections are daily; for the other hubs the port has three departures per week. We found only indirect connections to Prague, which results in an A-E lead time, and no connections to Katowice.
Trieste	Rijeka	
Trieste also offers direct, overnight train connections to Budapest and Munich, and for Munich even at a higher frequency than Koper. For Bratislava and Vienna the connections are slower than via Koper, but Trieste offers daily connections to Vienna whereas Koper only has three departures per week.	Of all the ports examined for this analysis, we found the least amount of publicly-available data for the Port of Rijeka. Market feedback obtained through forwarder testimony about cargo routings via Rijeka was, on the whole, poor, pointing towards HZ Cargo, the national rail operator providing the rail traction up to the border, as being not sufficiently customer focused, nor reliable. The data which we were able to find indicates that, like Koper, Rijeka offers rail connections to 4 of the 6 inland hubs. The train departures for Bratislava, Budapest, Munich, and Vienna are daily, but, with the exception of Budapest, they are mostly indirect, which results in transit times that are several days longer than would be the case for direct connections. Connections to Prague and Katowice would appear not to be available at the moment.	

Source: Drewry Supply Chain Advisors; World Bank analysis and research.

IDENTIFICATION OF BEST ROUTES PER DESTINATION REGION

In addition to the market data and estimates gathered through primary and secondary research and available data sources as shown above, our estimates of best routes were informed by assumptions on key parameters characterizing the itineraries assessed. In particular, we calculated best routes for containerized shipments of representative high-value and low-value containerized freight as shown in Table 3.23.

TABLE 3.23.
Key Best Route Model
Assumptions

	High-value containerized freight	Low-value containerized freight
Commodity and conveyance characteristics		
Representative examples	High-end electronics; autoparts	Basic apparel; basic toys
Cargo value (US\$ per TEU)	110,000	27,500
TEU per high-cube 40-foot container	2.3	2.3
Inventory cost assumptions		
Annual in-transit inventory carrying costs	16%	8%
Annual safety-stock inventory carrying costs	20%	10%
Demand predictability		
Coefficient of variation of daily demand	15%	8%
Delivery lead time predictability		
Coefficient of variation of Asia-Europe maritime transport	5%	5%
Coefficient of variation of port dwell at entry	80%	80%
Coefficient of variation of ramp-to-ramp rail intermodal leg	25-35%	25-35%
Coefficient of variation of dwell time at destination ramp	15%	15%
Coefficient of variation of truck drayage move at destination	25%	25%
Inventory policy		
Service level (probability not to stock out during a delivery cycle)	98%	96%

Source: Drewry Supply Chain Advisors; World Bank analysis and estimates.

Route-specific logistics costs were calculated per high-cube 40-foot container (FEU) according to the following expression:

$$\begin{aligned}
 &\textbf{Total logistics costs per FEU} = \\
 &\quad \textbf{Transport costs (US\$ per FEU)} \\
 &+ \underbrace{\frac{C * i_{cos} * \mu_{\tau}}{365}}_{\substack{\textbf{In-transit} \\ \textbf{inventory} \\ \textbf{carrying costs} \\ \textbf{per FEU}}} + \underbrace{\frac{C * i_{cosw} * Z * \sqrt{\mu_{\tau} * CV_{DD}^2 + \sigma_{\tau}^2}}{365}}_{\substack{\textbf{Safety-stock} \\ \textbf{inventory carrying} \\ \textbf{costs per FEU}}}
 \end{aligned}$$

Where:

C = commodity value (US\$ per FEU)

μ_{τ} = average delivery lead time (days)

σ_{τ}^2 = variance of the delivery lead time

CV_{DD}^2 = square of the coefficient of variation of daily demand

i_{cos} = inventory carrying cost (% points per year) applicable to in-transit inventory, comprising capital, obsolescence, and shrinkage costs

i_{cosw} = inventory carrying cost (% points per year) applicable to safety-stock inventory, comprising capital, obsolescence, shrinkage, and warehousing costs.

Z = service level parameter; assuming that demand during the lead time is normally distributed, a service level of 98% yields a Z value of 2.05, while a service level of 96% yields as Z value of 1.75.

The above expression usefully illustrates that in-transit inventory carrying costs are directly determined by the length of the delivery lead time; in other words, the longer the transit time, the higher the in-transit inventory carrying costs to be incurred by the shipper. Similarly, the expression illustrates how safety-stock inventory carrying costs are directly determined by the variability and duration of the lead time, the variability of demand, and the service level standard.

The delivery lead time and associated variability is the summation of all lead time components from port of origin to final destination, including the maritime journey, port of entry dwell time, rail transport leg, rail ramp dwell time, and truck drayage leg from destination ramp to consignee warehouse. Table 3.24 summarizes all of these individual components and shows the resulting total logistics cost per FEU for high-value and low-value shipments.

TABLE 3.24.
Summary of Inputs to Logistic
Costs Calculations by Route
per FEU Transported Between
Shanghai and Central Europe

			Measured in days																US\$ per FEU	
			Customs clearance																	
			Fastest	Average	Std. dev.	and	Std. dev.	Fastest					Std. dev.		Fastest		Std. dev.			
Destination	Port of		port-to-	port-to-	of P2P	shunting	of port	rail-to-	Avg rail	Std. dev.	Shunting	Std. dev.	Fastest	of	Fastest	Avg total	Std. dev.			
market	Origin port	entry	port lead	port lead	lead	at port of	dwell at	ramp	lead time	rail lead	at dest.	of dwell at	dray lead	Avg. dray	drayage	total lead	lead time	time	TLC high	TLC low
Munich	Shanghai	Koper	26.0	28.0	1.4	1.0	1.2	1	1.6	0.4	0.5	0.1	0.1	0.5	0.1	28.6	31.6	1.9	6,911	4,618
Munich	Shanghai	Trieste	29.0	30.5	1.5	1.0	0.9	1	1.7	0.6	0.5	0.1	0.1	0.5	0.1	31.6	34.2	1.9	7,122	4,669
Munich	Shanghai	Hamburg	31.0	34.4	1.7	1.0	0.9	1	1.5	0.4	0.5	0.1	0.1	0.5	0.1	33.6	38.0	2.0	7,438	4,736
Munich	Shanghai	Rotterdam	28.0	34.6	1.7	1.0	1.2	1	1.5	0.4	0.5	0.1	0.1	0.5	0.1	30.6	38.1	2.1	7,513	4,777
Munich	Shanghai	Antwerp	30.0	35.0	1.8	1.0	1.2	2	2.8	0.7	0.5	0.1	0.1	0.5	0.1	33.6	39.8	2.2	8,226	5,372
Katowice	Shanghai	Gdansk	34.0	35.0	1.8	1.0	0.9	1	1.7	0.6	0.5	0.1	0.1	0.5	0.1	36.6	38.7	2.1	7,479	4,718
Katowice	Shanghai	Koper	26.0	28.0	1.4	1.0	1.0	3	3.8	0.9	0.5	0.1	0.1	0.5	0.1	30.6	33.8	2.0	7,496	5,056
Katowice	Shanghai	Hamburg	31.0	34.4	1.7	1.0	0.9	2	2.8	0.7	0.5	0.1	0.1	0.5	0.1	34.6	39.2	2.1	8,064	5,269
Katowice	Shanghai	Rotterdam	28.0	34.6	1.7	1.0	0.9	3	3.8	0.9	0.5	0.1	0.1	0.5	0.1	32.6	40.4	2.2	8,271	5,392
Katowice	Shanghai	Antwerp	30.0	35.0	1.8	1.0	1.4	3	3.8	0.9	0.5	0.1	0.1	0.5	0.1	34.6	40.8	2.4	8,549	5,603
Prague	Shanghai	Hamburg	31.0	34.4	1.7	1.0	0.9	1	1.5	0.4	0.5	0.1	0.1	0.5	0.1	33.6	38.0	2.0	7,416	4,714
Prague	Shanghai	Koper	26.0	28.0	1.4	1.0	1.2	4	5.0	1.3	0.5	0.1	0.1	0.5	0.1	31.6	35.0	2.2	7,707	5,151
Prague	Shanghai	Piraeus	23.0	27.0	1.4	1.0	1.8	6	7.0	2.5	0.5	0.1	0.1	0.5	0.1	30.6	36.0	3.3	7,742	4,948
Prague	Shanghai	Rotterdam	28.0	34.6	1.7	1.0	0.9	1	1.5	0.4	0.5	0.1	0.1	0.5	0.1	30.6	38.1	2.0	7,845	5,131
Prague	Shanghai	Gdansk	34.0	35.0	1.8	1.0	0.9	2	3.0	1.1	0.5	0.1	0.1	0.5	0.1	37.6	40.0	2.2	8,303	5,433
Prague	Shanghai	Antwerp	30.0	35.0	1.8	1.0	1.2	2	2.8	0.7	0.5	0.1	0.1	0.5	0.1	33.6	39.8	2.2	8,452	5,598
Bratislava	Shanghai	Koper	26.0	28.0	1.4	1.0	0.9	1	1.1	0.3	0.5	0.1	0.1	0.5	0.1	28.6	31.1	1.7	6,835	4,604
Bratislava	Shanghai	Piraeus	23.0	27.0	1.4	1.0	1.2	5	6.0	2.1	0.5	0.1	0.1	0.5	0.1	29.6	35.0	2.8	7,172	4,529
Bratislava	Shanghai	Hamburg	31.0	34.4	1.7	1.0	1.2	2	2.8	0.7	0.5	0.1	0.1	0.5	0.1	34.6	39.2	2.2	8,102	5,286
Bratislava	Shanghai	Rotterdam	28.0	34.6	1.7	1.0	0.9	4	5.0	1.3	0.5	0.1	0.1	0.5	0.1	33.6	41.6	2.3	8,384	5,404
Bratislava	Shanghai	Gdansk	34.0	35.0	1.8	1.0	0.9	2	3.0	1.1	0.5	0.1	0.1	0.5	0.1	37.6	40.0	2.2	8,460	5,589
Bratislava	Shanghai	Antwerp	30.0	35.0	1.8	1.0	0.9	3	3.8	0.9	0.5	0.1	0.1	0.5	0.1	34.6	40.8	2.2	8,539	5,633
Vienna	Shanghai	Koper	26.0	28.0	1.4	1.0	1.2	1	1.1	0.3	0.5	0.1	0.1	0.5	0.1	28.6	31.1	1.8	6,745	4,488
Vienna	Shanghai	Piraeus	23.0	27.0	1.4	1.0	1.2	5	6.0	2.1	0.5	0.1	0.1	0.5	0.1	29.6	35.0	2.8	7,199	4,557
Vienna	Shanghai	Trieste	29.0	30.5	1.5	1.0	0.9	2	2.0	0.7	0.5	0.1	0.1	0.5	0.1	32.6	34.5	1.9	7,397	4,921
Vienna	Shanghai	Hamburg	31.0	34.4	1.7	1.0	0.9	2	2.8	0.7	0.5	0.1	0.1	0.5	0.1	34.6	39.2	2.1	7,852	5,057
Vienna	Shanghai	Rotterdam	28.0	34.6	1.7	1.0	0.9	2	2.8	0.7	0.5	0.1	0.1	0.5	0.1	31.6	39.4	2.1	7,954	5,148
Vienna	Shanghai	Antwerp	30.0	35.0	1.8	1.0	0.9	2	2.8	0.7	0.5	0.1	0.1	0.5	0.1	33.6	39.8	2.1	8,129	5,296
Vienna	Shanghai	Gdansk	34.0	35.0	1.8	1.0	1.4	6	8.1	2.8	0.5	0.1	0.1	0.5	0.1	41.6	45.1	3.6	9,551	6,145
Budapest	Shanghai	Koper	26.0	28.0	1.4	1.0	0.9	1	1.1	0.3	0.5	0.1	0.1	0.5	0.1	28.6	31.1	1.7	6,750	4,518
Budapest	Shanghai	Rijeka	30.0	32.0	1.6	1.0	0.9	1	1.2	0.4	0.5	0.1	0.1	0.5	0.1	32.6	35.2	1.9	7,162	4,646
Budapest	Shanghai	Piraeus	23.0	27.0	1.4	1.0	1.2	4	5.4	1.9	0.5	0.1	0.1	0.5	0.1	28.6	34.4	2.6	7,317	4,737
Budapest	Shanghai	Trieste	29.0	30.5	1.5	1.0	0.9	1	1.3	0.5	0.5	0.1	0.1	0.5	0.1	31.6	33.8	1.8	7,349	4,928
Budapest	Shanghai	Hamburg	31.0	34.4	1.7	1.0	0.9	2	2.8	0.7	0.5	0.1	0.1	0.5	0.1	34.6	39.2	2.1	7,874	5,079
Budapest	Shanghai	Rotterdam	28.0	34.6	1.7	1.0	0.9	3	3.8	0.9	0.5	0.1	0.1	0.5	0.1	32.6	40.4	2.2	8,382	5,503
Budapest	Shanghai	Antwerp	30.0	35.0	1.8	1.0	1.0	3	3.8	0.9	0.5	0.1	0.1	0.5	0.1	34.6	40.8	2.2	8,455	5,541
Budapest	Shanghai	Gdansk	34.0	35.0	1.8	1.0	1.4	5	6.8	2.4	0.5	0.1	0.1	0.5	0.1	40.6	43.8	3.3	9,385	6,121

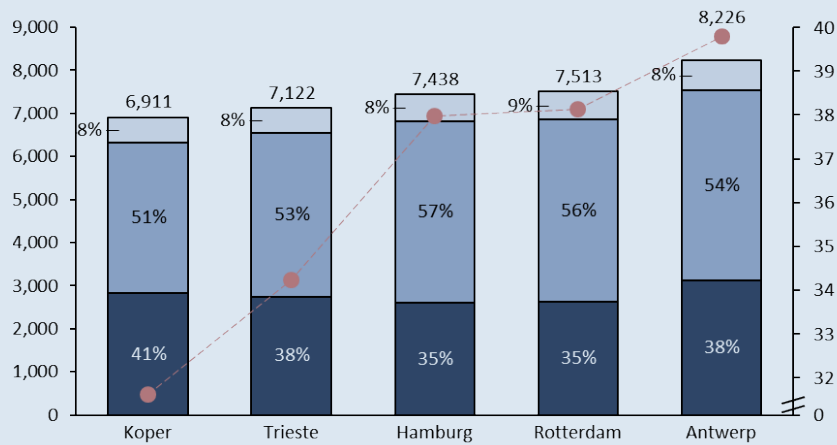
Source: Drewry Supply Chain Advisors; World Bank analysis and estimates.

Munich

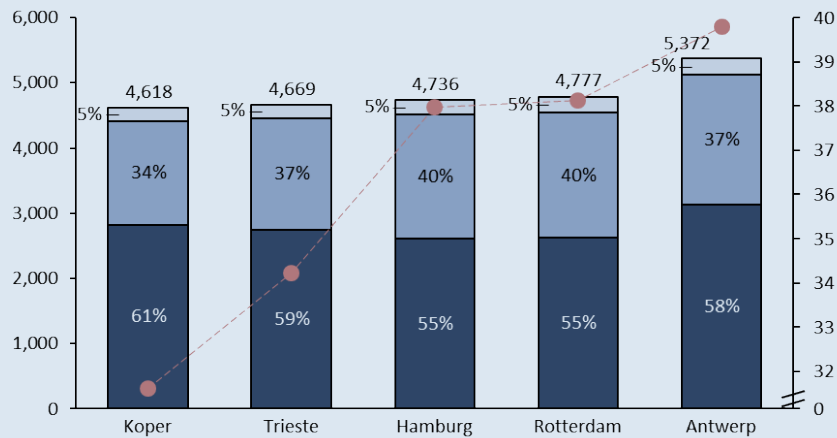
For Munich routing data was collected via five gateway ports. Routing via Rijeka is also possible in theory, but we were unable to obtain freight rate details from rail operators, major shipping lines, and local forwarders. For high-value cargo, the best routing option is via Koper, which is also the quickest routing option (Figure 3.10). For low-value cargo the best route is also via Koper, although Trieste, Hamburg, and Rotterdam are competitive.

FIGURE 3.10.
Total Logistics Costs and
Average Transit Time for
Routing Options
Shanghai→Munich
US\$ per FEU (transit time in
days, on right-axis)

For high-value shipments



For low-value shipments



- Avg. transit time (right-axis)
- Safety-stock ICC
- In-transit ICC
- Transport costs

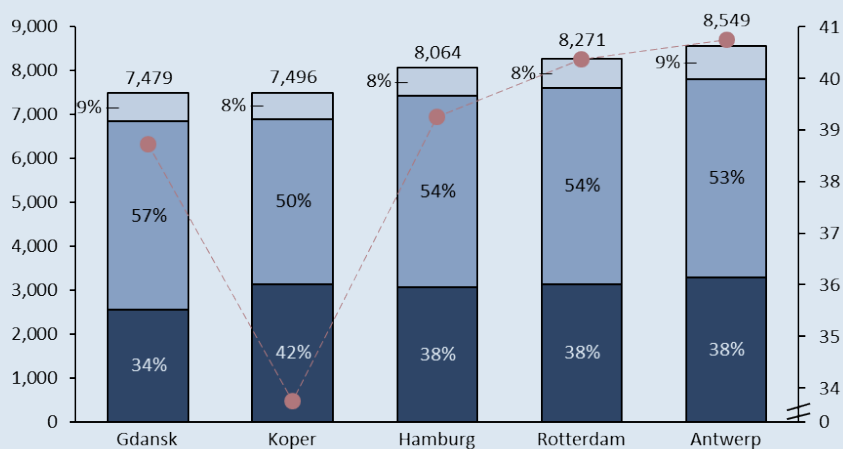
Source: Drewry Supply Chain Advisors; World Bank Analysis and estimates.

Katowice

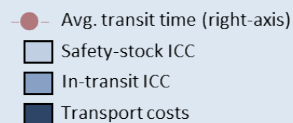
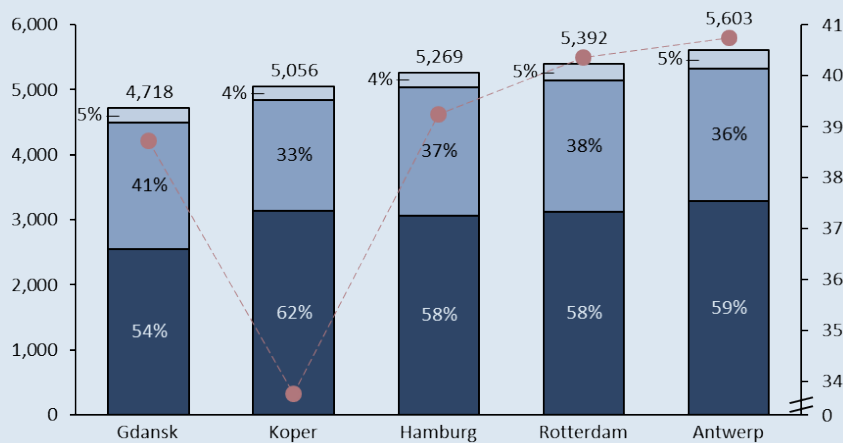
For Katowice routing data was collected via five gateway ports. For high-value cargo the best routing option is via Gdansk, even though it is not the quickest routing option (Figure 3.11). For low-value cargo the best route is also via Gdansk.

FIGURE 3.11.
Total Logistics Costs and
Average Transit Time for
Routing Options
Shanghai→Katowice
US\$ per FEU (transit time in
days, on right-axis)

For high-value shipments



For low-value shipments



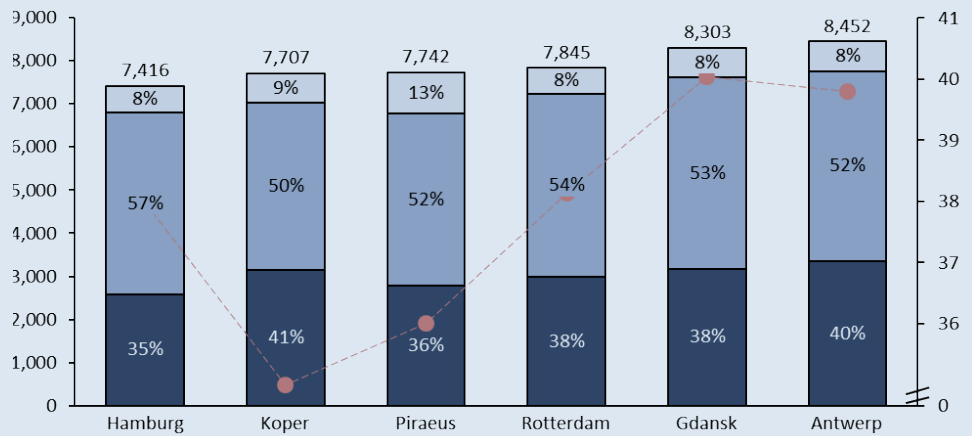
Source: Drewry Supply Chain Advisors; World Bank Analysis and estimates.

Prague

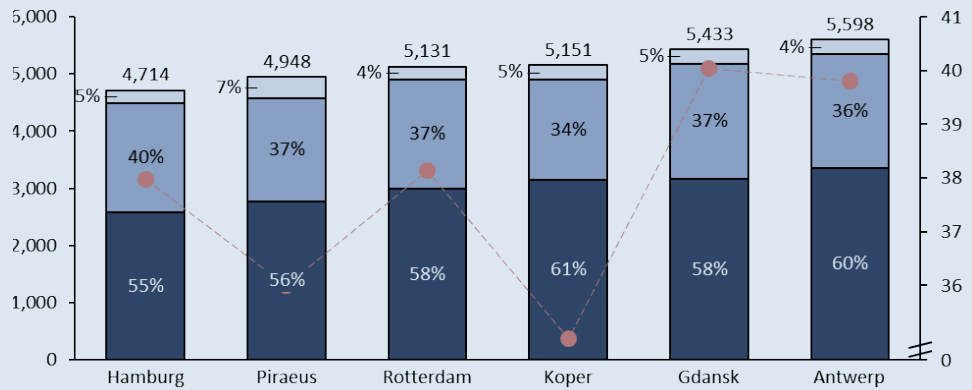
For Prague, we were able to collect routing data via six gateway ports. Although the fastest routing option is via Koper, the best route for both high and low value cargo is via Hamburg (Figure 3.12). Piraeus's competitive position is surprising for a market as distant from the port as Prague. That said, Piraeus's relative position is less strong for high-value shipments for which delivery lead time and lead time reliability carry a high logistics cost premium.

FIGURE 3.12.
Total Logistics Costs and
Average Transit Time for
Routing Options
Shanghai→Prague
US\$ per FEU (transit time in
days, on right-axis)

For high-value shipments



For low-value shipments



- Avg. transit time (right-axis)
- Safety-stock ICC
- In-transit ICC
- Transport costs

Source: Drewry Supply Chain Advisors; World Bank Analysis and estimates.

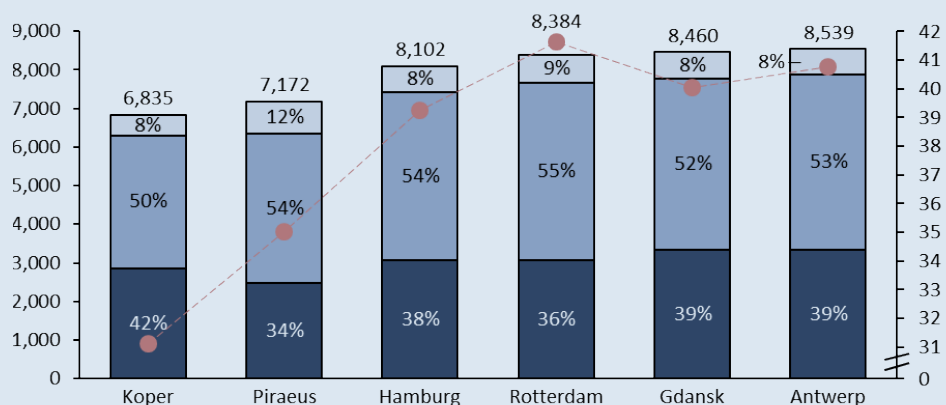
Bratislava

We were able to collect routing data from Shanghai to Bratislava via six gateway ports: Antwerp, Gdansk, Hamburg, Koper, Piraeus, and Rotterdam. Routings via Rijeka and Trieste are also possible in theory, but we were unable to obtain freight rate details from rail operators, major shipping lines, and local forwarders. Hence it is relatively safe to assume that the best route does not run via these ports. The lowest-cost routing for high-value cargo is Koper, which offers the fastest origin-to-destination transit time. Surprisingly, the most cost-competitive routing for low-value goods is Piraeus, owing primarily to its competitive transport cost component (Figure 3.13).

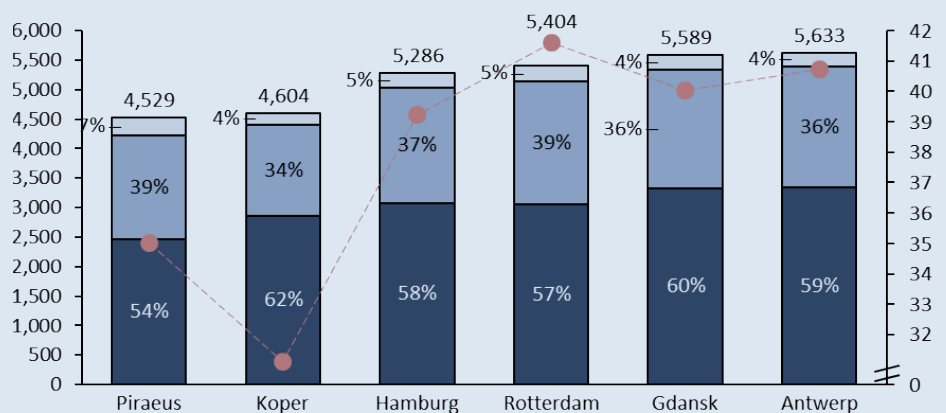
FIGURE 3.13.

Total Logistics Costs and Average Transit Time for Routing Options Shanghai→Bratislava
US\$ per FEU (transit time in days, on right-axis)

For high-value shipments



For low-value shipments



- Avg. transit time (right-axis)
- Safety-stock ICC
- In-transit ICC
- Transport costs

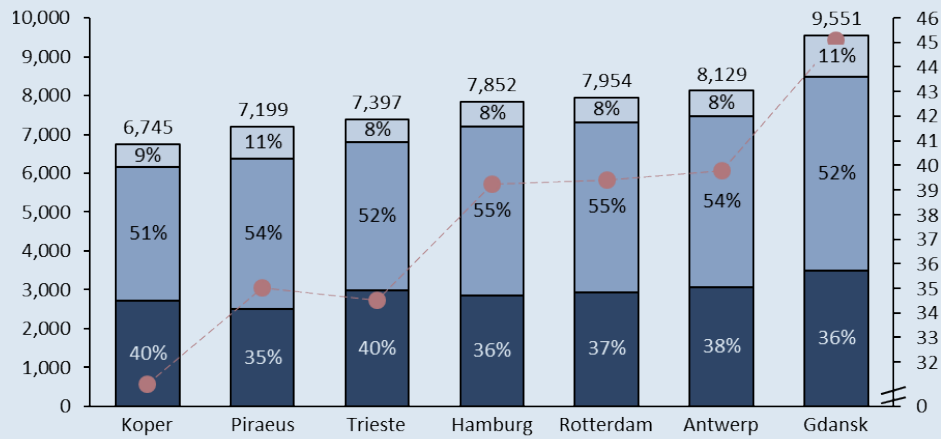
Source: Drewry Supply Chain Advisors; World Bank Analysis and estimates.

Vienna

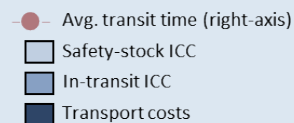
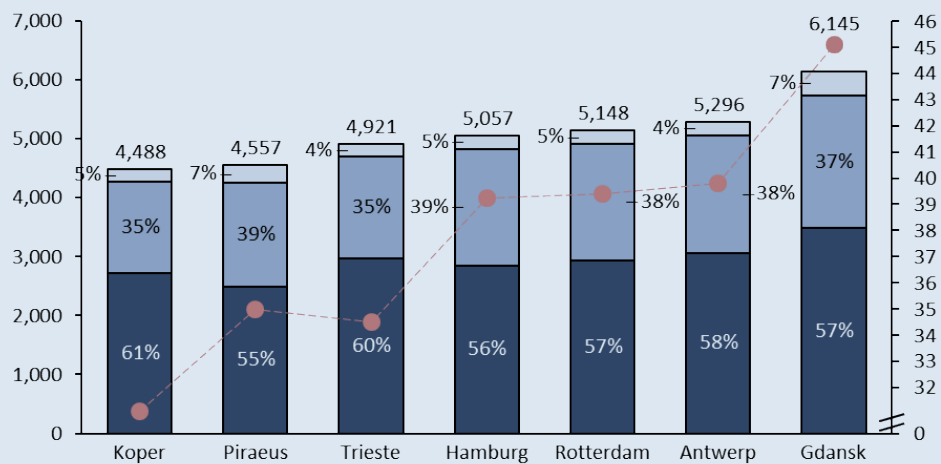
For Vienna we collected routing data via seven gateway ports. Koper is both the fastest and lowest-cost option for both high- and low-value shipments (Figure 3.14). Despite the distance involved, Piraeus is highly competitive for *both* high- and low-value shipments.

FIGURE 3.14.
Total Logistics Costs and
Average Transit Time for
Routing Options
Shanghai→Vienna
US\$ per FEU (transit time in
days, on right-axis)

For high-value shipments



For low-value shipments



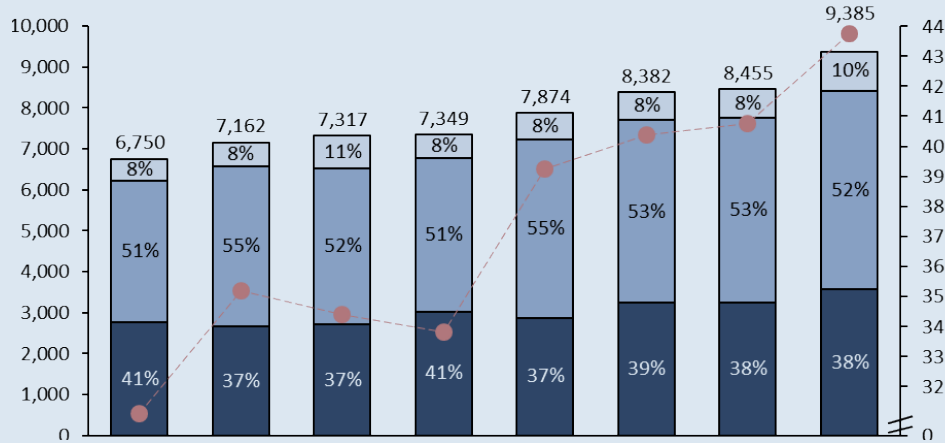
Source: Drewry Supply Chain Advisors; World Bank Analysis and estimates.

Budapest

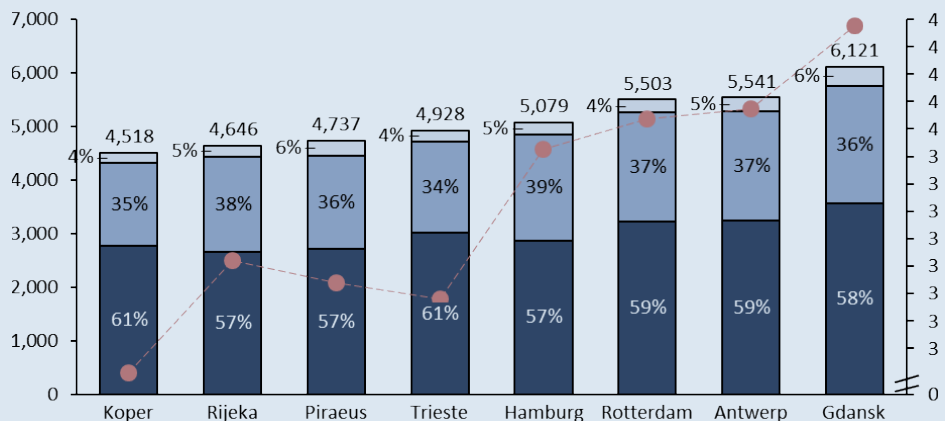
For Budapest we were able to collect routing data from eight gateway ports, making this the best-connected hub and clearly a hotspot in terms of hinterland competition. This is at present the only rail intermodal market in Central Europe served through direct service out of the Port of Rijeka. Proximity to market and reliable rail connectivity allow Koper and Rijeka to be the lowest-cost routings to Budapest for both high- and low-value shipments (Figure 3.15). Here again Piraeus is able to compete closely with North Adriatic ports despite the longer distance. And both the North Adriatic ports and Piraeus are more competitive to/from this market than the Northern European ports.

FIGURE 3.15.
Total Logistics Costs and
Average Transit Time for
Routing Options
Shanghai→Budapest
US\$ per FEU (transit time in
days, on right-axis)

For high-value shipments



For low-value shipments



- Avg. transit time (right-axis)
- Safety-stock ICC
- In-transit ICC
- Transport costs

Source: Drewry Supply Chain Advisors; World Bank Analysis and estimates.

CONCLUSIONS

Several conclusions stem from the above analysis:

With respect to the Asia-Central Europe market as a whole

- **Port-to-door transit times are a critical determinant of total logistics costs, through their impact on in-transit inventory carrying costs.** This stems from the fact that (a) delivery lead times in this market are long even in the best of circumstances—the average Asia port-to-door lead time among our six chosen ‘best routes’ is 33.6 days, and this translates into costly time-based costs, particularly in the case of high-value commodities, which are not uncommon in this trade; and (b) the variability of lead times in the trade appears to be moderate (our six chosen best routes yield an average coefficient of variation of lead time of only 6%), and as such the need to keep safety stock inventory on hand is limited and not as costly.
- **Transport costs are also critically important for high- and low-value commodity shipments alike.** This means that terminal operators, port authorities, freight forwarders, and other freight stakeholders have an opportunity to engage container shipping lines to find ways to reduce transport costs as a core component of their market share strategies vis-à-vis the Central European hinterland. The best example of this feature is Piraeus’s COSCO, which has managed to be competitive in several markets, despite much longer delivery lead times, due to very attractive through rates.
- **A direct result of the above two observations is the fact that Koper is, on the whole, the most competitive port in the trade, with Koper-based itineraries being either the best route or the second-best route in all six of our target markets for high-value shipments, and in five out of six for low-value shipments.** This stems from Koper’s unrivaled transit times in all target markets as well as favorable transport costs on offer.

With respect to Croatia

- **Rijeka has considerably strengthened its position in the North Adriatic and today it is a competitive port in the midst of a multi-pronged modernization effort involving the strengthening of its rail and road hinterland connectivity and an expected eventual (more than) doubling of throughput capacity as the new Zagreb Deep Sea Container Terminal becomes operational.** AGCT, the existing operational container terminal, is managed by ICTSI, an experienced global terminal operator that specializes in the operation of terminals in the challenging environments of emerging markets, which brings operational and financial resilience to this terminal and to the Port of Rijeka.
- **Rijeka currently offers Europe’s second lowest logistics cost connection from Shanghai to Budapest, one of Central Europe’s most attractive markets. The challenge for Rijeka, however, is its rail intermodal absence from the other five key Central European destination markets in our sample, which emerges as a glaring weakness from the benchmarking exercise.** While some (<10%) of Rijeka’s volumes do move to markets in Central Europe other than Budapest/Hungary, they do so by truck, taking a cost penalty in the process, due to the lack of direct rail service connectivity. In the process of conducting the market research that underpinned our benchmarking analysis, we were struck by the unfamiliarity of otherwise large, sophisticated logistics service providers as to the availability of intermodal itineraries to/from Rijeka, certainly for markets outside of Budapest but even sometimes for Budapest. This signals to us that AGCT/ICTSI and Port of Rijeka Authority face the urgent, yet clearly manageable challenge of expanding its hinterland service offering and deepening their marketing, customer outreach, and networking efforts to ensure that there is a critical mass of freight stakeholders—in particular, freight forwarders and other non-asset based intermediaries—that is familiar with the capabilities and offerings of the Port of Rijeka and its ecosystem.
- The good news for Rijeka, and for Croatia, is that Port of Rijeka Authority is already moving in this direction, as evidenced by their recently launched collaboration with COSCO on a weekly shuttle service between Piraeus and Rijeka. Indeed, this COSCO PRS service currently offers

the shortest maritime transit time between the Far East and Rijeka of all three options available at the port. Strategic partnerships such as this, which open new markets and expand the service offering to Port of Rijeka customers, can expand the port's 'sphere of influence' in the market and thus its reach. If past experience is any guide, Port of Rijeka Authority will need to complement this recent success with similar outreach efforts if Rijeka is to achieve minimally acceptable levels of handling utilization when the new container terminal becomes operational. In the highly-competited over Asia–Central Europe market, 'building' a new container terminal is far from sufficient to entice freight to 'come' to the port.

- **As part of expanding its sphere of influence, Port of Rijeka Authority has the opportunity to deepen its coordination and collaboration with MSTI** and other government entities, including local authorities of the City of Rijeka.

Other observations

- Routing options whereby ships bring the cargo to the port of discharge that is nearest to the shipment's final destination, from where it is moved inland through a sufficiently efficient inland distribution system, can reasonably be expected to be the standard scenario for best routes for the vast majority of Asia-Central Europe shipments.
- Piraeus's strong showing in our benchmarking assessment may seem surprising purely based on distance. But it exemplifies the power of hinterland connectivity—as well as the market offering and customer acquisition efforts afforded by high integration between a terminal operator and one or more of the container shipping lines that serve it (in Piraeus's case, the same parent company— COSCO—operates the port and provides container shipping and hinterland transportation services door-to-door, as well as putting in place a strategic collaboration agreement with the Port of Shanghai at origin). Using Piraeus as a gateway port to/from Central Europe, for example, increases the distance of overland transportation by well over 1,000 km compared to the North Adriatic ports, yet Piraeus remains competitive in several markets, particularly for low-value shipments, compared to some (and in some cases, all) northern European ports.
- As of June 2019, the Asia port-to-door routing via Piraeus was only offered by COSCO. The carrier offers a single 'all-in' through rate from Shanghai to the final destination in Central Europe under carrier haulage, making it impossible to see whether they are pricing their ocean leg or their inland leg at 'abnormally low' levels. It is possible that COSCO may be cross-subsidizing this new route as a market share strategy, as they seek to keep Piraeus as the largest port in the Mediterranean; BRI-linked ambitions may also be coming into play here. In the optimistic case, these subsidies could serve the build-up of base load volumes necessary to achieve acceptable utilization levels on the trains that serve this route. Such behavior would be in line with the experience of China-Europe landbridge rail products, where after two to five years of service provision, depending on the route, some of the subsidies are now being scaled back. However, if that is not the case and other motives are at play, these subsidies could persist for longer. Such a distortion of the 'level playing field' could prove detrimental to the volume growth aspirations of the North Adriatic ports, including Rijeka's—although here again the competition angle should not be seen as a zero-sum game, as evidenced by the Port of Rijeka's ongoing collaboration with COSCO and the Port of Piraeus.

CHAPTER 4

Profile of Croatia-based Freight Logistics Actors

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Profile of Croatia-based Freight Logistics Actors

A structured face-to-face, bespoke survey program was conducted among major Croatia-based freight stakeholders to develop a more detailed analysis of the current characteristics of logistics service provision in Croatia. The analysis covered a sample of 20 companies specialized in distribution services, transportation services, and transport organization and intermediation services. The respondent sample comprises firms with significant market share, including important Croatian producers (and exporters), foreign and local retail chains, foreign and local providers of logistics services, and local transporters.

Survey participants were divided into three main categories:

- Companies specialized in the **provision of transportation services** – mainly transport carriers in the trucking and railway sectors;
- Companies specialized in the provision of **warehousing and distribution services and shippers (manufacturers and retailers) either outsourcing or conducting own-account distribution**; and
- **Freight forwarders** – i.e., intermediaries between cargo owners and transport service providers.

All firms in the sample employ at least 25 people. All of them are significant in their field at the national and/or regional level, based on revenue and/or the volume of goods they transport or handle.

The survey-based analysis of the logistics sector in Croatia will be presented in five elements:

- General characteristics of Croatia-based LSPs;
- Characteristics of transportation service providers;
- Characteristics of warehousing and distribution service providers;
- Customs and freight forwarding service characteristics;³⁴ and
- Environmentally sustainable logistics systems and processes.

The survey's last component assesses the level of implementation of green logistics-oriented measures aimed at reducing local pollutant emission, climate change mitigation and adaptation contributions, and reductions of other negative externalities in the Croatian logistics market. This includes data collected from all respondents, irrespective of category.

The classification of companies in our sample according to country of ownership suggests that a significant number of companies in the Croatian logistics market (73% of our sample) are branches of foreign companies, particularly in the warehousing and distribution sector. In the transport sector, local companies are predominant in road transport, while in the railway sector they include state-owned enterprises, private operators that are mostly branches of foreign companies, and privately-owned domestic firms.

³⁴ Survey findings as to the characteristics of operators whose primary activity is freight forwarding were supplemented by findings from a study conducted by the University of Zagreb's Faculty of Transport and Traffic Sciences in 2018.

GENERAL CHARACTERISTICS OF CROATIA-BASED LSPs

Croatia's logistics sector has faced—and adapted to—cyclical fluctuations in demand and supply over the past ten years. The flow of goods significantly decreased in the period from 2008 to 2012 amid reduced economic activity, which affected the logistics service providers' business volume and resulted in reduced unit prices and the adaptation of operators to market conditions. The flows of goods saw an upward trend after 2014, which has continued to date. This period has seen a recovery among logistics service providers and their renewed investment in the development of services, equipment, and infrastructure, as well as the employment of additional workers. Among the key generators of this trend are tourism development, national GDP growth, and increased demand from neighboring countries, which has boosted demand for logistics services for goods in transit through Croatia.

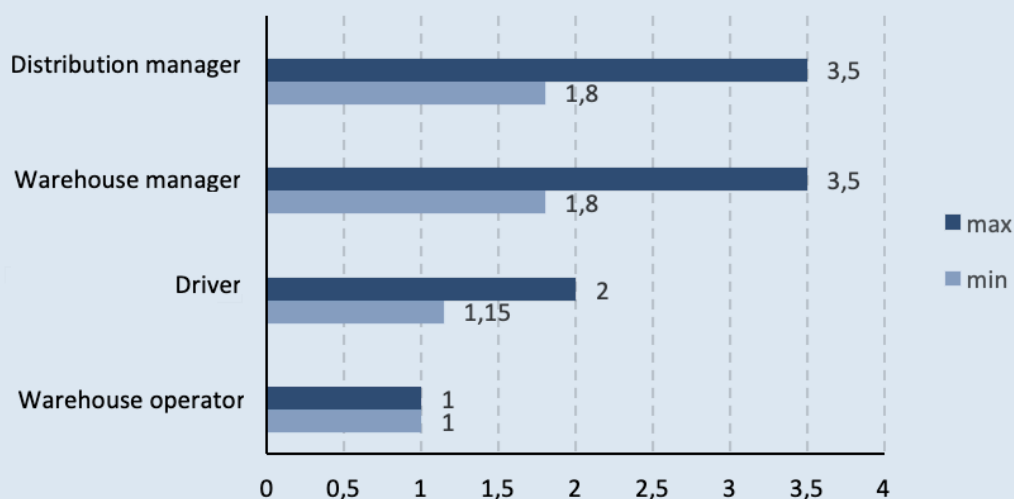
Croatia's EU accession led to a restructuring of the 3PL sector given an appreciable drop in standard freight forwarding activities. Immediately upon the country's EU accession a large number of small and medium-sized freight forwarders whose businesses focused primarily on customs clearance of goods in inbound and outbound flows between Croatia and the EU shut down. Operators that offered additional logistics services, primarily transport organization, warehousing, distribution, and various forms of 4PL or specialized logistics services, were the only ones to survive in the new, integrated market.

The present period is characterized by an increased demand for logistics services, which generates challenges for the industry. For example, the shrinking labor force trend in Croatia, driven by several factors, is also reflected in the logistics sector, where a lack of labor force is particularly evident in the transport and warehousing sector. There is a noticeable number of foreign-owned companies in the market. Local service providers are often organized as branches of foreign parent companies that provide financial, operational, and business support. These companies have also introduced their own standards and enabled the transfer of knowledge to their local branches in terms of business organization and improvement of logistics services (e.g., 80% of our LSP survey respondents are classified as branches). Although foreign companies are not significantly more advanced in terms of technology and operations, domestic companies are in an unfavorable position due to a lack of institutional support in Croatia.

As regards labor force structure, most employees are on permanent employment contracts (between 70% and 80% according to our survey). Temporary employees are mostly hired to meet seasonal demand fluctuations (the usual increase in the number of employees is approximately 20%), most notably between June and September, and in December. Shift work is common in major distribution companies (such as retail distribution operators). Work is most often carried out in two (50% of the respondents), or three shifts (50%). The driver/warehouse operator to middle manager salary ratio ranges from 1:1.8 to 1:3.5 (Figure 4.1), with warehouse operators being the lowest paid employees. IT assistance is usually outsourced; if there is an in-house team, the salaries of IT professionals typically equal those of middle management.

The service offered in the market is for the most part “tailor made” (approximately 90%) with logistics service providers adjusting their features to customer requirements in order to attract them. The collected data shows that there is little demand for standard logistics services in the market. Distributors are most often asked to fulfill customer-specific requirements, and lately there has been an increase in demand for tailored services from transport companies as well.

FIGURE 4.1.
Salary Ratio Among Logistics
Sector Employees by Role



Source: 2019-2020 World Bank-University of Zagreb Survey of Croatia-based Logistics Stakeholders.

Logistics service providers establish contact with potential customers in different ways. If a domestic branch of a foreign entity is involved, then the parent company uses the resources of its local branch to provide services to its major customers in the local market (typically in this situation, local branches have a limited role in customer acquisition). Alternatively, logistics service providers use different channels to actively acquire new customers: direct contacts, tenders, freight and vehicle exchanges and, more recently, social media. Survey respondents highlighted that potential customers ask logistics service providers to adapt to their requirements (tailormade services) and produce high KPI levels. **This structure suggests that LSPs in Croatia have adopted usual EU standards in attracting and acquiring customers.**

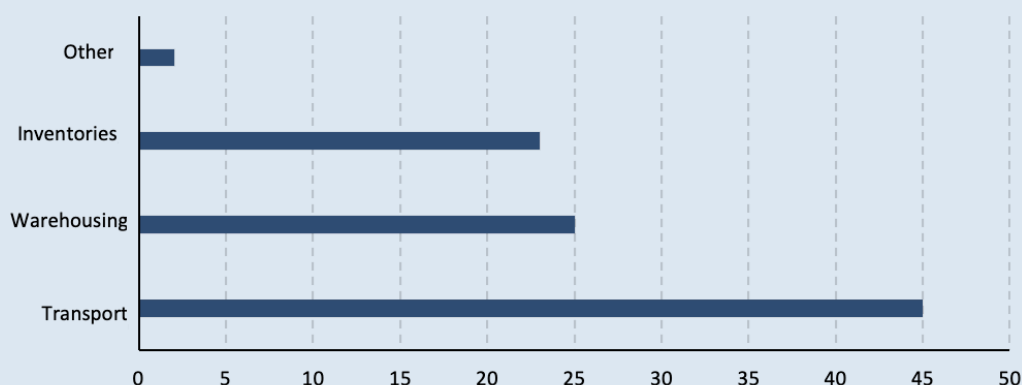
The ratio of foreign and domestic customers varies among entities, but there is a significant share of foreign business entities in the total number of customers. In the distribution segment some logistics service providers have 80% foreign customers, while up to 20% of transport sector services are provided in foreign markets.

As Croatia's most important economic and trading partners, EU member states are the most important markets for logistics service providers. The most important export markets where Croatian providers operate are Bosnia and Herzegovina, Serbia, and the EU member states that are Croatia's major partners in foreign trade—Italy, Slovenia, Germany, and Austria.

In the total cost structure of logistics services of survey respondents, transport accounts for the largest share of costs in the distribution segment, followed by storage and stock-keeping costs in almost equal shares (Figure 4.2). The cost structure is shown in general terms. Depending on the type of goods distributed, means of transport and distances, the logistics cost structure may vary to a significant extent.

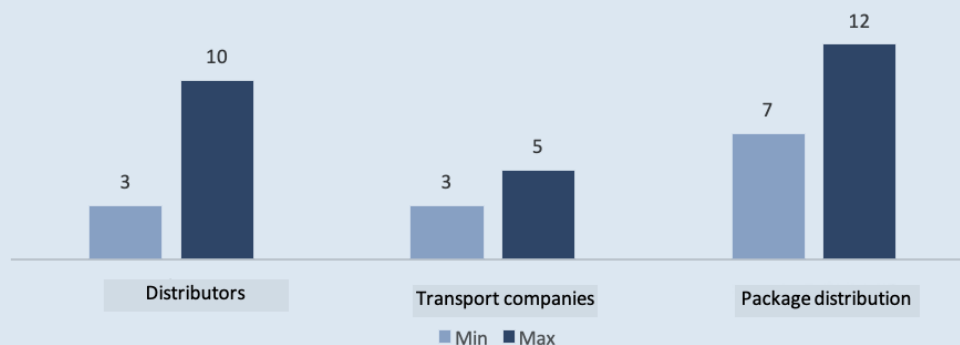
The profit margin of the majority of logistics service providers is in the 3% to 12% range (Figure 4.3). Some providers see better margins than others, depending on the nature of their service provision (specific service segments, complete distribution services). These profit margin levels are within the range of standard profitability in the logistics service sector in the broader European experience.

FIGURE 4.2.
Croatia-based Shippers: Logistics
Cost Structure by Category
In percent of total logistics costs



Source: 2019-2020 World Bank-University of Zagreb Survey of Croatia-based Logistics Stakeholders.

FIGURE 4.3.
Profit Margins of Croatia-based
Logistics Service Providers by
Business Activity
In percent of revenue



Source: 2019-2020 World Bank-University of Zagreb Survey of Croatia-based Logistics Stakeholders.

CHARACTERISTICS OF TRANSPORT SERVICE PROVIDERS

Transport service provision in Croatia features many road transport solutions and a high level of available road transport capacity. There is a wide range of companies in this market segment, from family-owned companies to road transport companies with large fleets (≥ 50 power units). **The transport capacity available in the domestic market generally satisfies the service demand.** This applies to both peak and off-peak seasonal demand. Insufficient capacity has been detected in the package distribution segment, but so far only during the period of increased seasonal demand. The road transport segment has the highest share of transport services rendered (the share of road transport in the Croatian market is approximately 74%).

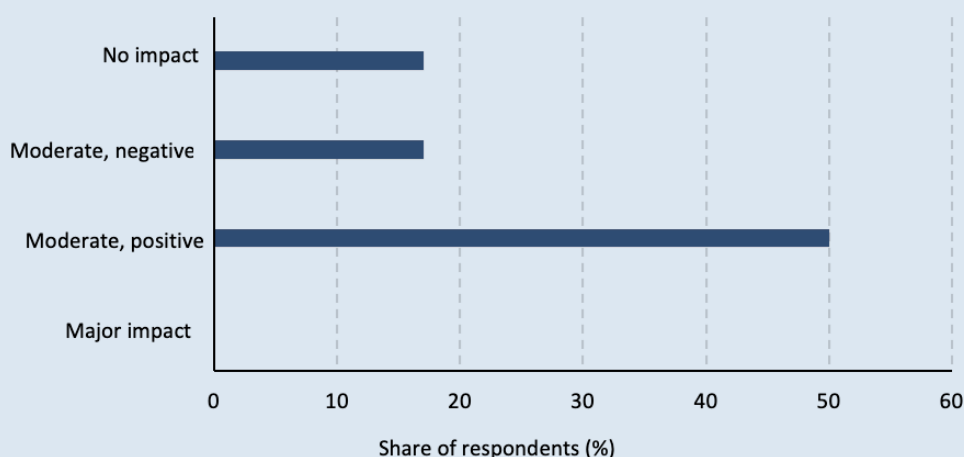
According to survey findings, the equipment ownership structure of transport service providers shows an almost equal share of owned and leased vehicles (50/50%). Entities using the leasing option point out that it facilitates vehicle cost planning and maintenance, thus simplifying fleet management and the planning of fleet renewal.

Nearly a third of transportation services are provided for international shipments. Sixty-six percent of the transport carrier survey respondents provide their services solely in the domestic market, while the rest of them accommodate customers in foreign markets as well. The share of services rendered in foreign markets ranges from 20% to 30% of the total number of services. Croatia's accession to the EU has made it easier for transport companies to

find cargo (cabotage options) and use online platforms to find customers in foreign markets (freight exchanges and similar online platforms).

Liberalization of the transport market has enabled Croatian road transport companies to transport goods in the markets of EU countries, but it has also provided foreign transport companies access to the Croatian market. According to the transport companies surveyed, the liberalization of road transport services has not had a major impact on their domestic market operations (Figure 4.4). On the other hand, the market liberalization gives additional options to transport companies when it comes to organizing return transport journeys in foreign countries, which positively affects profits and vehicle utilization. Foreign transport companies have not taken up many cabotage options in the Croatian market due to the market size and the widely available transport capacities of local transport companies.

FIGURE 4.4.
Impact of Transport Market
Liberalization on Transport
Company Operations



Source: 2019–2020 World Bank–University of Zagreb Survey of Croatia-based Logistics Stakeholders.

As regards railway transport, liberalization has enabled service providers (transport companies/railway undertakings) to enter the Croatian market, resulting in significant market changes. In the period since 2013, the share of rail freight tonnage transported by the incumbent state-owned rail transport company has steadily decreased, from 100% in 2013 (and near-100% in 2014) to approximately 50% by the first quarter of 2020. A total of eight new railway undertakings—providers entering the market since railway sector liberalization—handled the remaining tonnage.

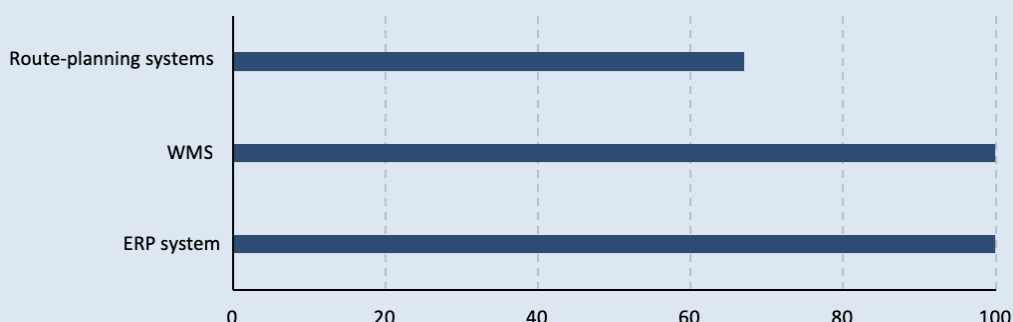
By type of goods in road transport, general cargo and consumer goods account for the largest share (83%). In the rail transport segment, bulk cargo is dominant (up to 60%), with petroleum products and general cargo being the top two commodity types transported by volume.

While EU-wide transport policy encourages the use of intermodal transport, its incidence in Croatia remains limited. The number of containers transported by rail is higher in neighboring EU member countries Austria, Slovenia, and Italy. Transport companies in our sample do not use intermodal technologies when rendering transport services. This is because they do not see advantages in using intermodal transport technologies compared to traditional ones. The only exception is container transport, used from the port of entry to the distribution

center, upon which shipments are broken down into several smaller ones and introduced into the usual distribution system. Depending on a company's sphere of operation the number of containers varies from 100 TEU per year to 2,500 TEU. It should be noted here that these are mainly imported goods.

All survey participants reported using a variety of IT tools in their everyday activities: all of them use Enterprise Resource Planning (ERP) software, and the second most commonly used tool (67%) is vehicle monitoring or route planning software solutions (Figure 4.5). In the route planning tools category, products from different developers with different levels and number of options are used, depending on the needs and financial position of the transport companies. Their functionality levels are different and the solutions used in the logistics market vary from simple to complex. Foreign companies that have entered the Croatian market generally have more complex IT support since they apply extensive solutions provided by their parent companies (such as high-capacity ERP systems integrated with warehousing management and transportation management systems). In this respect, purely domestic companies are in an unfavorable position, in some cases relying on basic solutions.

FIGURE 4.5.
Level of IT System Application in
Daily Business Operations
Share of respondents (%)



Source: 2019-2020 World Bank-University of Zagreb Survey of Croatia-based Logistics Stakeholders.

Vehicle types in road transport can be divided into several categories; however, there is a relatively small share of new vehicles (25% to 30% of vehicles compliant with Euro Standard VI or higher) and all of them are powered by internal combustion engines. None of the survey respondents use electric or hybrid vehicles, and it should be noted that there are no country-wide incentives or measures that would allow companies to purchase alternative fuel or electric vehicles at a more favorable price. **A number of survey respondents have stated that they would strongly consider purchasing such a vehicle if a system of incentives existed. Subsidy measures intended for physical persons are in place in Croatia for purchasing alternative fuel vehicles, but no such measures are offered to business entities.**

The following incentives could be proposed:

- Incentives for the acquisition of electric or hybrid commercial vehicles;
- Tax credits for companies using distribution systems that include electric vehicles, hybrid vehicles, delivery bikes or foot delivery;
- Incentives for researching environmentally friendly distribution systems;
- Incentives for developing innovative and environmentally friendly delivery services, with a particular focus on urban areas; and
- Promoting corporate social responsibility in the sphere of environmental preservation.

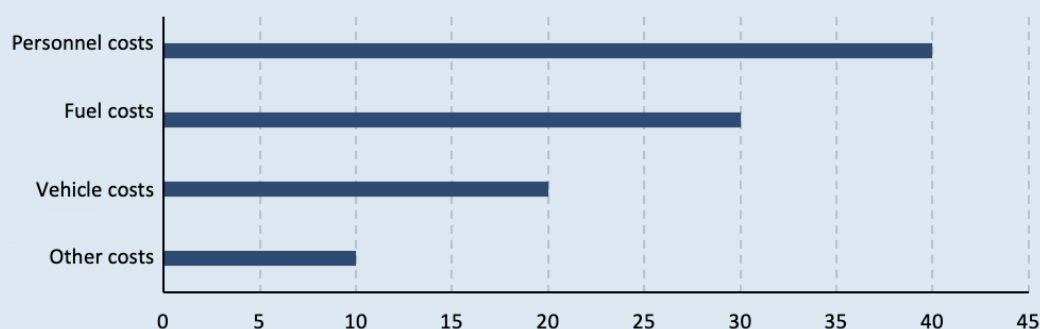
Delivery route planning and transportation management have contributed to a relatively small number of delivery delays; road transport companies (90% of respondents) do not experience significant losses caused by delays at the loading point, or those related to freight delivery. Given that the road transport survey respondents do not make heavy use of railways for multiple reasons (lack of access to rail lines, inflexibility of service, disorganized night lines, and significantly prolonged transport times on regular routes), no intermodal shipment delays were noted.

Almost all surveyed transport companies (95%) do not implement direct measures aimed at reducing negative environmental impacts from the transport segment (e.g., the acquisition of lower-emission vehicles). Cost reduction is the biggest motive for rationalizing transport arrangements. In this regard, various measures are used to reduce fuel consumption (such as eco-driving) or to optimize the utilization of cargo space.

In the transportation cost breakdown, the highest proportion of costs are associated with personnel, followed by fuel, vehicle, and other costs (maintenance, utilities, etc.) (Figure 4.6). The aggregate share of total costs accounted for by the leading transport cost categories is comparable with that of other Central European countries (Poland, Czech Republic, Hungary), but individual cost shares vary in amount. In Poland, for example, the share of fuel in the transport cost is slightly higher than in Croatia (between 40% and 50%). However, the sum of the two most significant cost categories is similar because of a smaller share of labor costs in total transport costs. Given that the EU transport and logistics market has a workforce shortage, transport companies seek to improve working conditions and thus attract workers or encourage them to stay. The upward trend in worker wages leads to increased transport costs or to process restructuring aimed at boosting efficiency and reducing other cost categories.

Profit margins in the transport sector vary by the type of cargo transported and the transport service offered, ranging from 3% to 5%. The most important element affecting further business development is the lack of skilled labor in the transport industry, especially in road transport. According to the respondents, the legal framework satisfies the needs of a basic market, where business activities are carried out according to the business-as-usual scenario, while there are no legislative framework features from the international experience in other high-income markets. Such models include various subsidies and incentives for business entities, encourage and provide financing of business development and expansion to foreign markets, encourage the use of advanced technologies, ensure benefits from local governments, and encourage the use of environmentally friendly business models. **A key point of alignment between environmental goals and private profitability goals is the fact that fuel costs account for a significant portion of the cost structure of transportation carriers in Croatia.**

FIGURE 4.6.
Breakdown of Transport
Costs by Category
In percent of total
transport costs



Source: 2019-2020 World Bank-University of Zagreb Survey of Croatia-based Logistics Stakeholders.

Transportation service providers (100% of survey respondents) actively monitor the transport service quality through a variety of performance indicators. Transport companies most often monitor the following KPIs: the number of timely deliveries, the percentage of vehicle space used, and the volume of ton-km transported.

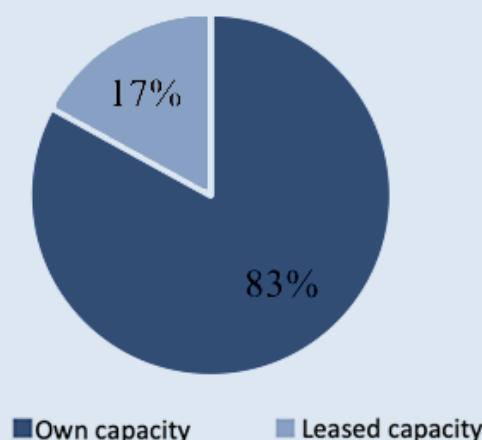
Monitoring the quality of transport service through different KPIs is a common practice in all companies operating in Croatia, as it enables them to monitor their performance and benchmark market competitors. The entry of foreign-owned companies into the Croatian market has further increased the need for national transport companies to monitor performance indicators and introduce a system for performance indicator analysis, with foreign companies having introduced these measures when they entered the market. The levels at which KPIs are set are broadly consistent with KPI levels in EU markets (this applies to the survey respondents), and this approach has boosted the competitiveness of domestic companies.

CHARACTERISTICS OF WAREHOUSING SERVICES AND WAREHOUSING SERVICE PROVIDERS

In the storage capacity segment, distribution warehouses—such as distribution centers—are dominant (90% of our sample). A part of storage capacity is related to the package distribution segment, serving for temporary storage and sorting of shipments. Facilities are, for the most part, owned rather than leased (Figure 4.7), while the warehouse floor area depends on the scope of business of individual entities. The warehouse floor area of the survey respondents ranges from 2,500 m² to 30,000 m². For rented warehouses, the market rental price depends on various criteria, with an average rental price of about 5 EUR/m². When compared to neighboring countries, warehouse rental prices are lower in Hungary and Serbia and about the same in Slovenia.

Almost all large warehouses (above 5,000 m²) are located in the area of the Zagreb transport hub (the Zagreb area and surroundings), while in the major cities (Rijeka, Osijek, Split) there are predominantly cross-dock terminals or smaller warehouses, with a floor area of up to 3,000 m². The city of Split is an exception to some extent, as many warehouses are located in the area of Dugopolje (hinterland of Split). This kind of arrangement results from the population density and the economic power of the City of Zagreb and its surroundings compared to the rest of Croatia.

FIGURE 4.7.
Storage Capacity
Breakdown by
Ownership

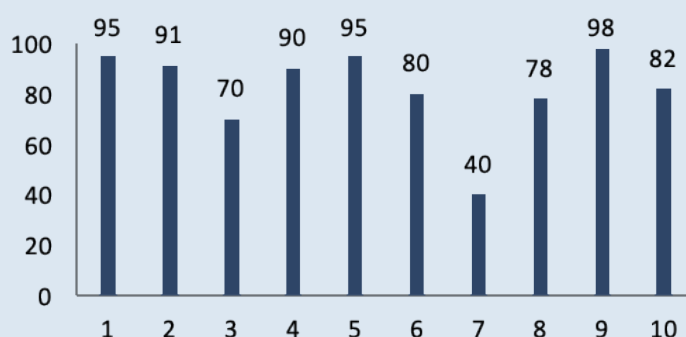


Source: 2019–2020 World Bank–University of Zagreb Survey of Croatia-based Logistics Stakeholders.

The price of land in the Zagreb area and its surroundings is the highest in Croatia but logistics service providers nevertheless most often choose it to build new warehouses and expand existing storage capacity. In addition to the reasons mentioned above, Zagreb's geographic location also enables transport companies to organize distribution to neighboring countries (primarily to Slovenia, Hungary, Bosnia and Herzegovina), while a good connection with the port of Rijeka allows them to process the flow of goods in containers.

Most service providers have a high warehouse occupancy percentage (Figure 4.8). Average warehouse occupancy is around 80%, with the exception of companies that have in the last couple of years invested in building new facilities to satisfy future demand. As the majority of service providers (88% of survey respondents) expect an increase in logistics services demand in the next few years, the recorded warehouse occupancy rates point to a need to build new warehouses and to expand existing capacity, along with necessary technological improvements at available public warehouses at the Zagreb Freight Station. **Neighboring countries, primarily Hungary, Slovenia and Serbia, have made significant investments in storage capacity over the last five years. In the context of increasing the regional significance of Croatian logistics service providers, the construction of new capacities and modernization of existing ones will boost the development of logistics service providers in Croatia and help them break into foreign markets.**

FIGURE 4.8.
Utilization of Storage
Capacity Among Survey
Respondents
In percent

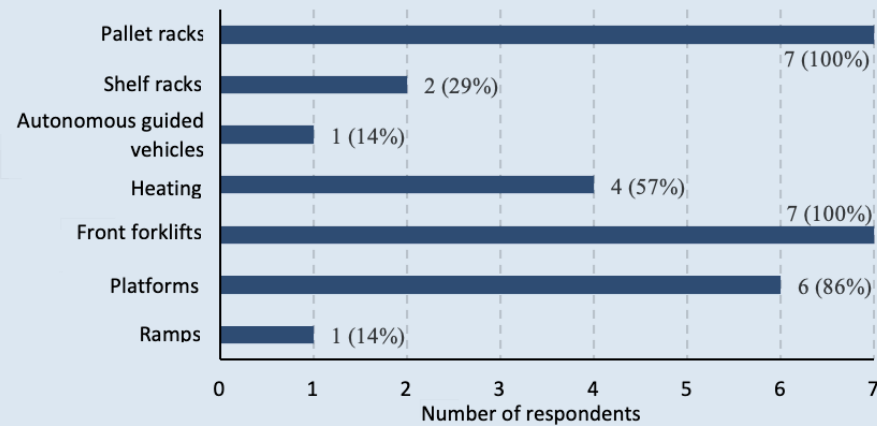


Source: 2019-2020 World Bank-University of Zagreb Survey of Croatia-based Logistics Stakeholders.

In the freight storage market there is a reported shortage of distribution warehouses with modern equipment and design, and of specialized warehouses. This includes, for example, storage for deep-frozen products, air-conditioned warehouses, and warehouses for storing hazardous cargo. This applies to both private and state-owned warehouses.

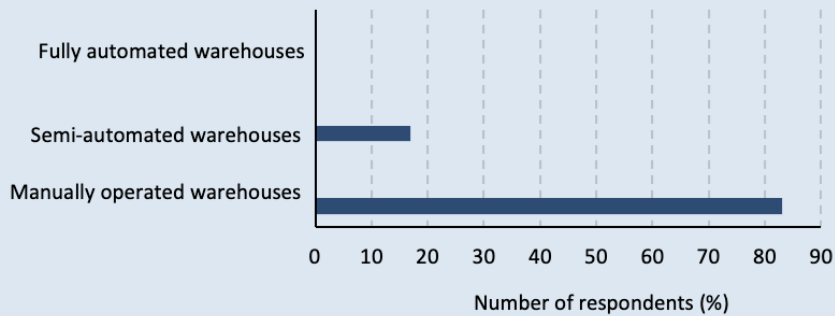
Automation in the Croatian warehousing sector is limited. Figures 4.9 and 4.10 show the prevalence of warehousing equipment and level of automating in warehousing, respectively. Though this differs depending on the type of goods and the business activities performed, survey findings show that standard warehouse equipment (pallet racks, front forklifts, ramps) are widely prevalent, while automation levels, for example though the use of autonomous guided vehicles, are low. The distribution warehouses of the surveyed entities are not equipped with automated storage and retrieval systems (AS/RS) for storing or commissioning goods. The share of specialized warehouse equipment (warehouses with narrow aisles, drive-in racks, FIFO racks, double-depth racks) is low; less than 10% of warehouses have this type of equipment. All survey respondents in the package distribution segment use warehouses that are equipped with automated parcel sorting systems.

FIGURE 4.9.
Warehouse Equipment Available at
the Surveyed Companies



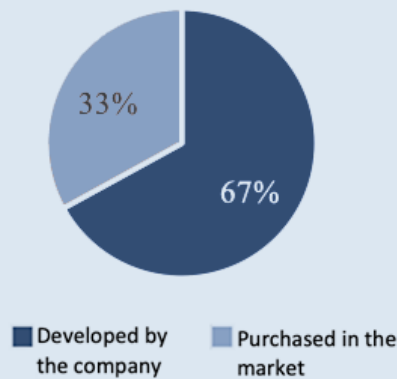
Source: 2019-2020 World Bank-University of Zagreb Survey of Croatia-based Logistics Stakeholders.

FIGURE 4.10.
Warehouse Automation Level –
Distribution Warehouses



Source: 2019-2020 World Bank-University of Zagreb Survey of Croatia-based Logistics Stakeholders.

FIGURE 4.11.
Warehouse Automation Level –
Distribution Warehouses



Source: 2019-2020 World Bank-University of Zagreb Survey of Croatia-based Logistics Stakeholders.

All warehouses operated by surveyed firms use Warehousing Management System (WMS) software, with varying approaches as to its deployment (Figure 4.11). WMS software is provided by different producers; some logistics service providers have developed their own software, while others use one of the systems available in the market off-the-shelf. The entities operating as branches of their parent companies mostly use the same systems as the parent company, which makes them more competitive than smaller companies.

While low, current levels of warehousing automation in Croatia seem adequate. The level at which warehouses are equipped in Croatia is comparable with neighboring countries; these are mostly clad-rack warehouses applying a version of WMS. In Croatia the level of automation or computer-assisted processes is relatively low. Considering the size and market requirements covered by this level of warehousing equipment, it can be considered adequate. Given the current level of workforce availability, financial stability and the pace of warehousing processes, there is still no overwhelming need to introduce automated goods commissioning and storage systems, the implementation of which is technically demanding and requires upfront investment, which can only be recouped with sufficient traffic volume over time. There are warehouse facilities in the Croatian logistics sector where certain process phases have been automated, for example implemented AS/RS, automated guided vehicles (AGVs), sorting units, etc., but still in a small proportion and often within the logistics department of a manufacturing company. Some logistics service providers use computer assistance to carry out storage processes (mainly Pick-by-Voice systems, due to their market availability).

Our survey shows that the leading logistics service providers in Croatia are abreast of market trends related to the development and improvement of warehousing equipment. However, the implementation of advanced storage systems or the introduction of innovations into existing operating methods depends significantly on assessments made by each individual provider, and is often limited in terms of available funds.

As a rule, distribution companies organize shift work (40% of the companies work in three shifts, 40% work in two shifts, and the remaining in one shift). The share of seasonal shift workers corresponds to seasonal changes in the number of employees.

In terms of logistics operations, survey respondents manage anywhere from 15 to more than 300 incoming shipments a day and an equal number of outgoing shipments. In Croatia, companies receiving and dispatching more than 500 pallets a day are considered major logistics service providers. By type of goods stored, consumer goods and general cargo account for as much as 90% of warehousing demand.

Most warehouses (approximately 85% of those surveyed) are not connected to the railway network. The logistics service providers consider a connection unnecessary in light of the underdeveloped railway infrastructure. Warehouses at the Zagreb Freight Station are connected to the railway network, but it currently does not represent a significant competitive advantage over other locations given that consumer goods or parcel distribution by rail is negligible in the Croatian market.

Approximately 80% of the warehousing service providers surveyed offer value-added services to their customers. The most common value-added services are repackaging and creating package declarations. Other services offered include return management services, promo packages, etc. The provision of value-added services is one of the essential elements ensuring competitiveness of a logistics service provider, such that this share of logistics service providers offering value-added services is to be expected.

Croatia-based warehousing operators face legal, regulatory, and labor market challenges (see Box 5). In the warehousing segment the legal framework (for example, as to the amount and method of calculating the utility fee, charged by volume and representing a significant business expense, as well as the regulatory practices regarding land acquisition), and difficulties finding skilled workers (there is a shortage of a wide range of workers in the sector, from warehouse operations personnel to highly qualified middle management) were identified as critical factors impacting business operations.

BOX 5. BOTTLENECKS IMPEDING THE GROWTH OF CROATIA'S WAREHOUSING SECTOR

Our survey findings identified a need to increase available international-standard warehousing capacity and the deployment of warehousing automation nationally, especially in the node of Zagreb; this would make Croatia-based warehousing operations more competitive across the region. The nature of this issue is illustrated by the testimony of a survey respondent, a prominent international logistics operator, which in 2017 opened a storage location in Croatia (Zagreb) intended as a regional distribution center for the Western Balkans region; yet, by 2020, as of the time of our survey, the firm was exploring options for exiting Croatia and moving this regional operation to neighboring Serbia. The operator also indicated that it uses the Port of Koper as its main gateway to/from Croatia at present (a position that is not inconsistent with our best-route findings of Chapter 3). It stated that administrative limitations in the process of acquiring land for logistics facilities in Croatia make the process excessively lengthy, which tends to discourage investment in warehousing facilities and other logistics clusters in the country. It also stated that the construction quality of the Croatian warehousing market was low, yet rental prices were up to twice as high as those of other EU member states, such as Romania.

Broad evidence from the World Bank's *Doing Business* database corroborates this anecdotal account (Table B5.1). Specifically, while Croatia and Serbia have roughly comparable performance in terms of the ease of registering existing warehousing property, Serbia has a clear competitive advantage over Croatia when it comes to the ease of compliance with regulatory and administrative processes for building new warehousing facilities. The latter advantage ultimately translates into half as many procedures to legally build a warehouse (22 vs. 11), shorter documentation and compliance processing time (46.5 days shorter), and almost seven times lower compliance costs as a percentage of warehouse value in Serbia compared to Croatia.³⁵ Indeed, Serbia is among the world's top 10 performers—ranked 9th overall, from a sample of 190 countries—regarding ease of compliance for newbuild warehousing capacity. Conversely, Croatia ranks 150th in the 190-country *Doing Business* sample.

TABLE B5.1.
Procedures, Time, and Cost
of Compliance for Building a
Warehouse, and Warehouse
Building Quality Control
Performance in 2020\1

Performance Indicator	Croatia	Serbia
Overall global performance rank (1=best, 190=worst)	150	9
Procedures (number)	22	11
Time required to complete procedures (days)	146	99.5
Cost of completing procedures (% of warehouse value)	9.2	1.4
Building quality control index (0-15, where 15=best)\2	12.0	14.0

1\ Including obtaining the necessary licenses and permits, submitting all required notifications, requesting and receiving all necessary inspections, and obtaining utility connections. To maintain comparability, the characteristics of the notional warehouse under consideration are kept constant across countries, including: commodity types/uses (general storage), size of land plot (929 m²), size of constructed area (1,300.6 m²), stories and building height (two above-ground stories, each 3 m in height), building valuation (50 times national income per capita), ownership status (100% owned by building company), status of preparatory documents (engineering and architectural designs completed), and expected construction time (30 weeks).

2\ This index measures the quality of construction of warehouses, based on an assessment of quality of building regulations; quality control before, during, and after construction; liability and insurance regimes; and professional qualification/certification requirements.

35 World Bank (2020), *Doing Business 2020*, Economy Profile of Croatia and Economy Profile of Serbia.

Serbia's success stems from sustained adoption of sectoral reforms during the 2014–2018 period,³⁶ including (i) implementing an online portal to streamline the process for obtaining building permits (e-permit system); (ii) setting and enforcing time limits for the registration of property rights in the real estate cadaster and for obtaining a building permit; (iii) eliminating a land development tax for warehouses and reducing administrative fees; and (iv) improving the reliability of the land administration system by implementing a geographic information system. According to the *Doing Business* 2020 rankings, only one EU member state (Denmark, ranked fourth globally) outperforms Serbia regarding the ease of compliance for building new warehouses, with most EU member states geographically close to Serbia trailing well behind, including Bulgaria (43rd), Greece (86th), Hungary (108th), Romania (147th), and Croatia (150th—second-lowest ranking among EU member states, after the Czech Republic [157th]).

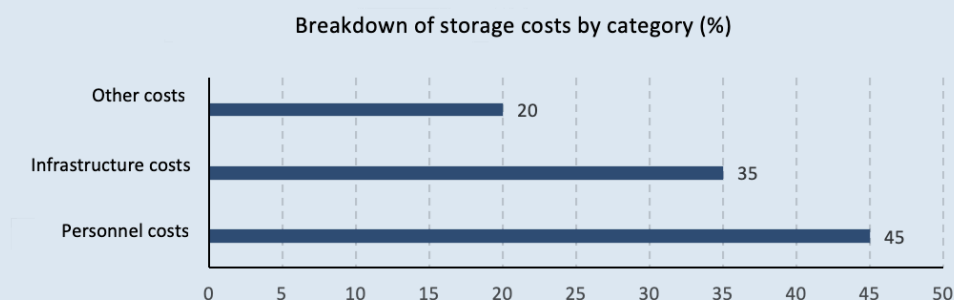
Put in this context, it is not surprising that warehousing occupancy rates in Croatia are high—more than 80% in the Zagreb hub area. Rents as a result are expensive, with an average rental price of about EUR5 per m², higher than those prevailing in many Eastern European capitals like Vilnius, Riga, Tallinn, Sofia, and Bucharest for prime warehousing capacity, despite the basic conditions of most Zagreb facilities, with modest levels of warehouse automation. Meanwhile, there have been significant investments in storage capacity in neighboring countries (most notably Serbia, Hungary, and Slovenia) over the last five years. Adequate provision of modern warehousing capacity in a manner that balances demand and supply should be considered a prerequisite for Croatia to evolve into a regional logistics platform.

Source: World Bank *Doing Business* database; Colliers International; authors' analysis and research.

Labor costs account for the largest share of total storage costs (Figure 4.12). This is followed by infrastructure-related costs (warehouse renting/leasing, utilities, and other costs). They fluctuate to some degree and the figure below shows average values.

Defining and monitoring KPI levels of warehousing operations in companies that monitor them has resulted in increased performance of warehousing processes and boosted their market competitiveness (similar to transport carriers). The KPI levels set by logistics service providers in the market are comparable to those in peer EU markets, serving as a reference point that foreign companies apply on the domestic market.

FIGURE 4.12.
Breakdown of Storage
Costs by Category



Source: 2019–2020 World Bank–University of Zagreb Survey of Croatia-based Logistics Stakeholders.

³⁶ As early as 2016, Serbia's ranking in the ease of administrative compliance related to new warehousing development was 139th out of 190 countries, compared to 9th ranking globally in 2020.

Companies in the storage segment have implemented environmental measures that help reduce energy consumption (environmentally friendly lighting, thermal insulation, etc.) and have a significant effect on cost reduction. With regard to the sustainability dimension, the survey respondents emphasize that there are no incentives to introduce environmentally friendly systems in the storage segment. The quality of service is actively measured by monitoring different KPIs. The following key performance indicators of logistics services are monitored continuously: collection time, collection accuracy, quantity of orders received per operator and item, and the number of incoming shipments per hour. This is not the practice of smaller domestic companies.

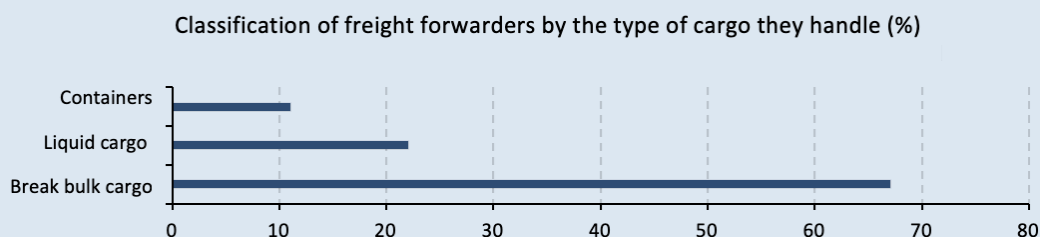
CUSTOMS CLEARANCE AND FREIGHT FORWARDING SERVICES

Freight forwarding service providers organize the distribution and transportation of goods in international, often intercontinental, supply chains, for goods with destinations in or through Croatia. About half of survey respondents primarily engaged in freight forwarding services use maritime container transport in the distribution process. Their port of entry is the port of Rijeka and these respondents have stated that the service level (at the container terminal) is satisfactory. This assertion should be considered in context: the volume of business they do using containers accounts for a small portion of their operations, ranging from 100 to 2,500 TEU per year. **The most important elements that make Rijeka's container terminal competitive to these end-users are travel time, container handling speed at the terminal, and the preparation time for road transport.**

Logistics service providers transporting goods by rail have highlighted as a problem a limited number of shunting operations, which slows the shipping of containers by rail. Respondents did not identify infrastructure limitations in road transport. The respondents also stated that certain port terminals (such as bulk and general cargo terminals) are inadequate because they are technologically outdated. For example, the bulk cargo terminal at the Rijeka port does not comply with environmental standards because it does not have a dust elimination system and the condition of the railway infrastructure at the terminal is also poor. A revamping project started in 2020 with the aim of introducing new technologies and increasing the transshipment capacity of the terminal.

In the freight forwarding segment companies are mostly engaged in organizing road transport, followed by rail, air, and sea transport. In terms of cargo types, the respondents are primarily engaged in organizing the transport of break bulk cargo, followed by liquid bulk and containerized cargo (Figure 4.13). The majority of freight forwarders in the Croatian market do business with the countries of the former Yugoslavia outside the EU (70%), 60% of them do business with EU member states, and 40% do business with countries outside the EU and Europe.

FIGURE 4.13.
Business Activities of Freight
Forwarders by Type of Cargo



Source: 2019-2020 World Bank-University of Zagreb Survey of Croatia-based Logistics Stakeholders.

FIGURE 4.14.
Services Most Often Requested
from Freight Forwarders



Source: 2019-2020 World Bank-University of Zagreb Survey of Croatia-based Logistics Stakeholders.

In terms of the type of service that freight forwarders provide to their customers, import customs clearance is the most represented service; export customs clearance and transport organization are equally represented (66.7%), followed by logistics services (44.4%) and special cargo transport (33.3%), while trade show operations are under-represented or not represented at all (Figure 4.14).

Since Croatia joined the EU, freight forwarders have diversified their service offering. Companies have expanded their businesses into the trading sector and started providing Intrastat reporting and distribution services in the domestic market. Intrastat³⁷ has proven to be an important system for collecting statistical data about goods exchange among EU member states. Freight forwarding prices are competitive with those in the EU market, and there is evident segmentation among freight forwarders in developing services of higher quality in aspects of their operations, e.g., livestock transport, trade shows, oversize cargo transportation, etc. Market competition requires freight forwarders to offer more specific services in order to stand out in a competitive market.

The customs system (organization and mode of operation) was assessed positively by most respondents. The benefits of Croatia's accession to the EU can also be seen in terms of customs operations: standard customs procedures are carried out quickly and the system has been harmonized with that of other EU countries. Some respondents noted that certain procedures and documents could be better aligned with operations, but improvement is expected as practices are further aligned with EU procedures.

Although some respondent did note a lack of uniformity in standards across customs offices, the overall assessment is that the system and organization of the Customs Service has become more efficient over the past five years. The respondents mentioned inspection bodies as an exception, noting that they could be more flexible in terms of working hours, operating capacity and availability so as not to cause delays, which frequently occur. Further, they noted that inspection bodies perform repeated monitoring without a specific reason, thus negatively impacting the flow of goods, and added that in neighboring EU countries this is not an issue, since their inspection bodies are significantly more efficient and flexible, and have longer working hours.

When asked about possible improvements to doing business in the market, respondents pointed to the need for a simpler and more efficient business framework. For example, it was suggested that the number of duties and contributions should be reduced, and that the underdeveloped or non-complaint IT system at the level of the state administration should be addressed. Expanding business development financing options (loans, investors, banks) was highlighted. Additional staff training and education, especially at the middle management level, is considered an important element in improving the quality of service.

³⁷ Intrastat is the data collection system covering the trading of goods between EU member states. It was introduced by Commission Regulation (EEC) No 3330/91 and has been in force since 1993, when the single market was established and physical borders between member states were removed.

ENVIRONMENTALLY SUSTAINABLE LOGISTICS SYSTEMS AND PROCESSES

Environmentally friendly measures are applied in the Croatian logistics sector only to a limited extent. These are used as a targeted solution for cost reduction (for example, the use of energy-saving lighting or installation of solar panels at storage facilities have been mentioned), and the companies surveyed have not made significant efforts to actively implement processes and measures aimed at reducing their environmental footprint. The respondents did not exhibit particular interest in this topic. The only training cited in this context is eco-driving training aimed at reducing fuel consumption.

Environmentally friendly methods are not being used for the following reasons:

- Lack of knowledge on methods of application;
- Financial constraints; and
- Lack of incentives from state bodies.

Respondents indicated that they would consider purchasing electric vehicles depending on their financial situation. They note that co-financing of legal entities through relevant institutions should improve to encourage ecologically friendly logistics processes that are the foundation of green logistics.

The application of environmentally friendly logistics processes includes:

- Skills and knowledge concerning the introduction of environmentally friendly processes – not observed among the respondents;
- The procurement of environmentally friendly equipment/resources – not observed among the respondents.

The implementation of these measures could be achieved by co-financing the procurement of equipment such as solar panels, ventilation equipment, insulation, glass domes, sensors, electric vehicles and other environmentally friendly transport and handling resources.

Training needs pertain to process optimization, computerization, more careful equipment handling, and the implementation of simpler methods, such as sensor placement and ventilation. The level of development of the logistics system significantly affects the environment. To illustrate this point, top-quality IT systems can be used to measure and monitor the environmental impact of an observed process, while efficient collection of items in a warehouse will positively affect the emission of harmful gases. Incentives related to staff training, and to the co-financing of advanced technological solutions (compared to the ones currently present in the market) would lead to systematic change in logistics processes towards green and sustainable operations.

Green logistics covers several areas of activity and respondents were asked about the following:

- *Reducing the environmental impact of transport* – external costs are not measured, and a decrease in the number of shipments made is only related to cost-effectiveness. Reducing the environmental impact of transport is based on three concepts: reducing the number of shipments/moves, switching to other means of transport, and optimizing vehicle utilization. The European Commission has noted the need to gradually break the link between economic growth and an increase in transport. In addition to the efficient use of fuels and reduced emissions of hazardous exhaust gases, environmental protection requires the application of more radical measures, such as reducing freight transport in general.

- *City logistics* – 15% of business entities are considering the purchase of electric vehicles, but no incentives are currently in place. Furthermore, in the cities there are none of the many potential urban logistics solutions that have been implemented in developed countries.
- *Reverse logistics* – respondents abide by this legal obligation and apply reusable packaging models, but are motivated by cost reduction rather than environmental considerations.
- *Logistics as part of corporate strategies on environmental impact* – 80% of the respondents do not have corporate strategies in place concerning the environmental impact of business operations; international companies present in the domestic market have these strategies in one form or another.
- *Green supply chain management* – not observed among respondents.

Low awareness of green and sustainable logistics systems is the biggest weakness of the logistics sector in this area. It has been observed in the Croatian logistics market that management is in some cases complacent; that it considers all advanced solutions resolved, all operational procedures adequate, the technology entirely satisfactory, and that training on environmental issues is superfluous to their core business. A limited number of logistics managers available in the market and rotated among businesses, and the rudimentary level of operations provided, results in a reduction of the quality of the overall Croatian logistics sector. Training and institutional support to applicable projects may encourage the development of the logistics sector and promote its technological advancement and competitiveness, with the ultimate objective of laying the groundwork for a sustainable logistics system.

CHAPTER 5

Policy Recommendations

CHAPTER 5

Policy Recommendations

Based on the evidence presented in the preceding chapters, the following policy and decision-making recommendations should help increase Croatia's logistics competitiveness and environmental sustainability as a means, ultimately, to increase the dynamism and resilience of the Croatian economy.

- 1. To make the most out of its ongoing expansion in container handling, vessel handling, and rail and road last-mile connectivity capacity, the Port of Rijeka—and the Government of Croatia—should expand its rail hinterland connectivity, particularly in terms of itinerary connections across Central Europe beyond Budapest, while significantly raising the port's market profile as a European gateway.** The Port of Rijeka has invested in infrastructure and service delivery improvements. Yet volumes are still modest and the port is only 50% utilized, even as a new container terminal is slated to come online in the short term. Meanwhile, freight forwarders consulted as part of this report's data gathering inputs for Chapter 3 were largely unaware of intermodal logistics services between the Port of Rijeka and Central Europe, and current direct intermodal services to the Central European hinterland only service Budapest. This reduces Rijeka's competitiveness relative to other ports serving this large and diverse hinterland. As a new container terminal comes online, Croatia cannot afford to rely on a 'build it and they will come' approach; not in a market as competed over as that of containerized freight to/from Central Europe. This will require an active customer acquisition strategy and a strategy to develop partnerships with carriers and logistics service providers, such as the ongoing collaboration with the COSCO shuttle. Ideally, these efforts should not only be conducted by the port authority in coordination with the terminal operator(s), but should also include a new level of engagement with MSTI, the City of Rijeka government, and other stakeholders in national and local government.
- 2. The process of deciding how to expand railway capacity in the most technically demanding portions of the all-important Rijeka–Zagreb railway corridor, e.g. the Karlovac–Škrlevo segment, is as important as the investment decision that is ultimately made.** The key stakeholders of this process—PRA, container terminal operators, HŽI, HŽC, private railway undertakings, MSTI, rail line end-users, key academic experts, and others—should be allowed to participate in the planning process. Evidence-based and scenario-based options should be considered, and a range of possible solutions should be compared. The process should consult the general public and it should reflect Croatia's national aspirations and risk profile.
- 3. Croatia should elevate the importance of logistics within its institutional practice by supporting *intra*-ministerial, *inter*-ministerial, and public-private mechanisms for collaboration and coordination in transport and logistics planning and policy making.** Logistics is multidisciplinary by nature, and international experience shows that the countries that attain better logistics performance typically do so on the basis of integration in planning and policy making: integration across modes, geographies, levels of government, and service types. These countries support this integration function through institutional mechanisms that overcome, or at least better empower, existing modal and sectoral silos in the public administration function.

For example, Germany's Federal Ministry of Transport and Digital Infrastructure (MTDI), while modally organized in a similar fashion as MSTI, assigns responsibility for logistics to its Policy Issues Directorate-General, a sub-agency at the same organizational level as that of the modally-defined general directorates (Germany is ranked as the highest-performing country in the world in international logistics by the World Bank's LPI standard). Furthermore, under Germany's Freight Transport and Logistics Masterplan, the country established a Federal Government Coordinator for Freight Transport and Logistics with the responsibility of facilitating collaboration between MTDI and other ministries involved in logistics, such as the Federal Ministry of Economics and Technology and the Federal Ministry for the Environment, Nature Conservation, and Nuclear Safety. This latter coordinating institution then supported the adoption, and update over time, of a Freight Transport and Logistics Action Plan, which in turn received strong input from private sector actors, including individual firms and trade associations, environmental groups, and trade unions.

Elsewhere in the EU, the Government of Greece has recently established the Government Committee for the Development of the Logistics Chain. This is a multidisciplinary coordination body comprised of senior government leadership at the national level, including the Deputy Minister of Development and Investment, Deputy Minister of Infrastructure and Transport, Deputy Minister of Environment and Energy (which includes the key issue of spatial planning), the Secretary General of Transport (Ministry of Infrastructure and Transport), and the Secretary General of Ports Policy and Maritime Investments (Ministry of Shipping and Island Policy). The Committee is responsible for the implementation of Greece's Transport Master Plan and Logistics Action Plan. Furthermore, Greece established the National Logistics Council, an institutional mechanism to promote collaboration between public sector, private sector, and academia in logistics, supply chain management, growth, and competitiveness. The Council, which comprises representatives from shippers, carriers, and logistics service providers, public sector agencies, and experienced academics, acts as a source of insight and as a sounding board on government interventions in the sector, such as the revamping of regulations or the preparation of investment plans.

Along similar lines, Australia has established a Transport and Infrastructure Council to, inter alia, "[integrate] national rail, road, aviation, port and maritime supply chains, and [improve] integration between land use and infrastructure planning".³⁸ This Council produced Australia's National Freight and Supply Chain Strategy and its associated National Action Plan. The Council introduced a national approach to the development of freight logistics in Australia, as it is comprised of ministers from Federal, state, and territory governments, and coordinates and engages with the private sector through its Industry Advisory Body.

The above vignettes from the international experience show that coordination in logistics should ideally go beyond the lead agency for transport at the national level (in Croatia's case, MSTI) and include other relevant ministries and agencies nationally and sub-nationally (collaboration between Port of Rijeka Authority, a part of MSTI, and the government of the City of Rijeka, is an example of this concept). Croatia has the opportunity to establish an institutional mechanism of coordination in planning and policy making in logistics to facilitate integrated infrastructure development and services delivery—integrated across modes, agencies, levels of government, geographies, and intended policy outcomes (including, for example, trade and competitiveness, environmental sustainability, resilience, and social and labor issues). Such an institution should ideally be empowered to engage across

³⁸ <https://www.transportinfrastructurecouncil.gov.au/about>. The Council's Terms of Reference are available at <https://www.transportinfrastructurecouncil.gov.au/sites/default/files/documents/council-terms-of-reference-2019.pdf>.

agencies based on leadership (Australia's Transport and Infrastructure Council, for example, is chaired by the Deputy Prime Minister, who is also Federal Minister for Infrastructure, Transport, and Regional Development). This institution can have a built-in mechanism for coordination with the private sector, such as an industry advisory board, similar to the role that Freight Advisory Committees play in the U.S. at both the national and sub-national levels.³⁹ The entity can lead Croatia to adopt a national logistics strategy that can reach deeper into logistics issues than the current Transport Development Strategy that, while clearly relevant and necessary, is wider in scope. And it can create the tools to keep track of progress over time. For example, as part of its National Freight and Supply Chain Strategy and Action Plan, Australia introduced and made public a Freight Performance Dashboard to measure progress quantitatively and show this visually.⁴⁰

- 4. The ease of doing business in the warehousing sector in Croatia, including the process for acquiring land for logistics purposes and for complying with all administrative procedures involved in building new warehousing facilities, should be improved as part of Croatia's effort to position itself as a regional logistics platform.** Multimodality, logistics hubs and platforms, and value-added logistics service provision all depend on the availability of adequate, competitively priced storage and handling capacity of modern standards, ideally organized within well-connected logistics clusters. Yet Croatia suffers from under-supply of prime warehousing capacity, and current compliance procedures disincentivize the provision of additional capacity in response to demand. Importantly, this process is prompting current investors already present in Croatia to consider investing and basing their distribution operations in other markets—most notably neighboring Serbia, which has positioned itself as a global leader in the ease of doing business associated with the construction of warehousing facilities. In addition to Serbia, Croatia underperforms all EU member states except the Czech Republic in terms of the number of procedures, time for compliance, cost of compliance, and building quality associated with the building of new warehouses. Turning this around should be at the core of any national strategy to position Croatia as a regional logistics hub.
- 5. Little is known about the disaggregated nature of the movement of freight in Croatia, which hampers decision making by private and public sector entities alike; the ongoing process of updating the NTM is an opportunity to turn this around.** Specifically, the survey(s) that will inform the model should be of greater depth of coverage than was the case for the existing model. The model structure should be simplified to facilitate its use. And in accordance with international good practice, the model should be made publicly available online, for use by the public sector, private sector, academia, and the general public.⁴¹
- 6. The dominant trucking sector has become more operationally efficient over time, but the age of the national truck fleet is a weakness; schemes to renew the fleet should be considered.** The disproportionate impact of trucking operations on local pollutant and GHG emissions, road safety outcomes, road infrastructure maintenance, and logistics costs have made a strong economic case in the international experience for governments to support the renewal of fleets as a means to address a market failure—insufficient access to credit by carriers, in particular SMEs and owner-operators. These are not simple schemes to run, and the international experience is mixed in the way they have been implemented. But reversing a trend towards the use of older equipment is an opportunity for Croatia to both stimulate a vital economic sector and making it more environmentally sustainable.

³⁹ See for example Blancas, Luis C. (2015), *Engaging the Private Sector in Transport and Logistics Planning and Policy Making*, World Bank.

⁴⁰ <https://www.freightaustralia.gov.au/freight-performance-dashboard>.

⁴¹ For an illustration of this experience, see the case of the U.S. Freight Analysis Framework, https://ops.fhwa.dot.gov/freight/freight_analysis/faf/.

- 7. Building on ongoing and further future work on feasibility studies and market assessments, the inland waterways of Croatia, which align with the country's lagging regions, should be developed as a means to provide basic connectivity between leading and lagging regions and as a component of broader economic development of these regions.** These investments are unlikely to be justified on financial grounds alone, but the broader economic benefits they can create, including intangible benefits like regional integration and collaboration, particularly in the Sava River basin, are likely to be of sufficient magnitude to justify public investment as these rivers, as shared natural resources, are public goods.
- 8. Eastern Croatian shippers of consumer goods and perishables would benefit from improvements in containerized transport and value-added warehousing and distribution services.** To spur economic activity in this region through lower-cost and more efficient access to market, a more granular analysis of shipper needs to and from this region should be conducted to promote the provision of containerized logistics operations.

ANNEX 1

Croatia's Subnational Logistics Markets

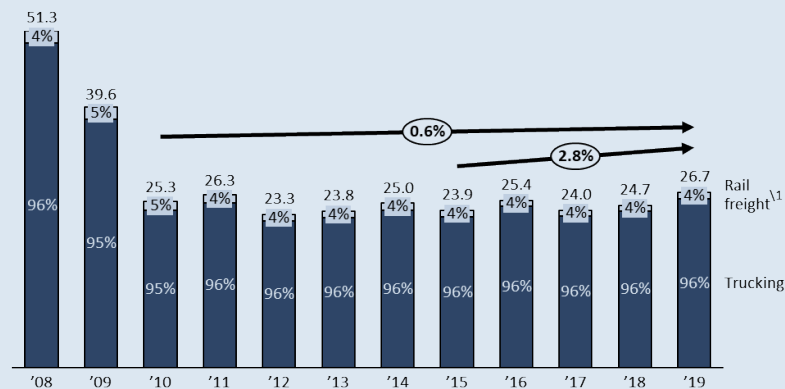
ANNEX 1

Croatia's Subnational Logistics Markets

FLOW OF GOODS IN THE ZAGREB HUB AREA

The Node of Zagreb is Croatia's most prominent subnational logistics market. For the purposes of this analysis, we define the Node of Zagreb area as comprising the City of Zagreb and Zagreb County. In 2019, nearly 27 million tons of freight moved through the Node of Zagreb, 96% of which were trucking flows, with the balance handled by rail freight (Figure A1.1).⁴² Freight activity in the Node of Zagreb has been growing at an average annual rate of 2.8% since 2015, with particularly solid growth (8.1%) in 2019 alone. However, when looked at from a longer-term perspective, freight volumes have been about flat since the 2009 global economic crisis, with an average annual growth rate of 0.6% over the 2010-2019 period.

FIGURE A1.1.
Freight Flows in the Node of
Zagreb by Mode, 2008-2019
Millions of tons

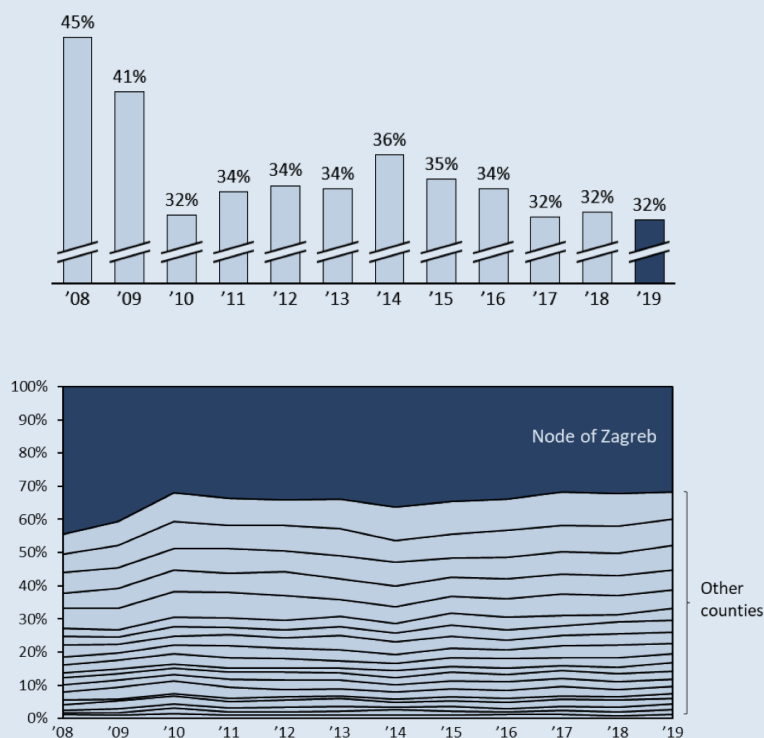


¹ Total loaded and unloaded rail freight tonnage.
Source: Croatian Bureau of Statistics; World Bank analysis.

Truck tonnage in the Node of Zagreb accounts for nearly a third (32%) of Croatia's overall county-level trucking activity (Figure A1.2). This is higher than Node of Zagreb's share of population (27%), and markedly down from the 45% it reached in 2008, prior to the 2009 global economic crisis. This is evidence that the spatial distribution of trucking activity in Croatia is less concentrated today than it was before the crisis. Outside of the Node of Zagreb, trucking activity is fairly evenly distributed across the rest of Croatia's counties.

⁴² In addition to trucking and rail freight flows, a small amount of tonnage in the Node of Zagreb was moved via air freight, accounting for 0.04% of total (not shown in Figure A1.1).

FIGURE A1.2.
Node of Zagreb Share
of Subnational Trucking
Flows, 2008-2019
In percent of total
subnational truck tonnage

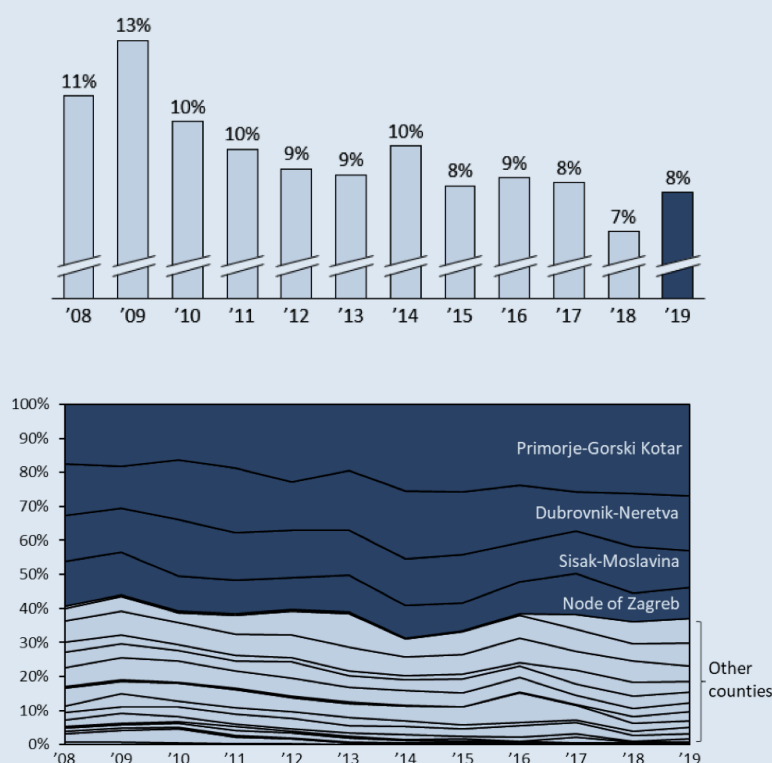


Source: Croatian Bureau of Statistics; World Bank analysis.

The Node of Zagreb's share of subnational rail freight activity—8% in 2019—is considerably lower than its share of trucking activity (Figure A1.3). This is due to the fact that Node of Zagreb is primarily an inbound market for rail freight, rather than a heavily outbound market or a balanced inbound-outbound market. The counties with the largest subnational freight rail activity by tonnage are all major sources of outbound flows: Primorje-Gorski Kotar County (where the city of Rijeka and Port of Rijeka are located), Dubrovnik-Neretva (where the county seat is the city of Dubrovnik), and Sisak-Moslavina County (where the county seat is the city of Sisak). All three of these counties account for a larger share of total subnational rail freight tonnage than the Node of Zagreb, which represents the fourth-largest subnational rail freight market. Outside of the top four, rail freight activity is fairly evenly distributed across most of the remaining counties.

The Node of Zagreb plays a key role in the distribution of freight flows nationally, but its economic impact at the regional level (e.g., Western Balkans and Central Europe) falls short of its geographic potential. The infrastructure bottlenecks in this area comprise primarily the condition of railway infrastructure (above all, the Rijeka-Zagreb-Hungary border main line). The Node of Zagreb is the central point from which distribution is organized across Croatia. The reason for this lies in the fact that population density is highest in the Zagreb area and that the purchasing power of its residents and the regional GDP significantly exceed the average values for Croatia as a whole. The level of demand in the Node of Zagreb (goods traffic of nearly 27 million tons in 2019) creates a need for increased warehousing capacity construction to match local distribution needs. Significant industrial capacity is sited in the Node of Zagreb area (food, industrial processing, and pharmaceutical industries), which also generate flows of goods (the City of Zagreb's total foreign trade in 2017 totaled EUR14 billion).

FIGURE A1.3.
Node of Zagreb Share of
Subnational Rail Freight
Flows, 2008-2019
In percent of total
subnational rail freight
tonnage



Source: Croatian Bureau of Statistics; World Bank analysis.

While warehousing and logistics capacities are located in several zones in the broader metropolitan area of Zagreb, this hub could play a more significant role at the regional level:

- By attracting operators whose business activities are regional (Slovenia, Hungary, Serbia, Bosnia and Herzegovina);
- By encouraging the construction of logistics parks in the broader Zagreb area, and by modernizing public warehouse capacity (e.g., container freight stations); and
- By encouraging the construction of a dry port for containers, which would enable the handling of containers from the Port of Rijeka.

FLows OF GOODS IN THE RIJEKA HUB AREA

The Port of Rijeka plays a key role in the flows of goods through the Rijeka hub and much of the rest of the country (and, increasingly, the region). It is also the most important inbound and outbound point in forming flows of goods in Croatia. In addition to the Port of Rijeka, the Rijeka hub covers Primorje-Gorski Kotar County, Istria County, and Lika-Senj County.

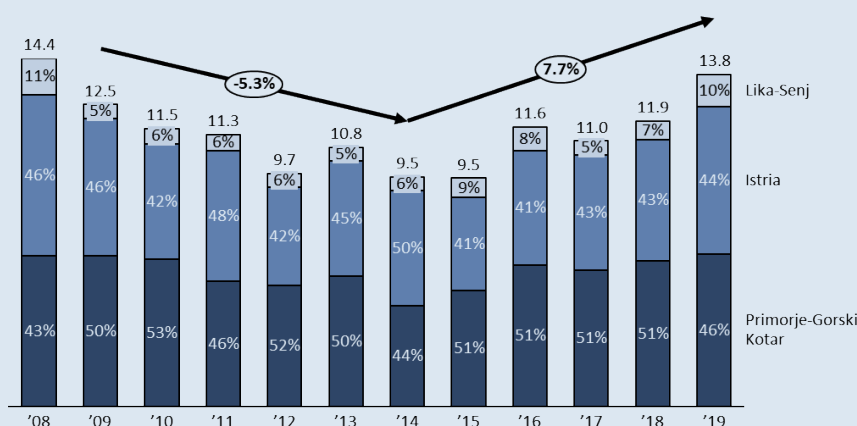
Brajdica/AGCT is the most important terminal in the context of international flows of goods. Container traffic takes place at the container terminal of the Port of Rijeka, which is located in the Sušak Basin. The terminal's theoretical annual capacity is about 600,000 container units (TEU), with the current level of utilization of terminal capacity (2019) at about 50%. Since 2015, container traffic at the Port of Rijeka has exceeded the level of 200,000 container units, and in 2019, for the first time, the level of 300,000 container units, as a result of several factors: (i) concessionaire activities related to the modernization of the terminal through

investment into front apron additions and transshipment mechanization; (ii) attracting major container operators to the Port of Rijeka; (iii) increasing the terminal's capacity while investing in supporting infrastructure (construction of the D404 road, construction of a marshalling yard). In addition to the above we must take into consideration the general trend of growing demand for consumer goods in the main countries gravitating towards the Port of Rijeka (Hungary, Slovakia, Czech Republic, Austria, and Serbia).

Truck tonnage in the Rijeka hub area has closely followed the broader economic activity of Croatia, further confirming the importance of the Port of Rijeka at the national level. Specifically, after several years of decline in truck volumes during the 2009–2014 recession, truck tonnage in the region has recovered to the point of nearly reaching its pre-recession level, with an average annual growth rate of 7.7% between 2014 and 2019 (Figure A1.4). This was also a period of expansion, modernization, and volume growth at the Port of Rijeka.

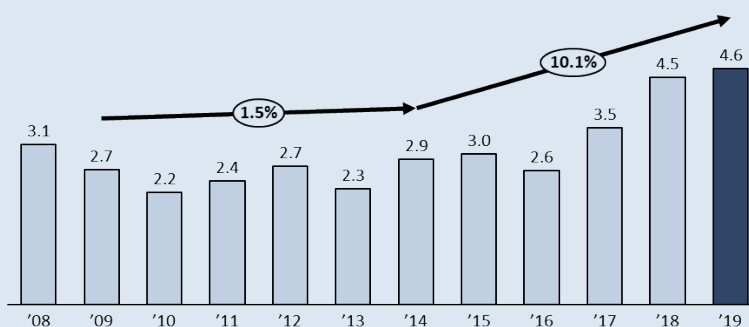
Rail freight tonnage in the Rijeka hub shows similar historical patterns as those of truck tonnage: modest growth during the recession years (1.5% average annual growth rate for 2009–2014) followed by rapid recovery thereafter (Figure A1.5). As a result, in part, of significant improvements in last-mile rail intermodal connectivity at the Port of Rijeka, in 2019 rail freight tonnage at the Rijeka hub was well above pre-recession levels.

FIGURE A1.4.
Trucking Freight Flows
in the Rijeka Hub Area,
2008–2019
Millions of tons



Source: Croatian Bureau of Statistics; World Bank analysis.

FIGURE A1.5.
Rail Freight Flows in the
Rijeka Hub Area, 2008–2019
Millions of tons



Source: Croatian Bureau of Statistics; World Bank analysis.

Most of the national logistics service providers whose activity is the distribution of goods in this area have no significant warehousing capacities, and distribution is organized in a capillary manner through cross-dock terminals. Given the relatively small number of residents there is no need for the construction of major warehousing capacity for local distribution. Although the tourism industry is highly developed in the Rijeka hub area, even this segment is insufficient to foster the construction of significant logistics capacity in the area that would be linked to local distribution. Other industrial capacities in the Rijeka hub are also not a significant generator of flows of goods. Major warehousing capacity is sited in the Škrlevo zone, where about 50,000 m² of indoor warehouse area and about 300,000 m² of outdoor warehouse area have been built.

This hub could play a more significant role at the national level:

- By strengthening the role of the Port of Rijeka through continued growth in the handling of inbound and outbound flows of goods and by increasing the number of/attracting operators whose business activities are related to the flows of goods through the Port of Rijeka;
- By better positioning the Port of Rijeka in northern Adriatic container transport; and
- By strengthening the industrial component in Primorje-Gorski Kotar County (wood and other industries), and by attracting operators with logistics support for these industrial activities.

FLOW OF GOODS IN THE OSIJEK-VINKOVCI HUB AREA

There are two zones gravitating to the Vinkovci logistics hub:

- The local zone gravitating to the Vinkovci hub: Vukovar-Syrmia County, Osijek-Baranja County, Slavonski Brod-Posavina County, and Požega-Slavonia County (Figure A1.6); and
- The broader zone gravitating to the Vinkovci hub (up to 400 km from the hub's center: southern Hungary, northern and central Bosnia and Herzegovina, central and northern Serbia).

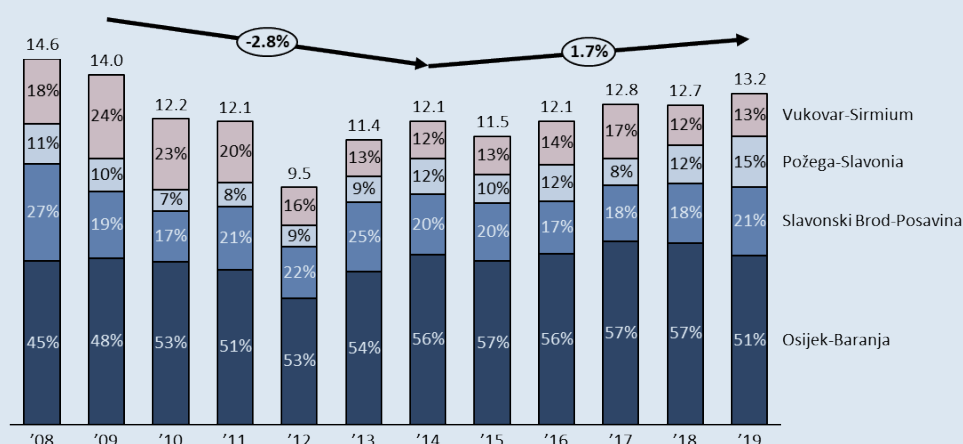
In the Osijek-Vinkovci hub area the road and railway routes of local (intercity and intercounty) significance and international significance (Corridor X) intersect. The infrastructure bottlenecks in this zone are primarily related to the condition of railway infrastructure (the Vinkovci–Vukovar connection and the Zagreb–Vinkovci–Serbian border main line). In addition to land transport, there are also opportunities for the reception of cargo transported by air as Osijek Airport is located in the wider Vinkovci hub area. The town of Vinkovci lies near the Danube River, an important transport corridor (Corridor VII) that connects central and western European countries with the Black Sea. The Port of Vukovar is Croatia's most important inland waterway port and the only one in the country that sees significant transshipment of goods.

Both trucking and rail freight tonnage in the Osijek-Vinkovci Hub Area have been growing only modestly (below 2% per year) in the period since the end of the 2009–2014 recession (Figure A1.6 and Figure A1.7). For both modes total tonnage is yet to recover the levels reached in 2008. Goods transport in zones gravitating to the Vinkovci hub relies primarily on transport by road over small, medium, and long distances. Freight rail has been on a stagnant trend in recent years.

The Osijek-Vinkovci hub area offers small scale publicly and privately-owned warehouse capacity used for goods heading for local markets.

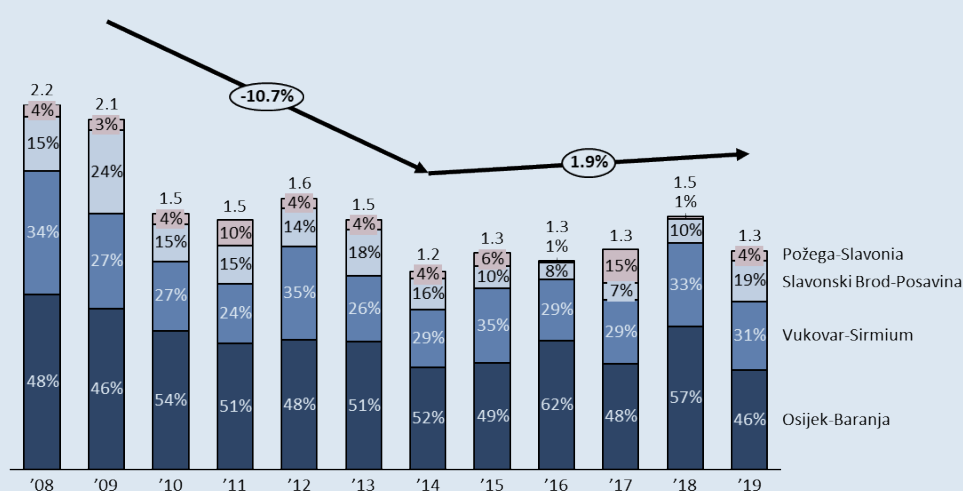
The Osijek-Vinkovci hub currently has no significant role in the flows of goods at the national level. The Port of Vukovar is the only major logistics hub in this area and its activities are mostly related to freight from neighboring Bosnia and Herzegovina. Most of the national logistics service providers in this area have no significant warehouse capacity and distribution is organized in a capillary manner through cross-dock terminals. The reason for this lies in the fact that the quantity of goods and the level of demand are relatively low in this area as a result of low population density and modest industrial capacity that does not generate significant

FIGURE A1.6.
Truck Tonnage in the
Osijek-Vinkovci Hub Area by
County, 2008-2019
Millions of tons



Source: Croatian Bureau of Statistics; World Bank analysis.

FIGURE A1.7.
Rail Freight Tonnage in the
Osijek-Vinkovci Hub Area by
County, 2008-2019
Millions of tons



Source: Croatian Bureau of Statistics; World Bank analysis.

flows of goods. In these circumstances the role of the Port of Vukovar is not primarily related to the narrow zone that gravitates to it, i.e. the Osijek-Vinkovci hub area; rather, it serves as an entry and exit port for Bosnia and Herzegovina and certain industrial entities in Croatia (Petrokemija Kutina, Končar Transformers, etc.).

This hub could play a more significant role at the national level:

- By strengthening the role of the Port of Vukovar through the handling of inbound and out-bound flows of goods, and by increasing the number of/attracting operators whose business activities are related to the flows of goods through the Port of Vukovar;
- By strengthening the industrial component in the area (wood, food, and other industries) and by attracting operators with logistics support for these industrial activities;
- By building logistics capacity intended for the logistics support of the broader region (Bosnia and Herzegovina, southern Hungary, Serbia) and attracting operators having an interest in this business segment;
- By using and developing the cargo terminal at Osijek Airport;
- By building specialized warehouse capacity for the food or wood industry; and
- By building indoor warehouses at the Port of Vukovar area.

FLOWS OF GOODS AT THE PORT OF PLOČE

The Port of Ploče is situated on the southern Adriatic coast in a natural bay protected by the Pelješac peninsula. The bay's depth of 13.8 m is sufficient for the reception of large cargo ships. Like the Port of Rijeka, it benefits from a favorable geographic position in the Adriatic. The areas gravitating to the Port of Ploče are Bosnia and Herzegovina (primarily), Montenegro, Serbia, and Southeastern Croatia.

The Port of Ploče is a multipurpose port divided into eight terminals for the handling of several types of goods. The terminals offer professional services at all levels, including goods warehousing, freight forwarding and other port services. A new container terminal was opened in 2011 offering transshipment of 20' and 40' containers, refrigerated, and other special containers. Utilization of the container terminal handling capacity of 66,000 TEU is about 30% at present.

While the area gravitating to the Port of Ploče to a certain extent overlaps with that gravitating to the Port of Rijeka, the Port of Ploče is primarily oriented to the markets of Bosnia and Herzegovina (about 90% of cargo traffic and 98% of container traffic), due to proximity and alignment of commodity types (primarily bulk commodity shipments). Considering current transport volumes, the container traffic volumes at the Port of Ploče do not represent a significant contribution to the volume of overall containerized flows in Croatia.

FLOWS OF GOODS IN THE VARAŽDIN-ČAKOVEC HUB AREA

The zone gravitating to the Varaždin-Čakovec hub covers Varaždin County and Međimurje County in northern Croatia. In terms of population and the concentration of economic operators, Varaždin County is one of Croatia's medium developed areas. In the Varaždin-Čakovec hub area there are significant public and private warehouse capacities used for goods intended for the local area.

The Varaždin-Čakovec hub has no significant role in the flows of goods. The infrastructure bottlenecks in this zone are primarily related to the condition of railway infrastructure (the Zagreb-Varaždin-Čakovec connection). Most of the national logistics service providers in this area have no significant warehouse capacity intended for distribution, such that distribution is capillary from central warehouses located in the Zagreb hub area. The reason for this lies in the fact that the quantity of goods and the level of demand are relatively low in this area as a result of low population density.

Despite the significant industrial capacity in this area there are few industrial entities important at the national or regional level.

This hub could play a more significant role at the national level:

- By further strengthening the industrial component in the area and attracting operators with logistics support for these industrial activities; and
- By building logistics capacity intended for the logistical support of the broader region (southern Hungary, Slovenia) and attracting operators having an interest in this business segment.

ANNEX 2

Technical Features of Croatia's National Transport Model

ANNEX 2

Technical Features of Croatia's National Transport Model

BUILDING BLOCKS OF THE NATIONAL TRANSPORT MODEL

The NTM comprises 1,273 traffic zones, not including outer zones. This makes it necessary to aggregate data at some meaningful level to facilitate the analysis. As such, we aggregated these traffic zones into 6 regions, consistent with those of Croatia's Transport Development Strategy (Figure A2.1):

- Central Croatia;
- Eastern Croatia;
- North Adriatic with Lika region;
- North Dalmatia;
- Central Dalmatia; and
- South Dalmatia.

The model also comprises *outer zones* for each European country (Figure A2.2), and *external zones* for the rest of the world, given that freight transport transit flows and import/export flows are a critical part of the overall freight picture—especially for a country like Croatia where transit logistics account for the majority of freight movements.

FIGURE A2.1.
Functional Regions of Croatia



Source: World Bank analysis.

FIGURE A2.2.
Outer Zones of European
Countries in the National
Transport Model



Source: Croatia NTM.

NTM INPUT DATA

Preparation of the NTM was informed by field surveys that captured demand-supply data on the ground. Specifically, the Ivo Pilar Institute of Social Sciences conducted a survey on the drivers of modal choice in freight planning. The specific objectives of the survey were to collect information on origin and destination of major freight transport flows, vehicle type usage, commodity types, and distance traveled/length of haul. The analysis also included the general description of captured shipments: vehicle type, reason for modal choice, type of origin and destination, national or international transport, distance traveled, time traveled, number of legs/consignees, type of goods, type of packaging, weight of transported goods, and categories of dangerous goods.

The sample was selected from the Croatian Company Directory provided by the Croatian Chamber of Economy. Overall, 400 firms were asked to participate in the survey, though only 37 respondents completed the questionnaire. In total, the characteristics of 220 shipments were described through the questionnaire. Findings from the analysis indicate that the dominant choice of vehicle in the sample was light goods vehicle (up to 3.5 ton payload). The most frequent reason cited for the choice of a certain type of vehicle was time savings (36%), followed by cost (28%) and reliability considerations (27%). Warehousing/storage facilities were the most common type of origin and destination, while the three most dominant categories of transported goods were mixed goods (31%), fertilizer and chemical products (30%), and wood and paper products (18%). As shown later, results from the full-blown NTM freight model arrive at a different list of transported goods by volume. A sample of only 37 companies for the whole of Croatia that responded to the questionnaire is a limitation of the model from the start, as this limited sample may not have been fully representative of national markets.

The data available to calculate external freight flows was taken from national and international trade statistics. The following sources of data to establish the model for external freight flows (import, export and transit) were used:

- UN Comtrade—provides freight flows between approximately 200 countries or country groups; and
- Croatian Bureau of Statistics (CBS)—provides import and export flows between Croatia and other countries.

The relevant road network for Croatia included in the model comprises the entire national network (motorways, state roads, county roads, and local roads) and the major urban road network (city avenues, main streets, streets, and residential streets). The total length of all relevant road network is almost 30,000 km (Figure A2.3).

In addition, about 2,550 km of railway lines of importance to international, regional, and local transport were included from the relevant railway network (Figure A2.4). Of this, around 2,300 km are single track and 900 km are electrified. The railway system contains 231 main stations and 299 local stops. Timetables for passenger and freight trains were implemented directly from the Siemens ROMAN system managed by HŽ Infrastructure Ltd, Croatia's public railway infrastructure manager.

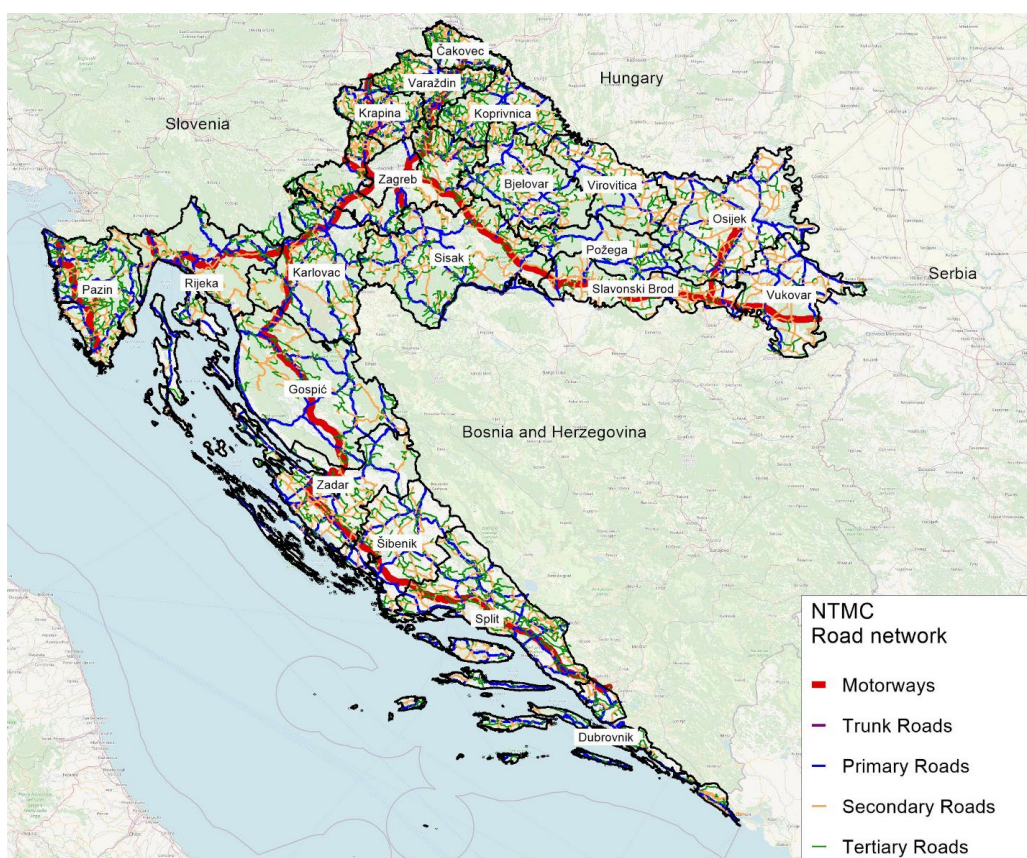
The model's maritime network representation includes 24 ferry and 25 boat lines connecting 96 ports. The lines are operated by 13 operators, of which the largest is the state-owned enterprise Jadrolinija Ltd. The maritime lines connect all islands with the mainland.

DEVELOPMENT OF THE FREIGHT MODEL

The freight model follows a disaggregated approach to calculating freight volumes. Since freight transport as a whole is a complex and heterogeneous process, it has been divided into 50 different commodities for model calculation. The commodity types range from agricultural goods to raw materials, oil products, industrial products, construction materials, and consumer goods.

Modal freight trip matrices were calculated with a commodity-based, multi-modal model using a four-step approach. These steps were calculated separately for each commodity to consider their specific characteristics regarding freight generation, distribution, mode choice, and assignment. In the first step, the generated tonnage flows for 50 commodities were determined, and in the second step the commodity-specific volumes were distributed between traffic zones. After splitting the tonnage flows to different transport modes, they were assigned to the multimodal transport infrastructure network.

FIGURE A2.3.
Road Network in the
Modeled Area



Source: Croatia NTM.

FIGURE A2.4.
Railway Network in
the Modeled Area



Source: Croatia NTM.

Import and export volumes by commodity type for each country partner were determined from UN Comtrade statistics and national import and export statistics. Local production and consumption indicators were either given by statistics, calculated by multiplying land use data and cargo generation-attraction factors, or determined by the balance between local production/imports and local consumption/exports. Main sources for local production were EU data (e.g., for agriculture and food commodities, manufactured goods, and similar products), FAO statistics (e.g., wood and wood products), and the Mineral Industry Yearbook (e.g., raw materials, energy).

Total transport costs, which are the determining factor for the model's route and modal split assignment, consist of time costs (mode-specific time related costs and commodity-specific losses in value), distance costs (mode-specific distance related transport costs), and handling costs (costs for loading/unloading and transshipment). The tonnage flow matrices of each commodity were assigned to the multimodal network with an iterative equilibrium assignment procedure.

ANNEX 3

Origin-Destination-Commodity Freight Flows in Croatia

ANNEX 3

Origin-Destination-Commodity Freight Flows in Croatia

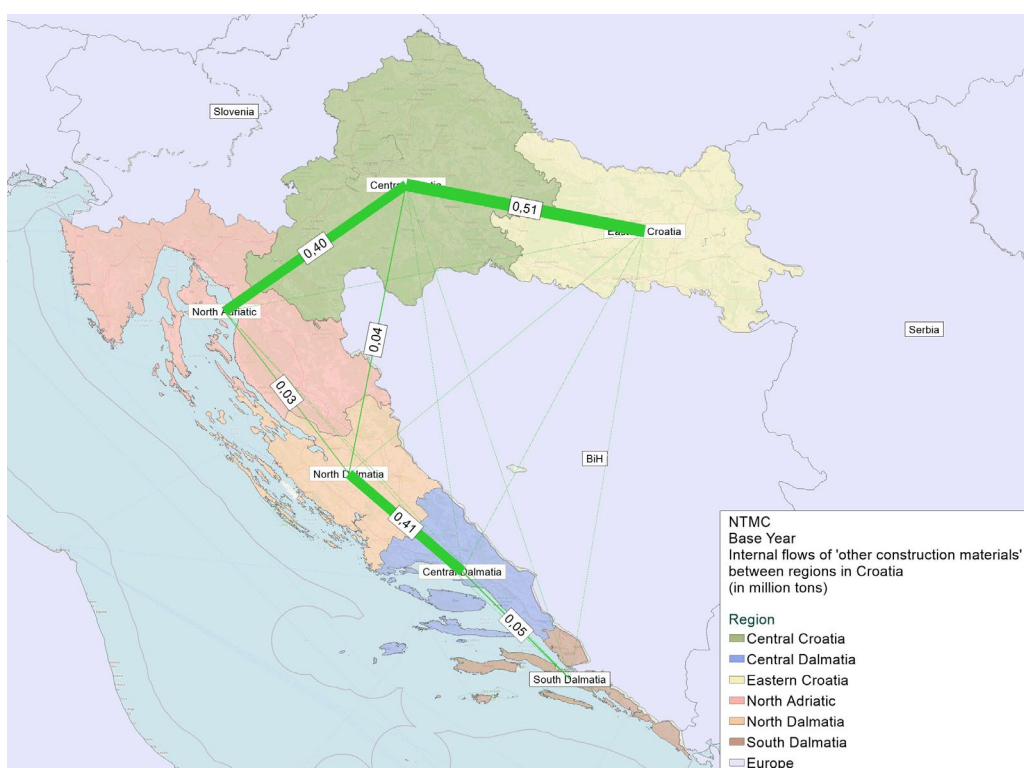
The highest-volume commodities transported between and within Croatian regions in the Croatian domestic freight market are:

1. Other construction materials – 12.5 million tons
2. Other consumer goods – 7.3 million tons
3. Other goods – 3.4 million tons
4. Oil products – 3.4 million tons
5. Raw wood – 2.8 million tons
6. Chemical products – 2.7 million tons
7. Cereals – 2.6 million tons.

In addition, food products are the fifth most transported commodity in Croatia by tonnage when international as well as purely domestic flows are considered.

OTHER CONSTRUCTION MATERIALS

FIGURE A3.1.
Internal flows of
'Other Construction
Materials' Between
Croatian Regions



Source: Croatia NTM; World Bank analysis.

Figure A3.1 (above) and Table A3.1 (below) show that most of the flows are internal inside the regions, especially the Central Croatia region. The largest flows of other construction materials between regions is from Eastern Croatia to Central Croatia, at 0.4 million tons (0.51 million tons in both directions).

TABLE A3.1.
Internal Flows of 'Other
Construction Materials'
Between Croatian Regions

From	To	Millions of tons
Central Croatia	Central Croatia	6.14
North Adriatic	North Adriatic	1.65
Eastern Croatia	Eastern Croatia	1.60
Central Dalmatia	Central Dalmatia	1.12
North Dalmatia	North Dalmatia	0.43
Eastern Croatia	Central Croatia	0.40
North Dalmatia	Central Dalmatia	0.32
North Adriatic	Central Croatia	0.29
Central Croatia	North Adriatic	0.12
Central Croatia	Eastern Croatia	0.11
South Dalmatia	South Dalmatia	0.09
Central Dalmatia	North Dalmatia	0.09
North Dalmatia	Central Croatia	0.03
South Dalmatia	Central Dalmatia	0.03
North Dalmatia	North Adriatic	0.02
Central Dalmatia	South Dalmatia	0.02
North Adriatic	North Dalmatia	0.01
Central Croatia	North Dalmatia	0.01

Source: Croatia NTM; World Bank analysis.

Tables A3.2 and A3.3 and Figure A3.2 expand this analysis to include freight moved not only between Croatian regions alone, but also between Croatian regions and neighboring countries. Specifically, Table A3.2 shows the 10 largest origins and 10 largest destinations of 'other construction materials' as the most transported category of goods in Croatia. It does not present OD pairs, which are shown in Table A3.3 and Figure A3.2.

Among the 10 largest origins, the largest share of transported other construction materials, 3.4 million tons per year (68.4%), has its origin in Central Croatia, 792,264 tons/year in the North Adriatic region (15.7%), 544,245 tons/year in Eastern Croatia (10.8%), and 260,974 tons/year in Central Dalmatia (5.2%). In Table A3.3, the 10 largest OD pairs of 'other construction materials' between the Croatian regions or with neighboring countries are shown. The internal flows in Central Croatia dominate with 6.14 million tons, followed by the North Adriatic region with 1.65 million tons.

Among the 10 largest destinations, the largest share of transported other construction materials, 1,000,740 tons/year (53.7%), has its destination in Central Croatia, 267,610 tons/year in Italy (14.4%), 265,470 tons/year in Eastern Croatia (14.2%), 186,140 tons/year in the North Adriatic region (10.0%), and 143,362 tons/year in Slovenia (7.7%).

TABLE A3.2.
Ten Largest Origins and
Destinations of 'Other
Construction Materials'

Origin municipality	Origin Region	Other Construction Materials		Destination Region	Freight volume (tons/year)
		Freight volume (tons/year)	Destination municipality		
Region	Central Croatia	1,070,020	Vrbik, Zagreb	Central Croatia	460,872
Pazin	North Adriatic	792,264	Sveti Duh, Zagreb	Central Croatia	215,877
Samobor	Central Croatia	653,629	Lokve	North Adriatic	186,140
Bedekovčina	Central Croatia	624,178	Donja Dubrava – sjever, Zagreb	Central Croatia	175,108
Ljeskovac	Central Croatia	499,779	Ivanić-Grad	Central Croatia	148,884
Novi Marof	Central Croatia	321,837	Osrednjeslovenska	Slovenia	143,362
Zaprešić	Central Croatia	287,200	Napoli	Italy	135,532
Lipik	Eastern Croatia	278,835	Industrijska četvrt, Osijek	Eastern Croatia	133,892
Zeleno Polje	Eastern Croatia	265,411	Milano	Italy	132,078
Pučišća	Eastern Croatia	260,974	Kanovci, Vinkovci	Eastern Croatia	131,578
TOTAL		5,054,124			1,863,322

Source: Croatia NTM; World Bank analysis.

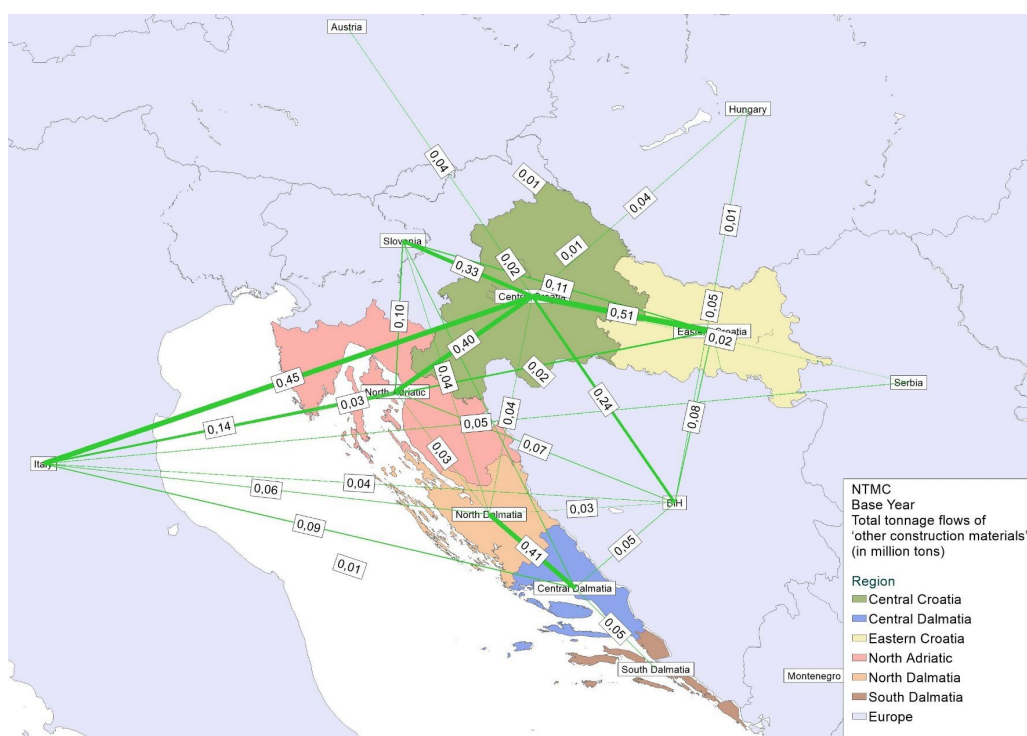
The largest OD tonnage volumes of other construction materials are between Central Croatia and Eastern Croatia, the North Adriatic, Italy, and Slovenia (Figure A3.2). Transport between Central Dalmatia and North Dalmatia is also notable. Significant values are between Bosnia and Herzegovina and Central Croatia, Central Dalmatia and Italy, and the North Adriatic region and Italy. Less significant values are seen between Eastern Croatia and Slovenia, and Eastern Croatia and Hungary.

TABLE A3.3.
Ten Largest Regional OD Pairs of
'Other Construction Materials'

No.	From	To	Millions of tons
1	Central Croatia	Central Croatia	6.14
2	North Adriatic	North Adriatic	1.65
3	Eastern Croatia	Eastern Croatia	1.60
4	Central Dalmatia	Central Dalmatia	1.12
5	North Dalmatia	North Dalmatia	0.43
6	Eastern Croatia	Central Croatia	0.40
7	Central Croatia	Italy	0.38
8	North Dalmatia	Central Dalmatia	0.32
9	North Adriatic	Central Croatia	0.29
10	Central Croatia	Slovenia	0.26

Source: Croatia NTM; World Bank analysis.

FIGURE A3.2.
Desire Lines of Largest Values of
'Other Construction Materials'
Between Croatian Regions and
Neighboring Countries



Source: Croatia NTM; World Bank analysis.

OTHER CONSUMER GOODS

Most of the flows of other consumer goods are intraregional, especially in the region of Central Croatia (Table A3.4). The largest flows of other consumer goods between regions is from the North Adriatic region to Central Croatia at 0.16 million tons (0.21 million tons in both directions) (Figure A3.3).

TABLE A3.4.
Internal flows of 'Other
Consumer Goods' Between
Croatian Regions

From	To	Millions of tons
Central Croatia	Central Croatia	4.36
North Adriatic	North Adriatic	0.88
Central Dalmatia	Central Dalmatia	0.66
Eastern Croatia	Eastern Croatia	0.46
North Dalmatia	North Dalmatia	0.23
North Adriatic	Central Croatia	0.16
North Dalmatia	Central Dalmatia	0.11
Eastern Croatia	Central Croatia	0.11
Central Dalmatia	North Dalmatia	0.10
Central Croatia	Eastern Croatia	0.06
South Dalmatia	South Dalmatia	0.05
Central Croatia	North Adriatic	0.05
Central Dalmatia	South Dalmatia	0.01
North Dalmatia	Central Croatia	0.01

Source: Croatia NTM; World Bank analysis.

FIGURE A3.3.
Internal Flows of 'Other
Consumer Goods' Between
Croatian Regions



Source: Croatia NTM; World Bank analysis.

Table A3.5 shows the 10 largest origins and destinations of the 'other consumer goods' category. The largest share of transported other consumer goods, 1,792,387 tons/year (78.6%), has its origin in Central Croatia, 385,930 tons/year in Central Dalmatia (16.9%), and 102,401 tons/year in the North Adriatic region (4.5%). The largest share of transported other consumer goods, 1,042,808 tons/year (84.4%), has its destination in Central Croatia, 96,543 tons/year in the North Adriatic region (7.9%), and 94,076 tons/year in Central Dalmatia (7.7%).

TABLE A3.5.
Ten Largest Origins and
Destinations of 'Other
Consumer Goods'

Origin municipality	Origin Region	Other Consumer Goods		Destination Region	Freight volume (tons/year)
		Freight volume (tons/year)	Destination municipality		
Trogir	Central Dalmatia	385,930	Jarun, Zagreb	Central Croatia	281,356
Trešnjevka sjever - Trešnjevački trg, Zagreb	Central Croatia	368,930	Zavrtnica, Zagreb	Central Croatia	177,622
Kutina	Central Croatia	327,827	Sveta Nedelja	Central Croatia	116,743
Stenjevec, Zagreb	Central Croatia	225,739	Gornja Dubrava – jug, Zagreb	Central Croatia	112,028
Borovje, Zagreb	Central Croatia	202,568	Ivanja Reka	Central Croatia	105,351
Kruge, Zagreb	Central Croatia	191,344	Vojak	North Adriatic	96,543
Voltino, Zagreb	Central Croatia	188,991	Trogir	Central Dalmatia	94,076
Sveta Nedelja	Central Croatia	148,504	Stenjevec, Zagreb	Central Croatia	86,350
Volovčica, Zagreb	Central Croatia	138,485	Podbrežnica	Central Croatia	81,467
Bakar	North Adriatic	102,401	Ferenščica	Central Croatia	71,697
TOTAL		2,280,718			1,223,235

Source: Croatia NTM; World Bank analysis.

The largest OD pair for other consumer goods is the internal flow in the Central Croatia region, with 4.36 million tons (Table A3.6).

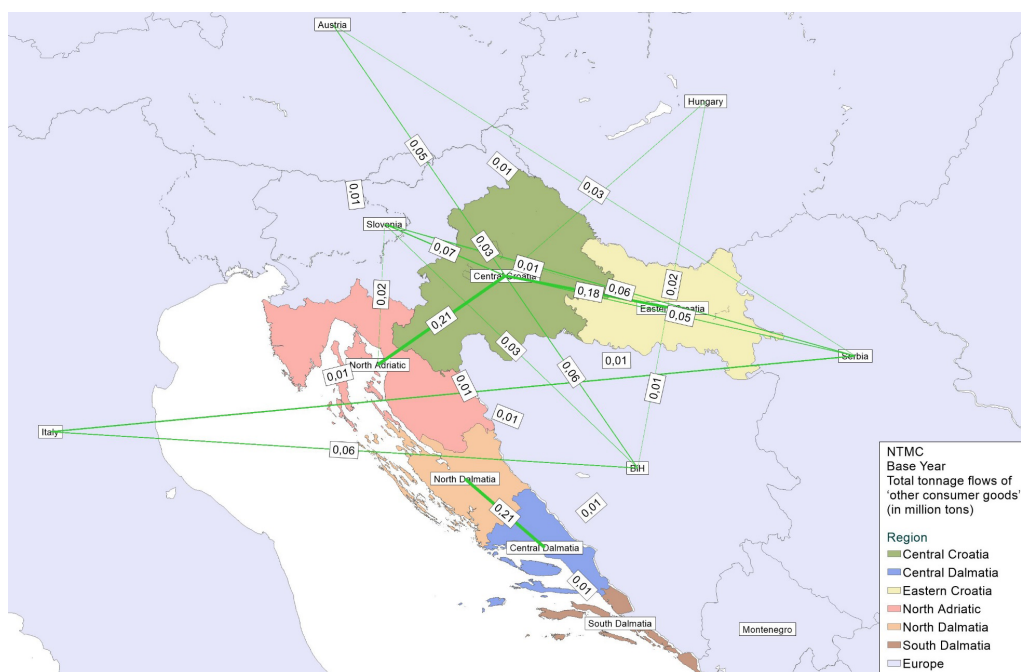
As shown in Figure A3.4, the largest volumes of other consumer goods transported are between Central Croatia and the North Adriatic region, Central Croatia and Eastern Croatia, and North Dalmatia and Central Dalmatia. Notable values are seen between Central Croatia and Slovenia, Bosnia and Herzegovina, and Serbia. Less significant values are seen between Eastern Croatia and Slovenia, and Eastern Croatia and Hungary.

TABLE A3.6.
Ten Largest Regional OD Pairs of
'Other Consumer Goods'

No.	From	To	Millions of tons
1	Central Croatia	Central Croatia	4.36
2	North Adriatic	North Adriatic	0.88
3	Central Dalmatia	Central Dalmatia	0.66
4	Eastern Croatia	Eastern Croatia	0.46
5	North Dalmatia	North Dalmatia	0.23
6	North Adriatic	Central Croatia	0.16
7	North Dalmatia	Central Dalmatia	0.11
8	Eastern Croatia	Central Croatia	0.11
9	Central Dalmatia	North Dalmatia	0.10
10	Central Croatia	Eastern Croatia	0.06

Source: Croatia NTM; World Bank analysis.

FIGURE A3.4.
Desire Lines of Largest Values
of 'Other Consumer Goods'
Between Croatian Regions and
Neighboring Countries



Source: Croatia NTM; World Bank analysis

OTHER GOODS

As depicted in Figure A3.5, most of the flows of 'Other Goods' across regions are concentrated in the northern part of the country. As for intra-regional flows, these are especially concentrated in the region of Central Croatia (Table A3.7). The largest flows of other goods between regions are from the North Adriatic to Central Croatia, at 0.15 million tons.

FIGURE A3.5.
Internal Flows of 'Other Goods'
Between Croatian Regions



Source: Croatia NTM; World Bank analysis

TABLE A3.7.
Internal Flows of 'Other Goods'
Between Croatian Regions

From	To	Millions of tons
Central Croatia	Central Croatia	1.78
Eastern Croatia	Eastern Croatia	0.37
North Adriatic	North Adriatic	0.35
Central Dalmatia	Central Dalmatia	0.30
North Dalmatia	North Dalmatia	0.11
North Adriatic	Central Croatia	0.11
Eastern Croatia	Central Croatia	0.09
South Dalmatia	South Dalmatia	0.08
North Dalmatia	Central Dalmatia	0.05
Central Croatia	Eastern Croatia	0.04
Central Croatia	North Adriatic	0.04
Central Dalmatia	North Dalmatia	0.03
South Dalmatia	Central Dalmatia	0.01
North Dalmatia	Central Croatia	0.01
North Adriatic	North Dalmatia	0.01
North Dalmatia	North Adriatic	0.01
Central Dalmatia	South Dalmatia	0.01

Source: Croatia NTM; World Bank analysis.

OIL PRODUCTS

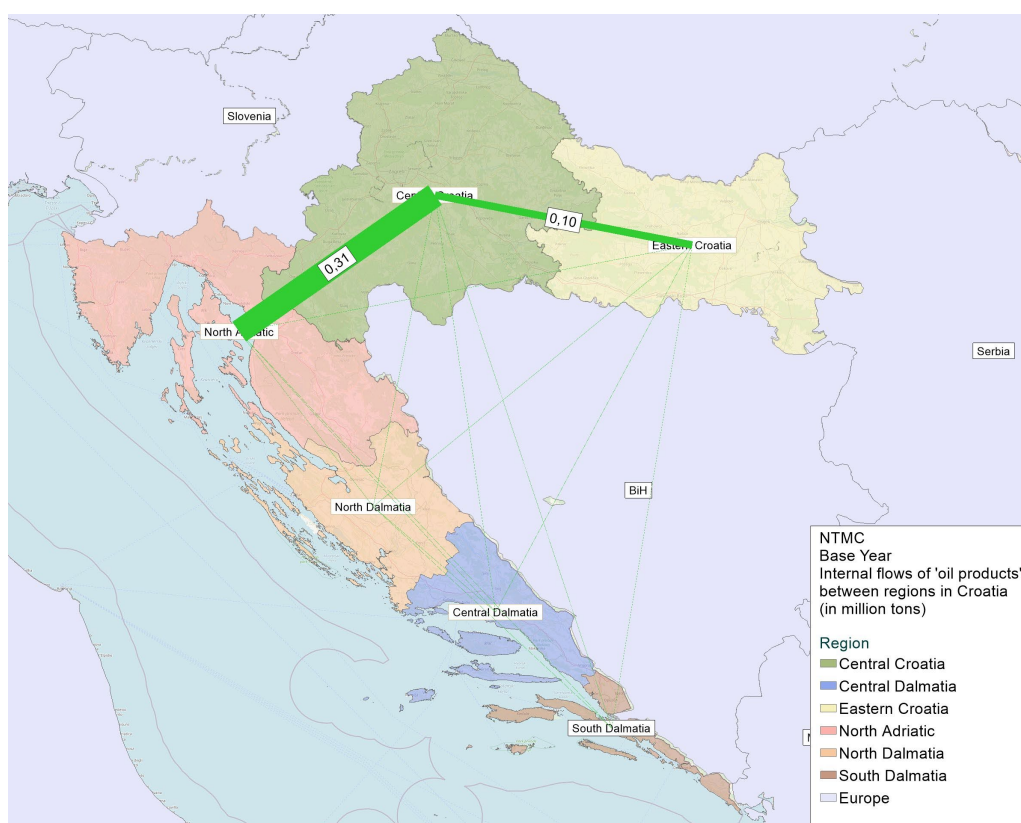
There are only five OD pairs of oil products between the Croatia regions (Table A3.8 and Figure A3.6). Most flows are internal to Central Croatia (2.08 million tons) and the largest inter-regional flow is between the North Adriatic region and Central Croatia (0.27 million tons; 0.31 million tons in both directions).

TABLE A3.8.
Internal Flows of 'Oil Products'
Between Croatian Regions

From	To	Millions of tons
Central Croatia	Central Croatia	2.08
North Adriatic	North Adriatic	0.88
North Adriatic	Central Croatia	0.27
Central Croatia	Eastern Croatia	0.10
Central Croatia	North Adriatic	0.04

Source: Croatia NTM; World Bank analysis.

FIGURE A3.6.
Internal Flows of 'Oil Products'
Between Croatian Regions



Source: Croatia NTM; World Bank analysis

Table A3.9 shows the 10 largest origins and destinations of oil products when the analysis is expanded to include international flows. The largest share of transported oil products, 3,228,619 tons/year (64.0%), has its origin in Central Croatia, while 1,698,371 tons/year originates in the North Adriatic (33.7%). The largest share of transported oil products, 967,202 tons/year (51.5%), has its destination in Central Croatia, 690,447 tons/year in the North Adriatic (36.8%), 121,251 tons/year in Eastern Croatia (6.5%), and 98,538 tons/year in Central Dalmatia (5.2%). With regard to OD pairs internal flows in Central Croatia are again dominant, at 2.08 million tons, while the North Adriatic region sees 0.88 million tons transported (Table A3.10.). The largest regional import flows of oil products originate in Italy, at 0.17 million tons.

TABLE A3.9.
Ten Largest Origins and
Destinations of 'Oil Products'

Origin municipality	Origin Region	Oil Products		Destination Region	Freight volume (tons/year)
		Freight volume (tons/year)	Destination municipality		
Caprag	Central Croatia	1,698,371	Črnomerec - jug	Central Croatia	359,516
Kostrena	North Adriatic	1,698,371	Svilno	North Adriatic	301,785
Kajzerica, Zagreb	Central Croatia	1,495,013	Buzet	North Adriatic	286,423
Borovje, Zagreb	Central Croatia	35,236	Donje Pokupje - zapad, Karlovac	Central Croatia	195,946
Osrednjeslovenska	Slovenia	29,176	Sveta Nedelja	Central Croatia	169,667
Budapest	Hungary	27,132	Peščenica - Žitnjak	Central Croatia	155,601
Gorenjska	Slovenia	17,480	Slavonski Brod	Eastern Croatia	121,251
Sarajevo	Bosnia and Herzegovina	15,563	Mlaka	North Adriatic	102,239
Zenica-Doboj	Bosnia and Herzegovina	13,668	Smiljanovac, Solin	Central Dalmatia	98,538
Murska Sobota	Slovenia	12,211	Pregrada	Central Croatia	86,472
TOTAL		5,042,220			1,877,438

Source: Croatia NTM; World Bank analysis.

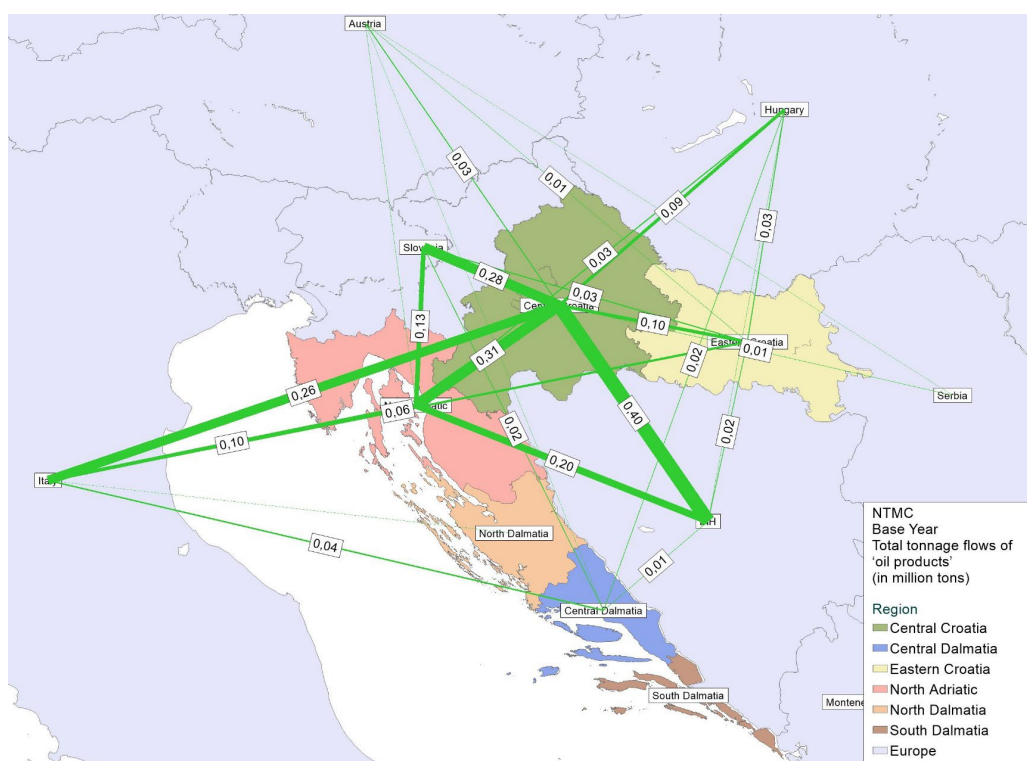
TABLE A3.10.
Ten Largest Regional OD
Pairs of 'Oil Products'

No.	From	To	Millions of tons
1	Central Croatia	Central Croatia	2.08
2	North Adriatic	North Adriatic	0.88
3	Central Croatia	BiH	0.34
4	North Adriatic	Central Croatia	0.27
5	Central Croatia	Slovenia	0.20
6	North Adriatic	BiH	0.18
7	Italy	Central Croatia	0.17
8	North Adriatic	Slovenia	0.10
9	Central Croatia	Eastern Croatia	0.10
10	Central Croatia	Italy	0.09

Source: Croatia NTM; World Bank analysis.

Figure A3.7 shows that the largest values of transported oil products are between Central Croatia and the North Adriatic, Bosnia and Herzegovina, Italy, and Slovenia. Significant values are between North Adriatic and Slovenia, Italy, and Bosnia and Herzegovina. Less significant values are seen between Eastern Croatia and Central Croatia, and the North Adriatic, and between Central Dalmatia and Italy.

FIGURE A3.7.
Desire Lines of Largest Values of
'Oil Products' Between Croatian
Regions and Neighboring
Countries



Source: Croatia NTM; World Bank analysis.

RAW WOOD

Table A3.11 shows that most of the flows of raw wood are internal to the Central Croatia region (2.4 million tons). As depicted in Figure A3.8, the largest flow of raw wood between regions is from Central Croatia to the North Adriatic, at 0.10 million tons (0.13 million tons in both directions).

TABLE A3.11.
Internal Flows of 'Raw Wood'
Between Croatian Regions

From	To	Millions of tons
Central Croatia	Central Croatia	2.40
Central Croatia	North Adriatic	0.10
Eastern Croatia	Eastern Croatia	0.06
Central Croatia	Eastern Croatia	0.06
Eastern Croatia	Central Croatia	0.05
North Adriatic	North Adriatic	0.05
North Adriatic	Central Croatia	0.03
Central Dalmatia	Central Dalmatia	0.01

Source: Croatia NTM; World Bank analysis.

FIGURE A3.8.
Internal Flows of 'Raw Wood'
Between Croatian Regions



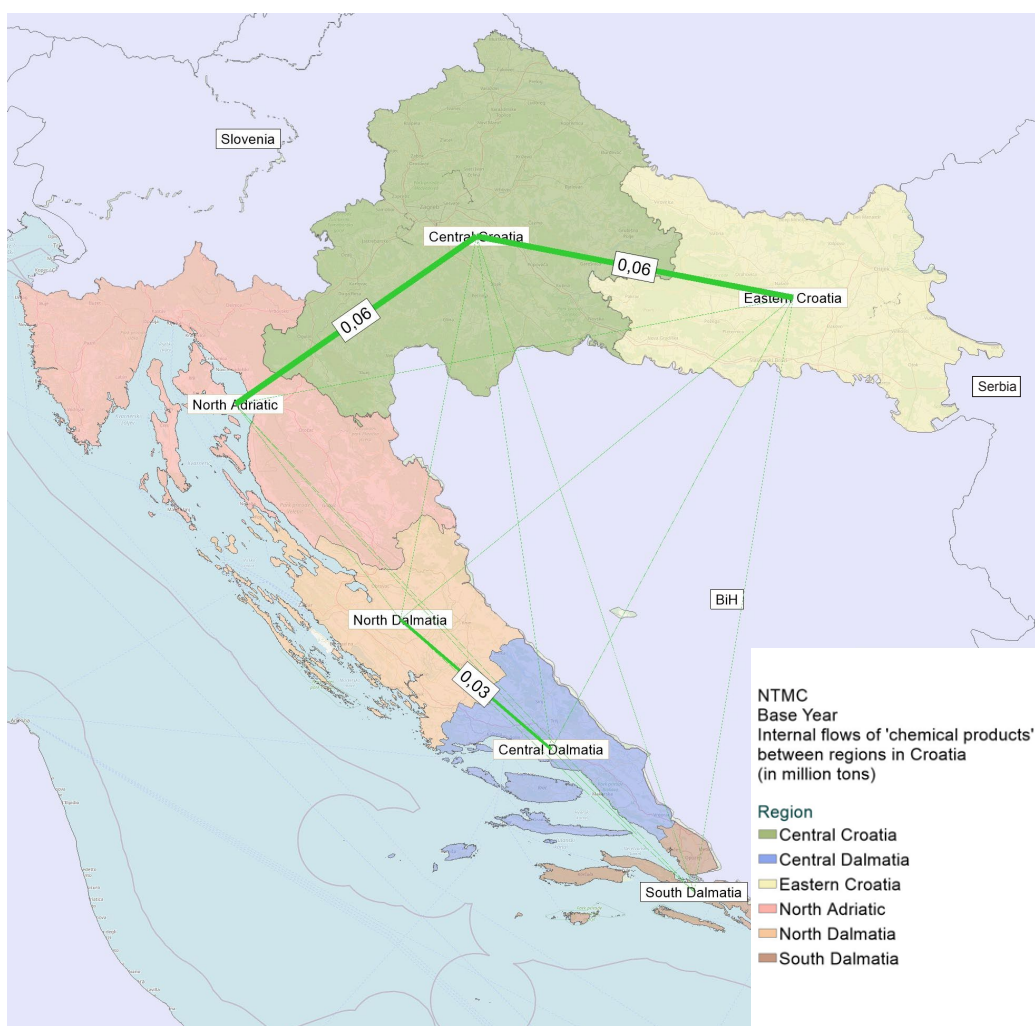
Source: Croatia NTM; World Bank analysis.

CHEMICAL PRODUCTS

Figure A3.9 and Table A3.12 show that most of the flows of chemical products are intraregional.

Table A3.13 shows the 10 largest origins and destinations of chemical products when the analysis is expanded to international in addition to purely domestic flows. The largest share of transported chemical products, 1,711,918 ton/year (90.6%), has its origin in Central Croatia, 111,553 ton/year in the North Adriatic (5.9%), and 66,205 ton/year in Slovenia (3.5%). The largest share of transported chemical products 975,652 tons/year (66.2%), has its destination in Central Croatia, 142,382 ton/year in the North Adriatic (9.7%), 133,963 tons/year in Central Dalmatia (9.1%), and 122,358 tons/year in Serbia (8.3%).

FIGURE A3.9.
Internal Flows of 'Chemical
Products' Between Croatian
Regions



Source: Croatia NTM; World Bank analysis.

TABLE A3.12.
Internal Flows of 'Chemical
Products' Between Croatian
Regions

From	To	Millions of tons
Central Croatia	Central Croatia	1.89
Eastern Croatia	Eastern Croatia	0.30
North Adriatic	North Adriatic	0.22
Central Dalmatia	Central Dalmatia	0.08
Central Croatia	North Adriatic	0.03
Eastern Croatia	Central Croatia	0.03
North Adriatic	Central Croatia	0.03
Central Croatia	Eastern Croatia	0.03
North Dalmatia	North Dalmatia	0.03
North Dalmatia	Central Dalmatia	0.03
South Dalmatia	South Dalmatia	0.01

Source: Croatia NTM; World Bank analysis.

TABLE A3.13.
Ten Largest Origins and
Destinations of 'Chemical
Products'

Origin municipality	Origin Region	Chemical Products		Destination Region	Freight volume (tons/year)
		Freight volume (tons/year)	Destination municipality		
Kajzerica, Zagreb	Central Croatia	894,866	Črnomerec – jug, Zagreb	Central Croatia	343,696
Črnomerec - jug, Zagreb	Central Croatia	216,821	Donji Grad - sjever, Zagreb	Central Croatia	152,934
Donji Grad - sjever, Zagreb	Central Croatia	159,774	Herešin, Koprivnica	Central Croatia	143,872
Herešin	Central Croatia	155,022	Buzet	North Adriatic	142,382
Svilno	North Adriatic	111,553	Smiljanovac, Solin	Central Dalmatia	133,963
Sveta Nedelja	Central Croatia	79,950	Grad Beograd	Serbia	122,358
Peščenica - Žitnjak, Zagreb	Central Croatia	73,319	Sveta Nedelja	Central Croatia	119,492
Hum Na Sutli	Central Croatia	69,940	Samobor	Central Croatia	108,221
Osrednjeslovenska	Slovenia	66,205	Peščenica - Žitnjak, Zagreb	Central Croatia	107,438
Samobor	Central Croatia	62,226	Slavonski Brod	Eastern Croatia	98,590
TOTAL		1,889,676			1,472,946

Source: Croatia NTM; World Bank analysis.

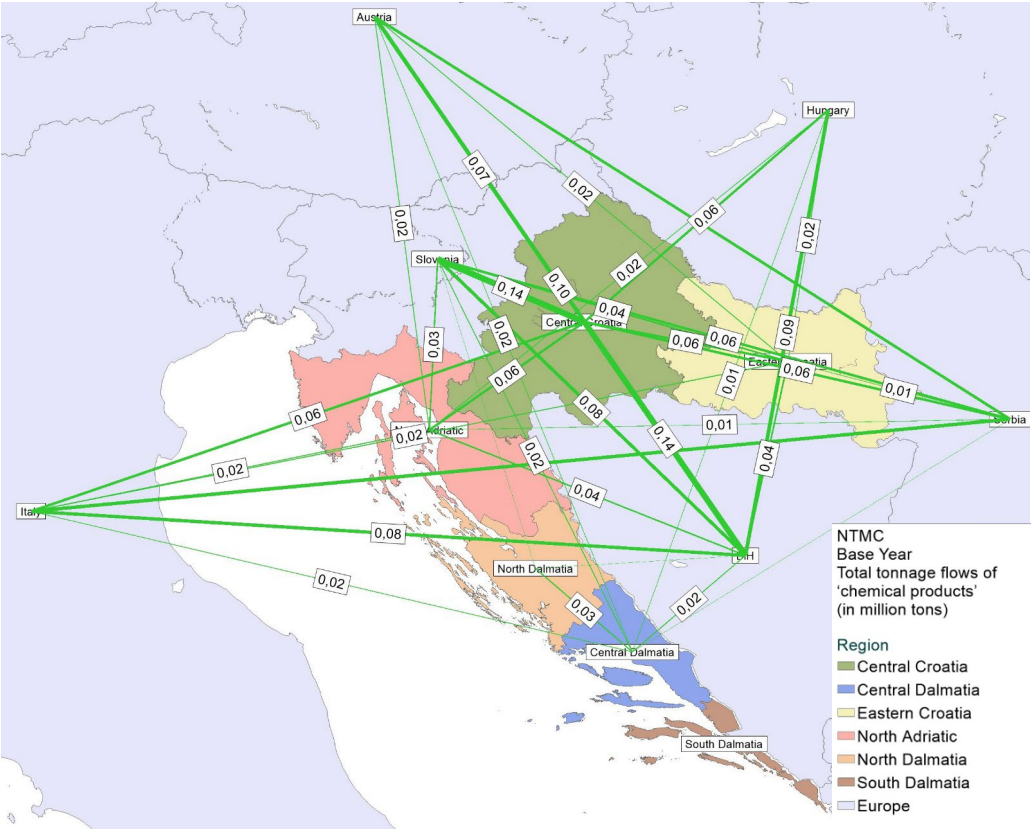
While the largest OD pairs of chemical products are transit flows, when it comes to the Croatian regions and neighboring countries the largest flows are between Central Croatia and Slovenia, and Central Croatia and Bosnia and Herzegovina (Table A3.14 and Figure A3.10). Transport between Central Croatia and Austria is also notable. Significant volumes move between Central Croatia and the North Adriatic and Italy, Italy and Bosnia and Herzegovina and Serbia, and Central Croatia and Serbia. Less significant values are seen between Central Dalmatia and North Dalmatia and Slovenia. Table A3.14. confirms that Central Croatia accounts for most intraregional flows of chemical products, with 1.89 million tons.

TABLE A3.14.
Ten Largest Regional OD
Pairs of 'Chemical Products'

No.	From	To	Millions of tons
1	Central Croatia	Central Croatia	1.89
2	Eastern Croatia	Eastern Croatia	0.30
3	North Adriatic	North Adriatic	0.22
4	Central Dalmatia	Central Dalmatia	0.08
5	Central Croatia	Slovenia	0.08
6	BiH	Central Croatia	0.08
7	BiH	Austria	0.07
8	Slovenia	Central Croatia	0.07
9	Italy	Serbia	0.06
10	Italy	Central Croatia	0.06

Source: Croatia NTM; World Bank analysis.

FIGURE A3.10.
Desire Lines of Largest
Values of 'Chemical Products'
Between Croatian Regions and
Neighboring Countries

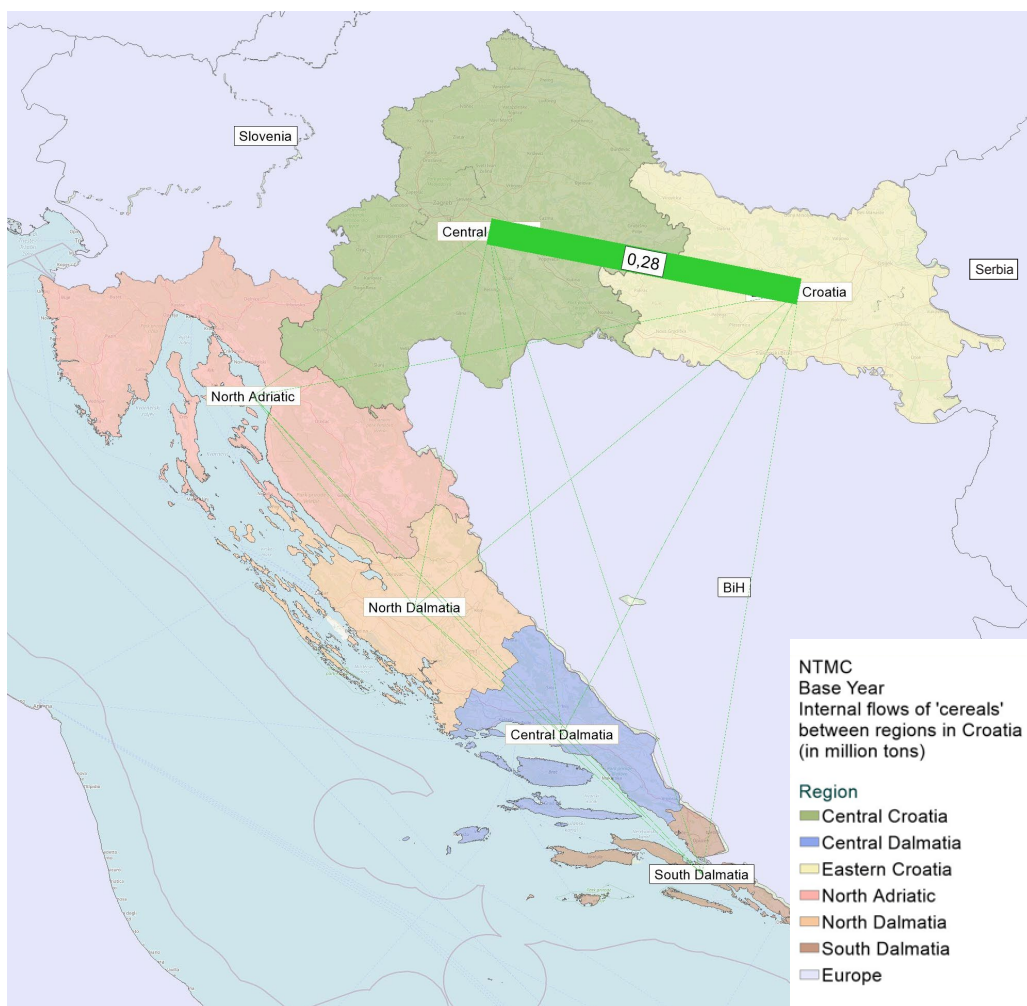


Source: Croatia NTM; World Bank analysis.

CEREALS

As shown in Figure A3.11 and Table A3.15, most of the flows of cereals are linked to the region of Eastern Croatia.

FIGURE A3.11.
Internal Flows of 'Cereals'
Between Croatian Regions



Source: Croatia NTM; World Bank analysis.

TABLE A3.15.
Internal Flows of 'Cereals'
Between Croatian Regions

From	To	Millions of tons
Eastern Croatia	Eastern Croatia	2.04
Central Croatia	Central Croatia	0.30
Eastern Croatia	Central Croatia	0.26
Central Croatia	Eastern Croatia	0.01

Source: Croatia NTM; World Bank analysis.

Table A3.16 shows the ten largest origins and destinations of cereals when the analysis is expanded to include international flows in addition to domestic flows. The largest share of transported cereals, 1,993,892 tons/year (89.0%), has its origin in Eastern Croatia, 124,144 tons/year in Hungary (5.5%), and 123,108 tons/year in Serbia (5.5%). The largest share of trans-

ported cereals, 216,463 tons/year, has its destination in Eastern Croatia (41.1%), 162,317 tons/year in Italy (30.8%), and 148,263 tons/year in Central Croatia (28.1%). In terms of the OD pairs we see dominant internal flows in the region of Eastern Croatia, at around 2 million tons (Table A3.17).

The largest OD values of transported cereals are between Eastern Croatia and Central Croatia, Hungary, Italy, and Bosnia and Herzegovina (Figure A3.12). Significant volumes move between Italy and Serbia, while less significant volumes move between Central Croatia and Italy, and Eastern Croatia and Slovenia.

TABLE A3.16.
Ten Largest Origins and
Destinations of 'Cereals'

Origin municipality	Origin Region	Cereals		Destination Region	Freight volume (tons/year)
		Freight volume (tons/year)	Destination municipality		
Darda	Eastern Croatia	660,620	Požega	Eastern Croatia	72,020
Kutjevo	Eastern Croatia	323,852	Napoli	Italy	62,484
Radićev blok	Eastern Croatia	266,992	Jarun, Zagreb	Central Croatia	58,088
Vukovar - jug	Eastern Croatia	250,615	Milano	Italy	57,084
Orahovica	Eastern Croatia	137,431	Đakovo	Eastern Croatia	51,442
Kanovci	Eastern Croatia	125,556	Industrijska četvrt, Osijek	Eastern Croatia	49,480
Debrecen	Hungary	124,144	Gornji grad – istok, Zagreb	Central Croatia	49,241
Grad Beograd	Serbia	123,108	Našice	Eastern Croatia	43,522
Donji Miholjac	Eastern Croatia	115,920	Roma	Italy	42,750
Semeljci	Eastern Croatia	112,904	Gornji grad – zapad, Zagreb	Central Croatia	40,934
TOTAL		2,241,143			527,043

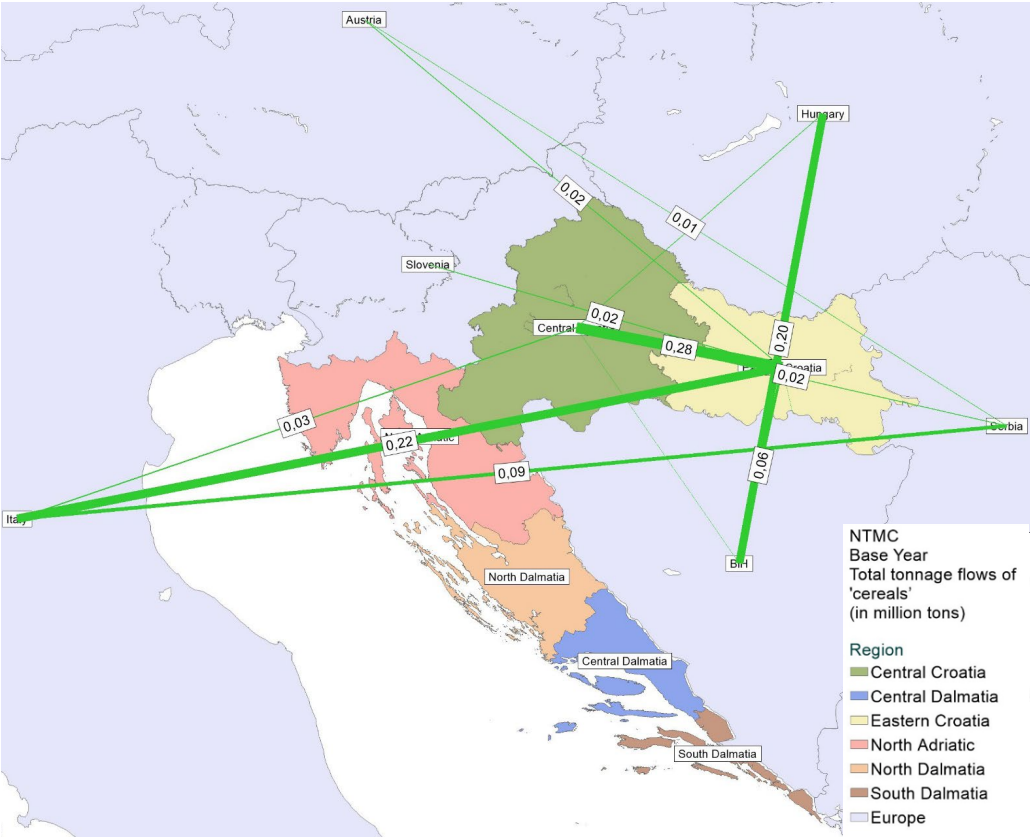
Source: Croatia NTM; World Bank analysis.

TABLE A3.17.
Ten Largest Regional OD
Pairs of 'Cereals'

No.	From	To	Millions of tons
1	Eastern Croatia	Eastern Croatia	2.04
2	Central Croatia	Central Croatia	0.30
3	Eastern Croatia	Central Croatia	0.26
4	Eastern Croatia	Italy	0.22
5	Hungary	Bosnia and Herzegovina	0.20
6	Serbia	Italy	0.09
7	Eastern Croatia	BiH	0.06
8	Central Croatia	Italy	0.03
9	Eastern Croatia	Slovenia	0.02
10	Serbia	Central Croatia	0.02

Source: Croatia NTM; World Bank analysis.

FIGURE A3.12.
Desire Lines of Largest Values
of 'Cereals' Between Croatian
Regions and Neighboring
Countries



Source: Croatia NTM; World Bank analysis.

FOOD PRODUCTS

Table A3.18 shows the ten largest origins and destinations of food products. The largest share of transported food products, 500,829 tons/year (69.7%), has its origin in Central Croatia, 63,131 tons/year in Central Dalmatia (8.8%), 58,511 tons/year in Serbia (8.1%), 55,260 tons/year in Hungary (7.7%), and 40,919 tons/year in North Dalmatia (5.7%). The largest share of transported food products, 391,057 tons/year (71.9%), has its destination Central Croatia, 52,672 tons/year in Central Dalmatia (9.7%), 41,470 tons/year in the North Adriatic (7.6%), 29,797 tons/year in Slovenia (5.5%), and 29,257 tons/year in Bosnia and Herzegovina (5.4%). In Table A3.19 we see that again the largest OD pairs are in Central Croatia, with around 1 million tons.

As depicted in Figure A3.13, the largest OD values of transported food products are between Central Croatia and Bosnia and Herzegovina, Hungary, and Slovenia. Significant tonnage moves between Central Croatia and Serbia, Italy and Bosnia and Herzegovina, and Italy and Serbia. Less significant tonnage moves between Eastern Croatia and Central Croatia and the North Adriatic, and Central Croatia and Central Dalmatia and Italy.

TABLE A3.18.
Ten Largest Origins and
Destinations of 'Food Products'

Food Products					
Origin municipality	Origin Region	Freight volume (tons/year)	Destination municipality	Destination Region	Freight volume (tons/year)
Koprivnica	Central Croatia	207,397	Jarun, Zagreb	Central Croatia	143,882
Srednjaci, Zagreb	Central Croatia	80,638	Koprivnica	Central Croatia	86,108
Kopilica	Central Dalmatia	63,131	Brda	Central Dalmatia	52,672
Grad Beograd	Serbia	58,511	Ferenščica, Zagreb	Central Croatia	44,273
Banfica	Central Croatia	58,284	Ivanja Reka	Central Croatia	44,175
Zeleni brijeg	Central Croatia	56,775	Gornja Dubrava - jug, Zagreb	Central Croatia	43,500
Debrecen	Hungary	55,260	Vojak	North Adriatic	41,470
Ravnice, Zagreb	Central Croatia	54,780	Osrednjeslovenska	Slovenia	29,797
Ferenščica, Zagreb	Central Croatia	42,955	Sarajevo	Bosnia and Herzegovina	29,257
Gaženica, Zadar	North Dalmatia	40,919	Čakovec	Central Croatia	29,120
TOTAL		718,650			544,253

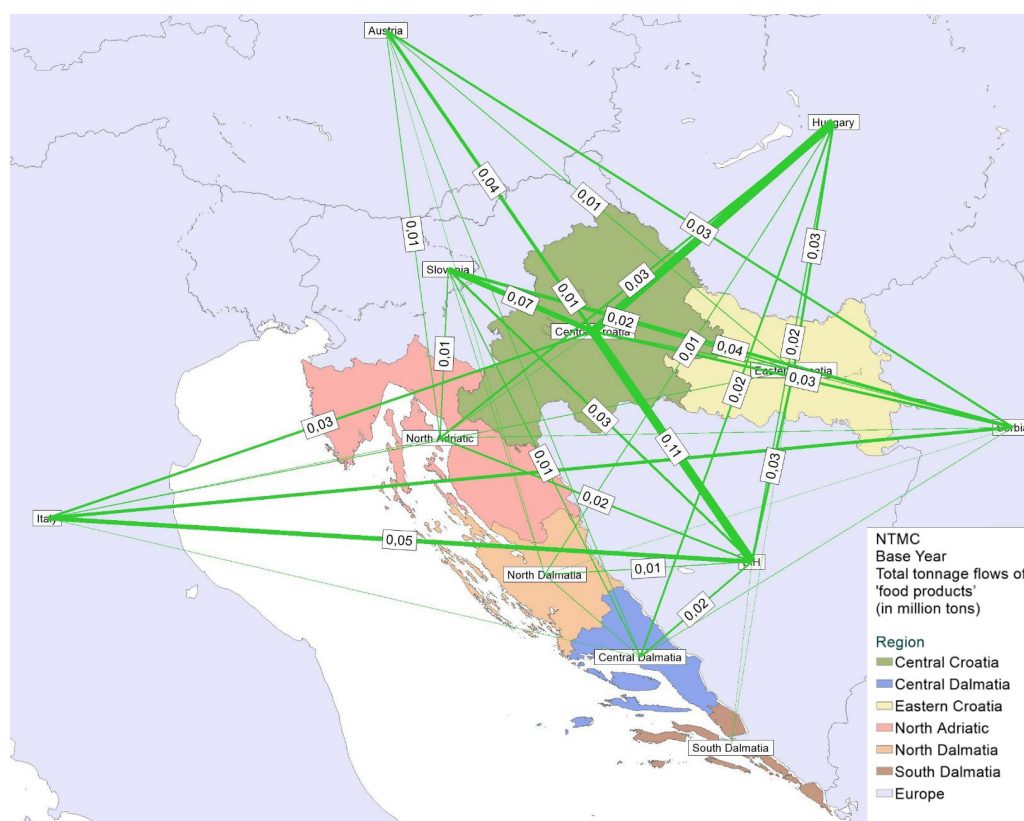
Source: Croatia NTM; World Bank analysis.

TABLE A3.19.
Ten Largest Regional OD
Pairs of 'Food Products'

No.	From	To	Millions of tons
1	Central Croatia	Central Croatia	0.97
2	Eastern Croatia	Eastern Croatia	0.31
3	Central Dalmatia	Central Dalmatia	0.18
4	North Adriatic	North Adriatic	0.18
5	North Dalmatia	North Dalmatia	0.08
6	Hungary	Central Croatia	0.07
7	Central Croatia	Bosnia and Herzegovina	0.07
8	BiH	Central Croatia	0.04
9	Central Croatia	Slovenia	0.04
10	Central Croatia	Hungary	0.04

Source: Croatia NTM; World Bank analysis.

FIGURE A3.13.
Desire Lines of Largest Values of
'Food Products' Between Croatian
Regions and Neighboring
Countries



Source: Croatia NTM; World Bank analysis.

